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40 CFR Part 131

Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule

R0019104

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 131

[FRL–6587–9]

RIN 2040–AC44

Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: This final rule promulgates: numeric aquatic life criteria for 23 priority toxic pollutants; numeric human health criteria for 57 priority toxic pollutants; and a compliance schedule provision which authorizes the State to issue schedules of compliance for new or revised National Pollutant Discharge Elimination System permit limits based on the federal criteria when certain conditions are met.

EPA is promulgating this rule based on the Administrator's determination that numeric criteria are necessary in the State of California to protect human health and the environment. The Clean Water Act requires States to adopt numeric water quality criteria for priority toxic pollutants for which EPA has issued criteria guidance, the presence or discharge of which could reasonably be expected to interfere with maintaining designated uses.

EPA is promulgating this rule to fill a gap in California water quality standards that was created in 1994 when a State court overturned the State's water quality control plans which contained water quality criteria for priority toxic pollutants. Thus, the State of California has been without numeric water quality criteria for many priority toxic pollutants as required by the Clean Water Act, necessitating this action by EPA. These Federal criteria are legally applicable in the State of California for inland surface waters, enclosed bays and estuaries for all purposes and programs under the Clean Water Act.

EFFECTIVE DATE: This rule shall be effective May 18, 2000.

ADDRESSES: The administrative record for today's final rule is available for public inspection at the U.S. Environmental Protection Agency, Region 9, Water Division, 75 Hawthorne Street, San Francisco, California 94105, between the hours of 8:00 a.m. and 4:30 p.m. For access to the administrative record, call Diane E. Fleck, P.E., Esq. at 415 744–1984 for an appointment. A reasonable fee will be charged for photocopies.

FOR FURTHER INFORMATION CONTACT: Diane E. Fleck, P.E., Esq. or Philip Woods, U.S. Environmental Protection Agency, Region 9, Water Division, 75 Hawthorne Street, San Francisco, California 94105, 415–744–1984 or 415–744–1997, respectively.

SUPPLEMENTARY INFORMATION: This preamble is organized according to the following outline:

A. Potentially Affected Entities

Citizens concerned with water quality in California may be interested in this rulemaking. Entities discharging pollutants to waters of the United States in California could be affected by this rulemaking since water quality criteria are used by the State in developing National Pollutant Discharge Elimination System (NPDES) permit limits. Categories and entities that ultimately may be affected include:

Category	Examples of potentially affected entities
Industry	Industries discharging pollutants to surface waters in California or to publicly-owned treatment works.
Municipalities	Publicly-owned treatment works discharging pollutants to surface waters in California

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be affected by this action. This table lists the types of entities that EPA is now aware could potentially be affected by this action. Other types of entities not listed in the table could also be affected. To determine whether your facility might be affected by this action, you should carefully examine the applicability criteria in § 131.38(c). If you have questions regarding the applicability of this action to a particular entity, consult the persons listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

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B. Introduction and Overview

1. Introduction

This section introduces the topics which are addressed in the preamble and provides a brief overview of EPA's basis and rationale for promulgating Federal criteria for the State of California. Section C briefly describes the evolution of the efforts to control toxic pollutants; these efforts include the changes enacted in the 1987 CWA Amendments, which are the basis for this rule. Section D summarizes California's efforts since 1987 to implement the requirements of CWA section 303(c)(2)(B) and describes EPA's procedure and actions for determining whether California has fully implemented CWA section 303(c)(2)(B). Section E provides the rationale and approach for developing this final rule, including a discussion of EPA's legal basis for this final rule. Section F describes the development of the criteria included in this rule. Section G summarizes the provisions of the final rule and discusses implementation issues. Sections H, I, J, K , L, M, N, O, P, and Q briefly address the requirements of Executive Order 12866, the Unfunded Mandates Reform Act of 1995, the Regulatory Flexibility Act, the Paperwork Reduction Act, the Endangered Species Act, the Congressional Review Act, Executive Order 13084, Consultation and Coordination with Indian Tribal Governments, the National Technology Transfer and Advancement Act, and Executive Order 13132, Federalism, respectively.

The proposal for this rulemaking was published in the **Federal Register** on August 5, 1997. Changes from the proposal are generally addressed in the body of this preamble and specifically addressed in the response to comments document included in the administrative record for this rulemaking. EPA responded to all comments on the proposed rule, including comments received after the September 26, 1997, deadline. Although EPA is under no legal obligation to respond to late comments, EPA made a policy decision to respond to all comments.

Since detailed information concerning many of the topics in this preamble was published previously in the **Federal Register** in preambles for this and other rulemakings, references are frequently made to those preambles. Those rulemakings include: Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Proposed Rule, 62 FR 42159, August 5, 1997 (referred to as the "proposed CTR"); Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants, 57 FR 60848, December 22, 1992 (referred to as the "National Toxics Rule" or "NTR"); and the NTR as amended by Administrative Stay of Federal Water Quality Criteria for Metals and Interim Final Rule, Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance—Revision of Metals Criteria, 60 FR 22228, May 4, 1995 (referred to as the "National Toxics Rule [NTR], as amended"). The NTR, as amended, is codified at 40 CFR 131.36. A copy of the proposed CTR and its preamble, and the NTR, as amended, and its preambles are contained in the administrative record for this rulemaking.

EPA is making this final rule effective upon publication. Under the Administrative Procedure Act, 5 U.S.C. 553(d)(3), agencies must generally publish a rule no more than 30 days prior to the effective date of the rule except as otherwise provided for by the Agency for good cause. The purpose of the 30-day waiting period is to give affected parties a reasonable time to adjust their behavior before the final rule takes effect. See *Omnipoint Corp.* v. *F.C.C.*, 78 F.3d 620, 630–631 (D.C. Cir. 1996); *Riverbend Farms, Inc.* v. *Madigan*, 958 F.2d 1479, 1485 (9th Cir. 1992).

In this instance, EPA finds good cause to make the final rule effective upon publication. In order to find good cause, an Agency needs to find that the 30-day period would be: (1) Impracticable, (2) unnecessary, or (3) contrary to the public interest. Here EPA is relying on the second reason to support its finding of good cause. EPA also notes that the State has requested EPA to make the rule immediately effective.

EPA finds that in this instance, waiting 30 days to make the rule effective is unnecessary. As explained in further detail elsewhere in this preamble, this rule is not self implementing; rather it establishes ambient conditions that the State of California will implement in future permit proceedings. These permit proceedings will, by regulation, take longer than 30 days to complete. This means that although the rule is immediately effective, no discharger's conduct would be altered under the rule in less than 30 days, and therefore the 30-day period is unnecessary.

2. Overview

This final rule establishes ambient water quality criteria for priority toxic pollutants in the State of California. The criteria in this final rule will supplement the water quality criteria promulgated for California in the NTR, as amended. In 1991, EPA approved a number of water quality criteria (discussed in section D), for the State of California. Since EPA had approved these criteria, it was not necessary to include them in the 1992 NTR for these criteria. However, the EPA-approved criteria were subsequently invalidated in State litigation. Thus, this final rule contains criteria to fill the gap created by the State litigation.

This final rule does not change or supersede any criteria previously promulgated for the State of California in the NTR, as amended. Criteria which EPA promulgated for California in the NTR, as amended, are footnoted in the final table at 131.38(b)(1), so that readers may see the criteria promulgated in the NTR, as amended, for California and the criteria promulgated through this rulemaking for California in the same table. This final rule is not intended to apply to waters within Indian Country. EPA recognizes that there are possibly waters located wholly or partly in Indian Country that are included in the State's basin plans. EPA will work with the State and Tribes to identify any such waters and determine whether further action to protect water quality in Indian Country is necessary.

This rule is important for several environmental, programmatic and legal reasons. Control of toxic pollutants in surface waters is necessary to achieve the CWA's goals and objectives. Many of California's monitored river miles, lake acres, and estuarine waters have elevated levels of toxic pollutants. Recent studies on California water bodies indicate that elevated levels of toxic pollutants exist in fish tissue which result in fishing advisories or bans. These toxic pollutants can be attributed to, among other sources, industrial and municipal discharges.

Water quality standards for toxic pollutants are important to State and EPA efforts to address water quality problems. Clearly established water quality goals enhance the effectiveness of many of the State's and EPA's water programs including permitting, coastal water quality improvement, fish tissue quality protection, nonpoint source controls, drinking water quality protection, and ecological protection. Numeric criteria for toxic pollutants allow the State and EPA to evaluate the adequacy of existing and potential control measures to protect aquatic ecosystems and human health. Numeric criteria also provide a more precise basis for deriving water quality-based effluent limitations (WQBELs) in

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National Pollutant Discharge Elimination System (NPDES) permits and wasteload allocations for total maximum daily loads (TMDLs) to control toxic pollutant discharges. Congress recognized these issues when it enacted section 303(c)(2)(B) to the CWA.

While California recognizes the need for applicable water quality standards for toxic pollutants, its adoption efforts have been stymied by a variety of factors. The Administrator has decided to exercise her CWA authorities to move forward the toxic control program, consistent with the CWA and with the State of California's water quality standards program.

Today's action will also help restore equity among the States. The CWA is designed to ensure all waters are sufficiently clean to protect public health and/or the environment. The CWA allows some flexibility and differences among States in their adopted and approved water quality standards, but it should be implemented in a manner that ensures a level playing field among States. Although California has made important progress toward satisfying CWA requirements, it has not satisfied CWA section 303(c)(2)(B) by adopting numeric water quality criteria for toxic pollutants. This section was added to the CWA by Congress in 1987. Prior to today, the State of California had been the only State in the Nation for which CWA section 303(c)(2)(B) had remained substantially unimplemented after EPA's promulgation of the NTR in December of 1992. Section 303(c)(4) of the CWA authorizes the EPA Administrator to promulgate standards where necessary to meet the requirements of the Act. The Administrator determined that this rule was a necessary and important component for the implementation of CWA section 303(c)(2)(B) in California.

EPA acknowledges that the State of California is working to satisfy CWA section 303(c)(2)(B). When the State formally adopts, and EPA approves, criteria consistent with statutory requirements, as envisioned by Congress in the CWA, EPA intends to stay this rule. If within the applicable time frame for judicial review, the States' standards are challenged, EPA will withdraw this rule after such judicial review is complete and the State standards are sustained.

C. Statutory and Regulatory Background

The preamble to the August 5, 1997, proposed rule provided a general discussion of EPA's statutory and regulatory authority to promulgate water quality criteria for the State of California. See 62 FR 42160–42163. EPA is including that discussion in the record for the final rule. Commenters questioned EPA's authority to promulgate certain aspects of the proposal. EPA is responding to those comments in the appropriate sections of this preamble, and in the response to comments document included in the administrative record for this rulemaking. Where appropriate, EPA's responses expand upon the discussion of statutory and regulatory authority found in the proposal.

D. California Water Quality Standards Actions

1. California Regional Water Quality Control Board Basin Plans, and the Inland Surface Waters Plan (ISWP) and the Enclosed Bays and Estuaries Plan (EBEP) of April 1991

The State of California regulates water quality through its State Water Resources Control Board (SWRCB) and through nine Regional Water Quality Control Boards (RWQCBs). Each of the nine RWQCBs represents a different geographic area; area boundaries are generally along watershed boundaries. Each RWQCB maintains a Basin Plan which contains the designated uses of the water bodies within its respective geographic area within California. These designated uses (or "beneficial uses" under State law) together with legally-adopted criteria (or "objectives" under State law), comprise water quality standards for the water bodies within each of the Basin areas. Each of the nine RWQCBs undergoes a triennial basin planning review process, in compliance with CWA section 303. The SWRCB provides assistance to the RWQCBs.

Most of the Basin Plans contain conventional pollutant objectives such as dissolved oxygen. None of the Basin Plans contains a comprehensive list of priority toxic pollutant criteria to satisfy CWA section 303(c)(2)(B). The nine RWQCBs and the SWRCB had intended that the priority toxic pollutant criteria contained in the three SWRCB statewide plans, the Inland Surface Waters Plan (ISWP), the Enclosed Bays and Estuaries Plan (EBEP), and the Ocean Plan, apply to all basins and satisfy CWA section 303(c)(2)(B).

On April 11, 1991, the SWRCB adopted two statewide water quality control plans, the ISWP and the EBEP. These statewide plans contained narrative and numeric water quality criteria for toxic pollutants, in part to satisfy CWA section 303(c)(2)(B). The water quality criteria contained in the SWRCB statewide plans, together with the designated uses in each of the Basin Plans, created a set of water quality standards for waters within the State of California.

Specifically, the two plans established water quality criteria or objectives for all fresh waters, bays and estuaries in the State. The plans contained water quality criteria for some priority toxic pollutants, provisions relating to whole effluent toxicity, implementation procedures for point and nonpoint sources, and authorizing compliance schedule provisions. The plans also included special provisions affecting waters dominated by reclaimed water (labeled as Category (a) waters), and waters dominated by agricultural drainage and constructed agricultural drains (labeled as Category (b) and (c) waters, respectively).

2. EPA's Review of California Water Quality Standards for Priority Toxic Pollutants in the ISWP and EBEP, and the National Toxics Rule

The EPA Administrator has delegated the responsibility and authority for review and approval or disapproval of all new or revised State water quality standards to the EPA Regional Administrators (see 40 CFR 131.21). Thus, State actions under CWA section 303(c)(2)(B) are submitted to the appropriate EPA Regional Administrator for review and approval.

In mid-April 1991, the SWRCB submitted to EPA for review and approval the two statewide water quality control plans, the ISWP and the EBEP. On November 6, 1991, EPA Region 9 formally concluded its review of the SWRCB's plans. EPA approved the narrative water quality criterion and the toxicity criterion in each of the plans. EPA also approved the numeric water quality criteria contained in both plans, finding them to be consistent with the requirements of section 303(c)(2)(B) of the CWA and with EPA's national criteria guidance published pursuant to section 304(a) of the CWA.

EPA noted the lack of criteria for some pollutants, and found that, because of the omissions, the plans did not fully satisfy CWA section 303(c)(2)(B). The plans did not contain criteria for all listed pollutants for which EPA had published national criteria guidance. The ISWP contained human health criteria for only 65 pollutants, and the EBEP contained human health criteria for only 61 pollutants for which EPA had issued section 304(a) guidance criteria. Both the ISWP and EBEP contained aquatic life criteria for all pollutants except cyanide and chromium III (freshwater only) for which EPA has CWA section

304(a) criteria guidance. The SWRCB's administrative record stated that all priority pollutants with EPA criteria guidance were likely to be present in California waters. However, the SWRCB's record contained insufficient information to support a finding that the excluded pollutants were not reasonably expected to interfere with designated uses of the waters of the State.

Although EPA approved the statewide selenium objective in the ISWP and EBEP, EPA disapproved the objective for the San Francisco Bay and Delta, because there was clear evidence that the objective would not protect the designated fish and wildlife uses (the California Department of Health Services had issued waterfowl consumption advisories due to selenium concentrations, and scientific studies had documented selenium toxicity to fish and wildlife). EPA restated its commitment to object to National Pollutant Discharge Elimination System (NPDES) permits issued for San Francisco Bay that contained effluent limits based on an objective greater than 5 parts per billion (ppb) (four day average) and 20 ppb (1 hour average), the freshwater criteria. EPA reaffirmed its disapproval of Californias' site-specific selenium objective for portions of the San Joaquin River, Salt Slough, and Mud Slough. EPA also disapproved of the categorical deferrals and exemptions. These disapprovals included the disapproval of the State's deferral of water quality objectives to effluent dominated streams (Category a) and to streams dominated by agricultural drainage (Category b), and the disapproval of the exemption of water quality objectives to constructed agricultural drains (Category c). EPA found the definitions of the categories imprecise and overly broad which could have led to an incorrect interpretation.

Since EPA had disapproved portions of each of the California statewide plans which were necessary to satisfy CWA section 303(c)(2)(B), certain disapproved aspects of California's water quality standards were included in EPA's promulgation of the National Toxics Rule (NTR) (40 CFR 131.36, 57 FR 60848). EPA promulgated specific criteria for certain water bodies in California.

The NTR was amended, effective April 14, 1995, to stay certain metals criteria which had been promulgated as total recoverable. Effective April 15, 1995, EPA promulgated interim final metals criteria as dissolved concentrations for those metals which had been stayed (Administrative Stay of Federal Water Quality Criteria for Metals and Interim Final Rule, Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance—Revision of Metals Criteria; 60 FR 22228, 22229, May 4, 1995 (the NTR, as amended)). The stay was in response to a lawsuit against EPA challenging, among other issues, metals criteria expressed as total recoverable concentrations. A partial Settlement Agreement required EPA to stay specific metals criteria in the NTR. EPA then promulgated certain metals criteria in the dissolved form through the use of conversion factors. These factors are listed in the NTR, as amended. A scientific discussion of these criteria is found in a subsequent section of this preamble.

Since certain criteria have already been promulgated for specific water bodies in the State of California in the NTR, as amended, they are not within the scope of today's final rule. However, for clarity in reading a comprehensive rule for the State of California, these criteria are incorporated into 40 CFR 131.38(d)(2). Footnotes to the Table in 40 CFR 131.38(b)(1) and 40 CFR 131.38(d)(3) clarify which criteria (and for which specific water bodies) were promulgated by the NTR, as amended, and are therefore excluded from this final rule. The appropriate (freshwater or saltwater) aquatic life criteria which were promulgated in the NTR, as amended, for all inland surface waters and enclosed bays and estuaries include: chromium III and cyanide. The appropriate (water and organism or organism only) human health criteria which were promulgated in the NTR, as amended, for all inland surface waters and enclosed bays and estuaries include:

antimony
thallium
asbestos
acrolein
acrylonitrile
carbon tetrachloride
chlorobenzene
1,2-dichloroethane
1,1-dichloroethylene
1,3-dichloropropylene
ethylbenzene
1,1,2,2-tetrachloroethane
tetrachloroethylene
1,1,2-trichloroethane
trichloroethylene
vinyl chloride
2,4-dichlorophenol
2-methyl-4,6-dinitrophenol
2,4-dinitrophenol
benzidine
bis(2-chloroethyl)ether
bis(2-ethylhexyl)phthalate
3,3-dichlorobenzidine
diethyl phthalate
dimethyl phthalate
di-n-butyl phthalate
2,4-dinitrotoluene
1,2-diphenylhydrazine
hexachlorobutadiene
hexachlorocyclopentadiene
hexachloroethane
isophorone
nitrobenzene
n-nitrosodimethylamine
n-nitrosodiphenylamine

Other pollutant criteria were promulgated in the NTR, as amended, for specific water bodies, but not all inland surface waters and enclosed bays and estuaries.

3. Status of Implementation of CWA Section 303(c)(2)(B)

Shortly after the SWRCB adopted the ISWP and EBEP, several dischargers filed suit against the State alleging that it had not adopted the two plans in compliance with State law. The plaintiffs in a consolidated case included: the County of Sacramento, Sacramento County Water Agency; Sacramento Regional County Sanitation District; the City of Sacramento; the City of Sunnyvale; the City of San Jose; the City of Stockton; and Simpson Paper Company.

The dischargers alleged that the State had not adopted the ISWP and EBEP in compliance with the California Administrative Procedures Act (Gov Code. Section 11340, *et seq.*), the California Environmental Quality Act (Pub. Re Code, Section 21000, *et seq.*), and the Porter-Cologne Act (Wat. Code, Section 13200, *et seq.*). The allegation that the State did not sufficiently consider economics when adopting water quality objectives, as allegedly required by Section 13241 of the Porter Cologne Act, was an important issue in the litigation.

In October of 1993, the Superior Court of California, County of Sacramento, issued a tentative decision in favor of the dischargers. In March of 1994, the Court issued a substantively similar final decision in favor of the dischargers. Final judgments from the Court in July of 1994 ordered the SWRCB to rescind the ISWP and EBEP. On September 22, 1994, the SWRCB formally rescinded the two statewide water quality control plans. The State is currently in the process of readopting water quality control plans for inland surface waters, enclosed bays and estuaries.

CWA section 303(c)(2)(B) was fully implemented in the State of California from December of 1992, when the NTR was promulgated, until September of 1994, when the SWRCB was required to rescind the ISWP and EBEP. The provisions for California in EPA's NTR together with the approved portions of

California's ISWP and EBEP implemented the requirements of CWA section 303(c)(2)(B). However, since September of 1994, when the SWRCB rescinded the ISWP and EBEP, the requirements of section 303(c)(2)(B) have not been fully implemented in California.

The scope of today's rule is to re-establish criteria for the remaining priority toxic pollutants to meet the requirements of section 303(c)(2)(B) of the CWA. Pursuant to section 303(c)(4), the Administrator has determined that it is necessary to include in today's action criteria for priority toxic pollutants, which are not covered by the NTR, as amended, or by the State through EPA-approved site-specific criteria, for waters of the United States in the State of California.

4. State-Adopted, Site-Specific Criteria for Priority Toxic Pollutants

The State has the discretion to develop site-specific criteria when appropriate e.g., when statewide criteria appear over-or under-protective of designated uses. Periodically, the State through its RWQCBs will adopt site-specific criteria for priority toxic pollutants within respective Basin Plans. These criteria are intended to be effective throughout the Basin or throughout a designated water body. Under California law, these criteria must be publicly reviewed and approved by the RWQCB, the SWRCB, and the State's Office of Administrative Law (OAL). Once this adoption process is complete, the criteria become State law.

These criteria must be submitted to the EPA Regional Administrator for review and approval under CWA section 303. These criteria are usually submitted to EPA as part of a RWQCB Basin Plan Amendment, after the Amendment has been adopted under the State's process and has become State law.

a. State-Adopted Site-Specific Criteria Under EPA Review

The State of California has recently reviewed and updated all of its RWQCB Basin Plans. All of the Basin Plans have completed the State review and adoption process and have been submitted to EPA for review and approval. Some of the Basin Plans contain site-specific criteria. In these cases, the State-adopted site-specific criteria are used for water quality programs.

EPA has not yet concluded consultation under the Endangered Species Act with the U.S. Department of Interior, Fish and Wildlife Service, and the U.S. Department of Commerce, National Marine Fisheries Service, on EPA's tentative approval/disapproval actions on the RWQCB Basin Plans. In this situation, the more stringent of the two criteria (the State-adopted site-specific criteria in the RWQCB Basin Plans, or the Federal criteria in this final rule), would be used for water quality programs including the calculation of water quality-based effluent criteria in National Pollutant Discharge Elimination System (NPDES) permits.

b. State-Adopted Site-Specific Criteria With EPA Approval

In several cases, the EPA Regional Administrator has already reviewed and approved State-adopted site-specific criteria within the State of California. Several of these cases are discussed in this section. All of the EPA approval letters referenced in today's preamble are contained in the administrative record for today's rule.

Sacramento River: EPA has approved site-specific acute criteria for copper, cadmium and zinc in the Sacramento River, upstream of Hamilton City, in the Central Valley Region (RWQCB for the Central Valley Region) of the State of California. EPA approved these site-specific criteria by letter dated August 7, 1985. Specifically, EPA approved for the Sacramento River (and tributaries) above Hamilton City, a copper criterion of 5.6 μg/l (maximum), a zinc criterion of 16 μg/l (maximum) and a cadmium criterion of 0.22 μg/l (maximum), all in the dissolved form using a hardness of 40 mg/l as $CaCO_3$. (These criteria were actually adopted by the State and approved by EPA as equations which vary with hardness.) These "maximum" criteria correspond to acute criteria in today's final rule. Therefore, Federal acute criteria for copper, cadmium, and zinc for the Sacramento River (and tributaries) above Hamilton City are not necessary to protect the designated uses and are not included in the final rule. However, the EPA Administrator is making a finding that it is necessary to include chronic criteria for copper, cadmium and zinc for the Sacramento River (and tributaries) above Hamilton City, as part of the statewide criteria promulgated in today's final rule.

San Joaquin River: The selenium criteria in this rule are not applicable to portions of the San Joaquin River, in the Central Valley Region, because selenium criteria have been either previously approved by EPA or previously promulgated by EPA as part of the NTR. EPA approved and disapproved State-adopted site-specific selenium criteria in portions of the San Joaquin River, in the Central Valley Region of the State of California (RWQCB for the Central Valley Region). EPA's determination on these site-specific criteria is contained in a letter dated April 13, 1990.

Specifically, EPA approved for the San Joaquin River, mouth of Merced River to Vernalis, an aquatic life selenium criterion of 12 μg/l (maximum with the understanding that the instantaneous maximum concentration may not exceed the objective more than once every three years). Today's final rule does not affect this Federally-approved, State-adopted site-specific acute criterion, and it remains in effect for the San Joaquin River, mouth of Merced River to Vernalis. Therefore, an acute criterion for selenium in the San Joaquin River, mouth of Merced River to Vernalis is not necessary to protect the designated use and thus is not included in this final rule.

By letter dated April 13, 1990, EPA also approved for the San Joaquin River, mouth of Merced River to Vernalis, a State-adopted site-specific aquatic life selenium criterion of 5 μg/l (monthly mean); however, EPA disapproved a State-adopted site-specific selenium criterion of 8 μg/l (monthly mean—critical year only) for these waters. Subsequently, EPA promulgated a chronic selenium criterion of 5 μg/l (4 day average) for waters of the San Joaquin River from the mouth of the Merced River to Vernalis in the NTR. This chronic criterion applies to all water quality programs concerning the San Joaquin River, mouth of Merced River to Vernalis. Today's final rule does not affect the Federally-promulgated chronic selenium criterion of 5 μg/l (4 day average) set forth in the NTR. This previously Federally-promulgated criterion remains in effect for the San Joaquin River, mouth of Merced River to Vernalis.

Grassland Water District, San Luis National Wildlife Refuge, and Los Banos State Wildlife Refuge: EPA approved for the Grassland Water District, San Luis National Wildlife Refuge, and Los Banos State Wildlife Refuge, a State-adopted site-specific aquatic life selenium criterion of 2 μg/l (monthly mean) by letter dated April 13, 1990. This Federally-approved, State-adopted site-specific chronic criterion remains in effect for the Grassland Water District, San Luis National Wildlife Refuge and Los Banos State Wildlife Refuge. Therefore it is not necessary to include in today's final rule, a chronic criterion for selenium for the Grassland Water District, San Luis National Wildlife Refuge and Los Banos State Wildlife Refuge, and thus, it is not included in this final rule.

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San Francisco Regional Board Basin Plan of 1986: EPA approved several priority toxic pollutant objectives (CWA criteria) that were contained in the1986 San Francisco Regional Board Basin Plan, as amended by SWRCB Resolution Numbers 87–49, 87–82 and 87–92, by letters dated September 2, 1987 and December 24, 1987. This Basin Plan, the SWRCB Resolutions, and the EPA approval letters are contained in the administrative record for this rulemaking. It is not necessary to include these criteria for priority toxic pollutants that are contained in the San Francisco Regional Board's 1986 Basin Plan as amended, and approved by EPA. Priority pollutants in this situation are footnoted in the matrix at 131.38(b)(1) with footnote "b." Where gaps exist in the State adoption and EPA approval of priority toxic pollutant objectives, the criteria in today's rule apply.

EPA is assigning "human health, water and organism consumption" criteria to waters with the States' municipal or "MUN" beneficial use designation in the Basin Plan. Also, some pollutants regulated through the Basin Plan have different averaging periods, *e.g.*, one hour as compared with the rule's "short-term." However, where classes of chemicals, such as polynuclear aromatic hydrocarbons, or PAHs, and phenols, are regulated through the Basin Plan, but not specific chemicals within the category, specific chemicals within the category are regulated by today's rule.

E. Rationale and Approach for Developing the Final Rule

This section explains EPA's legal basis for today's final rule, and discusses EPA's general approach for developing the specific requirements for the State of California.

1. Legal Basis

CWA section 303(c) specifies that adoption of water quality standards is primarily the responsibility of the States. However, CWA section 303(c) also describes a role for the Federal government to oversee State actions to ensure compliance with CWA requirements. If EPA's review of the States' standards finds flaws or omissions, then the CWA authorizes EPA to correct the deficiencies (see CWA section 303(c)(4)). This water quality standards promulgation authority has been used by EPA to issue final rules on several separate occasions, including the NTR, as amended, which promulgated criteria similar to those included here for a number of States. These actions have addressed both insufficiently protective State criteria and/or designated uses and failure to adopt needed criteria. Thus, today's action is not unique.

The CWA in section 303(c)(4) provides two bases for promulgation of Federal water quality standards. The first basis, in paragraph (A), applies when a State submits new or revised standards that EPA determines are not consistent with the applicable requirements of the CWA. If, after EPA's disapproval, the State does not amend its rules so as to be consistent with the CWA, EPA is to promptly propose appropriate Federal water quality standards for that State. The second basis for an EPA action is in paragraph (B), which provides that EPA shall promptly initiate promulgation "* * * in any case where the Administrator determines that a revised or new standard is necessary to meet the requirements of this Act." EPA is using section 303(c)(4)(B) as the legal basis for today's final rule.

As discussed in the preamble to the NTR, the Administrator's determination under CWA section 303(c)(4) that criteria are necessary to meet the requirements of the Act could be supported in several ways. Consistent with EPA's approach in the NTR, EPA interprets section 303(c)(2)(B) of the CWA to allow EPA to act where the State has not succeeded in establishing numeric water quality standards for toxic pollutants. This inaction can be the basis for the Administrator's determination under section 303(c)(4) that new or revised criteria are necessary to ensure designated uses are protected.

EPA does not believe that it is necessary to support the criteria in today's rule on a pollutant-specific, water body-by-water-body basis. For EPA to undertake an effort to conduct research and studies of each stream segment or water body across the State of California to demonstrate that for each toxic pollutant for which EPA has issued CWA section 304(a) criteria guidance there is a "discharge or presence" of that pollutant which could reasonably "be expected to interfere with" the designated use would impose an enormous administrative burden and would be contrary to the statutory directive for swift action manifested by the 1987 addition of section 303(c)(2)(B) to the CWA. Moreover, because these criteria are ambient criteria that define attainment of the designated uses, their application to all water bodies will result in additional controls on dischargers only where necessary to protect the designated uses.

EPA's interpretation of section 303(c)(2)(B) is supported by the language of the provision, the statutory framework and purpose of section 303, and the legislative history. In adding section 303(c)(2)(B) to the CWA, Congress understood the existing requirements in section 303(c)(1) for States to conduct triennial reviews of their water quality standards and submit the results of those reviews to EPA and in section 303(c)(4)(B) for promulgation. CWA section 303(c) includes numerous deadlines and section 303(c)(4) directs the Administrator to act "promptly" where the Administrator determines that a revised or new standard is necessary to meet the requirements of the Act. Congress, by linking section 303(c)(2)(B) to the section 303(c)(1) three-year review period, gave States a last chance to correct this deficiency on their own. The legislative history of the provision demonstrates that chief Senate sponsors, including Senators Stafford, Chaffee and others wanted the provision to eliminate State and EPA delays and force quick action. Thus, to interpret CWA section 303(c)(2)(B) and (c)(4) to require such a cumbersome pollutant specific effort on each stream segment would essentially render section 303(c)(2)(B) meaningless. The provision and its legislative background indicate that the Administrator's determination to invoke section 303(c)(4)(B) authority can be met by the Administrator making a generic finding of inaction by the State without the need to develop pollutant specific data for individual stream segments. Finally, the reference in section 303(c)(2)(B) to section 304(a) criteria suggests that section 304(a) criteria serve as default criteria; that once EPA has issued them, States were to adopt numeric criteria for those pollutants based on the 304(a) criteria, unless they had other scientifically defensible criteria. EPA also notes that this rule follows the approach EPA took nationally in promulgating the NTR for States that failed to comply with CWA section 303(c)(2)(B). 57 FR 60848, December 22, 1992. EPA incorporates the discussion in the NTR preamble as part of this rulemaking record.

This determination is supported by information in the rulemaking record showing the discharge or presence of priority toxic pollutants throughout the State. While this data is not necessarily complete, it constitutes a strong record supporting the need for numeric criteria for priority toxic pollutants with section 304(a) criteria guidance where the State does not have numeric criteria.

Today's final rule would not impose any undue or inappropriate burden on the State of California or its dischargers. It merely puts in place numeric criteria for toxic pollutants that are already used in other States in implementing CWA programs. Under this rulemaking, the State of California retains the ability to adopt alternative water quality criteria simply by completing its criteria adoption process. Upon EPA approval of those criteria, EPA will initiate action to stay the Federally-promulgated criteria and subsequently withdraw them.

2. Approach for Developing This Rule

In summary, EPA developed the criteria promulgated in today's final rule as follows. Where EPA promulgated criteria for California in the NTR, EPA has not acted to amend the criteria in the NTR. Where criteria for California were not included in the NTR, EPA used section 304(a) National criteria guidance documents as a starting point for the criteria promulgated in this rule. EPA then determined whether new information since the development of the national criteria guidance documents warranted any changes. New information came primarily from two sources. For human health criteria, new or revised risk reference doses and cancer potency factors on EPA's Integrated Risk Information System (IRIS) as of October 1996 form the basis for criteria values (see also 63 FR 68354). For aquatic life criteria, updated data sets resulting in revised criteria maximum concentrations (CMCs) and criteria continuous concentrations (CCCs) formed the basis for differences from the national criteria guidance documents. Both of these types of changes are discussed in more detail in the following sections. This revised information was used to develop the water quality criteria promulgated here for the State of California.

F. Derivation of Criteria

1. Section 304(a) Criteria Guidance Process

Under CWA section 304(a), EPA has developed methodologies and specific criteria guidance to protect aquatic life and human health. These methodologies are intended to provide protection for all surface waters on a national basis. The methodologies have been subject to public review, as have the individual criteria guidance documents. Additionally, the methodologies have been reviewed by EPA's Science Advisory Board (SAB) of external experts.

EPA has included in the record of this rule the aquatic life methodology as described in "Appendix B—Guidelines for Deriving Water Quality Criteria for the Protection of Aquatic Life and Its Uses" to the "Water Quality Criteria Documents; Availability" (45 FR 79341, November 28, 1980) as amended by the "Summary of Revisions to Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" (50 FR 30792, July 29, 1985). (Note: Throughout the remainder of this preamble, this reference is described as the 1985 Guidelines. Any page number references are to the actual guidance document, not the notice of availability in the **Federal Register**. A copy of the 1985 Guidelines is available through the National Technical Information Service (PB85–227049), is in the administrative record for this rule, and is abstracted in Appendix A of *Quality Criteria for Water*, 1986.) EPA has also included in the administrative record of this rule the human health methodology as described in "Appendix C—Guidelines and Methodology Used in the Preparation of Health Effects Assessment Chapters of the Consent Decree Water Criteria Documents" (45 FR 79347, November 28, 1980). (Note: Throughout the remainder of this preamble, this reference is described as the Human Health Guidelines or the 1980 Guidelines.) EPA also recommends that the following be reviewed: "Appendix D—Response to Comments on Guidelines for Deriving Water Quality Criteria for the Protection of Aquatic Life and Its Uses," (45 FR 79357, November 28, 1980); "Appendix E—Responses to Public Comments on the Human Health Effects Methodology for Deriving Ambient Water Quality Criteria" (45 FR 79368, November 28, 1980); and "Appendix B—Response to Comments on Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" (50 FR 30793, July 29, 1985). EPA placed into the administrative record for this rulemaking the most current individual criteria guidance for the priority toxic pollutants included in today's rule. (Note: All references to appendices are to the associated **Federal Register** publication.)

EPA received many comments related to the issue of what criteria should apply in the CTR if the CWA section 304(a) criteria guidance is undergoing re-evaluation, or if new data are developed that may affect a recommended criterion. As science is always evolving, EPA is faced with the challenge of promulgating criteria that reflect the best science and sound science. EPA addressed this challenge in some detail in its **Federal Register** notice that contained the Agency's current section 304(a) criteria guidance (63 FR 68335, December 10, 1998). There, EPA articulated its policy, reiterated here, that the existing criteria guidance represent the Agency's best assessment until such time as EPA's re-evaluation of a criteria guidance value for a particular chemical is complete. The reason for this is that both EPA's human health criteria guidance and aquatic life criteria guidance are developed taking into account numerous variables. For example, for human health criteria guidance, EPA evaluates many diverse toxicity studies, whose results feed into a reference dose or cancer potency estimate that, along with a number of exposure factors and determination of risk level, results in a guidance criterion. For aquatic life, EPA evaluates many diverse aquatic toxicity studies to determine chronic and acute toxicity taking into account how other factors (such as pH, temperature or hardness) affect toxicity. EPA also, to the extent possible, addresses bioaccumulation or bioconcentration. EPA then uses this toxicity information along with exposure information to determine the guidance criterion. Importantly, EPA subjects such evaluation to peer review and/or public comment.

For these reasons, EPA generally does not make a change to the 304(a) criteria guidance based on a partial picture of the evolving science. This makes sense, because to address one piece of new data without looking at all relevant data is less efficient and results in regulatory impacts that may go back and forth, when in the end, the criteria guidance value does not change that much. Certain new changes, however, do warrant change in criteria guidance, such as a change in a value in EPA's Integrated Risk Information System (IRIS) because it represents the Agency consensus about human health impacts. These changes are sufficiently examined across the Agency such that EPA believes they can be incorporated into EPA's water quality criteria guidance. EPA has followed this approach in the CTR. Included in the administrative record for today's rule is a document entitled "Status of Clean Water Act Section 304(a) Criteria" which further explains EPA's policy on managing change to criteria guidance.

2. Aquatic Life Criteria

Aquatic life criteria may be expressed in numeric or narrative form. EPA's 1985 Guidelines describe an objective, internally consistent and appropriate way of deriving chemical-specific, numeric water quality criteria for the protection of the presence of, as well as the uses of, both fresh and salt water aquatic organisms.

An aquatic life criterion derived using EPA's CWA section 304(a) method "might be thought of as an estimate of the highest concentration of a substance in water which does not present a significant risk to the aquatic organisms in the water and their uses." (45 FR 79341.) EPA's guidelines are designed to derive criteria that protect aquatic communities. EPA's 1985 Guidelines attempt to provide a reasonable and adequate amount of protection with only a small possibility of substantial overprotection or underprotection. As discussed in detail below, there are several individual factors which may make the criteria somewhat overprotective or underprotective. The approach EPA is using is believed to be as well balanced as possible, given the state of the science.

Numerical aquatic life criteria derived using EPA's 1985 Guidelines are expressed as short-term and long-term averages, rather than one number, in order that the criterion more accurately reflect toxicological and practical realities. The combination of a criterion maximum concentration (CMC), a short-term concentration limit, and a criterion continuous concentration (CCC), a four-day average concentration limit, are designed to provide protection of aquatic life and its uses from acute and chronic toxicity to animals and plants, without being as restrictive as a one-number criterion would have to be (1985 Guidelines, pages 4 & 5). The terms CMC and CCC are the formal names for the two (acute and chronic) values of a criterion for a pollutant; however, this document will also use the informal synonyms acute criterion and chronic criterion.

The two-number criteria are intended to identify average pollutant concentrations which will produce water quality generally suited to maintenance of aquatic life and designated uses while restricting the duration of excursions over the average so that total exposures will not cause unacceptable adverse effects. Merely specifying an average value over a time period may be insufficient unless the time period is short, because excursions higher than the average may kill or cause substantial damage in short periods.

A minimum data set of eight specified families is recommended for criteria development (details are given in the 1985 Guidelines, page 22). The eight specific families are intended to be representative of a wide spectrum of aquatic life. For this reason it is not necessary that the specific organisms tested be actually present in the water body. EPA's application of its guidelines to develop the criteria matrix in this rule is judged by the Agency to be appropriate for all waters of the United States (U.S.), and to all ecosystems (1985 Guidelines, page 4) including those waters of the U.S. and ecosystems in the State of California.

Fresh water and salt water (including both estuarine and marine waters) have different chemical compositions, and freshwater and saltwater species often do not inhabit the same water. To provide additional accuracy, criteria are developed for fresh water and for salt water.

For this rule, EPA updated freshwater aquatic life criteria contained in CWA section 304(a) criteria guidance first published in the early 1980's and later modified in the NTR, as amended, for the following ten pollutants: arsenic, cadmium, chromium (VI), copper, dieldrin, endrin, lindane (gamma BHC), nickel, pentachlorophenol, and zinc. The updates used as the basis for this rule are explained in a technical support document entitled, *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water* (U.S. EPA–820–B–96–001, September 1996), available in the administrative record to this rulemaking; this document presents the derivation of each of the final CMCs and CCCs and the toxicity studies from which the updated freshwater criteria for the ten pollutants were derived.

The polychlorinated biphenyls (PCB) criteria in the criteria matrix for this rule differs from that in the NTR, as amended; for this rule, the criteria are expressed as the sum of seven aroclors, while for the NTR, as amended, the criteria are expressed for each of seven aroclors. The aquatic life criteria for PCBs in the CTR are based on the criteria contained in the 1980 criteria guidance document for PCBs which is included in the administrative record for this rule. This criteria document explains the derivation of aquatic life criteria based on total PCBs. For more information see the Response to Comments document for this rule. Today's chronic aquatic life criteria for PCBs are based on a final residue value (FRV). In EPA's guidelines for deriving aquatic life criteria, an FRV-based criterion is intended to prevent concentrations of pollutants in commercially or recreationally important aquatic species from affecting the marketability of those species or affecting the wildlife that consume aquatic life.

The proposed CTR included an updated freshwater and saltwater aquatic life criteria for mercury. In today's final rule, EPA has reserved the mercury criteria for freshwater and saltwater aquatic life, but is promulgating human health criteria for mercury for all surface waters in California. In some instances, the human health mercury criteria included in today's final rule may not protect some aquatic species or threatened or endangered species. In such instances, more stringent mercury limits may be determined and implemented through use of the State's narrative criterion. The reasons for reserving the mercury aquatic life numbers are explained in further detail in Section L, Endangered Species Act.

a. Freshwater Acute Selenium Criterion

EPA proposed a different freshwater acute aquatic life criterion for selenium for this rule than was promulgated in the NTR, as amended. EPA's proposed action was consistent with EPA's proposed selenium criterion maximum concentration for the Water Quality Guidance for the Great Lakes System (61 FR 58444, November 14, 1996). This proposal took into account data showing that selenium's two most prevalent oxidation states, selenite and selenate, present differing potentials for aquatic toxicity, as well as new data which indicated that various forms of selenium are additive. Additivity increases the toxicity of mixtures of different forms of the pollutant. The proposed approach produces a different selenium acute criterion concentration, or CMC, depending upon the relative proportions of selenite, selenate, and other forms of selenium that are present.

The preamble to the August 5, 1997, proposed rule provided a lengthy discussion of this proposed criterion for the State of California. See 62 FR 42160–42208. EPA incorporates that discussion here as part of this rulemaking record. In 1996, a similar discussion was included in the proposed rule for the Great Lakes System. Commenters questioned several aspects of the Great Lakes proposal. EPA is continuing to respond to those comments, and to follow up with additional literature review and toxicity testing. In addition, the U.S. FWS and U.S. NMFS (collectively, the Services) are concerned that EPA's proposed criterion may not be sufficiently protective of certain threatened and endangered species in California. Because the Services believe there is a lack of data to show for certain that the proposed criterion would not affect threatened and endangered species, the Services prefer that EPA further investigate the protectiveness of the

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criterion before finalizing the proposed criterion. Therefore, EPA is not promulgating a final acute freshwater selenium criterion at this time.

b. Dissolved Metals Criteria

In December of 1992, in the NTR, EPA promulgated water quality criteria for several States that had failed to meet the requirements of CWA section 303(c)(2)(B). Included among the water quality criteria promulgated were numeric criteria for the protection of aquatic life for 11 metals: arsenic, cadmium, chromium (III), chromium (VI), copper, lead, mercury, nickel, selenium, silver and zinc. Criteria for two metals applied to the State of California: chromium III and selenium.

The Agency received extensive public comment during the development of the NTR regarding the most appropriate approach for expressing the aquatic life metals criteria. The principal issue was the correlation between metals that are measured and metals that are bioavailable and toxic to aquatic life. It is now the Agency's policy that the use of dissolved metal to set and measure compliance with aquatic life water quality standards is the recommended approach, because dissolved metal more closely approximates the bioavailable fraction of the metal in the water column than does total recoverable metal.

Since EPA's previous aquatic life criteria guidance had been expressed as total recoverable metal, to express the criteria as dissolved, conversion factors were developed to account for the possible presence of particulate metal in the laboratory toxicity tests used to develop the total recoverable criteria. EPA included a set of recommended freshwater conversion factors with its Metals Policy (see Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria, Martha G. Prothro, Acting Assistant Administrator for Water, October 1, 1993). Based on additional laboratory evaluations that simulated the original toxicity tests, EPA refined the procedures used to develop freshwater conversion factors for aquatic life criteria. These new conversion factors were made available for public review and comment in the amendments to the NTR on May 4, 1995, at 60 FR 22229. They are also contained in today's rule at 40 CFR 131.38(b)(2).

The preamble to the August 5, 1997, proposed rule provided a more detailed discussion of EPA's metals policy concerning the aquatic life water quality criteria for the State of California. See 62 FR 42160–42208. EPA incorporates that discussion here as part of this rulemaking record. Many commenters strongly supported the Agency's policy on dissolved metals aquatic life criteria. A few commenters expressed an opinion that the metals policy may not provide criteria that are adequately protective of aquatic or other species. Responses to those comments are contained in a memo to the CTR record entitled "Discussion of the Use of Dissolved Metals in the CTR" (February 1, 2000, Jeanette Wiltse) and EPA's response to comments document which are both contained in the administrative record for the final rule.

Calculation of Aquatic Life Dissolved Metals Criteria: Metals criteria values for aquatic life in today's rule in the matrix at 131.38(b)(1) are shown as dissolved metal. These criteria have been calculated in one of two ways. For freshwater metals criteria that are hardness-dependent, the metals criteria value is calculated separately for each hardness using the table at 40 CFR 131.38(b)(2). (The hardness-dependent freshwater values presented in the matrix at 40 CFR 131.38(b)(1) have been calculated using a hardness of 100 mg/l as CaCO3 for illustrative purposes only.) The hardness-dependent criteria are then multiplied by the appropriate conversion factors in the table at 40 CFR 131.38(b)(2). Saltwater and freshwater metals criteria that are not hardness-dependent are calculated by taking the total recoverable criteria values (from EPA's national section 304(a) criteria guidance, as updated and described in section F.2.a.) before rounding, and multiplying them by the appropriate conversion factors. The final dissolved metals criteria values, as they appear in the matrix at 40 CFR 131.38(b)(1), are rounded to two significant figures.

Translators for Dissolved to Total Recoverable Metals Limits: EPA's National Pollutant Discharge Elimination System (NPDES) regulations require that limits for metals in permits be stated as total recoverable in most cases (see 40 CFR 122.45(c)) except when an effluent guideline specifies the limitation in another form of the metal, the approved analytical methods measure only dissolved metal, or the permit writer expresses a metal's limit in another form (*e.g.*, dissolved, specific valence, or total) when required to carry out provisions of the CWA. This is because the chemical conditions in ambient waters frequently differ substantially from those in the effluent and these differences result in changes in the partitioning between dissolved and absorbed forms of the metal. This means that if effluent limits were expressed in the dissolved form, additional particulate metal could dissolve in the receiving water causing the criteria to be exceeded. Expressing criteria as dissolved metal requires translation between different metal forms in the calculation of the permit limit so that a total recoverable permit limit can be established that will achieve water quality standards. Thus, it is important that permitting authorities and other authorities have the ability to translate between dissolved metal in ambient waters and total recoverable metal in effluent.

EPA has completed guidance on the use of translators to convert from dissolved metals criteria to total recoverable permit limits. The document, *The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit From a Dissolved Criterion* (EPA 823–B–96–007, June 1996), is included in the administrative record for today's rule. This technical guidance examines how to develop a metals translator which is defined as the fraction of total recoverable metal in the downstream water that is dissolved, *i.e.*, the dissolved metal concentration divided by the total recoverable metal concentration. A translator may take one of three forms: (1) It may be assumed to be equivalent to the criteria guidance conversion factors; (2) it may be developed directly as the ratio of dissolved to total recoverable metal; and (3) it may be developed through the use of a partition coefficient that is functionally related to the number of metal binding sites on the adsorbent in the water column (*e.g.*, concentrations of total suspended solids or TSS). This guidance document discusses these three forms of translators, as well as field study designs, data generation and analysis, and site-specific study plans to generate site-specific translators.

California Regional Water Quality Control Boards may use any of these methods in developing water quality-based permit limits to meet water quality standards based on dissolved metals criteria. EPA encourages the State to adopt a statewide policy on the use of translators so that the most appropriate method or methods are used consistently within California.

c. Application of Metals Criteria

In selecting an approach for implementing the metals criteria, the principal issue is the correlation between metals that are measured and metals that are biologically available and toxic. In order to assure that the metals criteria are appropriate for the chemical conditions under which they are applied, EPA is providing for the

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adjustment of the criteria through application of the "water-effect ratio" procedure. EPA notes that performing the testing to use a site-specific water-effect ratio is optional on the part of the State.

In the NTR, as amended, EPA identified the water-effect ratio (WER) procedure as a method for optional site-specific criteria development for certain metals. The WER approach compares bioavailability and toxicity of a specific pollutant in receiving waters and in laboratory waters. A WER is an appropriate measure of the toxicity of a material obtained in a site water divided by the same measure of the toxicity of the same material obtained simultaneously in a laboratory dilution water.

On February 22, 1994, EPA issued *Interim Guidance on the Determination and Use of the Water-Effect Ratios for Metals* (EPA 823-B-94-001) now incorporated into the updated Second Edition of the Water Quality Standards Handbook, Appendix L. A copy of the Handbook is contained in the administrative record for today's rule. In accordance with the WER guidance and where application of the WER is deemed appropriate, EPA strongly encourages the application of the WER on a watershed or water body basis as part of a water quality criteria in California as opposed to the application on a discharger-by-discharger basis through individual NPDES permits. This approach is technically sound and an efficient use of resources. However, discharger specific WERs for individual NPDES permit limits are possible and potentially efficient where the NPDES discharger is the only point source discharger to a specific water body.

The rule requires a default WER value of 1.0 which will be assumed, if no site-specific WER is determined. To use a WER other than the default of 1.0, the rule requires that the WER must be determined as set forth in EPA's WER guidance or by another scientifically defensible method that has been adopted by the State as part of its water quality standards program and approved by EPA.

The WER is a more comprehensive mechanism for addressing bioavailability issues than simply expressing the criteria in terms of dissolved metal. Consequently, expressing the criteria in terms of dissolved metal, as done in today's rule for California, does not completely eliminate the utility of the WER. This is particularly true for copper, a metal that forms reduced-toxicity complexes with dissolved organic matter.

The *Interim Guidance on Determination and Use of Water-Effect Ratios for Metals* explains the relationship between WERs for dissolved criteria and WERs for total recoverable criteria. Dissolved measurements are to be used in the site-specific toxicity testing underlying the WERs for dissolved criteria. Because WERs for dissolved criteria generally are little affected by elevated particulate concentrations, EPA expects those WERs to be somewhat less than WERs for total recoverable criteria in such situations. Nevertheless, after the site-specific ratio of dissolved to total metal has been taken into account, EPA expects a permit limit derived using a WER for a dissolved criterion to be similar to the permit limit that would be derived from the WER for the corresponding total recoverable criterion.

d. Saltwater Copper Criteria

The saltwater copper criteria for aquatic life in today's rule are 4.8 µg/l (CMC) and 3.1 µg/l (CCC) in the dissolved form. These criteria reflect new data including data collected from studies for the New York/New Jersey Harbor and the San Francisco Bay indicating a need to revise the former copper 304(a) criteria guidance document to reflect a change in the saltwater CMC and CCC aquatic life values. These data also reflect a comprehensive literature search resulting in added toxicity test data for seven new species to the database for the saltwater copper criteria. EPA believes these new data have national implications and the national criteria guidance now contains a CMC of 4.8 µg/l dissolved and a CCC of 3.1 µg/l dissolved. In the amendments to the NTR, EPA noticed the availability of data to support these changes to the NTR, and solicited comments. The data can be found in the draft document entitled, *Ambient Water Quality Criteria—Copper, Addendum 1995*. This document is available from the Office of Water Resource Center and is available for review in the administrative record for today's rule.

e. Chronic Averaging Period

In establishing water quality criteria, EPA generally recommends an "averaging period" which reflects the duration of exposure required to elicit effects in individual organisms (TSD, Appendix D-2). The criteria continuous concentration, or CCC, is intended to be the highest concentration that could be maintained indefinitely in a water body without causing an unacceptable effect on the aquatic community or its uses (TSD, Appendix D-1). As aquatic organisms do not generally experience steady exposure, but rather fluctuating exposures to pollutants, and because aquatic organisms can generally tolerate higher concentrations of pollutants over a shorter periods of time, EPA expects that the concentration of a pollutant can exceed the CCC without causing an unacceptable effect if (a) the magnitude and duration of exceedences are appropriately limited and (b) there are compensating periods of time during which the concentration is below the CCC. This is done by specifying a duration of an "averaging period" over which the average concentration should not exceed the CCC more often than specified by the frequency (TSD, Appendix D-1).

EPA is promulgating a 4-day averaging period for chronic criteria, which means that measured or predicted ambient pollutant concentrations should be averaged over a 4-day period to determine attainment of chronic criteria. The State may apply to EPA for approval of an alternative averaging period. To do so, the State must submit to EPA the basis for such alternative averaging period.

The most important consideration for setting an appropriate averaging period is the length of time that sensitive organisms can tolerate exposure to a pollutant at levels exceeding a criterion without showing adverse effects on survival, growth, or reproduction. EPA believes that the chronic averaging period must be shorter than the duration of the chronic tests on which the CCC is based, since, in some cases, effects are elicited before exposure of the entire duration. Most of the toxicity tests used to establish the chronic criteria are conducted using steady exposure to toxicants for a least 28 days (TSD, page 35). Some chronic tests, however, are much shorter than this (TSD, Appendix D-2). EPA selected the 4-day averaging period based on the shortest duration in which chronic test effects are sometimes observed for certain species and toxicants. In addition, EPA believes that the results of some chronic tests are due to an acute effect on a sensitive life stage that occurs some time during the test, rather than being caused by long-term stress or long-term accumulation of the test material in the organisms.

Additional discussion of the rationale for the 4-day averaging period is contained in Appendix D of the TSD. Balancing all of the above factors and data, EPA believes that the 4-day averaging period falls within the scientifically reasonable range of values for choice of the averaging period, and is an appropriate length of time of

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pollutant exposure to ensure protection of sensitive organisms.

EPA established a 4-day averaging period in the NTR. In settlement of litigation on the NTR, EPA stated that it was "in the midst of conducting, sponsoring, or planning research related to the basis for and application of" water quality criteria and mentioned the issue of averaging period. See Partial Settlement Agreement in *American Forest and Paper Ass'n, Inc. et al.* v. *U.S. EPA* (Consolidated Case No. 93–0694 (RMU), D.D.C.). EPA is re-evaluating issues raised about averaging periods and will, if appropriate, revise the 1985 Guidelines.

EPA received public comment relevant to the averaging period during the comment period for the 1995 Amendments to the NTR (60 FR 22228, May 4, 1995), although these public comments did not address the chronic averaging period separately from the allowable excursion frequency and the design flow. Comments recommended that EPA use the 30Q5 design flow for chronic criteria.

While EPA is undertaking analysis of the chronic design conditions as part of the revisions to the 1985 Guidelines, EPA has not yet completed this work. Until this work is complete, for the reasons set forth in the TSD, EPA continues to believe that the 4-day chronic averaging period represents a reasonable, defensible value for this parameter.

EPA added language to the final rule which will enable the State to adopt alternative averaging periods and frequencies and associated design flows where appropriate. The State may apply to EPA for approval of alternative averaging periods and frequencies and related design flows; the State must submit the bases for any changes. Before approving any change, EPA will publish for public comment, a notice proposing the changes.

f. Hardness

Freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness and/or water quality characteristics that are usually correlated with hardness can reduce or increase the toxicities of some metals. Hardness is used as a surrogate for a number of water quality characteristics which affect the toxicity of metals in a variety of ways. Increasing hardness has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardnesses measured in milligrams per liter (mg/l) as calcium carbonate ($CaCO_3$).

Section 131.38(b)(2) of the final rule presents the hardness-dependent equations for freshwater metals criteria. For example, using the equation for zinc, the total recoverable CMCs at a hardness of 10, 50, 100 or 200 mg/l as $CaCO_3$ are 17, 67, 120 and 220 micrograms per liter (μg/l), respectively. Thus, the specific value in the table in the regulatory text is for illustrative purposes only. Most of the data used to develop these hardness equations for deriving aquatic life criteria for metals were in the range of 25 mg/l to 400 mg/l as $CaCO_3$, and the formulas are therefore most accurate in this range. The majority of surface waters nationwide and in California have a hardness of less than 400 mg/l as $CaCO_3$.

In the past, EPA generally recommended that 25 mg/l as $CaCO_3$ be used as a default hardness value in deriving freshwater aquatic life criteria for metals when the ambient (or actual) hardness value is below 25 mg/l as $CaCO_3$. However, use of the approach results in criteria that may not be fully protective. Therefore, for waters with a hardness of less than 25 mg/l as $CaCO_3$, criteria should be calculated using the actual ambient hardness of the surface water.

In the past, EPA generally recommended that if the hardness was over 400 mg/l, two options were available: (1) Calculate the criterion using a default WER of 1.0 and using a hardness of 400 mg/l in the hardness equation; or (2) calculate the criterion using a WER and the actual ambient hardness of the surface water in the equation. Use of the second option is expected to result in the level of protection intended in the 1985 Guidelines whereas use of the first option is thought to result in an even more protective aquatic life criterion. At high hardness there is an indication that hardness and related inorganic water quality characteristics do not have as much of an effect on toxicity of metals as they do at lower hardnesses. Related water quality characteristics do not correlate as well at higher hardnesses as they do at lower hardnesses. Therefore, if hardness is over 400 mg/l as $CaCO_3$, a hardness of 400 mg/l as $CaCO_3$ should be used with a default WER of 1.0; alternatively, the WER and actual hardness of the surface water may be used.

EPA requested comments in the NTR amendments on the use of actual ambient hardness for calculating criteria when the hardness is below 25 mg/l as $CaCO_3$, and when hardness is greater than 400 mg/l as $CaCO_3$. Most of the comments received were in favor of using the actual hardness with the use of the water-effect ratio (1.0 unless otherwise specified by the permitting authority) when the hardness is greater than 400 mg/l as $CaCO_3$. A few commenters did not want the water-effect ratio to be mandatory in calculating hardness, and other commenters had concerns about being responsible for deriving an appropriate water-effect ratio. Overall, the commenters were in favor of using the actual hardness when calculating hardness-dependent freshwater metals criteria for hardness between 0–400 mg/l as $CaCO_3$. EPA took those comments into account in promulgating today's rule.

A hardness equation is most accurate when the relationships between hardness and the other important inorganic constituents, notably alkalinity and pH, are nearly identical in all of the dilution waters used in the toxicity tests and in the surface waters to which the equation is to be applied. If an effluent raises hardness but not alkalinity and/or pH, using the hardness of the downstream water might provide a lower level of protection than intended by the 1985 guidelines. If it appears that an effluent causes hardness to be inconsistent with alkalinity and/or pH, the intended level of protection will usually be maintained or exceeded if either (1) data are available to demonstrate that alkalinity and/or pH do not affect the toxicity of the metal, or (2) the hardness used in the hardness equation is the hardness of upstream water that does not contain the effluent. The level of protection intended by the 1985 guidelines can also be provided by using the WER procedure.

In some cases, capping hardness at 400 mg/l might result in a level of protection that is higher than that intended by the 1985 guidelines, but any such increase in the level of protection can be overcome by use of the WER procedure. For metals whose criteria are expressed as hardness equations, use of the WER procedure will generally be intended to account for effects of such water quality characteristics as total organic carbon on the toxicities of metals. The WER procedure is equally useful for accounting for any deviation from a hardness equation in a site water.

3. Human Health Criteria

EPA's CWA section 304(a) human health criteria guidance provides criteria recommendations to minimize adverse human effects due to substances in ambient water. EPA's CWA section 304(a) criteria guidance for human health are based on two types of toxicological endpoints: (1) carcinogenicity and (2) systemic toxicity (i.e., all other adverse effects other than cancer). Thus, there are two procedures for assessing these health effects: one for carcinogens and one for non-carcinogens.

If there are no data on how a chemical agent causes cancer, EPA's existing human health guidelines assume that carcinogenicity is a "non-threshold phenomenon," that is, there are no "safe" or "no-effect levels" because even extremely small doses are assumed to cause a finite increase in the incidence of the effect (i.e., cancer). Therefore, EPA's water quality criteria guidance for carcinogens are presented as pollutant concentrations corresponding to increases in the risk of developing cancer. See Human Health Guidelines at 45 FR 79347.

With existing criteria, pollutants that do not manifest any apparent carcinogenic effect in animal studies (i.e., systemic toxicants), EPA assumes that the pollutant has a threshold below which no effect will be observed. This assumption is based on the premise that a physiological mechanism exists within living organisms to avoid or overcome the adverse effect of the pollutant below the threshold concentration.

Note: Recent changes in the Agency's cancer guidelines addressing these assumptions are described in the Draft Water Quality Criteria Methodology: Human Health, 63 FR 43756, August 14, 1998.

The human health risks of a substance cannot be determined with any degree of confidence unless dose-response relationships are quantified. Therefore, a dose-response assessment is required before a criterion can be calculated. The dose-response assessment determines the quantitative relationships between the amount of exposure to a substance and the onset of toxic injury or disease. Data for determining dose-response relationships are typically derived from animal studies, or less frequently, from epidemiological studies in exposed populations.

The dose-response information needed for carcinogens is an estimate of the carcinogenic potency of the compound. Carcinogenic potency is defined here as a general term for a chemical's human cancer-causing potential. This term is often used loosely to refer to the more specific carcinogenic or cancer slope factor which is defined as an estimate of carcinogenic potency derived from animal studies or epidemiological data of human exposure. It is based on extrapolation from test exposures of high doses over relatively short periods of time to more realistic low doses over a lifetime exposure period by use of linear extrapolation models. The cancer slope factor, q1*, is EPA's estimate of carcinogenic potency and is intended to be a conservative upper bound estimate (e.g. 95% upper bound confidence limit).

For non-carcinogens, EPA uses the reference dose (RfD) as the dose-response parameter in calculating the criteria. For non-carcinogens, oral RfD assessments (hereinafter simply "RfDs") are developed based on pollutant concentrations that cause threshold effects. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a lifetime. See Human Health Guidelines. The RfD was formerly referred to as an "Acceptable Daily Intake" or ADI. The RfD is useful as a reference point for gauging the potential effect of other doses. Doses that are less than the RfD are not likely to be associated with any health risks, and are therefore less likely to be of regulatory concern. As the frequency of exposures exceeding the RfD increases and as the size of the excess increases, the probability increases that adverse effect may be observed in a human population. Nonetheless, a clear conclusion cannot be categorically drawn that all doses below the RfD are "acceptable" and that all doses in excess of the RfD are "unacceptable." In extrapolating non-carcinogen animal test data to humans to derive an RfD, EPA divides either a No Observed-Adverse Effect Level (NOAEL), Lowest Observed Adverse Effect Level (LOAEL), or other benchmark dose observed in animal studies by an "uncertainty factor" which is based on professional judgment of toxicologists and typically ranges from 10 to 10,000.

For CWA section 304(a) human health criteria development, EPA typically considers only exposures to a pollutant that occur through the ingestion of water and contaminated fish and shellfish. Thus, the criteria are based on an assessment of risks related to the surface water exposure route only where designated uses are drinking water and fish and shellfish consumption.

The assumed exposure pathways in calculating the criteria are the consumption of 2 liters per day of water at the criteria concentration and the consumption of 6.5 grams per day of fish and shellfish contaminated at a level equal to the criteria concentration but multiplied by a "bioconcentration factor." The use of fish and shellfish consumption as an exposure factor requires the quantification of pollutant residues in the edible portions of the ingested species.

Bioconcentration factors (BCFs) are used to relate pollutant residues in aquatic organisms to the pollutant concentration in ambient waters. BCFs are quantified by various procedures depending on the lipid solubility of the pollutant. For lipid soluble pollutants, the average BCF is calculated from the weighted average percent lipids in the edible portions of fish and shellfish, which is about 3%; or it is calculated from theoretical considerations using the octanol/water partition coefficient. For non-lipid soluble compounds, the BCF is determined empirically. The assumed water consumption is taken from the National Academy of Sciences publication *Drinking Water and Health* (1977). (Referenced in the Human Health Guidelines.) This value is appropriate as it includes a margin of safety so that the general population is protected. See also EPA's discussion of the 2.0 liters/day assumption at 61 FR 65183 (Dec. 11, 1996). The 6.5 grams per day contaminated fish and shellfish consumption value was equivalent to the average per-capita consumption rate of all (contaminated and non-contaminated) freshwater and estuarine fish and shellfish for the U.S. population. See Human Health Guidelines.

EPA assumes in calculating water quality criteria that the exposed individual is an average adult with body weight of 70 kilograms. EPA assumes 6.5 grams per day of contaminated fish and shellfish consumption and 2.0 liters per day of contaminated drinking water consumption for a 70 kilogram person in calculating the criteria. Regarding issues concerning criteria development and differences in dose per kilogram of body weight, RfDs are always derived based on the most sensitive health effect endpoint. Therefore, when that basis is due to a chronic or lifetime health effect, the exposure parameters assume the exposed individual to be the average adult, as indicated above.

In the absence of this final rule, there may be particular risks to children. EPA believes that children are protected by the human health criteria contained in this final rule. Children are protected against other less sensitive adverse health endpoints due to the conservative way that the RfDs are derived. An RfD is a public health protective endpoint. It is an amount of a chemical that can be consumed on a daily basis for a lifetime without expecting an adverse effect. RfDs are based on sensitive health endpoints and are calculated to be protective for sensitive human sub-populations including children. If the basis of the RfD was due to an acute or shorter-term developmental effect, EPA uses exposure parameters other than those indicated above. Specifically, EPA uses parameters most representative of the population of concern (*e.g.*, the health criteria for nitrates based on infant exposure parameters). For carcinogens, the risk assessments are upper bound one in a million (10^{-6}) lifetime risk numbers. The risk to children is not likely to exceed these upper bounds estimates and may be zero at low doses. The exposure assumptions for drinking water and fish protect children because they are conservative for infants and children. EPA assumes 2 liters of untreated surface water and 6.5 grams of freshwater and estuarine fish are consumed each day. EPA believes the adult fish consumption assumption is conservative for children because children generally consume marine fish not freshwater and estuarine.

EPA has a process to develop a scientific consensus on oral reference dose assessments and carcinogenicity assessments (hereinafter simply cancer slope factors or slope factors or q1*s). Through this process, EPA develops a consensus of Agency opinion which is then used throughout EPA in risk management decision-making. EPA maintains an electronic data base which contains the official Agency consensus for oral RfD assessments and carcinogenicity assessments which is known as the Integrated Risk Information System (IRIS). It is available for use by the public on the National Institutes of Health's National Library of Medicine's TOXNET system, and through diskettes from the National Technical Information Service (NTIS). (NTIS access number is PB 90–591330.)

Section 304(a)(1) of the CWA requires EPA to periodically revise its criteria guidance to reflect the latest scientific knowledge: "(A) On the kind and extent of all identifiable effects on health and welfare * * *; (B) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and (C) on the effects of pollutants on the biological community diversity, productivity, and stability, including information on the factors affecting eutrophication rates of organic and inorganic sedimentation for varying types of receiving waters." In developing up-to-date water quality criteria for the protection of human health, EPA uses the most recent IRIS values (RfDs and q1*s) as the toxicological basis in the criterion calculation. IRIS reflects EPA's most current consensus on the toxicological assessment for a chemical. In developing the criteria in today's rule, the IRIS values as of October 1996 were used together with currently accepted exposure parameters for bioconcentration, fish and shellfish and water consumption, and body weight. The IRIS cover sheet for each pollutant criteria included in today's rule is contained in the administrative record.

For the human health criteria included in today's rule, EPA used the Human Health Guidelines on which criteria recommendations from the appropriate CWA section 304(a) criteria guidance document were based. (These documents are also placed in the administrative record for today's rule.) Where EPA has changed any parameters in IRIS used in criteria derivation since issuance of the criteria guidance document, EPA recalculated the criteria recommendation with the latest IRIS information. Thus, there are differences between the original 1980 criteria guidance document recommendations, and those in this rule, but this rule presents EPA's most current CWA section 304(a) criteria recommendation. The basis (q1* or RfD) and BCF for each pollutant criterion in today's rule is contained in the rule's Administrative Record Matrix which is included in the administrative record for the rule. In addition, all recalculated human health numbers are denoted by an "a" in the criteria matrix in 40 CFR 131.38(b)(1) of the rule. The pollutants for which a revised human health criterion has been calculated since the December 1992 NTR include:

mercury
dichlorobromomethane
1,2-dichloropropane
1,2-trans-dichloroethylene
2,4-dimethylphenol
acenaphthene
benzo(a)anthracene
benzo(a)pyrene
benzo(b)flouranthene
benzo(k)flouranthene
2-chloronaphthalene
chrysene
dibenzo(a,h)anthracene
indeno(1,2,3-cd)pyrene
N-nitrosodi-n-propylamine
alpha-endosulfan
beta-endosulfan
endosulfan sulfate
2-chlorophenol
butylbenzyl phthalate
polychlorinated biphenyls.

In November of 1991, the proposed NTR presented criteria for several pollutants in parentheses. These were pollutants for which, in 1980, insufficient information existed to develop human health water quality criteria, but for which, in 1991, sufficient information existed. Since these criteria did not undergo the public review and comment in a manner similar to the other water quality criteria presented in the NTR (for which sufficient information was available in 1980 to develop a criterion, as presented in the 1980 criteria guidance documents), they were not proposed for adoption into the water quality criteria, but were presented to serve as notice for inclusion in future State triennial reviews. Today's rule promulgates criteria for these nine pollutants:

copper
1, 2-dichloropropane
1,2-trans-dichloroethylene
2,4-dimethylphenol
acenaphthene
2-chloronaphthalene
N-nitrosodi-n-propylamine
2-chlorophenol
butylbenzene phthalate

All the criteria are based on IRIS values—either an RfD or q1*—which were listed on IRIS as of November 1991, the date of the proposed NTR. These values have not changed since the final NTR was published in December of 1992. The rule's Administrative Record Matrix in the administrative record of today's rule contains the specific RfDs, q1*s, and BCFs used in calculating these criteria.

Proposed Changes to the Human Health Criteria Methodology: EPA recently proposed revisions to the 1980 ambient water quality criteria derivation guidelines (the Human Health Guidelines). See *Draft Water Quality Criteria Methodology: Human Health*, 63 FR 43756, August 14, 1998; see also *Draft Water Quality Criteria Methodology: Human Health*, U.S. EPA Office of Water, EPA 822–Z–98–001. The EPA revisions consist of five documents: *Draft Water Quality Criteria Methodology: Human Health*, EPA 822–Z–98–001; *Ambient Water Quality Criteria Derivation Methodology Human Health, Technical Support Document, Final Draft*, EPA–822–B–98–005; and three Ambient Water Quality Criteria for the Protection of Human Health, Drafts—one each for Acrylonitrile, 1,3-Dichloropropene (1,3-DCP), and Hexachlorobutadiene (HCBD), respectively, EPA–822–R–98–006, –005, and –004. All five documents are contained in the administrative record for today's rule.

The proposed methodology revisions reflect significant scientific advances that have occurred during the past nineteen years in such key areas as cancer and noncancer risk assessments, exposure assessments and bioaccumulation. For specific details on these proposed changes and others, please refer to the **Federal Register** notice or the EPA document.

It should be noted that some of the proposed changes may result in significant numeric changes in the ambient water quality criteria. However, EPA will continue to rely on existing criteria as the basis for regulatory and non-regulatory decisions, until EPA revises and reissues a 304(a) criteria guidance using the revised final human health criteria methodology. The existing criteria are still viewed as scientifically acceptable by EPA. The intention of the proposed methodology revisions is to present the latest scientific advancements in the areas of risk and exposure assessment in order to incrementally improve the already sound toxicological and exposure bases for these criteria. As EPA's current human health criteria are the product of many years worth of development and peer review, it is reasonable to assume that revisiting all existing criteria, and incorporating peer review into such review, could require comparable amounts of time and resources. Given these circumstances, EPA proposed a process for revisiting these criteria as part of the overall revisions to the methodology for deriving human health criteria. This process is discussed in the Implementation Section of the Notice of *Draft Revisions to the Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health* (see 63 FR 43771–43776, August 14, 1998).

The State of California in its Ocean Plan, adopted in 1990 and approved by EPA in 1991, established numeric water quality criteria using an average fish and shellfish consumption rate of 23 grams per day. This value is based on an earlier California Department of Health Services estimate. The State is currently in the process of readopting its water quality control plans for inland surface waters, enclosed bays, and estuaries. The State intends to consider information on fish and shellfish consumption rates evaluated and summarized in a report prepared by the State's Pesticide and Environmental Toxicology Section of the Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency. The report, entitled, *Chemicals in Fish Report No. 1: Consumption of Fish and Shellfish in California and the United States*, was published in final draft form in July of 1997, and released to the public on September 16, 1997. The report is currently undergoing final evaluation, and is expected to published in final form in the near future. This final draft report is contained in the administrative record for today's rule. Although EPA has not used this fish consumption value here because this information has not yet been finalized, the State may use any appropriate higher state-specific fish and shellfish consumption rates in its readoption of criteria in its statewide plans.

a. 2,3,7,8-TCDD (Dioxin) Criteria

In today's action, EPA is promulgating human health water quality criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin ("dioxin") at the same levels as promulgated in the NTR, as amended. These criteria are derived from EPA's 1984 CWA section 304(a) criteria guidance document for dioxin.

For National Pollutant Discharge Elimination System (NPDES) purposes, EPA supports the regulation of other dioxin and dioxin-like compounds through the use of toxicity equivalencies or TEQs in NPDES permits (see discussion below). For California waters, if the discharge of dioxin or dioxin-like compounds has reasonable potential to cause or contribute to a violation of a narrative criterion, numeric water quality-based effluent limits for dioxin or dioxin-like compounds should be included in NPDES permits and should be expressed using a TEQ scheme.

EPA has been evaluating the health threat posed by dioxin nearly continuously for over two decades. Following issuance of the 1984 criteria guidance document, evaluating the health effects of dioxin and recommending human health criteria for dioxin, EPA prepared draft reassessments reviewing new scientific information relating to dioxin in 1985 and 1988. EPA's Science Advisory Board (SAB), reviewing the 1988 draft reassessment, concluded that while the risk assessment approach used in 1984 criteria guidance document had inadequacies, a better alternative was unavailable (see SAB's *Dioxin Panel Review of Documents from the Office or Research and Development relating to the Risk and Exposure Assessment of 2,3,7,8-TCDD* (EPA–SAB–EC–90–003, November 28, 1989) included in the administrative record for today's rule). Between 1988 and 1990, EPA issued numerous reports and guidances relating to the control of dioxin discharges from pulp and paper mills. See e.g., EPA Memorandum, "Strategy for the Regulation of Discharges of PHDDs & PHDFs from Pulp and Paper Mills to the Waters of the United States," from Assistant Administrator for Water to Regional Water Management Division Directors and NPDES State Directors, dated May 21, 1990 (AR NL–16); EPA Memorandum, "State Policies, Water Quality Standards, and Permit Limitations Related to 2,3,7,8-TCDD in Surface Water," from the Assistant Administrator for Water to Regional Water Management Division Directors, dated January 5, 1990 (AR VA–66). These documents are available in the administrative record for today's rule.

In 1991, EPA's Administrator announced another scientific reassessment of the risks of exposure to dioxin (see Memorandum from Administrator William K. Reilly to Erich W. Bretthauer, Assistant Administrator for Research and Development and E. Donald Elliott, General Counsel, entitled *Dioxin: Follow-Up to Briefing on Scientific Developments*, April 8, 1991, included in the administrative record for today's rule). At that time, the Administrator made clear that while the reassessment was underway, EPA would continue to regulate dioxin in accordance with existing Agency policy. Thereafter, the Agency proceeded to regulate dioxin in a number of environmental programs, including standards under the Safe Drinking Water Act and the CWA.

The Administrator's promulgation of the dioxin human health criteria in the 1992 NTR affirmed the Agency's decision that the ongoing reassessment should not defer or delay regulating this potent contaminant, and further, that the risk assessment in the 1984 criteria guidance document for dioxin continued to be scientifically defensible. Until the reassessment process was completed, the Agency could not "say with any certainty what the degree or directions of any changes in the risk estimates might be" (57 FR 60863–64).

The basis for the dioxin criteria as well as the decision to include the dioxin criteria in the 1992 NTR pending the results of the reassessment were challenged. See *American Forest and Paper Ass'n, Inc. et al. v. U.S. EPA* (Consolidated Case No. 93–0694 (RMU) D.D.C.). By order dated September 4, 1996, the Court upheld EPA's decision. EPA's brief and the Court's decision are included in the administrative record for today's rule.

EPA has undertaken significant effort toward completion of the dioxin reassessment. On September 13, 1994, EPA released for public review and comment a draft reassessment of toxicity and exposure to dioxin. See *Health Assessment Document for 2,3,7,8-Tetrachlorobenzo-p-Dioxin (TCDD) and Related Compounds*, U.S. EPA, 1994. EPA is currently addressing comments made by the public and the SAB and anticipates that the final

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revised reassessment will go to the SAB in the near future. With today's rule, the Agency reaffirms that, notwithstanding the on-going risk reassessment, EPA intends to continue to regulate dioxin to avoid further harm to public health, and the basis for the dioxin criteria, both in terms of the cancer potency and the exposure estimates, remains scientifically defensible. The fact that EPA is reassessing the risk of dioxin, virtually a continuous process to evaluate new scientific information, does not mean that the current risk assessment is "wrong". It continues to be EPA's position that until the risk assessment for dioxin is revised, EPA supports and will continue to use the existing risk assessment for the regulation of dioxin in the environment. Accordingly, EPA today promulgates dioxin criteria based on the 1984 criteria guidance document for dioxin and promulgated in the NTR in 1992.

Toxicity Equivalency: The State of California, in its 1991 water quality control plans, adopted human health criteria for dioxin and dioxin-like compounds based on the concept of toxicity equivalency (TEQ) using toxicity equivalency factors (TEFs). EPA Region 9 reviewed and approved the State's use of the TEQ concept and TEFs in setting the State's human health water quality criteria for dioxin and dioxin-like compounds.

In 1987, EPA formally embraced the TEQ concept as an interim procedure to estimate the risks associated with exposures to 210 chlorinated dibenzo-p-dioxin and chlorinated dibenzofuran (CDD/CDF) congeners, including 2,3,7,8-TCDD. This procedure uses a set of derived TEFs to convert the concentration of any CDD/CDF congener into an equivalent concentration of 2,3,7,8-TCDD. In 1989, EPA updated its TEFs based on an examination of relevant scientific evidence and a recognition of the value of international consistency. This updated information can be found in EPA's 1989 *Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -dibenzofurans (CDDs and CDFs)* (EPA/625/3–89/016, March 1989). EPA had been active in an international effort aimed at adopting a common set of TEFs (International TEFs/89 or I–TEFs/89), to facilitate information exchange on environmental contamination of CDD/CDF. This document reflects EPA's support of an internationally consistent set of TEFs, the I–TEFs/89. EPA uses I–TEFs/89 in many of its regulatory programs.

In 1994, the World Health Organization (WHO) revised the TEF scheme for dioxins and furans to include toxicity from dioxin-like compounds (Ahlborg et al., 1994). However, no changes were made to the TEFs for dioxins and furans. In 1998, the WHO re-evaluated and revised the previously established TEFs for dioxins (Ds), furans (Fs) and dioxin-like compounds (Vanden Bers, 1998). The nomenclature for this TEF scheme is TEQDFP–WHO98, where TEQ represents the 2,3,7,8-TCDD Toxic Equivalence of the mixture, and the subscript DFP indicates that dioxins (Ds) furans (Fs) and dioxin-like compounds (P) are included in the TEF scheme. The subscript 98 following WHO displays the year changes were made to the TEF scheme.

EPA intends to use the 1998 WHO TEF scheme in the near future. At this point however, EPA will support the use of either the 1989 interim procedures or the 1998 WHO TEF scheme but encourages the use of the 1998 WHO TEF scheme in State programs. EPA expects California to use a TEF scheme in implementing the 2,3,7,8-TCDD water quality criteria contained in today's rule. The TEQ and TEF approach provide a methodology for setting NPDES water quality-based permit limits that are protective of human health for dioxin and dioxin-like compounds.

Several commenters requested EPA to promulgate criteria for other forms of dioxin, in addition to 2,3,7,8-TCDD. EPA's draft reassessment for dioxin examines toxicity based on the TEQ concept and I–TEFs/89. When EPA completes the dioxin reassessment, the Agency intends to adopt revised 304(a) water quality criteria guidance based on the reassessment for dioxin. If necessary, EPA will then act to amend the NTR and CTR to reflect the revised 304(a) water quality criteria guidance.

b. Arsenic Criteria

EPA is not promulgating human health criteria for arsenic in today's rule. EPA recognizes that it promulgated human health water quality criteria for arsenic for a number of States in 1992, in the NTR, based on EPA's 1980 section 304(a) criteria guidance for arsenic established, in part, from IRIS values current at that time. However, a number of issues and uncertainties existed at the time of the CTR proposal concerning the health effects of arsenic. These issues and uncertainties were summarized in "Issues Related to Health Risk of Arsenic" which is contained in the administrative record for today's rule. During the period of this rulemaking action, EPA commissioned a study of arsenic health effects by the National Research Council (NRC) arm of the National Academy of Sciences. EPA received the NRC report in March of 1999. EPA scientists reviewed the report, which recommended that EPA lower the Safe Drinking Water Act arsenic maximum contaminant level (MCL) as soon as possible (The arsenic MCL is currently 50 µg/l.) The bladder cancer analysis in the NRC report will provide part of the basis for the risk assessment of a proposed revised arsenic MCL in the near future. After promulgating a revised MCL for drinking water, the Agency plans to revise the CWA 304(a) human health criteria for arsenic in order to harmonize the two standards. Today's rule defers promulgating arsenic criteria based on the Agency's previous risk assessment of skin cancer. In the meantime, permitting authorities in California should rely on existing narrative water quality criteria to establish effluent limitations as necessary for arsenic. California has previously expressed its science and policy position by establishing a criterion level of 5 µg/l for arsenic. Permitting authorities may, among other considerations, consider that value when evaluating and interpreting narrative water quality criteria.

c. Mercury Criteria

The human health criteria promulgated here use the latest RfD in EPA's Integrated Risk Information System (IRIS) and the weighted average practical bioconcentration factor (PBCF) from the 1980 section 304(a) criteria guidance document for mercury. EPA considered the approach used in the Great Lakes Water Quality Guidance ("Guidance") incorporating Bioaccumulation Factors (BAFs), but rejected this approach for reasons outlined below. The equation used here to derive an ambient water quality criterion for mercury from exposure to organisms and water is:

$$\mathrm{HHC} = \frac{\mathrm{RfD} \times \mathrm{BW}}{\mathrm{WC} + (\mathrm{FC} \times \mathrm{PBCF})}$$

Where:

RfD = Reference Dose
BW = Body Weight
WC = Water Consumption
FC = Total Fish and Shellfish Consumption per Day
PBCF = Practical Bioconcentration Factor (weighted average)

For mercury, the most current RfD from IRIS is 1×10^{-4} mg/kg/day. The RfD used a benchmark dose as an estimate of a No Observed Adverse Effect Level (NOAEL). The benchmark dose was calculated by applying a Weibel model for extra risk to all neurological effects observed in 81 Iraqi children exposed in utero as reported in Marsh, et. al. (1987). Maternal hair mercury was the measure of exposure. Extra risk refers to an adjustment for background incidence of a given health effect. Specifically, the extra risk is the added incidence of observing an effect above the background rate relative to the proportion of the population of interest that is not expected to exhibit such as effect. The resulting estimate was the lower 95% statistical bound on the 10% extra risk; this was 11 ppm mercury in maternal hair. This dose in hair was converted to an equivalent ingested amount by applying a model based on data from human studies; the resulting benchmark dose was 1×10^{-3} mg/kg body weight /day. The RfD was calculated by dividing the benchmark dose by a composite uncertainty factor of 10. The uncertainty factor was used to account for variability in the human population, in particular the wide variation in biological half-life of methylmercury and the variation that is observed in the ration of hair mercury to mercury in the blood. In addition the uncertainty factor accounts for lack of a two-generation reproductive study and the lack of data on long term effects of childhood mercury exposures. The RfD thus calculated is 1×10^{-4} mg/kg body weight/day or 0.1 µg/kg/day. The body weight used in the equation for the mercury criteria, as discussed in the Human Health Guidelines, is a mean adult human body weight of 70 kg. The drinking water consumption rate, as discussed in the Human Health Guidelines, is 2.0 liters per day.

The bioconcentration factor or BCF is defined as the ratio of chemical concentration in the organism to that in surrounding water. Bioconcentration occurs through uptake and retention of a substance from water only, through gill membranes or other external body surfaces. In the context of setting exposure criteria it is generally understood that the terms "BCF" and "steady-state BCF" are synonymous. A steady-state condition occurs when the organism is exposed for a sufficient length of time that the ratio does not change substantially.

The BCFs that were used herein are the "Practical Bioconcentration Factors (PBCFs)" that were derived in 1980: 5500 for fresh water, 3765 for estuarine coastal waters, and 9000 for open oceans. See pages C–100–1 of Ambient Water Quality Criteria for Mercury (EPA 440/5–80–058) for a complete discussion on the PBCF. Because of the way they were derived, these PBCFs take into account uptake from food as well as uptake from water. A weighted average PBCF was calculated to take into account the average consumption from the three waters using the following equation:

$$\text{Weighted Average Practical BCF} = \frac{\sum(\text{FC} \times \text{PBCF})}{\sum(\text{FC})} = \frac{(0.00172)(5500) + (0.00478)(3765) + (0.0122)(9000)}{0.00172 + 0.00478 + 0.0122} = \frac{137.3}{0.0187} = 7342.6$$

Given the large value for the weighted average PBCF, the contribution of drinking water to total daily intake is negligible so that assumptions concerning the chemical form of mercury in drinking water become less important. The human health mercury criteria promulgated for this rule are based on the latest RfD as listed in IRIS and a weighted PBCF from the 1980 § 304(a) criteria guidance document for mercury.

On March 23, 1995 (60 FR 15366), EPA promulgated the Great Lakes Water Quality Guidance ("Guidance"). The Guidance incorporated bioaccumulation factors (BAFs) in the derivation of criteria to protect human health because it is believed that BAFs are a better predictor than BCFs of the concentration of a chemical within fish tissue since BAFs include consideration of the uptake of contaminants from all routes of exposure. A bioaccumulation factor is defined as the ratio (in L/kg) of a substance's concentration in tissue to the concentration in the ambient water, in situations where both the organism and its food are exposed and the ratio does not change substantially over time. The final Great Lakes Guidance establishes a hierarchy of four methods for deriving BAFs for non-polar organic chemicals: (1) Field-measured BAFs; (2) predicted BAFs derived using a field-measured biota-sediment accumulation factor; (3) predicted BAFs derived by multiplying a laboratory-measured BCF by a food chain multiplier; and (4) predicted BAFs derived by multiplying a BCF calculated from the log Kow by a food-chain multiplier. The final Great Lakes Guidance developed BAFs for trophic levels three and four fish of the Great Lakes Basin. Respectively, the BAFs for mercury for trophic level 3 and 4 fish were: 27,900 and 140,000.

The BAF promulgated in the GLI was developed specifically for the Great Lakes System. It is uncertain whether the BAFs of 27,900 and 140,000 are appropriate for use in California at this time; therefore, today's final rule does not use the GLI BAF in establishing human health criteria for mercury in California. The magnitude of the BAF for mercury in a given system depends on how much of the total mercury is present in the methylated form. Methylation rates vary widely from one water body to another for reasons that are not fully understood. Lacking the data, it is difficult to determine if the BAF used in the GLI represents the true potential for mercury to bioaccumulate in California surface waters. The true, average BAF for California could be higher or lower. For more information see EPA's Response to Comments document in the administrative record for this rule (specifically comments CTR–002–007(b) and CTR–016–007).

EPA is developing a national BAF for mercury as part of revisions to its 304(a) criteria for human health; however, the BAF methodology that will be used is currently under evaluation as part of EPA's revisions to its National Human Health Methodology (see section F.3 above). EPA applied a similar methodology in its Mercury Study Report to Congress (MSRC) to derive a BAF for methylmercury. The MSRC is available through NTIS (EPA–452/R–97–003). Although a BAF was derived in the MSRC, EPA does not intend to use this BAF for National application. EPA is engaged in a separate effort to incorporate additional mercury bioaccumulation data that was not considered in the MSRC, and to assess uncertainties with using a National BAF approach for mercury. Once the proposed revised human health methodology, including the BAF component, is finalized, EPA will revise its 304(a) criteria for mercury to reflect changes in the underlying methodology, recommendations contained in the MSRC, and recommendations in a National Academy of Science report on human health assessment of methylmercury. When EPA changes its 304(a) criteria recommendation for mercury, States and Tribes will be expected to review their water quality standards for mercury and make any revisions necessary to ensure their standards are scientifically defensible.

New information may become available regarding the bioaccumulation of mercury in certain water bodies in California. EPA supports the use of this information to develop site-specific criteria for mercury. Further, if a California water body is impaired due to mercury fish tissue or sediment contamination, loadings of mercury could contribute to or exacerbate the impairment. Therefore, one option regulatory authorities should consider is to include water quality-based effluent limits (WQBELs) in permits based on mass for discharges to the impaired water body. Such WQBELs must be derived from and comply with applicable State water quality standards (including both numeric and narrative criteria) and assure that the discharge does not cause or contribute to a violation of water quality standards.

d. Polychlorinated Biphenyls (PCBs) Criteria

The NTR, as amended, calculated human health criteria for PCBs using a cancer potency factor of 7.7 per mg/kg-day from the Agency's IRIS. This cancer potency factor was derived from the Norback and Weltman (1985) study which looked at rats that were fed Aroclor 1260. The study used the linearized multistage model with a default cross-species scaling factor (body weight ratio to the ⅔ power). Although it is known that PCB mixtures vary greatly as to their potency in producing biological effects, for purposes of its carcinogenicity assessment, EPA considered Aroclor 1260 to be representative of all PCB mixtures. The Agency did not pool data from all available congener studies or generate a geometric mean from these studies, since the Norback and Weltman study was judged by EPA as acceptable, and not of marginal quality, in design or conduct as compared with other studies. Thereafter, the Institute for Evaluating Health Risks (IEHR, 1991) reviewed the pathological slides from the Norback and Weltman study, and concluded that some of the malignant liver tumors should have been interpreted as nonmalignant lesions, and that the cancer potency factor should be 5.1 per mg/kg-day as compared with EPA's 7.7 per mg/kg-day.

The Agency's peer-reviewed reassessment of the cancer potency of PCBs published in a final report, *PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures* (EPA/600/P-96/001F), adopts a different approach that distinguishes among PCB mixtures by using information on environmental processes. (The report is included in the administrative record of today's rule.) The report considers all cancer studies (which used commercial mixtures only) to develop a range of cancer potency factors, then uses information on environmental processes to provide guidance on choosing an appropriate potency factor for representative classes of environmental mixtures and different pathways. The reassessment provides that, depending on the specific application, either central estimates or upper bounds can be appropriate. Central estimates describe a typical individual's risk, while upper bounds provide assurance (*i.e.*, 95% confidence) that this risk is not likely to be underestimated if the underlying model is correct. Central estimates are used for comparing or ranking environmental hazards, while upper bounds provide information about the precision of the comparison or ranking. In the reassessment, the use of the upper bound values were found to increase cancer potency estimates by two or three-fold over those using central tendency. Upper bounds are useful for estimating risks or setting exposure-related standards to protect public health, and are used by EPA in quantitative cancer risk assessment. Thus, the cancer potency of PCB mixtures is determined using a tiered approach based on environmental exposure routes with upper-bound potency factors (using a body weight ratio to the ¾ power) ranging from 0.07 (lowest risk and persistence) to 2 (high risk and persistence) per mg/kg-day for average lifetime exposures to PCBs. It is noteworthy that bioaccumulated PCBs appear to be more toxic than commercial PCBs and appear to be more persistent in the body. For exposure through the food chain, risks can be higher than other exposures.

EPA issued the final reassessment report on September 27, 1996, and updated IRIS to include the reassessment on October 1, 1996. EPA updated the human health criteria for PCBs in the National Toxics Rule on September 27, 1999. For today's rule, EPA derived the human health criteria for PCBs using a cancer potency factor of 2 per mg/kg-day, an upper bound potency factor reflecting high risk and persistence. This decision is based on recent multimedia studies indicating that the major pathway of exposure to persistent toxic substances such as PCBs is via dietary exposure (*i.e.*, contaminated fish and shellfish consumption).

Following is the calculation of the human health criterion (HHC) for organism and water consumption:

$$HHC = \frac{RF \times BW \times (1{,}000\ \mu g/mg)}{q1^* \times [WC + (FC \times BCF)]}$$

Where:

RF = Risk Factor = 1×10^{-6}
BW = Body Weight = 70 kg
$q1^*$ = Cancer slope factor = 2 per mg/kg-day
WC = Water Consumption = 2 l/day
FC = Fish and Shellfish Consumption = 0.0065 kg/day
BCF = Bioconcentration Factor = 31,200

the HHC (μg/l) = 0.00017 μg/l (rounded to two significant digits).

Following is the calculation of the human health criterion for organism only consumption:

$$HHC = \frac{RF \times BW \times (1{,}000\ \mu g/mg)}{q1^* \times FC \times BCF}$$

Where:

RF = Risk Factor = 1×10^{-6}
BW = Body Weight = 70 kg
$q1^*$ = Cancer slope factor = 2 per mg/kg-day
FC = Total Fish and Shellfish Consumption per Day = 0.0065 kg/day
BCF = Bioconcentration Factor = 31,200

the HHC (μg/l) = 0.00017 μg/l (rounded to two significant digits).

The criteria are both equal to 0.00017 μg/l and apply to total PCBs. *See PCBs: Cancer Dose Response Assessment and Application to Environmental Mixtures* (EPA/600/9–96–001F). For a discussion of the body weight, water consumption, and fish and shellfish consumption factors, see the Human Health Guidelines. For a discussion of the BCF, see the 304(a) criteria guidance document for PCBs (included in the administrative record for today's rule).

e. Excluded Section 304(a) Human Health Criteria

As is the case in the NTR, as amended, today's rule does not promulgate criteria for certain priority pollutants for which CWA section 304(a) criteria guidance exists because those criteria were not based on toxicity to humans or aquatic organisms. The basis for those particular criteria is organoleptic effects (*e.g.*, taste and odor) which would make water and edible aquatic life unpalatable but not toxic. Because the basis for this rule is to protect the public health and aquatic life from toxicity consistent with the language and intent in CWA section 303(c)(2)(B), EPA is promulgating criteria only for those priority toxic pollutants whose criteria recommendations are based on toxicity. The CWA section 304(a) human health criteria based on organoleptic effects for zinc and 3-methyl-4-chlorophenol are excluded for this reason. See the 1992 NTR discussion at 57 FR 60864.

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f. Cancer Risk Level

EPA's CWA section 304(a) criteria guidance documents for priority toxic pollutants that are based on carcinogenicity present concentrations for upper bound risk levels of 1 excess cancer case per 100,000 people (10^{-5}), per 1,000,000 people (10^{-6}), and per 10,000,000 people (10^{-7}). However, the criteria documents do not recommend a particular risk level as EPA policy.

As part of the proposed rule, EPA requested and received comment on the adoption of a 10^{-5} risk level for carcinogenic pollutants. The effect of a 10^{-5} risk level would have been to increase (*i.e.*, make less stringent) carcinogenic pollutant criteria values (noted in the matrix by footnote c) that are not already promulgated in the NTR, by one order of magnitude. For example, the organism-only criterion for gamma BHC (pollutant number 105 in the matrix) is 0.013 µg/l; the criterion based on a 10^{-5} risk level would have been 0.13 µg/l. EPA received several comments that indicated a preference for a higher (10^{-4} and 10^{-5}) risk level for effluent dependent waters or other types of special circumstances.

In today's rule, EPA is promulgating criteria that protect the general population at an incremental cancer risk level of one in a million (10^{-6}) for all priority toxic pollutants regulated as carcinogens, consistent with the criteria promulgated in the NTR for the State of California. Standards adopted by the State contained in the Enclosed Bays and Estuaries Plan (EBEP), and the Inland Surface Waters Plan (ISWP), partially approved by EPA on November 6, 1991, and the Ocean Plan approved by EPA on June 28, 1990, contained a risk level of 10^{-6} for most carcinogens. The State has historically protected at a 10^{-6} risk level for carcinogenic pollutants.

EPA, in its recent human health methodology revisions, proposed acceptable lifetime cancer risk for the general population in the range of 10^{-5} to 10^{-6}. EPA also proposed that States and Tribes ensure the most highly exposed populations do not exceed a 10^{-4} risk level. However, EPA's draft methodology revisions also stated that it will derive 304(a) criteria at a 10^{-6} risk level, which the Agency believes reflects the appropriate risk for the general population and which applies a risk management policy which ensures protection for all exposed population groups. (Draft Water Quality Criteria Methodology: Human Health, EPA 822–Z–98–001, August 1998, Appendix II, page 72).

Subpopulations within a State may exist, such as recreational and subsistence anglers, who as a result of greater exposure to a contaminant are at greater risk than the standard 70 kilogram person eating 6.5 grams per day of fish and shellfish and drinking 2.0 liters per day of drinking water with pollutant levels meeting the water quality criteria. EPA acknowledges that at any given risk level for the general population, those segments of the population that are more highly exposed face a higher relative risk. For example, if fish are contaminated at a level permitted by criteria derived on the basis of a risk level of 10^{-6}, individuals consuming up to 10 times the assumed fish consumption rate would still be protected at a 10^{-5} risk level. Similarly, individuals consuming 100 times the general population rate would be protected at a 10^{-4} risk level. EPA, therefore, believes that derivation of criteria at the 10^{-6} risk level is a reasonable risk management decision protective of designated uses under the CWA. While outside the scope of this rule, EPA notes that States and Tribes, however, have the discretion to adopt water quality criteria that result in a higher risk level (*e.g.*, 10^{-5}). EPA expects to approve such criteria if the State or Tribe has identified the most highly exposed subpopulation within the State or Tribe, demonstrates the chosen risk level is adequately protective of the most highly exposed subpopulation, and has completed all necessary public participation.

This demonstration has not happened in California. Further, the information that is available on highly exposed subpopulations in California supports the need to protect the general population at the 10^{-6} level. California has cited the Santa Monica Bay Seafood Consumption Study as providing the best available data set for estimating consumption of sport fish and shellfish in California for both marine or freshwater sources (Chemicals in Fish Report No. 1: Consumption of Fish and Shellfish in California and the United States, Final Draft Report, July 1997). Consumption rates of sport fish and shellfish of 21g/day, 50 g/day, 107 g/day, and 161 g/day for the median, mean, 90th, and 95th percentile rates, respectively, were determined from this study. Additional consumption of commercial species in the range of approximately 8 to 42 g/day would further increase these values. Clearly the consumption rates for the most highly exposed subpopulation within the State exceeds 10 times the 6.5 g/day rates used in the CTR. Therefore, use of a risk level of 10^{-5} for the general population would not be sufficient to protect the most highly exposed population in California at a 10^{-4} risk level. On the other hand, even the most highly exposed subpopulations cited in the California study do not have consumption rates approaching 100 times the 6.5 g/day rates used in the CTR. The use of the 10^{-6} risk level to protect average level consumers does not subject these subpopulations to risk levels as high as 10^{-4}.

EPA believes its decision to establish a 10^{-6} risk level for the CTR is also consistent with EPA's policy in the NTR to select the risk level that reflect the policies or preferences of CWA programs in the affected States. California adopted standards for priority toxic pollutants for its ocean waters in 1990 using a 10^{-6} risk level to protect human health (California Ocean Plan, 1990). In April 1991, and again in November 1992, California adopted standards for its inland surface waters and enclosed bays and estuaries in its Inland Surface Waters Plan (ISWP) and its Enclosed Bays and Estuaries Plan (EBEP) using a 10^{-6} risk level. To be consistent with the State's water quality standards, EPA used a 10^{-6} risk level for California in the NTR at 57 FR 60867. The State has continued using a 10^{-6} risk level to protect human health for its standards that were not withdrawn with the ISWP and EBEP. The most recent expression of risk level preference is contained in the Draft Functional Equivalent Document, Amendment of the Water Quality Control Plan for Ocean Waters of California, October 1998, where the State recommended maintaining a consistent risk level of 10^{-6} for the human health standards that it was proposing to revise.

EPA received several comments requesting a 10^{-5} risk level based on the risk level chosen for the Great Lakes Water Quality Guidance (the Guidance). There are several differences between the guidelines for the derivation of human health criteria contained in the Guidance and the California Toxics Rule (CTR) that make a 10^{-5} risk factor appropriate for the Guidance, but not for the CTR. These differences result in criteria developed using the 10^{-5} risk factor in the Guidance being at least as stringent as criteria derived under the CTR using a 10^{-6} risk factor. The relevant aspects of the Guidance include:

• Use of fish consumption rates that are considerably higher than fish consumption rates for the CTR.

• Use of bioaccumulation factors rather than bioconcentration factors in

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estimating exposure, considerably increasing the dose of carcinogens to sensitive subgroups.

• Consideration of additivity of effects of mixtures for both carcinogenic and noncarcinogenic pollutants.

This combination of factors increase the calculated carcinogenic risk substantially under the Guidance (the combination would generally be more than one order of magnitude), making a lower overall risk factor acceptable. The Guidance risk factor provides, in fact, criteria with at least the same level of protection against carcinogens as criteria derived with a higher risk factor using the CTR. A lower risk factor for the CTR would not be appropriate absent concomitant changes in the derivation procedures that provide equivalent risk protection.

G. Description of Final Rule

1. Scope

Paragraph (a) in 40 CFR 131.38, entitled "Scope," states that this rule is a promulgation of criteria for priority toxic pollutants in the State of California for inland surface waters, enclosed bays, and estuaries. Paragraph (a) in 40 CFR 131.38 also states that this rule contains an authorizing compliance schedule provision.

2. EPA Criteria for Priority Toxic Pollutants

EPA's criteria for California are presented in tabular form at 40 CFR 131.38. For ease of presentation, the table that appears combines water quality criteria promulgated in the NTR, as amended, that are outside the scope of this rulemaking, with the criteria that are within the scope of today's rule. This is intended to help readers determine applicable water quality criteria for the State of California. The table contains footnotes for clarification.

Paragraph (b) in 40 CFR 131.38 presents a matrix of the applicable EPA aquatic life and/or human health criteria for priority toxic pollutants in California. Section 303(c)(2)(B) of the CWA addresses only pollutants listed as "toxic" pursuant to section 307(a) of the CWA for which EPA has developed section 304(a) criteria guidance. As discussed earlier in this preamble, the section 307(a) list of toxics contains 65 compounds and families of compounds, which potentially include thousands of specific compounds. Of these, the Agency identified a list of 126 "priority toxic pollutants" to implement the CWA (see 40 CFR 131.36(b)). Reference in this rule to priority toxic pollutants, toxic pollutants, or toxics refers to the 126 priority toxic pollutants.

EPA has not developed both aquatic life and human health CWA section 304(a) criterion guidance for all of the priority toxic pollutants. The matrix in 40 CFR 131.38(b) contains human health criteria in Column D for 92 priority toxic pollutants which are divided into Column 1: criteria for water consumption (i.e., 2.0 liters per day) and aquatic organism consumption (i.e., 6.5 grams per day of aquatic organisms); and Column 2: criteria for aquatic organism consumption only. The term aquatic organism includes fish and shellfish such as shrimp, clams, oysters and mussels. One reason the total number of priority toxic pollutants with criteria today differs from the total number of priority toxic pollutants contained in earlier published CWA section 304(a) criteria guidance is because EPA has developed and is promulgating chromium criteria for two valence states with respect to aquatic life criteria. Thus, although chromium is a single priority toxic pollutant, there are two criteria for chromium for aquatic life protection. See pollutant 5 in today's rule at 40 CFR 131.38(b). Another reason is that EPA is promulgating human health criteria for nine priority pollutants for which health-based national criteria have been calculated based on information obtained from EPA's IRIS database (EPA provided notice of these nine criteria in the NTR for inclusion in future State triennial reviews. See 57 FR 60848, 60890).

The matrix contains aquatic life criteria for 23 priority pollutants. These are divided into freshwater criteria (Column B) and saltwater criteria (Column C). These columns are further divided into acute and chronic criteria. The aquatic life criteria are considered by EPA to be protective when applied under the conditions described in the section 304(a) criteria documents and in the TSD. For example, water body uses should be protected if the criteria are not exceeded, on average, once every three year period. It should be noted that the criteria maximum concentrations (the acute criteria) are short-term concentrations and that the criteria continuous concentrations (the chronic criteria) are four-day averages. It should also be noted that for certain metals, the actual criteria are equations which are included as footnotes to the matrix. The toxicity of these metals is water hardness dependent and may be adjusted. The values shown in the table are illustrative only, based on a hardness expressed as calcium carbonate of 100 mg/l. Finally, the criterion for pentachlorophenol is pH dependent. The equation is the actual criterion and is included as a footnote. The value shown in the matrix is for a pH of 7.8. Several of the freshwater aquatic life criteria are incorporated into the matrix in the format used in the 1980 criteria methodology which uses a final acute value instead of a continuous maximum concentration. This distinction is noted in footnote g of the table.

The final rule at 40 CFR 131.38(c) establishes the applicability of the criteria to the State of California. 40 CFR 131.38(d) is described later in Section F, of this preamble. EPA has included in this rule provisions necessary to implement numeric criteria in a way that maintains the level of protection intended. These provisions are included in 40 CFR 131.38(c) of today's rule. For example, in order to do steady state waste load allocation analyses, most States have low flow values for streams and rivers which establish flow rates for various purposes. These low flow values become design flows for sizing treatment plants and developing water quality-based effluent limits and/or TMDLs. Historically, these design flows were selected for the purposes of waste load allocation analyses which focused on instream dissolved oxygen concentrations and protection of aquatic life. With the publication of the 1985 TSD, EPA introduced hydrologically and biologically based analyses for the protection of aquatic life and human health. (These concepts have been expanded subsequently in EPA's *Technical Guidance Manual for Performing Wasteload Allocations, Book 6, Design Conditions*, U.S. EPA, 1986. These analyses are included in Appendix D of the revised TSD. The discussion here is greatly simplified and is provided to support EPA's decision to promulgate design flows for instream flows and thereby maintain the adequacy of the criteria for priority toxic pollutants.) EPA recommended either of two methods for calculating acceptable low flows, the traditional hydrologic method developed by the U.S. Geological Survey or a biological based method developed by EPA. Other methods for evaluating the instream flow record may be available; use of these methods may result in TMDLs and/or water quality-based effluent limitations which adequately protect human health and/or aquatic life. The results of either of these two methods, or an equally protective alternative method, may be used.

The State of California may adopt specific design flows for streams and rivers to protect designated uses against the effects of toxics. EPA believes it is important to specify design flows in today's rule so that, in the absence of state design flows, the criteria promulgated today would be implemented appropriately. The TSD also recommends the use of three dynamic models to perform wasteload allocations. Dynamic wasteload models do not generally use specific steady state design flows but accomplish the same effect by factoring in the probability of occurrence of stream flows based on the historical flow record.

The low flows specified in the rule explicitly contain duration and frequency of occurrence which represent certain probabilities of occurrence. Likewise, the criteria for priority toxic pollutants are defined with duration and frequency components. Dynamic modeling techniques explicitly predict the effects of variability in receiving water, effluent flow, and pollution variation. Dynamic modeling techniques, as described in the TSD, allow for calculating wasteload allocations that meet the criteria for priority toxic pollutants without using a single, worst-case concentration based on a critical condition. Either dynamic modeling or steady state modeling can be used to implement the criteria promulgated today. For simplicity, only steady state conditions are discussed here. Clearly, if the criteria were implemented using design flows that are too high, the resulting toxic controls would not be adequate, because the resulting ambient concentrations would exceed EPA's criteria.

In the case of aquatic life, assuming exceedences occur more frequently than once in three years on the average, exceedences would result in diminished vitality of stream ecosystems characterized by the loss of desired species. Numeric water quality criteria should apply at all flows that are equal to or greater than flows specified below. The low flow values are:

Type of criteria	Design flow
Acute Aquatic Life (CMC).	1 Q 10 or 1 B 3
Chronic Aquatic Life (CCC).	7 Q 10 or 4 B 3
Human Health	harmonic mean flow

Where:

1 Q 10 is the lowest one day flow with an average recurrence frequency of once in 10 years determined hydrologically;

1 B 3 is biologically based and indicates an allowable exceedence of once every 3 years. It is determined by EPA's computerized method (DFLOW model);

7 Q 10 is the lowest average 7 consecutive day low flow with an average recurrence frequency of once in 10 years determined hydrologically;

4 B 3 is biologically based and indicates an allowable exceedences for 4 consecutive days once every 3 years. It is determined by EPA's computerized method (DFLOW model);

EPA is requiring that the harmonic mean flow be applied with human health criteria. The harmonic mean is a standard calculated statistical value. EPA's model for human health effects assumes that such effects occur because of a long-term exposure to low concentration of a toxic pollutant, for example, two liters of water per day for seventy years. To estimate the concentrations of the toxic pollutant in those two liters per day by withdrawal from streams with a high daily variation in flow, EPA believes the harmonic mean flow is the correct statistic to use in computing such design flows rather than other averaging techniques. (For a description of harmonic means see "Design Stream Flows Based on Harmonic Means," Lewis A. Rossman, Jr. of Hydraulics Engineering, Vol. 116, No. 7, July, 1990.)

All waters (including lakes, estuaries, and marine waters), whether or not suitable for such hydrologic calculations, are subject to the criteria promulgated today. Such criteria will need to be attained at the end of the discharge pipe, unless the State authorizes a mixing zone. Where the State plans to authorize a mixing zone, the criteria would apply at the locations allowed by the mixing zone. For example, the chronic criteria (CCC) would apply at the defined boundary of the chronic mixing zone. Discussion of and guidance on these factors are included in the revised TSD in Chapter 4.

EPA is aware that the criteria promulgated today for some of the priority toxic pollutants are at concentrations less than EPA's current analytical detection limits. Analytical detection limits have never been an acceptable basis for setting water quality criteria since they are not related to actual environmental impacts. The environmental impact of a pollutant is based on a scientific determination, not a measuring technique which is subject to change. Setting the criteria at levels that reflect adequate protection tends to be a forcing mechanism to improve analytical detection methods. See 1985 Guidelines, page 21. As the methods improve, limits based on the actual criteria necessary to protect aquatic life and human health become measurable. The Agency does not believe it is appropriate to promulgate criteria that are not sufficiently protective. EPA discusses this issue further in its Response to Comment Document for today's final rule.

EPA does believe, however, that the use of analytical detection limits are appropriate for assessing *compliance* with National Pollutant Discharge Elimination System (NPDES) permit limits. This view of the role of detection limits was first articulated in guidance for translating dioxin criteria into NPDES permit limits. See "Strategy for the Regulation of Discharges of PHDDs and PHDFs from Pulp and Paper Mills to Waters of the U.S." Memorandum from the Assistant Administrator for Water to the Regional Water Management Division Directors, May 21, 1990. This guidance presented a model for addressing toxic pollutants which have criteria less than current detection limits. EPA, in more recent guidance, recommends the use of the "minimum level" or ML for reporting sample results to assess compliance with WQBELs (TSD page 111). The ML, also called the "quantification level," is the level at which the entire analytical system gives recognizable mass spectra and acceptable calibration points, i.e., the point at which the method can reliably quantify the amount of pollutant in the sample. States can use their own procedures to average and otherwise account for monitoring data, *e.g.*, quantifying results below the ML. These results can then be used to assess compliance with WQBELs. (See 40 CFR part 132, Appendix F, Procedure 8.B.) This approach is applicable to priority toxic pollutants with criteria less than current detection limits. EPA's guidance explains that standard analytical methods may be used for purposes of assessing compliance with permit limits, but not for purposes of establishing water quality criteria or permit limits. Under the CWA, analytical methods are appropriately used in connection with NPDES permit limit compliance assessments. Because of the function of water quality criteria, EPA has not considered the sensitivity of analytical methods in deriving the criteria promulgated today.

EPA has promulgated 40 CFR 131.38(c)(3) to determine when freshwater or saltwater aquatic life criteria apply. This provision incorporates a time parameter to better define the critical condition. The structure of the paragraph is to establish applicable rules and to allow for site-specific exceptions where the rules are not consistent with actual field conditions. Because a distinct separation generally does not exist between freshwater and saltwater aquatic communities, EPA is establishing the following: (1) The freshwater criteria apply at salinities of 1 part per thousand and below at locations where this occurs 95% or more of the time; (2) saltwater criteria apply at salinities of 10 parts per thousand and above at locations where this occurs 95% more of the time; and (3) at salinities between 1 and 10 parts per thousand the more stringent of the two apply unless EPA approves the application of the freshwater or saltwater criteria based on an appropriate biological assessment. The percentiles included here were selected to minimize the chance of overlap, that is, one site meeting both criteria. Determination of these percentiles can be done by any reasonable means such as interpolation between points with measured data or by the application of calibrated and verified mathematical models (or hydraulic models). It is not EPA's intent to require actual data collection at particular locations.

In the brackish water transition zones of estuaries with varying salinities, there generally will be a mix of freshwater and saltwater species. Generally, therefore, it is reasonable for the more stringent of the freshwater or saltwater criteria to apply. In evaluating appropriate data supporting the alternative set of criteria, EPA will focus on the species composition as its preferred method. This assignment of criteria for fresh, brackish and salt waters was developed in consultation with EPA's research laboratories at Duluth, Minnesota and Narragansett, Rhode Island. The Agency believes such an approach is consistent with field experience.

Paragraph (d) in 40 CFR 131.38 lists the designated water and use classifications for which the criteria apply. The criteria are applied to the beneficial use designations adopted by the State of California; EPA has not promulgated any new use classifications in this rule.

Exceedences Frequency: In a water quality criterion for aquatic life, EPA recommends an allowable frequency for excursions of the criteria. See 1985 Guidelines, pages 11–13. This allowable frequency provides an appropriate period of time during which the aquatic community can recover from the effect of an excursion and then function normally for a period of time before the next excursion. An excursion is defined as an occurrence of when the average concentration over the duration of the averaging period is above the CCC or the CMC. As ecological communities are naturally subjected to a series of stresses, the allowable frequency of pollutant stress may be set at a value that does not significantly increase the frequency or severity of all stresses combined. See also TSD, Appendix D. In addition, providing an allowable frequency for exceeding the criterion recognizes that it is not generally possible to assure that criteria are never exceeded. (TSD, page 36.)

Based on the available data, today's rule requires that the acute criterion for a pollutant be exceeded no more than once in three years on the average. EPA is also requiring that the chronic criterion for a pollutant be exceeded no more than once in three years on the average. EPA acknowledges that States may develop allowable frequencies that differ from these allowable frequencies, so long as they are scientifically supportable, but believes that these allowable frequencies are protective of the designated uses where EPA is promulgating criteria.

The use of aquatic life criteria for developing water quality-based effluent limits in permits requires the permitting official to use an appropriate wasteload allocation model. (TSD, Appendix D–6.) As discussed above, there are generally two methods for determining design flows, the hydrologically-based method and the biologically-based method.

The biologically-based method directly uses the averaging periods and frequencies specified in the aquatic life criteria for determining design flows. (TSD, Appendix. D–8.) Because the biologically-based method calculates the design flow directly from the duration and allowable frequency, it most accurately provides the allowed number of excursions. The hydrologically based method applies the CMC at a design flow equal to or equivalent to the 1Q10 design flow (i.e., the lowest one-day flow with an average recurrence frequency of once in ten years), and applies the CCC at the 7Q10 design flow (i.e., the lowest average seven consecutive day flow with a recurrence frequency of once in ten years).

EPA established a three year allowable frequency in the NTR. In settlement of the litigation on the NTR, EPA stated that it was in the midst of conducting, sponsoring, or planning research aimed at addressing scientific issues related to the basis for and application of water quality criteria and mentioned the issue of allowable frequency. See Partial Settlement Agreement in *American Forest and Paper Ass'n, Inc. et al.* v. *U.S. EPA* (Consolidated Case No. 93–0694 (RMU) D.D.C. To that end, EPA is reevaluating issues raised about allowable frequency as part of its work in revising the 1985 Guidelines.

EPA recognizes that additional data concerning (a) the probable frequency of lethal events for an assemblage of taxa covering a range of sensitivities to pollutants, (b) the probable frequency of sublethal effects for such taxa, (c) the differing effects of lethal and sublethal events in reducing populations of such taxa, and (d) the time needed to replace organisms lost as a result of toxicity, may lead to further refinement of the allowable frequency value. EPA has not yet completed this work. Until this work is complete, EPA believes that where EPA promulgates criteria, the three year allowable frequency represents a value in the reasonable range for this parameter.

3. Implementation

Once the applicable designated uses and water quality criteria for a water body are determined, under the National Pollutant Discharge Elimination System (NPDES) program discharges to the water body must be characterized and the permitting authority must determine the need for permit limits. If a discharge causes, has the reasonable potential to cause, or contributes to an excursion of a numeric or narrative water quality criteria, the permitting authority must develop permit limits as necessary to meet water quality standards. These permit limits are water quality-based effluent limitations or WQBELs. The terms "cause," "reasonable potential to cause," and "contribute to" are the terms in the NPDES regulations for conditions under which water quality-based permit limits are required. See 40 CFR 122.44(d)(1).

Since the publication of the proposed CTR, the State of California adopted procedures which detail how water quality criteria will be implemented through NPDES permits, waste discharge requirements, and other regulatory approaches. These procedures entitled, *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* were adopted on March 2, 2000. Once these procedures are submitted for review under CWA section 303(c), EPA will review them as they relate to water quality standards, and approve or disapprove them.

Several commenters understood the language in the preamble to the proposed rule regarding implementation to mean that site-specific criteria, variances, and other actions would be prohibited or severely limited by the CTR. Site-specific criteria, variances and other actions modifying criteria are neither prohibited nor limited by the CTR. The State, if it so chooses, still can make these changes to its water quality standards, subject to EPA approval. However, with this Federal rule in effect, the State cannot implement any modifications that are less stringent than the CTR without an amendment to the CTR to reflect these modifications. EPA will make every effort to expeditiously accommodate Federal rulemaking of appropriate modifications to California's water quality standards. In the preamble to the proposed CTR, and here today, EPA is emphasizing that these efforts to amend the CTR on a case-by-case basis will generally increase the time before a modification can be implemented.

4. Wet Weather Flows

EPA has for a longtime maintained that CWA section 301(b)(1)(C) applies to NPDES permits for discharges from municipal separate storm sewer systems. Recently, the U.S. Court of Appeals for the Ninth Circuit upheld NPDES permits issued by EPA for five Arizona municipal separate storm sewer systems and addressed this issue specifically. *Defenders of Wildlife, et al.* v. *Browner*, No. 98–71080 (9th Cir., October 1999). The Court held that the CWA does not require "strict compliance" with State water quality standards for municipal storm sewer permits under section 301(b)(1)(C), but that at the same time, the CWA does give EPA discretion to incorporate appropriate water quality-based effluent limitations under another provision, CWA section 402(p)(3)(B)(iii).

The Court based its decision on the structure of section 402(p)(3), which contains distinct language for discharges of industrial storm water and municipal storm water. In section 402(p)(3)(A), Congress requires that "dischargers associated with industrial activity shall meet all applicable provisions of [section 402] and section [301]." 33 U.S.C. section 1342(p)(3)(A). The Court noted, therefore, that by incorporation, industrial storm water discharges need to achieve "any more stringent limitation, including those necessary to meet water quality standards * * *" The Court explained that industrial storm water discharges "must comply strictly with State water quality standards" but that Congress chose not to include a similar provision for municipal storm sewer discharges, including instead a requirement for controls to reduce pollutants to the maximum extent practicable or MEP standard in section 402(p)(3)(B). Reading the two related sections together, the Court concluded that section 402(p)(3)(B)(iii) does not require "strict compliance" by municipal storm sewer discharges according to section 301(b)(1)(C). At the same time, however, the Court found that the language in CWA section 402(p)(3)(B)(iii) which states that permits for discharges from municipal storm sewers shall require "such other provisions as the Administrator of the state determines appropriate for the control of such pollutants" provides EPA with discretion to incorporate provisions lending to ultimate compliance with water quality standards.

EPA believes that compliance with water quality standards through the use of Best Management Practices (BMPs) is appropriate. EPA articulated its position on the use of BMPs in storm water permits in the policy memorandum entitled, "Interim Permitting Approach for Water Quality-Based Effluent Limitations In Storm Water Permits" which was signed by the Assistant Administrator for Water, Robert Perciasepe on August 1, 1996 (61 FR 43761, August 9, 1996). A copy of this memorandum is contained in the administrative record for today's rule. The policy affirms the use of BMPs as a means to attain water quality standards in municipal storm water permits, and embraces BMPs as an interim permitting approach.

The interim permitting approach uses BMPs in first-round storm water permits, and expanded or better-tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards. In cases where adequate information exists to develop more specific conditions or limitations to meet water quality standards, these conditions or limitations are to be incorporated into storm water permits, as necessary and appropriate.

This interim permitting approach, however, only applies to EPA. EPA encourages the State to adopt a similar policy for municipal storm water permits. This interim permitting approach provides time, where necessary, to more fully assess the range of issues and possible options for the control of storm water discharges for the protection of water quality. More information on this issue is included in the response to comment document in response to specific storm water issues raised by commenters.

5. Schedules of Compliance

A compliance schedule refers to an enforceable sequence of interim requirements in a permit leading to ultimate compliance with water quality-based effluent limitations or WQBELs in accordance with the CWA. The authorizing compliance schedule provision authorizes, but does not require, the permit issuing authority in the State of California to include such compliance schedules in permits under appropriate circumstances. The State of California is authorized to administer the National Pollutant Discharge Elimination System (NPDES) program and may exercise its discretion when deciding if a compliance schedule is justified because of the technical or financial (or other) infeasibility of immediate compliance. An authorizing compliance schedule provision is included in today's rule because of the potential for existing dischargers to have new or more stringent effluent limitations for which immediate compliance would not be possible or practicable.

New and Existing Dischargers: The provision allows compliance schedules only for an "existing discharger" which is defined as any discharger which is not a "new California discharger." A "new California discharger" includes "any building, structure, facility, or installation from which there is, or may be, a 'discharge of pollutants', the construction of which commences after the effective date of this regulation." These definitions are modeled after the existing 40 CFR 122.2 definitions for parallel terms, but with a cut-off date modified to reflect this rule. Only "new California dischargers" are required to comply immediately upon commencement of discharge with effluent limitations derived from the criteria in this rule. For "existing dischargers" whose permits are reissued or modified to contain new or more stringent limitations based upon certain water quality requirements, the permit could allow up to five years, or up to the length of a permit, to comply with such limitations. The provision applies to new or more stringent effluent limitations based on the criteria in this EPA rule.

EPA has included "increasing dischargers" within the category of "existing dischargers" since "increasing dischargers" are existing facilities with a change—an increase—in their discharge. Such facilities may include those with seasonal variations. "Increasing dischargers" will already have treatment systems in place for their current discharge, thus, they have less opportunity than a new discharger does to design and build a new treatment system which will meet new water quality-based requirements for their changed discharge. Allowing existing facilities with an increasing discharge a compliance schedule will avoid placing the discharger at a competitive disadvantage vis-a-vis other existing dischargers who are eligible for compliance schedules.

Today's rule does not prohibit the use of a short-term "shake down period" for new California dischargers as is provided for new sources or new dischargers in 40 CFR 122.29(d)(4). These regulations require that the owner or operator of (1) a new source; (2) a new discharger (as defined in 40 CFR 122.2) which commenced discharge after August 13, 1979; or (3) a recommencing discharger shall install and implement all pollution control equipment to meet the conditions of the permit before discharging. The facility must also meet all permit conditions in the shortest feasible time (not to exceed 90 days). This shake-down period is not a compliance schedule. This approach may be used to address violations which may occur during a new facility's start-up, especially where permit limits are water quality-based and biological treatment is involved.

The burden of proof to show the necessity of a compliance schedule is on the discharger, and the discharger must request approval from the permit issuing authority for a schedule of compliance. The discharger should submit a description of the minimum required actions or evaluations that must be undertaken in order to comply with the new or more restrictive discharge limits. Dates of completion for the required actions or evaluations should be included, and the proposed schedule should reflect the shortest practicable time to complete all minimum required actions.

Duration of Compliance Schedules: Today's rule provides that compliance schedules may provide for up to five years to meet new or more stringent effluent limitations in those limited circumstances where the permittee can demonstrate to the permit authority that an extended schedule is warranted. EPA's regulations at 122.47 require compliance with standards as soon as possible. This means that permit authorities should not allow compliance schedules where the permittee fails to demonstrate their necessity. This provision should not be considered a default compliance schedule duration for existing facilities.

In instances where dischargers wish to conduct toxicological studies, analyze results, and adopt and implement new or revised water quality-based effluent limitations, EPA believes that five years is sufficient time within which to complete this process. See the preamble to the proposed rule.

Under this rule, where a schedule of compliance exceeds one year, interim requirements are to be specified and interim progress reports are to be submitted at least annually to the permit issuing authority, in at least one-year time intervals.

The rule allows all compliance schedules to extend up to a maximum duration of five years, which is the maximum term of any NPDES permit. See 40 CFR 122.46. The discharger's opportunity to obtain a compliance schedule occurs when the existing permit for that discharge is issued, reissued or modified to contain more stringent limits based on the water quality criteria in today's rule. Such compliance schedules, however, cannot be extended to any indefinite point of time in the future because the compliance schedule provision in this rule will sunset on May 18, 2005. The sunset applies to the authorizing provision in today's rule (40 CFR 131.38(e)), not to individual schedules of compliance included in specific NPDES permits. Delays in reissuing expired permits (including those which continue in effect under applicable NPDES regulations) cannot indefinitely extend the period of time during which a compliance schedule is in effect. This would occur where the permit authority includes the single maximum five-year compliance schedule in a permit that is reissued just before the compliance schedule provision sunsets (having been previously issued without WQBELS using the rule's criteria on the eve of the effective date of this rule). Instead, the effect of the sunset provision is to limit the longest time period for compliance to ten years after the effective date of this rule.

EPA recognizes that where a permit is modified during the permit term, and the permittee needs the full five years to comply, the five-year schedule may extend beyond the term of the modified permit. In such cases, the rule allows for the modified permit to contain a compliance schedule with an interim limit by the end of the permit term. When the permit is reissued, the permit authority may extend the compliance schedule in the next permit, provided that, taking into account the amount of time allowed under the previous permit, the entire compliance schedule contained in the permit shall not exceed five years. Final permit limits and compliance dates will be included in the record for the permit. Final compliance dates must occur within five years from the date of permit issuance, reissuance, or modification, unless additional or less time is provided for by law.

EPA would prefer that the State adopt an authorizing compliance schedule provision but recognizes that the State may not be able to complete this action for some time after promulgation of the CTR. Thus, EPA has chosen to promulgate the rule with a sunset provision which states that the authorizing compliance schedule provision will cease or sunset on May 18, 2005. However, if the State Board adopts, and EPA approves, a statewide authorizing compliance schedule provision significantly prior to May 18, 2005, EPA will act to stay the authorizing compliance schedule provision in today's rule. Additionally, if a Regional Board adopts, and the State Board adopts and EPA approves, a Regional Board authorizing compliance schedule provision, EPA will act to stay today's provision for the appropriate or corresponding geographic region in California. At that time, the State Board's or Regional Board's authorizing compliance schedule provision will govern the ability of the State regulatory entity to allow a discharger to include a compliance schedule in a discharger's NPDES permit.

Antibacksliding: EPA wishes to address the potential concern over antibacksliding where revised permit limits based on new information are the result of the completion of additional studies. The Agency's interpretation of the CWA is that the antibacksliding requirements of section 402(o) of the CWA do not apply to revisions to effluent limitations made before the scheduled date of compliance for those limitations.

State Compliance Schedule Provisions: EPA supports the State in adopting a statewide provision independent of or as part of the effort to readopt statewide water quality control plans, or in adopting individual basin-wide compliance schedule provisions through its nine Regional Water Quality Control Boards (RWQCBs). The State and RWQCBs have broad discretion to adopt a provision, including discretion on reasonable lengths of time for final compliance with WQBELs. EPA recognizes that practical time frames within which to set interim goals may be necessary to achieve meaningful, long-term improvements in water quality in California.

At this time, two RWQCBs have adopted an authorizing compliance schedule provision as an amendment to

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their respective Basin Plans during the Boards' last triennial review process. The Basin Plans have been adopted by the State and have come to EPA for approval. Thus, the Basin Plans' provisions are effective for the respective Basins. If and when EPA approves of either Regional Basin Plan, EPA will expeditiously act to amend the CTR, staying its compliance schedule provision, for the appropriate geographic region.

6. Changes From Proposed Rule

A few changes were made in the final rule from the proposal both as a result of the Agency's consideration of issues raised in public comments and Endangered Species Act consultation with the U.S. Fish and Wildlife Service (FWS) and U.S. National Marine Fisheries Service (NMFS). The important changes include: reserving the mercury aquatic life criteria; reserving the selenium freshwater acute aquatic life criterion; reserving the chloroform human health criteria; and adding a sunset provision to the authorizing compliance schedule provision. EPA also clarified that the CTR will not replace priority toxic pollutant criteria which were adopted by the San Francisco Regional Water Quality Control Board in its 1986 Basin Plan, adopted by the State Board, and approved by EPA; specifying the harmonic mean for human health criteria for non-carcinogens and adding a provision which explicitly allows the State to adopt and implement an alternative averaging period, frequency, and design flow for a criterion after opportunity for public comment.

The first two changes, the reservation of mercury criteria and selenium criterion, are discussed in more detail below in Section L., The Endangered Species Act (ESA). The selenium criterion is also discussed in more detail above in Section E., Derivation of Criteria, in subsection 2.b., Freshwater Acute Selenium Criterion. EPA has also decided to reserve a decision on numeric criteria for chloroform and therefore not promulgate chloroform criteria in the final rule. As part of a large-scale regulation promulgated in December 1998 under the Safe Drinking Water Act, EPA published a health-based goal for chloroform (the maximum contaminant level goal or MCLG) of zero, see 63 FR 69390, Dec. 16, 1998. EPA provided new data and analyses concerning chloroform for public review and comment, including a different, mode of action approach for estimating the cancer risk, 63 FR 15674, March 31, 1998, but did not reach a conclusion on how to use that new information in establishing the final MCLG, pending further review by the Science Advisory Board. EPA has now concluded that any further actions on water quality criteria should take into account the new data and analysis as reviewed by the SAB. This decision is consistent with a recent federal court decision vacating the MCLG for chloroform (*Chlorine Chemistry Council* v. *EPA*, No. 98–1627 (DC Cir., Mar. 31,2000)). EPA intends to reassess the human health 304(a) criteria recommendation for chloroform. For these reasons, EPA has decided to reserve a decision on numeric criteria for chloroform in the CTR and not promulgate water quality criteria as proposed. Permitting authorities in California should continue to rely on existing narrative criteria to establish effluent limitations as necessary for chloroform.

The sunset provision for the authorizing compliance schedule provision has been added to ease the transition from a Federal provision to the State's provision that was adopted in March 2000 as part of its' new statewide implementation plan. The sunset provision is discussed in more detail in Section G.5 of today's preamble. The CTR matrix at 40 CFR 131.38(b)(1) makes it explicit that the rule does not supplant priority toxic pollutant criteria which were adopted by the San Francisco Regional Water Quality Control Board in its 1986 Basin Plan, adopted by the State Board, and approved by EPA. This change is discussed more fully in Section D.4. of today's preamble. EPA modified the design flow for implementing human health criteria for non-carcinogens from a 30Q5 to a harmonic mean. Human health criteria for non-carcinogens are based on an RfD, which is an acceptable daily exposure over a lifetime. EPA matched the criteria for protection over a human lifetime with the longest stream flow averaging period, i.e., the harmonic mean. Lastly, the CTR now contains language which is intended to make it easier for the State to adopt and implement an alternative averaging period, frequency and related design flow, for situations where the default parameters are inappropriate. This language is found at 40 CFR 131.38(c)(2)(iv).

H. Economic Analysis

This final rule establishes ambient water quality criteria which, by themselves, do not directly impose economic impacts (see section K). These criteria combined with the State-adopted designated uses for inland surface waters, enclosed bays and estuaries, and implementation policies, will establish water quality standards. Until the State implements these water quality standards, there will be no effect of this rule on any entity. The State will implement these criteria by ensuring that NPDES permits result in discharges that will meet these criteria. In so doing, the State will have considerable discretion.

EPA has analyzed the indirect potential costs and benefits of this rule. In order to estimate the indirect costs and benefits of the rule, an appropriate baseline must be established. The baseline is the starting point for measuring incremental costs and benefits of a regulation. The baseline is established by assessing what would occur in the absence of the regulation. At present, State Basin Plans contain a narrative water quality criterion stating that all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. EPA's regulation at 40 CFR 122.44(d)(1)(vi) requires that where a discharge causes or has the reasonable potential to cause an excursion above a narrative criterion within a State water quality standard, the permitting authority must establish effluent limits but may determine limits using a number of options. These options include establishing "effluent limits on a case-by-case basis, using EPA's water quality criteria published under section 304(a) of the CWA, supplemented where necessary by other relevant information" (40 CFR 122.44(d)(1)(vi)(B)). Thus, to the extent that the State is implementing its narrative criteria by applying the CWA section 304(a) criteria, this rule does not impose any incremental costs because the criteria in this rule are identical to the CWA section 304(a) criteria. Alternatively, to the extent that the State is implementing its narrative criteria on a "case-by-case basis" using "other relevant information" in its permits this rule may impose incremental indirect costs because the criteria in these permits may not be based on CWA 304(a) criteria. Both of these approaches to establishing effluent limits are in full compliance with the CWA.

Because a specific basis for effluent limits in all existing permits in California is not known, it is not possible to determine a precise estimate of the indirect costs of this rule. The incremental costs of the rule may be as low as zero, or as high as $61 million. The high estimate of costs is based on the possibility that most of the effluent limits now in effect are not based on 304(a) criteria. EPA evaluated these indirect costs using two different approaches. The first approach uses existing discharge data and makes assumptions about future State NPDES permit limits. Actual discharge levels are usually lower than the level set by current NPDES permit limits. This approach, representing the low-end scenario, also assumes that some of the discretionary mechanisms that would enhance flexibility (*e.g.*, site specific criteria, mixing zones) would be granted by the State. The second approach uses a sample of existing permit limits and assumes that dischargers are actually discharging at the levels contained in their permits and makes assumptions about limits statewide that would be required under the rule. This approach, representing the high-end scenario, also assumes that none of the discretionary mechanisms that would enhance flexibility (*e.g.*, site specific criteria, mixing zones) would be granted by the State. These two approaches recognize that the State has significant flexibility and discretion in how it chooses to implement standards within the NPDES permit program, the EA by necessity includes many assumptions about how the State will implement the water quality standards. These assumptions are based on a combination of EPA guidance and current permit conditions for the facilities examined in this analysis. To account for the uncertainty of EPA's implementation assumptions, this analysis estimates a wide range of costs and benefits. By completing the EA, EPA intends to inform the public about how entities might be potentially affected by State implementation of water quality standards in the NPDES permit program. The costs and benefits sections that follow summarize the methodology and results of the analysis.

1. Costs

EPA assessed the potential compliance costs that facilities may incur to meet permit limits based on the criteria in today's rule. The analysis focused on direct compliance costs such as capital costs and operation and maintenance costs (O&M) for end-of-pipe pollution control, indirect source controls, pollution prevention, monitoring, and costs of pursuing alternative methods of compliance.

The population of facilities with NPDES permits that discharge into California's enclosed bays, estuaries and inland surface waters includes 184 major dischargers and 1,057 minor dischargers. Of the 184 major facilities, 128 are publicly owned treatment works (POTWs) and 56 are industrial facilities. Approximately 2,144 indirect dischargers designated as significant industrial users discharge wastewater to those POTWs. In the EA for the proposed CTR, EPA used a three-phased process to select a sample of facilities to represent California dischargers potentially affected by the State's implementation of permit limits based on the criteria contained in this rule.

The first phase consisted of choosing three case study areas for which data was thought to exist. The three case studies with a total of 5 facilities included: the South San Francisco Bay (the San Jose/Santa Clara Water Pollution Control Plant and Sunnyvale Water Pollution Control Plant); the Sacramento River (the Sacramento Regional Wastewater Treatment Plant); and the Santa Ana River (the City of Riverside Water Quality Control Plant and the City of Colton Municipal Wastewater Treatment Facility). The second phase consisted of selecting five additional major industrial dischargers to complement the case-study POTWs.

The third phase involved selecting 10 additional facilities to improve the basis for extrapolating the costs of the selected sample facilities to the entire population of potentially affected dischargers. The additional 10 facilities were selected such that the group examined: (1) Was divided between major POTWs and major industrial discharger categories in proportion to the numbers of facilities in the State; (2) gave greater proportionate representation to major facilities than minor facilities based on a presumption that the majority of compliance costs would be incurred by major facilities; (3) gave a proportionate representation to each of four principal conventional treatment processes typically used by facilities in specified industries in California; and (4) was representative of the proportionate facilities located within the different California Regional Water Quality Control Boards. Within these constraints, facilities were selected at random to complete the sample.

In the EA for today's final rule, EPA primarily used the same sample as the EA for the proposed rule with some modifications. EPA increased the number of minor POTWs and minor industrial facilities in the sample. EPA randomly selected four new minor POTW facilities and five new minor industrial facilities to add to the sample. The number of sample facilities selected in each area under the jurisdiction of a Regional Water Quality Control Board was roughly proportional to the universe of facilities in each area.

For those facilities that were projected to exceed permit limits based on the criteria, EPA estimated the incremental costs of compliance. Using a decision matrix or flow chart, costs were developed for two different scenarios—a "low-end" cost scenario and a "high-end" cost scenario—to account for a range of regulatory flexibility available to the State when implementing permit limits based on the water quality criteria. The assumptions for baseline loadings also vary over the two scenarios. The low-end scenario generally assumed that facilities were discharging at the maximum effluent concentrations taken from actual monitoring data, while the high-end scenario generally assumed that facilities were discharging at their current effluent limits. The decision matrix specified assumptions used for selection of control options, such as optimization of existing treatment processes and operations, in-plant pollutant minimization and prevention, and end-of-pipe treatment.

The annualized potential costs that direct and indirect dischargers may incur as a result of State implementation of permit limits based on water quality standards using today's criteria are estimated to be between $33.5 million and $61 million. EPA believes that the costs incurred as a result of State implementation of these permit limits will approach the low-end of the cost range. Costs are unlikely to reach the high-end of the range because State authorities are likely to choose implementation options that provide some degree of flexibility or relief to point source dischargers. Furthermore, cost estimates for both scenarios, but especially for the high-end scenario, may be overstated because the analysis tended to use conservative assumptions in calculating these permit limits and in establishing baseline loadings. The baseline loadings for the high-end were based on current effluent limits rather than actual pollutant discharge data. Most facilities discharge pollutants in concentrations well below current effluent limits. In addition, both the high-end and low-end cost estimates in the EA may be slightly overstated since potential costs incurred to reduce chloroform discharges were included in these estimates. EPA made a decision to reserve the chloroform human health criteria after the EA was completed.

Under the low-end cost scenario, major industrial facilities and POTWs would incur about 27 percent of the potential costs, indirect dischargers would incur about 70 percent of the potential costs, while minor dischargers would incur about 3 percent. Of the major direct dischargers, POTWs would incur the largest share of projected costs (87 percent). However, distributed among 128 major POTWs in the State, the average cost per plant would be $61,000 per year. Chemical and petroleum industries would incur the highest cost of the industrial categories (5.6 percent of the annual costs, with an annual average of $25,200 per plant). About 57 percent of the low-end costs would be associated with pollution prevention activities, while nearly 38 percent would be associated with pursuing alternativa methods of compliance under the regulations.

Under the high-end cost scenario, major industrial facilities and POTWs would incur about 94 percent of the potential costs, indirect dischargers would incur about 17 percent of the potential costs, while minor dischargers would incur about 5 percent. Among the major, direct dischargers, two categories would incur the majority of potential costs—major POTWs (82 percent), Chemical/Petroleum Products (9 percent). The average annual per plant cost for different industry categories would ranges from zero to $324,000. The two highest average cost categories would be major POTWs ($324,000 per year) and Chemical/Petroleum Products ($221,264 per year). The shift in proportion of potential costs between direct and indirect dischargers is due to the assumption that more direct dischargers would use end-of-pipe treatment under the high-end scenario. Thus, a smaller proportion of indirect dischargers would be impacted under the high-end scenario, since some municipalities are projected to add end-of-pipe treatment which would reduce the need for controls from indirect discharges. Over 91 percent of the annual costs are for waste minimization and treatment optimization costs. Waste minimization would represent nearly 84% of the total annual costs. Capital and operation and maintenance costs would make up less than 9 percent of annual costs.

Cost-Effectiveness: Cost-effectiveness is estimated in terms of the cost of reducing the loadings of toxic pollutants from point sources. The cost-effectiveness is derived by dividing the projected annual costs of implementing permit limits based on water quality standards using today's criteria by the toxicity-weighted pounds (pound-equivalents) of pollutants removed. Pound-equivalents are calculated by multiplying pounds of each pollutant removed by the toxic weight (based on the toxicity of copper) for that pollutant.

Based on this analysis, State implementation of permit limits based on today's criteria would be responsible for the reduction of about 1.1 million to 2.7 million toxic pound-equivalents per year, or 15 to 50 percent of the toxic-weighted baseline loadings for the high- and low-end scenarios, respectively. The cost-effectiveness of the scenarios would range from $22 (high-end scenario) to $31 (low-end scenario) per pound-equivalent.

2. Benefits

The benefits analysis is intended to provide insight into both the types and potential magnitude of the economic benefits expected as a result of implementation of water quality standards based on today's criteria. To the extent feasible, empirical estimates of the potential magnitude of the benefits were developed and then compared to the estimated costs of implementing water quality standards based on today's criteria.

To perform a benefits analysis, the types or categories of benefits that apply need to be defined. EPA relied on a set of benefits categories that typically apply to changes in the water resource environment. Benefits were categorized as either use benefits or passive (nonuse) benefits depending on whether or not they involve direct use of, or contact with, the resource. The most prominent use benefit categories are those related to recreational fishing, boating, and swimming. Another use benefit category of significance is human health risk reduction. Human health risk reductions can be realized through actions that reduce human exposure to contaminants such as exposure through the consumption of fish containing elevated levels of pollutants. Passive use benefits are those improvements in environmental quality that are valued by individuals apart from any use of the resource in question.

Benefits estimates were derived in this study using an approach in which benefits of discrete large-scale changes in water quality beyond present day conditions were estimated wherever feasible. A share of those benefits was then apportioned to implementation of water quality standards based on today's criteria. The apportionment estimate was based on a three-stage process:

First, EPA assessed current total loadings from all sources that are contributing to the toxics-related water quality problems observed in the State. This defines the overall magnitude of loadings. Second, the share of total loadings that are attributable to sources that would be controlled through implementation of water quality standards based on today's criteria was estimated. Since this analysis was designed to focus only on those controls imposed on point sources, this stage of the process entailed estimating the portion of total loadings originating from point sources. Third, the percentage reduction in loadings expected due to implementation of today's criteria was estimated and then multiplied by the share of point source loadings to calculate the portion of benefits that could be attributed to implementation of water quality standards based on today's criteria.

Total monetized annual benefits were estimated in the range of $6.9 to $74.7 million. By category, annual benefits would be $1.3 to $4.6 million for avoided cancer risk, $2.2 to $15.2 million for recreational angling, and $3.4 to $54.9 million for passive use benefits.

There are numerous categories of potential or likely benefits that have been omitted from the quantified and monetized benefit estimates. In terms of potential magnitudes of benefit, the following are likely to be significant contributors to the underestimation of the monetized values presented above:

• Improvements in water-related (in-stream and near stream) recreation apart from fishing. The omission of potential motorized and nonmotorized boating, swimming, picnicking, and related in-stream and stream-side recreational activities from the benefits estimates could contribute to an appreciable underestimation of total benefits. Such recreational activities have been shown in empirical research to be highly valued, and even modest changes in participation and or user values could lead to sizable benefits statewide. Some of these activities can be closely associated with water quality attributes (notably, swimming). Other recreational activities may be less directly related to the water quality improvements, but might nonetheless increase due to their association with fishing, swimming, or other activities in which the participants might engage.

• Improvements in consumptive and nonconsumptive land-based recreation, such as hunting and wildlife observation. Improvements in aquatic habitats may lead (via food chain and related ecologic benefit mechanisms) to healthier, larger, and more diverse populations of avian and terrestrial species, such as waterfowl, eagles, and otters. Improvements in the populations for these species could manifest as improved hunting and wildlife viewing opportunities, which might in turn increase participation and user day values for such activities. Although the scope of the benefits analysis has not allowed a quantitative assessment of these values at either pre- or post-rule conditions, it is conceivable that these benefits could be appreciable.

• Improvements in human health resulting from reduction of non-cancer risk. EPA estimated that implementation of water quality standards based on the criteria would result in a reduction of mercury concentrations in fish tissue and, thus, a reduction in the hazard from consumption of mercury contaminated fish. However, EPA was unable to monetize benefits due to reduced non-cancer health effects.

• Human health benefits for saltwater anglers outside of San Francisco Bay were not estimated. The number of saltwater anglers outside of San Francisco Bay is estimated to be 673,000 (based on Huppert, 1989, and U.S. FWS, 1993). The omission of other saltwater anglers may cause human health benefits to be underestimated. In addition, benefit estimates in the EA may be slightly overstated since potential benefits from reductions in chloroform discharges were included in these estimates. EPA made a decision to reserve the chloroform human health criteria after the EA was completed.

EPA received a number of comments which requested the Agency use the cost-benefit analysis in the EA as a factor in setting water quality criteria. EPA does not use the EA as a basis in determining protective water quality criteria. EPA's current regulations at 40 CFR 131.11 state that the criteria must be based on sound scientific rationale and must protect the designated use. From the outset of the water quality standards program, EPA has explained that while economic factors may be considered in designating uses, they may not be used to justify criteria that are not protective of those uses. 44 FR 25223–226, April 30, 1979. See e.g. *Mississippi Commission on Natural Resources* v. *Costle*, 625 F. 2d 1269, 1277 (5th Cir. 1980). EPA reiterated this interpretation of the CWA and its implementing regulations in discussing section 304(a) recommended criteria guidance stating that "they are based solely on data and scientific judgments on the relationship between pollutant concentrations and environmental and human health effects and do not reflect consideration of economic impacts or the technological feasibility of meeting the chemical concentrations in ambient water." 63 FR 36742 and 36762, July 7, 1998.

I. Executive Order 12866, Regulatory Planning and Review

Under Executive Order 12866 (58 FR 51735, October 4, 1993), the Agency must determine whether the regulatory action is "significant" and therefore subject to Office of Management and Budget (OMB) review and the requirements of the Executive Order. The Order defines "significant regulatory action" as one that is likely to result in a rule that may:

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another Agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

It has been determined that this rule is not a "significant regulatory action" under the terms of Executive Order 12866 and is therefore not subject to OMB review.

J. Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104–4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures to State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating any regulation for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows an Agency to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government Agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of the affected small governments to have meaningful and timely input in the development of regulatory proposals with significant Federal intergovernmental mandates, and EPA informing, educating, and advising small governments on compliance with the regulatory requirements.

Today's rule contains no Federal mandates (under the regulatory provisions of Title II of the Unfunded Mandates Reform Act (UMRA)) for State, local, or tribal governments or the private sector. Today's rule imposes no enforceable duty on any State, local or Tribal governments or the private sector; rather, the CTR promulgates ambient water quality criteria which, when combined with State-adopted uses, will create water quality standards for those water bodies with adopted uses. The State will then use these resulting water quality standards in implementing its existing water quality control programs. Thus, today's rule is not subject to the requirements of sections 202 and 205 of the UMRA.

EPA has determined that this rule contains no regulatory requirements that might significantly or uniquely affect small governments. This rule establishes ambient water quality criteria which, by themselves do not directly impact any entity. The State will implement these criteria by ensuring that NPDES permits result in discharges that will meet these criteria. In so doing, the State will have considerable discretion. Until the State implements these water quality standards, there will be no effect of this rule on any entity. Thus, today's rule is not subject to the requirements of section 203 of UMRA.

K. Regulatory Flexibility Act

The Regulatory Flexibility Act generally requires Federal agencies to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the Agency certifies that the rule will not have a significant economic impact of a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions. For purposes of assessing the impacts of today's rule on small entities, small entity is defined as: (1) A small business according to RFA default definitions for small businesses (based on SBA size standards); (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

After considering the economic impacts of today's final rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities. This final rule will not impose any requirements on small entities.

Under the CWA water quality standards program, States must adopt water quality standards for their waters that must be submitted to EPA for approval. If the Agency disapproves a State standard and the State does not adopt appropriate revisions to address EPA's disapproval, EPA must promulgate standards consistent with the statutory requirements. EPA has authority to promulgate criteria or standards in any case where the Administrator determines that a revised or new standard is necessary to meet the requirements of the Act. These State standards (or EPA-promulgated standards) are implemented through various water quality control programs including the National Pollutant Discharge Elimination System (NPDES) program that limits discharges to navigable waters except in compliance with an EPA permit or permit issued under an approved State NPDES program. The CWA requires that all NPDES permits must include any limits on discharges that are necessary to meet State water quality standards.

Thus, under the CWA, EPA's promulgation of water quality criteria or standards establishes standards that the State, in turn, implements through the NPDES permit process. The State has considerable discretion in deciding how to meet the water quality standards and in developing discharge limits as needed to meet the standards. In circumstances where there is more than one discharger to a water body that is subject to water quality standards or criteria, a State also has discretion in deciding on the appropriate limits for the different dischargers. While the State's implementation of federally-promulgated water quality criteria or standards may result indirectly in new or revised discharge limits for small entities, the criteria or standards themselves do not apply to any discharger, including small entities.

Today's rule, as explained above, does not itself establish any requirements that are applicable to small entities. As a result of EPA's action here, the State of California will need to ensure that permits it issues include limits as necessary to meet the water quality standards established by the criteria in today's rule. In so doing, the State will have a number of discretionary choices associated with permit writing. While California's implementation of today's rule may ultimately result in some new or revised permit conditions for some dischargers, including small entities, EPA's action today does not impose any of these as yet unknown requirements on small entities.

The RFA requires analysis of the economic impact of a rule only on the small entities subject to the rule's requirements. Courts have consistently held that the RFA imposes no obligation on an Agency to prepare a small entity analysis of the effect of a rule on entities not regulated by the rule. *Motor & Equip. Mrfrs. Ass'n* v. *Nichols*, 142 F.3d 449, 467 & n.18 (D.C. Cir. 1998)(quoting *United States Distribution Companies* v. *FERC*, 88 F.3d 1105, 1170 (D.C. Cir. 1996); see also *American Trucking Association, Inc.* v. *EPA*, 175 F.3d 1027 (D.C. Cir. 1999). This final rule will have a direct effect only on the State of California which is not a small entity under the RFA. Thus, individual dischargers, including small entities, are not directly subject to the requirements of the rule. Moreover, because of California's discretion in implementing these standards, EPA cannot assess the extent to which the promulgation of this rule may subsequently affect any dischargers, including small entities. Consequently, certification under section 605(b) is appropriate. *State of Michigan, et al.* v. *U.S. Environmental Protection Agency*, No. 98–1497 (D.C. Cir. Mar. 3, 2000), slip op. at 41–42.

L. Paperwork Reduction Act

This action requires no new or additional information collection, reporting, or record keeping subject to the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.*

M. Endangered Species Act

Pursuant to section 7(a) of the Endangered Species Act (ESA), EPA has consulted with the U.S. Fish and Wildlife Service and the U.S. National Marine Fisheries Service (collectively, the Services) concerning EPA's rulemaking action for the State of California. EPA initiated informal consultation in early 1994, and completed formal consultation in April 2000. As a result of the consultation, EPA modified some of the provisions in the final rule.

As part of the consultation process, EPA submitted to the Services a Biological Evaluation for their review in October of 1997. This evaluation found that the proposed CTR was not likely to jeopardize the continued existence of any Federally listed species or result in the destruction or adverse modification of designated critical habitat. In April of 1998, the Services sent EPA a draft Biological Opinion which tentatively found that EPA's proposed rule would jeopardize the continued existence of several Federally listed species and result in the destruction or have adverse effect on designated critical habitat. After lengthy discussions with the Services, EPA agreed to several changes in the final rule and the Services in turn issued a final Biological Opinion finding that EPA's action would not likely jeopardize the continued existence of any Federally listed species or result in the destruction or adverse modification of designated critical habitat. EPA's Biological Evaluation and the Services' final Biological Opinion are contained in the administrative record for today's rule.

In order to ensure the continued protection of Federally listed threatened and endangered species and to protect their critical habitat, EPA agreed to reserve the aquatic life criteria for mercury and the acute freshwater aquatic life criterion for selenium. The Services believe that EPA's proposed criteria are not sufficiently protective of Federally listed species and should not be promulgated. EPA agreed that it would reevaluate these criteria in light of the Services concerns before promulgating them for the State of California. Other commitments made by EPA are described in a letter to the Services dated December 16, 1999; this letter is contained in the administrative record for today's rule.

N. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the Agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. A major rule cannot take effect until 60 days after it is published in the **Federal Register**. This rule is not a major rule as defined by 5 U.S.C. 804(2). This rule will be effective May 18, 2000.

O. Executive Order 13084, Consultation and Coordination With Indian Tribal Governments

Under Executive Order 13084, EPA may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments, or EPA consults with those governments. If EPA complies by consulting, Executive Order 13084 requires EPA to provide to the Office of Management and Budget, in a separately identified section of the preamble to the rule, a description of the extent of EPA's prior consultation with representatives of affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, Executive Order 13084 requires EPA to develop an effective process permitting elected officials and other representatives of Indian tribal governments "to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities."

Today's rule does not significantly or uniquely affect the communities of Indian tribal governments nor does it impose substantial direct compliance cots on them. Today's rule will only address priority toxic pollutant water quality criteria for the State of California and does not apply to waters in Indian country. Accordingly, the requirements of section 3(b) of Executive Order 13084 do not apply to this rule.

P. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Public Law No. 104–113, section 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This final rule does not involve technical standards. Therefore, EPA did not consider the use of any voluntary consensus standards.

Q. Executive Order 13132 on Federalism

Executive Order 13132, entitled "Federalism" (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." "Policies that have federalism implications" is defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

Under section 6 of Executive Order 13132, EPA may not issue a regulation that has federalism implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, or EPA consults with State and local officials early in the process of developing the proposed regulation. EPA also may not issue a regulation that has federalism implications and that preempts State law, unless the Agency consults with State and local officials early in the process of developing the proposed regulation.

This final rule does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. The rule does not affect the nature of the relationship between EPA and States generally, for the rule only applies to water bodies in California. Further, the rule will not substantially affect the relationship of EPA and the State of California, or the distribution of power or responsibilities between EPA and the State. The rule does not alter the State's authority to issue NPDES permits or the State's considerable discretion in implementing these criteria. The rule simply implements Clean Water Act section 303(c)(2)(B) requiring numeric ambient water quality criteria for which EPA has issued section 304(a) recommended criteria in a manner that is consistent with previous regulatory guidance that the Agency has issued to implement CWA section 303(c)(2)(B). Further, this rule does not preclude the State from adopting water quality standards that meet the requirements of the CWA. Thus, the requirements of section 6 of the Executive Order do not apply to this rule.

Although section 6 of Executive Order 13132 does not apply to this rule, EPA did consult with State and local government representatives in developing this rule. EPA and the State reached an agreement that to best utilize its respective resources, EPA would promulgate water quality criteria and the State would concurrently work on a plan to implement the criteria. Since the proposal of this rule, EPA has kept State officials fully informed of changes to the proposal. EPA has continued to invite comment from the State on these changes. EPA believes that the final CTR incorporates comments from State officials and staff.

R. Executive Order 13045 on Protection of Children From Environmental Health Risks and Safety Risks

Executive Order 13045: "Protection of Children from Environmental Health Risks and Safety Risks" (62 FR 19885, April 23, 1997) applies to any rule that: (1) Is determined to be "economically significant" as defined under Executive Order 12866, and (2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

While this final rule is not subject to the Executive Order because it is not economically significant as defined in Executive Order 12866, we nonetheless have reason to believe that the environmental health or safety risk addressed by this action may have a disproportionate effect on children. As a matter of EPA policy, we therefore have assessed the environmental health or safety effects of ambient water quality criteria on children. The results of this assessment are contained in section F.3., Human Health Criteria.

List of Subjects in 40 CFR Part 131

Environmental protection, Indians—lands, Intergovernmental relations, Reporting and recordkeeping requirements, Water pollution control.

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Dated: April 27, 2000.

Carol Browner,

Administrator.

For the reasons set out in the preamble, part 131 of chapter I of title 40 of the Code of Federal Regulations is amended as follows:

PART 131—WATER QUALITY STANDARDS

1. The authority citation for part 131 continues to read as follows:

Authority: 33 U.S.C. 1251 *et seq.*

Subpart D—[Amended]

2. Section 131.38 is added to subpart D to read as follows:

§ 131.38 Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California.

(a) *Scope.* This section promulgates criteria for priority toxic pollutants in the State of California for inland surface waters and enclosed bays and estuaries. This section also contains a compliance schedule provision.

(b)(1) Criteria for Priority Toxic Pollutants in the State of California as described in the following table:

BILLING CODE 6560-50-P

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A		B Freshwater		C Saltwater		D Human Health (10^{-6} risk for carcinogens) For consumption of:	
# Compound	CAS Number	Criterion Maximum Conc. [d] B1	Criterion Continuous Conc. [d] B2	Criterion Maximum Conc. [d] C1	Criterion Continuous Conc. [d] C2	Water & Organisms (µg/L) D1	Organisms Only (µg/L) D2
1. Antimony	7440360					14 a,s	4300 a,t
2. Arsenic [b]	7440382	340 i,m,w	150 i,m,w	69 i,m	36 i,m		
3. Beryllium	7440417					n	n
4. Cadmium [b]	7440439	4.3 e,i,m,w,x	2.2 e,i,m,w	42 i,m	9.3 i,m	n	n
5a. Chromium (III)	16065831	550 e,i,m,o	180 e,i,m,o			n	n
5b. Chromium (VI) [b]	18540299	16 i,m,w	11 i,m,w	1100 i,m	50 i,m	n	n
6. Copper [b]	7440508	13 e,i,m,w,x	9.0 e,i,m,w	4.8 i,m	3.1 i,m	1300	
7. Lead [b]	7439921	65 e,i,m	2.5 e,i,m	210 i,m	8.1 i,m	n	n
8. Mercury [b]	7439976	[Reserved]	[Reserved]	[Reserved]	[Reserved]	0.050 a	0.051 a
9. Nickel [b]	7440020	470 e,i,m,w	52 e,i,m,w	74 i,m	8.2 i,m	610 a	4600 a
10. Selenium [b]	7782492	[Reserved] p	5.0 q	290 i,m	71 i,m	n	n
11. Silver [b]	7440224	3.4 e,i,m		1.9 i,m			
12. Thallium	7440280					1.7 a,s	6.3 a,t
13. Zinc [b]	7440666	120 e,i,m,w,x	120 e,i,m,w	90 i,m	81 i,m		
14. Cyanide [b]	57125	22 o	5.2 o	1 r	1 r	700 a	220,000 a,j
15. Asbestos	1332214					7,000,000 fibers/L k,s	
16. 2,3,7,8-TCDD (Dioxin)	1746016					0.000000013 c	0.000000014 c
17. Acrolein	107028					320 s	780 t
18. Acrylonitrile	107131					0.059 a,c,s	0.66 a,c,t
19. Benzene	71432					1.2 a,c	71 a,c
20. Bromoform	75252					4.3 a,c	360 a,c
21. Carbon Tetrachloride	56235					0.25 a,c,s	4.4 a,c,t
22. Chlorobenzene	108907					680 a,s	21,000 a,j,t
23. Chlorodibromomethane	124481					0.401 a,c	34 a,c
24. Chloroethane	75003						

A		B Freshwater		C Saltwater		D Human Health (10^{-6} risk for carcinogens) For consumption of:	
# Compound	CAS Number	Criterion Maximum Conc. [d] B1	Criterion Continuous Conc. [d] B2	Criterion Maximum Conc. [d] C1	Criterion Continuous Conc. [d] C2	Water & Organisms (µg/L) D1	Organisms Only (µg/L) D2
1. Antimony	7440360					14 a,s	4300 a,t
2. Arsenic [b]	7440382	340 i,m,w	150 i,m,w	69 i,m	36 i,m		
3. Beryllium	7440417					n	n
4. Cadmium [b]	7440439	4.3 e,i,m,w,x	2.2 e,i,m,w	42 i,m	9.3 i,m	n	n
5a. Chromium (III)	16065831	550 e,i,m,o	180 e,i,m,o			n	n
5b. Chromium (VI) [b]	18540299	16 i,m,w	11 i,m,w	1100 i,m	50 i,m	n	n
6. Copper [b]	7440508	13 e,i,m,w,x	9.0 e,i,m,w	4.8 i,m	3.1 i,m	1300	
7. Lead [b]	7439921	65 e,i,m	2.5 e,i,m	210 i,m	8.1 i,m	n	n
8. Mercury [b]	7439976	[Reserved]	[Reserved]	[Reserved]	[Reserved]	0.050 a	0.051 a
9. Nickel [b]	7440020	470 e,i,m,w	52 e,i,m,w	74 i,m	8.2 i,m	610 a	4600 a
10. Selenium [b]	7782492	[Reserved] p	5.0 q	290 i,m	71 i,m	n	n
11. Silver [b]	7440224	3.4 e,i,m		1.9 i,m			
12. Thallium	7440280					1.7 a,s	6.3 a,t
13. Zinc [b]	7440666	120 e,i,m,w,x	120 e,i,m,w	90 i,m	81 i,m		
14. Cyanide [b]	57125	22 o	5.2 o	1 r	1 r	700 a	220,000 a,j
15. Asbestos	1332214					7,000,000 fibers/L k,s	
16. 2,3,7,8-TCDD (Dioxin)	1746016					0.000000013 c	0.000000014 c
17. Acrolein	107028					320 s	780 t
18. Acrylonitrile	107131					0.059 a,c,s	0.66 a,c,t
19. Benzene	71432					1.2 a,c	71 a,c
20. Bromoform	75252					4.3 a,c	360 a,c
21. Carbon Tetrachloride	56235					0.25 a,c,s	4.4 a,c,t
22. Chlorobenzene	108907					680 a,s	21,000 a,j,t
23. Chlorodibromomethane	124481					0.401 a,c	34 a,c
24. Chloroethane	75003						
25. 2-Chloroethylvinyl Ether	110758						

26. Chloroform	67663					[Reserved]	[Reserved]
27. Dichlorobromomethane	75274					0.56 a,c	46 a,c
28. 1,1-Dichloroethane	75343						
29. 1,2-Dichloroethane	107062					0.38 a,c,s	99 a,c,t
30. 1,1-Dichloroethylene	75354					0.057 a,c,s	3.2 a,c,t
31. 1,2-Dichloropropane	78875					0.52 a	39 a
32. 1,3-Dichloropropylene	542756					10 a,s	1,700 a,t
33. Ethylbenzene	100414					3,100 a,s	29,000 a,t
34. Methyl Bromide	74839					48 a	4,000 a
35. Methyl Chloride	74873					n	n
36. Methylene Chloride	75092					4.7 a,c	1,600 a,c
37. 1,1,2,2-Tetrachloroethane	79345					0.17 a,c,s	11 a,c,t
38. Tetrachloroethylene	127184					0.8 c,s	8.85 c,t
39. Toluene	108883					6,800 a	200,000 a
40. 1,2-Trans-Dichloroethylene	156605					700 a	140,000 a
41. 1,1,1-Trichloroethane	71556					n	n
42. 1,1,2-Trichloroethane	79005					0.60 a,c,s	42 a,c,t
43. Trichloroethylene	79016					2.7 c,s	81 c,t
44. Vinyl Chloride	75014					2 c,s	525 c,t
45. 2-Chlorophenol	95578					120 a	400 a
46. 2,4-Dichlorophenol	120832					93 a,s	790 a,t
47. 2,4-Dimethylphenol	105679					540 a	2,300 a
48. 2-Methyl-4,6-Dinitrophenol	534521					13.4 s	765 t
49. 2,4-Dinitrophenol	51285					70 a,s	14,000 a,t
50. 2-Nitrophenol	88755						
51. 4-Nitrophenol	100027						
52. 3-Methyl-4-Chlorophenol	59507						
53. Pentachlorophenol	87865	19 f,w	15 f,w	13	7.9	0.28 a,c	8.2 a,c,j
54. Phenol	108952					21,000 a	4,600,000 a,j,t
55. 2,4,6-Trichlorophenol	88062					2.1 a,c	6.5 a,c
56. Acenaphthene	83329					1,200 a	2,700 a
57. Acenaphthylene	208968						
58. Anthracene	120127					9,600 a	110,000 a

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59. Benzidine	92875					0.00012 a,c,s	0.00054 a,c,t
60. Benzo(a)Anthracene	56553					0.0044 a,c	0.049 a,c
61. Benzo(a)Pyrene	50328					0.0044 a,c	0.049 a,c
62. Benzo(b)Fluoranthene	205992					0.0044 a,c	0.049 a,c
63. Benzo(ghi)Perylene	191242						
64. Benzo(k)Fluoranthene	207089					0.0044 a,c	0.049 a,c
65. Bis(2-Chloroethoxy)Methane	111911						
66. Bis(2-Chloroethyl)Ether	111444					0.031 a,c,s	1.4 a,c,t
67. Bis(2-Chloroisopropyl)Ether	39638329					1,400 a	170,000 a,t
68. Bis(2-Ethylhexyl)Phthalate	117817					1.8 a,c,s	5.9 a,c,t
69. 4-Bromophenyl Phenyl Ether	101553						
70. Butylbenzyl Phthalate	85687					3,000 a	5,200 a
71. 2-Chloronaphthalene	91587					1,700 a	4,300 a
72. 4-Chlorophenyl Phenyl Ether	7005723						
73. Chrysene	218019					0.0044 a,c	0.049 a,c
74. Dibenzo(a,h)Anthracene	53703					0.0044 a,c	0.049 a,c
75. 1,2 Dichlorobenzene	95501					2,700 a	17,000 a
76. 1,3 Dichlorobenzene	541731					400	2,600
77. 1,4 Dichlorobenzene	106467					400	2,600
78. 3,3'-Dichlorobenzidine	91941					0.04 a,c,s	0.077 a,c,t
79. Diethyl Phthalate	84662					23,000 a,s	120,000 a,t
80. Dimethyl Phthalate	131113					313,000 s	2,900,000 t
81. Di-n-Butyl Phthalate	84742					2,700 a,s	12,000 a,t
82. 2,4-Dinitrotoluene	121142					0.11 c,s	9.1 c,t
83. 2,6-Dinitrotoluene	606202						
84 Di-n-Octyl Phthalate	117840						
85. 1,2-Diphenylhydrazine	122667					0.040 a,c,s	0.54 a,c,t
86. Fluoranthene	206440					300 a	370 a
87. Fluorene	86737					1,300 a	14,000 a
88. Hexachlorobenzene	118741					0.00075 a,c	0.00077 a,c
89. Hexachlorobutadiene	87683					0.44 a,c,s	50 a,c,t
90. Hexachlorocyclopentadiene	77474					240 a,s	17,000 a,j,t
91. Hexachloroethane	67721					1.9 a,c,s	8.9 a,c,t

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92. Indeno(1,2,3-cd) Pyrene	193395					0.0044 a,c	0.049 a,c
93. Isophorone	78591					8.4 c,s	600 c,t
94. Naphthalene	91203						
95. Nitrobenzene	98953					17 a,s	1,900 a,j,t
96. N-Nitrosodimethylamine	62759					0.00069 a,c,s	8.1 a,c,t
97. N-Nitrosodi-n-Propylamine	621647					0.005 a	1.4 a
98. N-Nitrosodiphenylamine	86306					5.0 a,c,s	16 a,c,t
99. Phenanthrene	85018						
100. Pyrene	129000					960 a	11,000 a
101. 1,2,4-Trichlorobenzene	120821						
102. Aldrin	309002	3 g		1.3 g		0.00013 a,c	0.00014 a,c
103. alpha-BHC	319846					0.0039 a,c	0.013 a,c
104. beta-BHC	319857					0.014 a,c	0.046 a,c
105. gamma-BHC	58899	0.95 w		0.16 g		0.019 c	0.063 c
106. delta-BHC	319868						
107. Chlordane	57749	2.4 g	0.0043 g	0.09 g	0.004 g	0.00057 a,c	0.00059 a,c
108. 4,4'-DDT	50293	1.1 g	0.001 g	0.13 g	0.001 g	0.00059 a,c	0.00059 a,c
109. 4,4'-DDE	72559					0.00059 a,c	0.00059 a,c
110. 4,4'-DDD	72548					0.00083 a,c	0.00084 a,c
111. Dieldrin	60571	0.24 w	0.056 w	0.71 g	0.0019 g	0.00014 a,c	0.00014 a,c
112. alpha-Endosulfan	959988	0.22 g	0.056 g	0.034 g	0.0087 g	110 a	240 a
113. beta-Endosulfan	33213659	0.22 g	0.056 g	0.034 g	0.0087 g	110 a	240 a
114. Endosulfan Sulfate	1031078					110 a	240 a
115. Endrin	72208	0.086 w	0.036 w	0.037 g	0.0023 g	0.76 a	0.81 a,j
116. Endrin Aldehyde	7421934					0.76 a	0.81 a,j
117. Heptachlor	76448	0.52 g	0.0038 g	0.053 g	0.0036 g	0.00021 a,c	0.00021 a,c
118. Heptachlor Epoxide	1024573	0.52 g	0.0038 g	0.053 g	0.0036 g	0.00010 a,c	0.00011 a,c
119-125. Polychlorinated biphenyls (PCBs)			0.014 u		0.03 u	0.00017 c,v	0.00017 c,v
126. Toxaphene	8001352	0.73	0.0002	0.21	0.0002	0.00073 a,c	0.00075 a,c
Total Number of Criteria [h]		22	21	22	20	92	90

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Footnotes to Table in Parargraph (b)(1):

a. Criteria revised to reflect the Agency q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of October 1, 1996. The fish tissue bioconcentration factor (BCF) from the 1980 documents was retained in each case.

b. Criteria apply to California waters except for those waters subject to objectives in Tables III–2A and III–2B of the San Francisco Regional Water Quality Control Board's (SFRWQCB) 1986 Basin Plan, that were adopted by the SFRWQCB and the State Water Resources Control Board, approved by EPA, and which continue to apply.

c. Criteria are based on carcinogenicity of 10 (-6) risk.

d. Criteria Maximum Concentration (CMC) equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. Criteria Continuous Concentration (CCC) equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. ug/L equals micrograms per liter.

e. Freshwater aquatic life criteria for metals are expressed as a function of total hardness (mg/L) in the water body. The equations are provided in matrix at paragraph (b)(2) of this section. Values displayed above in the matrix correspond to a total hardness of 100 mg/l.

f. Freshwater aquatic life criteria for pentachlorophenol are expressed as a function of pH, and are calculated as follows: Values displayed above in the matrix correspond to a pH of 7.8. CMC = exp(1.005(pH) – 4.869). CCC = exp(1.005(pH) – 5.134).

g. This criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5–80–019), Chlordane (EPA 440/5–80–027), DDT (EPA 440/5–80–038), Endosulfan (EPA 440/5–80–046), Endrin (EPA 440/5–80–047), Heptachlor (440/5–80–052), Hexachlorocyclohexane (EPA 440/5–80–054), Silver (EPA 440/5–80–071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. For example, a "CMC" derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

h. These totals simply sum the criteria in each column. For aquatic life, there are 23 priority toxic pollutants with some type of freshwater or saltwater, acute or chronic criteria. For human health, there are 92 priority toxic pollutants with either "water + organism" or "organism only" criteria. Note that these totals count chromium as one pollutant even though EPA has developed criteria based on two valence states. In the matrix, EPA has assigned numbers 5a and 5b to the criteria for chromium to reflect the fact that the list of 126 priority pollutants includes only a single listing for chromium.

i. Criteria for these metals are expressed as a function of the water-effect ratio, WER, as defined in paragraph (c) of this section. CMC = column B1 or C1 value x WER; CCC = column B2 or C2 value x WER.

j. No criterion for protection of human health from consumption of aquatic organisms (excluding water) was presented in the 1980 criteria document or in the 1986 Quality Criteria for Water. Nevertheless, sufficient information was presented in the 1980 document to allow a calculation of a criterion, even though the results of such a calculation were not shown in the document.

k. The CWA 304(a) criterion for asbestos is the MCL.

l. [Reserved]

m. These freshwater and saltwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. Criterion values were calculated by using EPA's Clean Water Act 304(a) guidance values (described in the total recoverable fraction) and then applying the conversion factors in § 131.36(b)(1) and (2).

n. EPA is not promulgating human health criteria for these contaminants. However, permit authorities should address these contaminants in NPDES permit actions using the State's existing narrative criteria for toxics.

o. These criteria were promulgated for specific waters in California in the National Toxics Rule ("NTR"), at § 131.36. The specific waters to which the NTR criteria apply include: Waters of the State defined as bays or estuaries and waters of the State defined as inland, i.e., all surface waters of the State not ocean waters. These waters specifically include the San Francisco Bay upstream to and including Suisun Bay and the Sacramento-San Joaquin Delta. This section does not apply instead of the NTR for this criterion.

p. A criterion of 20 ug/l was promulgated for specific waters in California in the NTR and was promulgated in the total recoverable form. The specific waters to which the NTR criterion applies include: Waters of the San Francisco Bay upstream to and including Suisun Bay and the Sacramento-San Joaquin Delta; and waters of Salt Slough, Mud Slough (north) and the San Joaquin River, Sack Dam to the mouth of the Merced River. This section does not apply instead of the NTR for this criterion. The State of California adopted and EPA approved a site specific criterion for the San Joaquin River, mouth of Merced to Vernalis; therefore, this section does not apply to these waters.

q. This criterion is expressed in the total recoverable form. This criterion was promulgated for specific waters in California in the NTR and was promulgated in the total recoverable form. The specific waters to which the NTR criterion applies include: Waters of the San Francisco Bay upstream to and including Suisun Bay and the Sacramento-San Joaquin Delta; and waters of Salt Slough, Mud Slough (north) and the San Joaquin River, Sack Dam to Vernalis. This criterion does not apply instead of the NTR for these waters. This criterion applies to additional waters of the United States in the State of California pursuant to 40 CFR 131.38(c). The State of California adopted and EPA approved a site-specific criterion for the Grassland Water District, San Luis National Wildlife Refuge, and the Los Banos State Wildlife Refuge; therefore, this criterion does not apply to these waters.

r. These criteria were promulgated for specific waters in California in the NTR. The specific waters to which the NTR criteria apply include: Waters of the State defined as bays or estuaries including the San Francisco Bay upstream to and including Suisun Bay and the Sacramento-San Joaquin Delta. This section does not apply instead of the NTR for these criteria.

s. These criteria were promulgated for specific waters in California in the NTR. The specific waters to which the NTR criteria apply include: Waters of the Sacramento-San Joaquin Delta and waters of the State defined as inland (*i.e.*, all surface waters of the State not bays or estuaries or ocean) that include a MUN use designation. This section does not apply instead of the NTR for these criteria.

t. These criteria were promulgated for specific waters in California in the NTR. The specific waters to which the NTR criteria apply include: Waters of the State defined as bays and estuaries including San Francisco Bay upstream to and including Suisun Bay and the Sacramento-San Joaquin Delta; and waters of the State defined as inland (i.e., all surface waters of the State not bays or estuaries or ocean) without a MUN use designation. This section does not apply instead of the NTR for these criteria.

u. PCBs are a class of chemicals which include aroclors 1242, 1254, 1221, 1232, 1248, 1260, and 1016, CAS numbers 53469219, 11097691, 11104282, 11141165, 12672296, 11096825, and 12674112, respectively. The aquatic life criteria apply to the sum of this set of seven aroclors.

v. This criterion applies to total PCBs, e.g., the sum of all congener or isomer or homolog or aroclor analyses.

w. This criterion has been recalculated pursuant to the 1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water, Office of Water, EPA–820–B–96–001, September 1996. See also Great Lakes Water Quality Initiative Criteria Documents for the Protection of Aquatic Life in Ambient Water, Office of Water, EPA–80–B–95–004, March 1995.

x. The State of California has adopted and EPA has approved site specific criteria for the Sacramento River (and tributaries) above Hamilton City; therefore, these criteria do not apply to these waters.

General Notes to Table in Paragraph (b)(1)

1. The table in this paragraph (b)(1) lists all of EPA's priority toxic pollutants whether or not criteria guidance are available. Blank spaces indicate the absence of national section 304(a) criteria guidance. Because of variations in chemical nomenclature systems, this listing of toxic pollutants does not duplicate the listing in Appendix A to 40 CFR Part 423–126 Priority Pollutants. EPA has added the Chemical Abstracts Service (CAS) registry numbers, which provide a unique identification for each chemical.

2. The following chemicals have organoleptic-based criteria recommendations that are not included on this chart: zinc, 3-methyl-4-chlorophenol.

3. Freshwater and saltwater aquatic life criteria apply as specified in paragraph (c)(3) of this section.

(2) Factors for Calculating Metals Criteria. Final CMC and CCC values should be rounded to two significant figures.

(i) $CMC = WER \times (\text{Acute Conversion Factor}) \times (\exp\{m_A[\ln(\text{hardness})]+b_A\})$

(ii) $CCC = WER \times (\text{Acute Conversion Factor}) \times (\exp\{m_C[\ln(\text{hardness})]+b_C\})$

(iii) Table 1 to paragraph (b)(2) of this section:

Metal	m_A	b_A	m_C	b_C
Cadmium	1.128	−3.6867	0.7852	−2.715
Copper	0.9422	−1.700	0.8545	−1.702
Chromium (III)	0.8190	3.688	0.8190	1.561
Lead	1.273	−1.460	1.273	−4.705
Nickel	0.8460	2.255	0.8460	0.0584
Silver	1.72	−6.52		
Zinc	0.8473	0.884	0.8473	0.884

Note to Table 1: The term "exp" represents the base e exponential function.

(iv) Table 2 to paragraph (b)(2) of this section:

Metal	Conversion factor (CF) for freshwater acute criteria	CF for freshwater chronic criteria	CF for saltwater acute criteria	CF [a] for saltwater chronic criteria
Antimony	[d]	[d]	[d]	[d]
Arsenic	1.000	1.000	1.000	1.000
Beryllium	[d]	[d]	[d]	[d]
Cadmium	[b] 0.944	[b] 0.909	0.994	0.994
Chromium (III)	0.316	0.860	[d]	[d]
Chromium (VI)	0.982	0.962	0.993	0.993
Copper	0.960	0.960	0.83	0.83
Lead	[b] 0.791	[b] 0.791	0.951	0.951
Mercury	....	....	....	....
Nickel	0.998	0.997	0.990	0.990
Selenium	....	[c]	0.998	0.998
Silver	0.85	[d]	0.85	[d]
Thallium	[d]	[d]	[d]	[d]
Zinc	0.978	0.986	0.946	0.946

Footnotes to Table 2 of Paragraph (b)(2):

[a] Conversion Factors for chronic marine criteria are not currently available. Conversion Factors for acute marine criteria have been used for both acute and chronic marine criteria.

[b] Conversion Factors for these pollutants in freshwater are hardness dependent. CFs are based on a hardness of 100 mg/l as calcium carbonate ($CaCO_3$). Other hardness can be used; CFs should be recalculated using the equations in table 3 to paragraph (b)(2) of this section.

[c] Bioaccumulative compound and inappropriate to adjust to percent dissolved.

[d] EPA has not published an aquatic life criterion value.

Note to Table 2 of Paragraph (b)(2): The term "Conversion Factor" represents the recommended conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria", October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water available from Water Resource Center, USEPA, Mailcode RC4100, M Street SW, Washington, DC, 20460 and the note to § 131.36(b)(1).

(v) Table 3 to paragraph (b)(2) of this section:

	Acute	Chronic
Cadmium	CF=1.136672—[(ln {hardness}) (0.041838)]	CF = 1.101672—[(ln {hardness})(0.041838)]
Lead	CF=1.46203—[(ln {hardness})(0.145712)]	CF = 1.46203—[(ln {hardness})(0.145712)]

(c) *Applicability*. (1) The criteria in paragraph (b) of this section apply to the State's designated uses cited in paragraph (d) of this section and apply concurrently with any criteria adopted by the State, except when State regulations contain criteria which are more stringent for a particular parameter and use, or except as provided in footnotes p, q, and x to the table in paragraph (b)(1) of this section.

(2) The criteria established in this section are subject to the State's general rules of applicability in the same way and to the same extent as are other Federally-adopted and State-adopted numeric toxics criteria when applied to the same use classifications including mixing zones, and low flow values below which numeric standards can be exceeded in flowing fresh waters.

(i) For all waters with mixing zone regulations or implementation procedures, the criteria apply at the appropriate locations within or at the boundary of the mixing zones; otherwise the criteria apply throughout the water body including at the point of discharge into the water body.

(ii) The State shall not use a low flow value below which numeric standards can be exceeded that is less stringent than the flows in Table 4 to paragraph (c)(2) of this section for streams and rivers.

(iii) Table 4 to paragraph (c)(2) of this section:

Criteria	Design flow
Aquatic Life Acute Criteria (CMC).	1 Q 10 or 1 B 3
Aquatic Life Chronic Criteria (CCC).	7 Q 10 or 4 B 3
Human Health Criteria.	Harmonic Mean Flow

Note to Table 4 of Paragraph (c)(2): 1. CMC (Criteria Maximum Concentration) is the water quality criteria to protect against acute effects in aquatic life and is the highest instream concentration of a priority toxic pollutant consisting of a short-term average not to be exceeded more than once every three years on the average.

2. CCC (Continuous Criteria Concentration) is the water quality criteria to protect against chronic effects in aquatic life and is the highest in stream concentration of a priority toxic pollutant consisting of a 4-day average not to be exceeded more than once every three years on the average.

3. 1 Q 10 is the lowest one day flow with an average recurrence frequency of once in 10 years determined hydrologically.

4. 1 B 3 is biologically based and indicates an allowable exceedence of once every 3 years. It is determined by EPA's computerized method (DFLOW model).

5. 7 Q 10 is the lowest average 7 consecutive day low flow with an average recurrence frequency of once in 10 years determined hydrologically.

6. 4 B 3 is biologically based and indicates an allowable exceedence for 4 consecutive days once every 3 years. It is determined by EPA's computerized method (DFLOW model).

(iv) If the State does not have such a low flow value below which numeric standards do not apply, then the criteria included in paragraph (d) of this section apply at all flows.

(v) If the CMC short-term averaging period, the CCC four-day averaging period, or once in three-year frequency is inappropriate for a criterion or the site to which a criterion applies, the State may apply to EPA for approval of an alternative averaging period, frequency, and related design flow. The State must submit to EPA the bases for any alternative averaging period, frequency, and related design flow. Before approving any change, EPA will publish for public comment, a document proposing the change.

(3) The freshwater and saltwater aquatic life criteria in the matrix in paragraph (b)(1) of this section apply as follows:

(i) For waters in which the salinity is equal to or less than 1 part per thousand 95% or more of the time, the applicable criteria are the freshwater criteria in Column B;

(ii) For waters in which the salinity is equal to or greater than 10 parts per thousand 95% or more of the time, the applicable criteria are the saltwater criteria in Column C except for selenium in the San Francisco Bay estuary where the applicable criteria are the freshwater criteria in Column B (refer to footnotes p and q to the table in paragraph (b)(1) of this section); and

(iii) For waters in which the salinity is between 1 and 10 parts per thousand as defined in paragraphs (c)(3)(i) and (ii) of this section, the applicable criteria are the more stringent of the freshwater or saltwater criteria. However, the Regional Administrator may approve the use of the alternative freshwater or saltwater criteria if scientifically defensible information and data demonstrate that on a site-specific basis the biology of the water body is dominated by freshwater aquatic life and that freshwater criteria are more appropriate; or conversely, the biology of the water body is dominated by saltwater aquatic life and that saltwater criteria are more appropriate. Before approving any change, EPA will publish for public comment a document proposing the change.

(4) *Application of metals criteria.* (i) For purposes of calculating freshwater aquatic life criteria for metals from the equations in paragraph (b)(2) of this section, for waters with a hardness of 400 mg/l or less as calcium carbonate, the actual ambient hardness of the surface water shall be used in those equations. For waters with a hardness of over 400 mg/l as calcium carbonate, a hardness of 400 mg/l as calcium carbonate shall be used with a default Water-Effect Ratio (WER) of 1, or the actual hardness of the ambient surface water shall be used with a WER. The same provisions apply for calculating the metals criteria for the comparisons provided for in paragraph (c)(3)(iii) of this section.

(ii) The hardness values used shall be consistent with the design discharge conditions established in paragraph (c)(2) of this section for design flows and mixing zones.

(iii) The criteria for metals (compounds #1—#13 in the table in paragraph (b)(1) of this section) are expressed as dissolved except where otherwise noted. For purposes of calculating aquatic life criteria for metals from the equations in footnote i to the table in paragraph (b)(1) of this section and the equations in paragraph (b)(2) of this section, the water effect ratio is generally computed as a specific pollutant's acute or chronic toxicity value measured in water from the site covered by the standard, divided by the respective acute or chronic toxicity value in laboratory dilution water. To use a water effect ratio other than the default of 1, the WER must be determined as set forth in Interim Guidance on Determination and Use of Water Effect Ratios, U.S. EPA Office of Water, EPA–823–B–94–001, February 1994, or alternatively, other scientifically defensible methods adopted by the State as part of its water quality standards program and approved by EPA. For calculation of criteria using site-specific values for both the hardness and the water effect ratio, the hardness used in the equations in paragraph (b)(2) of this section must be determined as required in paragraph (c)(4)(ii) of this section. Water hardness must be calculated from the measured calcium and magnesium ions present, and the ratio of calcium to magnesium should be approximately the same in standard laboratory toxicity testing water as in the site water.

(d)(1) Except as specified in paragraph (d)(3) of this section, all waters assigned any aquatic life or human health use classifications in the Water Quality Control Plans for the various Basins of the State ("Basin Plans") adopted by the California State Water Resources Control Board ("SWRCB"), except for ocean waters covered by the Water Quality Control Plan for Ocean Waters of California ("Ocean Plan") adopted by the SWRCB with resolution Number 90–27 on March 22, 1990, are subject to the criteria in paragraph (d)(2) of this section, without exception. These criteria apply to waters identified in the Basin Plans. More particularly, these criteria apply to waters identified in the Basin Plan chapters designating beneficial uses for waters within the region. Although the State has adopted several use designations for each of these waters, for purposes of this action, the specific standards to be applied in paragraph (d)(2) of this section are based on the presence in all waters of some aquatic life designation and the presence or absence of the MUN use designation (municipal and domestic supply). (See Basin Plans for more detailed use definitions.)

(2) The criteria from the table in paragraph (b)(1) of this section apply to the water and use classifications defined in paragraph (d)(1) of this section as follows:

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Water and use classification	Applicable criteria
(i) All inland waters of the United States or enclosed bays and estuaries that are waters of the United States that include a MUN use designation.	(A) Columns B1 and B2—all pollutants (B) Columns C1 and C2—all pollutants (C) Column D1—all pollutants
(ii) All inland waters of the United States or enclosed bays and estuaries that are waters of the United States that do not include a MUN use designation.	(A) Columns B1 and B2—all pollutants (B) Columns C1 and C2—all pollutants (C) Column D2—all pollutants

(3) Nothing in this section is intended to apply instead of specific criteria, including specific criteria for the San Francisco Bay estuary, promulgated for California in the National Toxics Rule at § 131.36.

(4) The human health criteria shall be applied at the State-adopted 10 (−6) risk level.

(5) Nothing in this section applies to waters located in Indian Country.

(e) *Schedules of compliance.* (1) It is presumed that new and existing point source dischargers will promptly comply with any new or more restrictive water quality-based effluent limitations ("WQBELs") based on the water quality criteria set forth in this section.

(2) When a permit issued on or after May 18, 2000 to a new discharger contains a WQBEL based on water quality criteria set forth in paragraph (b) of this section, the permittee shall comply with such WQBEL upon the commencement of the discharge. A new discharger is defined as any building, structure, facility, or installation from which there is or may be a "discharge of pollutants" (as defined in 40 CFR 122.2) to the State of California's inland surface waters or enclosed bays and estuaries, the construction of which commences after May 18, 2000.

(3) Where an existing discharger reasonably believes that it will be infeasible to promptly comply with a new or more restrictive WQBEL based on the water quality criteria set forth in this section, the discharger may request approval from the permit issuing authority for a schedule of compliance.

(4) A compliance schedule shall require compliance with WQBELs based on water quality criteria set forth in paragraph (b) of this section as soon as possible, taking into account the dischargers' technical ability to achieve compliance with such WQBEL.

(5) If the schedule of compliance exceeds one year from the date of permit issuance, reissuance or modification, the schedule shall set forth interim requirements and dates for their achievement. The dates of completion between each requirement may not exceed one year. If the time necessary for completion of any requirement is more than one year and is not readily divisible into stages for completion, the permit shall require, at a minimum, specified dates for annual submission of progress reports on the status of interim requirements.

(6) In no event shall the permit issuing authority approve a schedule of compliance for a point source discharge which exceeds five years from the date of permit issuance, reissuance, or modification, whichever is sooner. Where shorter schedules of compliance are prescribed or schedules of compliance are prohibited by law, those provisions shall govern.

(7) If a schedule of compliance exceeds the term of a permit, interim permit limits effective during the permit shall be included in the permit and addressed in the permit's fact sheet or statement of basis. The administrative record for the permit shall reflect final permit limits and final compliance dates. Final compliance dates for final permit limits, which do not occur during the term of the permit, must occur within five years from the date of issuance, reissuance or modification of the permit which initiates the compliance schedule. Where shorter schedules of compliance are prescribed or schedules of compliance are prohibited by law, those provisions shall govern.

(8) The provisions in this paragraph (e), Schedules of compliance, shall expire on May 18, 2005.

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CITY OF LOS ANGELES
DEPARTMENT OF WATER AND POWER

POLLUTION PREVENTION PLAN FOR WATER SYSTEM DISCHARGES

Prepared By: Wastewater Quality Compliance Group

Approved by: [illegible]
Assistant General Manager - Water

Date: 5/31/2000

Pollution Prevention Plan for Water System Discharges

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PART I - BACKGROUND

PART II - BEST MANAGEMENT PRACTICES (BMPs)

PART I -- BACKGROUND

I. Historical

Congress enacted the Clean Water Act (CWA) to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" through reduction and eventual elimination of the discharge of pollutants into those waters. The CWA prohibits the discharge of pollutants from a point source, except in compliance with a National Pollutant Discharge Elimination System (NPDES) permit.

Water suppliers may have numerous releases of potable water from their storage and distribution systems to surface waters and surface water drainage courses. These releases include but are not limited to: pressure relief valves; system maintenance activities (e.g., cement lining); well development and maintenance activities; fire hydrant flow testing; and flushing and dewatering of pipelines, reservoirs, tanks, vaults, sumps and wells.

The Los Angeles Department of Water and Power (DWP) is required to either prohibit, or control by NPDES permit, the contribution of pollutants to surface waters or the storm drain system. The Federal regulations allow authorized states to issue either "general" NPDES permits (which lump numerous similar discharges under a single permit) or "individual" NPDES permits (permits issued on a site-by-site, activity-by activity basis) to regulate discharges of pollutants to Waters of the United States. Failure to comply with these requirements may result in a fine of up to $25,000 per day of violation and possible imprisonment.

II. Introduction

In 1990, the Environmental Protection Agency (EPA) adopted regulations for permitting stormwater and non-stormwater discharges to surface water and storm drain conveyances. The State Water Resources Control Board (SWRCB) and the respective regional boards, as well as local cities and counties, have been aggressively managing these discharges.

Over the past several years, significant changes have occurred in the regulations governing the direct, short term and intermittent discharges of drinking water supplies to Waters of the State. Based on the nature of water supplier discharges, a general permit was initially sought to legalize these discharges.

In 1994, the State of California began drafting a general permit that would allow utilities and water suppliers to discharge water system discharges and power system substructure discharges legally under the State Porter-Cologne Act. In February 1996, the SWRCB decided it was unable to adopt the draft general permit because of a conflict of interest on the part of some State Board members who were also water suppliers. When this permitting avenue closed, and in order to legally discharge water from water system activities to the storm drain, the Wastewater Quality Compliance Group (WQG) sought coverage of these activities under the Los Angeles Regional Water Quality Control Board's (RWQCB) Municipal Countywide Stormwater Permit (Muni Permit).

The Muni Permit (effective July 1996) provides for the legal discharge of water system releases to the storm drain, provided the American Water Works Association (AWWA) Pollution Prevention Plan (PPP) document is used. For all intents and purposes, such a document does not exist. However, the regulatory intent is none the less very clear, and it requires the application of Best Management Practices (BMPs) for preventing stormwater pollution. Thus, in accordance with the Muni Permit provisions, this document is the PPP for DWP and contains the BMPs which will be implemented when discharging potable water from water supply activities to surface waters of the State

This PPP is intended to cover all new or existing discharges from water system facilities to the storm drain. This PPP is also intended to cover short-term, intermittent discharges to surface waters or conveyances that in turn discharge to surface waters. Regulation of these discharges under the Muni Permit reduces the administrative burdens otherwise associated with processing and overseeing thousands of individual permit applications. The specific discharges addressed in this document are described in Table I.

Table 1
Water Supply Discharges

	Discharge Process	Activities	Probable Pollutants of Concern
1.	Cement Lining	Flushing, Disinfection	Sediment, Chlorine, Algae
2.	Main Flushing	Flushing	Sediment, Rust Particles, Chlorine, Algae
3.	Main/Service Pipeline Installation/Replacement	Leak Testing, Disinfecting, Flushing	Sediment, Chlorine, Algae
4.	Reservoir Dewatering/ Tank Dewatering	Tank Draining/Cleaning, Maintenance, Cyclic Blowoff Testing, Emergency Drawdown	Sediment, Chlorine, Algae, Metals
5.	Pump Station /Chlorination Station / Regulator Station Discharges	Relief Valves, Pump Packing/Sealing Water, Emergency Pump Cooling Water	Sediment, Chlorine, Algae
6.	Groundwater Well Development/ Maintenance/WQ Sampling	Sampling, Developing, Testing, Flushing, Drilling	Sediment, Chlorine, Algae, PCE,TCE, Nitrate
7.	System Pressure Protection	Relief Valves	Sediment, Chlorine, Algae
8.	Main and Service Leaks, Leak Repair and Hydrant Knockoffs	System Failures, Hydrant Knock-Offs	Sediment, Chlorine, Algae
9.	Service/Lateral Replacements	Flushing	Sediment, Chlorine, Algae
10.	Substructure/Vault Dewatering	Pumping	Sediment, Chlorine, Algae

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III. Pollution Prevention Plan

Pollution Prevention Plans (PPP) are prepared by the regulated community and are required to contain the procedures or practices which each company will institute to reduce or eliminate, to the maximum extent practicable, the discharge of pollutants to the Waters of the State. This PPP, when properly implemented, is intended to reduce or prevent the discharge of pollutants through the development and implementation of BMPs which constitute compliance with Best Available Technology (BAT) and Best Conventional Control Technology (BCT) and, in most cases, will achieve compliance with water quality standards

The objective of this PPP is twofold: (1) to help identify the sources of pollution that affect the quality of the discharges; and (2) to identify BMPs which will reduce or eliminate pollutants in the discharges. This approach provides the flexibility necessary to establish multiple BMPs for different types of water system activities and pollutant sources in lieu of "end of pipe" controls or treatment. As this PPP covers vastly different types of facilities/activities, the SWRCB recognizes that there is no single best way of developing or organizing a PPP. This PPP attempts to adequately identify and assess all potential sources of pollutants and describe and assess the appropriate BMPs necessary to reduce or eliminate pollutants. In implementing these BMPs, DWP will strive to achieve environmental results in the most cost-effective manner.

The following BMPs constitute the DWP's PPP for handling water supply discharges in order to ensure that a minimum of regulated contaminants are discharged to the storm drain system, and that DWP's discharges comply with the criteria in the Muni Permit.

Administrative, contracting and inspection procedures will be implemented to achieve the BMPs contained in this document. The procedures will target those activities with the potential to generate significant pollutant loads and focus on source minimization, education, good housekeeping, good waste management and good site planning.

IV. PPP Applicability - Conditions, Limitations, or Restrictions

The Muni Permit stipulates that allowed discharges shall not cause or contribute to a violation of an applicable water quality standard. Therefore, as a condition of coverage under the Muni Permit, the discharges in Table I shall not cause or contribute to a violation of a water quality standard. Facilities or activities covered by individual NPDES permits and facilities which do not discharge into Waters of the United States are not covered by this PPP. Discharges associated with auto washing, auto maintenance, groundwater cleanup activities or construction activities are also not covered by this PPP.

The applicable sections of the PPP shall be applied whenever there is discharge unless BMP implementation is technically infeasible, in which case the WQG (213) 367-0279 should be contacted in advance of commencing the job. To the extent possible, these BMPs will be employed during emergency operations, including taking all reasonable steps to minimize or prevent any discharge that has a reasonable likelihood of adversely affecting human health or the environment.

It is also recognized that some discharges may have unusual conditions which require additional treatment or control, and that these situations are best handled on a case-by-case basis in concert with the Regional Board. Discharges that are suspected of having the potential to impact the quality of the State's water after the implementation of the identified BMPs shall be held in impervious containers and handled in an appropriate legal manner. Discharges with acute or chronic toxicity, chemicals or organic constituents, bacteria, herbicides, pesticides, oil and grease, radioactivity, salinity or elevated temperature that may adversely affect the quality and beneficial uses of the State's receiving waters are not allowed to be discharged under the Muni Permit and therefore are not covered by this PPP.

Discharges under the Muni Permit are subject to periodic review and revision by the RWQCB. The regulating agency may conduct infrequent unannounced inspections to verify that the PPP is being followed and that it is effective at preventing contaminants from entering the storm drain system. Specifically, the regulating agency is allowed to:

1. enter the premises or job site where a regulated activity is located or conducted, or where records pertaining to this activity are kept;

2. gain access and copy any records pertaining to this activity;
3. inspect any facility, equipment, or practices pertaining to a regulated activity;
4. halt any discharge if the RWQCB Executive Officer so orders; and
5. photograph, sample, or monitor for the purpose of assuring compliance with existing regulations.

In addition, relevant sections of the PPP shall:

1. be made available to the RWQCB upon request;
2. be amended whenever there is a change in construction, operation or maintenance, when such amendment is necessary to ensure compliance with BAT/BCT and receiving water limits; and
3. be available at the activity site by the time the activity begins.

PART II - BEST MANAGEMENT PRACTICES (BMPs)

I General Guidelines

This section is designed to describe those Best Management Practices (BMPs) that can be applied to all activities described in Table I. Specific BMPs for each activity are discussed in the sections that follow. However, there are some practices which are generic and applicable to all types of discharges. These generic activities are discussed below.

Before discharging potable water from a water supply activity, the expected flow path should be quickly surveyed for the presence of such contaminants as motor fluid leaks or spills, fecal matter, dirt, or debris. If items such as these are found, they should be removed from the path by sweeping, or if necessary, the flows can be redirected around the contaminants. If the impact area (where the water first contacts the ground) or the surrounding area is unpaved or easily eroded, the flow path should be either redirected to a paved or non-erodible area or mechanisms to dissipate the water's energy should be considered.

Control practices that, to the extent feasible, will prevent an increase in sediment load in the discharge should be used. One or more sediment controls should be implemented for all significant discharges. Whenever possible, direct the discharge flow such that the water has the opportunity to pond or otherwise percolate into the soil rather than flow via gutters, storm drains, flood control channels, rivers, creeks, or streams. Whenever possible, projects shall be scheduled during the dry season or when not expecting rain, in order to minimize the exposure of maintenance activities to storm water.

Another source of discharge pollutants could come from the leaking vehicles and equipment used at the job site. All vehicles should be inspected prior to leaving DWP's equipment yard, and leaking vehicles or equipment should not be dispatched to the job site. Vehicles and equipment found to be leaking during the job should be reported and the vehicle/equipment repaired as soon as possible upon returning to the yard. For jobs which occur over several days and the equipment is to remain at the job site, fueling, maintenance, or vehicle/equipment washing at the job site should be avoided whenever feasible. Vehicles and equipment stored at job sites should either be stored on impermeable surfaces or drip pans and absorbent material should be placed under the stored equipment that is prone to leaks and drips.

There shall be no intentional release of petroleum products into streams or onto the soil. The site foreman is to ensure containment, prompt cleanup, and proper transportation of all petroleum waste to approved offsite areas for subsequent disposal in accordance with applicable regulations. If a significant spill occurs, the site foreman shall contact the Environmental Hotline at (213) 792-4989. In order to minimize risk, the use of hazardous materials will be minimized and employees will be trained in proper material use.

In project areas exposed to storm water, all fuels, chemicals, fuel and chemical wastes, animal waste, garbage, batteries, and other materials which have potentially adverse impacts on water quality are to be removed and lawfully disposed of from the project site. Hazardous material spills and leaks should be cleaned up with materials appropriate for the types of chemicals used on the job site such as brooms, gloves, shovels, dustpans, adsorbent for liquid spills, etc.

These BMPs are generic in nature and they may need to be tailored to the unique specifics of each job, location, topography, etc. in order to be effective. Some specific considerations may include: proximity of the job to the nearest storm drain or watercourse; and the presence of a busy intersection vs. undeveloped property; the slope the water travels down. Many of the BMPs are applicable to all types of activities, while some of them require preplanning and are applicable only to scheduled activities. Our approach is to conduct a pre-job evaluation of on-site conditions whenever practicable. This type of evaluation may also minimize the amount of area disturbed and the duration of the disturbance. Part of the evaluation process is to conduct a job site review to determine the anticipated flow path of the discharge and the relevant and appropriate BMPs for the job based on the site characteristics.

Prior to implementing any <u>scheduled</u> discharge activity, survey the project site and identify:

1. the entire affected area;
2. the location of buildings and paved areas;
3. the location of major activity areas;
4. drainage areas and the direction of runoff flows;
5. the discharge points from the job; and
6. points of entrance into the storm drain.

A key aspect to the implementation of this PPP is to ensure that all appropriate employees have knowledge and access to the BMPs described herein. An initial step towards this goal is to identify all appropriate employees who should receive training. Environmental awareness training for maintenance crews and subcontractors should be based on the following four objectives:

- promote a clear understanding of the problem, including activities with the potential to pollute storm water;
- identify the BMPs applicable or appropriate to the job;
- promote employee/subcontractor ownership of the problems and solutions;
- integrate employee/subcontractor feedback into training and BMP implementation.

Integrating employee/subcontractor training into existing programs will make the training process more streamlined.

Contractors who perform work for DWP will be responsible for implementing the BMPs outlined in this document.

Since the BMPs might be different depending on conditions (e.g., rainy days vs. dry days, summer vs. winter, etc.), employees should be trained with step-by-step guidance in the selection of appropriate BMPs. After the training sessions, provide employees with handouts, manuals or other documentation that can be used later as reference information.

Safety concerns should also be incorporated into the training programs. BMPs should be established for unexpected accidents and a safety program should be initiated which includes first aid, accident prevention and emergency response. The safety program should emphasize that public health and safety must be the highest priority when conducting emergency response activities.

II BMPs for Cement Mortar Lining

Background

Unlined cast iron and steel water mains are subject to tuberculation. Cleaning and lining such mains with cement mortar improves their performance, extends their life, and delays their replacement (which is a more disruptive activity).

Procedure:

A 6-foot by 8-foot section of the street is cut out (Hole A), and a hole is dug down to about 1 foot below the main line. The rubble and dirt is transported by truck to the contractor's yard. A 6-foot section of the pipe is removed. Any residual water is pumped out from the hole into the street. About 300 feet away another 6-foot by 8-foot hole is dug (Hole B) and the process is repeated.

A cable is pulled within the main line from Hole A to Hole B. A scraping device is then attached to a cable and moved from Hole A to Hole B. Successively thicker scrapers are added until they can be heard scraping against the metal pipe (that is, when all of the deposits, namely iron oxides, have been scraped off the pipe). A cement mortar application device is then inserted in Hole B and pulled through the pipe while cement mortar is pumped to it from Hole A. A smoothing device is then inserted in Hole B and pulled through to Hole A to smooth out the cement that was applied to the pipe. The cut sections of the pipe are replaced with new pipe.

The debris scraped from the pipe is removed from Hole A and Hole B with a backhoe and sent to an appropriate disposal facility. The holes are backfilled with slurry and are paved over. The line is then superchlorinated before it is returned to service.

All the service meters running along side of the newly lined main are replaced and new curb valves installed. If the service line from the main to the meter is galvanized, a new copper line is installed.

Potential Pollutants

The potential pollutants generated during this activity are tuberculation debris, soil, cement, chlorine, algae and oil and grease. The cement is generated when the mortar is handled and used to line the pipes, while rubble and sediment is generated when water comes into contact with the material in the excavation. The oil and grease may be generated by the construction equipment or vehicles. Chlorine is potentially generated when the line is initially opened up and the potable water drains out and also during the superchlorination process.

BMPs

Residue from the saw-cutting process should be contained and removed from the pavement. In some instances, a wet "shop-vac" can be used to vacuum up the water associated with the saw cutting. Drip pans or absorbent materials should be placed under saw-cutting equipment when not in use. Trenching and backfilling procedures shall be followed which minimize the contamination of storm water by sediment and debris.

Prior to excavation, berms will be deployed downstream of the excavation as a precautionary measure in the event that buried water-containing substructures are inadvertently hit causing an unexpected release of water to the street. During the excavation of the holes, the least possible amount of material shall be excavated from the hole. In order to minimize the amount of sediment escaping to the storm drain, the pavement surrounding the hole shall be swept up after excavation at the end of each day. The excavated material shall be hauled off site and disposed of appropriately. If rainfall is expected, all unfilled trenches shall be covered overnight to minimize the amount of rainfall that might potentially enter the trench. Whenever possible, work shall be performed during the dry season or when heavy rain is not anticipated.

While pumping the residual water out of the trench to the street, the hose inlet shall be underlain with coarse rock and have a screen on the inlet to reduce the amount of small pebbles and sediment being pumped out. Burlap sacks will be placed over the hose outlet to reduce the discharge of sediment. Where feasible, the pump discharge rate will be moderated to minimize the potential to stir up sediment in the excavation. Drainage controls, such as sediment traps, will be used where necessary. These drainage controls would be temporary set- ups intended to impede the water sufficiently for the sediment to settle out. Sediment retained behind the traps shall be removed promptly. Lastly, geotextile fabric will be secured over the storm drain inlet to minimize the discharge of sediment and debris to the storm drain system.

If sediment/debris removal from the hole is required <u>during</u> the course of the job, minimize the release of material to the street. Furthermore, the material which does land on the street should be minimized from entering the storm drain by sweeping the job site at the end of each day.

No cement washwater shall be discharged to the stormdrain. The washing of trucks, equipment or tools in contact with the cement is prohibited unless the washwater is discharged into the excavation hole and remains there.

In general, the reduction of residual chlorine by organic debris and other reducing agents in the gutter and storm drain, as well as the volatilization and dissipation of chlorine which will occur before the discharge reaches the receiving waters should lead to chlorine levels being acceptably low. The superchlorinated water shall be dechlorinated to a residual chlorine level of approximately 0.3 ppm prior to the discharge reaching the storm drain.

The backfill should be composed of cement slurry. This process will allow future work done at this site to be performed in the dried slurry, which will not produce a muddy water discharge to the storm drain, and which will reduce the overall discharge of sediment into the storm drain.

III BMPs for Main Flushing

Background

Existing water mains are periodically flushed to remove sediment and biofilm that can harbor microbiological organisms. The presence of these organisms can cause a violation of state and federal drinking water regulations, while other organisms produce chemicals that can cause drinking water violations. Periodic flushing of water mains also improves the aesthetic properties of the water (e.g., appearance, taste, and odor). Newly installed or repaired mains are flushed prior to and after being disinfected.

Procedure

Water Quality Inspectors manage two water main flushing programs, the Dead-end Flushing Program and the System-wide Flushing Program. The Dead-end Flushing Program is conducted by a Water Distribution flushing crew who open blow-off valves and flush across system divides at all dead-end water mains in the City. The System-wide Flushing Program is conducted by two Water Distribution flushing crews who systematically close gate valves and discharge water from fire hydrants in order to flush every water main in the City. For both programs, the mains are flushed anywhere from 10 minutes to approximately 2 hours depending on the amount of sediment in the line. The crews observe the discharge path to identify and correct any problems such as flooding. Discharging of water ceases when the water being discharged is visually clear of color, turbidity, and sediment.

Potential Pollutants

The potential pollutants generated during this activity are sediment (sand, dirt, pebbles) rust, algae, and chlorine. The sediment, rust and algae are generated when the hydrant valve is opened and the water discharged. The chlorine originates from the residual chlorine levels in the drinking water within the distribution system as required for public health by the Department of Health Services.

BMPs

Prior to initiating the flush, the discharge path shall be inspected and, if practicable, any potential pollutants (e.g., litter) in the path shall be removed. Wherever possible, hydrants shall be chosen that discharge to a storm drain without crossing major thoroughfares. This will minimize the contribution of pollutants due to automobile traffic.

All valves and hydrants to be used in the cleaning operation shall be inspected to ensure that a tight shutdown is possible in case any potential pollutants are discovered during discharge.

The potable water discharged from water system activities has residual chlorine levels ranging from 0.2 to 4 parts per million (ppm). However, the reduction of chlorine by organic debris and other reducing agents found in the gutter and storm drain, as well as the volatilizing of chlorine due to turbulence encountered by the discharge before it reaches the receiving waters, should lead to the levels of chlorine being acceptably low prior to the discharge reaching the receiving waters of the state.

To optimize the settling of suspended material flushed from the water distribution lines, temporary sediment traps (e.g., sand bag barriers) will be strategically placed upstream of all affected nearby storm drain inlets. Geotextile fabric will be secured over the entrance to all affected nearby storm drain inlet structures. Clear water shall continue to be discharged until it appears that the majority of the debris has been removed from the drainage path and is trapped behind the sediment dams. Alternatively, the drainage path shall be cleaned at the conclusion of the flushing job until the majority of sediment along the drainage path has been removed. The debris retained behind the sediment traps will be removed and properly handled so as to minimize the introduction of pollutants to the storm drain.

IV BMPs for Main/Service Pipeline Installation/Replacement

Background

The pipes used to distribute water age over time and occasionally need to be replaced to reduce the risk of leakage or breakage and to improve water quality. New installations of pipelines are done by both DWP and contractors, with contractors typically installing water mains and services for new developments (e.g., contractors typically install the 6" and 8" mains for new housing tracts).

DWP replaces mains that are leaky or have become too small to supply the necessary water for a given area. Most mains have diameters that range from 6 to 30 inches. DWP replaces any existing galvanized steel or lead services with 1 inch copper.

Trunklines are mains that are used to transport water over large distances without any branching off to serve distribution. Trunklines tend to be larger than other mains, ranging from 24 to 100 inches. Because of specialized equipment and mobilization required, contractors usually install trunklines with diameters of 60 or greater inches.

Procedure

Design engineers determine the size of the pipe to be installed and its location. The engineers then compile a construction work package (CWP). The district superintendent receives the CWP and assigns it to a crew supervisor. The supervisor reviews the CWP, goes to the site, lays out the job and orders marking for the underground utilities. He then orders the saw cutting for the trenches.

A main line crew is mobilized to the site with a backhoe and digs out the street where the saw cutting took place. The excavated soil is dumped into a dump truck which hauls off the material to be disposed of properly. In the case of replacement pipe, the new pipe is placed adjacent to the old pipe which is left undisturbed. The old pipe's valves are closed and the crew cuts through the pipe in order to connect the new pipe with the existing line. Water between the closed valve and the cut will run into the trench. If necessary, water is pumped out from trench to the gutter. Mud, which interferes with the replacement work, is lifted out by backhoe into a dump truck.

Before connecting the new pipe, it is disinfected with superchlorinated water, which is dechlorinated while being released to the street. The trench is backfilled with sand slurry and the street paved.

Potential Pollutants

The potential pollutants generated during this activity are sediment, chlorine, and debris. The sediment is generated when water comes into contact with the material in the hole. Sediment is also generated from saw cutting, trench excavation and backhoe mud removal. The chlorine is generated during the superchlorination process. The debris is generated with the removal of the pavement from the street.

BMPs

Residue from the saw cutting process should be contained and removed from the pavement. In some instances, a wet "shop-vac" can be used to vacuum up the water associated with the saw cutting. Drip pans or absorbent materials should be placed under saw cutting equipment when not in use. Trenching and backfilling procedures which minimize the contamination of storm water by sediment and debris shall be followed.

Prior to excavation, berms will be deployed downstream of the excavation as a precautionary measure in the event that buried water-containing substructures are inadvertently hit causing an unexpected release of water to the street. Whenever possible, the minimum amount of excavation necessary to perform the work should be done. In order to reduce the amount of sediment which can be potentially deposited onto the street and thus ultimately reach the storm drain, the pavement surrounding the hole shall be swept up after excavation at the end of each day. The excavated material shall be hauled off site and disposed of appropriately. If the material is transported to a yard prior to its disposal at a landfill, it shall be covered at the yard for protection against erosion from potential rainfall. If rainfall is expected, all unfilled trenches shall be covered overnight to minimize the amount of rainfall that might potentially enter the trench. Whenever possible, the work shall be performed during the dry season or when heavy rain is not anticipated.

The inlet of hoses used to pump residual water out of the trench shall be underlain with coarse rock and shall be fitted with screens to reduce the amount of sediment and debris being pumped out. Burlap sacks will be placed over the hose outlet to reduce the discharge of sediment. Where feasible, the pump discharge rate will be moderated to minimize the potential to stir up sediment in the excavation. Temporary sediment traps which promote sedimentation behind the trap, can be constructed of sandbag barriers. Sediment traps will be used on all discharges that have the potential to introduce substantial amounts of sediments into the storm drain. In all cases where the soil is expected to contain hazardous materials (e.g., the soil emits petroleum or solvent odors), sediment traps shall be used. Sediment shall be promptly removed from the sediment traps. Lastly, geotextile fabric will be secured over the storm drain inlet to minimize the discharge of sediment and debris to the storm drain system.

In general, the reduction of residual chlorine by organic debris and other reducing agents in the gutter and storm drain, and the volatilization and dissipation of chlorine which will occur before the discharge reaches the receiving waters should lead to chlorine levels being acceptably low. The superchlorinated water shall be dechlorinated to a residual chlorine level of 0.3 ppm prior to the discharge reaching the storm drain.

Any galvanized steel or lead service pipelines encountered during main pipeline installations will be replaced with 1 inch copper line, since copper pipelines are less likely to retain sediment, thereby making a pipeline leak or rupture less likely.

V BMPs for Reservoir/Tank Dewatering

Background

Tanks accumulate sediment that is contained in the water. To remove sediment, the tanks are occasionally drained. Tanks are drained more frequently than reservoirs, so the BMPs in this section will apply primarily to tank discharges. Approximately 20 tanks per year are drained.

DWP has reservoirs ranging from 3.3 acre-feet to 33,767 acre-feet. Dewatering for reservoirs over 1,000 acre-feet occurs very infrequently. Reservoirs are typically dewatered for improvement or construction reasons; some examples include lining the bottom/sides of the reservoir, improving the piping on the inlet/outlet of the reservoir, or dam improvements. Typically about two reservoirs per year are emptied for maintenance.

Procedure for Tank and Small Reservoir (<1000AF) Dewatering

Prior to dewatering a tank, the water in the tank is "drunk down." That is, the majority of tank's water is emptied into the distribution system and the tank is not refilled. This minimizes the amount of water being discharged.

The water is then discharged from the tank or small reservoir. Once the water is removed from the tank or small reservoir, the majority of the sediment is manually removed. The tank/small reservoir interior is then hosed down and discharged.

Procedure for Reservoir (>1000AF) Dewatering

Prior to dewatering a reservoir, the water in the reservoir is "drunk down" to a minimal operating level. That is, as much of the reservoir's water as possible is emptied into the distribution system and the reservoir is not refilled. This minimizes the amount of water that is being discharged to the storm drain.

The water is then discharged from the reservoir. Once the water is removed from the reservoir, the majority of the sediment is removed from the reservoir bottom. For larger reservoirs, heavy equipment is used for sediment removal. The sediment is transported to an approved landfill.

Once the sediment is removed, reservoir maintenance activities, such as dam improvements, piping improvements and reservoir lining, can be performed.

Potential Pollutants

The potential pollutants generated during this activity are sediment, debris, and chlorine. These pollutants originate from the drinking water that is brought into the tank or reservoir. Sediment is also generated from the reservoir maintenance activities performed. Oil and grease may be generated by the construction equipment or vehicles.

BMPs

The frequency of tank cleaning will be increased to once every 4 years so as to minimize the amount of accumulated sediment, if any, per cleaning event. Drinking the tank/reservoir down will minimize the amount of water being discharged. The residual water will be discharged at a rate that will minimize the potential for erosion to the surrounding environment. Draining the tanks/reservoirs in a slow, controlled manner will minimize the sediment leaving the tank/reservoir and will also allow more sedimentation to occur in the discharge stream, thus minimizing the amount of sediment reaching the storm drain.

Manually removing the majority of sediment from the tank/reservoir bottom minimizes the amount of sediment being discharged to the storm drain.

When tanks/reservoirs are in rural settings, water will be discharged via natural water courses to hillsides or other soil surfaces (i.e., not pavement or concrete) when possible. This will allow the water not to be "wasted" and to percolate into the ground without being discharged into the storm drain system. The residual water will be discharged at a rate that will allow the water to percolate into the ground with only minimal erosion to the environment.

Temporary sediment traps, which promote sedimentation behind the trap, will be constructed of sandbag barriers. Sediment traps will be used on all discharges that have the potential to introduce substantial amounts of sediments into the storm drain. The storm drainage structures shall be protected from entering sediment by promoting sedimentation upstream of the inlet and securing geotextile fabric over the inlet. Sediment traps shall be designed and used to minimize the amount sediment that reaches the storm drain. The sediment shall be promptly removed from the drainage path or from behind the sediment traps.

In general, the reduction of residual chlorine by organic debris and other reducing agents in the gutter and storm drain, and the volatilization and dissipation of chlorine which will occur before the discharge reaches the receiving waters should lead to chlorine levels being acceptably low.

VI BMPs for Pump Station/Regulator Station Discharges

Background

DWP has over 110 different pressure zones in the City. Pump stations and regulator stations are the primary means of modifying pressure from zone to zone. Some pump station or regulator station equipment may leak water, and some of this potable water may potentially enter the storm drain.

The primary purpose of the pumping station is to pump water from one pressure zone (alternatively, hydraulic grade) to a higher pressure zone. Water is taken from a trunk line, water tank, or a distribution main.

The purpose of a regulator station is to supply water from a higher hydraulic grade zone to a lower hydraulic grade zone.

Procedures

Small amounts of water from the pump and valve leaks at pumping stations are discharged from time to time into the storm drain. Water from relief valves at regulator stations unexpectedly discharge into the storm drain in order to protect the lower hydraulic grade zone.

Potential Pollutants

The potential pollutant generated during this activity is chlorine. Since the water is of potable quality, the amount of chlorine present is minimal. This chlorine is dissipated via volatilization during its exposure to the atmosphere.

BMPs

The valves isolating the high-pressure area shall be closed so that the discharge will release the minimum amount of water necessary to test or maintain the relief valve. This practice, which is controlled automatically, keeps the pipes from having a failure or rupture; should that happen, water, mud, rocks and all sorts of sediment would flow uncontrollably into the storm drain.

The stations shall be frequently maintained to minimize the need for relief valves to operate and to also minimize the amount of drips from leaky equipment.

VII BMPs for Groundwater Well Development/Well Maintenance

Background

Wells are important sources of water supply to the City. About 15 percent of the City's water is obtained from over 100 active and standby wells. This percentage can vary from year to year and during different seasons depending on quantity of source surface water and economics. During emergencies, such as severe drought or natural disasters (i.e. earthquake), groundwater makes up a large percent of the City's water supply. In addition, having wells on standby status gives greater flexibility in groundwater operations and adds to the available water supply.

The Department redevelops/rehabilitates groundwater wells because the well's production decreases. Specifically, the well perforations where the groundwater comes in through the soil matrix tend to clog up over time, decreasing the amount of water available to pump out of the well. The rehabilitation of the wells, which are usually 20 inches in diameter, decreases the draw down and maintains the groundwater production close to original design.

Procedure

Initially, the pump and motor are pulled up from the well where they usually reside about 300 to 400 feet down. This equipment is sent offsite for inspection and overhaul. A camera is lowered into the well to videolog the status of the well.

If necessary, mechanical measures are then employed to improve efficiency of the well. The well casing is cleaned to remove scaling from the inside of the well. A bailer with a one-way valve is then lowered into the well to bring out any sediment from the bottom and any debris floating on top of the well. As needed, a test pump is lowered into the well and surging is performed to backwash the perforations. The well is then test-pumped at a rate of between 2500 and 4000 gallons per minute for 8 to 40 hours, depending on the state of the well, to redevelop and test the capacity of the well. Usually the first 15 to 30 minutes of the discharge, and the first few minutes after surging, contain the majority of the turbidity.

If necessary, a camera is again lowered into the well to re-videolog the status of the well. The rebuilt or new pumps and motors are then reinstalled in the well.

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Potential Pollutants

The potential pollutants generated during this activity are groundwater contaminants (if any), suspended solids and an oil sheen from pump motors. Potential groundwater contaminants include PCE, TCE and nitrates. These pollutants are generated as a result of a property owner's improper handling of industrial products which result in subsurface contamination impacting the groundwater. Private sewage disposal facilities that are now mostly abandoned, as well as the historic use of crop fertilizers, have contributed elevated levels of nitrate to the basin groundwater.

Some of the pumps, which may be lubricated with food grade oil, may potentially contribute an oil sheen to the surface of the water within the well.

BMPs

A bailer is used to remove sediment and debris from the well. If the well produces more than one cubic yard of sediment or debris, the material is contained, hauled away, and either recycled or disposed of properly.

Water from the long-term well testing (testpumping) is directed from the well head to the gutter via extended piping to minimize any surface erosion which might otherwise occur over the ground surface.

The submersible motors will be cooled with food grade oil. Any leakage from the motor will float to the top and will not be discharged, since the motors are usually submerged about 100' from the surface of the well.

If oil-filled motors that are removed from the well have a potential to leak, they will have drip pans placed under them to prevent drips of oil from contaminating the area.

Temporary sediment traps which promote sedimentation behind the trap, will be constructed of sand bag barriers. Sediment traps will be used on all discharges that have the potential to introduce substantial amounts of sediments into the storm drain. Sediment traps may be placed along the discharge path or in front of the storm drain inlet. The sediment shall be promptly removed from the drainage path or from behind the sediment traps. Lastly, geotextile fabric will be secured over the storm drain inlet to minimize the discharge of sediment and debris to the storm drain system.

VIII BMPs for Main/Service Leaks, Leak Repair and Fire Hydrant Knock-offs

Background

All leaks and fire hydrant knock-offs are unanticipated occurrences, and are therefore very difficult to mitigate. Additionally, only large or catastrophic leaks, which occur infrequently, have the potential to produce significant pollutant discharges.

Most leaks occur in service pipelines and flow out onto the street and into a storm drain. Blowouts are pipeline failures that are so large that they cause at least $10,000 worth of damage to the street.

With respect to fire hydrants, in order to prevent unnecessary injury to motorists, DWP uses hollow bolts in its hydrants so as to break away during impact. At the request of the Fire Department, DWP uses wet barrel hydrants which are always charged with pressure from a main. As a result, when a knock-off occurs, a water gusher will occur. These usually range from 5- to 20-feet high, but they could gush as high as 100 feet. The testing of hydrants is performed by the Fire Department and therefore the development and implementation of any applicable BMPs associated with hydrant testing will be under their jurisdiction. Accordingly, this document does not address hydrant testing.

Procedure for Leaks and Leak Repair

Once the source of the leak is isolated, the crew supervisor orders saw cutting into the asphalt surrounding the leak. The field crew comes out with a backhoe and digs out the street where the saw cutting took place. The asphalt, concrete or asphalt/concrete combination comprising the topmost covering of the pipe is removed using a backhoe and loaded into a dump truck. The soil covering the pipe is also removed and put into a dump truck. These dump trucks either dispose of the material immediately at a landfill or stockpile it covered at a facility yard for a few days until enough soil and debris are accumulated for larger deliveries to the landfill.

The crew may repair the leak by either plugging the leak, placing a sleeve around the failed pipeline portion, or replacing the failed line with new pipe. Mud which forms in the trench and which needs to be removed in order to complete the job, is lifted via backhoe into a dump truck and is disposed of properly.

The trenches are then backfilled with a sand slurry and the street is paved.

Procedure for Hydrant Knock-offs

Once DWP is notified of a knock-off, a field crew is dispatched to turn off the valves to the hydrant as soon as possible.

Potential Pollutants

The potential pollutants generated during this activity are sediment, chlorine and debris. Sediment and debris are generated from catastrophic ruptures and from excavations during leak repair. Fire hydrant knock-offs may cause debris which is already present in the street to enter the storm drain. Chlorine may be present in the discharge from the residual levels in the drinking water as mandated by law.

BMPs for Leaks or Leak Repair

Reported leaks shall be responded to as quickly as possible in order to minimize the amount of water lost and the effects of that water on the surrounding areas.

Residue from the saw-cutting process should be contained and removed from the pavement. In some instances, a wet "shop-vac" can be used to vacuum up the water associated with the saw cutting. Drip pans or absorbent materials should be placed under saw-cutting equipment when not in use. Trenching and backfilling procedures shall be followed which minimizes the contamination of storm water by sediment and debris.

Prior to excavation, berms will be deployed downstream of the excavation as a precautionary measure in the event that buried water-containing substructures are inadvertently hit causing an unexpected release of water to the street. Whenever possible, the minimum amount of excavation necessary to perform the work should be done. This reduces the amount of sediment, rocks, etc. which can be potentially deposited onto the street and thus enter the storm drain. In order to further reduce the amount of sediment which can reach the storm drain, the pavement surrounding the hole shall be swept up after excavation at the end of each day. The excavated material shall be hauled off site and disposed of appropriately. If the material is transported to a yard prior to its disposal at a landfill, it shall be covered at the yard as protection against erosion from potential rainfall. If rainfall is expected, all unfilled trenches shall be covered overnight to minimize the amount of rainfall that might potentially enter the trench.

The inlet of hoses used to pump residual water out of the trench, if necessary, shall be underlain with coarse rock and shall be fitted with screens to reduce the amount of sediment and debris being pumped out.

Burlap sacks will be placed over the hose outlet to reduce the discharge of sediment. Where feasible, the pump discharge rate will be moderated to minimize the potential to stir up sediment in the excavation. Temporary sediment traps which promote sedimentation behind the trap, will be constructed of sandbag barriers or other equally effective devices. Sediment traps will be used on all discharges that have the potential to introduce substantial amounts of sediments into the storm drain. In all cases where the soil is expected to contain hazardous materials (e.g., the soil emits petroleum or solvent odors), sediment traps shall be used. Sediment shall be promptly removed from behind the sediment traps. Lastly, geotextile fabric will be secured over the storm drain inlet to minimize the discharge of sediment and debris to the storm drain system.

In general, the reduction of residual chlorine by organic debris and other reducing agents in the gutter and storm drain, the volatilization and dissipation of chlorine which will occur before the discharge reaches the receiving waters should lead to chlorine levels being acceptably low.

BMPs for Hydrant Knock-Offs

The most effective BMP DWP employs is to turn off the valves supplying water to the hydrant as soon as it is notified of the knock-off. DWP also ensures that Fire Department personnel have been trained in turning off the valves to the hydrant so that they may do so if they are notified.

Hydrants are usually situated on a street corner, near the curb. Storm drains are also usually located near a street corner, so hydrant knock-offs frequently flow directly into the storm drain, without collecting a large amount of debris and pollutants from the street.

General

BMPs will be instituted as warranted and as conditions permit for hydrant knock-offs, blow outs, and catastrophic ruptures. However, DWP's first responsibility is to respond to restoring essential public services, ensuring public health and safety and minimizing damage to public and private property.

IX BMPs for Underground Substructure Dewatering (Using Sensory-Screening Techniques)

Background

DWP addresses two categories of underground structures in this chapter: service boxes and vaults. Service boxes have dimensions of 4-feet by 5-feet or less, are prefabricated of a fiberglass compound and have no bottom. The great majority of underground structures are domestic service meter boxes with dimensions of 12 inches by 18 inches.

These underground structures can fill with water due to groundwater intrusion, storm water runoff, a leak from pipes within the structure, or runoff from some domestic activity (e.g., irrigation).

DWP conducted a four-month study of water infiltrated power system structures in an attempt to develop a reliable yet easy-to-use field administered "sensory screening technique". This study led to the development of the Sensory Checklist Method (SCM). While the pilot study focused on Energy System applications, it has also been applied to the Water Service Organization's (WSO) contaminated commercial water meter vaults and can be applied to the larger WSO vaults and substructures.

The pilot study involved the inspecting of over one hundred underground water-filled substructures using the SCM. Water which passed the SCM, and presumed dischargable, was subject to parallel laboratory water quality analysis. Vaults passing the SCM were then compared with the lab test results to check for consistency and reliability. The results of the study validated the use of the SCM as a dependable, reliable, and easy to use means of detecting the presence of gross pollutants.

The SCM was found to be so effective for the presence of gross pollutants that, in fact, the only class of contaminants regularly present in <u>trace</u> amounts in the sample water which could not be detected by the sensory method were pesticides and herbicides. The presence of pesticides and herbicides cannot be attributed to DWP operations (i.e., DWP did not add the pollutant), but rather is the result of "run on" into DWP substructures from stormwater infiltration.

Procedure

An SCM Checklist is completed for any partial or full discharge of vault/substructure water to the street/storm drain system. A copy of the SCM and an overview of the checklist follows.

CHECK 1 – Is the water cloudy, discolored and/or have an unusual odor?

This first check identifies substructure conditions that would require it to be contained and formally tested by a chemistry laboratory to determine the proper handling procedures. These conditions include but are not limited to cloudiness, discoloration and odors (sewage, chemicals, solvents, gasoline, etc.).

CHECK 2 – While monitoring the discharge being pumped, is there an occurrence of oil, tar, soil, cloudy discharge and/or unusual odors?

Monitor the discharge while pumping and enter the required information when appropriate (date pumped, amount pumped, and where it was pumped to [alley, street, etc.]). If any contaminants are detected during discharge, immediately stop pumping. Return to CHECK 1 to reassess the situation. If it is subsequently determined that containment is necessary, an SCM Checklist must still be completed and the line labeled "Storm Drain Discharge Stopped" must be marked. Give a detailed description of the condition that prompted the stopping of the discharge.

Completed SCM Checklists should be kept on file by the discharging facility for one year. After one year, they must be forwarded to the Wastewater Quality Compliance Group in Room 1213 for permanent record keeping.

BMPs

The primary BMP we employ is the SCM. DWP's four-month study, referenced above, revealed that hazardous chemicals, solvents, oil, grease, tar, sewage, etc. found in the vault/substructure waters could be easily detected in a sensory manner by inspecting the substructure and the water for the following signs:

- Strong chemical odor for - solvents, gasoline, diesel, etc.;
- Rainbow sheens or layers for - oil;
- Floating, suspended, and/or sinking materials for - debris, tar, etc.;
- Sulfurous (rotten egg) odor for - decaying matter, sewage, etc.;
- Color or discoloration for - sediment, minerals, heavy metals, etc.

SCM Checklist

Must be Completed for Every Discharge to the Street/Stormdrain System

DATE : ____________________ VAULT LOCATION : ____________________

TIME : ____________________ VAULT SIZE : ____________________

RECENT RAIN : Yes ___ No ___ ESTIMATED WATER DEPTH : ____________________

CHECK 1. Conditions Requiring Containment of Vault Water

1. Is the vault water cloudy, discolored, and/or has an unusual odor ? No ___ Yes ___

NO. Go on to CHECK 2.

YES. The vault water must be pumped to containment for formal chemistry laboratory testing to determine proper handling.

CHECK 2. Oil, Tar, and/or Soil

2. Is there any oil, tar or soil particles ? No ___ Yes ___

NO. Go on to CHECK 3.

YES. Can the water be pumped without disturbing the pollutants such that they are not discharged to the street ?

NO. The vault water must be pumped to containment for formal chemistry laboratory testing to determine proper handling.

YES. Go on to CHECK 3. If needed, the remaining contaminants must be pumped to containment for formal laboratory testing to determine proper handling.

CHECK 3. Pumping Clean Water / Monitoring the Discharge (Form must be completed)

3. While monitoring the discharge begin pumping the vault water to the street/stormdrain system. Fill in only the information directly below (date, amount, and destination). If any of the following conditions appear during discharge, immediately stop pumping. Return to CHECK 1 to reassess the situation. If it is determined that containment is necessary, mark "Storm Drain Discharge Stopped" and describe the condition that prompted the stopping of the discharge and the new condition of the vault water itself.

Date pumped ____________ Amount (gal) ____________ Discharge destination (alley, etc.) ____________

STOP IF : Oil, Tar, Soil, Cloudy Discharge, and/or Unusual Odors Occur

______ Storm Drain Discharge Stopped

Describe conditions : ____________________

The information provided is true and correct to the best of my knowledge.

____________________ Print Name

____________________ Signature

- Maintain this sheet at your reporting location for one year -

Forward to SHEPBU Water Quality (GOB 1121) after one year for [illegible]

Putting the Pieces Together:
State Nonpoint Source Enforceable Mechanisms in Context

June 2000

R0019175

PUTTING THE PIECES TOGETHER:
STATE NONPOINT SOURCE ENFORCEABLE MECHANISMS IN CONTEXT

R0019176

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Putting the Pieces Together: State Nonpoint Source Enforceable Mechanisms in Context

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Table of Acronyms

GENERAL/ FEDERAL	DEFINITION
319	Nonpoint source grant program under Clean Water Act
BMP	Best Management Practices
CAFO	Concentrated Animal Feeding Operations
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	Combined sewer overflow
CZARA	Coastal Zone Act Reauthorization Amendments of 1990
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
FIP	Forestry Incentive Program
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NGO	Non-Governmental Organization
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	USDA Natural Resources Conservation Service
SIP	Stewardship Incentive Program for forestry
TMDL	Total Maximum Daily Load
US EPA/ EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USGS	United States Geologic Survey
WHIP	Wildlife Habitat Incentives Program
WQIP	Water Quality Incentive Program
WRP	Wetland Reserve Program

State of Georgia	Definition
DCA	Georgia Department of Community Affairs
DNR	Georgia Department of Natural Resources
EPD	Georgia Environmental Protection Division
GFC	Georgia Forestry Commission
LAS	Land Application Systems
RC&D	Resource Conservation and Development Program
SWCC	Georgia Soil and Water Conservation Commission
SWCD	Soil and Water Conservation District

State of Maine	Definition
CEO	Code Enforcement Officer
DAFRR	Department of Agriculture, Food, and Rural Resources
DEP	Maine Department of Environmental Protection
DMR	Maine Department of Marine Resources
DOT	Maine Department of Transportation
FAME	Finance Authority of Maine
L&WRC	Land and Water Resources Council
LEA	Lakes Environmental Association
LMF	Land for Maine's Future
LURC	Land Use Regulation Commission
MFS	Maine Forest Service
NRPA	Natural Resources Protection Act
PWD	Portland Water District
SPO	State Planning Office
SWCD	Soil and Water Conservation District
VLMP	Volunteer Lake Monitoring Program

STATE OF MARYLAND	DEFINITION
DNR	Maryland Department of Natural Resources
MACS	Maryland Agricultural Water Quality Cost Share Program
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
SRF	Water Quality State Revolving Fund

STATE OF OHIO	DEFINITION
DNR	Ohio Department of Natural Resources
HB 88	Ohio's cost share program, created by House Bill 88.
OEPA	Ohio Environmental Protection Agency
SWCD	Soil and Water Conservation District

STATE OF OREGON	DEFINITION
BPA	Bonneville Power Administration
DLCD	Department of Land Conservation and Development
GWEB	Governor's Watershed Enforcement Board
IMST	Independent Multidisciplinary Scientific Team
LAC	Local Advisory Committee
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
DEQ	Oregon Department of Environmental Quality
OWEB	Oregon Watershed Enforcement Board
SB 1010	Agricultural Water Quality Act, created by Senate Bill 1010
SWCD	Soil and Water Conservation District
WQMP	Agricultural Water Quality Management Plan

STATE OF TEXAS	DEFINITION
503	Texas cost share incentive program created by Senate Bill 503
DOPA	Dairy Outreach Program Area
EAPP	Edwards Aquifier Protection Program
ETJ	Extraterritorial Jurisdiction
NOV	Notice of Violation
PAP	Pollution Abatement Plan
RIO	Regionally Initiated Order
SWCD	Soil and Water Conservation District
TNRCC	Texas Natural Resources Conservation Commission
TPDES	Texas Pollutant Discharge Elimination System
TSSWCB	Texas Soil and Water Conservation Board

STATE OF VIRGINIA	DEFINITION
AMTA	Agricultural Market Transition Act
CBLAD	Chesapeake Bay Local Assistance Department
CBPA	Chesapeake Bay Preservation Area
CFO	Conservation Farm Option
DCR	Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
SWCB	Virginia Soil and Water Conservation Board
SWCD	Soil and Water Conservation District
VDACS	Virginia Department of Agriculture and Consumer Services

State of Wisconsin	Definitions
DATCP	Department of Agriculture, Trade and Consumer Protection
DILHR	Department of Industry, Labor, and Human Relations
DNR	Wisconsin Department of Natural Resources
LCC	County Land Conservation Commission
NOD	Notice of Discharge
AFO	Animal Feeding Operation
DLC	County Department of Land Conservation
UDC	Uniform Dwelling Code

Introduction

Pollution of our nation's waters is a continuing problem despite nearly thirty years of regulatory attention and funding. The largest remaining obstacle is "nonpoint source" water pollution. The federal Clean Water Act's National Pollutant Discharge Elimination System (NPDES) permit program regulates discharges of pollutants from "point sources," which include wastewater discharges from pipes, outlets, and other discrete conveyances, and stormwater discharges from industrial facilities, municipal sewer systems, and construction sites of five acres or more (one acre or more under recent regulations). But the NPDES program does not address nonpoint source water pollution from farms, forests, and other lands. Runoff from these lands carries sediment, nutrients, bacteria, metals, pesticides, organic compounds and other forms of pollution into the nation's rivers, lakes, estuaries, and wetlands.

The primary federal and state responses have been to provide financial and technical assistance and to encourage voluntary actions. Traditional nonpoint control methods include planning, technical assistance, promotion of voluntary best management practices (BMPs), funding of cost-share mechanisms, and public funding of stream buffers. But these assistance-oriented approaches have not succeeded in preventing pollution of the nation's rivers and streams.

Paying landowners not to pollute, providing free technical advice, and relying on voluntary adherence to BMPs has proven to be an incomplete strategy in many cases. Gradually, states are turning to enforceable mechanisms – including discharge prohibitions, direct enforcement of water quality standards, pollution abatement orders, required operating practices, nuisance and misdemeanor prosecutions, and civil and administrative penalties – to supplement other approaches. While enforceable mechanisms are not the primary instrument used to address nonpoint source pollution in any state, they are increasingly used to complement the other mechanisms.

This study examines representative experiences in eight states. It is intended to assess how enforceable mechanisms are used in practice. The study builds on several prior studies by the Environmental Law Institute (ELI) and available at www.eli.org. In 1997, ELI published a detailed analysis of enforceable state laws that were being used, or could be used, to address nonpoint source pollution. That report, *Enforceable State Mechanisms for the Control of Nonpoint Source Water Pollution*, identified the types of enforceable mechanisms available to the states and described their legal advantages and limitations. In late 1998, ELI published a companion state-by-state compendium of the enforceable laws – *Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution.* In 1999, ELI also published a related look at state programs affecting livestock operations, including those that can assist in making water pollution controls more effective – *Locating Livestock: How Water Pollution Control Efforts Can Use Information from State Regulatory Programs.*

The need for states to take further action to control nonpoint sources has been prompted by highly visible fish kills, endangered species listing of salmon runs in the Northwest, unacceptable fecal coliform levels in drinking water supplies, manure spills, nutrient pollution of major estuaries and lakes, and pollution effects on beaches and waterfronts. Concerns from point source dischargers that other polluters share some pollution prevention obligations are beginning to have some effect. Federal laws are also helping to drive the trend. Under section 6217 of the 1990 Coastal Zone Act Reauthorization Amendments (CZARA), over half the states are developing and beginning to implement enforceable mechanisms in their coastal zones in order to remain eligible for continued grant funding. And all states will need to develop Total Maximum Daily Loads (TMDLs) to clean up their impaired waters identified under section 303(d) of the Clean Water Act. As they do so, many will need to use enforceable mechanisms to achieve more effective control over the nonpoint source discharges that comprise a significant source of the impairments.

The current challenges are deciding how to integrate enforceable mechanisms into the broad menu of assistance-oriented approaches, determining when enforcement is appropriate, and structuring a system that can act effectively when enforcement is invoked.

Methodology

This study uses a case study method to look at application of the tools identified in the *Almanac of Enforceable State Laws*. ELI examined the operation of nonpoint source control programs in the context of specific watersheds – including programs operated by state, local, and federal environmental, agriculture, forestry, natural resources, soil and water conservation, and land use agencies. The study:

- examines how these programs work, and what tools they use to achieve results;
- identifies how and where the enforceable mechanisms interact with the cost-share, voluntary, and technical assistance methods that comprise the primary approaches in these watersheds; and
- describes tools that can be adopted or adapted for use in other states.

The case studies include all of the pieces of the puzzle that now constitute nonpoint source controls in each watershed -- ranging from federal agricultural funding, to EPA funding, to state environmental programs, forestry programs, and agriculture programs, to local government programs, and soil and water conservation district programs.

We selected eight states for study: Georgia, Maine, Maryland, Ohio, Oregon, Texas, Virginia, and Wisconsin. Neither a cross section nor a collection of leading programs, the states were selected primarily to study particular enforceable mechanisms identified in the prior studies. A watershed approach was used to assess the operation of state nonpoint source programs. In several states we included more than one watershed in the study in order to examine different tools or different pollution problems. Although states were selected in order to study particular mechanisms, the research examined all of the enforceable and assistance-oriented policy tools relevant to the watersheds studied.

Georgia was selected because of its apparent authority to regulate nonpoint pollution sources under the state's water pollution law, and because of its river corridor protection law imposing enforceable obligations on local jurisdictions. Maine was selected to examine its array of land use laws relevant to nonpoint source pollution. Maryland was selected because of its new mandatory nutrient management planning law and its enforcement programs addressing discharges from agriculture, development, and forest harvest sites. Ohio was selected because of its authority to issue state-level nonpoint source abatement orders to farming and forest operations. Oregon offered the opportunity to examine integration of land use and watershed planning, an agricultural abatement order linked to watershed planning, and a comprehensive forest practices act. Texas was selected in order to examine its programs authorizing local regulatory controls, and specifically special controls in the Edwards Aquifer area. Virginia's forest and agriculture nonpoint source abatement orders were the basis for its selection. Wisconsin was selected because of its integration of enforceable, technical assistance, and cost share mechanisms through the state's long-standing priority watershed program.

This study focuses on program delivery and implementation rather than on water quality outcomes. One of the incidental findings – worthy of its own future analysis – is how little monitoring data exist to assess the effect of any nonpoint source programs on water quality. Indeed, even where water quality data exist for a particular place and time – demonstrating nutrient impairment, for example – there is rarely comparable data from an earlier and later time that can show trends. Thus, program effectiveness is expressed in this study in terms of compliance with standards, norms, or BMPs, that are believed to protect water quality.

ELI conducted the research by collecting and examining laws, regulations, manuals, policies, and reports, and by conducting numerous interviews. Draft chapters were prepared and circulated for comment, then revised.

Each state chapter begins with a brief summary. This is followed by descriptions of the watershed(s) studied, the enforceable mechanisms available, and the assistance-oriented nonpoint source programs available in the watershed. Each chapter then discusses how these various tools and resources have been applied – or not applied – in the study watersheds. A brief conclusion to each chapter highlights issues, impediments, and opportunities resulting from each state's approach.

Putting the Pieces Together: Nonpoint Source Enforceable Mechanisms in Context

The eight case studies offer lessons for state and federal officials, policy makers, and others interested in improving nonpoint source pollution programs. Among these are the following:

1. ***Enforcement is already a small part of the strategic mix to control nonpoint sources.***

Each state, even though leading with other strategies, has recourse to enforcement tools for some nonpoint source problems. Some results simply cannot be accomplished by other means. For example, enforceable standards are widely used in addressing land clearing and grading activities not subject to NPDES stormwater permitting. States have found that waiting until after pollution occurs to take action, or relying wholly on voluntary standards, is an ineffective strategy. Similarly, for timber harvesting – where the land disturbance is temporary and the logger often is not readily available for post-harvest correction of problems – standards and enforceable mechanisms can be used to prevent pollution problems. Enforcement plays a critical role in agricultural pollution control as well. For agricultural animal operations falling below the numerical thresholds for NPDES permitting as concentrated animal feeding operations (CAFOs), many states have found that regulation and enforcement is needed to promote construction of necessary facilities and adherence to management plans. This is the case both because control costs may be fairly high for such operations (thus inhibiting voluntary compliance even where cost shares are available), and because the impacts that occur are significant as most livestock operations are sited near water. Finally, for all forms of nonpoint source pollution, there is always some set of actors that will not respond to other means (not even 100 percent funding). For these actors, enforcement is an essential back-stop to other strategies.

2. *Enforcement authority can be 1) linked to operating requirements or standards, and 2) integrated with a watershed plan.*

Enforceable nonpoint source mechanisms fall generally into two categories. One category provides an after-the-fact remedy. This category includes sanctions associated with violating a general prohibition on the discharge of pollution to the waters of the state, enforceable water quality standards, and authority to order the abatement of a nonpoint activity. The other category prescribes enforceable operating standards intended to prevent nonpoint pollution. Such mechanisms include construction requirements for the containment of manures, requirements for the filing of forest harvest plans, prohibitions on certain activities within 50 feet of streams, site erosion control requirements, and many other measures.

The study states have both of these types. State mechanisms that provide only an after-the-fact remedy without significant influence on operating approaches or inspection and monitoring appear to be less effective. For example, Ohio is able to invoke its nonpoint source abatement order authority only after pollution occurs. Virginia recently amended its formerly complaint-driven silvicultural nonpoint abatement order law in order to gain greater information and accountability from operations prior to any discharge occuring. In contrast, Maryland's agricultural enforcement programs are linked to on-farm water quality management planning and to nutrient management planning. Oregon links enforcement of agricultural practices to water quality management planning.

Some states link all of their nonpoint source efforts to watershed assessment and planning. This improves accountability for outcomes, while it enhances delivery of cost share and technical assistance. It also ties enforcement more closely to water quality objectives. Of the eight study states, Wisconsin and Oregon have the most detailed and comprehensive watershed planning associated with their nonpoint source controls. Maine is increasing its reliance on this kind of approach. While EPA's § 319 nonpoint source grant program has recently required watershed assessments in order for states to share in the additional funding available under that program, a number of states have used this approach for some time – applying it to other cost-shares, technical assistance, and enforceable mechanisms.

3. *Cost-share mechanisms continue to play a substantial role, particularly for agricultural sources.*

All of the states use cost-share and technical assistance as a primary approach to nonpoint source water pollution controls on agricultural lands. Federal funds often provide the bulk of cost-shares, but several of the study states – including Wisconsin, Maryland, and Virginia – have made significant state-funded cost-shares available. Several states have also enacted property and income tax breaks to encourage agricultural planning and installation of pollution control practices. Cost shares can play an important role in assuring compliance with regulatory programs. For example, Maryland has supported its new mandatory nutrient planning law's implementation with additional loan and cost-share funding. Wisconsin integrates costs shares with enforcement by linking eligibility for some cost shares to an operator's prompt response to an enforceable mechanism – such as the notice of discharge for animal operations. Ohio takes the opposite approach by prohibiting the issuance of an enforcement order that requires installation of a cost sharable practice unless cost share funding is actually provided.

Integration of technical assistance and cost share with enforcement has been difficult in some respects. Many agriculturally-oriented agencies do not want to be associated with enforcement. The case studies show that even states with the most fully developed enforceable mechanisms generally seek to assure that in addressing agriculture and forestry, the enforcement function is assigned to a separate entity from the cost-share and technical assistance function.

4. *Geographically-targeted enforceable protections are significant features of state nonpoint programs.*

Although many state programs emphasize BMPs and rely on "no discharge of pollution" or abatement order provisions to address violations wherever they may occur, there is a clear trend toward geographically focused protections. For example, Georgia's unique river corridor protection program is intended to focus particular regulatory attention on these areas. Maine's Natural Resources Protection Act and Mandatory Shoreland Zoning Act provide special protections for areas vulnerable to nonpoint source pollution. So do the Chesapeake Bay protection acts of Maryland and Virginia, and the Edwards Aquifer protection program in Texas. Wisconsin's use of a priority watershed program – and designation of critical sites within these watersheds – reflects another way to focus both cost share and regulatory efforts.

5. *Enforcement procedures are more effective when simple to use and prompt in their effect.*

Because in the nonpoint source universe enforcement generally comes only after all other approaches have failed, it is important that the enforceable mechanisms be straightforward and effective as early as possible. The track record of the states in this area is mixed. Ohio's abatement orders often restart the negotiations that led to the request for enforcement by the soil and water conservation district. Wisconsin's state-level agricultural pollution abatement orders also can result in a long waiting period. Prompt approaches include measures that can be locally taken. This can include enforcement by county and local officials and enforcement by other state officials using local magistrates (as with Ohio's wildlife officers). Local governments play a significant role in nonpoint source regulation in a number of states – primarily in the field of erosion and sediment control from nonagricultural activities, but also including agriculture and silviculture in several states.

Local programs seem to require a great deal of state support, funding, and technical assistance, but when fully staffed seem to offer some advantages in effectiveness and visibility. Maryland, Wisconsin, and Maine have integrated nonpoint concerns into a vast array of laws, many of which involve local government. Georgia has some interesting locally-enforceable mechanisms, including the river corridor protection law, but its implementation experience is too recent to assess the effectiveness of this program generally. Texas's Edwards Aquifer program provides another example of a targeted regulatory regime with local enforcement that seems to operate well.

Enforceable Mechanisms Are Here To Stay

States are adopting enforceable mechanisms to supplement more traditional approaches. The case studies show that states often take some time to adopt and then use these mechanisms, but that once in use the enforceable mechanisms are supplemented or strengthened.

Maryland and Wisconsin appear to have the most fully integrated systems of nonpoint source controls. Both combine substantial cost-share funding with the realistic option to use enforceable mechanisms. Of the two, Wisconsin seems to have devoted greater effort to planning and targeting, Maryland to the development of an array of enforceable programs.

Nonpoint source enforcement is not a great unknown. Nor is it a mere spectre of the much debated TMDL process. The experiences of the states examined in this study offer substantial guidance about ways to structure enforcement, to develop programs, and to integrate traditional approaches with enforcement.

Nonpoint source pollution is perhaps our biggest water quality problem, and it remains one of our greatest problems of environmental governance. It will continue to be a problem until we address nonpoint source pollution with the same seriousness with which we addressed industrial and sewage discharges beginning in 1972. The solution will require a shared state and national commitment to solve the problem – demonstrated by:

! accountability for results in improving water quality,
! adequate state and federal funding, and
! enforcement.

Many of the pieces of this puzzle are already on the table. Some states have even assembled parts of the picture. It is time to finish the job.

Georgia Case Study

Summary

This study examines the mechanisms used to manage and control nonpoint source pollution in the Coosa River watershed in northwestern Georgia.[1] The study specifically examines the relationship between enforcement approaches and voluntary, technical assistance, and cost share approaches as used in the watershed. Georgia primarily uses voluntary and technical assistance programs that emphasize best management practices for nonpoint source pollution management – especially in agriculture and forestry. Although the need to maintain certain water quality standards can be used to enforce against agricultural and forestry nonpoint source runoff, in practice this enforcement mechanism seldom is used. Georgia does have an innovative mechanism for requiring localities to include environmental criteria in their comprehensive plans and local ordinances, including river corridor protection criteria. Georgia also requires localities to implement erosion and sedimentation control requirements on land development activities, and especially localities in high growth areas are developing innovative enforcement programs to manage this type of nonpoint source pollution. The state is strengthening its permitting programs for stormwater, concentrated animal feeding operations, and land application systems.

The Coosa River Watershed

The Coosa watershed in the northwest corner of Georgia is a mixture of rural and rapidly suburbanizing lands. Its streams are impacted by runoff from farms, forestry operations, and small surface mining sites. However, the southern counties of the region and the areas around municipalities are seeing an increase in subdivision development. Such development is leading to increased erosion and sedimentation runoff from construction, as well as urban runoff and sewer overflow problems. In general, the Coosa watershed is still fairly pristine, however threats exist from a variety of nonpoint sources and certain stream segments are impaired. Impaired streams in the Coosa watershed are primarily impacted by nonpoint source and urban runoff, fecal coliform being the most common contaminant.[2]

Named among the ten most endangered rivers in the United States in 1999, by the conservation group American Rivers, the Coosa River Basin in Georgia and Alabama flows through many wild and natural areas and supports a wide range of biodiversity.[3] The Coosa watershed, encompassing approximately 4,700 square miles, includes most of the counties in the Northwest corner of Georgia.[4] Several major rivers run through the watershed, including the Conasauga River, the Coosawattee River, the Oostanaula River, the Etowah River, and the Coosa River.[5]

The Coosa region is a priority watershed for agricultural nonpoint source management. Approximately 6 of its rivers and streams exhibit water quality impairments due to agricultural nonpoint source pollution, while 16 have a high potential of water quality problems.[6] Most of the farms in the region are still small family farms, but there is a recent increase in concentrated animal feeding operations. The watershed includes 2.4 million acres of forested land of which 11% is owned by the forestry industry while the rest are held by landowners. Nonpoint source pollution from forestry accounts for a relatively small percentage of the overall water quality impairment. Major pollution risks involve sediment from roads and skid trails, soil disturbance during site preparation, and streamside cutting.

Georgia Environmental Protection Division (EPD) studies have concluded that, statewide, sediment is the most severe pollutant from nonpoint sources.[7] The proximity to suburban Atlanta affects both water quality and water quantity in the Coosa watershed. Increased construction from new housing developments contributes to sedimentation in the southeastern localities of the watershed.

Finally, surface mining is a $1.7 billion industry in Georgia. Mining in Georgia is concentrated primarily in stone, clays, and other construction and industrial materials. The Coosa watershed has a mixture of surface mining operations, some of which require NPDES permits, such as quarries, and some of which require surface mining permits, such as pit operations and borrow pits for clay, fill dirt, gravel, etc. Almost every county in the watershed has some type of surface mining.[8] There are approximately 24 quarries, 18 borrow pits, 12 dredgers, and 10 pits (primarily for clay) permitted in the region.

Enforceable Mechanisms

Of the Georgia nonpoint source enforceable mechanisms, the following were reviewed because of their relevance to the Coosa watershed.

! *Water quality standards.* The Georgia Water Quality Control Act requires that the water quality standards for Georgia not be violated and provides civil and criminal enforcement sanctions for water quality violations.[9] As implemented, it does not establish a permitting process for nonpoint discharges, although the Act apparently would allow EPD to do so.[10] The Act is used primarily in forestry and agricultural nonpoint source discharge cases where there is a serious violation of water quality standards and the agency responsible for best management practices (BMP) implementation and technical assistance cannot secure compliance or implementation of BMPs. In these cases, the responsible agency may turn the case over to Georgia Department of Natural Resources' Environmental Protection Division (EPD) for enforcement.

! *Land disturbance permitting.* The state Erosion and Sedimentation Act establishes a permitting process for land-disturbing activities such as clearing, grading, excavating, or filling of land.[11] To receive a permit, an applicant must submit an erosion and sediment control plan that outlines specific BMPs for implementation. This Act also directs local governments to enact erosion and sedimentation ordinances for review by the EPD. Once an ordinance has been found consistent with state law, EPD grants the local government authority to issue and enforce permits for land-disturbing activities. In areas where a local government has not been certified, the EPD is responsible for permitting, inspection, and enforcement under the Act. However, in much of the state, local governments have adopted erosion and sedimentation ordinances and have been given the authority to issue and enforce permits for land-disturbing activities.[12]

! *Surface mining permitting*. The Georgia Surface Mining Act requires a permit from EPD for surface mining operations.[13] The Act applies to surface mining activities statewide. Surface mining is defined as any activity or process for the removal of minerals, ores, or other solid matter.[14] Tunnels, shafts, and dimension stone quarries are not considered to be surface mining. Minerals include sand, clay, stone, gravel, phosphate, and other rocks and ore of commercial value found in natural deposits on or in the earth. The Act covers dredging of sand as well as other surface mining activities. EPD has the authority to enforce violations of the permit, including water quality and discharge violations.[15]

! *Land application systems permitting*. Under the Water Quality Control Act, Georgia requires a general permit for all land application systems (LAS), including agricultural systems for spreading animal waste, municipal systems for spreading treated wastewater, and industrial systems for spreading treated wastewater.[16] A general permit can be issued for all facilities within a specific geographic area or to a specific category of LAS facilities. EPD may also require specific facilities to obtain an individual LAS permit. LAS permits are no-discharge permits and refer back to the accepted best management practices for land application of animal waste, human waste, or industrial waste, including a requirement for a treatment, storage, operation, and management plan that is incorporated by reference into the permit.

! *River corridor protection*. Under state law, protection of river corridors and other critical natural resources is to be accomplished through comprehensive planning at the local level. Localities in Georgia are required to develop comprehensive plans if they wish to receive and maintain the status of "qualified local government" in order to participate in certain state financial assistance programs.[17] These plans must contain the minimum environmental criteria set out by EPD to protect large rivers from the impacts of human activities on land immediately adjacent to the river.[18] Each local government with a protected river in its jurisdiction is directed to adopt a river corridor protection plan which meets minimum planning standards established by the Department of Natural Resources.[19] Further, the river corridor protection standards must be incorporated into a local ordinance.

! *Total Maximum Daily Loads*. Under section 303(d) of the Clean Water Act states must list impaired waters and provide that information to USEPA. Further, states must develop total maximum daily loads for certain pollutants for the impaired waters identified in the section 303(d) report. The state must then ensure that the TMDLs are met by point and nonpoint sources alike. In Georgia, a 1997 consent decree after litigation initiated in part in the Coosa watershed by the Coosa River Basin Initiative, started the TMDL identification and implementation process in the state. The draft Georgia 2000 list of waters under section 303(d) was submitted March 2, 2000 to USEPA.[20]

Assistance-Oriented Nonpoint Source Programs

This section describes a number of the technical assistance, cost-share and voluntary programs that address nonpoint source water pollution in the Coosa watershed. It is not an exhaustive list, but provides a brief description of programs that have influenced activities and water quality in the watershed.

! *Agricultural Incentives to Protect Sensitive Lands.* Incentive programs offer a combination of rent payments and cost-share assistance covering 50-100 percent of the expense of the specific conservation practices or restoration activities. Incentives to shift agricultural production from sensitive lands and to restore them to more natural conditions mainly are provided through four federal programs, the Conservation Reserve Enhancement Program, the Wetlands Reserve Program, the Environmental Quality Incentives Program (EQIP), and Section 319 financing under the federal Clean Water Act. In the Coosa watershed, EQIP and Section 319 funding are the two most common programs used to manage nonpoint source pollution. The Wetlands Reserve Program and the Conservation Reserve Program are less commonly used, partly because eligible land is not as abundant as in other parts of Georgia and partly due to rising land values making landowners reluctant to enter into long term conservation agreements.

! *Forestry Best Management Practices.* Forestry is subject to the Georgia Water Quality Control Act, but exempt from erosion and sedimentation control permit programs, provided that best management practices are used. Education and training focus on proper installation and maintenance of BMPs to minimize or eliminate nonpoint source pollution from forestry activities.

! *Watershed Assessments.* Georgia has a relatively recent policy that any locality asking for an environmental permit from the state that facilitates growth and development, such as a wastewater permit or a water withdrawal permit must conduct a watershed assessment before receiving the permit.[21] There are 30 assessments currently taking place around Georgia.

! *Adopt-A-Stream and Citizen Monitoring.* Georgia Adopt-A-Stream is a volunteer network of citizens and local governments that monitor water quality and conduct water body enhancement activities. Volunteers in the Georgia Adopt-A-Stream program and in other citizen programs monitor and record water quality providing valuable information to help citizens, the state, and localities understand both point and nonpoint pollution discharge sources, types, and quantities.

Discussion and Analysis

River Corridor Protection and Local Comprehensive Planning

Georgia establishes corridors along selected rivers as critical natural resource areas. The Conasauga, Oostanaula, Etowah and Coosa Rivers of the Coosa watershed are all state-designated protected river corridors. State law requires the Department of Natural Resources to develop minimum standards for the "protection of the natural resources, environment, and vital areas of the state, including, but not limited to, the protection of mountains, the protection of river corridors, the protection of watersheds of streams and reservoirs which are to be used for public water supply, for the protection of the purity of ground water, and for the protection of wetlands, which minimum standards and procedures shall be used by local governments in developing" comprehensive plans.[22]

The minimum standards for watershed protection include buffer areas along streams and reservoirs, land development densities, and land use activities.[23] Standards for protection of river corridors include natural vegetative buffer areas for a distance of 100 feet on both sides as measured from river banks.[24] Septic tanks and septic tank drainfields for non-single family residential developments are expressly prohibited within the 100-foot buffer. In addition, areas for receiving, storing, or disposing hazardous waste or hazardous materials, as well as solid waste landfills are prohibited within the buffer. Construction of single family dwellings with a two acre minimum lot size which comply with local zoning is exempt from the river corridor protection requirements.[25] The statute gives local government the authority to exempt agriculture and silviculture consistent with BMPs from river corridor protection plans, but it does not require that agriculture and forestry be exempt.[26] The regulations, in contrast, treat agriculture and forestry as acceptable uses provided they do not impair the long term functions of the protected river or the river corridor.[27] It is not clear how EPD, DCA, and localities have dealt with this inconsistency.

In addition, at the discretion of local governments, mining and quarrying activities may also be exempted from river corridor protection requirements, according to both the statute and the regulations.[28] Finally, local governments may exempt wildlife and fisheries management activities and wastewater treatment.

In 1990, when comprehensive plans were first required, the Georgia Department of Community Affairs (DCA) asked local governments to address how they would handle river protection both in the comprehensive plan and in a 5-year short-term work-plan. DCA required that local governments also develop ordinances, but did not yet enforce this requirement.

As most governments complete their first 5-year short term review, DCA is requiring ordinances for all of the environmental criteria under the Comprehensive Planning Act. Localities that do not pass ordinances according to the time schedule set out by DCA will loose their qualified local government status until the ordinances and other planning requirements are in place. A loss of the qualified local government status means that a locality is no longer eligible for state environmental permits, state grants, and state loans.

All but four of the localities in the Coosa River Watershed contain river corridors for which ordinances must be developed.[29] Cherokee, Floyd, Gordon, and Forsyth Counties and the City of Rome recently have adopted river corridor protection ordinances. The other localities that require the ordinances have due dates in the year 2000 or beyond. All local governments in the Coosa River Watershed have had qualified local government status. Recently the qualified local government status for a few localities in the Coosa watershed was put on hold pending review of river corridor and wetlands protection ordinances that were submitted after their deadline had passed.

The river corridor ordinances typically follow the model ordinance developed by EPD, with a few exceptions. For example, the City of Rome widened the required buffer for tributaries specifically identified in the ordinance to 40 feet.[30] Localities tend to combine enforcement of the river corridor protection ordinances with erosion and sediment control inspections for new construction. For example, in the City of Rome when a developer asks for a zoning verification prior to receiving a building permit, he or she also receives verification of the buffer requirements. The Building Inspector must enforce the buffer during the inspection process. To date, no enforcement actions have taken place in this area under this ordinance in Rome.

Construction Activities: Erosion and Sedimentation Control

Certain activities under the Erosion and Sedimentation Act are unconditionally exempt from permitting requirements; these include: surface mining, granite quarrying, home gardening and landscaping, *agricultural and forestry operations*, and any other project carried out under the technical supervision of the Natural Resources Conservation Service. Other activities are partially exempt, meaning they do not need to obtain a permit prior to land disturbance, but BMPs must be followed. Such activities include: construction of single-family residences, construction or maintenance of roads by state or local governments, and land-disturbing activities conducted by public utilities.

Under state law, activities on sites of one and one-tenth acres or less are exempt from both permitting and BMP requirements unless such activities occur within 200 feet of lakes or perennial streams, in which case landowners must prevent sediment from moving beyond the property boundaries. Local governments with delegated authority for erosion and sediment control can, however, elect not to exempt activities on small sites from permitting or BMP requirements.

Local governments, with oversight by the EPD and the area Soil and Water Conservation District (SWCD) are primarily responsible for implementing the Erosion and Sedimentation Act. The Erosion and Sedimentation Control Act directs local governments to enact erosion and sedimentation ordinances. These ordinances are reviewed by EPD and, if consistent with state law, the local government is granted the authority to issue permits for land-disturbing activities. In much of the state, local governments have adopted erosion and sedimentation ordinances and have been given the authority to issue and enforce permits for land-disturbing activities.[31]

The state Soil and Water Conservation Commission (SWCC) has instituted program oversight to help municipalities to implement the erosion and sediment control requirements. In cases where a locality consistently does not implement the program, the SWCC can ask EPD to take back the issuing authority. This has happened or been threatened in several cases in the Coosa River Basin Watershed – as is described in the description of the revised Cherokee County program below.

Reports of suspected violations of the Erosion and Sedimentation Control Act are made to the body that issued the permit. Except in localities with strong inspection programs, the complaints typically come from citizens. In cases with a local issuing authority, if the violation continues, the complaint is then referred to the SWCC. The SWCC typically will write a letter to the issuing authority asking it to solve the violation. In the Coosa watershed region (Region 1), the SWCC received over 1000 complaints in 1999. Approximately half were successfully handled with a phone call or a letter to put the locality on notice. Of the remaining complaints, approximately 1 in 4 needed a site visit from the SWCD before they were remedied. Approximately 10% are ongoing problems that need stricter enforcement measures. If the situation remains unresolved after the appropriate SWCD has exhausted site visits, letters, and action by the locality, the complaint is then referred to EPD for enforcement.

Enforcement, by EPD or the issuing authorities, consists of administrative orders, injunctions, and civil penalties. Civil penalties for non-certified counties and municipalities are authorized up to $2,500 per day. Permit revocation, suspension, modification, and bond forfeiture constitute additional enforcement sanctions.

In addition to erosion and sediment control, Georgia also has a NPDES permit program regulating discharge of stormwater from construction activities. As of 1997, the program was undergoing judicial review and implementation had been halted pending the results of that review. According to a February 2000 settlement of cases challenging the stormwater NPDES permit system, EPD will issue new stormwater permits for construction sites of 5 acres or more sometime in summer 2000.[32]

Erosion and Sediment Control in Cherokee County -- As a metro-Atlanta locality, Cherokee County is one of the fastest growing areas in the nation. The constant development and construction poses an enormous erosion and sediment control challenge to the county. In 1997, Cherokee County was put on warning by the EPD that if it did not do a better job as an issuing authority under the Erosion and Sediment Control Act, the program would be taken away and assumed by EPD. At the time, Cherokee County had an erosion and sediment control ordinance based on the model ordinance prepared for localities by the SWCC. However, there was very little implementation of the ordinance. Cherokee County hired new inspectors and developed a teamwork approach to enforcement of the erosion and sediment control provisions, that included housing all erosion and sediment control permitting in a single department. With the backing of elected officials, they restarted their program with a zero tolerance policy for non-compliance.

Currently, in Cherokee County, developers submit a plan in order to be granted a permit to clear, allowing trees to be cut and erosion control devices to be put in place.[33] The area is then inspected, after which the developer can receive a land disturbance permit. Once the projects start, inspectors drop by regularly, as much as several times a week, depending on the nature of the project. To build a house, the builder must apply for an erosion control permit in order to cut trees and install the erosion control devices. Once the site is inspected, the builder can receive the erosion control permit. Only with the erosion control permit can the builder receive a building permit from the Building Inspections Department.

Cherokee County counts on cooperation with its County Marshall and Magistrate to implement the zero tolerance enforcement policy. Inspectors can and regularly do issue stop work orders in the field as soon as they spot a violation. These stop work orders last until the violation is fixed, sometimes a day, sometimes a week or longer. One recent stop work order lasted a year. If inspectors find a problem that is actively impacting a waterway, they ask the County Marshall to issue a field citation. The developer must then go in front of the County Magistrate. Under this zero tolerance policy, compliance rates in the county are rising.

Agricultural Pollution

Education, technical assistance, and financial incentives are the primary mechanisms used to prevent agricultural nonpoint source pollution. Agricultural programs emphasize the use of best management practices (BMPs) to minimize or eliminate erosion, sedimentation, and runoff of other pollutants. Georgia has developed recommended BMPs for a wide range of agricultural activities. The Georgia Soil and Water Conservation Commission (SWCC), in conjunction with the 40 Soil and Water Conservation Districts (SWCD) and with other cooperating agencies, such as the U.S. Natural Resources Conservation Service (NRCS), conducts a statewide education and technical assistance program to promote the adoption of BMPs.

Agricultural operations fall under the Georgia Water Quality Control Act which sets water quality standards that may not be violated by agricultural runoff. Enforcement actions are rarely if ever brought for nonpoint source pollution from activities that do not need any type of permit. Only land application systems and concentrated feeding operations need permits in Georgia under the Water Quality Control Act regulations.

All agricultural operations are exempt from the Erosion and Sedimentation Control Act, and may be exempt from the River Corridor Protection Act provided the activities are consistent with BMPs.

In general, the SWCC and the NRCS believe that enforcement techniques do not work well with farmers, finding that family farms respond best to assistance, voluntary programs and training. However, the growing number of concentrated animal feeding operations (CAFOs) and other large scale hog and chicken farms is causing the state agencies to think about permitting and enforcement techniques for these types of farming operations.

Concentrated Animal Feeding Operations (CAFOs) – The DNR Board recently promulgated rules on permits for swine feeding operations with over 300 animal units.[34] New rules covering dairy and poultry are expected in late 2000. The rules allow no discharge from the swine feeding operations into surface waters of the state. By October 31, 2001, the owner or operator of an existing swine operation is required to submit a comprehensive nutrient management plan to EPD. The owner or operator of a new operation must have the plan in place before receiving the permit. Any failure to comply with any condition of the regulations will be deemed a violation of the Water Quality Control Act and may be punishable in accordance with the penalties provided for in the Act.

Prior to these rules, EPD had a memorandum of understanding (MOU) with the NRCS and the SWCC about best management practices for land application systems (LAS) on concentrated animal feeding operations. The MOU was first developed in 1981 and revised in 1991. Under the MOU, EPD issued new large CAFOs (over 1000 animal units for swine, dairy, and poultry) with land application system permits. There were only 13 permitted CAFOs statewide. The MOU is still in place for those facilities not covered by the new regulations (dairy and poultry), although its implementation is currently on hold pending new regulations that are expected later in 2000 concerning dairy and poultry. The SWCC has seen an increased interest among CAFOs in improving their pollution prevention systems: the SWCC reports an increase in calls from CAFOs requesting assistance with best management practices since the new regulations were proposed.

Agricultural land application systems require permits. Violations by farmers are handled by SWCC in the first instance to try to bring the system into compliance. If there is a fish kill or public health hazard associated with the violation then EPD will consider enforcement actions. EPD issues approximately 2 - 3 consent orders a year concerning agricultural land application system violations. A review of the EPD published enforcement orders found that no EPD enforcement orders had been proposed or finalized between 1998 and early 2000 in any of the localities of the Coosa watershed for violations of agricultural LAS permits.

Resource Conservation and Development Program (RC&D) – Most of the Coosa watershed is covered by the Resource Conservation and Development Program of USDA. Jurisdictions have banded together to form "Council Areas" that then identify the most important resource issues, set priorities, develop projects, and look for funding. Funding under Section 319 of the federal Clean Water Act is commonly used in the RC&D program and the projects carried out are often water quality demonstration projects. Water quality demonstration projects are a common component of the education and technical assistance program. Assistance with implementation of total resource management systems or of specific BMPs is provided in identified priority project areas. Assistance can include, for example, funding to agricultural producers for water related BMPs. These demonstration projects are implemented through cost-sharing programs with a combination of federal funds and state, local, and producer matching funds. The Coosa watershed is divided into three Council areas that would impact the basin. The Chestatee - Chattahoochee RC&D program covers the area around Lake Lanier and the Upper Coosa watershed. The Limestone Valley RC&D progra covers most of the Northwest to the Alabama line. The Rolling Hills RC&D program picks up west of the metro-Atlanta area.

Environmental Quality Incentives Program (EQIP) Priority Areas – The federal EQIP program focuses on priority areas where agricultural improvements will help meet water quality objectives and where financial assistance is available from state or local governments. EQIP will offer five to 10-year contracts providing incentive payments and cost-sharing for selected conservation practices, including grassed waterways, filter strips, buffer strips, and others. The SWCC encourages fencing out of streams to keep animals from watering directly in streams by providing financial assistance to build alternative watering locations. The Coosa watershed includes two EQIP priority areas: Armuchee Creek in Floyd, Walker and Chatooga Counties and the Conasauga River. Under EQIP a local workgroup sets conservation priorities for the area that are funded in part through EQIP and in part through other programs such as Section 319 funding. The types of practices that are typically priorities in the Coosa watershed concern livestock waste, alternative water supplies, and grazing practices.

Forestry Water Quality Programs

In 1978, EPD designated the Georgia Forestry Commission (GFC) as the lead agency in coordinating the forest water quality portion of the overall state program.[35] The Forestry Nonpoint Source Pollution Technical Task Force developed recommendations that forestry activities be carried out in accordance with voluntary best management practices.[36]

Because soil characteristics and slope vary greatly across the state, BMPs have been tailored to each of Georgia's four regions. The Coosa watershed falls in both the Piedmont and the Mountains regions. Individual BMPs have been developed for eight groups of forestry activities: streamside management zones, stream crossings, access roads and their construction, timber harvesting, site preparation, reforestation, forest protection (prescribed burning, fire lines, and chemical fire retardants), and chemical treatments. BMPs include recommended activities as well as practices to be avoided. The Georgia Forestry Commission issued revised BMPs for commercial forestry, specifying new widths for streamside management zones, a refined list of streamside scheduled recommended activities within those zones, and other BMPs in January 1999.[37]

Since 1991, the GFC has carried out BMP compliance surveys in each river basin. The surveys identify any problems with implementation of best management practices. The compliance surveys function as a compliance audit. The GFC acts on findings of non-compliance by notifying the landowner and working with them to bring the forestry operation into compliance. In the Coosa River Basin, the 1992 compliance survey found that most of the forestry operations were in compliance. For example, in the Coosawattee River Basin where 3 sites involving 260 acres of forestry operations were evaluated, 72% of road miles, 96% of harvested acres, and 98% of prepared sites were in compliance. In the Etowah River Basin where 10 sites involving 1161 acres of forestry operations were evaluated, 89% of road miles, 95% of harvested acres, 69% of prepared sites, and 100% of regenerated areas were in compliance. GFC carries out the compliance surveys every two years.

In addition to helping the GFC identify problems, the compliance survey is used to target educational needs in the forestry community. GFC has carried out 3 or 4 workshops since 1995 in the Coosa River Basin. In general they have found that sites on U.S. Forest Service land are almost always in compliance, industrial forestry operations are generally in compliance, while private landowners are less often in compliance. For example, in the Etowah River Basin, as discussed above, on private lands compliance for roads was 72% while on forest industry lands, compliance for roads was 93%.

Complaints about actual or potential water quality impacts from commercial forestry activities first are referred to the GFC. Complaints from citizens are common, particularly in the counties with growing populations where landowners are living closer to forestry operations than in prior years. After notifying the forest owner, the GFC district coordinator makes a field inspection to determine if BMPs were followed, if there is a potential for water quality problems and who was responsible for the activity (e.g., site preparation or timber harvesting). If problems exist, the GFC will work with the responsible parties until the problem is corrected or until it determines that the issue cannot be resolved. GFC estimates that it has a 90% success rate in obtaining compliance through working with the responsible parties.

In situations where the GFC cannot gain satisfactory compliance, the case is turned over to EPD for action under the Georgia Water Quality Control Act.[38] For example, in Lumpkin County, a case was turned over to EPD for enforcement where the developer was trying to use the forestry exemption from the Erosion and Sedimentation Control Act to cut timber without a permit in order to sell the land for development. Under the Georgia Water Quality Control Act, if during logging the water quality standards in streams are exceeded and best management practices are not in place, EPD may bring enforcement actions. EPD actions include issuing a warning to the responsible party or landowner, undertaking water quality investigations to document nonpoint source impacts, referring the complaint to USEPA or initiating enforcement action as provided by the Georgia Water Quality Control Act. Typically, enforcement action will be taken by EPD where there is a demonstrable violation of water quality standards and the responsible party has a history of causing chronic water quality problems. There have been a few cases, including in the Coosa River Basin, where EPD assessed civil penalties.

Surface Mining Runoff Control

There is some surface mining in the Coosa River Basin Watershed, primarily stone or granite quarries and extraction of fill materials. An application for a surface mining permit must be accompanied by a mining land use plan consistent with the land use in the area of the mine. The plan also must specify activities for control of erosion and sedimentation and disposal of refuse, as well as provisions for reclamation of the affected land. The mine operator is responsible for completion of the plan. In addition to the land use plan, surface mining operators must file a surety bond with EPD for land reclamation activities. EPD surface mining permits incorporate best management practices for protecting water quality. Site operation, objectives of the land use plan, and estimated cost factors for completion of the mining land use plan are subject to review and evaluation by EPD at least every five years. Following the review, bonding amounts will be adjusted as needed to ensure adequate funding for site reclamation.

In practice, EPD Land Protection Branch will take actions under both the Surface Mining Act and the Water Quality Control Act to enforce permits and to remedy violations of water quality standards. The Branch typically uses the Surface Mining Act with its lesser fines of $1,000 per violation and $500 for each day of violation thereafter for minor or one-time violations,[39] and uses the Water Quality Control Act with its higher penalties for major or continuing violations. EPD enforcement typically starts with one to two notices of violation, a consent order if the problem is not fixed, and an administrative order if the violation is severe or if the consent order does not achieve compliance. EPD can also request penalty hearings connected to the administrative order.[40]

New Water Quality Enforcement Policy

As of 1998, EPD has become more vigilant about bringing enforcement actions in the case of violations of the Water Quality Control Act for certain areas, including the Coosa River watershed.[41] These enforcement actions are primarily brought in urban areas against violations of NPDES permits and sanitary sewer overflows. In practice, the Georgia Water Quality Control Act is rarely used to enforce against nonpoint source pollution. According to the published EPD enforcement orders, as of 1998, only two enforcement orders were brought in the Coosa watershed for nonpoint source violations of the Water Quality Control Act. These were both in Forsyth County and included an unauthorized discharge from a hog farm in September 1998 and an unpermitted land disturbing activity violation by a developer in January 1999.[42] The bulk of the enforcement orders in the Coosa watershed were for violations of NPDES permits and for sewer system overflows. There was one enforcement order concerning violation of a LAS permit.

In late 1997, the Georgia Department of Natural Resources (DNR) Board in reaction to several high profile water quality problems in high growth areas, asked EPD to identify areas of the state where the water systems were under stress. At the time there were a significant number of sanitary sewer overflows due to high growth in the metro-Atlanta region straining the existing sewer systems. EPD identified the Coosa River Basin, the Chattahochee River Basin, the Tallapoosa River Basin, and the 14 county metro-Atlanta region. The DNR Board asked EPD to come up with a strategy for addressing and resolving the water quality problems in these areas. Based on EPD's report, the DNR Board issued a resolution that any violation of the Georgia Water Quality Control Act, especially in the metro-Atlanta region, would be addressed by immediate enforcement action.[43] Although this theoretically covers both point and nonpoint source violations, it is primarily intended to address permit violations (NPDES, LAS, pretreatment, and CSOs) and sanitary sewer overflows. The resolution is silent about enforcement of violations of water quality standards. In addition, inspection and surveillance is required to be increased in the designated areas. This "zero tolerance" policy is also seen as an added incentives for localities and others to invest in compliance.

Total Maximum Daily Loads (TMDLs)

As the process for determining TMDLs continues in Georgia, ensuring compliance with pollutant load allocations on the part of nonpoint sources on impaired waters will most likely require that some type of enforceable mechanism be implemented. However, the TMDL process in Georgia has not yet reached a stage where TMDLs are being enforced. Under the current implementation schedule, the EPD will provide public notice of TMDLs for the Coosa watershed by June 30, 2003.[44]

Watershed Assessments

Under a new Georgia policy, any locality asking for an environmental permit from the state that facilitates growth and development, such as a wastewater permit or a water withdrawal permit must conduct a watershed assessment before receiving the permit.[45] There are 30 assessments currently taking place around Georgia, creating an additional pool of information about nonpoint sources of water pollution.

Under the watershed assessment guidelines, the permit applicant must identify the point and nonpoint sources of water pollution, carry out predictive modeling and land use scenarios based on future growth, and propose solutions to address current and future water quality problems.[46] The watershed assessment must be carried out for the entire service area covered by the local authority. The assessment includes the gathering of existing information about a watershed and its point and nonpoint pollution sources. This information is then used to evaluate current and predicted future water quality problems and to recommend short and long term solutions, including a list of corrective actions. The local government can use this information to develop a watershed protection plan, parts of which will be incorporated into an NPDES discharge permit or other enforceable program.

In the Coosa watershed, the Regional Development Councils, the City of Rome, various other localities, and EPD have undertaken a regional watershed assessment. The City of Rome initiated this approach when they were considering applying for a wastewater treatment facility expansion permit. Although they will only apply for the permit in another 2 or 3 years, the City decided to initiate a watershed assessment that would meet the watershed assessment policy and go beyond it by undertaking an assessment of a much larger area than required in the policy. The hope is that a regional assessment will avoid each wastewater and drinking water service area conducting small assessments in an uncoordinated fashion and that the assessment will provide the localities with new information concerning sources, types, and quantities of point and nonpoint source pollution.

Georgia Adopt-A-Stream and Citizen Water Monitoring

At the state-level, the Georgia Adopt-A-Stream program is coordinated through the Environmental Protection Division's Non-Point Source Program, which provides technical advice and information. In addition, there are five Regional Training Centers located at colleges and universities throughout the state. Currently, there are 225 Adopt-A-Stream groups in Georgia, with two in the Coosa Basin (City of Rome and Conasauga). In addition, through the Coosa River Basin Initiative and Alabama Waterwatch, citizens get test kits and monitor water quality on a monthly basis. This data is sent to Alabama Waterwatch which compiles the information for the whole Basin. Currently USEPA accepts Alabama Waterwatch data and Georgia EPD accepts Adopt-A-Stream data, but the two programs are coordinating their protocols and training practices in the hope that all the monitoring data will be accepted by both EPA and EPD.

Conclusions

Georgia has a variety of nonpoint source control programs operating in the Coosa watershed, including cost-share, technical assistance, voluntary, and enforceable programs. The

Coosa watershed reflects many of the trends and nonpoint source pollution programs found throughout Georgia.

The Coosa watershed shows that local erosion and sedimentation control programs such as the Cherokee County program can make a difference in water quality through a zero tolerance enforcement policy, adequate staff and funding, consolidation of the program in one office, and cooperation with local law enforcement agencies. The Coosa watershed also shows that the state requirement that local governments incorporate environmental criteria, such as river corridor protection criteria into their comprehensive plans and local ordinances strengthens local protection of these resources.

At the same time, the review of the Coosa watershed shows that while Georgia has worked to have best management practices in place for management of nonpoint source pollution from agricultural and forestry operations, it is very difficult to bring enforcement actions in these areas. The only enforcement "hook" is the Water Quality Control Act. Although fish kills and overt violations of water quality standards could be used in theory to enforce against nonpoint source pollution from agriculture and forestry operations, in practice, EPD has recorded only one enforcement order between 1998 and early 2000 for the Coosa watershed for agriculture and none for forestry operations. In addition, with very different agencies responsible for technical assistance and enforcement, coordination of these efforts can be very difficult.

The use of enforceable mechanisms has increased slightly over the past, although the primary nonpoint source control mechanisms are still technical assistance, cost-share and voluntary programs. In most cases, regulatory programs seemed understaffed with few financial resources at their disposal. Technical assistance programs are well-established for farmers and foresters, although those programs also seemed understaffed. Cost-share programs rely almost exclusively on federal funds, with few apparent state financial assistance programs.

Georgia seems to divide the traditional areas of nonpoint source pollution management, such as family farms and forestry operations, from newer sources, such as land development and concentrated animal feeding operations. In the traditional areas of nonpoint source pollution management, the state and the localities depend almost exclusively on traditional nonpoint source management mechanisms, such as best management practices and one-on-one resolution of compliance problems for family farms and forestry operations. When dealing with newer sources, such as erosion and runoff from sprawling development, sanitary sewer overflows, and concentrated animal feeding operations, permitting and the use of enforceable mechanisms are becoming more common. The state government also is pushing localities to protect their local water resources, using the carrot of maintaining "qualified local government" status to encourage the development of environmental ordinances, such as river corridor protection ordinances or threatening to assume authority for local programs such as erosion and sedimentation control.

The Georgia programs maintain a sharp distinction between entities providing assistance in coming into compliance (the soil and water conservation districts and the forestry commision), and enforcers (the EPD and the localities). This leads to complexity in coordination. It is understandable that the organizations with technical assistance as their primary function have a harder time referring their constituents to EPD or the localities for enforcement actions. Enforcement has been more likely where the entity providing technical assistance is also the enforcer, such as erosion and sedimentation control from land development, although even here state oversight has been important.

Endnotes

1. In addition to the sources cited, the following individuals were interviewed by telephone or in person: Todd Bethune, Environmental Specialist, NW Regional Environmental Protection Division Office; Rick Brooks, Planning and Environmental Management Division, Georgia Department of Community Affairs; David Bullard, Municipal Permitting Unit, Environmental Protection Division; Jeff Cown, Land Protection Branch, Environmental Protection Division, Mike Creason, Permitting Unit, Environmental Protection Division; Jim Dixon, Assistant City Manager, City of Rome; Kevin Farrell, Unit Coordinator, Watershed Planning and Monitoring Program, Environmental Protection Division; Beth Fraser, TMDL Community Program, Georgia Legal Watch; Frank Green, State Water Quality Coordinator, Georgia Forestry Commission; Larry Hedges, Chief, Nonpoint Source Pollution Unit, Environmental Protection Division, Department of Natural Resources; David Howerin, Planning Director, Coosa Valley Regional Development Center; Suzanne Hutchinson, County Attorney, Gordon County; Richard King, Resource Specialist, Georgia Soil and Water Conservation Commission; Mitch Lawson, Intern, Coosa River Basin Initiative; Martha Little, Director of Planning, City of Rome, Rome Floyd County Planning Commission; Meredith Mason, County Engineer, Cherokee County; Richard Oliver, Natural Resources Conservation Service; Lee Ross, Director, Water Department, City of Rome; Heather Seckman, Basin Coordinator, Coosa River Basin Initiative, Jim Sommerville, Compliance and Enforcement Unit, Environmental Protection Division; Pamela B. Traylor, District Conservationist, Natural Resources Conservation Service, United States Department of Agriculture; and Bill White, Program Manager, Rural Water Resources, Georgia Soil and Water Conservation Commission.
2. Georgia Rivers and Streams Partially Supporting Designated Uses and Not Supporting Designated Uses, Section 303(d) of the Clean Water Act report, February 29, 2000.
3. American Rivers, 1999.
4. Based on the cumulative area for the Etowah, Coosawattee, Upper Coosa, and Oostanaula Rivers.
5. The localities in the Coosa Watershed include Bartow, Chatooga, Cherokee, Cobb, Dade, Dawson, Fannin, Floyd, Forsyth, Fulton, Gilmer, Gordon, Lumpkin, Murray, Paulding, Pickens, Polk, Walker, and Whitfield counties and the City of Rome.
6. *Nonpoint Source Management in Georgia: An Update of the Georgia Nonpoint Source Management Program*, Georgia Environmental Protection Division, April 1998.
7. *Nonpoint Source Management in Georgia: An Update of the Georgia Nonpoint Source Management Program*, Georgia Environmental Protection Division, April 1998.
8. Only Dawson and Dade Counties do not have any permitting surface mining operations.
9. Georgia Water Quality Control Act, O.C.G.A. 12-5-29 [Makes it unlawful to discharge excessive pollutants (sediments, nutrients, pesticides, animal wastes, etc.) into waters of the State in amounts harmful to public health, safety, or welfare, or to animals, birds, or aquatic life or the physical destruction of stream habitats.]
10. Georgia has a provision at O.C.G.A. 12-5-30(b) that requires a permit for anyone seeking to "erect or modify facilities or commence or alter an operation of any type which will result in the discharge of pollutants from a *nonpoint source* into the waters of the state, which will render or is likely to render such waters harmful to the public health, safe, or welfare, or harmful or substantially less useful for domestic, municipal, industrial, agricultural, recreational, or other lawful uses, or for animals, birds, or aquatic life." But the regulations limit this provision. They require only "written approval" and use of BMPs under the circumstances described in the statute, but do not require a permit unless the Director of the Environmental Protection Division (EPD) "has issued one to the

same person for a point source discharge." Ga. Comp. R. & Regs. 391-3-6-.06(3). This provision is not used to regulate nonpoint source dischargers.

11. Erosion and Sedimentation Act of 1975, O.C.G.A. 12-7-1 *et seq.* (as amended through 1995).
12. *Environmental Management Requirements for Stream and River Corridors in Georgia*, University of Georgia, 1997.
13. Georgia Surface Mining Act of 1968, O.C.G.A. 12-4-70, 12-4-75.
14. Georgia Surface Mining Act of 1968, O.C.G.A. 12-4-72.
15. Georgia Surface Mining Act of 1968, O.C.G.A. 12-4-75.
16. Rules for General Permit Land Application System Requirements, Chapter 391-3-6-.19, (Rules of Georgia Department of Natural Resources, Environmental Protection Division).
17. Georgia Comprehensive Planning Act of 1989, O.C.G.A. 50-8-1 *et seq.*
18. Rules for Environmental Planning Criteria, Chapter 391-3-16-04 [Criteria for River Corridor Protection], (Rules of Georgia Department of Natural Resources Environmental Protection Division).
19. Environmental Criteria Promulgation, O.C.G.A. 12-2-8, Georgia Comprehensive Planning Act of 1989, O.C.G.A. 50-8-7.1, 50-8-7.2, Rules for Environmental Planning Criteria Chapter 391-3-16-.04 [Criteria for River Corridor Protection] (Rules of Georgia Department of Natural Resources Environmental Protection Division).
20. Georgia Department of Natural Resources letter of March 2, 2000 to Ms. Beverly Banister, Water Management Division, USEPA.
21. *Planning for Domestic Wastewater Systems*, Georgia Department of Natural Resources, Environmental Protection Division (February 1999).
22. O.C.G.A. 12-2-8(b).
23. O.C.G.A. 12-2-8(d)-(f).
24. O.C.G.A. 12-2-8(g)(1)(A).
25. O.C.G.A. 12-2-8(g)(1)(A).
26. O.C.G.A. 12-2-8(g)(2)(D), "Local governments *may* exempt from the planning process: (...) (D) Specific forestry and agricultural activities from buffer and set-back criteria in accordance with the following conditions..." [emphasis added].
27. Rules for Environmental Planning Criteria, Chapter 391-3-16-.04(4)(f) [Criteria for River Corridor Protection] (Rules of Georgia Department of Natural Resources Environmental Protection Division, 1998), "River Corridor Protection Plans, developed by local governments, *shall provide the following acceptable uses* of river corridors (...) 1. Timber production and harvesting (...) 6. Agricultural production and management (...)" [emphasis added].
28. O.C.G.A. 12-2-8(g)(2)(B).
29. According to Georgia Department of Community Affairs records, there are no protected river corridors in Dade, Paulding, Polk, and Walker Counties.
30. Code of the City of Rome, Section 23-67 Environmental Protection Requirements.
31. *Environmental Management Requirements for Stream and River Corridors in Georgia*, University of Georgia, 1997.
32. Department of Natural Resources, Environmental Protection Division, Permit No. GAR 100000 *for settlement purposes only*, February 7, 2000.
33. Cherokee County Soil Erosion and Sedimentation Control Ordinance (amended 1995).
34. Rules for Swine Feeding Operation Permit Requirements, Chapter 391-3-6-.20 (Rules of Georgia Department of Natural Resources Environmental Protection Division).
35. O.C.G.A. 12-6-2.

36. Green, Frank, *Georgia Forestry Commission's Forest Water Quality Program* (Georgia Forestry Commission).
37. *Georgia's Best Management Practices for Forestry*, Georgia Forestry Commission, January 1999.
38. Georgia Water Quality Control Act, O.C.G.A. 12-5-29 [Makes it unlawful to discharge excessive pollutants (sediments, nutrients, pesticides, animal wastes, etc.) into waters of the State in amounts harmful to public health, safety, or welfare, or to animals, birds, or aquatic life or the physical destruction of stream habitats.]
39. Georgia Surface Mining Act, O.C.G.A. 12-4-83.
40. Georgia Surface Mining Act, O.C.G.A. 12-4-83(b).
41. Permitting, Compliance and Enforcement Program Enforcement Management Strategy for the Sensitive/High Growth Areas in the Chattahoochee River Basin, Coosa River Basin, Tallapoosa River Basin and the Metro Atlanta Area.
42. EPD Enforcement Orders: http://dnrnet.dnr.state.ga.us. (As of March 20, 2000).
43. Georgia Department of Natural Resources Resolution, January 26, 1998.
44. Georgia Department of Natural Resources letter of March 2, 2000 to Ms. Beverly Banister, Water Management Division, USEPA.
45. *Planning for Domestic Wastewater Systems*, Georgia Department of Natural Resources, Environmental Protection Division (February 1999).
46. Environmental Protection Division Guidelines for Watershed Assessments for Domestic Water Systems, Rev. 2/24/99.

Maine Case Study

Summary

In controlling nonpoint source pollution Maine relies on a combination of enforceable mechanisms and technical and financial assistance programs.[1] The Maine Department of Environmental Protection (DEP) is the lead agency for both enforceable and voluntary nonpoint source pollution control mechanisms. Although Maine gives priority to educational and technical assistance efforts in promoting compliance, it does have authority under several statutes to institute formal enforcement proceedings. Under the Natural Resources Protection Act, the Mandatory Shoreland Zoning Act, the Site Location of Development Law, the Stormwater Management Law, the Erosion and Sedimentation Control Law and a general discharge prohibition under the Protection and Improvement of Waters Act, DEP has enforceable authority to address a wide range of nonpoint source problems, including those resulting from development, forestry, and agricultural activities. In enforcing these laws, DEP officials follow a policy of progressive compliance, attempting first to educate, then obtain voluntary compliance, then pursuing administrative consent orders, filing a civil case in district court and ultimately referring the case to the Attorney General's Office. Most cases are resolved early in the progressive compliance process without advancing to more formal enforcement measures.

One of the unique aspects of Maine's nonpoint source efforts is the important role played by municipalities in setting, promoting compliance with, and enforcing nonpoint source laws. Under the Mandatory Shoreland Zoning Act, municipalities are required to adopt a local ordinance consistent with and no less stringent than the state standards. The Growth Management Law allows municipalities to adopt growth management programs, which may include drafting local ordinances to implement the program. Several communities have, for example, drafted their own phosphorous control ordinances. The Subdivision Law also requires that communities consider nonpoint source pollution prevention in reviewing subdivisions for approval and when adopting any subdivision regulations. Local code enforcement officers (CEOs) certified by the state and appointed by the local planning board implement and enforce these ordinances, with the state retaining oversight authority.

Maine has created a number of innovative institutional mechanisms that support the development and implementation of enforceable authorities as well as traditional forms of technical and financial assistance. For instance, municipalities may form watershed districts to protect and restore water quality. Watershed districts are authorized to undertake research, develop and implement plans, and implement municipal ordinances that protect water quality.[2] To date, only one watershed district has been formed under these provisions. Another mechanism the state has recently created to strengthen its enforcement presence is the position of lakes enforcement and compliance officer. This official is responsible for pro-actively seeking out potential nonpoint source violations in targeted watersheds. The targeted watersheds include priority lakes and other local water bodies. If a violation is found, the officer follows the same progressive compliance strategy as other DEP officials. Another unique institutional mechanism that supports enforcement in Maine is the Rule 80k certification program that trains and authorizes local code enforcement officers and

DEP staff who are not lawyers to bring cases in district court. By reducing the backlog of cases to be processed by the Attorney General that must be heard in district court, this mechanism has increased the likelihood of enforcement in the eyes of the regulated community.

Maine also has several sectoral laws that provide additional enforceable mechanisms to address nonpoint source pollution. The recently amended Forestry Practices Act now requires separation areas for clearcuts, and harvest plans must describe actions that will be taken to protect riparian zones and minimize erosion into water bodies. Statewide timber harvesting standards for riparian areas are currently being proposed which would transfer authority to Maine Forest Service (MFS) from DEP and the Land Use Regulation Commission.[3] The Department of Agriculture, Food, and Rural Resources (DAFRR) also has a number of enforceable tools under the Right to Farm Law, the Cull Potato Law and the Action Against Improper Manure Handling. DAFRR consider its authority to revoke protection against enforcement of local nuisance laws under the Right to Farm Law one of its most effective enforcement tools. The Right-to-Farm law protects farmers from enforcement of these laws if they are in compliance with best management practices; when this protection is revoked the farmer may be subject to enforcement under nuisance provisions.

In addition to the wide array of enforceable mechanisms, Maine has a number of non-enforceable mechanisms to address nonpoint source pollution, including cost sharing, technical assistance, and land conservation programs. DEP administers the state's Nonpoint Source Program, which coordinates the nonpoint source activities of all state agencies, designates priority rivers and lakes, and funds grants for nonpoint source and watershed mangement projects. The funding for grants under the program comes from the federal 319 program and a state bond initiative. Grants for nonpoint source projects are also available through other federal programs, primarily EQIP.

Local lake and river associations play a role in nonpoint source programs in Maine. These associations address the concerns of a specific waterbody. In the Sebago Lake watershed, the Lakes Environmental Association (LEA) is one of few regional lake associations in the state that is working on more than one lake. Generally the associations conduct outreach on BMPs and will refer landowners to technical assistance and cost share programs such as the Soil and Water Conservation Districts (SWCD). Representatives of the groups may on occassion also accompany DEP and local CEOs on enforcement activities.

Sebago Lake Watershed

In order to obtain a better understanding of the role of the enforceable mechanisms in Maine's overall strategy to address nonpoint source pollution, and particularly the coordination and interplay between enforcement and voluntary efforts, this report examined these issues in the context of the Sebago Lake watershed. This watershed was selected because a diversity of governmental and non-governmental actors are involved in nonpoint source control in the area using a wide range of tools.

The Sebago Lake watershed is the largest of five subwatersheds that make up the Casco Bay Watershed, occupying 640 square miles of the 985 square miles of the Casco Bay watershed. It is also the primary source of water used by the Portland Water District. The Portland Water District is a quasi-municipality that provides water and wastewater services to Portland and surrounding communities.[4] Sebago Lake covers approximately 100 square miles and supplies one-third of the state's water. The water from Sebago Lake is piped to 180,000 consumers in the greater Portland area. The watershed is considered pristine; water quality is high enough that the district received a waiver from drinking water filtration requirements. The lake is one of the state's priority lakes for nonpoint source efforts due to the potential for high population growth in the area, use for water supply, outstanding clarity of the lake, high use of the lake, and outstanding fishery resources.[5]

Approximately 10 percent of the state's population lives in the watershed. The lakes are used for recreation and are the site of many seasonal cottages. Land in the watershed is 90 percent forested. Until spring 1999, a pulp and paper mill operated in the area and most of the pulp that was harvested in the watershed was used at the mill. It is unclear whether this harvesting will continue now that the pulp mill closed, but there continues to be lumber harvesting for board. Agricultural operations are scattered throughout the watershed.

The Sebago Lake watershed falls within the organized portion of the state. In the unorganized portion of the state the Land Use Regulation Commission (LURC) regulates many of the sources of nonpoint source pollution.

Enforceable Mechanisms

The following section provides an introduction to the enforceable mechanisms studied in detail in this report. The mechanisms were selected from the universe of mechanisms described in the *Almanac*[6] because of their relevance to the Sebago Lake watershed, their importance to the Maine program, or their innovative nature.

! *Protection and Improvement of Waters Act.* Maine's Protection and Improvement of Waters Act prohibits any person from directly or indirectly discharging or causing to be discharged any pollutant without first obtaining a license.[7] This prohibition (§413) includes nonpoint source discharges. The term "discharge" encompasses "any spilling, leaking, pumping, pouring, emptying, dumping, disposing or other addition of any pollutant to water of the State." The term "pollutant" is broadly defined and includes "rock, sand, dirt and industrial, municipal, domestic, commercial or agricultural wastes of any kind." Erosion from agricultural activities may be exempt if an erosion and sedimentation control plan or conservation plan has been certified for the land and the agricultural activities are in compliance with the plan or federal and state funds are not available for implementation.

Whenever there is a soil discharge, DEP usually cites this authority in addition to the other statutory violations cited. Although there have been some instances of this provision being relied upon to negotiate consent agreements or to take a violator to court, this prohibition normally serves as a threat to bring a violator into compliance.

! *Mandatory Shoreland Zoning Act.* The Mandatory Shoreland Zoning Act[8] protects areas within 250 feet of the normal highwater line of any great pond, river or saltwater body, within 250 feet of a coastal wetland or the upland edge of a freshwater wetland, and within 75 feet of the highwater line of a stream if the stream is the outward stream of a great pond or below the confluence of two perennial streams shown on a USGS topographic map. The law requires setbacks, limits on timber harvesting, and vegetation buffers between buildings and shorelands.[9] Municipalities are required to adopt a local ordinance consistent with and no less stringent than the state standards. Alternatively, the state may impose these requirements. A local CEO and the local planning board are responsible for implementing and enforcing the ordinance. If the town fails to act, the state may enforce against the town and/or the violator.[10] To encourage municipal enforcement, which can be expensive, there is a state fund to reimburse towns for their enforcement costs, which is currently unfunded.

! *Natural Resources Protection Act.* The Natural Resources Protection Act (NRPA) prohibits certain development activities without a permit if the activity will take place in, on, or over any protected natural resource or will result in material or soil being washed into coastal and freshwater bodies and wetlands.[11] Examples of activities that may be regulated by NRPA include construction and renovation projects, culvert construction, and wetland fill. Permit standards address erosion and sedimentation control, protection of wildlife habitat, and water quality. Routine projects may qualify for a "permit by rule" with standard setback and erosion control requirements. Eighty-five percent of all NRPA development permits are issued under permit-by-rule provisions. Permit-by-rule standards have been developed for 13 activities. Activities affecting wetlands or intended to alter wetlands require more detailed individual permits. Various activities, including farming activities and forest management, are exempt from permitting requirements provided other regulatory requirements are met. NRPA is normally enforced by DEP, but DEP may delegate enforcement authority to qualified municipal CEOs as well.

NRPA is administered by the DEP Bureau of Land and Water Quality, Division of Land Resource Regulation. The Division has staff in all four regional offices. In most of the offices, all of the staff do compliance inspections; only the enforcement staff, however, resolve violations.

! *Site Location of Development Law.* The Site Location of Development Law regulates large scale development by requiring a permit from DEP prior to construction, operation, sale or lease.[12] There are two permit triggers: 1) development creating more than three acres of impervious cover (buildings or building parts dating prior to 1975 are exempt from the permitting requirement); and 2) development of a residential subdivision involving more than 30 acres or 15 lots.[13] Development in the unorganized areas of the state subject to the jurisdiction of the Maine Land Use Regulation Commission is exempt from regulation under this law as are developments protected under certain other regulatory programs.

! *Stormwater Management Law.* The 1996 Stormwater Management Law requires a permit in two situations. In watersheds designated as "most at risk," a permit is required if there will be 20,000 square feet of new impervious area or five acres of open, disturbed area. In watersheds "not at risk," a permit is required if there is one acre of new impervious area or five acres of disturbed area.[14] Stormwater standards address both water quality and water quantity. Water quality standards include standards for phosphorous and suspended solids, and apply only in watersheds considered at risk. The law does not apply within the unorganized areas of the state. Certain forest management and farming activities, as well as single family home construction and federally-permitted industrial facilities are exempt from the law. Department of Transportation (DOT) construction projects are exempt if they are constructed pursuant to the stormwater quality and quantity standards set forth in the Memorandum of Agreement between DOT and DEP.

! *Erosion and Sedimentation Control Law.* Pursuant to this law unreasonable erosion of soil and sedimentation from construction activities beyond the project site or into a protected natural resource must be prevented.[15] Activities in the unorganized portion of the state as well as certain forestry management and agricultural activities are exempt from this requirement.

This law was enacted in 1996 and became effective July 1, 1997. No civil or criminal enforcement of these provision was allowed prior to July 1, 1998 if a good faith effort to comply was demonstrated. In a 1998 report to the state legislature, DEP recommended that the Erosion and Sedimentation Control Law be made retroactive so it would apply to chronic, historical erosion control problems. The legislature acted on DEP's recommendation to require any person who owns property that is subject to erosion as a result of filling, displacing, or exposing soil prior to July 1, 1997 to take measures to prevent unreasonable erosion of soil or sediment into a protected natural resource. This requirement applies as of July 1, 2005 to property in watersheds most at risk and as of July 1, 2010 to other property.[16]

! *Comprehensive Planning and Land Use Regulation Act, and Subdivision Law.* The Comprehensive Planning and Land Use Regulation Act (also known as the Growth Management Law) allows municipalities to adopt local growth management programs. These include comprehensive plans and implementation programs.[17] The towns also have home rule authority to take these actions.[18] Although towns are not required to develop a plan or implement a program, there are financial incentives (discussed below) to do so. The majority of the nearly 500 cities and towns in Maine have a comprehensive plan, although not all of the plans have been implemented.

The Subdivision Law provides another legal framework for towns to implement growth management plans. Towns must consider several criteria relating to nonpoint source pollution control when reviewing a subdivision for approval and when adopting any subdivision regulations. The proposed subdivision must not result in undue water or air pollution.[19] If the proposed subdivision is within the watershed of any pond or lake or within 250 feet of any wetland, great pond or river, it must not adversely affect the quality of that body of water or unreasonably affect the shoreline of that body of water.[20] Also, the long-term cumulative effects of the proposed subdivision must not unreasonably increase a great pond's phosphorous concentration during the construction phase and life of the proposed subdivision.[21] The State Planning Office (SPO) provides model ordinances and guidelines for subdivision ordinances and grants for developing them. Most towns currently have subdivision ordinances on the books.

The local CEO conducts all enforcement of the Growth Management Law and Subdivision Law. SPO trains and certifies code officers on administering and enforcing the Mandatory Shoreland Zoning Act, the Growth Management Law and the Subdivision Law. They also provide training on the Stormwater Management Law.

! *Forest Practices Act.* During 1999 changes were made to the Forest Practices Act and rules that provide for enforcement activities related to non-point source pollution. Under the old version of the law, the Commissioner of Forestry was authorized to promulgate rules establishing forest practices for clearcuts and forest harvests to ensure adequate regeneration, and set performance standards for clearcuts including standards to minimize soil erosion and protect water quality.[22] Management plans conforming to these standards were required for clear-cuts of 50 acres more. Landowners were required to give notice of harvesting operations. None of these requirements or the initial regulations implementing them provided a significant opportunity for formal enforcement. The requirement that the landowner provide notice prior to commencing operations was simply a notice requirement, not a permitting requirement which could be reviewed. The initial regulations for the management plans did not have substantive performance standards linked to nonpoint source pollution or water quality. The clearcut standards were not developed to address nonpoint source pollution. Under the old law, harvest plans were not reviewed in advance or kept on file.

Under the new harvest plan[23] requirements for clearcuts greater than 20 acres, there are 13 minimum elements required, including an assessment of the soil erosion potential of the harvest area and a description of the actions that will be taken to protect riparian zones and minimize erosion into water bodies.[24] For clearcuts of 20 - 75 acres, the plans must be developed and made available for inspection. For clearcuts over 75 acres, the plans must be reviewed and approved. The Forest Policy and Management Division Field Team Leaders or their field staff will review the plans for sufficiency.

Although not specifically aimed at addressing nonpoint source pollution, Maine's Forest Practices Act also requires that there be a separation zone between clearcut areas if the harvesting activities result in a clearcut larger than five acres. In this case, regeneration standards must be met as well.[25]

! *Agricultural Requirements (Right to Farm Law, Cull Potato Law, Manure Law).* The Right to Farm Law provides protection against nuisance suits if a farmer complies with BMPs. However, the Commissioner of the Department of Agriculture, Food, and Rural Resources (DAFRR) is required to investigate all complaints involving farms. If the source of the problem is found to be a nuisance caused by failure to use BMPs, the Commissioner shall determine the changes needed in the farm to comply with BMPs and prescribe site-specific BMPs for the operation.[26]

The Cull Potato Law prohibits cull potato piles between June 10 and October 1 each year and requires immediate and proper disposal of any cull potatoes generated during that time period.[27] The rules establish standards for disposal during the prohibited periods by various methods. Violations of this law may be identified during inspections or through complaints made from farmers or DEP to DAFRR.

In 1998 the legislature enacted a Action Against Improper Manure Handling Law (or the Manure Law) which requires farms with more than 50 animal units or that receive 100 or more tons of manure a year to implement a certified nutrient management plan.[28] New farms with more than 300 animal units must hold a livestock operations permit issued by DAFFR. Beginning December 1, 1999, manure spreading is prohibited between December 1 and March 15. Failure to develop or implement a nutrient management plan or to comply with a permit are offenses punishable by civil forfeiture of up to $1,000 plus $250 per day; winter spreading of manure is punishable by civil forfeiture of up to $1,000 for every day that spreading occurs.

Assistance-Oriented Nonpoint Source Programs

Nonpoint Source Program

In 1991 Maine created its Nonpoint Source Program.[29] The Maine Department of Environmental Protection (DEP) is the lead agency for the program. DEP is charged with cooperating with DAFFR, Department of Conservation (Maine Forest Service), Department of Transportation, Department of Human Services (Division of Health Engineering), Department of Marine Resources, and the State Planning Office to ensure a coordinated approach to nonpoint source pollution control for agriculture, forestry, transportation, and development. DEP also coordinates with other state, federal and local governmental agencies, non-governmental organizations, and citizens.

The program promotes the use of "best management practice guidelines" (BMPs) to address nonpoint source pollution. Four state agencies (DAFFR, Maine Forest Service, Transportation and DEP) are charged with developing and implementing best management practice guidelines to prevent water pollution from nine types of activities: agriculture, forestry, development, resource extraction, transportation facilities and support, chemical use and storage, solid waste disposal, marine industries, and hydrologic modification.

In 1997 the comprehensive watershed protection program was established.[30] The Maine Land & Water Resources Council (L&WRC) works with other state agencies to develop and implement nonpoint source strategies, conduct scientific research and water quality surveys, implement regulatory and nonregulatory approaches, coordinate with other governmental and non-governmental organizations, and establish priorities for directing resources. DEP and the State Planning Office (SPO) co-chair the Maine Watershed Management Committee which implements this program. The committee developed the "Nonpoint Source Priority Watershed List" to be used by federal, state and local authorities in directing resources. Under Maine's nonpoint source grant program, projects that aim to protect or restore waters on the priority watershed list are given priority. Other state and federal agencies also direct discretionary resources towards activities to improve waters on the list.

The Division of Watershed Management administers the nonpoint source program and relies on voluntary cooperation. They help prepare nonpoint source watershed surveys, identify specific nonpoint problems of concern and develop voluntary projects to address these problems.

Nonpoint Source Grants Program/319 Funding

Maine's Nonpoint Source Grants Program, administered by DEP, provides financial assistance to help public entities, including state agencies, Soil and Water Conservation Districts (SWCDs), regional planning councils, watershed districts, municipalities and nonprofit organizations, conduct projects to reduce or prevent nonpoint source pollution.[31] Maine solicits proposals for projects annually. Four types of projects may be submitted for consideration: a watershed survey project; a nonpoint source implementation project; development of a watershed management plan; or implementation of a watershed management plan. Priority is given to projects that benefit nonpoint source priority watersheds. DEP program staff serve as technical advisors to the projects. In 1999, 30 project were funded. There are currently over 100 active projects, including several in the Sebago Lake watershed.

The Nonpoint Source Grants Program is financially supported by the state bond funds for planning or implementing a "watershed management plan" and U.S. Environmental Protection Agency 319 funds.[32] In 1999, $500,000 of state bond funds went to the Nonpoint Source Grants Program. Approximately 50 percent of the 319 funds received by the State since 1992 have been used for Nonpoint Source Program Grants.

Nonpoint Source Training and Resource Center

The Nonpoint Source Training and Resource Center managed by DEP provides publications, videos and training on stormwater management and erosion control, and coordinates the Voluntary Contractor Certification Program, which provides education and certification to contractors engaged in earth moving activities.[33] Certification entitles the contractor to reduce the mandatory waiting period for permit-by-rule projects. Certification may be revoked in the event of a formal enforcement action against the contractor. The Center also serves as a clearinghouse for nonpoint source and BMP information.

Volunteer Lake Monitoring Program

Maine supports one of the nation's oldest and largest citizen-based environmental monitoring program, known as the Volunteer Lake Monitoring Program (VLMP). VLMP is an independent non-profit corporation with close links to DEP. Volunteer efforts provide a substantial amount of data on lake water quality. In 1999, volunteers made 4,450 visits to 400 lake basins in Maine to monitor for clarity through Secchi disk readings and in some cases to measure for dissolved oxygen. To ensure that volunteer data is of high quality, DEP has developed quality assurance standards for volunteers, and all volunteers must be certified at least every two years (every year for those monitoring dissolved oxygen). The data gathered by volunteers is used by Main state agencies, including DEP, Department of Conservation, and SPO, as well as lake associations and educational institutions. The data is used by DEP specifically for its phosphorous review programs, to determine the lakes at risk for the stormwater protection program, and identifying priority watersheds. The program is supported by 319 funding.

USDA/NRCS/SWCD Programs

Soil and Water Conservation Districts are the primary providers of nonpoint source related technical training programs sponsored by USDA, DEP, DAFRR, and MFS. Resource specialists conduct watershed and BMP demonstration projects which include technical assistance, education and outreach, BMP installation and demonstration, and workshops for targeted audiences. NRCS and the SWCDs provide cost share assistance for BMPs through the EQIP program. The Nonpoint Source Priority Watershed List is part of the criteria for EQIP cost-share funds for landowners adopting conservation measures to benefit water resources. Maine receives approximately $1 to $2 million in EQIP funding annually to provide cost-shares to landowners, and funding is primarily used for animal waste management and erosion control purposes.

Land for Maine's Future

The Land for Maine's Future (LMF) program seeks to acquire lands of state significance which "make a substantial and lasting contribution towards assuring all of Maine citizens, present and future, the traditional Maine heritage of public access to Maine's land and water resources or continued quality and availability of natural resources important to the interests and continued heritage of Maine people."[34] The program is primarily funded through a $35 million state bond authorized by voter referendum in 1987.[35] A LMF affinity credit card which features two local natural scenes has provided approximated $40,000 in revenue for the program from royalties to date. In addition to these sources, the program receives some Farm Bill funding for acquiring farm development rights and money from the Land and Water Conservation Fund and Forest Legacy Program when it is available. The Land and Water Conservation Fund provides funding to federal, state, and local governments for acquisition of private lands for conservation and recreation purposes. The Forest Legacy Program supports acquisition of conservation easements on forest lands by state and federal governments.

To select land for acquisition, the program uses a scoring system to ensure that the purchase will provide protection of undeveloped land and preservation of ecological integrity of riparian, wetland, coastal, and other systems. The program will only purchase natural, unbuilt lands. The LMF Board receives proposals for acquisitions which are ranked by a subcommittee of the board according to scoring criteria. The criteria address the prevention of deterioration of natural resource systems. The top ten percent are then considered by the full Board, which considers criteria like geographic distribution and other more intangible qualities. The top choices are appraised, and the designated negotiator deals with the seller. Once the seller has agreed to the appraisal value, the acquisition is subject to a public vote by the Board.

The program requires that agricultural land be managed under a conservation plan that meets

NRCS standards for erosion control and nutrient management. Management plans are also required for non-agricultural lands that receive access-improvement funds for trail development, parking lot construction, and boat launch facilities (or other public access features). The managing agency can receive up to five percent of the appraisal value in access improvement funds. The program is not regulatory so must rely on the managing agencies to ensure that the properties are maintained in a way that will not cause damage to ecosystems.

One site enrolled in the LMF program is located in the case study watershed. On Sebago Lake, the Department of Conservation holds an easement on a 35 acre tract of lakefront land.[36] The land has 980 feet of high quality sand beach and 35 acres of white pine and hardwood forests. It was identified as one of the eight outstanding beaches in Maine's organized towns in an inventory prepared for the Maine Critical Areas Program. The town of Raymond manages the property as a park with a day-use area for swimming and picnicking.

State Revolving Loan Fund

Maine also offers nutrient management loans which can be used for building storage and handling facilities for manure and milk room wastes, including equipment that is used solely for this purpose. The loans are available through the Finance Authority of Maine (FAME) and have an effective interest rate of 2% for up to 20 years.[37] The program offers low interest loans of up to $350,000 for installation of manure storage facilities to assist facilities in complying with the Nutrient Management Law and other DAFRR rules. CAFOs may not be eligible for loans under this program.

Forestry Programs

For forestry stewardship and best management practices, funding is available from the Stewardship Incentive Program (SIP) and Forestry Incentive Program (FIP). SIP funding comes from the US Forest Service, and is provided to landowners with forest management needs through the Maine Forest Service. The funding can be used to develop recreational trails or improve wildlife habitat. FIP funding through USDA Natural Resources Conservation Service has not been as significant. However, a large ice storm in 1998 devastated area forests and special "Ice Tree money" was available to repair and improve forests. Some EQIP money is used for erosion controls on forest harvests.

The state of Maine also has a tree growth program which provides a tax break for forest land under a management plan. The elements of the management plan vary based on the goals for the land (*i.e*, preservation v. timber harvest) but usually address erosion concerns and identify state sensitive areas, including shoreland zones.[38]

Watershed Districts

Municipalities are authorized to form watershed districts "to protect, restore and maintain the natural functions and values," of wetlands, rivers, great ponds, bays, and estuaries.[39] A watershed district is authorized to conduct research on water quality in the district; implement natural resource protection, management, and restoration plans; work with municipal officials and state agencies to encourage enforcement or enactment of ordinances or laws that will improve or protect water quality in the district; and enter into agreements with municipalities to administer municipal land use ordinances.[40] The Cobbossee Watershed District is the only district in the state formed under these provisions.

Discussion and Analysis

This section discusses the implementation and enforcement of the mechanisms described above and describes the relationship between these mechanisms and traditional cost-share and technical assistance programs. Examples drawn from the Sebago Lake watershed are provided when appropriate; however, innovative statewide enforcement practices are also described. Maine's land use and development provisions are discussed first, with a focus on DEP and local CEO roles in enforcement and technical assistance. Regulation and technical assistance for forestry and agriculture are discussed more briefly.

Land Use and Development

Many of Maine's mechanisms to control nonpoint source pollution are directed at land use activities, both during and subsequent to development. Many laws specifically target development activities, for instance the Site Location of Development Law and NRPA, the Erosion and Sedimentation Control Law, the Stormwater Management Law, the Mandatory Shoreland Zoning Act, and local subdivision and growth control regulations. These laws employ permit mechanisms, BMPs, performance standards, and critical area protection provisions. Additionally, the Protection and Improvement of Waters Act does not specifically address development but serves more generally as a backup to protect water quality through general discharge prohibitions. These laws apply not only to construction activities, but also to activities conducted by landowners on their properties. For instance, in some areas of Maine landowners commonly violate shoreland zoning provisions by removing trees within 75 feet of the shoreline to create a view of the lake. Another common landowner violation of land use laws occurs when landowners add sand to their lake front beaches. In addition to ensuring compliance with the array of related laws, both DEP and the local CEOs, the principal enforcement entities, provide technical assistance to landowners in complying with these laws. In the Sebago Lake watershed, laws regulating land development and use are the most commonly invoked of the laws regulating nonpoint source pollution due to the limited extent of agricultural and forestry operations in the area.

DEP Role Generally

As the lead agency in Maine for nonpoint source pollution concerns, DEP plays a major role in enforcement of related laws, primarily in the area of land use and development. The Water Resource Regulation Division and Land Resource Regulation Division of DEP have primary enforcement responsibility for the Protection and Improvement of Waters Act, Site Location of Development Law, Stormwater Management Act, Erosion and Sedimentation Control Law, and NRPA.

The Water Resource Regulation Division of DEP is primarily responsible for enforcement of point source pollution violations, but a small part of the enforcement efforts relate to nonpoint source pollution. Nonpoint source enforcement is generally triggered by complaints from citizens or lake associations. The four regional DEP offices handle the complaints. When a complaint is received in the regional office the department first determines if the complaint has merit. Next DEP will conduct a site investigation, although the timing of the inspection is based on the severity of the problem. For example, DEP will respond immediately to a severe violation. If there is not a potentially severe impact, DEP may schedule the inspection with other trips to the area or after priority complaints are addressed.

If a problem is documented DEP discusses the necessary corrective action with the property owner. DEP sometimes accompanies representatives of voluntary programs to visit a site. DEP's presence provides a glimpse of the threat of enforcement if violators do not voluntarily comply. DEP staff report that they usually have only to write a letter to the violator to obtain compliance. For severe violations or uncooperative violators, DEP will propose an administrative settlement. DEP must clear the proposed settlement with the Attorney General's office before presenting it to the violator. The Board of Environmental Protection gives final approval to all settlements.

DEP staff also have the authority to go to District Court. Most people will settle after these cases are filed. The last option is to refer the case to the Attorney General's office who will file an enforcement action in Superior Court. Cases referred usually involve developers and medium sized commercial operations, not homeowners. Follow-up inspections are done as needed.

Another example of DEP's enforcement approach is that of the Land Resources Regulation Division's enforcement activities under NRPA. DEP's first priority when a *permit* violation is discovered is to request the violator to correct the problem. If the problem is not corrected, DEP will send the permit holder a notice of violation. For significant violations (even in some cases where the party is being cooperative), there are three enforcement mechanisms that DEP can use. DEP can file a civil case in District Court (only a few have been filed); it can refer the case to the Attorney General's office (only a few have been referred); or it can enter into an administrative consent agreement, the most common mechanism used. Most violations are resolved voluntarily, and if there have been no prior problems, usually no penalty is imposed. Voluntarily resolved cases are recorded to track repeat violations. In addition to enforcing this law, DEP will refer people to other programs for technical assistance if there are complicated requirements.

DEP will coordinate its efforts with the Department of Marine Resources (DMR). DMR monitors shellfish for pollution and can close shellfish beds. It conducts shoreland surveys and gives DEP information on pollution sources. However, DMR generally calls the local plumbing inspector before calling DEP in response to a problem believed to originate from overboard discharge systems. The departments conduct joint sanitary surveys to identify malfunctioning septic systems. In one situation in Vinalhaven, an island where there is no sewage treatment plant, DEP and DMR discovered numerous illegal discharges. DEP and DMR looked at the entire watershed for each cove including houses on and behind the shore. In bringing these illegal discharges under control they were able to open a substantial acreage for shellfish harvesting.

In response to a recommendation of the Great Ponds Task Force, the Maine legislature recently created a new full-time position for enforcement and compliance on lakes. The initial goal for the enforcement position was to boost compliance with state and local laws by improving CEO capacity. This position is currently held by an individual based in the Southern Maine Regional Office. He focuses his attention exclusively on a few ponds and watersheds that are identified in coordination with the Division of Watershed Management. The selection process first involves identifying several priority watersheds to be covered. Several "non-priority list" great ponds within the geographical area of the identified priority watersheds are also selected for attention. DEP hopes to be proactive at these lakes to prevent them from becoming a priority watershed. As described above, there are other field and enforcement officials in the office that have primary responsibility for responding to citizen complaints and answering compliance questions.

The lakes enforcement and compliance official goes out on his own initiative, not only in response to complaints, to patrol by boat, car and foot looking for violations of land use laws including NRPA, the Site Location of Development law, the Erosion and Sedimentation Control Law, and the Stormwater Management Law. The focus on a few lakes allows local people to see an increase in DEP presence. This situation is in contrast to traditional enforcement work which has almost exclusively responded to complaints. The large geographical scope of problems and limited resources have prevented DEP from using the proactive inspection and enforcement strategy of the lakes official statewide. The official also devotes considerable time to education and outreach, advising government officials and the public on how to use BMPs He works very closely with CEOs, serving as a liaison between towns and DEP shoreland zoning staff. He focuses on small towns where limited resources may prevent the CEO from being aware of the latest information from DEP. In these towns, the CEO may work only part time or may lack expertise on specific issues.

Sometimes requirements under NRPA, the Site Location of Development Law, and the Mandatory Shoreland Zoning Act prohibitions overlap. The officer will address problems jointly with the CEO in this case since the CEO has responsibility for enforcing some of these laws. Both will agree on the action a violator should take and the deadline for compliance, and will jointly notify violator of the violation.

DEP provides financial support to local projects through its Nonpoint Source Program. DEP has funded these types of projects in the Sebago Lake watershed through the Nonpoint Source Program and 319 funds. In 1999, the Portland Water District received approximately $100,000 in 319 and state matching funds to encourage the use of BMPs with demonstration projects in subwatersheds around Sebago Lake. Certain DEP units also provide technical and engineering assistance in dealing with nonpoint source pollution concerns from land development and land use activities. DEP also provides funding to small communities to build individual septic or small cluster septics where there is no municipal treatment.[41]

The Portland Water District falls within the jurisdiction of the Southern Region of DEP. In this area, DEP actively enforces NRPA, the Site Location of Development Law, and the Protection and Improvement of Waters Act. The Erosion and Sedimentation Control Law may be used if water is directly affected. NRPA and the Protection and Improvement of Waters Act address erosion and sediment control concerns as well. DEP also inspects for compliance with the stormwater program.

In the entire Southern Region last year, 234 complaints were received and 224 complaints resolved. Not all of these complaints were related to nonpoint source problems. Fifteen were resolved through formal penalties, one through a judicial proceeding, and 106 cases were resolved voluntarily. In 98 cases no violation was identified. Four cases were referred to other agencies. One case involving a minor discharge from a gravel pit was referred to the Attorney General's office, mostly because of ownership issues of the site and not because of the nature of the violation.

DEP regional offices inspect facilities permitted under NRPA. Of the facilities permitted under "permit by rule" in the Southern Region in 1998, 40 percent were inspected in 1999. "Permit by rule" facilities are only inspected for two years after permit issuance, usually after construction to ensure that the site is stabilized. Sites issued individual permits under NRPA and under the Site Location of Development are also inspected by the licensing staff. One hundred percent were inspected in 1999. The licensing staff will refer violations to enforcement staff.

The Southern Region works with other agencies, including the SWCDs, local CEOs, the LEA, and the Portland Water District.[42] DEP receives complaints from LEA and makes site visits with them. Generally, other agencies do not refer complaints to DEP.

Local Code Enforcement

Local code enforcement officers are employed by municipalities to enforce the Mandatory Shoreland Zoning Act; the Growth Management Act; and plumbing, subsurface waste water and building standard codes.[43] Municipalities may also employ plumbing inspectors to inspect plumbing and other construction projects.[44] Plumbing inspectors approve permits for interior plumbing and subsurface waste disposal; some towns may task a CEO with these duties.[45] All CEOs and plumbing inspectors must be certified by the State Planning Office in their areas of responsibility.[46] Separate certifications are required for areas such as planning, plumbing, electrical, shoreland and 80k enforcement functions. In some cases, certification is required for subspecialities (e.g, indoor and outdoor plumbing). Recertification is required every five years.

Septic tank problems are a nonpoint source concern that DEP has regulated since the 1970s. Today, DEP serves as a backstop to local enforcement efforts and in response to a problem, DEP will generally call the town plumbing inspector or code enforcement officer. The municipally-appointed plumbing inspectors have the authority to act more immediately than DEP in response to plumbing or septic problems if there is a direct discharge that can be observed. If the plumbing inspector doesn't have the political support or isn't aggressive enough, DEP may act directly.

Local CEOs may be trained and certified to bring enforcement actions in district court. The District Court sets aside one day a month for hearing these cases. Maine officials describe this provision as a "velvet hammer" in promoting compliance. In the past people thought they could stall cases in the court system because cases might take years to be scheduled. Because the district court sets aside a day to hear these cases, it is more likely that a case against a violator will be heard quickly. Since violators are aware that their cases may be heard quickly under these provisions, they are more likely to cooperate at an earlier point in the compliance process.

In the Sebago Lake watershed, the local code enforcement officers conduct enforcement activities although most nonpoint source-related violations are resolved without resorting to formal enforcement. In one town, the local CEO has not had to go beyond informing a violator of a problem in order to achieve compliance. Property owners around the lakes generally want to protect their investments by keeping the lake clean. The local code enforcement officers from five towns (Casco, Raymond, Bridgton, Naples and Harrison) coordinate with LEA and the Portland Water District to coordinate strategies and exchange information. Information concerning violations is commonly received from neighbors who are acutely aware of the restrictions on development and other activities. This reduces the need to conduct inspections to monitor for compliance. When a complaint is received, the local CEO will check to see if there is a permit on file for the activity and will investigate the complaint initially by phone. If needed, a site investigation will also be conducted.

The local CEOs also rely heavily on education as an important tool for promoting compliance. The target audience for their outreach is broad; for instance, the CEOs conduct road shows for real estate brokers so brokers can educate new owners about nonpoint source regulations. CEOs often advise the public on restrictions and prohibited activities under the Mandatory Shoreland Zoning Act and NRPA.

The local CEOs will on occasion work jointly or turn a case over to the state to handle enforcement and work cooperatively with them. One major case in the late 1980s involved a subdivision with a 72 unit complex which ultimately was shut down. The subdivision was built on a wet, low property back from the shore. The engineering calculations and construction techniques for stormwater retention during floods and storms did not work correctly, and while the project was under construction the dams broke and a large sediment plume went into the water. LEA joined the CEO and state against the developer. The local CEO issued a stop work order which gave the state and LEA time to bring other orders and actions. The developer eventually ended the project.

Growth Management Law Implementation

Local CEOs are responsible for enforcing municipal ordinances adopted pursuant to the Comprehensive Planning and Land Use Act (or the Growth Management Law). For 13 years, SPO through the Growth Management Program has provided grants to towns to develop and implement comprehensive local growth management plans as well as technical assistance. When a town requests a grant, it agrees to develop the plan in accordance with the state goals and guidelines outlined in the Growth Management Law. SPO has seven staff who work with towns on developing comprehensive plans. Several guidelines for the comprehensive plans address nonpoint source pollution. One guideline directs that plans should "Protect, maintain and, when warranted, improve the water quality of each water body. . . and ensure that the water quality will be protected from long-term and cumulative increases in phosphorous from development in great pond watersheds."[47] SPO grants for implementing the plan include funding for drafting a phosphorus control ordinance. SPO and the eleven regional planning councils provide technical assistance to draft the ordinances. DEP also provides technical assistance in developing ordinances. For example, DEP developed a phosphorus control manual in the early years of the program that serves as a specific guide for drafting phosphorus control ordinances as well as local implementation of the Site Location of Development Law and Stormwater Management Law.

The financial incentive for implementing the plan is that "certified programs" get preference for certain state funding programs including Land for Maine's Future, community development block grants and other community development programs. SPO reviews plans to determine if they are consistent with the Growth Management Law. Other state agencies review the plans in the certification process. SPO also certifies town growth management programs based on a review of the plans and the implementation strategies. Implementation strategies include ordinance drafting and plans for capital improvements like sewer and fire protection. "Certified programs" become eligible for preferential funding, but SPO also encourages funding preference for aspects of certified plans.

Shoreland Zoning Implementation

DEP provides an oversight role in local enforcement of shoreland zoning laws. Three DEP staff members provide technical assistance to municipalities and help them enforce the Shoreland Zoning Program (one in Bangor and two in Augusta). DEP staff review local ordinances and make recommendations to the Commissioner of DEP who is responsible for approving all ordinances and amendments. The staff conduct general oversight of enforcement by municipalities. If towns continually fail to enforce their shoreland zoning ordinance, the state can take action against the town. In the last 13 years, however, only three towns have been taken to court. DEP attempts to resolve problems with towns before resorting to prosecution.

Some towns have gone beyond the minimum state standards in their local ordinances. For example, some have developed legislation on control of phosphorus in their local shoreland zoning ordinance or in separate legislation (*i.e.*, China, Manchester). Some towns have greater setbacks than required by the state (greater than 100 ft. v. 75 ft.). However, misunderstandings in measurement of the high water line have caused a problem in the application of the more stringent standards in at least one case. Another modification to the state standards implemented by towns in the Sebago Lake watershed is setting minimum lake frontage standards for high density development to prevent funnel lots and clustered housing on the shore. Most towns adopt the state minimum standards in their ordinances.

The federal Coastal Zone Management Program provides substantial funding for the staff and day-to-day operation of DEP's Shoreland Zoning Program. There has been no funding to date from agricultural programs or 319 grants.

There are some concerns about the ability of local municipalities to administer the program, particularly in the area of enforcement. Specific concerns include: the capacity of local administration, the influence of local politics and limited resources. Also, some municipalities do not have a local CEO or only have one that works part-time or is uncertified. Towns are concerned, on the other hand, about the lack of state funding to cover a CEO's time spent in state training programs as well as the possibility of having to pay for training courses in the future.

Portland Water District

The Portland Water District also plays a significant role in controlling nonpoint source pollution both through enforcement and voluntary programs. The PWD has authority to inspect all septic systems within 200 feet of the high water mark of Sebago Lake pursuant to the private and special law adopted in 1912. This law requires that notice in writing be provided to PWD prior to any construction in this lakeside zone.[48] The notification must include the method for disposing of waste and drainage, which may then be inspected by the trustees of PWD. The law also provides for the state board of health to make orders or regulations to protect Sebago Lake or any of its tributaries. Today PWD inspectors patrol only Sebago Lake. PWD may require the implementation of erosion control measures. The town CEOs who enforce this requirement under NRPA depend on PWD to identify problems around Sebago Lake. If people do not comply with their recommendations, the PWD refers the matter to the local CEO for formal enforcement, and then to DEP.

There is a 3,000 foot no trespassing zone around the two water intakes in Lake Sebago. No body contact with the water is allowed within two miles of the intakes. One PWD inspector stays at the boat launch area to enforce the no body contact rule by ensuring that boats are launched by people wearing boots. There is another inspector who patrols the area by boat to ensure there is no swimming, sailboarding, or jet skiing. Only boats with more than seven inches of freeboard are allowed in this zone.

In wintertime, the District has on staff a source protection coordinator, an inspector, an educator and two Americorps volunteers. In summertime, they add five positions, including two inspectors who provide information to property owners and look for failing septic systems.

As the water supplier, the Portland Water District also conducts outreach to homeowners and others on ways they can maintain good water quality in the watershed. In addition to inspection and enforcment activities, PWD conducts outreach activities at schools and camps, helping to identify problems and the BMPs to solve them. They will make small grants to schools and camps for low cost BMP projects such as building paths to the lake and planting vegetation. The District has received a Section 319 grant to work at Kettle Cove, a residential area with nonpoint source erosion problems. Work under this grant is directed at nonpoint source problems from camp roads. The District conducted a watershed survey to identify problems, and installed BMPs. They monitored the condition of the cove before the project began and will monitor after implementation of the BMPs.

Lakes Environmental Association

The Lakes Environmental Association (LEA) assists with compliance and technical assistance activities in the area of the Portland Water District. The Lakes Environmental Association is a nongovernmental regional lake association. LEA works on 37 lakes. Its direct service area includes the towns of Bridgton, Naples, Harrison, Denmark, and Sweden, as well as the rim of Sebago Lake. Indirectly, LEA works throughout the Portland region. The organization is 60 percent member-supported, and members include local residents and businesses. Additional funding comes from federal grants, endowment, the Portland Water District, and miscellaneous grants. LEA conducts educational programs in schools and the community and conducts water quality monitoring in all 37 lakes.

Six years ago LEA developed the Clean Lake Check Up program, which has since been adopted by the Portland Water District. The program involves visiting properties to provide an analysis of what the landowner can do to reduce pollutants entering the lake. Sometimes the visit will be at the request of the local CEO or through a referral from DEP; most visits are at the request of the landowner. Sometimes the visit will identify serious concerns and the code officer will also work with the landowner. LEA conducts 30 to 40 of these check ups annually. LEA also assists with full NRPA permitting or permitting-by-rule.

LEA formerly appeared before town planning boards and provided comments on applications for subdivision. For the past five or ten years, developers have been consulting with LEA during the planning stage so that LEA has input while the application is developed and no longer needs to provide comments in front of the boards. LEA has also drafted some local ordinances, either on request or on its own initiative. LEA drafted a phosphorous control amendment to the townwide zoning ordinance for the town of Sweden. Using DEP's phosphorous control manual, LEA developed a matrix which requires a buffer with a variable width based on the land area disturbed during development. LEA is considering developing a phosphorous standard for the Highland Lake watershed based on triggers dependent on water quality.

LEA has received two 319 grants. One grant three years ago provided funding for 19 demonstration sites in the Highland Lake watershed in conjunction with the SWCD and DEP. LEA also conducted a survey of the watershed during a heavy rain and identified the "Big Nine" spots with the worst stormwater problems. The office uses a GIS Hotspots model to predict where problems may be found. PWD has adopted the Hotspots model as well as the Clean Lake Check Up program for its own use. The two organizations work together and try to leverage their resources. For instance, LEA works with the Portland Water District on the Crooked River Initiative. The Crooked River is a major tributary to Sebago Lake. Long Lake and the Crooked

River come together at the locks to provide 80 percent of the flow to Sebago Lake. The initiative develops conservation easements on land near the river.

Forestry

Under forest harvest regulations, landowners are required to give notice to the Maine Forest Service (MFS) before beginning activities. Statewide, 5,000 - 7,000 notifications of harvest are received annually. MFS conducts regular inspections of forest harvest sites. Each ranger is assigned a unit. When a notice of intent to harvest is sent to the state, the information is sent to the unit officer. Inspections are based on priorities, such as operations in a salmon area, or an area where there is a sensitive feature (e.g. an eagle's nest) or where there have been past violations. MFS responds immediately to any complaints. MFS randomly selects sites for in-depth BMP monitoring to ensure that BMPs are properly applied. There are approximately 75 unit managers statewide. There is no state financial assistance for the preparation of harvest plans. Large landowners usually have foresters on staff and small landowners (under 100 acres) are exempt from the requirements. There are only nine field staff at MFS who have training to help in the preparation of harvest plans. Full forest management plans are still voluntary.

MFS has developed voluntary Best Management Practices for reducing erosion and sedimentation.[49] Since discharges are generally prohibited, the BMPs focus on eliminating "discharge" through site appropriate measures. There are two vehicles to disseminate information and provide training on BMPs. The nine field foresters conduct training with the certified logging professional program (a private course). Another mechanism is the Sustainable Forestry Initiative, an industry program in which MFS personnel serve as trainers. MFS disseminates information on BMPs by speaking at NRCS and SWCD workshops. MFS also conducts some landowner and logging site visits.

MFS has a Memorandum of Agreement (MOA) with DEP to coordinate enforcement. The MOA allows MFS field staff to identify and investigate water quality violations and to work out a solution; if no solution is achieved, they are required to turn the case over to DEP or the local code enforcement officer. In most cases, if a water quality violation is found, an enforcement action would be brought under the water quality laws rather than the clearcut laws and regulations. There has been some initial enforcement activity under forest harvest plan provisions. In one case the operator did not leave an adequate separation zone between the clear cuts and the plan did not reflect on-the-ground practice. This represented a violation of the Forest Practices Act. The violator received a letter of warning and then corrected the problem. Since a letter of warning was sent, a further violation would be treated as a second violation for penalty purposes. Violation of these provisions results in a civil penalty.[50]

DEP and LURC also have regulations addressing nonpoint source pollution from forestry activities and are currently considered the primary agencies for dealing with these problems. In order to harmonize the regulations in the organized and unorganized areas of Maine, statewide timber harvesting standards for riparian areas have been proposed.[51] They are based on current LURC and DEP shoreland zoning rules. These standards would be administered and enforced by MFS. Forestry activities in riparian zones would be exempt from regulation under LURC, the NRPA and Shoreland Zoning statutes if conducted in accordance with the new statewide standards.

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There is little forest harvest activity in the Sebago Lake watershed. Forestry activities are monitored by PWD by air twice a year to make sure buffers and BMPs are maintained.

Agriculture

Agricultural Compliance Officer

There is one Agricultural Compliance Officer for the entire state of Maine who works on compliance and enforcement activities for the Right to Farm Law, the Cull Potato Law, and the Manure Law. Enforcement activity under the "Right to Farm Law" is completely complaint driven; the state does not conduct regular inspections to identify compliance problems. About 75 percent of the complaints are made to DAFRR and 25 percent to DEP; all complaints are then forwarded to the Agricultural Compliance Officer. Once received, the officer investigates the site. If there is a problem, the officer recommends changes or BMPs to address the problem. Normally, the farmer has 30 days to begin making the changes. Other agencies may be brought in to identify and design appropriate BMPs. The Agricultural Compliance Officer will also visit the complaining party to explain the problem, and what changes have been recommended, although in some cases there are no changes recommended because the activity does not violate the law.

Regular follow-up inspections are conducted by the Agricultural Compliance Officer after the recommendations are given. If the requested changes have not been made, the complaint will be referred to DEP if it involves a water quality violation or to the Attorney General's office if it involves a nuisance. For example, in the case of a manure pile too close to a stream, the case would be referred to DEP to test the stream for a water quality violation. If a violation were found, the Agricultural Compliance Officer would work with DEP to develop the case. To date, no court cases have resulted from nuisance complaints referred to the Attorney General's office; most cases have been resolved with a letter from the Attorney General's office to the violator.

Another enforcement option is to revoke protection of the Right to Farm Law. Ordinarily if a farmer complies with BMPs, the farmer cannot be sued for creating a nuisance. Potential revocation of this protection has proven to be the most effective enforcement tool.

Violations of the Cull Potato Law are identified during inspections by the Agricultural Compliance Officer as well as through complaints from the public. When a violations is identified, the Agricultural Compliance Officer first tries to solve the problem voluntarily. If immediate action is not taken in a reasonable period (12 hours to 10 days depending on problem), the case is turned over to the Attorney General's office. Only the Attorney General can obtain fines. The Agricultural Compliance Officer also has the authority to have the state hire a contractor to remove the problem and then recuperate costs through the Attorney General's office. Under this law, there has been only one case where fines have been sought by the

Attorney General. Only a few cases have gone to the Attorney General's office and most are resolved early in the process.

The Agricultural Compliance Officer usually handles between 100 - 150 complaints a year. During calendar year 1998, 99 complaints were received (three related to noise problems, 21 for water quality problems, and 75 related to insect, odor, carcass and potato cull pile problems). Of these cases, the majority (92) were resolved by voluntary compliance. Three were resolved by MOUs between the department heads and the violator. One case was referred to the Attorney General's Office. In another case involving a farmer who refused to move a manure pile in a ditch, the Agricultural Compliance Officer pulled the protection of the Right to Farm Law, allowing the town to proceed with enforcement. Two cases are still active, with the officer working on developing BMPs.

The Agricultural Compliance Officer relies on NRCS and the SWCD to provide assistance in identifying and designing appropriate BMPs. He also uses the Extension Service at the University of Maine and occasionally a hydrogeologist from DEP and the state soil scientist. A farmer may apply for EQIP money to fund the implementation of BMPs. Section 319 funding is available for projects that will protect salmon habitat.

The Agricultural Compliance Officer also enforces the new Manure Law. Legal mechanisms in existence prior to the adoption of this law were ineffective in dealing with nonpoint source pollution from manure handling because it was difficult to identify a water quality violation during the spring melt. Enforcement of this law begins in the winter of 2000. It is not expected to play a major role in the Sebago Lake watershed, but in other areas of the state this law may generate some enforcement actions. Generally, the local CEO will refer people to other government agencies for help.

In the Sebago Lake watershed, there are scattered agricultural operations and these laws are infrequently invoked. The statewide Agricultural Compliance officer has not handled many problems in the Sebago Lake watershed. DEP is involved with some agricultural problems in the area. In most cases, DEP will only become involved if the Agricultural Compliance Officer determines that there is a water quality problem and that the farmer is not willing to implement BMPs. In one example near Waterford a pig farmer was expanding his herd and had runoff problems. The pigs were in the wetland near a stream. Because the farmer cooperated with DEP and SWCD the state did not resort to formal enforcement. If the violator had not cooperated, DEP reports that it would have initiated a formal enforcement action even if the violation was not severe.

Soil and Water Conservation Districts/NRCS

Although Soil and Water Conservation Districts and NRCS are primarily agricultural agencies, in areas of Maine the staff will provide technical assistance to anyone with erosion problems, regardless of the source. Lake associations often refer people to NRCS and the local SWCD for assistance with non-agriculturally related problems, such as camp roads. DEP and DAFRR will also refer people to NRCS. Most often, DEP refers farmers to the SWCD if they are eligible for cost-share or technical assistance. The SWCD may suggest that a farmer contact DEP for technical assistance, but will not inform DEP if they suspect a farmer is violating a law. The local SWCD and NRCS staff distance themselves from enforcement efforts generally. NRCS notifies landowners if they observe a situation where the landowner may need to obtain a permit, and ensures that any plans they develop abide by the regulations. In the course of planning, if any activity is proposed that might cause a violation of state law, NRCS will suggest that the landowner check with the town to ensure the activity is in compliance with the law. In cases where it is clear that a permit is needed, NRCS will tell the landowner to get a permit. NRCS will not normally notify the town that an activity that might violate local ordinances is ongoing.

No state funding is currently provided for cost share assistance. The state does provide low-interest loans for manure storage equipment through the state's financing entity.

There have been significant nonpoint efforts by NRCS and the SWCDs in the Sebago Lake watershed since the early 1990s. In 1991 the Casco Bay Regional Water Quality project was funded by NRCS to support management practices for nonpoint source treatment in the watershed. This program was related to the Casco Bay Estuary Project, a ten year program involving a five year planning period and five year implementation period. The current focus is on-the-ground implementation of nonpoint management practices. As part of the project several area SWCDs developed a comprehensive land use inventory for the Casco Bay watershed. The watershed received an EQIP grant in 1996. EQIP is the primary program used for land treatment activities in the watershed. There are currently eight EQIP contracts in the Portland Water District. The most requested practice is waste management systems, but EQIP can also fund erosion controls, agricultural chemical handling facilities, and riparian and stream bank protection. Early in the 1990's the Portland Water District organization worked with NRCS on a 319 project to protect drinking water quality through reduction in nonpoint source pollution. NRCS was involved in bringing together various organizations to combat erosion problems at the intake pipes for the water supply system, and coordinated the installation of 1000 feet of erosion controls.

Conclusions

A variety of enforceable mechanisms to control nonpoint source pollution are available to state and local officials in Maine. Because of limited forestry and agricultural operations in the Sebago Lake watershed, enforceable mechanisms are more often used to control pollution from land development or land use activities than from agricultural sources. Statewide, the preponderance of enforceable mechanisms also address nonpoint source pollution from development, although the use of enforceable mechanisms is growing in the agricultural and forestry areas. In the watershed and throughout the state, Maine uses a variety of tools to address nonpoint source pollution from land use and development activities, including planning and zoning provisions, permit-based schemes requiring control of sedimentation, critical area protection, and prohibitions on discharges of sediment to water during construction activities.

Most often, formal enforcement provisions serve as threats or deterrents. DEP, as well as local CEOs enforcing municipal ordinances, follows a progressive compliance policy that seeks voluntary cooperation prior to the use of penalties or more formal enforcement approaches. Voluntary program staff tend to draw a distinction between their roles and the role of enforcement staff. DEP enforcement staff report that they rarely have to develop a consent agreement to bring landowners into compliance; a letter informing the landowner of the violation is generally a sufficient incentive to elicit compliance. Local CEOs may also bring a case in District Court under special procedures or enforce laws using standard enforcement procedures. However, they report that they generally do not need to resort to these procedures to obtain compliance. Even though the District Court enforcement procedure provides CEOs with the opportunity and basic skills to bring a case in court, some hesitate to go up against a formally trained lawyer. Nevertheless, by increasing the likelihood of enforcement, the procedure serves as a "velvet hammer" for obtaining compliance.

Some attribute the ease with which compliance may be obtained to the ethics of state residents. SPO conducted a survey of Maine home buyers which showed a strong ethic for resource protection. In the Sebago Lake watershed, lakeside residents are very aware of the restrictions on activity near the lakes and report violations to municipal and state enforcers.

However, some associated with enforcement activity in Maine report that the limited number of cases referred to formal enforcement proceedings reflects DEP's preference for voluntary measures to respond to problems. Others state that limited formal enforcement is the result of insufficient enforcement staff and reduced attention to violations. Some report witnessing substantial violations with minimal or no DEP enforcement. Where laws are enforced by municipalities with DEP oversight (eg shoreland zoning), limited DEP enforcement activity of other laws sends a mixed message to the towns regarding the need to rigorously prosecute violations of the laws. In particular, people note that the compliance situation is worse in rural areas of the state in terms of both DEP and CEO enforcement. It was noted that a visit from DEP enforcement staff makes a difference in these areas by demonstrating that DEP cares about compliance with the law.

Towns in Maine may enact more stringent ordinances than state laws require. In the Portland Water District, towns have worked with the Lakes Environmental Association to develop phosphorous control ordinances that are not required by state law. The ability of towns to enact a variety of more stringent laws provides for the possibility of enhanced water quality protection.

However, the effectiveness of the municipal law often depends more on the quality of town administration and enforcement than the quality of the rules. The local code enforcement officer, often a part-time employee, bears heavy responsibility in the decentralized scheme. Limited town support for CEO enforcement or poor enforcement by the CEO may create a weak link in nonpoint source pollution control process. Training and certification programs for CEOs are considered by some to be crucial to the success of local efforts, and there is some concern that the state may decrease its support for these activities. For instance, the state does not always provide full funding for CEO training; the state pays for the course but not for the time the instructor spends at the course. There has recently been some discussion that the state will start charging for classes.

Many of Maine's sectoral laws addressing significant sources of nonpoint source pollution, such as the revised Forest Practices Act, Erosion and Sedimentation Control Law, and the Manure Law, have been recently enacted. Some enforcement activity has been initiated by the Maine Forest Service for violations of forest harvest laws. MFS may be increasing its enforcement role if statewide standards for forest harvesting are adopted. The state manure spreading law became effective this winter so it is difficult to assess the results of any enforcement. Some observers report that there has been significant earth moving activity without erosion and sedimentation controls as required by the recently enacted erosion and sedimentation control laws.

Maine state agencies leverage their limited resources by working together and adopting MOUs to eliminate duplication of efforts. For instance, MFS and DEP have an MOU to coordinate training and education, inspection and technical assistance, investigation of complaints, and both formal and informal enforcement. Inspections and corrective actions are the responsibility of MFS; DEP staff are responsible for issuing notices of violation or other less formal notification, as well as carrying out the formal enforcement process, if necessary. Through this collaboration DEP enlists the support of MFS rangers, who are present in the forests, in enforcement of DEP laws such as NRPA or Shoreland Zoning.

Maine nonpoint programs reflect a significant level of attention to nonpoint problems by a variety of actors. The effectiveness of these programs, particularly in regulation of lakeside activities, appears to be enhanced to varying degrees by the participation of local residents and lake associations. For example, in the Sebago Lake watershed, LEA serves as a link between the providers of technical assistance services and the enforcement entities. Although technical assistance staff rarely turn the attention of enforcement personnel to violators, enforcement personnel will refer violators to technical assistance programs. The high concentration of nonpoint source programs, both enforcement and voluntary, in DEP serves to coordinate at least some aspects of the enforcement and technical assistance processes.

Endnotes

1. In addition to the sources cited, the following individuals were interviewed by telephone: Rich Baker, DEP; Greg Bean, DEP; Carol Blaisi, Conservation Law Foundation; Phil Boissoneaux, Portland Water District; Roy Bouchard, DEP; Jim Cassida, DEP Central Region; Will Cook, DEP Southern Region; John Delvecchio, State Planning Office; Mark Desmeules, State Planning Office; Ron Faucher, Portland Water District; Bill Galbraith, Land Use Regulation Commission; Phil Garwood, DEP; Frank King, CEO, Bristol; Craig Leonard, Agriculture; Peter Lowell, Lakes Environmental Association; Norm Marcotte, DEP; Morton Moesswilde, Maine Forest Service; Bill Monagle, Cobbossee Watershed District; Wayne Monroe, Cumberland County Field Office, NRCS; Roger Ryder, Maine Forest Service; John Thompson, CEO, Naples; Mary Thompson, Warren County Field Office, NRCS; and Bill Yarmantino, NRCS.
2. 38 M.R.S.A §2001 et seq.
3. LURC currently regulates many activities creating nonpoint source pollution, including certain aspects of forestry operations.
4. http://www.pwd.org. February 23, 2000.
5. Maine DEP. Draft rev. 9/18/98: Nonpoint Source Priority List. http://janus.state.me.us/dep/blwq/docwatershed/prilist5.pdf. February 23, 2000.
6. *See* Environmental Law Institute, *Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution* (1998).
7. Me. Rev. Stat. Ann. Tit. 38 § 413 (West 1989 & Supp. 1997).
8. Me. Rev. Stat. Ann. tit. 38 § 435 et. seq.
9. Me. Rev. Stat. Ann. tit. 38 § 439-A.
10. Me. Rev. Stat. Ann. tit. 38 §443-A, §347-A *et. seq.*
11. Me. Rev. Stat. Ann. tit. 38 § 480-A *et. seq.*
12. Me. Rev. Stat. Ann. tit. 38, §483-A.
13. Me. Rev. Stat. Ann. tit. 38 §§482(2) and (5).
14. Me. Rev. Stat. Ann. tit. 38 §420-D.
15. Me. Rev. Stat. Ann. tit. 38 §420-C.
16. Me. Rev. Stat. Ann. tit. 38 §420-C.
17. Me. Rev. Stat. Ann. tit. 30-A §4311 *et seq.*
18. Me. Rev. Stat. Ann. tit. 30-A §2101 and Maine Constitution, Article VIII, Part Second.
19. Me. Rev. Stat. Ann. tit30-A § 4404 1.
20. Me. Rev. Stat. Ann. tit. 30-A § 4404 11.
21. Me. Rev. Stat. Ann. tit. 30-A § 4404 18.
22. Me. Rev. Stat. Ann. tit. 12 § 8869.
23. The term "harvest plan" replaced the term "management plan" in the new regulations. 04-058 MRC ch. 20, §2.A.27.
24. 04-058 MRC ch.20 Section 5.C.
25. Me. Rev. Stat. Ann. tit. 12 § 8869.
26. Me. Rev. Stat. Ann. tit. 17, § 2805.
27. Me. Rev. Stat. Ann. tit. 7 §1007-A.
28. Me. Rev. Stat. Ann. tit. 7 §§4201-4209.
29. Me. Rev. Stat. Ann. tit. 38 §410-H *et. seq.*
30. Me. Rev. Stat. Ann. tit. 5 §3331(7)
31. Maine Nonpoint Source Control Program: Program Upgrade and 15 year strategy (9/23/99). http://janus.state.me.us/dep/blwq/docwatershed/npsstrategy.pdf.

32. *Id.*
33. http://janus.state.me.us/dep/blwq/training/is-vccp.htm. February 29, 2000.
34. Me. Rev. Stat. Ann. tit. 5 §6200.
35. http://janus.state.me.us/spo/lmf/history.htm. February 29, 2000.
36. http://janus.state.me.us/spo/lmf/sebago.htm. February 29, 2000.
37. http://www.famemaine.com/biz/nutrient.htm. February 29, 2000.
38. Me. Rev. Stat. Ann. tit. 36 §571 *et. seq.*
39. Me. Rev. Stat. Ann. tit. 38 §2001.
40. Me. Rev. Stat. Ann. tit. 30 §2007.
41. DEP website.
42. The Portland Water District is a quasi-municipality providing water and wastewater services to 10 Greater Portland Communities.
43. Me. Rev. Stat. Ann. tit. 30-A §4451.
44. Me. Rev. Stat. Ann. tit. 30-A §4221.
45. Me. Rev. Stat. Ann. tit 30-A §4452.
46. Me. Rev. Stat. Ann. tit. 30-A §4451.
47. Me. Rev. Stat. Ann. tit. 30-A, § 4326 3. C.
48. Laws of Maine 1913, Private and Special. Ch. 157. "An Act to Prevent the Pollution of the Waters of Sebago Lake."
49. BMP Guide.
50. 04-058 Ch. 20. Sec. 3-E
51. Maine Department of Conservation, Maine Forest Service. *The Impact of Timber Harvesting on Nonpoint Source Pollution: Report to the 119th Maine Legislature Joint Standing Committee on Agriculture, Conservation and Forestry.* January 15, 1999. http://www.state.me.us/doc/mfs/h20.htm

Maryland Case Study

Summary

This study examines the relationship between enforceable mechanisms for the control of nonpoint source water pollution, and the voluntary, technical assistance, and cost share approaches used in a Maryland watershed, the Monocacy River watershed. Maryland uses a great many programs and planning mechanisms to address nonpoint source water pollution, and it provides substantial cost share funding from state sources as well as from federal programs. The state also has a full suite of enforceable mechanisms. In the agricultural sector these are used primarily to move producers into planning, cost share, and technical assistance programs and to provide a backup approach where these assistance-based mechanisms are not implemented by the discharger. Among the key enforceable mechanisms for agriculture are a back-up "no discharge" provision to deal with significant problems, a soil and sediment discharge provision with exemptions for agricultural operations operating under approved plans, and a mandatory enforceable nutrient planning program. For non-agricultural sources, including land development activities and forest harvests, Maryland relies on county enforcement of a state sediment control law. Maryland also has a forest conservation law, administered by the counties, which requires retention of forests and buffers in connection with development activities.

Monocacy River Watershed

The Monocacy River watershed is a subbasin of the Potomac River[1]. The 899 square mile watershed is mostly in Maryland, although part of the headwaters lies within Pennsylvania.[2] In Maryland, the watershed lies mostly within Frederick County and Carroll County, north of Washington, DC and northwest of Baltimore. The Monocacy was designated a state Scenic River in 1974.[3] It is part of the Upper Potomac watershed for purposes of Maryland's tributary strategy under the Chesapeake Bay Agreement, which is aimed at reducing nutrients entering the Bay. The watershed includes substantial agriculture, comprising about 3,500 farms within these two counties. Dairy and other livestock operations are significant. Both counties are also undergoing rapid suburban development.

The Monocacy watershed and its subwatersheds have been the focus of a number of targeted projects to address nonpoint source water pollution from agriculture, including sediment, nitrogen, and phosphorous, among other pollutants. The state's required assessment under § 303(d) of the federal Clean Water Act lists nutrients and suspended sediment as impairments from non-point and natural sources.[4] Maryland's Unified Watershed Assessment for 1998 classifies the Monocacy as both Category 1 (waters needing restoration) and Category 3 (waters needing protection).

Enforceable Mechanisms Studied

Of the Maryland nonpoint source enforceable mechanisms described in the *Almanac*,[5] the following were reviewed in detail because of their relevance in the Monocacy watershed.

! *No discharge.* Maryland's water pollution control law contains a broad prohibition against discharges of any pollutant to the waters of the state. "Except as provided in this subtitle [regarding permits][6] and Subtitle 4 of Title 4 of this article [relating to soil and sediment discharges] and the rules and regulations adopted under those subtitles, a person may not discharge any pollutant into the waters of this State."[7] The term "discharge" is defined as "(1) The addition, introduction, leaking, spilling, or emitting of a pollutant into the waters of this State; or (2) The placing of a pollutant in a location where the pollutant is likely to pollute."[8] This broad prohibition is enforced by the Maryland Department of the Environment (MDE), which may use administrative orders, injunctions, and civil penalties of up to $10,000 per day (judicially) or $1,000 per day (administratively), or criminal prosecution.[9] The discharge prohibition is referred to by MDE generally as its Title 9 authority.

! *Soil or sediment discharges.* Maryland also has a law prohibiting the discharge of soil or sediment into the waters of the state *except* as authorized under a discharge permit or when discharged from land managed under an agricultural soil conservation and water quality plan approved by the local soil conservation district. This provision, referred to as 4-413, provides that apart from these exceptions, "it is unlawful for any person to add, introduce, leak, spill, or otherwise emit soil or sediment into waters of the State or to place soil or sediment in a condition or location where it is likely to be washed into waters of the State by runoff of precipitation or by any other flowing waters."[10] MDE enforces the soil or sediment provisions by corrective action order[11] or injunction.[12] Civil penalties are authorized up to $25,000 per day (judicially) or $10,000 per day (administratively), and criminal sanctions up to $50,000 and/or one year imprisonment.[13] A person engaged in agricultural land management practices *without* an approved soil conservation and water quality plan is covered by the law, but is not liable for penalties if the person complies with MDE's corrective action order.[14] Conversely, if a person has an approved soil conservation and water quality plan, and violates that plan and a discharge of soil or sediment results, the MDE may enforce under its Title 9 authority described above.

! *Maryland's Water Quality Improvement Act.* This law, passed in 1998, requires farmers that use commercial fertilizers to prepare nitrogen and phosphorous nutrient management plans by December 31, 2001 and to implement them by December 31, 2002.[15] Farmers that use manure or sewage sludges must similarly prepare a nitrogen management plan and implement it by the same dates. Farmers using manure or sludges must prepare phosphorous management plans by July 1, 2004, and implement them by July 1, 2005. The plans must be prepared by state-certified nutrient management consultants. The requirements apply to all agricultural operations with an annual income of at least $2,500, and livestock operations with 8 or more animal units.

Enforcement will be the responsibility of the Maryland Department of Agriculture (MDA). Farmers who fail to develop a plan may be fined up to $250; those who fail to implement a plan by the required dates will receive a warning for a first offense and an administrative penalty of up to $100 for each subsequent violation, not to exceed $2,000 per year.[16] Persons applying commercial fertilizer for hire to nonagricultural property of three or more acres or to state property inconsistently with University of Maryland Cooperative Extension recommendations will be subject to a penalty of up to $1,000 for a first violation, and up to $2,000 for subsequent violations, but not to exceed a total of $10,000.[17]

! *Grading and land clearing permits.* This enforceable permitting program for the control of non-agricultural sediment and erosion is administered by MDE or by county and municipal governments to which the program has been delegated. It applies to forestry activities as well as land clearing and development exceeding 5,000 square feet, but not to "agricultural land management practices, construction of agricultural structures, or, except in Calvert County, to construction of single-family residences or their accessory buildings that disturb an area of less than one-half acre and occur on lots of two acres or more."[18] "A grading or building permit may not be issued until the developer (1) submits a grading and sediment control plan approved by the appropriate soil conservation district, and (2) certifies that all land clearing, construction, and development will be done under the plan."[19] "A person may not begin or perform any construction unless the person: (i) Obtains an approved sediment control plan; (ii) Implements the measures contained in the approved sediment control plan; (iii) Conducts the construction as specified in the sequence of construction contained in the approved sediment control plan; (iv) Maintains the provisions of the approved sediment control plan; and (v) Implements any sediment control measures reasonably necessary to control sediment runoff."[20] Enforcement includes stop work orders, corrective action orders, and injunctions; administrative penalties of up to $1,000 per violation (not exceeding $20,000 for any action), judicial civil penalties of double the cost of installation and maintenance of erosion and sediment controls and permanent restoration of the land; and misdemeanor fines of up to $5,000 and/or one year imprisonment.[21]

! *Forest conservation requirements.* The state also has an enforceable forest conservation program related to land development. "A unit of local government having planning and zoning authority shall develop a local forest conservation program, consistent with the intent, requirements and standards of this subtitle."[22] "Before the approval of the final subdivision plan, or the issuance of the grading or sediment control permit by the State or local authority, the applicant shall have an approved forest conservation plan."[23] The forest conservation subtitle applies "to any public or private subdivision plan or application for a grading or sediment control permit on areas 40,000 square feet or greater." It does not apply to construction of highways, to forest cutting in areas governed by the Chesapeake Bay Critical Area Protection Law (which have their own protective provisions), or to agricultural activity that does not result in a change in land use.[24] Enforcement includes a penalty of 30 cents per square foot of the area found to be in noncompliance,[25] plan revocation,[26] a stop work order by the state or local authority, injunctive relief, and civil penalty of up to $1,000 per day.[27]

These enforceable mechanisms are relevant to nonpoint sources in the Monocacy watershed. Their interaction with Maryland's various nonpoint source voluntary and technical assistance and cost share programs is discussed following the brief description of the latter programs in the watershed.

Maryland's *Chesapeake Bay Critical Areas Law* is not analyzed in this case study, despite its importance statewide to nonpoint source pollution control. It applies to activities within 1000 feet of the Chesapeake Bay and its tributaries influenced by the tide, a definition that does not include the Monocacy watershed. In general, the law limits the creation of impervious surface within the critical area, requires forest buffer retention, and requires that agricultural activities employ best management practices.[28]

Assistance-Oriented Nonpoint Source Programs

This section describes a number of the major programs that address nonpoint source water pollution in the Monocacy watershed. It is not an exhaustive list, but provides a brief description of programs that have influenced activities and water quality in the watershed.

Rural Clean Water Project - Double Pipe Creek Watershed

This project, in a subwatershed of the Monocacy in Carroll County, was funded under a U.S. Department of Agriculture nationwide pilot program in the 1980s to address agricultural water pollution concerns in small watersheds. The project ran from 1980 to 1990, and provided over $3.5 million in cost share assistance to farmers in the 120,000 acre Double Pipe Creek watershed. Dairy farmers were the main participants, although some beef operations and wheat farmers also participated. Each of the over 100 participating farms signed a contract, developed a conservation plan, and implemented best management practices (BMPs) The program provided up to $50,000 in cost share assistance per farmer, paying three-quarters of the cost for installation of BMPs. The contracts required farmers to return the cost share funds if BMPs were not maintained.

The Monocacy River Watershed Water Quality Demonstration Project

The Monocacy Project was funded by USDA from 1989-1998 as a project to "accelerate the widespread, voluntary adoption of land treatment and management practices that provide a cost effective means of reducing agrichemical and nutrient loadings to surface and ground water resources."[29] Primary staffing for the project was provided by Maryland Cooperative Extension, although funds were also allocated to the participating soil conservation districts. For much of the project, the emphasis was on encouraging adoption and implementation of voluntary nutrient management plans and integrated pest management in three subwatersheds of the Monocacy - the Piney/Alloway (in Carroll County), and the Linganore Creek and Israel Creek (in Frederick County).

Voluntary Nutrient Management Planning

The nutrient management program in Maryland has been a voluntary program until the recent enactment of the Water Quality Improvement Act, which makes it mandatory in future years. Carried out by Maryland Cooperative Extension, voluntary nutrient management plans achieved widespread adoption by farmers in the Monocacy watershed. Such nutrient planning has also been required in order to participate in federal or state cost share programs. Extension staff perform tests on the fields and develop a customized plan for the farm which specifies what levels and amounts of fertilizers and manures can be applied consistent with good agronomic practice.

In addition to nutrient plan services provided by Extension free of charge, farmers may also develop a nutrient management plan by consulting a state-certified nutrient management consultant, often an employee or consultant to a fertilizer company. Maryland developed the private nutrient consultant certification program in 1993, and has certified well over 450 consultants, of whom about 70-110 are actively preparing plans. Planners must take a state examination to achieve certification, and the Maryland Department of Agriculture (MDA) reviews a sample of plans from time to time to verify that certified private planners are correctly carrying out their function. Statewide, Extension staff have written 8700 nutrient management plans since 1989, and private consultants over 2600 plans since 1993. Over 1.1 million acres of Maryland farmland have been covered by nutrient management plans, including updates.[30]

Soil Conservation and Water Quality Plans

Soil conservation districts work with farmers to develop soil conservation and water quality plans. Soil conservation district staff develop plans for installation of BMPs, assist with design and cost estimates and applications for cost-share assistance, and provide assistance with installation of practices as well as advice on maintenance. Over half the farmers in the watershed have soil conservation and water quality plans in place. These plans are voluntary, but are required for participation in various cost share programs under federal and state laws. They also provide some protection against enforcement by MDE under section 4-413 of the state's water pollution control law. Provisions in the 1996 federal Farm Bill require farmers on highly erodible lands to adopt and implement soil and water conservation plans in order to receive federal benefits. These Farm Bill provisions have increased the planning workload in the Monocacy watershed.

Property Tax Credit for Conservation Plan and Nutrient Management Plan

Maryland has enacted legislation authorizing counties to offer up to a 50 percent tax credit against property taxes due on agricultural land that is subject to and compliant with a current soil conservation and water quality plan approved by the county soil conservation district, and a nutrient management plan (where eligible).[31] Neither Frederick nor Carroll County has adopted this credit.

Maryland Agricultural Water Quality Cost Share Program (MACS)

The MACS program was created by the Maryland General Assembly in 1984 as part of the Chesapeake Bay Agricultural Initiative. It provides funding for most of Maryland's agricultural water quality programs, including funding for BMPs under various programs. MACS now provides cost-share assistance for the installation of 29 different agricultural BMPs. The amount of assistance available varies for each management practice, but funding is available up to 87.5% of the total cost.[32] MAC cost-share has a lifetime limit per farm while under the same ownership of $75,000, scheduled to increase to $100,000. USDA Farm Services Agency funds may be combined with MACS funds to maximize cost share assistance.

Soil conservation districts provide the farmer with assistance in selecting the appropriate management practices and developing cost estimates used in applying for cost share money. MACS funding is substantial. Statewide, MACS has funded about 12,000 projects with over $48 million in assistance over its 15 year history. Annual funding in recent years has been over $4 million. However, fiscal year 1999 appropriations for MACS are in excess of $8.9 million (not including federal funds). In fiscal year 1998, MACS provided cost share assistance for 121 projects in Carroll County and 86 in Frederick County.[33] MACS usually only funds construction of practices, but not maintenance activities. However, at times funding is available for special practices, such as the cover crop program, which was made available in the Monocacy watershed for the first time in 1998. The cover crop program, which prevents erosion and retains nutrients that would otherwise be washed into the waterways, funds the planting of cover crops in the fall, and then kill-off of the crop in March.

Environmental Quality Incentives Program (EQIP)

EQIP is another of the federal Farm Bill programs. In Maryland, EQIP serves primarily as an additional source of funding beyond MACS cost shares. It provides up to $10,000 in cost share funding per farmer. Until 1998 EQIP money in Maryland was allocated in such a way that the western counties of Maryland all had to compete for funding in the same pool, but this has changed. Carroll and Frederick Soil Conservation Districts each received just under $100,000 in EQIP funds in 1998. Carroll's funds were targeted for use in the Little Pipe Creek watershed.

Conservation Reserve Enhancement Program (CREP)

This addition to the federal Conservation Reserve Program, available in Maryland, is targeted at areas that will provide water quality benefits. It pays farmers to take riparian lands, highly erodible lands, or wetlands out of production for up to 15 years, and provides incentive bonuses to install conservation practices such as forested or vegetative buffers, to retire highly erodible land within 1000 feet of a waterway, or restore wetlands.[34] Eligible lands include cropland that has been planted to an agricultural commodity for two of the last five years, or marginal pastureland suitable for use as a riparian forest buffer. In April 1999 the program, which operates throughout the state, had enrolled 563 acres in Carroll County and 890 acres in Frederick County, mostly in the Monocacy watershed.

CREP has been popular in the watershed. CREP is more attractive to landowners than to many of the active farmers in the watershed, many of whom rent much of the land on which they farm. CREP has also raised some concerns among farmers about making land unavailable for agriculture as well as concerns with having land out of production adjacent to productive land such that deer or Johnson grass might become a problem for the remaining land in production.

319 Program

The federal grant funds provided under Section 319 of the Clean Water Act for control of nonpoint source water pollution have been used for a variety of projects in the watershed, including a number of projects under the Monocacy Project. Statewide, Maryland usually has $1.4 million in 319 money each year, but will have $2.6 million in 1999 and 2000. These funds are in addition to the Chesapeake Bay implementation grant. In the Monocacy, § 319 funds have supported technical assistance for animal waste management practices and erosion controls, monitoring projects to determine the effectiveness of agricultural and forestry best management practices, development of water quality modeling programs, and homeowner education on residential best management practices.

Agricultural Land Preservation Program and Maryland Rural Legacy Program

Maryland's Agricultural Land Preservation Program is aimed at acquiring permanent easements on agricultural land to keep it in agriculture. Since 1985, a condition of the easements has been that the owner must develop a soil conservation and water quality plan, outlining best management practices to be installed and maintained on the property. The plan includes a schedule of implementation and is included as a condition in the easement. In 1998, Carroll County had preserved the most acreage in the state under this program, over 25,000 acres.

The Rural Legacy Program provides funding for 12 areas around the state. Carroll County recently received $2.5 million as part of this program, which will be used in the watershed to create an agricultural buffer around the town of New Windsor. The program will promote CREP, the Maryland Agricultural Land Preservation Program, and also provide for easements on non-agricultural lands such as environmentally sensitive lands and wooded property.

Discussion and Analysis

Agricultural Pollution Generally

The Maryland approach to agricultural sources of nonpoint source pollution is primarily through technical assistance, cost-share, and voluntary programs administered through the soil conservation districts. This is backed by enforcement by MDE for unlawful discharges that are not remedied by farmers when they are put on notice and offered assistance by the soil conservation districts.

MDE's field office acts on agricultural nonpoint source pollution largely in response to citizen complaints, or staff may act on personal observation of a pollution problem. Complaints may be made directly to MDE at its field office or at headquarters. Citizens who complain to a soil conservation district may be referred to the MDE. Under MDE policy, citizen complaints are acted upon within three days. MDE's normal approach upon receipt of a complaint is to contact the local soil conservation district to determine whether the operation has a soil conservation and water quality plan or is working on one with the district. MDE also invites the soil conservation district to conduct a joint inspection of the operation. If there is an existing plan, the district staff will often go with MDE to visit the site. If not – as is more typical in complaint cases – the district usually declines the invitation. Both MDE and soil conservation district staff noted that the districts do not want to be associated by farmers in the first instance with enforcement-oriented activity, believing that this may make their provision of technical assistance and farmer acceptance of voluntary programs more difficult.

An MDE staff member visits the site and determines whether a discharge or potential discharge situation is occurring. The MDE staffer then produces a Field Investigative Report on a computer-generated form and leaves a copy with the farm operator. If there is a violation, the MDE staff member will advise the operator to contact the soil conservation district for assistance. Typically, the MDE will wait a few weeks and then contact the district to determine whether the farmer has sought assistance. If the farmer has not, the MDE visits the farm again. More serious situations may result in issuance of a Site Complaint, whose issuance requires approval from MDE management. (There are 4 regional compliance divisions in the state). The Site Complaint, while more serious in form, has no additional legal significance, however, unless it is accompanied by an order. An order can only be issued if pre-authorized by an assistant state attorney general advising the MDE.

If an observed violation is for soil and sediment under 4-413, the violator is directed to get a soil and water conservation plan from the soil conservation district. If the violator obtains a plan and thereafter does not violate it, then there is no sanction for the original violation. MDE did not identify any instances in the Monocacy watershed of an enforcement action arising after preparation of a plan under these circumstances. However, one Frederick County farmer outside the Monocacy watershed was advised to contact the soil conservation district to develop a plan and to implement it, after he mass-graded his fields and disturbed a stream. The district prepared the plan, but the farmer then failed to maintain the practices specified in the plan. Subsequent MDE enforcement activity resulted in a settlement in which the farmer took corrective action and paid a fine of $750.

The assistant attorney general responsible for advising MDE did not recall any sediment pollution cases prosecuted in court by the attorney general's office against agricultural operations. The approach of directing such violators into the planning process with soil conservation districts has apparently resolved all of the known violations short of formal enforcement.

Most agricultural water pollution in the state, as well as in the Monocacy watershed, involves manure discharges and/or animals in the stream. The MDE can take enforcement for these violations directly under the Title 9 "no discharge" prohibition, and is not required to offer the discharger an initial opportunity to correct the problem without penalty as under 4-413. Ordinarily, however, the MDE official uses a similar approach – advising the farmer to get in touch with the soil conservation district to develop and implement a plan to correct the problem. Carroll County Soil Conservation District officials note that one farm in the county is currently under a site complaint related to discharges of barnyard and dairy wash water to a wetland and stream. While this is a violation, the MDE has not pressed the enforcement action to a formal order (with administrative review, penalties, and other consequences) because the soil conservation district still needs to do the design work to support the remedy and the cost shares necessary to solve the problem. Thus, although provision of cost share money is not a legal prerequisite to enforcement action in Maryland, nevertheless, the MDE exercises its enforcement discretion in cases where the problem is expected to be solved. Frederick County Soil Conservation District officials note a similar case in which a tenant dairy farmer received a field inspection report from MDE advising him to contact the district to resolve a nonpoint source pollution problem and a related problem with a pipe discharging milking parlor waste water. The district perceives some difficulty in solving the problem in the near term as the operator is near retirement, the remedy will require substantial capital investment (including cost share) and the landowner may not want to invest in expensive engineered solutions; the current hope is to develop some sort of management plan. Each of these cases shows that enforcement is intended to serve what remains a largely technical assistance and cost-share oriented approach.

The Frederick County Soil Conservation District currently is working with ongoing projects involving 200-400 farmers; fewer than a dozen of these are relationships initiated by MDE referrals/complaints. Projects can take from 2-6 years to develop and implement. In Carroll County, the Soil Conservation District works with about 1000 farmers annually but fewer than ten of the projects are related to MDE involvement. The office tries to resolve problems within six months, but practices may take between 1 to 3 years to install. Cost share funds play a role in the adoption of practices. Federal funding is currently limited, but state MACS funding is by far the largest source of cost share money.

The soil conservation districts also noted that they do not use the specter of potential MDE enforcement as a "selling point" when seeking to promote the voluntary adoption of practices or participation in agricultural cost share programs – even for animal waste situations (where costs are much higher and enforcement consequences more likely). Their experience shows that a farmer has to have a strong desire to participate and to integrate the recommended practices and constructed facilities into the farm operation if they are to have any chance of long term maintenance or operation. Imposed solutions, in their view, often lack this level of commitment and fail after a few years. This also explains, in part, the districts' desire to be the provider of solutions in an enforcement context, rather than to appear as a co-enforcer (e.g., declining joint site visits with MDE in most instances).

Nutrient Planning and Water Quality Improvement Act Implementation

Maryland has received national attention for its Water Quality Improvement Act adopted in 1998 in response to the *Pfiesteria* problem in certain tributaries of the Chesapeake Bay. The Act imposed mandatory nutrient management planning requirements statewide. This mandatory program follows years of promotion of voluntary nutrient management planning.

However, the new law's approach does not simply make mandatory what was previously voluntary. The law makes substantive changes in the required content of plans, thus requiring new plans and plans that address animal operations more holistically. The law also raises issues of administration. In practice, the law divides responsibility for nutrient management planning and regulation among at least four entities – the Maryland Department of Agriculture, Maryland Cooperative Extension, the local soil conservation districts, and the Maryland Department of the Environment.

Historically, nutrient management planning was the responsibility of Maryland Cooperative Extension, while soil conservation and water quality planning was the responsibility of the soil conservation districts. As described previously, soil conservation districts provide broad planning services for farmers and serve as the gateway for cost-shares and other programs. Within the soil conservation and water quality plans, the districts schedule specific "practices" to meet the needs identified. Nutrient management is one of the component "practices" of the soil conservation and water quality plan, but the nutrient management plan was prepared by Extension (or a private certified consultant) rather than by the district staff.

Soil conservation and water quality plans also contained a "waste management system" practice. The district prepares a waste management plan, which addresses management of animal waste and runoff in the area of the barn and barnyard, but does not address the application of such materials to fields (which is the subject of nutrient management planning). A farmer with a waste management plan must also have a nutrient management plan because it is a component practice of the overall soil conservation and water quality plan.

Alternatively, a farmer could have Extension or a certified private consultant prepare a stand-alone nutrient management plan, without engaging with the soil conservation district in preparation of a soil conservation and water quality plan.

The new Water Quality Improvement Act requires *mandatory* preparation of nutrient management plans. But these plans take in elements that were previously not part of nutrient management planning in Maryland. The plans required by the new law require consideration of rates of runoff and pollution from the land, and measures for management and containment of manures. But the previous nutrient management plans prepared by Extension only determined agronomically appropriate rates of application of manures and fertilizers on the land; they did not address runoff rates or manure storage and management issues. Moreover, the handling and storage of "excess" manure not applied to the fields must also be addressed under the mandatory program, a change from the prior system where this was an issue handled only in the waste management plan prepared by the soil conservation district. Thus, the new mandatory plans involve features not part of the voluntary plans. Some soil conservation district staff are concerned that Extension nutrient planners will not be equipped to handle the new demands of the mandatory program – either because of lack of experience with waste management practices, or unfamiliarity with farm conservation and water quality issues on a holistic basis. Others are confident that the gap can be closed and needs addressed cooperatively. The Maryland Department of Agriculture expects Extension nutrient planners to become familiar with these requirements, and/or to refer the farmer to soil conservation district staff for detailed planning and construction of waste management structural practices. Under any scenario, soil conservation districts will need to work more closely with Extension by providing soil loss and runoff data to aid in the development of the new nutrient management plans and by assuring that the waste management element has been prepared.

The new program is likely to mean that a substantial number of animal operations in the Monocacy watershed will need to upgrade their existing waste management system plans in order to come into full compliance. Soil conservation district staff estimate that up to eighty percent of existing dairy farms in Frederick County are likely to need new or revised waste management plans in conjunction with the new nutrient management plans. In anticipation of these costs, the state recently announced a new loan program to help cover the portion of farmers' expenses not covered by the 87.5 % cost shares available under MACS. This Maryland Agricultural/Nonpoint Source Loan Program uses Water Quality State Revolving Fund (SRF) monies administered by the MDE to make low interest loans. The farmer works with the soil conservation district to develop the necessary practices; the district certifies the need to prevent nonpoint source pollution, and the farmer then seeks a loan from a commercial bank. If the application is approved by the bank, the bank applies to the MDE for a "linked deposit" of SRF monies. The bank disburses the loan.[35]

Cost shares are also available to assist with the planning. The MACS program is providing up to a 50 percent cost share (limited to $3 per acre) for the preparation of nutrient management plans by certified private nutrient consultants.[36] Extension nutrient planners will continue to provide their planning services free of charge.

Enforcement of the new law will be the responsibility of the Maryland Department of Agriculture (MDA), rather than MDE. The soil conservation districts, Cooperative Extension staff, and private nutrient planners will also not have enforcement responsibilities under the Water Quality Improvement Act. The MDA has hired six inspectors statewide in anticipation of implementing the enforcement program. In addition, in anticipation of increased planning and cost share workloads in the soil conservation districts, the state has funded 15 new positions last year and will add 33 this year statewide. Four of these will be in Frederick, five in Carroll. (The net increase in district staffs will be somewhat smaller, owing to downsizing in recent years. For example, the Carroll County Soil Conservation District's five new staff will represent a net gain of two because of three previous unfilled positions).

Although MDA will be responsible for enforcement of the Water Quality Improvement Act, MDE will retain the ability to use its Title 9 authority where there is an unlawful discharge of pollutants. Because MDE has a history as an enforcement agency, and because the penalties are so much higher under its Title 9 authority than under the Water Quality Improvement Act administered by MDA, there is great concern among the agricultural community about sharing of information among the agencies. Under existing practice, a nutrient management plan is kept by the farmer and the preparer. The soil conservation and water quality plan (with its waste management component) is kept by the farmer and the district. Under the new program, MDA will receive only a summary of the new nutrient management plan, not a copy of the plan itself. In 1999, the Maryland legislature amended existing law to provide that information from soil conservation and water quality plans could be shared with MDE "for enforcement under 4-413" (soil or sediment) and further providing that the MDA can share information with MDE "to support the development of a compliance or enforcement case for purposes of addressing *an existing water quality problem*" (viz. Title 9) but only pursuant to procedures to be established between the two departments and the state soil conservation committee.[37] These authorizations and limitations were the subject of substantial negotiations in the legislature. MDE and MDA are currently "negotiating" over how their respective enforcement duties will be carried out under the Water Quality Improvement Act.

Soil conservation districts and Extension staff also have concern with being associated with an "enforceable" program. They suggest that MDA will need to take the heat of doing inspection and enforcement if the two assistance-oriented organizations are to be effective in gaining cooperation of farmers in developing and implementing the plans.

The new enforceable program clearly represents a step forward in water quality protection. It will undoubtedly improve both nutrient and waste management planning for those Monocacy watershed farms that already have plans, and will bring in those farms that do not. However, the program is highly dependent on the provision of sufficient staff and the investment of substantial cost share funds, and its division of functions may complicate implementation.

Land Development Regulation

Nonpoint source pollution from land development activities is addressed by a number of regulatory laws. Here, the approach is not voluntary, but mandatory.

State law requires a sediment control plan for land disturbances over 5,000 square feet other than agriculture. The plan must be reviewed and approved by the soil conservation district before the county may issue grading permits. Frederick and Carroll Counties have taken delegation of the sediment control program. The City of Frederick has not, so MDE enforces the district-approved sediment control plans within the city limits.

Land disturbances over 20,000 square feet in Carroll County (or 15,000 square feet in Frederick county) require a full sediment control and grading permit. The county receives a copy of the plan at the same time as the soil conservation district, but will not issue a permit until the plan has been approved by the district. In Frederick City, the MDE receives a copy of the approved plan. Land disturbances between 5,000 and 20,000/15,000 square feet are subject to minor permits with standard conditions for sediment control. Sediment control plans for minor permits are not individually reviewed by the soil conservation district.

Bonds are required to assure compliance with the plan for disturbances greater than 20,000 square feet. Carroll County requires dedication of a 100 foot water resource protection easement along streams. Frederick County does not, but under its zoning ordinance simply prohibits or limits developments within variously defined "floodplain" widths, and within 50 feet of unmapped intermittent streams. Frederick County also has an inconsistently enforced provision in its zoning laws requiring that intermittent streams be protected with native vegetation/grasses.

County inspectors (or MDE in the city of Frederick) enforce the sediment control law. County inspectors ordinarily visit sites biweekly and also after precipitation events. If the county inspector identifies a violation, the inspector issues a field report identifying the violation and specifying the number of days to correct it. If the violation is not corrected in this time period, the inspector may issue a notice of violation or site complaint, again specifying a time for compliance. Failure to comply may lead to a stop work order. If a violation is significant, such as actual discharge of sediment offsite, a stop work order may be issued on the first inspection. In Carroll County in 1998, 3,204 inspections were performed, resulting in 19 stop work orders and 7 notices of violation. In each case these were resolved without assessment of a fine or commencement of a court case.[38] In Frederick County there were 13 stop work orders and 49 notices of violation issued between July 1998 and July 1999. There were also 3 citations issued with fines totaling $750 in the same period. MDE inspectors do not observe the identical inspection frequency, but prioritize the workload based on anticipated potential for pollution; MDE enforcement is typically by administrative civil penalty.

The Maryland Forest Conservation Law also has requirements that apply to development that affects 40,000 square feet or more of land. The state law sets forth standards which are implemented through county ordinances, which must be at least as stringent as the state law. These ordinances provide that the developer must conduct a forest stand delineation which is reviewed by the county, and then must submit a forest conservation plan. The plan must provide for forest retention and reforestation, and in certain cases for afforestation of previously non-forested areas. Developments in agricultural and resource areas or zoned for medium residential density that have less than 20% of the net tract area in forest cover must be afforested up to 20%; and commercial or industrial properties and high density residential areas with less than 15% must afforest up to 15%. In order to assure that forested areas remain in forest to some extent, areas that are deforested by the development activity must be reforested. Reforestation is required at a ratio of 1:1 (one acre reforested for each acre deforested) in Carroll County; and on a sliding scale (from 1/4:1 to 2:1) in Frederick County. The sliding scale in Frederick County, which follows the state law model, depends on a number of factors. If the forest cover removed by the development activity results in a residual forest area above a specified numerical threshold, reforestation is required only at the 1/4:1 ratio (with a 1 for 1 credit for each acre retained above the threshold). If the amount of forest cover removed results in a residual forest cover below the threshold, reforestation at the ratio of 1/4:1 is required for acres deforested down to the threshold and at 2:1 for acres deforested below the threshold.

In both counties, the developer must post a bond to assure performance of the forest conservation plan. In Carroll County the bond is $5,000 per acre to be forested; in Frederick it is either $0.10 per square foot or, for larger sites, an amount equal to the market rate for the required forest plantings plus a 15% contingency.

Forested or reforested land covered by the forest conservation plan must be placed under easement conveyed to the county. The easement requires that the land remain permanently in forest. In Carroll County developers may use offsite forest mitigation banking; the county does not allow "fee in lieu" mitigation. Frederick County allows offsite banking as well; the county ordinance makes agricultural streams the number one priority for off-site reforestation or forest banking. Such "banks" are subject to the same review, bonding, and easement requirements as for approval of onsite forest conservation activities.

The Carroll County Forest Conservation Ordinance requires creation and retention of a 50 ft. forest stream buffer. (County subdivision ordinances require 100 feet, and the Forest Conservation Ordinance may soon be changed to require 100 feet. The county normally seeks a 100 foot forest buffer despite the current 50 foot provision in the ordinance). Frederick County forest stream buffers under the ordinance are 50 feet or floodplains.

Forest conservation enforcement in Carroll County includes conducting an initial inspection to ensure that the planting has taken place as specified in the plan, then following up after 12 months. At that time, if 75% of the trees planted have survived, the developer receives 50% of the bond back. The final inspection is after 26 months. If 75% of the originally planted trees still survive, the developer receives the remaining 50% of the bond. A similar approach is used in Frederick County.

Frederick County depends on citizen complaints to identify individual landowners who may be conducting activities that are subject to the Forest Conservation Act without filing the appropriate plans. This generally only happens with private landholders since the review process for development ensures that commercial developers follow the requirements. There have been 2 or 3 violations in the county that the landowner rectified.

Forest Harvest Operations

Forest harvesting operations disturbing more than 5,000 square feet are also subject to enforceable mechanisms under the grading and clearing law. Like land development operations, these harvest operations prepare a sediment control plan for soil conservation district review and approval, and must obtain a permit from the county. As noted, operations disturbing between 5,000 and 15,000/20,000 square feet will obtain the standard (or minor) grading permit; larger operations need major permits. While bonds are required for major grading permits involving development, they are not required in either Frederick or Carroll County for forest harvests.

The MDE and the Department of Natural Resources (DNR) have established a "compliance agreement for the standard erosion and sediment control plan for forest harvest operations." This provides the requirements including Best Management Practices (BMPs) and stream buffers needed for sedimentation control.[39] For harvests affecting streams, the approved sediment control plan is required to include a forest stream buffer management plan for the "streamside management zone." The buffers are a minimum of 50 feet at zero percent grade, with an additional 4 feet of width for every percent above zero. The plan must provide for the post-harvest basal area within the buffer being at least 60 percent of the pre-harvest basal area. No landings are allowed in the buffer, and haul roads in the buffer are allowed only if preexisting and stable, or if they merely cross the buffer laterally. Research in the Monocacy watershed funded by 319 money has shown that use of best management practices for forest harvests avoids significant impacts to water quality.

Enforcement is by the county sediment control inspectors. Stop work orders and related enforcement on logging operations occurs in both counties. The last civil citation for a grading violation in Carroll County that resulted in a fine was about 7-8 years ago, involving a timber harvest that occurred without the required plan and approval. It was cited because the harvest involved stream crossings and wetlands.

Maryland has a separate state law authorizing regulation of some forest harvest practices on private lands.[40] The law requires notice to the local district forestry board (in each Maryland County) for commercial harvests affecting more than three acres of forest land, and is implemented mostly in the Chesapeake Bay critical area.[41] However, in Frederick County, the county government has adopted zoning ordinance provisions that require the board to review timber harvests occurring in the county's "conservation areas." This provides an additional level of scrutiny to assure the retention of stream buffers.

Conclusions

Maryland has many programs operating in the Monocacy watershed, including cost-share, technical assistance, voluntary, and enforceable programs. The substantial impression left by review of these efforts is their sheer magnitude - in dollars, staffing, and duration. With respect to agricultural sources of nonpoint pollution, Maryland's approach centers on the delivery of services by the soil conservation districts, but enforcement is the responsibility of the MDE. With respect to the new mandatory nutrient management program, responsibilities will be divided further, with MDA having initial enforcement responsibility, backed by MDE enforcement if water pollution occurs. Thus, the enforcement tools are plainly intended to be used to support traditional planning, cost share, and technical assistance approaches.

Many of the technical assistance and voluntary programs in the watershed have come and gone, often with substantial participation rates and results, but with little formal coordination at the state level. Although Maryland does have all of its waters divided into basins under its tributary strategy, the multi-stakeholder tributary teams seem to be chiefly engaged in public outreach and promotion of water pollution control and prevention techniques rather than in watershed goal-setting or development of projects. Similarly, unified watershed assessment has provided a means for the state to target its 319 money, but the 319 funding (while substantial) is small in comparison with the MACs and USDA funding that has come to the state and into the watershed.

For land development and nonpoint source pollution from forest harvests, enforceable mechanisms adopted by the counties under state legislation are the central approaches in Maryland. These seem to be working in coordinated fashion. Indeed, the centering of approval and enforcement in county governments appears to assure better understanding of requirements and controls over activities. The involvement of the soil conservation districts in review and approval of plans also helps to assure coordination of agriculture and non-agriculture expertise in the watershed.

The Maryland programs maintain a sharp distinction between entities providing assistance in coming into compliance (the soil conservation districts and the cost-share programs they serve as gateways), and enforcers (the MDE, county governments, and now the MDA). While this can lead to complexity in coordination, it also apparently alleviates concerns of land holders who can then seek compliance assistance from familiar entities without concerns over a potential conflicting role as enforcers.

Endnotes

1. In addition to the sources cited, the following individuals were interviewed by telephone or in person: Donna Baker, Carroll County Forester, Maryland Forest Service; Elizabeth Bonar-Bouton, 319 Coordinator, Maryland Department of Natural Resources; Patty Burdette, Nutrient Management Planner, Frederick County Extension Service; Dawn Early, District Manager, Frederick County Soil Conservation District; Mike Kay, Frederick County Forester, Maryland Forest Service; Carole Larsen, Environmental Planner, Frederick County; Louise Lawrence, Maryland Department of Agriculture; Bill Limpert, District Manager, Water Management Administration, Maryland Department of Environment; Vicky Luther, Division of Landscape and Forest Conservation, Carroll County Department of Planning and Development; Dave Lyons, Chief, Water Management Administration Enforcement Division, Maryland Department of Environment; Rick Masser, Environment Preservation Agency Manager, Frederick County Department of Public Works; Tom Miller, Agronomist, Maryland Extension Service; Steve Nelson, Division of Water Resource Management, Carroll County Department of Planning and Development; Ed Null, District Manager, Carroll County Soil Conservation District; Steve O'Phillips, Frederick County Development Review Office; Phil Panel, Frederick County Forester, Maryland Forest Service; Bill Powell, Agricultural Preservation Planner, Carroll County; Maggie Rhodes, USDA-NRCS District Conservationist, Carroll County; Ed Sanders, Administrator for Conservation Grants, Maryland Department of Agriculture; Mark Siebert, District Conservationist, Frederick County Soil Conservation District; Gail Smith, Sediment Control Inspector, Bureau of Development Review, Carroll County Department of Planning and Development; Bryan Snyder, Sediment Control Planner, Carroll County Soil Conservation District; Rosewin Sweeney, Assistant Attorney General, Maryland Department of Environment; Doug Valentine, USDA-NRCS Soil Conservationist, Carroll County; and Lauren Wenzel, Tributary Team Program Coordinator, Maryland Department of Natural Resources.
2. Monocacy Project, Fiscal Year 1997 Annual Report, Exec. Summ.
3. *See* Alliance for the Chesapeake Bay, The Monocacy River, Factsheet.
4. "Maryland Clean Water Action Plan, Final 1998 Report on Unified Watershed Assessment, Watershed Prioritization and Plans for Restoration Action Strategies." December 31, 1998; and http://www.epa.gov/iwi/303d/02070009_303d.html, November 19, 1999.
5. *See* Environmental Law Institute, *Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution* (1998).
6. Maryland law does authorize the MDE to require dischargers, potentially including nonpoint source dischargers, to obtain permits as "other activity" under some circumstances if an "operation could cause or increase the discharge of pollutants into the waters of this State." Md. Code Ann., Envir. §§ 9-323(a)(3), (b). This authority has not been used to require permits for nonpoint sources, but has been used to require permits for spray irrigators.
7. Md. Code Ann., Envir. § 9-322.
8. Md. Code Ann., Envir. § 9-101(b).
9. Md. Code Ann., Envir. §§ 9-334, 9-335, 9-338, 9-339, 9-342, 9-343.
10. Md. Code Ann., Envir. § 4-413(a).
11. Md. Code Ann., Envir. § 4-412(a), § 4-415.
12. Md. Code Ann., Envir. §§ 4-405, 4-415, 4-416.
13. Md. Code Ann., Envir. § 4-417.
14. Md. Code Ann., Envir. § 4-413(b).
15. Md. Code Ann., Agriculture, § 8-801 et seq.
16. Md. Code Ann., Agriculture, § 8-803.1.

17. Md. Code Ann., Agriculture, § 8-803.4.
18. Md. Code Ann., Envir. § 4-102. Section 4-105(a)(1)(i) includes "otherwise disturbing land for any purpose" within the definition of "construction" subject to the law.
19. Md. Code Ann., Envir. section 4-103(a).
20. Md. Code Ann., Envir. § 4-105(a)(3).
21. Md. Code Ann., Envir. §§ 4-103, 4-110, 4-113, 4-116.
22. Md. Code Ann., Nat. Res. § 5-1603(a)(1).
23. Md. Code Ann., Nat. Res., § 5-1608(b).
24. Md. Code Ann., Nat. Res., § 5-1602.
25. Md. Code Ann., Nat. Res., § 5-1608(c).
26. Md. Code Ann., Nat. Res., § 5-1612(b).
27. Md. Code Ann., Nat. Res., § 5-1612(c), (d).
28. Md. Code Ann., Nat. Res., § 8-1801 et seq.
29. Monocacy Project, Annual Reports.
30. Maryland Department of Agriculture, 1998 Agricultural Nutrient Management Annual Report.
31. Md. Code Ann., Tax - Prop., § 9-226.
32. Md. Code Ann., Agriculture §§ 8-701 et seq.
33. Maryland Agricultural Water Quality Cost-Share Program, 1998 Annual Report: Conservation Efforts in Progress.
34. New Benefits: Your Farm and the Maryland Conservation Reserve Enhancement Program.
35. Maryland Department of Agriculture, Agricultural/Nonpoint Source (NPS) Loan Program Fact Sheet.
36. Maryland Department of Agriculture, Cost-Share Assistance for Nutrient Management Plans.
37. HB 706 (1999), amending Md. Code Ann., Agriculture, § 8-306.
38. Application for Renewal of Delegation of Erosion and Sediment Control Enforcement Authority - 1998 (Carroll County).
39. Best Management Practices for Forest Harvests (www.dnr.state.md.us/Forests/Landplanning/bmp.html).
40. Md. Code Ann., Nat. Res. § 5-601 et seq.
41. Md. Code Ann., Nat. Res. § 5-608; see § 8-1808(c) (requiring that all harvesting of timber in the critical area be in accordance with plans approved by the district forestry board.)

Ohio Case Study

Summary

In addressing nonpoint source water pollution from agriculture and silviculture, Ohio relies primarily on its 88 county soil and water conservation districts.[1] While these districts chiefly use voluntary measures and technical assistance, they have the power to require filing of operations and management plans to *abate* agricultural or silvicultural pollution. If plans are not prepared or carried out to abate ongoing pollution, enforcement can be requested from the chief of the Department of Natural Resources' Soil and Water Conservation Division to ensure that the necessary measures are put in place. These administrative "chief's orders" are enforceable, and can also lead to judicial enforcement. Ohio's law requires the state to provide cost share funds as a condition for the validity of chief's orders that require the installation of any practices eligible for cost-shares. Enforcement-driven cost shares rise to the top of the list for state eligibility. Fairly limited funding, capped at $15,000, is available for such enforcement-based cost shares, however. Very few chief's orders are requested by the districts or issued by the DNR, and use of this mechanism takes significant time. Ohio's state wildlife officers can also address nonpoint source pollution, seeking misdemeanor fines, court orders, and restitution for nonpoint source pollution that results in fish kills. They also may seek enforcement when litter and other materials are found in streams.

Ohio EPA plays a limited role in enforcement in the nonpoint context. The state's general water pollution law administered by OEPA does not cover agricultural, silvicultural, or non-agricultural nonpoint pollution otherwise subject to DNR or county authority. OEPA's involvement occurs primarily when a discharge can be defined as a point source or when a water pollution situation is not covered by these other laws.

Watersheds

Two rural watersheds (in eastern and western Ohio) were examined in order to assess the use of enforceable mechanisms, and their relationship to cost-share and technical assistance approaches to nonpoint source discharges.

Stillwater River Watershed

The Stillwater River Watershed in western Ohio drains an area of 673 square miles. Comprising most of the land area of Darke County and flowing southeastward through western Miami County and northwestern Montgomery County, the Stillwater watershed is a part of the Great Miami River drainage basin. The Stillwater River flows into the Great Miami River at Dayton. The Stillwater River and Greenville Creek (its tributary) were designated State Scenic Rivers by the Ohio legislature in 1975. The watershed is predominantly agricultural; and the largest town in the watershed is Greenville, with a population of 12,850.[2]

The headwaters of the watershed, and 70 percent of its total area, lie in Darke County, on the Indiana border. Of the 400,000 acres in Darke County, approximately 325,000 acres are agricultural. The county is one of the most agriculturally productive in the state, regularly ranking among the top three counties for production of corn, soybeans, and wheat. In addition to crop production, almost two-thirds of agricultural revenue in 1997 was derived from livestock farms. The county has over 200,000 animal units and approximately 10 million animals, more than any other county in the Miami Valley region. While the number of livestock operations has decreased steadily since the 1940s, the number of animals has increased. Poultry and hog numbers have increased, while beef and dairy cattle have declined in number. Chickens now comprise almost half of the total number of animal units, and more than 90 percent of the animals.[3] Most of the stream miles in the watershed are classified as warmwater habitat or exceptional warmwater habitat for water quality purposes. However, almost 60 percent of the stream miles assessed in 1996 were not attaining or were only partially attaining water quality use standards. Causes of impairment included livestock pastures/feedlots, row-crop agriculture, and on-lot wastewater systems, as well as some industrial and municipal point sources.[4]

Belmont County

Belmont County lies in eastern Ohio, and is bordered on the east by the Ohio River. Its terrain is rugged and steep. The major stream systems, running from west to east into the Ohio River, are associated with McMahon Creek and Captina Creek. Most of the streams are designated warmwater habitat.[5] Primary land uses in Belmont County include forestry, agriculture, and mining. The county is the second highest in the state for annual soil losses, and contains the fourth largest amount of highly erodible soil and the third highest number of total stream miles. Forty percent of the county is forested. Forest harvests are increasing in the county as the demand for high quality hardwood increases. Most forest land is privately owned, and logging operations are generally arranged through contracts between logging companies and landowners. Approximately 45 percent of the county is agricultural land, with slightly more land devoted to pastures than cropland. More than half of the cropland is enrolled in cost-shares for conservation practices. Water quality impairments are primarily nonpoint in origin.

Enforceable Mechanisms Studied

"Chief's Orders" for Agriculture and Silviculture

Ohio law directs Ohio DNR's Division of Soil and Water Conservation, with the approval of the Soil and Water Conservation Commission, to adopt rules establishing "technically feasible and economically reasonable standards to achieve a level of management and conservation practices in farming or silvicultural operations that will *abate* wind or water erosion of the soil or *abate* the degradation of the waters of the state by animal waste or by soil sediment including substances attached thereto."[6] The key concept is that these standards come into play where abatement of pollution is needed; absent pollution, operators are not subject to any of these standards except on a voluntary basis.

This law does not "restrict the excrement of domestic or farm animals defecated on land outside a concentrated animal feeding operation or runoff therefrom into the waters of the state."[7] The definitions are important. "Concentrated animal feeding operation" is not defined by numerical animal unit thresholds as under the federal Clean Water Act. Instead, the term is defined as including "animal feedlot and animal waste management facilities and land application areas for managing and disposal of animal waste."[8] An "animal feedlot" is defined as a feeding or holding area "where grass or other suitable vegetative cover is not maintained," while an "animal waste management facility" means "any area or facilities used for the collection, storage, handling or treatment of animal waste."[9] Thus, the law provides authority for the DNR to set standards to address manure spreading, handling, collection, and application practices, and other forms of animal waste such as wash waters; but it does not address animal waste excreted in pastures.

DNR regulations provide that to abate pollution from animal waste collection, storage, or treatment facilities, the operator shall "design, construct, operate, and maintain" such facilities to prevent discharge, and must follow the standards in the "Field Office Technical Guide."[10] The operator must prevent seepage from animal waste management facilities, and "if pollution of waters of the state occurs from an existing facility, corrective measures shall be taken."[11] Pollution from land application of animal waste, flooding, waste waters, and related activities must be prevented.[12]

DNR sediment regulations under this law also require control of sheet and rill erosion, wind erosion, and concentrated channel erosion.[13] Farmers "responsible for agricultural pollution" must apply and maintain "Field Office Technical Guide" measures and install practices in accordance with an approved operation and management plan.[14] Soil and water conservation districts are required to review and approve "operations and management plans."[15] Such plans must "contain implementation schedules and operational procedures for a level of management and pollution abatement practices which will abate the degradation of the waters of the state by animal waste and by soil sediment including attached pollutants."[16] The sediment regulations further provide that there shall be no earth disturbing practices (including tillage) immediately adjacent to waters of the state "except for those practices constructed or implemented in accordance with generally accepted agricultural, silvicultural and engineering practices."[17] The sediment regulations also require silviculture operators to apply Best Management Practices, and provide that such operators "may" file operations and management plans with soil and water conservation districts.[18]

The Division of Soil and Water Conservation is required to "establish procedures for...enforcement of rules for agricultural pollution abatement."[19] The procedures rely on the abatement measures administered by Ohio's 88 soil and water conservation districts (one in each county),[20] but are backed by authority for the chief of the Division at the state level to issue enforcement orders.

Typically, citizen complaints about agricultural or silvicultural pollution are investigated by the conservation district. After the district invites the violator to comply, provides any assistance, and gives a voluntary period to correct the problem,[21] the district may refer the matter to the Division of Soil and Water Conservation for a "chief's order."[22] State law created the chief's order for animal waste pollution in 1978. In 1991, "chief's order" authority was extended to include pollution from discharges of sediment.

After conducting an adjudicatory hearing, the Division chief may order an agricultural or silvicultural operation to comply with the standards, and operate in accordance with an operation and maintenance plan.[23] However, the chief *may not* issue an order that requires the recipient to implement an agricultural pollution abatement practice eligible for cost sharing unless public funds are actually made available to cover not less than 75 percent of the required cost (not exceeding $15,000/person/yr).[24] Cost shares are available only to owners and operators that develop and have approved by the soil and water conservation district a current operation and management plan for their *entire* operation.[25]

Chief's orders are appealable to the court of common pleas.[26] The orders are also judicially enforceable.[27] Violation of an order is a misdemeanor punishable by imprisonment up to 6 months, fine of up to $1,000 per day, and restitution.[28] Also the state may recover any expenditures it made from the "agricultural pollution abatement fund" to protect public health.[29] In addition, the Division may seek a court order against a discharger at any time if the violation "causes pollution of the waters of the state and constitutes a danger to public health."[30] For discharges of animal waste that cause pollution of the waters of the state and require immediate action to protect the public health, the chief may issue an emergency order effective immediately, and the Division may enter on the lands to abate the problem if the person responsible does not comply.[31]

Land Clearing and Development Erosion and Sediment Programs

State law also empowers the Division of Soil and Water Conservation, subject to approval of the Ohio Soil and Water Conservation Commission, to adopt rules for "technically feasible and economically reasonable standards to achieve a level of management and conservation practices that will *abate* wind or water erosion of the soil or *abate* the degradation of the waters of the state by soil sediment in conjunction with land grading, excavating, filling, or other soil disturbing activities on land used or being developed for *nonfarm* commercial, industrial, residential, or other nonfarm purposes."[32] Municipalities and counties may develop their own programs. The Division "may recommend" criteria and procedures for "approval of urban sediment pollution abatement plans and issuance of permits" prior to the disturbance of five or more acres. Although areas less than five acres do not need plans or permits, they are not exempt from the "other [substantive] provisions of this chapter and rules adopted under them."[33] Areas of any size require use of conservation practices including sediment trapping, stabilization of denuded areas, and stream crossing work; and no dumping of material is authorized into waters or in such proximity that material may slough, slip, or erode into the waters unless specifically authorized.[34] Developments of five or more acres must develop an "erosion and sediment control plan" which must be approved by the state or local approving agency, and must institute stormwater controls.[35]

The soil and water conservation districts and the Division do not have enforcement responsibilities under this program, and "chief's orders" are not available. Instead, local municipal or county ordinances provide the enforcement.

Concurrent with these responsibilities, the Ohio EPA has permitting and enforcement responsibility for the federal Clean Water Act industrial and urban Phase I stormwater program, which applies to land development activities including land clearing for development in excess of five acres. Enforcement is by the municipalities or counties, or the Ohio EPA. The Ohio EPA has also entered into agreements with 17 soil and water conservation districts (not including the counties comprising the watersheds examined in this case study). These mostly urban counties do local education on erosion control at construction sites, review notices of intent to construct, and some conduct inspections.

Other Nonpoint Source Authority

Apart from the above provisions, enforceable mechanisms for nonpoint sources are limited in Ohio.

Enforcement by Ohio EPA under the state's *water pollution law* does not apply to most nonpoint sources.[36] The state water pollution law states that "No person shall cause pollution or place or cause to be placed any sewage, industrial waste, or other wastes in a location where they cause pollution of any waters of the state, and any such action is hereby declared to be a public nuisance"[37] But the law expressly exempts from this prohibition "[a]pplication of materials to land for agricultural purposes or runoff of such materials from such application or pollution by animal waste or soil sediment including attached substances, resulting from farming, silvicultural, or earthmoving activities regulated by Chapter 307 or 1515 of the Revised Code."[38] The referenced laws are those discussed above under which Ohio counties regulate earthmoving associated with development, and under which Ohio's soil and water conservation districts and DNR address agricultural discharges of sediment and animal waste. The general prohibition also exempts excrement of domestic and farm animals and runoff therefrom.[39]

Only when an animal operation has a controlled, direct discharge of wastewater or has 1,000 animal units or more, is it required to have a discharge permit or "permit to install" issued by the Ohio EPA.[40] Similarly, only where earthmoving falls under the federal stormwater permitting program or is unregulated by county ordinances does it fall within the Ohio EPA's enforcement purview. Where the prohibition does apply, enforcement includes administrative orders, injunctions, and civil penalties of up to $10,000 per day.[41]

Ohio also has several *nuisance-type misdemeanor* provisions that can be used to address some kinds of water pollution that may include nonpoint sources. For example, "No person shall....corrupt or render unwholesome or impure, a watercourse, stream, or water."[42] This is a third degree misdemeanor, with a penalty of no more than 60 days and/or $500; the court may also impose restitution for any property damage.[43] Similarly, "No person, regardless of intent, shall deposit litter or cause litter to be deposited...in or on waters of the state."[44] "Litter" means "garbage, trash, waste, rubbish, ashes, cans, bottles, wire, paper, cartons, boxes, automobile parts, furniture, glass, or anything else of an unsightly or unsanitary nature."[45] This is also a third degree misdemeanor. And

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the court may, in lieu of or in addition to any penalty, require such person to "remove litter from any public or private property, or in or on waters of the state.[46] These misdemeanor provisions are enforceable by any sheriff, police officer, constable, wildlife officer, conservancy district officer or any other law enforcement officer.[47]

Ohio's *wildlife law* contains a similar provision: "No person shall place or dispose of in any manner, any garbage, waste, peelings of vegetables or fruits, rubbish, ashes, cans, bottles, wire, paper, cartons, boxes, parts of automobiles, wagons, furniture, glass, oil, or anything else of an unsightly or unsanitary nature...in any ditch stream, river, lake, pond, or other water course...or upon the bank thereof where the same is liable to be washed into the water either by ordinary flow or floods."[48] However, this provision does not apply to substances placed in accordance with a permit under the water pollution control provision referenced above "or exempted by such section." Thus it exempts runoff of waste or sediment from agriculture, silviculture, and earthmoving where otherwise regulated, and exempts animal manure generally. The wildlife law prohibition is enforced in local courts as a misdemeanor by wildlife officers or local law enforcement officials.[49] The first offense is punishable by no more than 60 days and/or $500 fine; subsequent offenses by no more than 6 months and/or $1,000 fine.[50] The court may also impose restitution for all or part of any property damage.

Assistance-Oriented Nonpoint Source Programs

This section describes the primary assistance-oriented state, federal, and local programs used in Darke and Belmont Counties to address nonpoint source pollution.

The Stillwater River Watershed Protection Project

The Stillwater River Watershed Project is a locally initiated watershed project. Working with numerous local partners, the project is administered through the Darke and Miami County Soil and Water Conservation Districts. The project's mission is "to protect and enhance the ground and surface water resource base through voluntary land use practices that are both practical and economical."[51] The project began in the late 1980's but received its first formal funding in the form of a Section 319 grant in 1993. Additional funding from the project has originated in many of the programs described in this section. The project has received over $1.5 million from U.S. EPA 319 funding, from state cost share (HB 88) funding, and from the USDA water quality incentive program (WQIP). In addition, reduced interest loans totaling about $1 million have been issued in the watershed under the Linked Deposit Program.[52] Each of these programs is described in more detail below. The $2.5 million in funding expended or loaned for cost share and incentive practices funded work by 216 landowners, many of whom received funding from multiple sources.[53]

The project continues to use a series of inventories to assess the potential for addressing nonpoint source pollution from a variety of sources. Each of 28 subwatersheds in the Stillwater was evaluated on the number of stream miles, the size of the subwatershed, the percent of the subwatershed that is Highly Erodible Land, the number of animal units, the tons of manure produced per acre per year, and the number of on-site septic systems. On the basis of these evaluations, each subwatershed was ranked to identify the areas with the most likely pollution potential. The project then targets funding to the highest ranked areas.[54] One-third of the project's funding (including loans through the Linked Deposit program) has been targeted at the number-one ranked subwatershed, Swamp Creek.[55] Practices funded include no-till, manure holding structures, erosion control, filter strips, and demonstrations of innovative best management practices. Participation in most programs requires that farmers develop an operation and management plan for livestock facilities, and a conservation plan for all cropland. The Darke and Miami County SWCDs develop these plans with funding from their general allocations.

The project is overseen by a 15 member Joint Board of Supervisors, who hire staff to work on the project out of the Darke County SWCD office. The Board is assisted by a full-time project coordinator hired with 319 funding.

Ohio Cost Share Program ("HB 88")

Ohio's cost share program, commonly referred to as "HB 88," provides funding to individual landowners to implement practices to abate nonpoint source pollution from agricultural and silvicultural activities. The program is administered by DNR's Division of Soil and Water Conservation and provides cost-sharing up to 75 percent of the cost of a practice, with a limit of $15,000 per year. The general assembly allocated $1.3 million in 1999 for this program. Locally, the program is administered by the soil and water conservation districts. Funds are allocated first to resolving complaints, in accordance with Ohio's agricultural pollution abatement laws that require cost share assistance to be provided for the installation of management practices to resolve complaints. An individual requesting cost share assistance must have a soil and water conservation plan in order to receive funding, as well as an operation and management plan if the funding is to be used for an animal waste management facility. DNR also provides small grants to soil and water conservation districts through this program for watershed projects; this source of funding is reserved to provide the required local match for EPA's 319 funding.[56]

In the Stillwater River watershed, HB 88 funding of $50,000 was provided in 1994-96 to help 20 farmers with no-till practices, manure holding structures, soil testing, and manure testing. A second grant of $15,000 was recently issued under the nonpoint source grant program for nonpoint source pollution prevention practices in the watershed.[57]

In Belmont County, HB 88 funding has been used primarily for animal waste management. The county has provided between $30,000 and $40,000 to farmers for animal waste management systems. The program does not generally provide cost-share assistance for the installation of silviculture BMPs, regarding these practices as a cost of doing business.

Water Pollution Control Fund Linked Deposit Program

Ohio's Linked Deposit program, administered by Ohio EPA, is a mechanism for the state to provide loans for water pollution abatement activities through commercial lending institutions at below market interest rates. The program was created in 1993, and has since provided $3.5 million in loans to farmers in six participating Ohio watersheds, including the Stillwater, but not including any in Belmont County. Each participating watershed is required to develop (or amend) a watershed management plan, identifying the pollution sources in the watershed, the proposed solutions to pollution problems, the areas which will be prioritized for assistance, the sources of funding, and a schedule for implementing the plan. The plans are generally developed collaboratively by local water quality and agricultural agencies, and must be approved by Ohio EPA.

Individual landowners work with the soil and water conservation district to develop their applications for loans through this program. Each landowner must develop a soil and water conservation plan, and the landowner must present a Certificate of Qualification issued by the district to the local participating bank in order to receive a loan. The bank evaluates the candidate using its own lending criteria. If the bank chooses to issue a loan, Ohio EPA and the Ohio Water Development Authority then deposit funds equal to the face value of the loan through a certificate of deposit with a term equal to the term of the loan. The bank issues the certificate of deposit at a reduced interest rate, and is required to pass along the interest savings to the landowner in the form of a reduced loan interest rate. The bank services the loan according to its normal procedures.[58]

The Stillwater River Watershed has participated in the program since 1995, and has generated about $1 million in approved loans. A total of $5.4 million in loan authority has been approved for this watershed to finance a variety of pollution control practices, including livestock waste handling systems, manure handling equipment, no-till planters and drills, conservation tillage equipment, and erosion and runoff control practices.[59]

Streambanking

Ohio's Streambanking program is funded by bonds issued under the state's Natureworks bond program. It is intended to establish and conserve forested stream buffers. DNR provides grants to soil and water conservation districts working in cooperation with local park districts or nonprofit land trusts for the purchase of easements or fee-title interests in land. In order to participate, the district and its partners must develop a Riparian Area Protection Plan that includes an inventory of areas in need of improvement or protection, identification of tools to protect areas, and short and long term goals for the watershed. The district must hold the easements or fee ownerships acquired under this program for at least 15 years, and monitor easements annually.[60]

The Miami County soil and water conservation district spearheaded the Streambanking effort in the Stillwater River Watershed, in partnership with the Miami County Park District. The program has purchased seven easements since 1995, protecting 104 acres. Of the acreage enrolled, 84 acres were forested and 20 were cropland. Two of the acquisitions were fee-simple purchases of potential development sites, near or adjoining parcels owned by DNR. These parcels totaled almost 7 acres. The remaining 97 acres are easements on privately owned lands. The total cost of all easements has been close to $150,000.

Belmont County does not participate in the Streambanking program because of the county's topography. The narrow stream gullies make stream buffers a lower priority for most landowners, and cropping rarely extends near streams.

Natureworks Watershed Management Program

A state program funded by the same bond issue as the Streambanking program, the Watershed Management program provides up to $250,000 to watershed projects for cost sharing management practices. By supplementing on-going federal cost share programs, the program provides anywhere from 50 to 100 percent of the cost for materials and installation of water quality improvement practices. Funded practices include stream fencing for livestock exclusion, riparian buffers, streambank stabilization, stream habitat restoration, and animal waste practices. All practices funded under this program must be maintained a minimum of 15 years.[61] The Stillwater Watershed Project has received $250,000 from this program. Funding has been used to install erosion control measures, construct animal waste storage facilities, and improve wetlands and wildlife habitat.[62]

Ohio's 319 Program

Ohio EPA administers the state's 319 program, federal nonpoint source funding available from U.S. EPA under the Clean Water Act. Ohio has received around $3 million annually in 319 money, but received $6 million with the incremental federal funding available in 1999. The federal program requires a 40 percent state match for all funds granted.

The Stillwater River Watershed Project has received three grants through the 319 program totaling approximately $550,000 since 1993. The initial grant, received in 1993, constituted the first funding for the project, and provided funds to test innovative management practices, help purchase manure handling equipment, construct streambank stabilize measures, and hire a project coordinator. Further grants have similarly provided funding for BMP installation and a project coordinator.[63]

Belmont County and 3 adjacent counties receive 319 funding for a project on their Stillwater Creek watershed (unrelated to the Miami-Darke County Stillwater River watershed) which crosses four counties. The grant of $209,000 provides funding for tree planting on reclaimed strip mines, pasture management practices, and livestock watering systems.

USDA Environmental Quality Incentive Program

The Water Quality Incentive Program (WQIP) was replaced by the Environmental Quality Incentive Program (EQIP) in the 1996 Farm Bill. These cost share programs are designed to reduce agricultural nonpoint source pollution problems in small watersheds. The Stillwater Watershed Project received over $500,000 in two grants over a six year period from this program. The funding was directed to projects in two subwatersheds for no-till practices, well-testing, and ICM plans.

Belmont County has also received some funding from EQIP. In 1999, Belmont County also received $300,000 in emergency funding from USDA and state sources due to drought conditions. The funding was provided for livestock watering systems and the purchase of hay.

USDA Conservation Reserve Program

The Conservation Reserve Program (CRP) is administered by the USDA Farm Services Agency. Under CRP, agricultural landowners can apply to enroll their highly erodible and environmentally sensitive lands. In return, landowners must enter into 10-15-year contracts with USDA, under which they agree to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, native grasses, wildlife plantings, trees, filterstrips, or riparian buffers.[64] Landowners participating in CRP can receive up to 50 percent of the costs of establishing the approved practices. Landowners may also be reimbursed for up to 25 percent of the cost of restoring wetlands.[65] There are 4100 acres in Darke County enrolled in CRP.

Forestry Practices Information

Ohio does not have a specific cost-share program for forest harvest operations. Belmont County addresses forestry issues through information and outreach to loggers and landowners. The soil and water conservation district has held two outreach programs for landowners on forestry requirements and BMPs. One hundred and twenty two landowners attended these workshops. The soil and water conservation district created a timber packet for landowners with information on best management practices (BMPs), a sample contract, a list of certified loggers, and a sample O&M plan that it will send upon request. There is a full time forester on staff in the district, but requests for assistance exceed availability. Generally, the requests for assistance are from private landowners who are interested in improving or created forested areas on their land. Ohio recognizes a voluntary program for certification of loggers. To become certified, loggers must attend a one day training course on BMPs and pass an exam. However, there is no requirement that loggers become certified or that landowners use certified loggers. The soil and water conservation district has held a logger certification training course.

Discussion and Analysis

Agriculture and Silviculture

Chief's orders play a minor role in Ohio's agriculture and silviculture nonpoint source controls. Traditional cost-share, education, and technical assistance mechanisms are the heart of the program.

DNR's Soil and Water Conservation Division surveys the state's 88 soil and water conservation districts every 3 years to determine how they are responding to complaints. Statewide statistics compiled by the Division in 1997 show that urban stormwater was the leading source of formal and informal complaints, followed by construction runoff, animal waste, rural flooding, and silviculture impacts. The districts receive only about 200 complaints per year statewide from the public about agriculture and silviculture pollution. Of the *formal* pollution complaints received by the districts concerning agriculture and forestry statewide in 1996, 121 concerned animal waste, 23 cropland erosion, and 44 silviculture erosion. Of the formal complaints fielded by the districts concerning agriculture or silviculture, only about 2-5 each year lead to district requests for chief's orders, and even fewer of these result in the issuance of chief's orders.

The Belmont County soil and water conservation district has requested issuance of chief's orders with respect to sediment pollution from logging operations. In 1998, the district requested 3 chief's orders, 2 of which were for logging-related pollution. In both of the logging cases, operators had damaged the areas logged and left the sites. The district contacted the operators numerous times regarding the violations, and sent certified letters as required by law. When the operators did not respond to the district, it forwarded the complaints to the chief. Although orders were drafted, they were not yet issued when the operators agreed (at the encouragement of the local forestry association) to install required practices, including mulch, seeding, and waterbars. The administrative and chief's order request process took between twelve to fifteen months, and the on-site remedy occurred long after the completion of the logging operations.

Because of concern with the timeliness and effectiveness of chief's orders in encouraging operators to avoid pollution (since it is an after-the-fact abatement mechanism rather than a provision for sound logging practices), the Belmont County soil and water conservation district's board of supervisors passed a motion seeking to have the county require a permit for logging in order to gain closer control over logging practices. Such a permit would have required logger adherence to BMPs and following an operations and maintenance plan as a condition of being allowed to operate in the county. (Ohio's agricultural pollution abatement law provides that forestry operators "may" file an operations and maintenance plan with the soil and water conservation district.[66] The districts therefore accept these plans only if volunteered; they cannot require them). The county permit system proposed by the district board was opposed by DNR and by the logging industry, and is no longer under active discussion. DNR increased its education and informational outreach for loggers; and formal complaints related to pollution caused by silvicutural activities decreased in Belmont County. The district reports that it received no complaints related to silviculture in 1999.

The Darke County soil and water conservation district has had among the highest number of citizen complaints about animal operations. Most of these have related to odors rather than to water pollution. This district has never requested a chief's order. Pollution related complaints have all been resolved informally, frequently including the provision of cost-share money as part of the remedy. The existence of the Stillwater River Watershed Protection Project has, in effect, provided a well-funded infrastructure for technical assistance and cost shares that has forestalled the use of enforcement tools.

Financial assistance for producers needing to address livestock pollution problems statewide in Ohio has come from a variety of sources: 38 percent received state funds, 38 percent received USDA program funds, 14 percent required no assistance, 6 percent received § 319 funds, 3 percent received NatureWorks funds, and 1 percent received other funding assistance.[67] Soil and water conservation districts identified the primary practices needed to correct livestock pollution as storage facilities, facility management, runoff control, and nutrient utilization practices. Statewide statistics show that about 2/3 of the agricultural cost share funds administered by the Division of Soil and Water Conservation in recent years have been allocated to addressing complaints (about $647,000 in fiscal year 1998, for example).[68] Requiring cost-shares as a condition for enforcement has been criticized as "paying the polluter."

Ohio has had only 3 chief's orders that couldn't be resolved at the Division level in the last 10 years and that had to be forwarded to the Attorney General for enforcement in court. Referrals to the Attorney General are a last resort for the Division, both because the process is perceived to be time-consuming and because the Attorney General bills the Division for time spent on Division matters. Two of the three cases referred for judicial enforcement subsequently settled, while the third did not but is still expected to settle (culminating a 4-5 year process since the original complaint).

The Ohio system is geared to voluntary compliance at every step, so it is not a speedy process. Both state and local officials noted that the process is unwieldy and slow, and enforcement comes into effect only in the most prolonged of cases. The soil and water conservation districts wish the enforcement process were quicker after they request a chief's order, largely because they seldom refer any cases for chief's orders until they have themselves exhausted every opportunity for informal resolution.

The DNR's Division of Wildlife plays a role in nonpoint source enforcement when there is a fish kill directly attributable to activities on the land. There is a wildlife officer in each county. For a first offense, Wildlife generally refers the situation to the soil and water conservation district if less than $50 in fish are involved in the kill. If a claim of more than $50 is involved, then the Division of Wildlife seeks restitution from the discharger itself – sending a bill for fish and for investigative costs, and offering settlement. If there is no settlement, then the Division seeks a criminal fine and payment of restitution. For repeated offenses, the Division of Wildlife proceeds criminally. Under the stream litter and nuisance provisions, the potential sanctions are up to $500 and/or 60 days in jail (fine up to $3,000 if a corporate violator). Soil and water conservation district staff report that wildlife officers are hesitant to enforce against agricultural or silvicultural pollution because there is some uncertainty as to whether natural substances such as sediment (or tree tops) would be considered stream litter by local judges.

Urban Stormwater/Nonfarm Program

The Division of Soil and Water Conservation developed standards for urban runoff, but has no enforcement authority in this area. Ohio EPA has authority to issue enforcement orders. Ohio EPA has Memoranda of Understanding (MOUs) with 17 soil and water conservation districts on stormwater. These mostly urban counties do local education on erosion control at construction sites, and review notices of intent to construct. Some also conduct inspections. Local governments also have regulatory and enforcement authority.

Conclusions

Ohio DNR's chief's orders present a unique state-based mechanism to address agricultural or silvicultural nonpoint source pollution when soil and water conservation districts cannot resolve matters voluntarily. However, the process depends heavily on voluntary and cost-share programs, requires provision of cost-shares where cost-sharable practices are needed, and takes a great deal of time. The wildlife officer enforcement option is useful in the case of fish kills traceable to particular activities and has been used. Ohio EPA has little enforcement authority with respect to nonpoint source water pollution.

ENDNOTES

1. In addition to the documentary sources cited, the following individuals were interviewed by telephone in connection with this case study: Larry Antosch, Ohio EPA; Jim Bennett, District Conservationist, Darke County SWCD; Tammie Brown, Division of Soil and Water Conservation, DNR; David Hanselmann, Assistant Chief, Division of Soil and Water, DNR; Gail Hesse, 319 Coordinator, Ohio EPA; Karen McAlister, District Conservationist, Miami County SWCD; Bob Monserrat, Division of Environmental and Financial Assistance, Ohio EPA; Bob Phelps, Ohio EPA; Beverly Riddle, Program Assistant, Belmont County SWCD; Dan Schneider, Division of Wildlife, Law Enforcement, DNR; Len Snedeker, District Manager, Belmont County SWCD; Jerry Wager, Division of Soil and Water Conservation, DNR. Comments were also provided by George Kleevic, Belmont County SWCD.
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3. Miami Valley Regional Planning Commission. *Animal Feedlot and Poultry Operation Inventory and Assessment for Darke County, Ohio.* June 1998. See also *Census of Agriculture.*
4. *The 1996 Ohio Water Resource Inventory (305b Report).* See http://chagrin.epa.state.oh.us/watershed/attain/use57.htm.
5. *Ibid.* See http://chagrin.epa.state.oh.us/watershed/attain/use07.htm.
6. Ohio Rev. Stat. § 1511.02(E)(1).
7. Ohio Rev. Stat. § 1511.02.
8. Ohio Admin. Code § 1501:15-5-01(B)(13).
9. Ohio Admin. Code § 1501:15-5-01(B)(4), (6).
10. Ohio Admin. Code § 1501:15-5-02.
11. Ohio Admin. Code § 1501:15-5-03.
12. Ohio Admin. Code §§ 1501:15-5-04 to -07.
13. Ohio Admin. Code §§ 1501:15-5-08, -09, -10.
14. Ohio Admin. Code § 1501:15-5-08.
15. Ohio Admin. Code § 1501:15-5-15.
16. Ohio Admin. Code § 1501:15-5-01(B)(26).
17. Ohio Admin. Code § 1501:15-5-11.
18. Ohio Admin. Code § 1501:15-5-12.
19. Ohio Rev. Stat. § 1511.02(E)(4).
20. Ohio Rev. Stat. §§ 1515.08(L),(R),(S),(T) provide for soil and water conservation districts to agree to carry out the program under Chapter 1511.
21. Ohio Admin. Code § 1501:15-5-15.
22. Ohio Rev. Stat. § 1511.02(G); Ohio Admin. Code § 1501:15-5-16.
23. Ohio Rev. Stat. § 1511.02(G).
24. Ohio Rev. Stat. § 1511.02(H); Ohio Admin. Code § 1501:15-5-13.
25. Ohio Admin. Code § 1501:15-5-13(A)(2)(e).
26. Ohio Rev. Stat. § 1511.08.
27. Ohio Rev. Stat. § 1511.07(B).
28. Ohio Rev. Stat. § 1511.99; Ohio Admin. Code § 1501:15-5-16(A)(2).
29. Ohio Rev. Stat. § 1511.071.
30. Ohio Rev. Stat. § 1511.07(A)(2).

31. Ohio Rev. Stat. § 1511.02(A)(3).
32. Ohio Rev. Stat. § 1511.02(E)(2).
33. Ohio Rev. Stat. § 1511.02(E)(3).
34. Ohio Admin. Code § 1501:15-1-04.
35. Ohio Admin. Code § 1501:15-1-03, § 1501:15-1-05.
36. See, e.g., Randall Edwards, "Pulling pollution out of water can be tug of war: the Ohio EPA says it is limited to what comprehensive plans it can enforce," *Columbus Dispatch*, Nov. 1, 1999.
37. Ohio Rev. Stat. § 6111.04.
38. Ohio Rev. Stat. § 6111.04(C).
39. Ohio Rev. Stat. § 6111.04(D).
40. See Environmental Law Institute, Locating Livestock: How Water Pollution Control Efforts Can Use Information From State Regulatory Programs (June 1999), at p. 149.
41. Ohio Rev. Stat. §§ 6111.06, 6111.07, 6111.08.
42. Ohio Rev. Stat. § 3767.13(C).
43. Ohio Rev. Stat. §§ 3767.13, 2929.21(E).
44. Ohio Rev. Stat. § 3767.32(A).
45. Ohio Rev. Stat. § 3767.32(D).
46. Ohio Rev. Stat. § 3767.99(C); § 2929.21(E).
47. Ohio Rev. Stat. § 3767.32(E).
48. Ohio Rev. Stat. § 1531.29.
49. Ohio Rev. Stat. § 1531.131.
50. Ohio Rev. Stat. § 1531.99; see § 2929.21.
51. "Stillwater Watershed Project: Working Together To Protect Our Water Resources." October 1995.
52. "Over $1,500,000 Raised for the Stillwater Watershed Project," *Stillwater Watershed Project Newsletter.* Issue 15, November 1998.
53. Id.
54. Miami Valley Regional Planning Commission. *Stillwater River Watershed Protection Project, Darke and Miami Counties.* September 1995 (Revised).
55. "Over $1,500,000 Raised for the Stillwater Watershed Project." *Stillwater Watershed Project Newsletter.* Issue 15, November 1998.
56. See Ohio EPA. *A Guide to Developing Local Watershed Action Plans in Ohio.* June 1997.
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58. Ohio EPA Division of Environmental and Financial Assistance. Http://www.epa.ohio.gov/defa/linkdepo.html.
59. *Ibid.* See also Stillwater River Project (mission statement and fact sheet).
60. *Natureworks: Guidelines for Nonpoint Source Pollution Control Grants Program.* 1997-1998; and Vance, Lawrence G. Memorandum to Soil and Water Conservation Districts, March 18, 1997.
61. *Ibid.*
62. "Over $1,500,000 Raised for the Stillwater Watershed Project.: *Stillwater Watershed Project.* Issue 15, November 1998.
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66. Ohio Admin. Code § 1501:15-5-12.

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68. Memorandum, Lawrence G. Vance, Chief; DSWC, June 26, 1997.

Oregon Case Study

Summary

This study surveys enforceable legal mechanisms for nonpoint source pollution control in Oregon, together with a variety of voluntary and assistance-oriented approaches, as illustrated by practice in two watersheds, the Tualatin River Basin and the Grande Ronde River Basin.[1] The three mechanisms studied include: (1) watershed-level management planning under SB 1010, Oregon's Agricultural Water Quality Act; (2) enforceable best management practices under the Oregon Forest Practices Act and its accompanying rules; and (3) implementation of water-related planning goals through Oregon's statewide comprehensive land-use planning law, which is unique in the nation.

Each of these mechanisms has become a key element of Oregon's attempts to meet not only state water-quality goals and federal TMDL requirements, but also the habitat concerns raised by recent Endangered Species Act listings of several salmonid species. In this context, there has been much discussion in each of the affected sectors as to whether the existing state-law mechanisms can be made adequate to implement federal mandates, or whether more stringent regulation will be needed in the future. In agriculture, debate centers on current policy approaches that favor stakeholder participation and voluntary compliance versus expanded use of SB 1010's relatively untested enforcement and penalty sections; in forestry, where water quality provisions have been enforced for some time, on the adequacy of existing management practices for ensuring continued protection of salmon habitat; and in the urban sector, on the application of generally-worded statewide planning goals to local water quality issues, and their translation into enforceable local ordinances.

Coupled with both new and ongoing programs to encourage voluntary control of nonpoint sources, these enforceable legal mechanisms also are at the core of overarching initiatives by the Governor's Office and the Oregon Department of Environmental Quality to integrate water-related issues statewide. A common aspect of both the voluntary and enforceable mechanisms is their emphasis on planning and management at the watershed level. The two watersheds studied served as models for the approaches now being undertaken, and highlight the path that is being followed in other watersheds throughout the state.

Tualatin and Grande Ronde Watersheds

! The *Tualatin River Basin*, just southwest of the Portland metropolitan area, is about 80 miles long and a tributary of the Willamette River. Its drainage basin is approximately 43 miles long and 29 miles wide, and covers an area of 712 square miles.[2] Over half of the watershed is forested, one-third is agricultural, and fifteen percent (70,000 acres) is urban,[3] including the Portland metropolitan area communities of Tigard, Beaverton, and Hillsboro as well as the cities of Tualatin, Sherwood, and Forest Grove.[4] It is one of the fastest-growing areas in the state, with forecasts of 400,000 additional people living in the Metro region (which includes the Tualatin Basin) over the next twenty years.[5] The river is the major source of drinking and irrigation water in its valley, but the

Oregon DEQ has designated it and its tributaries as "Water Quality Limited."[6] "Tualatin" derives from an Indian word meaning "slow and lazy" – an accurate description of the river's meandering course. For this reason, shading and temperature issues are prominent in the basin, alongside more traditional concerns about discharges and runoff.

The Tualatin basin was chosen for study because it combines agricultural, forest, and urban issues, and thus is affected by each of the enforceable mechanisms examined. In addition, due to a long history of litigation over water quality issues, the basin was among the first to fully develop and adopt various federal and state programs for water quality management and nonpoint source pollution control. It has the oldest TMDL in the state, and also was the first to adopt an agricultural water quality management plan under Oregon law. The basin's early adoption of these mechanisms means that they have recently become eligible for active enforcement action, including enforcement against nonpoint sources.

! The study also briefly examined the *Grande Ronde River Basin* in Northeastern Oregon. This basin, which is centered on the city of La Grande, encompasses the Blue Mountain region, covers more than 5,000 square miles, and includes 280 streams and rivers that contain 2,900 miles of fisheries.[7] Land ownership in the basin is approximately 65% public land and 35% private land.[8] In Eastern Oregon, nonpoint source issues are concentrated in the agricultural sector, and center on ranching, grazing, and irrigation practices and their effect on water quality and stream temperature. A chief concern is the declining population of Snake River spring chinook salmon, which is listed under the Endangered Species Act.[9] The basin was chosen for study because it is frequently cited as an example of a strong voluntary effort -- the Grande Ronde Model Watershed Program, described in detail below -- that predated and provided a solid foundation for more recent planning and regulatory mechanisms in the agricultural sector.

Enforceable Mechanisms Studied

Of the Oregon nonpoint source enforceable mechanisms described in the *Almanac*,[10] the following were reviewed in detail because of their particular relevance to ongoing statewide efforts to control nonpoint source pollution, as illustrated by the Tualatin and Grande Ronde watersheds.

! *Agricultural Water Quality Act (SB 1010).* This 1993 law, still commonly referred to by its bill number, authorized the Oregon Department of Agriculture (ODA) to designate areas to be governed by a water quality management plan and to adopt rules that require landowners in the affected area to perform those actions necessary to carry out the plan.[11] In general, once a plan is implemented, all activities, including pesticide use, irrigation, and grazing, within the affected area of the plan must be conducted "in full compliance with the plan and rules implementing the plan and with all rules and standards of the [Environmental Quality Commission] relating to water pollution control... ."[12]

In 1995, SB 1010 was supplemented and strengthened by SB 502, which required ODA to develop and implement programs and rules "that directly regulate farming practices that are for the purpose of protecting water quality" and that are applicable both to exclusive farm use zones under the state planning law and to other lands where agricultural practices are taking place.[13] ODA has interpreted this mandate as giving it exclusive authority to regulate agricultural activities that affect water quality.[14] The water quality management plans themselves are developed through a public process in individual watersheds, with priority given to impaired watersheds listed under § 303(d) of the Clean Water Act. ODA has enacted administrative rules to ensure consistency and uniformity in the planning process throughout the state.[15]

ODA is authorized to determine compliance with the management plans through entry and inspection, but must give a notice of violation and an opportunity for compliance prior to assessing a civil penalty. Penalties can be up to $2,500 for the first violation and up to $10,000 for a second violation.[16] In addition, violations of the plans and/or administrative rules are subject to all remedies and sanctions available to the Oregon Department of Environmental Quality (DEQ) or Environmental Quality Commission.[17]

! *Oregon Forest Practices Act.* Under the Oregon Forest Practices Act, the Oregon Board of Forestry must establish best management practices (BMPs) "to insure that to the maximum extent practicable nonpoint source discharges of pollutants resulting from forest operations on forestlands do not impair the achievement and maintenance of water quality standards."[18] Forest operators are required to comply with these BMPs, unless they can demonstrate that alternative practices will yield better results.[19] If forest operators are in good-faith compliance with the BMPs, then their operations are given a safe harbor from enforcement, and considered not to be in violation of any water quality standards.[20] BMPs can be subjected to review pursuant to a petition alleging that existing forestry operations conducted in accordance with them are nonetheless contributing to violations of water quality standards. Upon receiving such a petition, the Forestry Board must either revise the BMPs within two years or dismiss the petition;[21] if it fails to issue revisions or dismiss the petition within the specified time, then water quality standards may be enforced directly against forest operators.[22]

Aside from requiring BMPs, the Act also contains specific requirements governing forestry operations. Forest operators must give written notice of all operations to the State Forester, and interested parties may subscribe to receive notification of all proposed operations. Similarly, when operators give notice of chemical applications, the State Forester must notify persons within 10 miles of the application, if those persons have requested such notice and hold downstream surface water rights.[23] The Board of Forestry also has authority to require a written plan for operations conducted within 100 feet of a stream used by fish or for domestic use, or within 300 feet of an area that contains threatened or endangered species, sensitive bird nesting or roosting sites, or significant wetlands.[24]

The State Forester enforces all of these requirements through inspection, citations, and issuance and service of administrative orders, such as cease and desist or reparation orders.[25] No penalties may be imposed unless a citation is issued.[26] The Act provides for general criminal and civil penalties,[27] including potential civil sanctions of up to $5,000 per violation.[28]

! *Statewide comprehensive land-use planning.* Oregon has a comprehensive statewide land-use planning law that in part provides for the protection in local comprehensive plans of a variety of environmentally sensitive areas, including flood plains, estuarine areas, wetlands, lakes, coastal areas, and wilderness and scenic areas.[29] The Department of Land Conservation and Development (DLCD) also has authority to designate "areas of critical state concern" as part of the planning process.[30]

The law is implemented through a series of statewide planning goals, including goals that can be applied to cover nonpoint sources. These goals must be complied with in the development of city and county land use plans and implementing regulations, which govern community growth and development. Of particular relevance are Goal 5, which relates to natural resource protection; Goal 6, which covers the quality of air, water, and land resources; Goal 7, which protects floodplains and other areas subject to natural disasters and hazards; and Goals 3 and 4, which govern agricultural lands and forest lands, respectively. The plans were submitted to DLCD for initial review and "acknowledgment"; once acknowledged by the Department, the plan, rather than the goals, is the controlling legal authority. However, the plans also are subject to periodic review, especially as the planning goals change and evolve.

Local governments then enforce these requirements through their police power. In the "areas of critical state concern," the Commission, as well as the county governing bodies, has investigative and hearing authority for alleged violations, and injunctive relief also is available;[31] however, the Commission has not yet exercised its authority to designate these areas. Remedies for noncompliance of a local plan with the statewide goals include withholding state grant money to local governments, as well as legal and equitable remedies.[32]

These three enforceable mechanisms were chosen for their relevance to nonpoint sources in the Tualatin, Grande Ronde, and other key watersheds not examined in this study. The interaction among these state-level enforceable mechanisms, between these mechanisms and federal pollution control law, and between these mechanisms and Oregon's voluntary, technical assistance, and cost-share nonpoint source pollution programs is complex. Statewide coordination of many of these programs is occurring under the "Oregon Plan," a recent initiative sponsored by the Governor's Office. The Oregon Plan and several of the new and traditional assistance-oriented mechanisms for nonpoint source control are discussed in the next section.

Voluntary and Assistance-Oriented Nonpoint Source Programs

The Oregon Plan for Salmon and Watersheds/Watershed Councils

The Oregon Plan for Salmon and Watersheds is the umbrella for a number of related activities aimed at improving water quality, including nonpoint source control. Developed and administered by the Governor's Office in 1997 in response to declining fish populations and proposed listings of salmonids under the Endangered Species Act (ESA), and affirmed by executive order in 1999, the Oregon Plan establishes three main priorities: (1) achievement of water quality standards through federal and state law and technical assistance through the "Healthy Streams Partnership"; (2) restoration of native fish populations; and (3) watershed assessment and restoration, largely through encouraging and funding the creation of local watershed councils in each basin. The

Oregon Plan's emphasis on basin-level improvements is meant to represent a "place-based" approach to meeting water quality goals.

Central to the Oregon Plan is the distinction between watershed restoration activities, which seek to undo past harm, and planning and regulatory mechanisms that address ongoing pollution. Restoration activities are the primary focus of the watershed councils, and are coordinated at the state level through the Oregon Watershed Enhancement Board (OWEB, formerly the Governor's Watershed Enhancement Board or GWEB). Since July 1997, OWEB has awarded almost 568 grants totalling $39 million to assist with implementation of watershed restoration projects. OWEB's work has included not only grants and other support to the watershed councils, but also projects such as the development of a watershed assessment manual for the councils' use. The Board also has played a role in facilitating coordination among state agencies on water policy.

The watershed council concept emerged from the "Watershed Health Program," a two-year trial program that appropriated ten million dollars between 1993 and 1995 to help create watershed councils in each of two trial basins -- the South Coast and the Grande Ronde -- and worked to integrate state-funded programs and Section 319 efforts in those basins. When this program ended, the remaining activities were incorporated into GWEB. With new funding through the Oregon Plan, 90 watershed councils have now been established statewide. DEQ works with and participates on the watershed councils, largely through training on data collection and sampling, and the other state natural resource agencies also play a major role.

The Oregon Plan also incorporates the Healthy Streams Partnership, a 1997 initiative to forestall additional regulation by developing a series of agreed-upon principles for integrating Clean Water Act and TMDL requirements with aquatic systems preservation and fish habitat needs. The Partnership consists of a stakeholder process supported by the state's commitment to carry out certain regulatory objectives, such as SB 1010 implementation and TMDL development, and to increase agency staffing. The goals of the Partnership include investing in state water resources under existing legal authorities; developing TMDLs for all 92 sub-basins; and developing a stakeholder focus that emphasizes collaborative processes.

In 1997, a total of $30 million was appropriated for implementation of the various aspects of the Oregon Plan, $20 million of which was earmarked for cost-share grants through OWEB. Sources of these funds included timber tax revenue ($13 million), a surcharge on salmon fishing licenses ($1 million), contributions from the concrete industry ($1 million), and monies from the state's general fund ($5 million). In 1998, a ballot initiative passed a constitutional amendment that dedicates 15% of state lottery funds to ongoing support of these initiatives. The amendment is in place for fifteen years, and is expected to yield $30-40 million every two years. These allocations allowed the creation at both the Oregon Department of Environmental Quality and the Oregon Department of Agriculture of 19 new staff positions specifically devoted to water quality issues and to working with the watershed councils.

While the political, financial, and human resources invested in the Oregon Plan have been substantial, some NGO representatives charged that the Governor's Office "significantly oversells the role and efficacy of watershed councils" as a primary solution, favoring them over regulatory approaches. According to these critics, the council process is slow, taking years to draft a restoration workplan for the Tualatin Basin, much less to address regulatory issues. Further, they claimed, the emphasis on involvement of all stakeholders circumvents development of regulatory approaches where they are needed. However, even these NGO sources acknowledged that watershed councils are critical for promoting communication and coordination within a basin, and have served that purpose very well.

The Tualatin River Watershed Council was formed in 1993. The Unified Sewerage Agency, which serves the urban areas of Washington County, was a major force behind initiating the watershed council, even before the Oregon Plan was in place. The Council's stated purposes are to: "increase local input in management of watershed resources; initiate resolution of problems and issues within the watershed; identify problems and issues of importance to local citizens, groups, and users of the watershed; diminish and eliminate further degradation of the watershed and its resources through better management practices; increase the viability, diversity, and health of the watershed; undertake a proactive approach in management of the watershed; [and to] create and implement a watershed action plan encompassing, but not limited to, current and potential problems and issues, potential solutions, restoration/enhancement measures, and monitoring programs within the Tualatin River Watershed."[33]

Like other watershed councils throughout the state, the Tualatin River Watershed Council is not itself an enforcement agency, instead making recommendations to policymakers.[34] It consists of twenty members who represent key interests in the watershed (citizens, agriculture, business and industry, environmental groups, forestry, education, local governments, chambers of commerce, and water and sewer providers), and attempts to reach its decisions by consensus.[35] In 1996, the Council was officially recognized by the Washington County Board of Commissioners, applied for and received an operating grant from the GWEB, and hired a full-time coordinator.[36] In January 1999, the Council adopted the Tualatin River Watershed Action Plan -- "a long-term vision on how to improve water quality, improve fish and wildlife habitat, minimize soil erosion, minimize flooding, and increase recreational opportunities within the Tualatin River Watershed" that strives to integrate existing plans and efforts within the watershed.[37]

The Council views the Action Plan as a technical review that helps set its priorities and define in concrete terms the necessary conditions for ensuring the health of the Tualatin watershed. In addition to this core work, the Council responds to immediate challenges, such as watershed health emergencies and new issues, as they arise. The members interviewed felt that the effort is working well so far, although some noted that the possibility of stricter ESA mandates could present a challenge for the cooperative process. Council representatives have been effective in dealing with their constituencies on smaller problems -- for example, a 1996 flood that caused mudslides on forest land -- but the Council hasn't yet tackled anything as controversial or as comprehensive as the ESA.

Model Watershed Program

The Grande Ronde Model Watershed Program was established in 1992, one of three such programs created in Oregon, Idaho and Washington by the Northwest Power Planning Council. In the Grande Ronde, the Union County and Wallowa County Commissions had foreseen the imminent ESA listing of spring chinook salmon and "determined that a grass-roots, locally-based effort working to coordinate existing local, state and federal programs could effectively maintain, enhance, and restore [the] watershed."[38] The Grande Ronde Program was one of the original models for watershed councils statewide, and continues to act as the watershed council for the Grande Ronde basin. It works closely with the local (Union County and Wallowa County) Soil and Water Conservation Districts, which help implement some of the Program's initiatives.

The Program received initial funding from the Bonneville Power Administration (BPA) and the Bureau of Reclamation, followed by five million dollars from the Watershed Health Program. The BPA has continued to provide funding for administration of the Program, as much as 65-70% of its annual budget. The Program also receives funds or in-kind support from the Bureau of Reclamation, Oregon Watershed Enhancement Board, Natural Resource Conservation Service, and the Union County and Wallowa County SWCDs.

The restoration projects have included small modifications with immediate results, such as upgrading irrigation diversions to allow fish passage; channel restoration, which already has led to significant temperature reduction; and projects, such as fencing and livestock exclusion, vegetation and shading, that are expected to have longer-term results. About 100 projects were undertaken in 1994-95. Since then, between thirty and forty additional projects have been proposed each year, approximately thirty of which get funded -- a total of 260 to date. Funding decisions are made by the Program's Board with the assistance of a technical committee, composed of ten representatives from relevant agencies, that reviews all project proposals and recommends funding priorities to the Board. In addition, OWEB has its own process for reviewing and funding restoration projects, and last year at least fifteen or twenty of these were in the Grande Ronde basin.

The Program maintains a database that keeps track of all restoration projects dating back ten years, and serves as a clearinghouse for that data. Each funded project over a certain size has a monitoring component that requires monitoring for five years, and this data also is made available. In addition, there is a basin-wide water quality monitoring program that is administered through the Union County SWCD, and established to coordinate the activities of the many agencies that were conducting monitoring. The monitoring program's goal is to gather baseline data on temperature, nutrients, sedimentation, and so forth, and to track long-term changes in water quality.

Federal Farm Bill Programs

The various U.S. Department of Agriculture programs for nonpoint source pollution control are administered through the Oregon offices of the Natural Resource Conservation Service, which is headquartered in Portland. The Service's mandate is to provide landowners and local Soil and Water Conservation Districts with technical assistance for carrying out USDA programs. In addition to its regular activities, as part of the Oregon Plan the Service has signed an MOU with the Governor's Office, the EPA Region X office, and NMFS to assist with consultation on ESA issues affecting private lands. NRCS has around 30 field offices in Oregon and 135 staff positions, of which at least two-thirds are in the field.

The Oregon Department of Agriculture coordinates with NRCS to leverage the available funding. The two agencies have formed the "Conservation Partnership," a consortium of agency representatives from ODA, NRCS, the local SWCDs, and the Oregon Association of SWCDs, which meets monthly or bi-monthly to work through issues of common interest. In practice, most implementation activity occurs through the local Soil and Water Conservation Districts, where the real integration happens -- the SWCDs are the direct recipients of both USDA/NRCS and ODA funds.

In 1999, USDA programs active in Oregon included: the Environmental Quality Incentives Program (EQIP), which was described as "the heart and soul" of the Farm Bill programs, with $3.9 million allocated for cost-share assistance in FY 99; the Wetland Reserve Program (WRP), with $1.5 million allocated; the Wildlife Habitat Incentives Program (WHIP), largely focused on threatened and endangered species issues, which had $0.5 million allocated for FY 99 but is unfunded for FY 2000; and the P.L. 556 small watershed program, which has provided "a few million dollars" in targeted planning assistance to address local-level concerns such as watershed plan development and implementation.

Program funding is targeted primarily at identified priority areas within the state. Since Oregon organizes its efforts on a watershed basis, the NRCS has followed suit, creating basin workgroups and local workgoups within the basins that are composed of representatives from NRCS, the local SWCDs and other relevant parties. These workgroups identify resource issues needing attention, set priorities, and make funding recommendations to the State Technical Committee. This approach has been fairly successful; thus far, the greatest limiting factor has not been funding per se, but rather the low availability of technical assistance to implement activities once they are funded.

Recent (FY 98) priority areas for EQIP funding have included the John Day/Umatilla Basin ($742,000), Snake River Basin ($492,000), North Coast Basin ($442,500), Deschutes/Hood Basin ($709,500), Southwest Basin ($481,000), Lower Willamette Basin ($537,000), Central Coast/Upper Willamette Basin ($328,000), and the High Desert Basin ($384,000). However, the Service attempts to fund at least the top priority project in every basin, in order to maintain its presence across the state. In these and other projects statewide, there is a current focus on three issues: salmon habitat, promotion of healthy watersheds, and the Mid-Columbia Plateau.

The NRCS also has a history of providing technical assistance and funding to the Tualatin Basin, dating back to the 1980s. The Tualatin was designated as a "hydrologic unit area," an experimental ground for watershed modeling and testing theories. In addition, the Service has worked on the social aspects of agricultural issues in the basin, including sponsoring focus groups to get the local communities involved and to help them recognize water quality problems.

In addition to the programs described above, Oregon has developed a program under the USDA's Conservation Reserve Program (CRP) and Conservation Reserve Enhancement Program (CREP). Approved in late 1998, the Oregon CREP will be funded at approximately $250 million dollars over 15 years, with 80% coming from the federal government. The program, which is designed to assist in restoration of habitat for salmon and trout listed under the ESA, will restore freshwater riparian habitat along 4,000 miles of streams throughout the state. Agricultural landowners are eligible to enter into 10- to 15-year contracts to plant long-term vegetative cover and exclude livestock in exchange for cost-share and technical assistance. Program goals include: reducing temperature to natural ambient conditions; reducing sediment and nutrient pollution from agricultural lands adjacent to streams by more than 50 percent; stabilizing stream banks along critical salmon and trout streams; and restoring stream hydraulic and geomorphic conditions. The state will conduct monitoring throughout the project to evaluate and record progress in achieving these goals.

Section 319 Program

According to the Oregon DEQ, "grant funds available through Section 319 of the Water Quality Act of 1987 are a critical element in turning Oregon's NPS control program into water quality protection realities in watersheds throughout the state."[39] Section 319 funding totalled $8.7 million dollars between 1991 and 1998, with a budget of $1.35 million in both 1997 and 1998.[40] According to DEQ, funding originally tended toward a large number of smaller projects, peaking in 1994 when EPA approved 32 projects averaging $44,400 each. Starting in 1995, this trend was reversed, "emphasizing fewer, bigger, and longer projects in order to address needs for whole watershed enhancement, to sustain this effort over enough time to effect significant improvements, and to avoid the growing administrative burden on DEQ resulting from having 50 to 60 projects active simultaneously."[41]

The Department has worked to prioritize and apply its Section 319 funding in the basins where TMDLs are needed, because there is more knowledge about water quality concerns in those basins and therefore a greater degree of certainty that money spent will be used directly to meet or achieve water quality standards. In channelling Section 319 funding, DEQ works closely with the local watershed councils. Similarly, Section 319 funds also have provided some support for the local advisory councils and development of water quality management plans under SB 1010, and have been applied to water-quality-related revisions of the Oregon Forest Practices Act.

In the Tualatin Basin, the Section 319 program has funded projects designed to "increase local involvement and stewardship in nonpoint source pollution control projects and contribute to environmental education and water quality monitoring."[42] These include the Dairy-McKay Hydrologic Unit Area Project, which studies the link between agricultural BMPs and water quality; and the Student Watershed Research Project, which encourages middle- and high-school students to monitor water quality data throughout the Tualatin and add it to a regional watershed database.[43]

Discussion and Analysis

Agricultural Water Quality Management Plans (WQMPs)

In 1993, the Oregon Legislature passed Senate Bill 1010 (SB 1010), which directs the Oregon Department of Agriculture to work with the state's agricultural community on non-point source water pollution control. Under the legislation, ODA is authorized to develop and implement watershed-based water quality management plans (WQMPs) that identify measures landowners can use to prevent and control water pollution. ODA must initiate the planning process once water quality concerns have been identified in a watershed and a management plan becomes required by any state or federal law. In practice, EPA's Section 303(d) list of water-quality-impaired watersheds is the strongest driver for watershed planning.

Combined with Senate Bill 502, which further called upon ODA to develop and implement programs and rules that regulate farming practices for the purpose of water-quality protection, this legislation gives ODA exclusive responsibility for regulating agricultural practices that affect water quality. The Department's authority extends to any land being used for agricultural purposes, regardless of its designation under the state land-use planning law or local zoning laws. Although the Department prefers to emphasize technical assistance and other non-regulatory approaches for nonpoint source control, SB 1010 provides enforcement authority when voluntary measures prove insufficient for ensuring compliance with the WQMPs and rules.

ODA has established a four-year time frame for WQMP development in impaired basins. In parallel, the Oregon DEQ has established a ten-year time frame for its issuance of Clean Water Act TMDLs that will cover many of the same basins and apply to many of the same non-point sources. As a result, the WQMPs already in place have in part served as "early action plans," which contain enforceable conditions intended to minimize nonpoint pollution, even before specific TMDL numbers have been calculated and allocated among the various point and nonpoint sources within the basin. ODA acknowledges that its four-year timetable is ambitious, but notes that it has roughly been able to adhere to this schedule, allowing for some initial delays in starting up the process. While only a few final plans are in place at the time of this study, many more are in draft form, and a number of final plans will be issued over the next six months to one year.

To ensure consistency and uniformity in plans throughout the state, ODA has adopted rules governing the process for plan development and enforcement.[44] Although ODA retains the ultimate decision-making authority, these rules call for public consultation with ad hoc local advisory committees (LACs) composed of various stakeholder representatives from the basin. Local advisory committees are distinct from the watershed councils promoted under the Oregon Plan, but there is considerable overlap between the two, and it is generally felt that inclusion of watershed council members on the local advisory committees helps to promote coherence and collaboration.

As developed through this stakeholder process, the WQMPs establish both general goals for the basin (for example, reduction of sediment loading) and performance standards designed to encourage or discourage certain activities consistent with these goals. In crafting the plans and their accompanying rules, ODA's goal is to leave flexibility for landowners to achieve performance standards through the practices they deem most appropriate for their operations. These can include adoption of specific BMPs. After being developed by the LAC and reviewed by ODA, the rules are issued through a formal rulemaking process, and thus go through an additional round of notice and comment before becoming final. They then are given to the appropriate local management agency -- usually the county soil and water conservation district or districts -- for implementation. In many cases, a year or more may elapse from the time a local advisory council is appointed until the rulemaking process is finalized.

The Tualatin River Basin is noteworthy for having adopted Oregon's first agricutural water quality management plan, in April 1996; it also has the state's first TMDLs, for phosphorus and ammonia, which were issued in 1988 and approved by EPA in the early 1990s. Significantly, there is a history of controversy and litigation that played a role in attaining these milestones, including citizen suits that established the TMDL process and subsequent lawsuits to enforce TMDLs. In effect, the existing nonpoint source control measures in the basin stemmed from point source concerns during the 1980's, when local environmental groups went to court over pollution from thirty municipal wastewater treatment facilities. In 1986, the Northwest Environmental Defense Center filed a lawsuit against Oregon DEQ and U.S. EPA for failing to set effluent discharge limits within 180 days, as required by the federal Clean Water Act -- the first successful suit in the nation to require enforcement of the total maximum daily load provision of the Act.[45]

This case was resolved in part by a consent decree that divided the area into forest, agriculture, and urban districts, assigning load allocations for each, and assigning responsibility for meeting the allocations to different local management agencies. For forestry, the designated agency is the Oregon Department of Forestry; for agriculture, the Oregon Department of Agriculture, which can delegate its authority to the local Soil and Water Conservation Districts; for urban, the Unified Sewerage Agency (a regional agency that covers twelve cities), Clackamas, Multnomah, and Washington Counties, and the cities of Portland, Lake Oswego, and West Linn. In short, the consent decree mandated a cooperative, cross-sectoral planning process well before the enactment of SB 1010.

Indeed, the substance of what became SB 1010 was pioneered by the Washington County Soil and Water Conservation District, which helped implement the judge's decision for the agricultural sector. The SWCD developed an approach through a public procedure that involved all stakeholders and attempted to foster agreement on the importance of water quality protection. This approach was directly incorporated into the legislation, and paved the way for further development of the Tualatin WQMP after the legislation was enacted in 1993.

Once SB 1010 was passed, a local advisory committee was formed to develop a draft plan and rules for the Tualatin basin and submit them to ODA. Participants included a number of local farmers, representatives of environmental groups, and various local government agencies. The committee also employed a 15-person technical committee composed of volunteer experts from the NRCS, university extension services, and several state government agencies. Operating through discussion, negotiation, and consensus, the advisory committee spent nearly a year working with ODA to draft the water quality management plan and the proposed implementing rules. Once the plan was drafted, ODA drafted administrative rules, which were subject to notice and comment before being finalized in April 1996.

Opinions were mixed on the level and efficacy of stakeholder involvement in the Tualatin planning process. In general, regulators argue that the composition of the local advisory council is critical to its efficacy; for the rules to carry weight with the landowners, they need to be put forth by credible representatives of the different user groups. Similarly, most participants from the agricultural community appear to feel that the combination of stakeholder representation on the local advisory committee and expert assistance from the technical advisory committee were instrumental in making the process work in the Tualatin. More recently, however, the process has provoked resistance from farmers in other basins.[46]

Further, some representatives of local conservation groups view the heavy emphasis on stakeholder input and consensus as an obstacle to the development of effective, enforceable plans. These sources cited the extensive outreach effort required to raise awareness of the importance of wetland and riparian areas in the first place, and to convince farmers that their practices can have negative impacts on these resources. They further argued that even after the agricultural community had been brought to the table, it exhibited an exclusive preference for voluntary, education-based approaches over regulatory mechanisms, and a "total opposition" to considering any new taxes or fees to cover the cost of implementing even these measures.

The resulting Tualatin WQMP essentially constitutes a basin-wide resource assessment, which identifies performance standards required of all landowners, other resource concerns, endangered species issues, current farming practices and fertilizer use. Its primary objective is to address water quality violations, issues raised by other laws such as the Endangered Species Act, and fish and wildlife concerns as they affect water quality. The Washington County SWCD implements the plan by prescribing best management practices that address erosion control, temperature, and so forth. There was a grace period of two years for public notice and education about the rules and the consequences of violating them, in accordance with SB 1020, a companion bill that requires that the public be adequately informed about the new rules before they become the object of proactive enforcement.

In the Grande Ronde River Basin, the SB 1010 WQMP recently was completed. There, the local advisory committee included a number of local ranchers and farmers, the county extension services, Union County government, the Department of Public Works, and Union County and Wallowa County SWCDs, and produced a plan that has now been enacted into regulations.

On a roughly parallel track, the TMDL process for the Grande Ronde basin is nearing completion for parameters of temperature, nutrients, dissolved oxygen, pH, and sediment -- most of these resulting from nonpoint source discharges. For this reason, the Grande Ronde TMDLs drew upon and incorporated much of the information generated during the SB 1010 process, even though the TMDL process includes sectors besides agriculture. Stakeholders represented on the TMDL planning committee included the SWCDs, Union County, the La Grande city government, transit and public works agencies, the forestry sector, and private companies such as

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Boise Cascade. The committee was divided into subcommittees that dealt with specific sources such as agriculture, forestry, urban runoff, etc.

Relationship Between WQMPs and the TMDL Process

The situation in the Grande Ronde basin illustrates the complex interrelationship between the SB 1010 WQMP process and the ongoing development of TMDLs under the federal Clean Water Act. Oregon DEQ is currently more than two years into its ten-year schedule to complete all TMDLs statewide. A lot of the work to date has been driven by Clean Water Act citizen suits, decisions, and settlements, as well as ongoing concerns about ESA salmon species listings that have brought habitat issues such as sedimentation and temperature to the forefront. (Indeed, as this study was being drafted, the Sierra Club announced that it was filing suit to compel DEQ to finish TMDLs for all Oregon waters within 180 days.)

The Department has adopted a sub-basin approach, noting that there is incomplete information on water quality in many areas and that it therefore makes most sense to focus more widely rather than on isolated stream segments. By covering an entire sub-basin, both point and nonpoint source concerns can be identified, and point source control and nonpoint source control can be more tightly integrated.

For these reasons, and because of the broader coordination goals under the Oregon Plan, DEQ has decided to include implementation plans as part of its TMDL load allocations. These plans are the point at which the various enforceable elements of state law (SB 1010, the Forest Practices Act, and the statewide planning law) intersect with one another and with the federal TMDL process. DEQ has entered into separate memoranda of agreement with ODA and the Oregon Department of Forestry (ODF), specifying each agency's role in the TMDL process, and has issued guidance on the elements necessary in an SB 1010 plan if it also is to serve as a TMDL for nonpoint sources.[47] In addition, the Governor's Office has been working through the Healthy Streams Partnership to better integrate WQMPs and other state efforts into the TMDL process.

Statewide, there has been some debate over the appropriate timing for development of an SB 1010 plan vis-á-vis TMDL development for the same basin. As noted, ODA is currently on a four-year timetable for completion of all WQMPs, and although the agency is uncertain whether it will meet this goal, it is likely that most plans will be in place before all the TMDLs are completed. As one regulator explained, this discrepancy results in a "chicken-and-egg" problem: it is difficult to craft a definitive SB 1010 plan without knowing load allocations for the agricultural sector, but it is also difficult to calculate and implement realistic load allocations without mechanisms such as the SB 1010 rules and performance standards in place. As a result, some sources thought ODA should postpone WQMP development until TMDLs have been developed, in order to generate plans that are directly driven by numerical standards; others believe it is appropriate for 1010 plan development to get underway before TMDLs are issued.

Most regulators found merit in the early stakeholder involvement afforded by the SB 1010 planning process, arguing that it provides a valuable opportunity to get the agricultural community into the mindset of revising its practices. ODA in particular contends that the lead time is important for introducing new ideas and for facilitating a climate of good stewardship in advance of federal mandates. By issuing plans on a shorter timetable, ODA seeks to set initial performance standards for landowners, and to add elements to these plans as needed to meet the TMDL allocations. The Department claims that it is attempting to reach a middle ground of "goal-oriented" measures rather than purely prescriptive practices. It acknowledges that it has yet to fully convince EPA that its approach will work, but argues that it resonates better with its constituents than prescriptive measures would. In short, ODA doesn't want debate about numerical endpoints to stall the possibility of immediate progress, and it hopes to avoid resistance to a second round of potentially more stringent planning and regulation by anticipating and educating parties about it through the current planning process.

Nevertheless, there remains some concern within the agricultural community about the interaction of the SB 1010 process, the TMDL process, and the perennial specter of Endangered Species Act requirements. According to one source, some farmers wonder why they're doing so much work now if the federal government is simply going to come along and add another layer of regulation. Landowners feel that they can live with what they know now, even if it requires some additional work, but "they're scared to death about what's coming down the pike." One reaction is that DEQ and EPA will need to interact better with people in the field to consider the efficacy of the requirements and the process used, rather than just assign load allocations: "The people writing the [TMDL] rules need to sit down with real live people."

In the Tualatin Basin, TMDL concerns are already being incorporated into the second round of the SB 1010 process, which has reconvened the local advisory committee to review and amend the existing WQMP. Interviewees felt that this was an appropriate juncture for using the local advisory committee process to integrate the two programs, though they expressed some concern about the time required to get new members of the advisory committee up to speed. In the Grande Ronde Basin, the TMDL process used a lot of information generated during the just-completed SB 1010 process, and the TMDL implementation plan specifically identifies the WQMP as a mechanism for meeting load allocations. Interviewees there felt that early development of the WQMP had offered localities a stronger voice in TMDL development and let farmers "get a jumpstart" on updating their practices.

Enforceability of WQMPs

By design, WQMPs tend to embody a "graduated suite" of enforceable mechanisms that grow progressively more severe if violations are not corrected. To begin with, the plans typically allow for a phase-in period of at least two years, during which time notice of the requirements is given, but they are not proactively enforced. During this period and subsequently, the local SWCD is at the front line of compliance efforts. The SWCDs work with landowners to correct any problems, and will give the landowner a certain amount of time to come into compliance. If this approach does not work, the SWCD can correspond with landowners and notify them of the availability of technical assistance, and will continue to work with the landowner to reach agreement on a resolution of the problem. If this effort fails, the District then may turn the case over to ODA for enforcement. In the Tualatin, SWCD officials have resolved more than 300 cases through voluntary compliance since the rules became final in 1996.[48]

Similarly, ODA's policy is that enforcement action "is pursued only when reasonable

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attempts at voluntary solutions have failed."[49] The Department may initiate an investigation when it receives a written complaint of a violation of WQMP implementing rules, or its staff is referred to or directly observes conditions that violate the rules.[50] If noncompliance is verified, the agency can employ its own spectrum of enforcement actions, including issuance of a warning, issuance of a citation with an order to correct the violation, and generation of a compliance plan with prescribed measures and dates for implementing them and correcting the violation. If a landowner does not comply with these mechanisms, the Department may assess civil penalties of $50 to $2,500 for a first violation and $100 to $10,000 for repeat violations, based on the history of violations and the gravity of the violation's impacts on human health and the environment. Abatement actions also are available.

Given its long history, the Tualatin WQMP was the first plan in the state to become ripe for enforcement action starting in early 1998. Since the plan became enforceable, the Washington County SWCD has received at least sixty complaints requiring investigation, only three of which it referred to ODA. The referrals resulted in the Department issuing one notice of noncompliance and several "water quality advisory letters" warning of potential problems. Ultimately, however, each of these situations was remedied without resorting to penalties.

The Washington County SWCD expressed some initial frustration with the ODA's handling of the enforcement referrals, noting that in each case, the SWCD had established a long history of attempting to work with the landowner prior to the referral, and was more than ready for enforcement to begin. Instead, in the SWCD's view, ODA occasionally had a tendency to retrace the SWCD's steps in attempting to persuade the landowner to make improvements, rather than bringing regulatory mechanisms immediately to bear.

The Washington County SWCD also noted the complementary nature of enforceable and voluntary mechanisms, and the significant amount of voluntary action that is taken in the shadow of a credible enforcement threat. Once a few notices had been issued, the SWCD experienced an influx of other people interested in adopting voluntary measures and taking advantage of technical assistance programs. In one month alone, 35 people came forward wanting to write a voluntary management plan for their land, which created a backlog because the SWCD lacked sufficient staff to accommodate everyone at once. While this situation is atypical, the SWCD believes that interest in voluntary actions will continue to ebb and flow with enforcement, and that the next high-profile enforcement action will cause a similar influx of volunteers.

In sum, the Washington County SWCD believes that enforcement is needed to deal with the small percentage ("three to five percent") of people who are genuine bad actors. In the District's experience, problem cases tend to stem from absentee landowners or new residents who have just moved to the area. In contrast, they view long-time landowners and small commercial farmers as generally more sympathetic to the concept of good stewardship, and able to be convinced to work within the emerging planning and regulatory processes.

Similar attitudes toward enforcement were noted in the Grande Ronde Basin, though the grace period means that there has not yet been a test of enforceability of the new WQMP. There, voluntary actions by the agricultural sector have been spurred by enforcement action taken by the DEQ on water quality, the Oregon Water Resources Department on water quantity -- water rights being a major issue in arid Eastern Oregon -- and the Division of State Lands on fill and removal permits. The threat of what might happen in the future, particularly with respect to water rights, has been a big motivator for restoration and other voluntary activities: "people would rather take the initiative now."

In general, it was felt that attitudes in the Grande Ronde area have improved substantially over recent years, with more people talking about water quality. The large proportion (65-70%) of federal land holdings in the area have simplified the process, as the U.S. Forest Service and Bureau of Land Management have been cooperative. For private landowners, the SWCDs are the focal point, as the majority of their work is on private agricultural or ranch land. Perhaps the most important factor is the local land ethic -- most private landowners are individuals and families, not companies, so they care about aesthetics as well as property values. As in the Tualatin, the locals believe that the only genuine bad actors tend to be recent arrivals or absentee landowners.

Forest Operations

Enacted in 1971 and significantly revised in 1986 and 1991, the Oregon Forest Practices Act[51] is administered by the Oregon Department of Forestry. The Act applies on any non-federal land where a commercial forest operation is being carried out, regardless of how the land is zoned and even inside urban growth boundaries. However, the Act is primarily targeted at ongoing harvest operations, and is not ideally suited for addressing one-time operations such as clearing an urban lot and selling off the timber. For this reason, local governments also have the ability to develop forest ordinances within urban growth boundaries, in which case ODF usually defers to their authority.

Under the Act, the Oregon Board of Foresty has adopted forest practice rules containing best management practices for forestry.[52] The BMPs serve as a safe harbor from the state water quality law and other pollution control statutes; if operators comply with the BMPs, they are also deemed to be in compliance with pollution control laws.[53] In recent years, the Act, rules, and BMPs have increasingly focused on water quality issues. In September 1994, the rules were specifically amended to increase streamside protection -- according to the Department, "the most comprehensive riparian protection rules ever enacted on non-federal land in Oregon."[54] The new rules focused on maintaining trees and vegetation along streams, developing woody debris to create stream structure for fish habitat, and maintaining adequate fish passage along the length of a stream.[55] Among other requirements, they mandate that all fish-bearing streams have a riparian management area of between 50 and 100 feet, including a twenty-foot no-harvest buffer zone on either side.[56]

The Act requires forest operators to notify ODF of pending operations, and the Department receives 18,000-20,000 such notifications annually. There are 54 Forest Practices Foresters who review notifications and written plans, prioritize oversight based on potential risks to natural resources, and issue approvals. A number of operations are then chosen for inspection. ODF is currently in the process of doing a statistical analysis of compliance rates.

Based on the notifications and inspections, ODF issues 200-400 citations per year, some for procedural violations (e.g., failure to notify or to obtain an approval), and others for actual damage to forest resources. For the past 10 years, ODF has focused its efforts on civil penalty mechanisms; while criminal penalties are available, it has proven difficult to get criminal courts to pay attention to water violations as opposed to violent crimes. In assessing civil penalties, ODF uses a formula to ensure consistency. The formula is spelled out in the administrative rules, and takes into account such factors as the level of damage to natural resources and the operator's previous history of violations. The Department has found this procedure to be an effective deterrent, but slow -- any citation can be appealed and receive a full administrative hearing, and 20-30% of violators elect to go this route. As a result, there is a backlog in assessing and collecting penalties, and the agency is constantly lacking adequate staff and budget resources.

ODF maintains a civil penalties database that is capable of generating statistics on penalties issued and breaking out substantive violations from purely procedural violations. According to that database, in 1997 there were 41 cases of penalties assessed for violations of water-quality-related rules, including one instance of criminal penalties for illegal instream operation of machinery. Civil penalties assessed totalled nearly $41,000, for an average of approximately $1,000 per violation, and the highest penalty assessed for a single violation was $3,400. Assessed penalties frequently were reduced, suspended, or mitigated due to new facts or subsequent cooperation by the violator.

The Department cited one significant case in Clatsop County in Northwestern Oregon as crucial to its enforcement efforts. There, an operator with a history of violations was cited $30,000 in civil penalties for multiple violations. As a result of this case, ODF received new legal authority to bar forest operators with outstanding penalties or non-compliant conditions from conducting forest operations altogether, a useful gain: "We have stretched out the continuum of enforcement tools we have available to us."

Given the well-established enforcement structure, most current attention has centered not on enforceability of the existing forest practice rules, but on their adequacy for protecting water quality. In addition to the Forest Practice Act's own provisions for periodic review of the BMPs, the Oregon Plan has been a major driver for various other review mechanisms. In 1997, as part of a memorandum of agreement between the State and the National Marine Fisheries Service that was intended to forestall ESA listing of coho salmon, the Governor agreed to set up a forestry advisory committee to assess current practices. The committee was established, but its work came to a halt in mid-1998, when a federal court ruled that NMFS was required to make the listing.

In January 1999, the Governor's Executive Order 99-01 reaffirming the Oregon Plan spelled out additional requirements for salmon habitat protection. It required the Board of Forestry to reappoint a Forest Practices Advisory Committee to finish the task of considering the adequacy of regulatory and non-regulatory forestry practices, and to provide the Board with policy recommendations, including possible changes in regulations. There has been some carry-over in membership from the original forestry advisory committee, though the current Committee is not as narrowly focused on ESA issues. The Committee's recommendations are expected in 2000.

In parallel, the state legislature has established an "Independent Multidisciplinary Science Team" (IMST) that is charged with looking at all aspects of the salmon issue in Oregon and making recommendations through a series of reports. In September 1999, the IMST issued its assessment of the forest practice rules, concluding that "the current rules for riparian protection, large wood management, sedimentation, and fish passage are not adequate to [p]reserve depressed stocks of wild salmonids."[57] While the IMST report makes several recommendations for improvements within the existing policy framework, it also argues for more sweeping changes, such as incorporation of the Oregon Plan and Executive Order 99-01 into the Oregon Forest Practices Act and/or the Board of

Forstry's policies and adoption of a "landscape-scale approach" that goes beyond site-specific measures to consider cumulative watershed impacts.[58] These recommendations were presented to the Forestry Practices Advisory Committee; ODF believes that the IMST's findings largely parallel recommendations that are already on the table in the Advisory Committee's deliberations.

Relationship Between Oregon Forest Practices Act and the TMDL Process

Beyond the safe harbor provision of the Act, any potential overlap between ODF and DEQ jurisdiction (especially in developing TMDLs) is handled by a memorandum of understanding between the two agencies, which determines what kind of action will be taken in certain kinds of situations. In basins where the two agencies agree that water quality impairment is not attributable to forestry, the existing forest practice rules are deemed to be the compliance mechanism for forest lands, and ODF generally does not participate in the TMDL or WQMP process. In basins where a legacy of forest practices has contributed to water quality impairment but the agencies agree that the current BMPs are adequate for ongoing protection, the forest practice rules are deemed to be the compliance mechanism, and ODF will participate in the planning process "as necessary." In basins where the agencies disagree about whether the current BMPs are adequate, the forest practice rules serve as the interim compliance mechanism, but ODF must design a specific monitoring program as part of the basin plan; if the monitoring indicates that changes are needed, the agencies then will work together to develop further watershed-specific rules. Likewise, if both agencies agree that current BMPs are inadequate for a basin, they also must collaborate on watershed-specific rules.[59]

Similarly, coordination between ODF and other agencies such as ODA varies depending on the basin in question. For the most part, ODF and ODA operate independently from one another, each agency having its own MOU with DEQ. To the extent that the TMDL process is shaped by specific landscapes, DEQ tends to work with each agency independently. The Governor's Office has been encouraging ODA, ODF, and DEQ to coordinate their efforts, and the agencies have met at the policy level several times in the past year. The agencies acknowledge the need to cultivate closer relations in the future, particularly in basins characterized by mixed forest and agricultural practices, such as construction of dual-use roads or grazing on forest land.

More generally, where nonpoint source pollution is concerned, there is a certain amount of finger-pointing between the forestry and agricultural sectors, on the part of both the agencies and the regulated community. The forestry industry cites its history of scrutiny and regulation under the Forest Practices Act, and argues that, whatever reforms may still be needed, it should not bear the brunt of the blame for the salmon crisis. Some regulators agree, noting that forestry has presented an easy target for regulation because it has a smaller constituency of readily identifiable operators, as opposed to agriculture, which has multiple constituencies that are more reluctant to acknowledge their role in nonpoint source pollution. Even environmental NGOs, long-time critics of Oregon's forest industry, conceded that some progress has been made through the Forest Practices Act, and lamented that comparable headway has not yet been made with agriculture.

Responses from agriculture sources sometimes appear to confirm this assessment: in the Grande Ronde, a heavily agricultural basin, a survey conducted by the Union County SWCD showed that "most residents consider watershed health as an issue concerning logging and forestry....and many did not link their own actions to watershed health problems."[60] However, regulators argued that in fairness, the agriculture sector has had ten to fifteen fewer years than the forestry sector to think about nonpoint issues, and pointed to the progress currently being made under SB 1010. They believe it is important for the agricultural community to adopt responsibility for controlling its own pollution, and lauded the steady, if "incrementalist," approach being taken by ODA to bring its own constituency on board. Further, they pointed out that some of the same oversight mechanisms used in the forestry sector, such as a statewide advisory committee, may soon be applied to agriculture; the IMST is planning to do a comparable analysis of the relationship between agricultural practices and the goals of the Oregon Plan.

Statewide Comprehensive Land-Use Planning

Oregon's statewide comprehensive land-use planning program supports nonpoint source pollution control by providing a framework in which local jurisdictions can implement enforceable mechanisms related to development and specifically targeted at nonpoint sources. Passed in 1973, the law requires municipal, county, and regional governments to develop local land-use plans and to comply with 19 statewide planning goals. Plans are updated on an ongoing basis through a process known as "periodic review."

According to DLCD officials, the statewide planning process provides authority to enact local ordinances governing land uses that affect watershed functions and aquatic habitat under several of the existing statewide goals. These include Goal 5 (natural resource protection, including riparian and wetlands resources), Goal 6 (protection of air, water, and land resources), and Goal 7 (natural hazards and floodplain protection). Some also argued that similar results could be achieved through the creative application of Goal 11 (public facilities, including stormwater control), Goal 14 (urbanization and "smart growth"), Goal 15 (the Willamette River Greenway), Goal 16 (estuarine resources), and Goal 17 (coastal shorelands). Only some of the planning goals have been implemented through administrative rules.

Goal 5 covers "natural resources" in their broadest sense; provisions under this goal that are relevant to nonpoint source pollution include protection of riparian areas and wetlands. Goal 5 has been codified in rules that require local jurisdictions to adopt programs that comply with the goal when they revise their comprehensive plans.[61] Goal 5 requires localities to inventory certain specified natural resources to determine their "significance" and to protect significant resources. Importantly, the riparian rule provides a safe harbor whereby communities can opt out of the inventory requirement simply by designating a 50-foot protective buffer zone along all streams as "significant."

The purpose of *Goal 6* is "[t]o maintain and improve the quality of the air, water, and land resources of the state." This goal does not have administrative rules, and in practice typically results in the inclusion in local plans of a statement that all land-use decisions will comply with federal and state environmental laws. However, DLCD officials point out that little attention has been paid to the goal since it was adopted in 1974-75, when point sources were perceived as the major cause of water pollution. For this reason, they believe that the potential for Goal 6 to be applied to nonpoint sources has not been fully analyzed. For example, the goal states that discharges may not exceed the carrying capacity of receiving water bodies, and a recent decision of the Land Use Board of Appeals applied this provision to prevent a local government from amending its plan to allow future development near an impaired water body.[62] Since that decision was not limited to point sources, it could easily extend to planning decisions that affect nonpoint sources.

However, the planning law's interaction with major categories of nonpoint source pollution is unclear. While *Goal 3* and *Goal 4* aim at the conservation of agricultural lands and forest lands, respectively, they do not expressly allow for land-use regulation for the purpose of protecting water quality within areas designated for those uses. Indeed, there is a statutory provision that gives the forest practice rules precedence over land-use rules, and SB 1010 similarly appears to preempt jurisdiction over agricultural practices. DLCD feels the TMDL process ultimately will become the superstructure for integrating these concerns, including the land-use planning goals, but notes that this coordination hasn't yet happened.

Similarly, Department sources believe that there is room for more thorough integration of local land-use planning into the basin-level initiatives taking place under the Oregon Plan and the watershed councils. They expressed admiration for the work of the watershed councils, but note that they are focused on restoration and are careful to avoid regulatory responsibility. The intersection between watershed planning and local comprehensive planning is ill-defined, and there could be more interaction between the two. In part, this is for political reasons -- local officials are not yet paying sufficient attention to the Oregon Plan, except for a forward-looking few who already have some sense of what the ESA mandates may soon require. Until local planners get authority and resources from local administrations and city councils, they will be unable to address these issues in a comprehensive fashion.

In an attempt to raise awareness and to provide regulatory tools at the local level, DLCD presently is drafting a model water quality code for small cities (population 10,000 or less). Essentially a technical assistance document rather than an enforceable mechanism, the model code contains detailed provisions that cities could voluntarily adopt, enact and enforce locally. The Department hopes that growing concern over TMDL load allocations and ESA liability will be the drivers for the code's adoption, and it includes model load allocations on a sliding scale. The draft is expected to be completed in early 2000.

The Tualatin Basin is an excellent example of land-use planning being employed to address water quality issues. There, the combination of a history of water pollution issues, some uniquely powerful regional government agencies, and the political sensibilities of the Portland metropolitan area has resulted in a number of ongoing planning and regulatory efforts. Both state and local government officials, as well as NGOs within the basin, cited these as relevant to nonpoint source control and an essential component of addressing ESA and TMDL concerns.

The metropolitan Portland area has a regional planning organization known as "Metro" that handles comprehensive land-use planning for the entire region, which covers three counties and 24 cities and includes part of the Tualatin Basin.[63] More than a simple council of governments, Metro is the only directly-elected regional government in the country; it was created by referendum and governs directly in its region. By law, once Metro adopts a policy at the regional level, its constituent local governments must amend their comprehensive land-use plans to comply. While Metro has the legal authority to compel localities' compliance, enforcement more typically is through fiscal measures, such as withholding regional transportation funding from the non-complying jurisdiction.

In 1993-94, Metro began work on "Region 2040," a growth concept for the Portland metropolitan region, predicated on holding the urban growth boundary steady and protecting the natural resources within it. In short, Metro projected growth trends and needs, removed 16,000 acres from the "buildable lands" category within the growth boundary, and concluded that there was no need to move the boundary (though it recently has been extended by 5,000 acres, amid much controversy). The original 16,000 acres removed included all floodplains, wetlands, stream corridors, and slopes above 25% grade. In addition to this regulatory move, Metro inaugurated an "Urban Green Spaces Program" to acquire streamside habitat land, a non-regulatory, acquisition-based approach.

More recently, Metro adopted Title 3, a set of regulations on floodplain and water quality management in urban riparian areas that is designed to implement statewide planning Goals 6 and 7. Title 3 has three main focuses: it mandates region-wide erosion controls for all new developments, regardless of size; requires every local government to adopt vegetative corridors for stream segments within their jurisdiction; and improves management of the 100-year floodplain. The regulations include a model local ordinance that has already been adopted and become enforceable in many of Metro's constituent communities; the formal deadline for compliance was December 1999.

Both regulators and NGOs agreed that the next large challenge for the urban portion of the Tualatin Basin will be control of stormwater discharges and the reduction of impervious surfaces. In dealing with stormwater issues, Metro can draw upon the Unified Sewerage Agency (USA), a regional service district that covers the urban areas of Washington County, as well as portions of Multnomah and Clackamas Counties and the City of Portland. USA was formed about 30 years ago to deal with the sanitary waste problem in the watershed, and its initial mandate was limited to sanitary waste.

In the late 1980s, following the TMDL suit filed by the Northwest Environmental Defense Center, USA was given authority to deal with stormwater, and it now holds the Municipal Separate Storm Sewer System (MS4) permit for twelve cities. Stormwater is handled primarily via intergovernmental agreements among these cities, which have agreed to have USA set minimum standards (for example, erosion control and buffer widths) for surface water quality control, and to take responsibility for implementing the standards. USA retains a degree of oversight capability because the cities are required to obtain USA's consent before issuing any new site permit for connection to sewage and stormwater systems.

In addition, through its Surface Water Management Program, USA also has its own regulatory authority. For example, the Agency handles erosion control permits for construction sites up to five acres, and also has an erosion control program that goes down to the single family home. Under the latter program, there is a two-tier enforcement structure. The first step is to notify violators of any problem and to request correction within 24 hours; the next step is to stop work until the situation is corrected. The hook for compliance is the requirement that USA sign off on building permits, although problems arise with developers who modify plans after USA signs off. The Agency is currently trying to identify enforceable mechanisms to control this type of situation.

Metro has asked USA to assist with implementation of Goal 6 water quality standards through Title 3; cities also have asked USA to help them meet the requirements, since Title 3 is modeled in part on USA's model municipal ordinance package that requires certain buffer widths. According to the Agency, it is willing to help, but concerned about trying to simultaneously manage water quality and land use. Its primary responsibility under the MS4 permit is water quality control. In protecting water quality through land use, however, the agency risks falling subject to takings claims, and has therefore been reluctant to make any final decisions on land use.

Some local NGOs were critical of the USA's role in managing stormwater discharges, claiming that the MS4 permit fails to incorporate specific load allocations, instead referencing only BMPs, and that the effect of USA's role has been to shield the individual municipalities from Clean Water Act liability. At the time of this study, Tualatin Riverkeepers and Northwest Environmental Defense Center had filed a notice of intent to sue EPA and Oregon DEQ to correct this situation.

Conclusions

Oregon has a broad array of both assistance-oriented and enforceable mechanisms aimed at improving watershed health and reducing nonpoint source pollution. The steadily growing concern over TMDL requirements and ESA listings of salmonid species has led to increased attention being paid to these issues. It also has led to the need to integrate the State's numerous water quality programs. The main initiative for habitat restoration, the Oregon Plan, relies primarily on cost-share and technical assistance and voluntary activities through local watershed councils. The main regulatory effort, development of TMDLs with enforceable implementation plans at the watershed level, builds upon and attempts to coordinate existing state-law processes for the agricultural, forestry, and urban sectors, among others. In turn, these state mechanisms may need to be ratcheted up to meet potentially stringent federal standards, given the current preference for encouraging voluntary compliance with SB 1010, the criticisms of the adequacy of the current forest practice rules, and the difficulty of ensuring local compliance with statewide planning goals.

There is ample evidence of the efficacy of deploying voluntary and cost-share programs alongside enforceable mechanisms. However, there may also be some tension between the two, or at least the danger of sending mixed signals, particularly if both are administered by the same agency. In this regard, the example set by ODA will be crucial, as it continues to evolve from its historical role of provider of technical assistance to that of implementer and ultimate enforcer of the SB 1010 plans.

The SWCDs appear well-situated to continue to provide technical assistance and cooperative oversight of voluntary activities, in addition to serving as ODA's early warning system for enforcement issues. However, they also indicated a need for more decisive action once an enforcement referral to the Department is made. Oregon's brief experience thus far suggests that while stakeholder participation and voluntary compliance are worthy goals, they must be backed by a credible threat of enforcement against genuine bad actors. It remains an open question whether ODA will be able to overcome the political resistance from its own constituency and be successful, first, in meeting its ambitious timetable for development of the WQMPs; and second, in enforcing their provisions once they are established.

Other questions relate to the integration of the WQMPs, forest practice rules, and land-use planning into the TMDL process. As discussed, Oregon DEQ has devised agreements with both ODA and ODF that govern its relationship with each of those agencies. But equally important is the relationship between ODA and ODF, especially in watersheds that have both farming and forest uses, and the two agencies expressed a desire to cooperate more closely with one another in such watersheds. But each department inevitably reflects its constituency, and finger-pointing between the agriculture and forest sectors could come to hinder their cooperation on planning and regulatory goals. Ultimately, the task of coordination could fall to the Governor's Office, which is attempting to encourage dialogue among all state agencies.

Less well-defined is the actual or potential connection between WQMPs and TMDL implementation on the one hand, and state and local land-use planning on the other. There is significant overlap between the objectives of the water-quality statutes and the planning law, though they are administered in very different ways. Since both WQMPs and TMDLs are being developed through separate planning-oriented processes at the basin level, it may make sense to explore more direct integration of local land-use planning into watershed planning.

Indeed, a key advantage of Oregon's statutory framework and current policy decisions is that all the major legal mechanisms -- the TMDL process, agricultural water quality management plans, forest practice rules, and land-use planning -- are not only being authorized and coordinated at the state level, but also are targeted at, and delegated down to, the watershed or local levels. This thorough adoption of a basin-by-basin approach, which is also reflected in the voluntary activities under the Oregon Plan, provides a sound hydrological basis for water quality improvements, and facilitates coordination among the relevant agencies and regulated communities. Equally important, it allows for meaningful stakeholder participation and decision-making at the local level.

ENDNOTES

1. In addition to the sources cited, the following individuals were interviewed by telephone: Jeff Allen, Executive Director, Oregon Environmental Council; Ann Beier, State Floodplain Program Manager, Oregon Department of Land Conservation and Development; Ken Bierly, Program Manager, Oregon Watershed Enhancement Board; Rosemary Furfey, National Marine Fisheries Service; Don Greiner, Director of Field Operations, Natural Resources Conservation Service; Stephanie Hallock, Office of the Governor; Mike Houck, Audubon Society, Portland; John Jackson, Planning Director, Unified Sewerage Agency; Lyle Kuchenbecker, Executive Director, Grande Ronde Model Watershed Program; Sue Marshall, Public Policy Director, Tualatin Riverkeepers; John McDonald, Chair, Washington County Soil and Water Conservation District; Sandy Middleton, Civil Penalty Specialist, Forest Practices Program, Oregon Department of Forestry; David Morman, Policy Unit Manager, Forest Practices Program, Oregon Department of Forestry; Dick Pedersen, Manager, Standards and Assessments Section, Water Quality Division, Oregon Department of Environmental Quality; Amanda Punton, Coastal Specialist, Oregon Department of Land Conservation and Development; Jeffrey Weber, Salmon Plan Coordinator, Oregon Department of Land Conservation and Development; Bill White, Program Officer, Natural Resources Conservation Service; Mike Wolf, Water Quality Program Manager, Natural Resources Division, Oregon Department of Agriculture; and Lorna Youngs, Oregon Department of Agriculture.
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3. Tualatin River Watershed Council, "Tualatin River Watershed Facts," <<http://www.upa.pdx.edu/CWSP/WATSHED/tualatin/tual.htm>>.
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5. Tualatin River Watershed Council, "Council History and Purpose," <<http://www.trwc.org/council.html>>.
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13. Or. Rev. Stat. § 561.191.
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15. See Or. Admin. R. § 603.95.
16. Or. Rev. Stat. §§ 568.915, 568.918 & 568.933.
17. Or. Rev. Stat. § 568.930.
18. Or. Rev. Stat. § 527.765(1).
19. Or. Admin. R. 629-24-102.
20. Or. Rev. Stat. § 527.770.

21. Or. Rev. Stat. § 527.765(3).
22. Or. Rev. Stat. § 527.770.
23. Or. Rev. Stat. § 527.670(6).
24. Or. Rev. Stat. § 527.670(3)(a).
25. Or. Rev. Stat. § 527.680.
26. Or. Rev. Stat. § 527.683.
27. Or. Rev. Stat. §§ 527.990 & 527.992.
28. Or. Rev. Stat. §§ 527.683-.687.
29. Or. Rev. Stat. § 197.230(1)(c).
30. Or. Rev. Stat. § 197.405.
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Texas Case Study

Summary

In addressing nonpoint source water pollution from agriculture, Texas relies primarily on the Texas Soil and Water Conservation Board (TSSWCB) which administers the water quality management plan certification program cooperatively with the Soil and Water Conservation Districts.[1] Any facility that is not required to obtain a permit from the Texas Natural Resources Conservation Commission (TNRCC) may develop a certified water quality management plan. The plans are voluntary, although if water pollution is occurring, the TSSWCB may request that the discharger obtain a plan. In most cases, operators will obtain a plan rather than risk regulation or enforcement by TNRCC. Facilities that have a plan may be eligible for cost-share assistance, capped at $10,000 over the lifetime of the operation. These funds are available to a limited degree across the state, but most are specifically targeted at priority watersheds identified by TSSWCB. Failure to comply with the plan may result in repayment of any cost-share assistance and animal feeding operations may be required to obtain a permit from TNRCC. The TSSWCB investigates violations of the plan and any law or rule relating to agricultural pollution in cooperation with the local Soil and Water Conservation District and, if necessary, develops a corrective action plan. If the violator fails to take corrective action the complaint is referred to TNRCC for enforcement. Although authorized by law Texas has yet to develop a certified water quality management program for silvicultural activities.

Development and earth-moving activities are regulated in the Edwards Aquifer region of the state primarily through the Edwards Aquifer Protection Program (EAPP). Any construction-related or post-construction activity that has the potential for polluting the Edwards Aquifer *and hydrologically connected surface streams* may not proceed until the required plans, including a water pollution abatement plan (PAP) have been approved by TNRCC. The PAP must describe temporary and permanent best management practices for preventing pollution of surface water, groundwater, and stormwater. TNRCC reviews and approves the EAPP permits and conducts enforcement.

Development activities may also be regulated on the local level through programs authorized by various state laws that allow a municipality to protect for watersheds, to develop a water pollution control and abatement program, and to enter into cooperative agreements with TNRCC to inspect public waters to determine whether water quality meets state water quality standards and to check compliance with permitting requirements. Austin, for example, has enacted several ordinances over the years regulating development through permit mechanisms, starting with an ordinance regulating development activity near creeks in the Lake Austin and Lake Travis areas and then moving to a comprehensive watershed ordinance for the entire city. A particular stringent ordinance was passed for the Barton Springs watershed. Austin also has a stormwater program and an Emergency Spills and Pollution Complaint Response Project. The City carries out inspections and formal enforcement and also provides technical assistance and outreach activities to implement these programs.

Watersheds

One urban (Edwards Aquifer) and one rural (North Bosque River) watershed in Texas were examined in order to assess the use of enforceable mechanisms and their relationship to cost share and technical assistance approaches.

Edwards Aquifer

The Edwards Aquifer is one of the most valuable water resources in the central Texas area. This aquifer provides water for municipal, industrial, and agricultural uses, and serves as the principal source of water for a number of cities, including San Antonio and Austin. In 1975, the San Antonio portion of the Edwards Aquifer was the first in the country to be designated a Sole Source Aquifer by EPA under the Safe Drinking Water Act, and the Austin portion received the same designation in 1988. The designation is reserved for aquifers that provide 50 percent or more of the drinking water for an area where there are no reasonable alternative drinking water sources.[2]

The aquifer lies in an underground layer of porous limestone that is 400 to 600 feet thick. The aquifer runs in an arch from an area west of San Antonio to north of Austin. The aquifer can be divided into three parts: the contributing zone, or drainage area; the recharge zone; and the artesian area. The contributing zone is found in Texas Hill Country and is about 4400 square miles. The area receives about 30 inches of rainfall per year which drains through streams and the water table into the Edward Aquifer in the recharge zone. The recharge zone is an area where highly faulted and fractured Edwards limestones outcrop at the land surface, allowing large quantities of water to flow into the aquifer. About 85 percent of recharge occurs when rivers and creeks cross the recharge zone. The artesian zone, unlike the recharge zone, is confined between two impermeable rock formations. Artesian wells and natural springs exist where water can be pushed through wells or faults to the surface.[3] The aquifer is unusual due to its rapid acceptance of recharging waters, large yields in springs and wells, and relatively rapid groundwater movement.[4]

The area over the Edwards Aquifer has been subject to increasing development in recent years. Since 1970 the population of the greater Austin area has approximately tripled. The increased urban development has resulted in increased water quality problems due to urban runoff from streets, industries, and lawns.[5]

Barton Springs is the main discharge point for the Barton Springs segment of the Edwards Aquifer. Ninety percent of all water that discharges from this segment of the aquifer emerges at Barton Springs. Water discharged at Barton Springs has been channeled and dammed since the early twentieth century to form a naturally fed pool known as Barton Springs Pool. Recently the spring, pool, and ancillary springs were identified as the only surface habitat of the Barton Springs salamander, which was listed under the Endangered Species Act in 1977. The majority of pollutants that enter the Barton Springs segment of the Edwards Aquifer must exit the aquifer through salamander habitat. The primary threats to the Barton Springs salamander are degradation of the quality and quantity of water that feeds Barton Springs due to urban expansion over the Barton Springs watershed.[6]

North Bosque River

The North Bosque river flows 97 miles through north-central Texas. The river runs through Erath County, Hamilton County, Bosque County and McLennan County where it joins the Middle and South Bosque Rivers and flows into Lake Waco on the edge of the city of Waco. The terrain is generally flat with a clay and sandy loam soil. The watershed is in one of the primary dairy producing areas in Texas. Erath County alone contains over 200 dairies, and the Upper North Bosque watershed has over 38,000 cows[7]. The watershed has been targeted by the state for TMDL development before April 2000, and the Texas Institute for Applied Environmental Research at Tarleton State University has conducted modeling activities and convened stakeholder committees as part of the TMDL development process. Representatives of local governments, the Soil and Water Conservation Districts, and local dairy farmers are among the members of the stakeholder committee that will determine the TMDL. The primary sources of impairment in the watershed are nonpoint sources which have lead to high fecal coliform and nutrient levels in the watershed[8]. Manure spreading from the growing number of dairies may be one of the major causes of the water quality problems in this watershed.

Enforceable Mechanisms

Of the Texas nonpoint source enforceable mechanisms described in the *Almanac*,[9] the following were reviewed in detail because of their relevance in the Edwards Aquifer or North Bosque River Watershed.

! *General discharge prohibition.* The state Water Code provides that, except as authorized, no person may "discharge sewage, municipal waste, recreational waste, agricultural waste, or industrial waste into or adjacent to any water in the state," discharge other waste which in itself or in conjunction with any other discharge or activity causes pollution of any water of the state, or commit any other act which causes pollution of any water of the state[10]. Exempted from this prohibition are: discharges authorized by permit, discharges in compliance with a certified water quality management plan as provided under the state agriculture code (discussed in greater detail below), and activities under the jurisdiction of the Parks and Wildlife Department, the General Land Office (coastal management) or the Railroad Commission of Texas. The Texas Natural Resources Conservation Commission (TNRCC) enforces these provisions.

Enforcement of the water code, or any other rule, permit, or order issued pursuant to it, is through administrative penalties up to $10,000 per day, civil penalties of between $50 and $10,000, and injunctions.[11] TNRCC uses these provisions to enforce against violations of both agricultural and development related permits.

! *Water quality management plan certification program.* The state Soil and Water Conservation Board is the lead agency for the abatement of agricultural and silvicultural nonpoint source pollution.[12] The Board is required to plan, implement and manage programs and practices for abating such pollution, and other state agencies with responsibilities in this area must coordinate their actions with the Board. In areas identified as having agricultural nonpoint source water quality problems (or in coastal zone areas), the Board is required to establish a water quality management plan certification program. The program is administered through the soil and water conservation districts. Participating farmers develop individual water quality management plans for agricultural lands, including animal feeding operations not otherwise permitted under the NPDES program. The state board adopts rules for these plans in compliance with state water quality standards.[13]

All complaints concerning a violation of a water quality management plan or a violation of a law or rule relating to agricultural or silvicultural nonpoint source pollution are referred to the state Board. The Board investigates the complaint in cooperation with the local Soil and Water Conservation District and, if necessary, develops a corrective action plan. If the violator refuses to take corrective action, the Board refers the complaint to TNRCC.

! *Animal feeding operations.* Texas was delegated authority to issue federal NPDES permits to CAFOs in September 1998. All facilities confining more than 1000 animal units (700 mature dairy cattle) for at least a 45 day period annually must obtain a TPDES permit.[14] However, smaller facilities in the Dairy Outreach Program Area, which includes Erath, Bosque, Hamilton, Comanche, Johnson, Hopkins, Wood and Rains counties, must also obtain a TPDES permit if they confine more than 300 animal units (or 200 mature dairy cattle) for the same time period[15]. A facility which qualifies for and obtains a certified water quality management plan as described above is not considered a CAFO and is not subject to permit requirements unless it is referred to TNRCC for enforcement purposes.[16] The TPDES permit requires the operator to develop a pollution prevention plan that addresses water and air pollution as well as the land application of wastes and wastewater.[17]

! *Edwards Aquifer Protection Rules.* Development activities over the Edwards Aquifer, one of the largest sources of drinking water for Austin and San Antonio, are regulated under the Edwards Aquifer protection program. The authority for this program is found in the Water Code, which states that "discharges of pollutants, disposal of wastes, or other activities subject to regulation by state agencies be conducted in a manner that will maintain present uses and not impair potential uses of groundwater."[18] The Edwards Aquifer protection rules govern activities in the recharge and contributing zones of the aquifer. The rules require that developers obtain a letter of approval before beginning construction activity and require that developers implement both temporary and permanent BMPs during and after construction.

! *Protection of Streams and Watershed by Home-Rule Municipality.* Texas's local government code includes provisions allowing a home-rule municipality to prohibit the pollution of streams, drains, and tributaries that "may constitute the source of the water supply of any municipality," including the power to police the water bodies.[19] The law more broadly states that a home-rule municipality may provide protection for and police any watersheds. A municipality may exercise both provisions inside or outside the municipality's boundaries.[20] The city water pollution control program embodied in the city of Austin's Land Development Code, described in detail in the Discussion and Analysis section, is based on the authority granted to home-rule municipalities in the local government code.

! *City Water Pollution Control and Abatement Program.* A city may establish a water pollution control and abatement program. If the watershed water quality assessment reports or other assessments identify water pollution attributable to non-permitted sources in a city that has a population of 10,000 or more, TNRCC, after providing the city an opportunity to correct the problem and after a public hearing, may require the city to establish a water pollution control and abatement program.[21] A city's water pollution control and abatement program includes the entire city and may include areas within its extraterritorial jurisdiction. The law lists a number of program components, including "the development and execution of reasonable and realistic plans for controlling and abating pollution or potential pollution resulting from generalized discharges of waste which are not traceable to a specific source, such as storm sewer discharges and urban runoff from rainwater."[22] The water pollution control and abatement program must be submitted to TNRCC for review and approval.[23] The City of Austin also uses the authority provided under this law to establish its city water pollution control program, described in detail below, and submitted the programs developed under these provisions to TNRCC for review following approval by the City Board.

! *Local government authority.* State law provides local governments with the authority to inspect public water to determine whether water quality meets state water quality standards, unpermitted discharges to water are occurring, and permitted discharges are in compliance with permit requirements.[24] TNRCC may, by cooperative agreement, assign any powers or functions normally held by TNRCC to a local government if necessary for the local government to perform water quality management, inspection, and enforcement functions.[25] Local governments have the same power as TNRCC to enter public and private property within their territorial jurisdiction to inspect and investigate water quality concerns. The results of any inspection made by local government must given to TNRCC if requested.[26] The City of Austin administers municipal storm sewer discharge pollution prevention programs and emergency spills and pollution complaint response programs under the authority of these provisions.

! *City of Austin Water Pollution Control Program.* The City of Austin established its water pollution control program under the authority of Local Government Code 401.002 and Water Code 26.177. The law states that municipalities with a population over 10,000 "may" develop a water pollution control and abatement program through municipal ordinance. Development activities are regulated throughout the city and its extraterritorial jurisdiction (ETJ) area as described in the Land Development Code, volume two of the city's ordinances. Generally, developers must implement erosion and water quality controls and protect critical environmental features on property during and following development.[27] The Comprehensive Watershed Ordinance, passed in 1986, was the first ordinance to regulate development throughout Austin and the ETJ. This ordinances established critical water quality zones, mandatory setbacks, and impervious cover restrictions. In 1992 the city adopted one of the more stringent provisions in the Land Development Code, the citizen-initiated Save Our Springs Initiative, which also limits impervious cover in developments, increases the distance permitted between development and water bodies, and eliminates increased loading of suspended solids, phosphorous, nitrogen, and other contaminants.[28] These regulations apply to the Barton Creek, Barton Springs, and Barton Springs aquifer area. Unlike other ordinances, there are no variances or exemptions permitted from these standards.

A provision of state law requires that permits for development be evaluated only on the basis of the regulations in effect at the time that the original permit was first approved[29]. Under this law, preliminary plans including subdivision plats, site plans, and other development permits on land covered by a preliminary subdivision permit are considered to be a single permit. This may allow certain development activities in the City of Austin to be "grandfathered" under older provisions of the land development code.

Assistance-Oriented Nonpoint Source Programs

Senate Bill 503 Cost Share and Technical Assistance

The Texas State Soil and Water Conservation Board (TSSWCB or Board) administers the 503 program, the state's cost share incentive program established as part of Senate Bill 503. Funds from the incentive program are available to a limited degree across the state, but most are specifically targeted at priority watersheds identified by the Board. Priority watersheds are based on lists developed by the state under Clean Water Act Section 319(a), and include primarily watersheds impacted by agricultural activities. The North Bosque is included among the priority areas. Each priority watershed is allocated funding annually by TSSWCB. Funding for cost share assistance is provided through the Soil and Water Conservation District (SWCD) offices in the priority watersheds. In addition to funding provided to the priority watersheds, funds are set aside for the purpose of addressing animal feedlot operations in any watershed in the state.

To be eligible for cost share assistance, an individual must develop a certified water quality management plan with the assistance of the local SWCD and TSSWCB's regional staff. For animal feedlot operations, any facility not required to obtain a TNRCC permit is eligible to develop a water quality management plan. All other agricultural operations may also develop a plan on a voluntary basis. Plans are approved by NRCS field office staff and agreed to by the SWCD. To receive cost share assistance for a specific practice, the practice must be included in the certified plan. The TSSWCB regional office responsible for the North Bosque has approved approximately 500 plans since the 503 program went into effect in 1994.

Local SWCD's have some latitude in administering the cost share program. State law sets the maximum portion of a project's cost that can be funded by cost share at 75 percent,[30] but the SWCD may set a lower rate. The SWCD also determines which practices it will fund through the 503 program.[31] The lifetime limit for cost share is $10,000 per operation throughout the state, although this does not fund 75 percent of the cost of most waste management systems for animal feedlot operations. In priority watersheds, requests for cost share assistance can be approved by SWCDs without referral to TSSWCB. In other areas of the state, operators of animal feeding operations must submit requests to the Board who will award funding on a first come, first served basis.

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EQIP

EQIP is the most active of the Farm Bill programs in both the North Bosque river watershed and the Edwards Aquifer. The state has received over $10 million a year in funding for the past three years. The NRCS State Technical Committee selects priority areas around the state from proposals from regional NRCS staff and other agencies. In 1999, 25 priority areas received funding while 25 percent of the state's total allocation was reserved for applicants outside of the priority areas. The North Bosque and Edwards Aquifer are the state's top two priority regions for EQIP. The Edwards Aquifer region has been a priority area for four years. Most contracts are in Medina and Uvalde counties, and focus on water quantity issues such as improving the efficiency of irrigation. The Bosque River region has been a priority area for three years, and contracts are primarily focused on water quality concerns. Funding has been used for waste management systems and nutrient management planning for cropland. In all areas of the state, funding is limited by law to 75 percent of the cost of the practice with a maximum of $50,000 for a five year contract. Grants are evaluated in each priority area for cost-effectiveness, and about 20 percent of applications are funded each year. Applications originating outside priority areas are evaluated against other non-priority area applications statewide, but are grouped into four resource concerns so that problems that may be more costly to address, such as animal waste management, are evaluated against similar proposals.

319 in Texas

TSSWCB's 319 program for agricultural and silvicultural nonpoint source pollution targets its funding to priority areas identified on the state 303(d) list of impaired waters. Efforts under this program are intended to complement the state's TMDL development process. The program receives approximately $2.3 million in funding annually. By Memorandum of Understanding,[32] TNRCC and TSSWCB have divided responsibility for implementing the provisions of the EPA Clean Water Act 319 programs. TNRCC is responsible for programs relating to non-agricultural nonpoint source pollution, while TSSWCB is responsible for managing programs addressing agricultural and silvicultural nonpoint source pollution.

Discussion and Analysis

Agricultural Pollution Generally

The TSSWCB and the TNRCC have entered into a memorandum of understanding that governs the procedure for coordinating jurisdictional authority, program responsibility and procedural mechanisms for nonpoint source pollution programs.

The 503 program allows any facility that is not required to obtain a permit from TNRCC to participate in the program and develop a certified water quality management plan. (See discussion below on when a facility is required to have a permit). The certified plans contain all of the elements that would be required under a TNRCC TPDES permit. They encompass the whole operating unit and all natural resources. For example, even if the landowner comes in only for assistance on animal waste management practices, the plan will also address other problems, such as erosion, that are present on the property. There are approximately 3,000 plans for nonpoint source sites around the state, including small animal feeding lots.

The North Bosque River watershed is under jurisdiction of the regional office of the Board in Dublin. This office covers a number of major dairy areas in Central Texas, including Erath, Commanche, Bosque, Hamilton and Johnson counties. Since 1995, this office has prepared certified water quality management plans. In Erath County the majority of dairies are permitted because of their large size. Although the number of dairies in the area has dropped by 50 percent in the last 4 years (from 212 to 151), the dairy production of the region has remained the same.

The TSSWCB is responsible for investigating complaints and monitoring compliance of all animal feeding operations with a certified water quality management plan or other Board rules. The Board is also responsible for maintaining an electronic database to track and document the proceedings of the plans and corrective actions. If the Board receives a complaint and determines that TNRCC has jurisdiction over the facility (see discussion below), it must refer the case to TNRCC within five working days of the investigation. The Board also automatically refers to TNRCC any complaint involving "an immediate impact to aquatic life"[33] or any complaint involving a documented violation of a plan that requires immediate action because it is affecting human health and safety or will cause serious impact on the environment.

The first step taken by the Board in the case of a complaint is to check whether a facility has a plan and if so, whether the facility is complying with the plan. If a compliance problem exists, a "violation letter" will be sent, citing the facility as in violation of Section 26.121 of the Texas Water Code. The letter will direct the violator either to obtain a plan or to implement a corrective action plan. Corrective actions could include steps necessary to implement the plan or other steps necessary to come into compliance. A facility without a plan may not necessarily be required to obtain a plan; the corrective action may be limited to those steps necessary to come into compliance. Although compliance with the plan technically exempts a party from enforcement of the "no discharge" prohibition, it is unlikely that an agricultural operation would be in compliance with the plan in the event of a discharge causing a public health or wildlife hazard.

In the event that the facility is not under a plan, the operator is given 45 days to apply for one and have the plan approved at a monthly meeting of the Board. The Board follows up after 45 days to see if the operator has applied for the plan. Once the plan is approved, the operator must present evidence of an effort to begin implementation of the plan within 90 days. This allows time for the agencies providing technical assistance, the SWCD and NRCS, to work with the individual. If the violator does not obtain a plan or come into compliance with the existing plan within the time frame established by the Board and the SWCD, the plan will be nullified and the case will be referred to TNRCC for enforcement.

In one example of a complaint handled by the Board, a small hog feeding operation (150 hogs) allowed waste to go into a ditch and then flow into a water source. A letter was sent by the Board requiring the violator to apply for a plan in 45 days and implement the plan. Since the Board meets every 30 days, the violator was basically being given two opportunities to get a plan. The violator did not prepare a plan and the case was referred to TNRCC for enforcement. Usually the TSSWCB does not hear back from TNRCC about cases unless TNRCC determines that the violator is now fully willing to remedy the problem and that a certified water quality management plan would be the appropriate next course of action.

There is one TSSWCB staff person statewide in charge of investigating complaints. The regional TSSWCB offices do not investigate complaints. However, the regional offices conduct status reviews of plan implementation (described below). From the start of FY94 to date, the Board has received 127 complaints, mostly involving animal feeding operations. There have been no complaints received concerning silviculture operations. Fifty-one of those complaints involved dairy operations. The majority (92) of these complaints have been referred by other agencies, while the remainder (35) came from the general public. Most of the complaints under Board jurisdiction relate to problems in suburban areas. Thirty-eight cases were resolved by requiring a water quality management plan, twenty required other corrective action and ten were referred to TNRCC for action. Of these ten referrals, two cases involved operations of permitted facilities or facilities that should have been permitted so TNRCC jurisdiction was automatic. The other eight were referred because they had failed to comply with the water quality management plan program.

Each year ten percent of the certified water quality management plans get a status review. These are conducted by the regional TSSWCB offices. When a status review of a certified plan reveals that the implementation of the plan is not on schedule, TSSWCB works with the operator to correct the problem. The inspector will generally notify the operator of any problems identified. If the problem threatens public health, it will be treated as a priority and the inspector will return to the site to ensure that it is addressed quickly. More often, the problems are less severe such as the operator being unable to meet the implementation schedule. In this case, the regional TSSWCB staff and the SWCD will amend the schedule in the plan and follow up to ensure that the plan is implemented according to the new schedule.

If the operator continually fails to implement the plan on schedule, TSSWCB will eventually void the contract, requiring repayment of cost shares or the return of any equipment purchased, and the plan will be canceled. In the DOPA, TNRCC is aware of all the dairies and the status of any plans. As soon as a plan is cancelled TNRCC can regulate the facility, which may include putting the facility on its inspection list and requiring the facility to obtain a permit. However, given the cost share limit of $10,000, there are very few actions by the Attorney General to retrieve the contract funds. The funds are usually retrieved on the local level without court action.

In the North Bosque River watershed TSSWCB has conducted three 319 program projects, working closely with TNRCC. The projects have studied innovative best management practices to control phosphorous and assessed the contributions of various sources of nonpoint source pollution to the watershed.

Although authorized by law, TSSWCB has yet to develop a water quality management certification program for silvicultural operations. Nonpoint source pollution problems in this area are addressed through voluntary best management practices.

TNRCC Role

TNRCC takes the lead in regulating and enforcing management of livestock and poultry waste from concentrated animal feeding operations. CAFOs over a certain size are required to obtain a permit from TNRCC. For example, dairy operations with 700 or more mature dairy cattle are required to obtain a permit. In the dairy outreach program areas (Erath, Bosque, Hamilton, Comanche, Johnson, Hopkins, Woods and Rains), permits are required for for facilities with at least 200 hundred mature dairy cattle. TNRCC also has general discretion to require an animal feeding operation of any size to acquire a permit in certain cases where water quality is threatened.

Enforcement actions against animal feeding operations are primarily handled by the 16 regional TNRCC offices. Each office has one staff person to handle enforcement. The regional offices may refer cases to the main office by a Regionally Initiated Order (RIO). Examples of cases that may be referred include those with recalcitrant, repeat or egregious violators.

When a TNRCC regional office receives a complaint, an inspector will be sent to investigate. The Stephenville TNRCC office (which handles the North Bosque River watershed) receives most complaints directly and usually responds within a few hours. TNRCC also conducts regular inspections of animal feeding operations under its jurisdiction. All facilities with more than 200 dairy cattle in the dairy outreach program are inspected annually. Facilities that have had their water quality management plan cancelled will also be put on TNRCC's inspection list. During the period September 1, 1998 to August 31, 1999, the TNRCC Stephenville office conducted 265 scheduled compliance inspections and 66 complaint inspections, issued 123 notices of violation and referred 23 cases for enforcement.

If a minor violation is found, the inspector can issue a written notice of violation (NOV). The notice will include a deadline for correcting the problem. If the violator corrects the problem within the specified time, the enforcement proceeding ends. A verbal NOV may be issued if (i) no emissions or discharges occurred, (ii) no documented oral notice or NOV was issued to the operator in the last year, and (iii) the violation can be and is corrected within 14 days.

More serious violations are subject to formal enforcement proceedings. Two types of orders are used depending on the severity of the violation: "1660 orders" and "findings orders." The former are issued for less serious violations. "1660 orders" are no-contest orders that allow for a deferral or reduction of the penalty if the violator complies with the order. "Findings orders" including findings of fact and conclusions of law. Each time a findings order is issued, the penalty increases.

In one recent case involving a permitted animal feeding operation in the North Bosque watershed, TNRCC received a complaint that the facility was discharging onto a neighbor's property. Only a month earlier, TNRCC had issued an order to the same facility for an unauthorized discharge. The facility had five prior NOVs on record. TNRCC is now developing an order for the facility. TNRCC is also considering referral of the case to the Attorney General's office. This office has the authority to institute a civil action or seek a temporary injunction against the violator. Enforcement through the AG's office also opens the possibility for imposing jail time for future violations.

In another case a small dairy operation was given a "1660" order for a first-time discharge violation. The order required the facility to get a Subchapter B permit and to pay a fine of $3,125. When the facility committed a second discharge violation, a findings order with a stiffer penalty of $4,875 was issued.

Land Development Requirements

Nonpoint source pollution from development activities in the Edwards Aquifer region is primarily addressed through a number of regulations at the state and local level that use permitting requirements to impose development restrictions and require the use of best management practices. These regulatory programs are then backed by enforcement mechanisms and technical assistance.

Development activities in various portions of the Edwards Aquifer have been regulated since 1970 when the Texas Water Quality Board issued a board order designed to protect the quality of water entering the Edwards Aquifer recharge zone.[34] Recently the rules were extended to cover the contributing zone to the recharge area. Collectively, the regulations and associated approvals and programs are referred to as the Edwards Aquifer Protection Program (EAPP).

The Edwards Aquifer regulations prohibit any person from commencing any construction-related or post-construction activity that has the potential for polluting the Edwards Aquifer *and hydrologically connected surface streams* until the required plans, including a water pollution abatement plan, have been approved by TNRCC.[35] Specific plans are also required for the rehabilitation or construction of sewage collection systems, underground storage tank systems, and aboveground storage tank systems. Activities exempt from this approval process include agricultural activities (other than feedlots/concentrated animal feeding operations regulated under Chapter 321), oil and gas operations, routine maintenance, and construction of a single family residence on a lot no larger than five acres. The Edwards Aquifer Protection Rules also prohibit new feedlot/concentrated animal feeding operations regulated under Chapter 321 on the recharge zone.[36]

The program requirements and their implementation in the contributing zone are similar to those of the recharge zone. The primary difference is in the activities that are regulated; only activities disturbing more than five acres are included. The plans required are very similar to the Phase I storm water plans required by EPA for construction sites and in some cases TNRCC has allowed the submission of the storm water pollution plan in lieu of the water pollution abatement plan. The BMPs required for post-construction activity are the same as those required in the recharge zone, and inspections are handled in the same way.

The information that must be submitted in the water pollution abatement plan includes the site location, a geologic assessment, a description of the proposed activities, the expected volume and characteristics of wastewater to be produced, any activities or processes which may be a potential source of contamination, and temporary and permanent best management practices for preventing pollution of surface water, groundwater and stormwater.[37]

The plan is submitted to the appropriate TNRCC regional office (in either Austin or San Antonio) where the staff review the plan for administrative completeness. Staff conduct a site inspection to verify that the information submitted in the plan is accurate and perform a technical review of the proposed permanent and temporary BMPs. Most of the time the plan requires little modification before the approval is issued.

TNRCC's Austin and San Antonio Regional Offices provide both formal and informal technical assistance to promote compliance with the requirements of the Edwards Aquifer Protection Program. Informal assistance is the predominant mechanism for providing technical assistance to the engineering, consulting, and development community that is subject to the land development requirements. The Austin regional office receives over 3000 telephone inquiries each year seeking assistance with the requirements of the program. Inspectors rotate through telephone duty where they respond to these calls. The San Antonio regional office reports similarly that it relies on telephone contacts to provide the majority of the technical assistance. The San Antonio office will also contact site owners to let them know about the requirements of the program. The Austin regional office will more formally hold workshops for various associations to discuss the requirements of the program; a recent workshop involved the Highway Contractors Association. TNRCC provides two guidance documents on the requirements of the program, and TNRCC's small business assistance program is assessing ways to assist small businesses in complying with the program.

Once the application meets the requirements, TNRCC issues an approval letter. The approval letter may contain special conditions for approval. Some examples of special conditions are plugging of abandoned wells or installing mitigation practices such as buffers around a sensitive feature (a zone of easy infiltration to the aquifer). The applicant must also provide written notice of the intent to commence construction to the appropriate regional office no later than 48 hours in advance.[38] At this time, it will be determined if the applicant is eligible for an extension of an approved plan. If any sensitive feature is discovered during construction, all regulated activities must cease until the methods proposed to protect the sensitive feature and the Edwards Aquifer from potentially adverse impacts to water quality have been reviewed and approved. When the approval letter has been issued and construction has begun, TNRCC does a follow up inspection during and after construction to ensure that BMPs are being implemented and maintained. The staff reviews from 20 to 30 percent of existing projects.

Over the lifetime of the program there have been 2,500 plans created for development projects. The Austin and San Antonio offices receive about 500 to 600 plans each year.

The letter of approval and a notation that the property is located over the aquifer are recorded in the deed for the parcel.[39] The requirement to maintain the BMPs on the site runs with land. The plans are good as approved for two years in the recharge zone and five years in the contributing zone. Projects in the recharge zone must be 10% completed within the first two years and 50% completed within the first 10 years.

Developers who are not in compliance with their plans are identified randomly by TNRCC staff through the inspection process. Most enforcement of EAPP is carried out by TNRCC regional staff in Austin and San Antonio. When an inspector identifies a site that is not maintaining BMPs as required by their approval letter, or not employing the proper controls, the inspector issues a notice of violation (NOV). The NOV has a due date for compliance. If the developer misses the due date, the inspector can initiate formal enforcement.

Sites that are identified as not having a letter of approval are immediately subject to formal enforcement. TNRCC issues an administrative order. The maximum penalty they can issue under Texas water quality laws is $10,000 per violation per day, but this penalty is reduced by a number of specific factors. The average penalty assessed against a site that is operating without a letter of approval is $2,000. The penalty provisions also call for a 20 percent deferral if this is a first time violation.

Through the third quarter of this year, the Austin regional office (Williamson, Travis, and Hays Counties) monitored 76 sites for compliance by conducting a follow-up inspection. Of those, 20 were issued an NOV, and four were referred to formal enforcement. The four sites referred to formal enforcement may have been operating without an approval letter or violating their plan in other ways.

The most common violations are the failure to submit a water pollution abatement plan or to get approval in advance of construction. One recent case brought by the Austin regional office involved a violator who had failed to identify and notify the regional office of a sensitive feature, in this case, a cave. The original complaint was made to the City of Austin who referred the case to TNRCC which sent out its inspectors. The penalty imposed was $2,000 in accordance with the penalty policy. The violator received a 20 percent deferral and was allowed to conduct a supplemental environmental project (providing kits to test water to the school system for use in fifth grade science classes). There are usually no hearings in connection with EAPP cases because the proposed agreements are usually based on standard policies, but a hearing can be held if the violator is unhappy with the proposed agreement.

The general discharge prohibition under the state water code is rarely used as the basis for enforcement actions involving land development activities in the recharge and contributing zones if the Edwards Aquifer, although it may be used for other types of problems such as a spill. From an enforcement perspective it is difficult to prove a violation of the general discharge prohibition because TNRCC must provide evidence that a discharge actually occurred. This involves having an inspector on the site at the time of the discharge in order to document the event by taking upstream and downstream photographs and samples. Enforcement of violations under the EAPP, such as the failure to implement or maintain BMPs during construction or failure to obtain prior approval before construction, are much easier to prove.

Although the law allows a local authority to be certified to review, approve and enforce Edwards Aquifer Protection plans,[40] no counties or other local entities have been delegated authority to implement their own program and TNRCC administers the EAPP. Even if a local entity were to assume program responsibilities, the EAPP fees would continue to be paid to the Commission to assure continued proper oversight and enforcement. Plans are distributed to appropriate municipalities and groundwater districts for comments. The City of Austin often provides comments.

The TNRCC's Austin regional office receives 319 funding for basic programmatic funding as well as funding to pass through to other local groups conducting research on the Edwards Aquifer. The regional office has received its own 319 grant since 1992. The most recent grant was a three year grant for $100,000 per year. The grant funds two positions for review and enforcement of the Edwards Aquifer Protection Program. One of the other organizations funded through 319 is the Barton Springs Edwards Aquifer Conservation District which conducts studies monitoring the effects of BMPs.

Local Initiatives

Development activities in the Edwards Aquifer may also be restricted by city or municipal laws. State law authorizes cities to establish a water pollution control and abatement program.[41] This program may include areas within a city's extraterritorial jurisdiction if necessary to achieve the objectives for the area within its territorial jurisdiction. In addition, if certain reports, assessments or studies identify a water pollution problem from non-permitted sources, the Commission may require a city that has a population of 10,000 or more to establish this type of program. However, the city in question must first be given an opportunity to correct the problem and a public hearing must be held.

The City of Austin, for example, has enacted several ordinances over the years regulating of nonpoint source pollution created by development activities. The first city ordinance, the Lakes and Creeks Ordinance, was passed in the 1970's. This ordinance regulated development activity near creeks in the Lake Austin and Lake Travis areas in the western part of Austin. Since then, a number of ordinances have been passed regulating development activities in various watersheds. In 1986 the Comprehensive Watershed Ordinance encompassing the entire City of Austin was passed. For the first time, the eastern part of the city was regulated. The ordinance also covered a five mile extraterritorial area. In September 1992 the City adopted the Save our Springs Ordinance for the Barton Creek and Barton Springs Watershed.

The resulting program requires erosion control for site development, restricts impervious surfaces, and requires water quality control measures to be implemented following construction. The program applies to development throughout the city and into a five mile extraterritorial jurisdiction (ETJ) are outside city limits. However, in the ETJ the city's ordinances require only water quality protection measures, not zoning or other land use controls. The requirements applicable to a given area depend on its location; activities in certain watersheds are more stringently regulated. Overall, the city's requirements are as stringent or more stringent than the requirements of the Edwards Aquifer Protection Program.

The Save our Springs ordinance sets out special requirements for development of lands in watersheds which contribute to Barton Springs.[42] Impervious cover for all such development is limited to a maximum of 15 percent in the entire recharge zone, 20 percent in the contributing zone within the Barton Creek watershed and 25 percent in the remainder of the contributing zone. Runoff is to be managed so that no increases occur in the average annual loadings of total suspended solids, total phosphorus, total nitrogen, chemical oxygen demand, biochemical oxygen demand, total lead, cadmium, fecal coliform, fecal streptococci, volatile organic compounds, total organic carbon, pesticides, and herbicides from the site. Impervious cover is to be reduced if needed to assure compliance with these pollutant load restrictions. These requirements are not subject to the regular exemptions, special exceptions, waiver or variances allowed generally under the Land Development Code.

Austin requires a site development permit for all non-single family home construction activity. The Development Review and Inspection Office issues the permit after compliance with the water quality control requirements is verified. In the case of single family home construction, a permit is required for infrastructure development. A building permit, but not a site development permit, is required when the actual home is constructed, and this application is reviewed to ensure compliance with impervious cover limitations and other environmental requirements. Financial assurance is required for each permitted site to cover the costs of maintaining erosion controls or revegetation is the site is abandoned.

Austin has eleven full-time inspectors in the Watershed Protection Department. The frequency of inspections varies. A very large and active site may be visited by inspectors two or three times a month. Inspectors are assigned to a specific area of the city which enables them to identify more easily unpermitted development.

The most common violation is failure to maintain erosion controls.[43] When a violation is identified, it is classified as either a routine or priority violation. Routine violations include failure to maintain or repair erosion controls, or tracking of soils in minor roads. In the case of a routine violation, a verbal warning is given and the violator is allowed 24 hours to remedy the violation. If the violation is not addressed within 24 hours, the inspector will issue a written notice. If the violation is not addressed in the time frame specified in the written notice, the inspector will issue a stop work order, known as a red tag. This requires construction to stop, and also stops all other city inspections that are required for approval.

A red tag is the first step in a priority violation. Priority violations include any activity without a permit or activity that has begun without a pre-construction meeting with Watershed Protection Department staff. Other priority violations are construction that has gone outside the specified limits of construction, any offsite discharge in the Barton Springs zone (even if the construction has been grandfathered under an earlier ordinance) or any violation in a critical water quality zone or involving a critical environmental feature. After the issuance of a stop work order (red tag), the city may file a Class C Misdemeanor in municipal court. The maximum fine is $2,000 per day, with each day counted as a separate violation. The city may offer a deferred disposition when violations are identified. In this scenario, a judge will lay out a schedule for compliance and will require the developer to post bond with this court. A deferred disposition is only considered when construction is on-going.

During the period from October 1, 1998 to September 30, 1999, the Environmental Review and Inspection Division of the Watershed Protection Department issued a total of 111 red tags for violations of the Land Development Code. During the same period, 71 Class C misdemeanor complaints were filed in Municipal Court against 14 developers/owners. The number of complaints filed against each person ranged from two to twelve, depending on several factors, including the severity of the violation, failure to respond to the stop work order, and willingness of the defendant to come into compliance.

Certain development activities may not be subject to these requirements because of grandfathering provisions passed by the state and later by the City of Austin itself. The state legislature passed the grandfathering provisions in direct response to Austin's water quality protection initiatives. The first state law was passed in 1987, one year after the City passed its Comprehensive Watershed Ordinance. The legislature was responding to what it perceived as aggressive regulation by the City that took away land use rights, particularly in regard to impervious surfaces and water quality controls. The first legislative bill simply stated that the regulations in effect on the filing date of a project would apply to *all* subsequent applications.[44] This provision was somewhat general and difficult for the city to implement. Because it was general, the city read the provision as stringently as possible and looked for ways to reject projects from being grandfathered. Much litigation occurred over this provision between 1987 and 1995, with cases decided both in favor of the state and the city.

In 1995, the legislature continued to be alarmed by changes in the Land Development Code and passed SB 1704, which more clearly stated the legislature's intent.[45] Austin enacted guidelines on the grandfathering process in an effort to limit the impact of the new law. These guidelines were much disputed, but considered workable by both the city and the legislature. In September 1997, SB 1704 was inadvertently repealed. The legislature wanted to call a special session to reenact the provisions, but the city suggested instead that they develop a municipal law to address these concerns. The legislature agreed to this suggestion and Austin passed the Interim Development Order. The provisions were very complicated albeit attempting to be fair, but the order upset many people, including the legislature which passed HB 1704 in May 1999, reenacting the provisions of the 1995 statute (SB 1704). Instead of developing formal guidelines, the city has responded by handling each case individually and relying on litigation to enforce its stricter interpretation of this statute. A committee addresses each case and will not decide whether it can be grandfathered unless a member of the law department is present and agrees. Usually several attorneys participate in the decision. Generally, the lawyers will assess how likely they would be to prevail in a suit, and that determines whether the project will be grandfathered or rejected.

Some of the more specific elements that are considered in reviewing the applications are changes in land use and active permits. The city will divide the land use of applications into five categories: single family/duplex; multi-family; office; commercial; industrial; and civic. If the land use of the project has changed since the first permit was approved, the project is considered new and is not grandfathered. Each project must receive a series of permits. The first generally is the subdivision permit, which is based on zoning and may cover a very large area. After this permit is issued, the applicant must have an application for a final plat for a least a portion of the subdivision reviewed and approved within 2 years. If this is done, the subdivision permit remains active; if not, the permit expires. If the first permit has expired, the project is not grandfathered. If the first permit has not expired, the project may be grandfathered; however it is often the case that the proposed land use has changed over time and this too makes the project ineligible for grandfathering.

Local Voluntary Programs

Austin has its own storm sewer discharge pollution prevention program which is an inspection and permitting program that is different from the federal stormwater program. The federal storm water program inspectors are in Dallas and rarely inspect Austin facilities. The City's program is carried out by going to businesses likely to pollute such as auto dealers, detailing businesses, dry cleaners, fuel storage operations, and others that have historical problems with pollution. These facilities are inspected, permitted and required to implement BMPs that have been developed for various sectors. Stormwater Discharge Permits are issued annually for the period January 1 to December 31 and renewal notifications are sent in December of each year.[46] The program tries to obtain compliance without formal believes it is successful with this approach. When contamination is found, staff often provide guidance to owners of small businesses on remediation and assist in the cleanup. If necessary, the City will take people to court to get the actual clean up done.

The City of Austin also has a voluntary program called Clean Water Partners which is primarily an educational program. The City sought partners to implement a checklist of more stringent standards than those in the permit checklist. Those who came into compliance with the standards were given banners, stickers, and public recognition. The City targeted specific geographic areas and types of businesses with a history of problems. The worst offenders chose not to participate. The City also created a "how to" notebook for businesses.

Austin also has an Emergency Spills and Pollution Complaint Response Project which responds to complaints and is on call 24 hours, 7 days a week[47]. The program also provides technical assistance and outreach to the public and other City departments. They try to respond to priority calls in 15 to 30 minutes. Their job is to coordinate cleanup among agencies and to keep the spill out of waterways and identify the responsible party. The responsible party will have to pay for the cleanup. The city is allowed to go after the responsible party under state law; Ch. 26 of the State Water Code gives municipalities authority to enforce state law.

Conclusion

In the North Bosque River watershed efforts to address non-point source pollution from agricultural operations rely heavily on the voluntary water quality management certification program. The primary incentives for participation in this program are limited cost share assistance as well as exemption from regulation under the TPDES in certain cases. In the event of a serious discharge to surface water, TSSWCB might revoke cost share funds, and TNRCC enforcement authority, including enforcement and penalties, might be exercised as well. The thrust of efforts to resolve complaints encourages participation in the voluntary program. The lower threshold of animals required for the TPDES program in the Dairy Outreach Program Area brings a substantial number of operations under the more structured enforcement policies of TNRCC.

Texas's efforts to regulate land development activity over the Edwards Aquifer have resulted in significant TNRCC enforcement activities. The EAPP, unlike the general discharge prohibititions of the Texas Water Code, does not require inspectors to prove that a discharge occurred, but instead requires the use of best management practices which are intended to prevent nonpoint source pollution. TNRCC inspectors are unable to inspect every site regulated under this program to identify an illegal discharge, but have the legal tools to ensure that erosion and other pollution controls are implemented and maintained.

Some believe that the EAPP is a good first step at regulating land development, but would prefer a more stringent approach. The City of Austin, under state authority but of its own initiative, has implemented a series of regulations that are often more stringent that the EAPP in regulating land development. Some provisions, like the Save Our Springs ordinance in the Barton Springs zone, were passed as a result of citizen initiatives. In spite of the popular support behind the land development regulations and the legislative authority to establish a water pollution control program, Austin has been challenged by the state legislature as the stringency and scope of its regulations increase. The legislature has passed a series of laws that limit the power of Austin's regulations by requiring the city to regulate development under the regulations in effect at the time the initial permit for development was issued, often turning the regulatory clock back many years to much weaker provisions. The city has turned to the courts in an attempt to validate its interpretations of grandfathering provisions, but the state laws continue to provide developers an opportunity to evade the more stringent laws, and require the city to expend resources battling the state. The City of Austin appears to determined to protect water quality, not only through its Land Development Code, but also through its stormwater and emergency spill programs which make use of non-enforcement measures such as outreach to reduce pollution.

ENDNOTE

1. In addition to the sources cited, the following individuals were interviewed by telephone: Mary Ambrose, Texas Natural Resources Conservation Commission; Bobby Cauldwell, Texas Natural Resource Conservation Commission; Laurie Eaves; Texas Natural Resource Conservation Commission; David Faller, Texas Natural Resource Conservation Commission; Steve Jones, Texas State Oil and Water Conservation Board; Gary Keith, Texas Institute for Applied Environmental Research; Mary Kelly, Texas Center for Policy Studies; Ken Kramer, Sierra Club, Lone Star Chapter; James Moore, Texas State Soil and Water Conservation Board; Duncan Muir, City of Austin Watershed Protection Department; Lee Munz, Texas State Soil and Water Conservation Board; Carol Piza, Texas Natural Resource Conservation Commisison; Patty Reeh, Texas Natural Resource Conservation Commission; Susan Scroggins, City of Austin Watershed Protection Department; Sherry Smith, Texas Natural Resource Conservation Commission; Sam Umberhagen, Texas State Soil and Water Conservation Board; and Darryl Williams, Texas Natural Resource Conservation Commission.
2. See Environmental Law Institute, Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution (1998).
3. Http://www.edwardsaquifer.net/intro.html.
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9. *See* Environmental Law Institute, Almanac of Enforceable State Laws to Control Nonpoint Source Water Pollution (1998).
10. Vernon's Texas Code Annotated Water Code 26.121(a).
11. VTCA Water Code 26.123, 26.122(a), 26.136.
12. VTCA Water Code 26.1311, VTCA Agriculture Code 201.026.
13. VTCA Agriculture Code 201.026.
14. 30 TAC § 321.32(9)(a).
15. 30 TAC § 321.32(9)(b) and (11).
16. 30 TAC § 321.33(d).
17. 30 TAC §§ 321.39 and 321.41.
18. VTCA Water Code 26.401.
19. VTCA Local Government Code 401.002(a).
20. VTCA Local Government Code 401.002(b) and (c).
21. VTCA Water Code 26.177(a).
22. VTCA Water Code 26.177(b).
23. VTCA Water Code 26.177(c).
24. VTCA Water Code 26.171 (1999).
25. VTCA Water Code 26.175 (1999).
26. VTCA Water Code 26.173 (1999).
27. City of Austin Land Development Code § 25-8.
28. City of Austin Land Development Code § 25-8-511 *et. seq.*
29. Texas House Bill 1704 (1999).
30. VTCA Agriculture Code 201.308.

31. VTCA Agriculture Code 201.305(b).
32. Memorandum of Understanding: Texas SSWCB and TNRCC, May 27, 1997.
33. *Id.*
34. U.S. EPA, "Section 319 Success Stories: Volume 11", EPA 841-R-97-001, October 1997.
35. 30 TAC § 213.4.
36. 30 TAC § 213.8.
37. 30 TAC § 213.5 (b).
38. 30 TAC § 213.5(f)
39. 30 TAC § 213.4(g).
40. 30 TAC § 213.4(a)(5).
41. VTCA Water Code 26.177.
42. City of Austin Land Development Code § 25-8-514.
43. City of Austin Land Development Code § 25-8-81.
44. Texas House Bill 4 (1987).
45. Texas Senate Bill 1704 (1995).
46. Title IV, Ch 401 Austin City Code 1992, Subtitle D (Water Quality Control) Ch. 26, Texas Water Code, and 31 TAC Ch. 307-321, and VTCA Water Code 26.175 (1999). City of Austin, "Program Storm Sewer Discharge Facilities."
47. Title IV, Chapter 401 Austin City Code 1992, Texas Water, Ch 26, Title 2, Subtitle D, and City of Austin." Program 23, Emergency Spills and Pollution Complaint Response."

Virginia Case Study

Summary

This study examines the mechanisms used to manage and control nonpoint source pollution in the James River watershed. The James River starts in the Blue Ridge Mountains and continues through Virginia to the Chesapeake Bay.[1] The study specifically examines the relationship between enforcement approaches and voluntary, technical assistance, tax incentives, and cost share approaches as used in the watershed.

Virginia primarily uses incentive-based programs that emphasize best management practices for nonpoint source pollution management – especially in agriculture and forestry. The state has completed the development of a tributary nutrient and sediment reduction strategy and draft goals for the James River. The goals will, to a large extent, determine the future priorities for technical assistance, funding, and enforcement actions in the James River watershed. Virginia's enforcement of nonpoint source pollution violations largely is triggered by citizen complaints, although forestry recently has included an inspection and monitoring program. Identification of nonpoint source pollution typically first goes through a process of working with the landowner to correct the problems, with enforcement actions taken only where attempts to achieve compliance do not work. Virginia depends heavily on its localities for implementation and enforcement of urban runoff controls, such as erosion and sediment control during construction and other land-disturbing activities, as well as stormwater management of runoff from existing developments and urban areas. Combined with the fact that many areas in Virginia and in the James River watershed are undergoing heavy growth and development pressures, this means that erosion and sediment control and stormwater runoff continue to need attention under nonpoint source pollution management programs.

James River Watershed

Virginia has nine major river basins with an estimated 49,350 miles of rivers and streams and approximately 2,500 square miles of estuaries.[2] In general, fecal coliform bacteria exceedances are the leading cause of non or partial support of designated uses in rivers and streams. Agricultural practices appear to be one of the primary sources causing the loss of designated use support. Indications are present that agricultural and pasture land use results in much of the fecal coliform bacteria and nutrient contamination in Virginia's waters. However, urban runoff, as well as municipal and industrial discharges, are also significant contributing sources.

Forested land covers approximately 55.6% of Virginia's landscape.[3] More than 400,000 private forest landowners own 77% of the commercial timberland, while the forest industry owns 10% and the remaining 13% is owned by federal, state, and local government. The second most prevalent land use in Virginia is agriculture, covering 25.9% of the state's total land area. Cropland accounts for 2,903 square miles, about 7.1% of the state's total area, pasture and hay production accounts for 6,845.3 square miles or about 16.8% of the state's land.

The James River Basin occupies the central portion of Virginia and drains 10,102 square miles or approximately 25% of the Commonwealth's total land area.[4] It is Virginia's largest river basin and is made up of the Upper, Middle, and Lower James River Subbasins and the Appomattox River Subbasin.[5] The James originates along the Virginia/West Virginia border in the Allegheny Mountains, flows in a southeasterly direction to Hampton Roads where it enters the Chesapeake Bay, a total of 450 miles. The James constitutes 10% of the waters flowing to the Chesapeake Bay. Most of the James is forested, with about 25% in cropland and 9% urban.[6] The population along the James River is primarily concentrated in two metropolitan areas: Tidewater and the Richmond Metropolitan area with approximately one million people each. Most of the extensive urban development and industrial activity is concentrated in this lower portion of the James watershed in Richmond, Petersburg, Hopewell, and Hampton Roads. Two smaller, but growing, population centers are the Lynchburg and Charlottesville areas, each with over 100,000 inhabitants. In total, nearly one-third of Virginia's population live in the James watershed and use its waters. The James is stressed by a combination of pollutants, including sediments, nutrients, toxics, and bacteria. The James River watershed is primarily impacted by agricultural and urban nonpoint source pollution.[7]

Enforceable Mechanisms

Of the Virginia nonpoint source enforceable mechanisms, the following were reviewed because of their relevance to the James River watershed.

! *Water quality standards.* Under the Virginia Water Pollution Control Law, it is unlawful to discharge wastes or other deleterious substances into or adjacent to the waters or to alter their state without a permit. Enforcement is by special order and can include injunctive relief and civil penalties of up to $25,000 per day.[8] In practice, enforcement actions in response to water quality standard violations are not common. Silviculture and agriculture have developed their own enforcement mechanisms.

! *Agricultural Stewardship Plans.* Virginia's Agricultural Stewardship Act establishes a complaint-driven enforcement mechanism applicable to agricultural nonpoint source pollution. If, after receiving a complaint, the Commissioner of Agriculture finds pollution or a threat of pollution, he can require that the landowner submit an agricultural stewardship plan to the local soil and water conservation district.[9] Failure to implement an agricultural stewardship plan subjects the landowner or operator to corrective action that sets out a timetable for implementation. The corrective action order can be enforced by injunction, by entry and abatement (with cost recovery), and by assessment of a civil penalty of up to $5,000 per day.[10] The Commissioner also can issue an emergency corrective action if runoff from an agricultural activity is causing or is likely to cause imminent or substantial danger to public health, animals, fish and aquatic life, public water supply, or agricultural, recreational or industrial uses. An emergency order may direct cessation of all or part of the agricultural activity and require specific stewardship measures.

! *Confined animal feeding operations.* Since 1994, animal waste from confined animal operations in excess of 300 animal units (hogs and cattle) has been managed primarily through a Virginia general pollution abatement permit.[11] These operations are required to meet a number of conditions that will assist in reducing nutrients from liquid animal waste and preventing runoff and ground water contamination. These conditions include requirements for an approved nutrient management plan and standards for waste unit operations. In 1999, the Virginia General Assembly passed legislation which requires DEQ to develop regulations for the management of poultry waste.[12] The statute requires that growers with more than 200 animal units of poultry (about 20,000 chickens) implement nutrient management plans which limit land application of manure to crop nutrient needs and crop nutrient uptake.

! *Virginia Chesapeake Bay Preservation Act.* The Virginia General Assembly enacted the Chesapeake Bay Preservation Act in 1988, establishing a cooperative program between state and local governments to reduce nonpoint source pollution.[13] Under the Chesapeake Bay Preservation Act, localities designate and map Chesapeake Bay Preservation Areas, implement specific performance criteria, adopt or amend a comprehensive plan to enhance water quality, and adopt development standards, as necessary to preserve water quality. The localities of Tidewater Virginia must incorporate general water quality protection measures into their comprehensive plans, zoning ordinances, and subdivision ordinances.[14] Localities in the region must establish Chesapeake Bay Preservation Areas, identifying lands that if improperly developed may result in water quality damage. The regulations on land use standards are intended to prevent a net increase in nonpoint source pollution from new development, achieve a 10% reduction in nonpoint source pollution from redevelopment, and achieve a 40% reduction in nonpoint source pollution from agricultural and silvicultural uses.[15] State regulations set out general performance criteria to minimize erosion, reduce land application of nutrients and pesticides, and maximize rainwater infiltration for Chesapeak Bay areas. The criteria become mandatory on the local program adoption date and are enforceable by localities. The local program stormwater management water quality criteria required of local developers is consistent with the state Stormwater Management Program implemented by DCR.

! *Forestry BMPs and water quality enforcement.* The Virginia Department of Forestry has a system of inspection and enforcement for all timber harvesting. When actual or threatened water quality violations occur, the Department has authority to recommend corrective action, issue orders, stop harvesting, or initiate civil penalties.[16] As long as best management practices are not in place, the Virginia State Forester may issue a special order to an operator conducting business in a way that is likely to cause or is causing water pollution.[17] The order can include a stop-work order and corrective actions that must be implemented within a specific timetable. The State Forester can also issue emergency orders if there is an imminent and substantial endangerment of public health or the health of animals or fish, or if commercial or recreational activities are endangered.

! ***Land disturbance permitting.*** Virginia's Erosion and Sediment Control Law sets forth the regulation of land disturbing activities including clearing, grading, excavating, transporting, and filling of land.[18] The Law also sets forth the establishment of a state erosion and sediment control program (state program) and local erosion and sediment control programs (local programs). The state program is administered by the Department of Conservation and Recreation (DCR) under the authority of the Virginia Soil and Water Conservation Board. Counties, cities, and towns currently administer local programs. Local programs (totaling 166 separate programs throughout the Commonwealth) exercise program authority over private and municipal projects. The DCR exercises program authority over all state agency projects. The Virginia Soil and Water Conservation Board is responsible for periodically evaluating the effectiveness of local program implementation to ensure consistency with the state program. Persons undertaking land disturbing activities cannot receive a building or any other permit unless they have an approved erosion and sediment control plan and certification that the plan will be implemented. Plan approval is granted by local program authorities or the Department of Conservation and Recreation as appropriate. The appropriate program or plan approving authority is required to conduct periodic inspections of projects in accordance with the regulations. When violations are found, the inspector notifies the owner about needed corrections and when they must be made. If violations are not corrected on time, the locality (or DCR if applicable) is responsible for enforcement. The program authority can serve notice on the violator specifying a timetable for meeting the requirements of the plan. Localities can establish civil penalty schedules for violations, issue stop-work orders, apply corrective actions, or revoke the permit. The Erosion and Sediment Control Law does not apply to specifically identified agricultural or silvicultural operations. It also does not apply to activities under 10,000 square feet, unless the locality chooses to lower this threshold. For example, Chesapeake Bay Preservation Act areas have a threshold of under 2,500 square feet. Program authorities have authority to grant a variance for specific activities from the requirements of the law.

! *Stormwater Management.* The Virginia Department of Environmental Quality (DEQ), Department of Conservation and Recreation (DCR), and the Chesapeake Bay Local Assistance Department (CBLAD) are coordinating related yet separate state programs that regulate the management of pollution carried by stormwater runoff, including an urban and industrial stormwater permit program under the federal Clean Water Act. The Virginia Stormwater Management Act and regulations enable local governments to establish management plans and adopt ordinances that require control and treatment of stormwater runoff to prevent flooding and contamination of local waterways.[19] Local programs must meet or exceed the minimum standards contained in regulations. Under the act, state agencies must employ management practices whether or not the locality in which a state facility is to be located has a program.

Assistance-Oriented Nonpoint Source Programs

This section describes a number of the technical assistance, cost-share, and voluntary programs that address nonpoint source water pollution in the James River watershed. It is not an exhaustive list, but provides a brief description of programs that have influenced activities and water quality in the watershed.

! *Virginia Agricultural BMP Cost-Share Program.* The cost-share program is administered by DCR to improve water quality in the Commonwealth's streams, rivers, and the Chesapeake Bay. The program is funded with state and federal monies through local Soil and Water Conservation Districts. SWCDs encourage farmers and landowners to use BMPs to better control sediment, nutrient loss, and runoff of pollutants into Virginia's waters from excessive surface flow, erosion, leaching, and inadequate animal waste management. The objective of the program is to solve water quality problems by fixing the worst problems first. Thus, program participants are recruited by the District based upon those factors which most influence their land use impact upon water quality. The individual cost-share limit for all BMPs is $50,000.

! *Virginia Agricultural Best Management Practices Tax Credit Program.* For years, the Virginia SWCB has promoted BMPs. The legislature two years ago added a statewide income tax credit program. This program provides an incentive to install agricultural BMPs in accordance with an approved conservation plan. Its goal is to reduce the amount of nonpoint source pollution entering the state's streams, rivers, and estuaries. For all taxable years beginning on and after January 2, 1998, any individual or corporation engaged in agricultural production for market who has in place a soil conservation plan approved by the local SWCD shall be allowed a credit against the tax imposed by Virginia Code section 58.1-320 of an amount equaling twenty-five percent of the first $70,000 expended for agricultural BMPs by the individual. Agricultural BMP means a practice approved by the SWCB which will provide a significant improvement to water quality in the state's streams and rivers and the Chesapeake Bay, and is consistent with other state and federal programs that address agricultural nonpoint source pollution management. Any practice approved by the local SWCD Board shall be completed within the taxable year in which the credit is claimed. The credit shall be allowed only for expenditures made by the taxpayer from funds of his own. The amount of the credit shall not exceed $17,500 or the total amount of the tax imposed, whichever is less, in the year the project was completed, as certified by the Board. If the amount of the credit exceeds the taxpayer's liability for the taxable year, the excess may be carried over for credit against income taxes in the next five taxable years until the total amount of the tax credit has been taken.

! *Virginia Nutrient and Pesticide Application Equipment Tax Credit* This tax credit program encourages the purchase of improved and more precise nutrient and pesticide application equipment. It is managed by DCR and the SWCDs and is applicable statewide. The Virginia Nutrient and Pesticide Application Equipment Tax may be claimed for the year of purchase for equipment meeting state approved specifications. A 25% Virginia income tax credit may be applied to qualifying purchases of up to $15,000 resulting in a maximum credit of $3,750. The credit balance may be carried forward up to five years into the future if the credit amount exceeds the farmer's tax liability for the year of the purchase. Persons or corporations must be engaged in agricultural production for market to be eligible for the credit. In addition, a nutrient management plan must be developed for the farm and approved by the SWCD by the required filing date of the tax return. A letter from the SWCD indicating plan approval must be sent in with the tax return. The nutrient management plan should incorporate the use of the new equipment and meet DCR criteria for nutrient management plans.

! *Conservation Reserve Enhancement Program (CREP).* CREP is Virginia's largest cost-share program. Beginning in 2000, its five year total will exceed $91 million with 30,500 acres of riparian buffers, 4,500 acres of wetlands restoration, and 8,000 acres of riparian easements anticipated statewide. The federally-funded CREP program supports annual rental payments, cost-share for BMPs, and the ability to add on riparian easements if desired. The program also offers a sign-up incentive payment and a practice incentive payment. The cost-share ranges from 75% to 100% for eligible BMPs and approximately 25% comes from local SWCD funds.

! *Conservation Reserve Program (CRP).* The CRP is primarily for environmentally sensitive lands and for highly erodible lands. Under the CRP, the USDA's Farm Service Agency tries to sign up highly valuable environmental acreage, establish long-term resource conserving covers on eligible land, and to reduce erosion, runoff, and leaching. It is applicable in all counties in Virginia. Offers from landowners to enroll lands, placing them under conservation easements for a period of years, are accepted provided the acreage and producer meet certain eligibility requirements, including suitability of the land for riparian buffers, filter strips, grassed waterways, shelterbelts, salt tolerant vegetation, or shallow water areas for wildlife.

! *Environmental Quality Incentive Program (EQIP).* EQIP is managed by the Natural Resources Conservation Service (NRCS) and is applicable statewide to address priority concerns and in special targeted priority areas. The program was established under the 1996 Farm Bill to provide a single voluntary conservation program for farmers and landowners to address significant natural resource needs. Approximately 65% of the EQIP funding in Virginia is directed towards "priority areas." These areas are selected by the State Technical Committee based on proposals submitted by the locally led conservation work group. The remaining 35% of the funds are directed toward statewide priority concerns of environmental needs. EQIP offers 5-10 year contracts to landowners and farmers to provide cost-share assistance or incentive payments to implement conservation practices. Eligibility is limited to persons who are engaged in livestock or agricultural production. Eligible land includes cropland, pasture, and other agricultural land in priority areas or if the land has a need that matches one of the statewide concerns.

! *Conservation Farm Option (CFO).* The Conservation Farm Option provides landowners and farmers the option of consolidating the different types of payments available under the Conservation Reserve Program, the Wetlands Reserve Program, and the Environmental Quality Incentives Program into a single annual payment. CFO provides an incentive for coordinated, long-term natural resource planning and gives farmers additional flexibility. CFO is managed by the Farm Service Agency and only owners and producers that have a farm with contract acres enrolled in production flexibility contracts established under the Agricultural Market Transition Act (AMTA) are eligible to participate.

! *Forestry Incentive Program (FIP).* FIP is a reforestation program managed by the Natural Resources Conservation Service and the Virginia Department of Forestry. It is applicable statewide. FIP is a voluntary cooperative program with landowners to encourage the development, management, and protection of non-industrial, private forest lands in the state. The program provides cost-sharing assistance to landowners for site preparation and tree planting.

Discussion and Analysis

Tributary Strategies

In Virginia, various state agencies, such as DEQ, DCR, and the Chesapeake Bay Local Assistance Department (CBLAD), work together to develop tributary strategies for river basins, such as the James, to ensure that reductions of nutrients, toxics, and sediments, are sufficient to improve water quality and restore the living resources of the Chesapeake Bay and its tributaries.[20] The *Initial James River Basin Tributary Nutrient and Sediment Reduction Strategy* was completed in July 1998 through a cooperative process among state and local government, agriculture, business, industry, citizens and others. The *Tributary Strategy: Goals for Nutrient and Sediment Reduction in the James River* was sent out for public comment in January 2000.

In 2000, over $20 million was appropriated for the biennium to the Virginia Water Quality Improvement Fund, which by law receives a portion of any budget surplus.[21] The Water Quality Improvement Fund supports point and nonpoint source nutrient and sediment reduction through grants to local governments, farmers and others and is the cornerstone of Virginia's Chesapeake Bay Tributary Strategy Program. The fund also provides grants to areas outside of the Chesapeake Bay watershed. Nonpoint source grants are administered by DCR. Since 1997, approximately 113 million has been appropriated to the Water Quality Improvement Fund. Most of this funding has gone to point sources. In theory, cost-share funding is available for nonpoint source control projects that have been identified in the Initial James River Basin Tributary Strategy, and for other, innovative or cost-effective practices that will help achieve the goals of the Strategy. In practice, access to this funding has been limited, but may increase in the James River Basin when the tributary strategy goals are finalized, although the sufficiency of the amount of available funds to meet the pollution reduction needs is in question.[22] Virginia also applies other funds from Clean Water Act Section 319, Virginia's Chesapeake Bay Implementation Grant Program, and Coastal Zone Management Act Section 6217.

Agricultural Pollution

The Virginia Department of Agriculture and Consumer Services (VDACS) works with farmers and local Soil and Water Conservation Districts to resolve water quality problems reported to VDACS concerning nutrients, sediment and toxins from agricultural activities. Incentives and cost-share programs are the main avenue for nonpoint source pollution management. Enforcement against agricultural nonpoint source pollution is bifurcated. The first prong is regulatory, such as permits for CAFOs. The second prong of Virginia's system addresses agricultural runoff and ground water pollution from CAFOs that are too small for the DEQ permit system, as well as runoff and ground water pollution from crop land and all other forms of agriculture. This second prong is complaint-driven and strives to achieve compliance before resorting to enforcement actions.

Incentive Programs – The primary vehicle for cost-share funding of point source and nonpoint source nutrient controls is the Virginia Water Quality Improvement Fund administered by DEQ and DCR. The Fund is managed as a grant fund for individual projects, identified through the River Basin Strategy. It is also managed as a fund for Soil and Water Conservation Districts to disburse through their normal process of agricultural best management practices and cost share programs.

Animal Feeding Operations – Currently, confined animal feeding operations (CAFOs) (except poultry operations) must obtain a permit. All permitted CAFOs are required to be designed and operated according to specific standards contained in the permit and are subject to inspection by DEQ. Violation of the permit requirements or failure to obtain a permit opens the owner or operator to enforcement by DEQ in the form of civil penalties, criminal charges, and/or injunctive or other equitable relief. Most of Virginia's regulated animal feeding operations are found outside of the James River watershed. However, DEQ has taken some enforcement actions based on violations of permits, primarily on dairy and hog farms. For example, in 1999, statewide, three enforcement actions were completed – one for a small dairy in Tidewater, one for a small dairy in West Central, and one for a larger hog farm. There have not yet been any enforcement actions again chicken farmers as the changes to the law are still too new.

Complaint-Driven Enforcement – Virginia's agricultural stewardship program gives the farmer an opportunity to correct a water quality problem voluntarily before any enforcement action is taken.[23] Under the program, VDACS receives complaints and contacts the local Soil and Water Conservation District for an initial investigation. After the complaint is investigated, VDACS reviews the findings and determines if the complaint is founded and requires further action under the Agricultural Stewardship Act. If so, the farmer is required to develop a plan to correct the problem

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and then complete plan implementation within 18 months. The Agricultural Stewardship Act does not cover agricultural activities subject to water quality permits from the Department of Environmental Quality, forestry activities, or problems that do not involve agricultural products. Typical activities covered under the Act include nutrients from manure in feedlot runoff, sediment from erosion on crop fields, and toxins from pesticide runoff.

In practice, DEQ, in the course of its water quality monitoring or permit compliance inspections will identify potential water pollution problems under the Agricultural Stewardship Act and notify VDACS as a complainant. Since the complaint-driven process was established in April 1997, VDACS has received approximately 300 inquiries, 100 of which underwent the first step of the process to develop a corrective plan. Of those 100, in only one case was the plan not implemented within the 18 month time limit, causing VDACS to undertake an enforcement action which was still underway in May 2000. This enforcement case is in the James River Basin. In general, the enforcement process is triggered when there is a pollution problem and the landowner (1) does not develop a corrective plan; (2) plan is not being implemented 6 months later upon VDACS inspection; or (3) implementation of the plan is not completed within 18 months of plan approval.[24]

Forestry Water Quality Programs

Virginia has developed best management practices for water quality, such as streamside management zones, design guidance for roads, skid trails, and stream crossings, revegetation of bare soil areas, and wetlands protection.[25] Virginia complements its complaint-driven enforcement mechanism in forestry, with a system of Department of Forestry monitoring, inspection, and specific triggers for enforcement actions.

In order to ensure the monitoring and inspection, Virginia has developed a series of forms to facilitate enforcement of the Silvicultural Water Quality Law.[26] The harvest inspection form is for all private land harvesting operations and is usually filled out by the DOF inspector and then submitted to the Regional Office.[27] Department field personnel can inspect at any time, and in any case will inspect operations of landowners not meeting DOF requirements. If the harvesting inspection form shows that a violation of the Silvicultural Water Quality Law has taken place, the inspector must complete and issue a water quality law enforcement form.[28] In some cases, the inspection form may indicate a BMP deficiency problem that is not a water quality law violation. In these cases, the inspector will re-inspect the tract for BMP corrective action if requested by the owner/operator. Landowners who receive a law enforcement form are given specified periods of time for implementation of corrective measures in a "notice of required action." These deadlines are mandatory. Ninety percent of problems are solved at the notice of required action stage. If the corrective action is not properly taken, the inspector prepares a law enforcement case summary and sets up an informal conference. DOF also can issue emergency special orders or stop-work orders if the silvicultural activity is causing an "imminent and substantial danger to the waters of the Commonwealth by introducing sediment deposition." Landowners can request formal administrative hearings. After either the informal conference or the hearing, DOF issues a final order that can include civil penalties or civil charges. In determination of the civil penalty or charge amount, DOF considers the seriousness of the violation, the degree of negligence, the owner's good faith, and any previous history of violation.

In practice, a weak link in the new enforcement procedures can be identifying logging jobs that do not self-report. The citizen organization Virginia Forest Watch has begun a new program in early 2000 to assist the Virginia Department of Forestry in identifying the location of logging jobs. Between February and April 2000, the watchdog program reported 30 jobs in 15 different counties across the state. According to Virginia Forest Watch, the first two jobs looked at by DOF resulted in the discovery of water quality violations and "notice of required action" was served on the loggers and the owners.

Land Development and Urban Runoff

Erosion and Sediment Control - DCR Soil and Water Division coordinates the erosion and sediment control program for the state. The Soil and Water Conservation Board has the authority to revoke a local program. However, in the case of revocation, the local Soil and Water Conservation District would be able to take over the program, and if they refuse to do so, the program then would fall under the jurisdiction of DCR. In practice, all localities in Virginia have retained control over their erosion and sediment control programs, knowing that lack of resources in the local Soil and Water Conservation Districts and in the DCR offices might cause their building permit fees to rise in order to provide the resources for running the program. However, program consistency with state law generally and in the James specifically is at approximately twenty-five percent. Erosion and sediment control has become a big problem for localities facing increased growth, although sedimentation remains a relatively small contribution to the James River overall.

Stormwater - Eight urban localities (Chesapeake, Norfolk, Newport News, Virginia Beach, Portsmouth, Chesterfield, and Henrico) in the James River basin and its adjacent Bay waters have been required to develop stormwater management programs under provisions of the federal Clean Water Act, administered by Virginia DEQ. Permits obtained by localities require them to implement and monitor programs that reduce the discharge of pollutants from municipal storm sewers to the maximum extent possible and to prohibit illicit discharges into stormwater systems. Other localities regulate stormwater runoff on a case-by-case basis through subdivision laws and other zoning regulations. Most stormwater enforcement actions are taken by localities administering the programs. DEQ has investigations underway, but no enforcement actions.

The Chesapeake Bay Preservation Act establishes requirements for stormwater management within Chesapeake Bay preservation areas in all Tidewater localities. Under this legislation, each local government enforces its own program, which has been patterned on a model developed by the Chesapeake Bay Local Assistance Board and Department. State resources for the implementation and enforcement of stormwater regulations are low, with only five stormwater engineers statewide who oversee state agency stormwater management practices as well as local stormwater management programs.

Conclusions

Virginia has a variety of nonpoint source control programs operating in the James River watershed, including cost-share, technical assistance, voluntary, and enforceable programs. The James River watershed reflects many of the trends and nonpoint source pollution programs found throughout Virginia. The process of developing a tributary strategy for the James River has helped state and local government, as well as citizens and others identify priorities and set goals for reduction of nutrients and sediment from nonpoint source pollution. This process is helping the state government and local governments to determine priorities for technical assistance, cost-share funding, and enforcement actions.

The review shows that Virginia emphasizes best management practices for management of nonpoint source pollution from agricultural and forestry operations. The various regulatory agencies focus on bringing land owners into compliance, using enforcement actions as a final resort in cases of continued noncompliance. Coordination among agencies, such as VDACs and DEQ or DOF and DEQ, can facilitate identification of real and threatened harm to water quality in order to support compliance and enforcement actions. Compliance and enforcement for forestry operations is supplemented by a recently adopted monitoring and inspection process by DOF. The James River watershed experience shows both that local erosion and sedimentation control programs are very important to maintaining healthy rivers, and that a more resource-intensive mixture of technical assistance, training, priority-setting, and enforcement is needed to make the local and state programs in these areas more effective.

In general, the impression left by review of existing efforts is that the use of enforceable mechanisms has increased slightly over the past, although the primary nonpoint source control mechanisms are still technical assistance, cost-share, and voluntary programs. In most cases, regulatory programs seemed understaffed with few financial resources at their disposal. Nonpoint source controls have never been relatively well funded, although there was a significant level of funds this year for the first time. Historically nonpoint controls have been left to be accomplished voluntarily, with cost-share largely carrying out "demonstration" of practices, rather than broader-scale implementation.

Still, a significant level of agency interaction and cooperation in Virginia has enabled the Commonwealth to achieve certain improvements with the limited resources available. Voluntary conservation and stewardship have also played a role. The rapid pace of development, alongside continued agricultural and silvicultural activity, poses a challenge to state and local government agencies. These will require additional resources for strengthening implementation, compliance assurance, and enforcement in the future.

ENDNOTES

1. In addition to the sources cited, the following individuals were interviewed by telephone or in person: Jack Frye, Director Soil and Water Conservation Division, Virginia Department of Conservation and Recreation; Patti Jackson, James River Association; Kathleen O'Connell, Water Enforcement Program Manager, Department of Environmental Quality; Collin Powers, Virginia Chesapeake Bay Program, Department of Environmental Quality; and Sarah Pugh, Virginia Agriculture Commissioner's Office.

2. Virginia 305(b) Water Quality Assessment Report, Virginia Department of Environmental Quality, 1998.

3. Virginia 305(b) Water Quality Assessment Report, Virginia Department of Environmental Quality, 1998.

4. All or a portion of the following 39 counties and 14 cities lie within the basin: counties: Alleghany, Amherst, Bath, Nelson, Rockbridge, Augusta, Bedford, Botetourt, Campbell, Craig, Giles, Highland, Montgomery, Roanoke, Amelia, Buckingham, Chesterfield, Cumberland, Fluvanna, Goochland, Henrico, Powhatan, Albemarle, Appomattox, Prince Edward, Dinwiddie, Greene, Hanover, Louisa, Nottoway, Orange, Charles City, Isle of Wight, James City, Nansemond, New Kent, Prince George, Surry, and York; cities: Buena Vista, Clifton Forge, Covington, Lexington, Lynchburg, Charlottesville, Colonial Heights, Petersburg, Richmond, Hopewell, Norfolk, Newport News, Suffolk, and Williamsburg.

5. Major tributaries to the James River are Craig Creek, Maury River, Tye River, Rockfish River, Slate River, Rivanna River, Willis Creek, Appomattox River, Chickahominy River, Pagan River, Nansemond River, and the Elizabeth River.

6. *Initial James River Basin Tributary Nutrient and Sediment Reduction Strategy*, July 1, 1998, p. 24.

7. Virginia 303(d) TMDL Priority List, Virginia Department of Environmental Quality, 1996.

8. Water Pollution Control Law, Va. Code 62.1-44.5

9. Agricultural Stewardship Act, Va. Code 10.1-559.3

10. Agricultural Stewardship Act, Va. Code 10.1-559.5, 10.1-559.7

11. General Permits for Confined Animal Feeding Operations, Va. Code 62.1-44.17:1. Confined animal feeding operations that do not qualify for the general permits must obtain individual permits under either the Virginia Pollution Abatement (VPA) permit system or the Virginia Pollution Discharge Elimination System. See, Va. Code 62.1-44.5, 62.1-44.15.5, 62.1-44.17:1-1.

12. Poultry Waste Management, Va. Code 62.1-44.17:1.1

13. Chesapeake Bay Preservation Act, Va. Code 10.1-2100 *et seq.*

14. Chesapeake Bay Preservation Act, Va. Code 10.1-2100, 10.1-2109

15. Chesapeake Bay Program 9 VAC 10-20-110

16. Silvicultural Water Quality Law, Va. Code 10.1-1181

17. Silvicultural Water Quality Law, Va. Code 10.1-1181.2

18. Erosion and Sediment Control Act, Va. Code 10.1-560

19. Virginia Stormwater Management Regulations, 4 VAC 3-20

20. Virginia Chesapeake Bay Tributaries Strategies Law, Va. Code 2.1-51.12:1 *et seq.*

21. Chesapeake Bay Commission, *Legislative Update*, May 2000. See also, Chesapeake Bay Commission, *Annual Report 1999: Policy for the Bay.*

22. Demand for cost share funding currently exceeds the amount available, even in areas in which increased funds have been made available, and this demand is expected to increase.

23. Agricultural Stewardship Act, Va. Code 10.1-559.1

24. See amendments to the Agricultural Stewardship Act, HB 1307 Agricultural Stewardship Act, approved by Governor April 2000, effective July 1, 2000.
25. *Forestry Best Management Practices for Water Quality in Virginia: Technical Guide*, Virginia Department of Forestry, 1997.
26. Virginia Department of Forestry Harvest Procedures and Water Quality Law Enforcement Procedures, August 1998.
27. Harvest Inspection Form, Form 30.
28. Law Enforcement Form, Form 145.

Wisconsin Case Study

Summary

Unlike many other states, Wisconsin has for many years had a fully articulated program for nonpoint source water pollution control.[1] Thus, its enforceable mechanisms have long been linked with its cost share and technical assistance provisions. Wisconsin's nonpoint source pollution abatement program originated in 1978. Initially, the program administered grants to individual landowners and communities in both urban and rural watersheds to cover the cost of voluntary best management practices. To assist in targeting projects, as well as to meet federal and state requirements to identify waters in need of attention, the state developed a system known as the "priority watershed program." The Department of Natural Resources (DNR), with cooperation from the Department of Agriculture, Trade, and Consumer Protection (DATCP), ranked the watersheds. For each priority watershed, DNR, DATCP, and the local government developed a priority watershed plan to guide cost-share assistance and related activities. In 1993, the priority watershed program was amended to include a requirement that "critical sites" be identified in the planning process. A critical site is one that, due to the amount of pollution it generates and/or its location in the watershed, *must* be addressed in order for the plan to achieve its water quality objectives.

After nearly ten years of experience with the nonpoint source program, it became clear that enforceable mechanisms would be needed to assure the state's ability to assure the effectiveness of nonpoint source pollution controls. In 1987, DNR received authority to issue Nonpoint Source Abatement Orders. DNR can issue such orders whether or not the site is in a priority watershed, although more complex procedures apply when the site is agricultural.[2] Orders may be issued for all sources of nonpoint source pollution except animal waste, which has been regulated under a separate program since 1984. The "Notice of Discharge" system for animal waste nonpoint sources provides a way to obtain corrective action for these sites.[3]

In 1997, the Wisconsin legislature significantly changed the direction of the state's nonpoint source programs. Act 27 (the common name for the 1997 amendments) placed the priority watershed program, which is chiefly administered by DNR, into a long multi-year phase-out period. It also strengthened the role of DATCP in addressing agricultural nonpoint source pollution. The changes required the agencies to develop explicit performance standards for nonpoint sources. Further, Act 27 created new competitive funding programs available across the state rather than just in priority watersheds. In 1999, the legislature reinforced these changes by shifting more funding to DATCP to support agricultural nonpoint source control staff and cost share activities in all 72 of Wisconsin's counties.

Wisconsin's counties, and to some extent towns and cities, play a substantial role in the state's nonpoint programs. Funding and cost share assistance are provided by the state through the county Land Conservation Commissions (LCCs). Counties also adopt and administer land

and water resource management plans and enforceable ordinances which may address erosion, shoreline protection, animal waste and manure management, land use, and pollutant management practices.

Wisconsin's comprehensive nonpoint efforts reflect objectives of setting state standards and state priorities, while providing for local control and flexibility. The programs reflect as well the continued legislative experimentation with the role of DNR (which largely administers Chapter 281 of the Wisconsin Statutes) and DATCP (which administers Chapter 92). The legislature adjusts their relationship *each biennium* through budget legislation, which often includes substantive amendments. The recent changes reflect the legislature's judgment that more funding and attention should go to nonpriority counties and watersheds.

Watersheds

This study examines the use of state and local nonpoint source programs and authorities in watersheds in two parts of Wisconsin: La Crosse County (along the Mississippi River in western Wisconsin) and Brown County (in the Green Bay area in northeastern Wisconsin).

Both counties have developed local ordinances for the control of nonpoint source pollution, and both have been funded for priority watershed projects in the past. The watersheds - which have substantial agriculture and development activity - are described in greater detail in the "Discussion and Analysis" section.

Enforceable Mechanisms Studied

This study examines the following enforceable mechanisms:

! *DNR Nonpoint Source Abatement Order.* These orders apply to all types of nonpoint source pollution except animal waste pollution, and may be issued by DNR if pollution is determined to be "significant." Significant nonpoint source pollution is defined as causing violation of a water quality standard, significantly impairing aquatic habitat or organisms, restricting navigation, deleterious to human health, or otherwise significantly impairing water quality.[4]

! *Animal Waste Notice of Discharge.* A complaint-driven process can result in a DNR determination that an animal waste pollution discharge is significant. If so, DNR issues a Notice of Discharge (NOD) which requires correction of the problem. If the NOD does not result in compliance, the DNR requires the operator to obtain a state NPDES permit which specifies all of the requirements to abate the discharge and come into compliance.[5]

! *Local Ordinances.* Wisconsin law provides for many kinds of enforceable local ordinances that may be directed at nonpoint source water pollution. These include soil and water conservation and nonpoint source pollution abatement ordinances; shoreland ordinances; livestock operation and manure management ordinances; and zoning ordinances that address contruction erosion and stormwater runoff.[6]

Nonpoint Source Programs, Cost-Shares, Standards, and Enforcement

Responsible Agencies

Operating under Title 281, DNR's Bureau of Watershed Management has primary responsibility for administering Wisconsin's nonpoint source program, for standard setting, and for grant funding, particularly in priority watersheds.[7] DNR also has abatement order authority. DNR must consult with DATCP on elements of the nonpoint program that relate to agricultural standards and agricultural watersheds.

For its part, operating under Title 92, DATCP sets soil and water conservation policies and administers agricultural grant and planning programs.[8] The legislature recently gave DATCP greater responsibility for standard setting, and for local staffing and cost shares in addressing nonpoint source problems. DATCP interacts with county land conservation committees (LCCs), which are created by Wisconsin's county boards.[9]

The appointed Land and Water Conservation Board (Board) oversees both DNR's nonpoint source program and DATCP's soil and water conservation program, reviewing administrative rules and plans. The Board also approves the list of priority watersheds, which until recently served as the core of the Wisconsin nonpoint program.

Local government units, including cities, counties, villages, towns, metropolitan sewerage districts, town sanitary districts, public inland lake protection and rehabilitation districts, regional planning commissions, or drainage districts, also play a role in nonpoint source controls.[10] County and municipal governments are authorized to enact ordinances to address nonpoint source pollution, including the prohibition of land uses or management practices that cause erosion, sedimentation, nonpoint source water pollution, or storm water runoff.[11]

Priority Watershed Program

The priority watershed program has for two decades been the state's primary vehicle for targeting its cost sharing grants. The process of identifying priority watersheds was linked to Wisconsin's original areawide water quality management planning process.[12] DNR set water quality objectives for each priority watershed and established a committee (including farmers, public inland lake protection and rehabilitation districts, riparian landowners) for each watershed to advise DNR and DATCP.[13] DNR, in consultation with DATCP and the appropriate local governmental unit, prepared the proposed priority watershed plan.[14] During the planning process, DNR:

- Conducted a water resource assessment
- Set water quality goals
- Analyzed alternative management practices
- Incorporated best management practices (BMPs) into the plan
- Determined whether a city, town, village or county must develop construction site erosion control ordinances or manure storage ordinances[15]

The implementation plan[16] prepared by the local government must contain:

- A list of BMPs that are most critical to achieving water quality objectives
- Designations of critical sites
- Priorities for implementation
- Requirement to review plan periodically
- Provisions for public notice and education[17]

Following two public meetings to receive comments, the county could approve, conditionally approve, or reject the priority watershed plan. Once the plan received county approval, its subsequent approval by the Board and by DNR would render the project eligible for funding.[18] DNR was required to provide cost share grants to governmental units and landowners for cost-effective best management practices.[19] The local government unit specified in its application for funding the percentage of the implementation costs that the grant would cover, but the grant could not exceed 70 percent of the cost of implementing the BMPs.[20]

Cost sharing grants could also be issued to governmental units or individual landowners in non-priority watersheds if projects were in conformance with areawide water quality management plans, but at least 70 percent of cost-sharing grants annually were required to be used in priority watersheds.[21]

The priority watershed program was amended in 1993 to include a requirement that "critical sites" be identified in the watershed planning process. A critical site is one that, due to the amount of pollution it generates and/or its location in the watershed, *must* participate and be addressed in order for the plan to achieve its water quality objectives. DNR was required to notify the owner or operator of a designation.[22] The owner or operator could request a review of the designation by the county land conservation committee and further appeal to the Board.[23] The owner or operator of a critical site must apply best management practices.[24] However, once the owner or operator has installed BMPs as provided in the plan, the site is no longer considered a critical site.[25]

The priority watershed program underwent significant changes beginning in 1997. There had been 60 priority watersheds designated – mostly in the southern and eastern part of the state. Legislative concern arose over the treatment of the northern counties. Accordingly, Act 27 required the Land and Water Resource Board to determine by mid-1998 whether or not to continue *existing* priority watershed projects, assuming no increases in the funding available to the program. Act 27 further provided that there would be *no new priority watersheds* designated after that time. DNR was required to submit to the Board a list of watersheds ranked on the basis of impairment (based on the state's § 303(d) list prepared under the federal Clean Water Act).[26] The Board was then to decide on whether to approve continuation of the existing priority watersheds based on the list and DNR and DATCP recommendations.[27] In 1998, the Board voted to approve continuation of *all* of the existing priority watersheds. The continued priority watershed projects will remain a substantial part of the state's program for many years, as the phase-out is expected to run through 2008.

Base-Level County Planning and Funding

Chapter 92 was amended in 1997 and in 1999 to redirect a significant portion of the state's nonpoint efforts. The new focus is on providing a base level of staff and funding for *all* counties, rather than only priority watersheds.

Under an older provision of Chapter 92, DATCP was required to identify priority soil erosion control counties.[28] Under that program, which was never large, a county LCC was to prepare a county land and water resource management plan which specified maximum acceptable rates of soil erosion, identified specific land parcels exceeding acceptable erosion rates and management practices that would bring these lands into compliance, and identified other nonpoint source pollution.[29] This plan was then to be reviewed by the DATCP and Board, and cost share money was to be provided to deal with problems.

Under the 1997 legislation, the priority soil erosion county designation was abolished. Now *every county* is to prepare a land and water resources management plan. The plan must be a multi-year action plan of three to five years, not focused only on soil erosion, but also on meeting water quality objectives through control of nonpoint sources. Counties are encouraged to incorporate the use of local ordinances to achieve their water quality objectives. Under 1999 legislation, each county will be provided with funding to plan for and begin implementing the nonpoint source performance standards discussed below.[30]

DATCP has been given a goal to provide each of the state's 72 counties with an average of $100,000 for cost shares ($7.2 million). It will also provide funding for 3 staff persons for each county (cost shared at 100 percent, 70 percent, and 50 percent), another $7.1 million.[31] About $6 million in base budget funding was transferred from DNR to DATCP for the program.

Competitive Grant Programs

Act 27 also established a new $2 million competitive grant program under which any county or local government or local lake association could apply to DNR for nonpoint source grants. This was intended to help overcome a perceived imbalance that urban watersheds were only receiving 25 percent of priority watershed monies. DNR was required to develop a scoring system for the new money, including 1) the extent to which BMPs will be used in the project; 2) the level of impairment of the water (§303d list); 3) the extent to which the project will result in the attainment of water quality objectives; 4) local interest in the project; 5) the inclusion of a means to measure the results of the project; and 6) the extent to which the project proposes to use federal funding. DNR, with DATCP consultation, scores each project and the Board selects projects for funding by November 1.[32]

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In 1999, the legislature authorized a further targeted competitive program. It allows anyone, including non-profit groups, to apply to DNR for funding for nonpoint source projects for up to four years. This funding may address anything from watershed scale to subwatersheds to site-specific actions. The program is starting with $1 million. DNR anticipates a substantial increase to this program in the future.

In 1999 the legislature also established a new urban competitive nonpoint source program administered by DNR. The program will have $19 million available in grants. Additional bond funding has been made available for nonpoint source controls, including urban and stormwater controls.

Other Funding

Wisconsin's priority watershed program has been used to target US EPA § 319 funds. Rather than projects applying separately for 319 grants as in most other states, Wisconsin has used 319 funding to augment the state's own funding for priority watersheds. Wisconsin received $2.583 million in 1999 and has been allocated $5.166 million for 2000.

USDA's Environmental Quality Improvement Program (EQIP) has been active in Wisconsin since 1997. The Natural Resources Conservation Service (NRCS) office in Wisconsin establishes EQIP priority watersheds. These are not limited to state priority watersheds. However, incorporating the availability of other sources of funding in the NRCS ranking system gave DNR priority watersheds an advantage in obtaining EQIP funds. The program received $3.2 million in funding in 1998 and again in 1999, of which $2.8 million was reserved for EQIP priority watersheds. Wisconsin's EQIP program also focuses on educational programs. NRCS has received $800,000 during the past three years to implement educational programs. Any local organization can apply for this funding as long as the educational efforts will be directed towards producers.

Standard Setting

Act 27 introduced formal standard setting requirements to the state's nonpoint source programs.

Act 27 requires DNR to prescribe, by rule, performance standards for *non-agricultural nonpoint sources*. The performance standards must be designed to achieve water quality standards.[33] DNR must also, by rule, specify a process for developing and disseminating technical specifications to implement these performance standards.[34]

For *agricultural nonpoint sources*, DNR, in consultation with DATCP, must promulgate rules prescribing performance standards and prohibitions to achieve water quality standards. For its part, DATCP must, in consultation with DNR, promulgate rules prescribing conservation practices to implement the performance standards and prohibitions. DATCP must also identify, by rule, the *process* by which agricultural technical standards are to be developed and disseminated,[35] and develop and disseminate technical standards to implement the performance standards.[36] The agricultural performance standards must at a minimum require livestock operations to 1) have no overflow of

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manure storage structures; 2) have no unconfined manure pile in a water quality management area; 3) allow no direct runoff from a feedlot or stored manure into water; and 4) prevent unlimited access by livestock to water in a location where high concentrations of animal cause stream bank erosion.[37] The conservation practices and technical standards must at a minimum address animal waste management, nutrients applied to soil, and cropland sediment delivery.[38]

The performance standards and technical specifications rulemakings are scheduled to be completed in 2000.[39] The standard-setting processes relate not only to cost-share requirements, but also to the enforceable mechanisms used in Wisconsin. County-based land and water resources management plans will be required, at a minimum, to address the statewide performance standards and prohibitions. The DNR and DATCP are pursuing an approach that would set statewide performance standards and prohibitions, but that would also provide for targeted performance standards that may be established by DNR or local governments in particular watersheds where statewide performance standards are not adequate to meet water quality goals. Statewide standards would apply to cropland soil erosion, soil loss from riparian fields, manure storage and management, nutrient management, standards for new development and redevelopment during construction activities, and for management of stormwater after construction, and for management of pollution from previously developed urban areas.

Forestry standards are not currently under development as existing forestry BMPs are fairly recent in Wisconsin and hence will be given an opportunity for experience to be gained using them.

DNR Abatement Orders

DNR has authority to issue abatement orders for both agricultural and non-agricultural nonpoint sources of pollution determined to be "significant." Significance includes "pollution which causes the violation of a water quality standard, pollution which significantly impairs aquatic habitat or organisms, pollution which restricts navigation due to sedimentation, pollution which is deleterious to human health or pollution which otherwise significantly impairs water quality."[40] While the abatement order authority operates in both priority and non-priority watersheds, DNR can issue orders for abatement of *agricultural* nonpoint source pollution in priority watersheds *only* if the site has been designated a critical site.[41]

The process begins when DNR sends a written a notice of intent to issue the order to the person responsible for the source of pollution. The notice of intent describes DNR's findings and provides the individual at least one year to abate the pollution or implement the required BMPs, unless the pollution is causing severe water quality degradation, in which case a temporary emergency order (described below) may be issued.[42] If an order is issued and compliance still does not occur, civil forfeitures of up to $5,000 per day are authorized; the state may recover its cosets of investigation and attorney's fees. In addition the DNR may take the action itself and recover the costs incurred.[43]

Agricultural sources are subject to additional procedures. DNR must send the notice of intent to the LCC and DATCP.[44] DATCP must provide the person responsible for the pollution a list of management practices that would reduce pollution to a level acceptable to DNR, as well as a list of sources of financial and technical assistance available from DATCP and other sources.[45]

DATCP must issue a report to DNR within one year after the date of the notice describing the actions taken by the person and providing a recommendation as to whether DNR should issue an order. DNR may not issue an order until it receives DATCP's report.[46]

If the notice of intent involves agricultural pollution in a priority watershed, the LCC may within 60 days of the notice disapprove issuance of an order. DNR can request the Board to review an LCC disapproval decision.[47] If the LCC approves the proposed order, the owner may obtain a review of the proposed order by filing a written request with the Board.[48]

DNR is prohibited from requiring any agricultural facility or practice that was in existence prior to October 14, 1997, to comply with newly prescribed performance standards, prohibitions, conservation practices or technical standards unless cost-share funding is made available.[49]

Despite the one year minimum abatement period, and the special review requirements applicable to agricultural sources, DNR may issue a temporary emergency order before issuing a notice of intent if the pollution is causing or will cause severe water quality degradation and the required abatement action does not involve a capital expense. If the source is agricultural, DNR must provide a copy of the order to DATCP and the appropriate LCCs. As soon as practicable after a temporary order has been issued, DNR must either issue a written notice of intent to issue a regular abatement order or rescind the temporary order.[50]

DNR's abatement order authority has seldom been invoked. Rather it has served chiefly as a back stop to cost share and technical assistance approaches. DNR has used its abatement order authority at least 10 to15 times.

Animal Waste Notices of Discharge

DNR does not have authority to issue nonpoint source abatement orders for pollution caused by animal waste. But it has a complaint-driven process available under its animal waste management regulations (NR 243) to address complaints.[51] If investigation of a complaint reveals that an animal waste pollution discharge is significant, the DNR issues a Notice of Discharge (NOD), which requires correction of pollution. The NOD identifies the problem and potential solutions and identifies cost share and technical assistance sources; it allows a minimum of 60 days and a maximum of two years to remedy the problem. The designated county agency (land conservation commissions) may seek to review the proposed corrective action plan. Issuance of the NOD expressly makes the operator eligible for DATCP cost-share funding during the time that the NOD is in force. If the operator does not remedy the problem, then DNR requires the operator to obtain a state NPDES permit which specifies all of the requirements to abate the discharge and bring the facility into compliance.[52] Accepted animal waste management practices must be used in implementing corrective measures needed for runoff control, storage, or disposal of animal wastes.[53] However, the DNR may not require an animal feeding operation in existence prior to October 14, 1997 to comply with newly prescribed performance standards, prohibitions, conservation practices or technical standards unless cost-sharing is available.[54] If the operator ignores the NOD and also fails to obtain an NPDES permit, the whole range of judicial enforcement tools comes into effect (including civil forfeitures of up to $10,000 per day).[55] Statewide, DNR has issued NODs to about 550 AFOs during the course of the program. Recently, the NOD program at the state level has changed from a reactive program to a targeted program, focusing on complaints arising in outstanding resource waters, exceptional value resource waters, 303 (d) waters, or source water protection. DATCP currently plays a role in administering cost shares for AFOs; it maintains a database of NOD recipients, updated quarterly. In the future, it appears that DNR will be responsible for handling these cost shares (or arranging them with federal agricultural agencies).

Local Ordinances

Wisconsin law authorizes numerous kinds of enforceable local ordinances that may be directed at nonpoint source water pollution.

Under Chapter 92, a county, city, village or town has explicit authority to enact ordinances for soil and water conservation or nonpoint source pollution abatement. Such ordinances may regulate "land use, land management, and pollutant management practices."[56] The ordinance may be made applicable throughout a county or to any part of it, including both incorporated and unincorporated areas. However, the ordinance must be adopted by the county board and by *referendum* of the voters in the area covered by the ordinance. Enforcement of an ordinance adopted under Chapter 92 requires an LCC to make a reasonable effort to contact a landowner and to provide a plan and identify any cost-shares that are available, at least one year before taking any enforcement action. Enforcement includes civil forfeitures (penalties) and injunctions.

Counties, cities, villages, and towns also have authority to adopt certain other ordinances *without* referendum. These include enforceable shoreland ordinances,[57] livestock operation and manure management ordinances,[58] and zoning ordinances that address construction erosion and stormwater runoff.[59] Each of these is enforceable by the local jurisdiction through civil forfeitures (penalties) and injunctions. For example, local governments may enact ordinances requiring manure storage facilities constructed after July 2, 1983 to meet local standards.[60] Likewise, livestock operations that do not meet the new nonpoint performance standards established under Act 27 may be regulated by local ordinance if necessary to achieve water quality standards, provided that cost sharing is made available if the operation was initiated prior to October 14, 1997.[61] Shoreland management ordinances adopted under these provisions may be enforced only if cost share funding is made available.[62]

Local zoning ordinances may also help protect lands under, abutting or lying close to navigable waters. The purposes of such ordinances are to "further the maintenance of safe and healthful conditions; prevent and control water pollution; protect spawning grounds, fish and aquatic life; control building sites, placement of structure and land uses...."[63] The DNR is responsible for providing general recommended standards and criteria for navigable water protection regulations and their administration, and for authorizing such regulations.

Wisconsin counties are *required* to adopt zoning and subdivision regulations for the protection of shorelands in unincorporated areas.[64] State regulations require that these county shoreland ordinances include, at a minimum, zoning regulations for shoreland-wetland zoning districts.[65] The ordinances must "provide sufficient control of the use of shorelands to afford the protection of water quality...."[66] The regulations further specify minimum components, including building setbacks that "conform to health, safety and welfare requirements, preserve natural beauty, reduce flood hazards and avoid water pollution."[67] The regulations also require limits on alterations to existing nonconforming structures.[68] Exemptions from local shoreland zoning ordinances are provided for state highway and bridge work and for farm drainage ditches in certain circumstances.[69] Where a county has not adopted an ordinance that meets the "reasonable minimum standards," the DNR is to adopt an ordinance to be administered by the county.[70]

State law also requires municipalities (cities and villages) to adopt shoreland zoning ordinances to protect wetlands.[71] State regulations establish minimum standards for the municipal ordinances. If a municipality fails to establish an ordinance that meets "reasonable minimum standards," the DNR is to adopt an ordinance for the municipality.[72] Enforcement mechanisms are specified in the local ordinance. In addition, the DNR may initiate enforcement through fines (not more than $50 per day) and injunctions if it determines that the city or village fails to keep its ordinance "current, effective and enforceable." [73]

State law provides that county ordinances in general "shall be enforced by appropriate fines and penalties," and may be enforced by injunction in a suit by the local government or local affected property owners.[74] State law also provides that violations of city zoning ordinances are punishable by fine and by imprisonment for failure to pay such fine, and that violators are subject to suit by local government or affected property owners to prevent or correct the unlawful practice.[75]

Wisconsin law authorizes municipal and county construction site erosion control ordinances "for the efficient use, conservation, development and protection of this state's groundwater [and] surface water," for the prevention and control of water pollution, and for the control of building sites and placement of structures and land uses.[76] Indeed, under the priority watershed program, DNR was authorized to determine that a county, city, village or town was required, as a condition of a grant, to develop a construction site erosion control ordinance in order to meet the water quality objectives.[77]

DNR must establish the minimum standards for local ordinances covering erosion from site activities other than construction of a building.[78] The minimum standards must require regulation of site erosion where the activity involves grading or other land disturbance of 4,000 square feet or more; moving 400 cubic yards or more of material by excavation or filling; constructing a street, highway, or bridge; pipeline construction exceeding 300 feet; or an activity requiring a subdivision plat approval or certified survey.[79] DNR's minimum standards for storm water management must also regulate any residential development larger than five acres (or larger than 3 acres with 1.5 acres of impervious surfaces) or any non-residential development larger than 3 acres.[80] The DNR must consult with the Department of Transportation in developing minimum erosion control and stormwater management standards for street, highway, road or bridge construction.[81] Site erosion control ordinances must require consistency with the Wisconsin Construction Site Best Management Practice Handbook.[82] The Wisconsin Department of Industry, Labor, and Human Relations (DILHR) has developed standards for erosion control related to building construction - for one and two family dwellings and commercial construction projects.[83] Certified local building inspectors or county inspectors enforce these building construction erosion control requirements.

Discussion and Analysis

Wisconsin's many nonpoint source program mechanisms can be observed in operation by examining watershed experiences in western (La Crosse County) and eastern (Brown County) parts of the state.

La Crosse County Nonpoint Source Controls

La Crosse County, with a population of about 90,000, contains portions of three river basins: the Black in the northern part of the county, the La Crosse in the center, and the Bad Axe in the south, all flowing westward to the Mississippi. There are two lakes in the county: Lake Onalaska (5,400 acres of flowage) created by Corps of Engineers dams on the Black and Mississippi Rivers, and Lake Neshonoc (600 acres) created by a dam on the La Crosse River. The county has 274 miles of streams and 730 surface acres of lakes excluding Onalaska. Water sampling in 1998 showed that 84 percent of the county's streams do not meet standards for whole body contact recreation.[84] The county is urbanizing although it still has significant crop and livestock operations. Nonpoint source water quality impairments are attributed to cropland soil erosion, sedimentation from urban development, pesticide and fertilizer runoff, and animal waste runoff. The county's topography has caused runoff problems, as it is a flat plain dissected by streams and gullies, which often have steep slopes. Residential construction is occurring on some of these steeper lands. La Crosse County has a five member LCC, and the county's department of land conservation (DLC) has a six member staff.

Priority Watershed Program

The Lower Black River watershed (one of the three primary watersheds in the county) was selected as a priority watershed project in the early 1980s, and received funding for roughly ten years. At the time that this watershed was chosen for the program, much of the planning responsibility was centralized in DNR. The county's Department of Land Conservation (DLC) provided information on the watershed and DNR developed a fairly generic plan for the county using boilerplate formatting. DNR has greatly increased the county role in recent years of the project, although developing the plan now takes more time. The priority watershed program built staff capacity in the DLC, and the staff hired during the project continue to work in the department.

In its priority watershed effort, La Crosse County focused on implementing streambank corridor practices to prevent soil erosion, on feedlot improvement, and on contour strip cropping. The county had no baseline data, so no numerical phosphorous reduction goal was established and evaluation of the project's success was done on a site-by-site basis. The project also had very little water quality testing or monitoring, although DNR used some bio-monitoring data to conclude that the project had positive results. Lack of baseline water quality data and monitoring results proved problematic for the DLC, which now has instituted an aggressive monitoring program to assess the success of its own recent water quality programs and local ordinances.

Other Watershed Planning

La Crosse County's original cropland erosion control plan was adopted in 1988 in accordance with chapter 92. Approximately 94 percent of the county's identified cropland is under some kind of plan. The county plan established soil loss goals and identified needs for conservation practices as well as for cost-shares and technical assistance. The county attributes not attaining these goals to lack of adequate state funding (particularly base level funding). County officials hope that the additional base level funding provided under the state's revised nonpoint program will make achievement possible.

La Crosse County's new Land and Water Resource Management Plan (required per Act 27) was adopted by the county and approved by DATCP in 1999.[85] It includes identification of data needs, the status of water pollution and erosion issues in the county, a work plan for achieving performance standards, and revenue sources. The plan gives detailed descriptions of how the county ordinances described below (and other programs) are designed to operate; and it identifies watershed objectives. In the state review process the DNR called it "one of the best...plans we have had an opportunity to review," while DATCP in its approval memorandum called it an "excellent plan."[86]

Erosion Control Ordinance

La Crosse County adopted a land disturbance erosion control ordinance in 1992. The county used authority provided by the state's general zoning law in order to avoid the referendum that would have been required had it adopted such an ordinance under chapter 92.[87] The erosion control ordinance applies only in unincorporated areas of the county. It regulates land disturbances of 4,000 sq. feet or greater on slopes less than 20 percent, and disturbances of 2,000 sq. feet or greater on 20-30 percent slopes. The ordinance prohibits development on slopes greater than 30 percent. The ordinance also covers logging road installation, and tracks timber cutting notices filed by landowners. In addition to these sites, the ordinance has a catch-all provision that allows the county to regulate other sites that are causing severe erosion (even if a structure has already been completed).[88]

The ordinance requires submission of a detailed erosion and sedimentation control plan and schedules to the LCC for approval. The county Department of Land Conservation (DLC) issues the erosion control permit. There are three categories of permit. These depend on the slope of the site and the location of the site in relation to the shoreline. The amount of information required and the permit fee increases for each category. It usually takes the county three days to process the information and issue the permit. Data from 1992 to 1998 show that each year between 123-197 permits were granted for activities on 0-12 percent slopes, 17-34 permits on 13-20 percent slopes, and 7-20 permits on 21-30 percent slopes. Logging road permits ranged from 16-32 per year.[89] Enforcement is with stop work orders, permit revocations, forfeitures of $50-500 per offense/day plus costs of prosecution, or injunction.

The county has experienced some difficulty with its ordinance because in 1994 the state adopted a provision in the Uniform Dwelling Code (UDC) prescribing erosion controls for construction of 1 and 2 family homes.[90] The state standards are arguably less stringent than those in the county erosion ordinance. The UDC provisions have been interpreted to allow enforcement only where sediment is actually leaving the site. In contrast, the county erosion control ordinance requires that the erosion control plan be implemented as specified regardless of any offsite impacts.

Eventually the county agreed to apply the state standards for residential construction, and became the enforcer of the state UDC through memoranda of understanding with 10 of the 12 townships. But the grading of sites and roads, and development-wide activities are regulated under the stricter county standards. Once construction of the residence is to begin, the state standards apply. Under the UDC, the county issues a notice of non-compliance. The operator has 72 hours to respond to the notice and fix the problem. If the problem is not repaired the county will issue a stop work order. Although the county can use the courts, it prefers not to because of concern about possible delays, and concern that sediment or erosion violations may not result in a substantial sanction. The county process for enforcement of the county ordinance is similar.

Animal Waste Management Ordinance

La Crosse County's animal waste management ordinance was adopted in December 1998 to implement the animal waste performance standards under Act 27.[91] It requires permits for new manure management impoundments and feedlots. Preexisting feedlots are exempt from enforcement and permit requirements unless a site evaluation has been completed and cost-share funding is provided.

Manure management plans are required for unconfined manure stacks within 1,000 feet of a lake or 300 feet of a stream ("water quality management areas"). Also the ordinance prohibits direct runoff from feedlots (defined as discharging 5 lbs. or greater total phosphorous) and from "mismanaged pastures" within the water quality management area. Mismanaged pastures are defined as areas where confinement of livestock for feeding, browsing, or loafing prevents the adequate maintenance of sod cover, causing bank erosion.

Manure management plans are required for any farmer who receives cost shares, and for any operation constructing a new manure storage pit. The county allows certified private planners to develop manure management plans, but prefers to have farmers develop their own plans in group sessions that DLC conducts. In order to construct a new manure storage pit, a farmer must provide the county with a construction plan developed by a professional engineer and pay a $50 fee. The county does not inspect these sites to ensure that they are constructed as planned; the ordinance gives the professional engineer this responsibility.

Direct runoff from feedlots is prohibited by both the county ordinance and by Chapter 281. The county ordinance defines direct runoff as runoff containing more than 5 lbs of phosphorous per year. The phosphorous load is determined using NRCS's BARNY model, which accounts for the amount and type of livestock, slope of the site, the water at the site, and vegetation. The county has been in conflict with some state officials over the definition of direct runoff. While the state has generally preferred a definition based on the number of animal units, the county believes that such a cutoff point would not be effective in addressing problems caused by small but concentrated dairy operations in the county (many of which, even though including fewer than 100 cattle, cause problems because of the steep topography near the waterways).

The county is working to achieve voluntary compliance, and is offering 100 percent cost share for measures that achieve the county's standards. Cost share funding may be obtained from DATCP, from DNR, or from the county's own "environmental fund." The environmental fund, established in 1998, provides county funding for low-cost practices that have high water quality benefits, such as grass filter areas.[92] Feedlot owners voluntarily seeking assistance will receive first priority for cost shares; the next priority will be volunteers responding to county action in county-targeted watersheds. The county will not seek to provide cost shares for manure storage pits, nor for practices associated with the expansion or the establishment of a new feedlot. The DLC believes that expansion of a business inherently includes costs for protection of the environment, and that the public should not bear those costs.

The county intends to focus its cost shares on existing facilities, as it cannot enforce the new standards against an existing facility (constructed before 1997) unless it can provide cost share assistance. Enforcement has not yet occurred under the ordinance, but when the county begins to enforce the law, it intends to proceed by watersheds on a priority basis. Enforcement will begin with notices of noncompliance setting a timetable for compliance. Stop work orders are authorized if a notice of noncompliance has expired and the severity of the runoff is such that a stop work order is deemed to be warranted. Violations of orders are subject to injunction, and to a civil forfeiture of $50 to $500 per day of offense plus costs of prosecution.

State Enforcement

In La Crosse County, the relevant enforcement authority is ordinarily the county DLC. In part this is because DNR enforcement staff are spread thinly. For instance, one DNR enforcement staff person is assigned to deal with animal waste complaints in more than ten counties in the area. The DLC also has concern with the speed of state response to complaints referred by the DLC. Officials note that the response is slowed by the process and the number of agencies involved. For instance, one case investigated by DNR as a result of a complaint referred by the DLC has taken several years to resolve, in part because of the division of functions – DNR information gathering and enforcement, DATCP technical remedy design, and county distribution of cost share funding.

DNR has apparently not used its nonpoint source abatement order authority in La Crosse County. DLC reports one instance in which the county requested that DNR issue an abatement order. In this case, a large quantity of sediment ran from a quarry into a trout stream, covering the streambed with clay. DNR declined to issue an order, expressing concern that an abatement order would not be upheld in court because DNR might have to demonstrate that the discharge was intentional. The county anticipates using its erosion and sediment control ordinance in the future in such cases where necessary.

Brown County Nonpoint Source Controls

Brown County lies within the Fox-Wolf Basin, which drains 6400 square miles, discharging into Lake Michigan at Green Bay. This is the second largest tributary contributor of sediment to lake Michigan, as well as the largest contributor of phosphorous. Nonpoint discharges from agricultural land are the primary sources of the sediment and nutrients throughout the basin and in Brown County. The region is experiencing a rapid growth in the size of dairy operations, with a total of 200,000 milk cows in Brown County and its 5 bordering counties (33,000 in Brown County alone, which is first in the state in density of cows).[93] About a third of the cows in Brown County are concentrated on ten very large farms. Most of the crop agriculture in the area is corn and alfalfa. The county is also facing significant urban sprawl and growth. The township of Bellevue is the fastest growing in the state, and the village of Alloway is the fastest growing village in the state. The city of Green Bay has over 100,000 residents and is increasing in population. The county has over 200,000 residents. The county's Land Conservation Department has 17 staff, including 3 agronomists to do nutrient management planning.

Priority Watershed Projects

Brown County has five on-going priority watershed projects. These are the East River (started in 1989), Red River (1995), Branch River (1996), Duck Creek (1997), and Apple/Ashwabenon Creek (1997).[94] The East River is the largest area, and the watershed most centrally located in the county, bisecting it from north to south. The county has 150 contracts with landowners in this watershed. Some of the newer priority watershed projects have critical sites.

The large number of staff in the county is due to the high number of priority watershed projects. Of its $1.1 million annual budget, the department receives $750,000 from the state and $350,000 from the county. Most of the staff time is devoted to working in priority watershed areas. The program has built the capability of the staff.

Projects in Brown County have generally focused on reduction of sediment or phosphorous pollution. Each plan included a detailed inventory of problems and potential sources in the watershed. The LCD set goals for the reduction of each pollutant and used models to determine the contribution of each source to the water body. Using the inventory of sources, the county could determine the number of practices that must be installed or initiated to achieve the goal. The implementation plan stated the desired water quality improvement and the type and number of practices required to achieve the goal. Critical sites were designated in the newer priority watershed by use of similar inventory and modeling techniques. When the county submitted the project for public review, proposed critical sites were not identified by name but by number. Once the project was submitted to DNR, the landowners were contacted and informed that their land is a critical site and that they must participate or face potential enforcement by DNR. DNR will enforce against critical sites, although in Brown County most landowners cooperated with the program. Although landowners of critical sites often installed a number of conservation practices, they were not required to develop a full conservation plan but to install only those practices which would bring their properties below the required pollutant discharge level contemplated by the implementation plan.

For each practice, the state has established a cost share. The funding a project receives is directly related to the number of proposed practices, to ensure that the county will be able to provide sufficient cost shares. This process is subject to some negotiation, and with the approval of DNR, counties can reduce the cost share provided to cooperators. Brown County has also increased the cost share it has provided as an incentive when it found that DNR's incentives were not sufficient to encourage participation. For instance, DNR's incentive rates for conservation tillage were $15/acre for 3 years, and Brown County raised the rate to $18.50/acre for up to 6 years, if necessary. Raising the rate allowed farmers to more easily purchase the required equipment. The types of practices stressed in the priority watershed cost-share program have changed since it began in 1978. Originally, the program focused on the construction of "brick and mortar" practices, such as manure storage facilities. In 1978, the state cost share for a manure storage facility was $6000; it has now increased to $35,000. The program has switched to focus on lower-cost measures such as conservation tillage, buffer strips, and manure management.

Funding for priority watershed projects depends on the size of the watershed as well as on the practices funded; urban projects will receive more funding than rural projects because the practices are much more expensive. Generally, the grants reflect funding for a 75% participation rate. The various priority watershed projects in Brown County have received from $0.5 million to $2.5 million in funding.

Other sources of funding often reach the county through the priority watershed program. For instance, EPA § 319 money goes to DNR, which uses the funds to supplement funding available for priority watershed projects. Brown County received a $600,000 EQIP grant to supplement state funding in a priority watershed when state funding was particularly low. The priority watershed funds available to the county helped it leverage the EQIP funds effectively, however, and improved the chances that this watershed would be funded through EQIP. The Duck-Ashwabenon portion of the Duck-Apple-Ashwabenon watershed in Brown County received funding in 1997 and 1998 from EQIP.

Assessment of the result of the priority watershed program is conducted primarily by the use of water quality modeling. Based on the number of practices implemented and the water quality improvement predicted for each practice, the county will determine the water quality improvements achieved throughout the watershed. Continuous water quality monitoring would be more costly, and the county plans to assess its progress in achieving its land and water quality management planning goals with the same model-based mechanisms.

Animal Waste Management

The county's animal waste management ordinance was passed by the county board in 1985. It was significantly amended on January 20, 1999. The ordinance applies only in unincorporated areas, which comprise most of the county.

The original 1985 ordinance regulated the construction of animal waste storage facilities and feedlots. The ordinance required a permit to construct or alter an animal waste management facility and compliance with NRCS Technical Guide standards in the design of the facility. The county began to encounter opposition from town governments to proposed siting of new facilities. The protests generally concerned locating animal waste storage facilities near proposed developments or existing residences. These conflicts, along with Act 27's provisions for performance standards and prohibitions, led to some of the changes in the 1999 amendments to the ordinance. The 1999 amendments added setback requirements and nutrient management requirements. Variances in setback from property lines may be allowed with the approval of the neighboring landowners; four variances have been granted.

The ordinance currently requires animal feedlots and animal waste storage facilities to meet county standards and specifications.[95] The standards and specifications were developed by a group of 14 farmers representing the farm bureau, town chairmen, county Farm Services Agency committee, and large dairy operations. The ordinance also incorporates the four prohibitions included in the state's 1997 Act 27, prohibiting 1) overflow of manure storage structures; 2) unconfined manure stacking; 3) direct runoff from feedlots or stored manure to waters of the state; 4) unlimited access of livestock to water of the state where such a practice prevents sod cover maintenance. Under the county ordinance, new and existing animal feedlots must not discharge more than 20 lbs of phosphorous annually, and new animal feedlots must meet setback requirements from adjacent properties, lakes and streams, and groundwater. New, expanded or modified animal waste storage facilities must meet NRCS technical standards and similar setback requirements. Every animal waste storage facility must develop a nutrient management plan. The plan must be submitted annually to the Land Conservation Department while the facility is in use. An abandonment plan must be submitted for any animal waste storage facility, whether existing or new. The ordinance requires operators to obtain permits from the LCD for any existing animal feedlots with more than 500 animal units, for any new animal feedlots with more than 40 animal units, and for any sites that violate the four prohibitions described above or that have received a notice of discharge (NOD) from the DNR.

Violations of the ordinance are punishable by civil forfeiture of not less than $50 plus costs of prosecution, with each day constituting a separate offense. Injunctions or restraining orders may also be sought by the county.[96]

Since 1985, the county has approved 190 permits for animal feedlots and animal waste storage facilities. One of the county's new efforts under the 1999 ordinance will be to develop nutrient management plans for the 190 existing permitted facilities. Also, in an inventory for the county's Land and Water Conservation Plan, the county identified 20 sites which are discharging more than 20 lbs of phosphorous annually. It plans to address five of these sites each year.

Over 150 animal waste storage facilities have been installed in Brown County since the original ordinance, using state and federal cost share programs. The county cannot require any modification to *existing* barnyards without a cost share. The county will not provide cost share for nutrient management practices or animal waste storage, citing these costs as a cost of doing business. The state has provided the cost share funding to address modifications of barnyards, including animal waste storage facilities.

Shoreland Ordinances

Brown County has adopted two separate ordinances regulating agricultural activities on shorelands - one in 1991 and one in 1998. Both are used in controlling nonpoint source pollution in the county.

The *Shoreland and Floodplain Management Zoning Ordinance* was passed in October 1991.[97] This ordinance is intended to address sediment problems. Green Bay harbor requires significant dredging at great cost. Two watersheds near the mouth of the Fox River contribute 65 percent of the sediment and 55 percent of the phosphorous to Green Bay while comprising only 7 percent of the land area. The county determined that a program of stream buffers on the 1200 miles of streams in Brown County would greatly reduce sediment runoff to Green Bay. The 1991 ordinance requires a minimum of 35 feet of land free of row crops, and seeded to grass, alfalfa, or a close-growing crop to be maintained along the edge of all navigable streams. The exact width of the required buffer is determined by use of a rating worksheet that accounts for slope, land use, and drainage area.

The1991 shoreland management ordinance also provides that in cases where a pollution problem results from grazing or pasturing of livestock, fencing must be installed no closer than 16 ½ feet from the edge of the stream unless another solution is approved by the county Land Conservation Department. The stream fencing provision is enforceable only where cost share funds are available for any required practices. Subject to these provisions, however, the ordinance explicitly permits landowners to water their livestock in streams in some manner.[98]

The county provides landowners with incentive payments of $500 per acre taken out of production under the ordinance. The county uses both state and county funding to provide incentive payments. The county has contributed $10,000 per year, but may double its funding this year. The county will allow payment of incentives to farmers who include additional acres by squaring off their fields instead of contouring along the stream. Due to the incentives offered, demand for participation has been very high, and some farmers want to enroll as much land as possible. The county will only pay incentives as far as the buffer is justifiable by use of the ratings sheet. Buffers can be mowed by landowners, but not plowed. All buffers are perpetual, and a restrictive covenant is attached to the deed stating requiring a future landowner to contact the LCD before removing the buffer. State cost share funds have also been available up to 70 percent for seeding and shaping of the buffer.

Of the 1200 stream miles in Brown County, 500 were determined to be adequately buffered at the time the 1991 ordinance was passed. The county program has established buffers on 200 additional miles of stream. The county goal is to install 50 miles of buffers each year for the next ten years. The LCD staff often identifies landowners who are subject to the buffer requirements while working with them on contracts for other conservation practices. If a staff member identifies an unbuffered stream, he or she will inform the landowner of the requirement to have a stream buffer, and will require the landowner to install a buffer in order to continue working on other cost shared practices.

The Wisconsin farmland preservation program, a state program that provides tax incentives to farmers to keep their land in agriculture, requires that farmers operate to stay below the T value for erosion. There are 800 to 900 farms in this program in the county, and their plans are reviewed by the Land Conservation Department. When the LCD is reviewing the plans, staff also address stream buffers.

There have been more takers than available cost share funds, and while the county has not required anyone to install a buffer without providing cost share, in order to meet its 50 mile goal next year it will do so. The county plans to leverage other cost share funding (e.g. for animal waste or conservation practices) to encourage landowners to install buffers without cost shares. The county will also use the animal waste management ordinance to identify people who are required to have buffers, and will use GIS to determine which landowners have the largest stretches of stream that require buffers. The office will target such landowners and send staff to discuss the ordinance with them.

The county has had some problems with landowners who do not maintain their buffers. This has been particularly a problem with large dairy operations, where contractors or lessees might plow the buffer. The landowner is generally unaware of these violations. When the county identifies violations, it first requires that the buffer be reseeded at the landowner's expense. If a second violation occurs, the county will install posts marking the buffer. Repeat offenders can be turned over to the county attorney for civil enforcement, but this has never been done.

The county passed its *Agricultural Shoreland Management Ordinance* in January 1998.[99] While the ordinance addresses similar concerns as the shoreland ordinance of 1991, it is both broader in scope (in the land areas it regulates) and more limited (in that *all* practices under this ordinance require cost shares, in accordance with recent amendments to Wis. Stat. 92.17). This ordinance regulates activities in the "agricultural shoreland corridor" which is defined as land extending 20 feet from each bank of a perennial stream or from the centerline of an intermittent stream, or the high water mark of a lake; and activities in the "agricultural shoreland management area" which is land within 300 feet of perennial stream banks or the centerline of an intermittent stream, or the high water mark for a lake.

The 1998 ordinance generally requires all agricultural activities within the agricultural shoreland management area to prevent erosion and to minimize movement of sediment to surface water. It prohibits cropland with annually tilled soils from exceeding T, and requires pastures to comply with NRCS Technical Guidance for pasture and hayland management and with University of Wisconsin-Extension guides for rotational grazing. The ordinance also requires all land in the management area on which manure or other nutrients are applied to develop a nutrient management plan.

Within the agricultural shoreland corridor, the ordinance requires that a vegetative buffer be maintained, and prohibits row cropping and tillage. Barnyards (defined as a feedlot, dry lot or area other than a pasture where animals have been fed, confined, maintained, or stabled for 45 or more days in any 12 month period) are prohibited in the agricultural shoreland corridor unless an approved management system is installed. The requirement to maintain a vegetative buffer is similar to the requirement in the county's 1991 ordinance. The county (after battling with the state) included in the 1998 ordinance language providing that "Any conflict or inconsistency between this ordinance and Brown County's Shoreland Zoning Ordinance will be governed by the more restrictive provision." This enables the county to continue to require a 35 foot vegetative buffer as specified in the earlier ordinance, even though the newer ordinance (following DATCP models) only requires a 20 foot buffer in the agricultural shoreland corridor. The county further takes the position that cost shares are not required for the installation of buffers because they are not required by the more restrictive earlier ordinance.

The Land Conservation Department administers and enforces this ordinance. The LCD is required to notify landowners in violation by mailing a notice of problem, including a list of BMPs to address the problem and a statement allowing the landowner to appeal the decision. The 1998 ordinance includes a provision allowing for variances if cost share funds are not provided. Variances are also permitted due to excessive county staff workload or if conservation practices will still not bring the landowner into compliance with the ordinance. The LCD will work with the landowner to develop a conservation plan and a schedule of implementation, and must notify the landowner when funds are available to install or implement the required practices. Penalties include civil forfeitures of up to $50 per day of violation, and the ordinance may be enforced by injunction.

State law allows townships, as well as counties, to develop agricultural shoreland management ordinances, and three towns in Brown County have done so. Towns and counties that have developed an ordinance receive state funding for cost shares to implement the required practices. The LCD administers the ordinance for towns that have passed one, and receives separate cost share money from the state to use in the towns.

State Enforcement

DNR issues 5 to 10 NODs under the NR 243 provisions in Brown County for animal waste each year. The program is complaint driven and most often it is neighbors who report the violations or problems. DNR staff must be able to prove that there has been a discharge to surface or groundwater. Evidence of the discharge is generally persistent enough that it is not difficult to demonstrate that a discharge occurred. If the animal waste site is in a priority watershed, DNR cost sharing is available. If not, the county does not normally provide cost sharing for construction of animal waste storage facilities but does have some funding from DATCP associated with the land and water planning process. This funding can only be used for construction of practices with a twenty year life span. DNR staff cannot recall needing to issue an NPDES permit as a result of noncompliance with an NOD in the county.

DNR does not frequently issue abatement orders for sediment related pollution. Problems with land development generally get referred to the county zoning office for action.

Conclusions

The Wisconsin nonpoint efforts reflect substantial funding, attention to standards, and some use of enforceable mechanisms. The priority watershed approach served as the main paradigm for planning, funding, and regulatory attention. Now, Wisconsin seems to be devoting more base funding and assistance to areas that have not received priority attention in the past, while adding competitive grant programs to take advantage of local initiative.

The enforceable provisions of Wisconsin's nonpoint programs are administered by DNR and by the counties. These are significant, but greatly subordinate to the substantial technical assistance efforts and cost shares available through counties, DATCP, and DNR (including federal 319 and EQIP funds). The state generally relies on counties to handle violations through enforcement of local ordinances. State level enforcement can be time consuming and complex. At the local level, too, enforcement generally follows assistance; stop work orders are more common than civil forfeitures or judicial actions.

Wisconsin has statewide standards and practices and is developing even more detailed performance standards and technical specifications. However, state and county conflicts over standards may hinder a county's ability to handle its nonpoint source pollution problems. La Crosse County has some concerns over enforcement of its animal waste management ordinances because its standards are not entirely in line with state requirements. Brown County has also negotiated with the state to ensure that enforcement of its ordinances is less dependent on the availability of cost shares. While the state's goal of ensuring equity among its counties has increased the focus on counties – both through funding redistribution and the development of statewide performance standards and specifications – the program has also constrained some efforts.

The biennial legislative struggles over how much authority and budget control DATCP and DNR should have respectively, have also increased the complexity and variability of the Wisconsin nonpoint effort. Substantial state agency rulemakings are in progress (largely in response to the 1997 Act 27), but it is not clear whether major modifications will continue to occur each legislative biennium. It may be important to allow the state and county programs the breathing space to establish an ongoing and predictable mode of operation.

ENDNOTES

1. In addition to the documentary sources cited, the following individuals were interviewed in connection with this case study: Bob Behrens, DNR Regional Office; Don Franke, Lacrosse County Land Conservation Department; Lynn Goldade, DNR; Bill Hafs, Brown County Land Conservation Department; Dave Jelinski, DATCP; Jim Jolly, Brown County Land Conservation Department; Jill Jonas, DNR; Al Shea, DNR; Jan Whitcomb, NRCS Wisconsin.
2. Wis. Stat. § 281.20.
3. Wis. Admin. Code (WAC) NR 243.
4. Wis. Stat. § 281.20.
5. Wis. Stat. ch. 283; WAC NR 243.
6. Wis. Stat. § 92.11, § 92.15, § 92.16, § 92.17, § 59.693, § 60.627, § 61. 354, § 62.234.
7. Wis. Stat. §§ 281.65(4)(a) and (ar).
8. Wis. Stat. § 92.05(1).
9. Wis. Stat. § 92.06(1)(b).
10. Wis. Stat. § 281.65(2)(am).
11. Wis. Stat. § 92.11.
12. WAC NR 121.
13. Wis. Stat. § 281.65(4).
14. Wis. Stat. § 281.65(4)(g).
15. Wis. Stat. §§ 281.65(4)(g)(3)-(5).
16. WAC NR 120.08(1).
17. Wis. Stat. §§ 281.65(4)(g)(8)(a)-(e).
18. WAC NR 120.08(2).
19. Wis. Stat. §§ 281.65(8)(a) and (e).
20. Wis. Stat. § 281.65(8)(f).
21. Wis. Stat. §§ 281.65(8)(b),(c), and (k).
22. Wis. Stat. § 281.65(5w).
23. Wis. Stat. § 281.65(7).
24. Wis. Stat. § 281.65(4)(g)(8)(am).
25. Wis. Stat. § 281.65(5y).
26. Wis. Stat. § 281.65(4)(c).
27. Wis. Stat. §281.65(3)(a)(2).
28. Wis. Stat. §92.10(3) - repealed in 1999.
29. Wis. Stat. § 92.10(6)(1997).
30. Wis. Stat. § 92.10(6)(1999).
31. § 92.14(6).
32. Wis. Stat. §§ 281.65(4c).
33. Wis. Stat. § 281.16(2)(a).
34. Wis. Stat. § 281.65(2)(b).
35. Wis. Stat. § 281.16(3)(a).
36. Wis. Stat. §§ 281.16(3)(b) and (c).
37. Wis. Stat. § 281.16(3)(a)(1-4).
38. Wis. Stat. § 281.16(3)(d).
39. See DNR and DATCP, Nonpoint Source Program Redesign Initiative (Sept. 1999 draft).
40. Wis. Stat. § 281.20(1)(a).

41. Wis. Stat. § 281.20(1)(a).
42. Wis. Stat. § 281.20(3)(a).
43. Wis. Stat. §§ 281.98(1),(2), 281.19(7).
44. Wis. Stat. §§ 281.20(3)(b)and (c).
45. Wis. Stat. § 281.20(3)(c)(1).
46. Wis. Stat. § 281.20(3)(c)(2).
47. Wis. Stat. §§ 281.20(3)(b) and (5)(a).
48. Wis. Stat. §§ 281.20(5)(a) and (b).
49. Wis. Stat. § 281.16(3)(e).
50. Wis. Stat. § 281.20(3)(d).
51. Wis. Stat. ch. 283.
52. NR § 243.23.
53. NR § 243.26.
54. Wis. Stat. §281.16(4).
55. Wis. Stat. § 283.91.
56. Wis. Stat. § 92.11.
57. Wis. Stat. § 92.17.
58. Wis. Stat. §§ 92.15, 92.16.
59. Wis. Stat. §§ 59.693, 60.627, 61.354, 62.234.
60. Wis. Stat. § 92.16.
61. Wis. Stat. §§ 92.15(3) and (5).
62. Wis. Stat. §§ 92.17, 92.14(3)(b) (1997); § 92.17(2m) (1999).
63. Wis. Stat. § 281.31.
64. Wis. Stat. § 59.971.
65. WAC NR 115.05(1).
66. WAC NR 115.05(3).
67. WAC NR 115.05(3).
68. WAC NR 115.05(e).
69. WAC NR 115.02, 115.03(5).
70. WAC NR 115.01(1).
71. Wis. Stat. § 62.231, 61.351.
72. Wis. Stat. § 62.231(6).
73. Wis Stat. § 87.30(2); WAC NR 117.06(3).
74. Wis. Stat. § 59.97(11).
75. Wis. Stat. § 62.23(7)(f).
76. Wis. Stat. § 281.33. See also WS 59.69 and 59.693, which specifically authorize county zoning ordinances for construction site erosion control at sites where the activities do not include construction of a building.
77. Wis. Stat. §281.65(4)(g)(5).
78. Wis. Stat. §281.33(3)(a)(1).
79. Wis. Stat. §281.33(3)(b).
80. Wis. Stat. §§281.33(3)(a)(1) and (c).
81. Wis. Stat. §§281.33(3)(a)(1) and (2).
82. WAC NR 120.16.
83. WAC IHLR Chap. 21. (esp. 21.125 - one and two family residential construction).
84. La Crosse County Land and Water Resource Management Plan (1999).
85. Wis. Stat. 92.10(6)(1997).

86. La Crosse County Land and Water Resource Management Plan (1999) App. D-F.
87. Wis. Stat. § 59.693; cited in La Crosse County Erosion Control Land Disturbance Ordinance, Chapter 21.
88. La Crosse County Erosion Control Land Disturbance Ordinance, 21.07(e).
89. La Crosse County Land and Water Resource Management Plan (1999).
90. WAC ILHR 21.125.
91. Wis. Stat. §281.16(3). Animal Waste Management Ordinance of the General Code of La Crosse County, Chapter 23. Ordinance 15/12-98.
92. La Crosse County Land & Water Resource Management Plan (rev. March 8, 1999).
93. Impacts of Agriculture on Water Quality in the Green Bay Ecosystem and Proactive Agriculture Approaches to Protecting Water Quality (Brown County Land Conservation Department).
94. William C. Hafs, *Rural Management for Nonpoint Source Control* (n.d.).
95. Brown County Ordinance § 26.11.
96. Brown County Ordinance § 26.12.
97. Brown County Ordinance ch. 22; see especially § 22.24.
98. Wis. Stat. § 92.14(3m) (1997) required state cost share funding for any stream fencing required by local shoreland management ordinances, but the 1999 amendments to state law repealed this provision and replaced it with §92.14(3)(b)(1) which simply makes such cost share funding available to counties. However, § 92.17(2m)(1999), provides that a county cannot enforce a shoreland ordinance unless the county uses state funds provided under §92.14(3)(b) for the required purposes, and that a city, village, or town with such an ordinance cannot enforce it unless the county provides it such state funds.
99. Brown County Ordinance ch. 10.

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National Conference on Tools for Urban Water Resource Management & Protection

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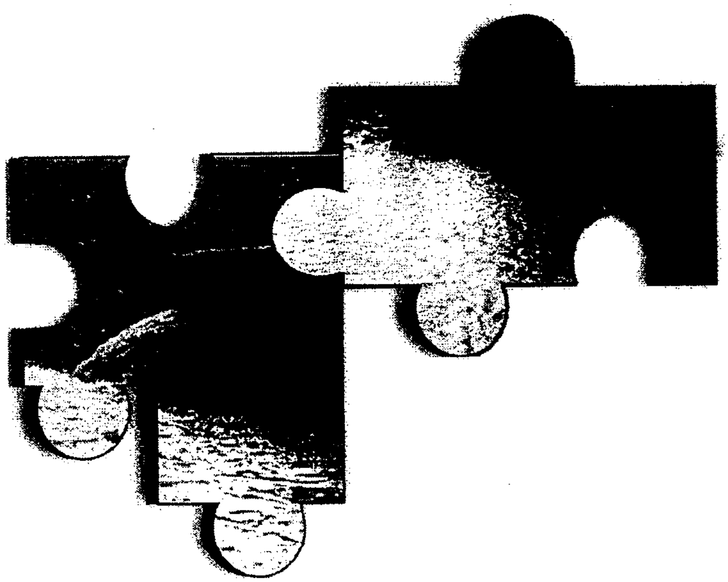

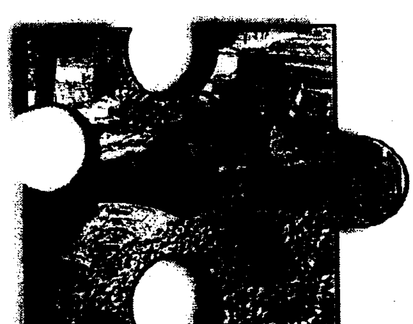

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Notice

Preface

A wide array of effective water quality management and protection tools has been developed for urban environments, but implementation is hindered by a shortage of technology transfer opportunities. Held in Chicago, Illinois on February 8-10, 2000, the ***National Conference on Tools for Urban Water Resource Management and Protection*** was designed to facilitate the educational process and transfer state-of-the-art information to state, regional, and local urban water quality practitioners.

The Chicago Botanic Garden, which is owned by the Forest Preserve District of Cook County and managed by the Chicago Horticultural Society, was pleased to coordinate the Office of Wastewater Management and its Region 5 office, as well as the Northeastern Illinois Planning Commission. The conference was conducted in cooperation with the Water Environment Federation. Over 450 attendees participated, including representatives from Australia, Brazil, Canada, Chile, New Zealand, and Turkey.

The timing for this conference coincided well with the U.S. Environmental Protection Agency's release of the NPDES Storm Water Phase II Final Rule in October 1999. The conference provided participants with practical, applied information on the most effective tools and technologies for meeting these new NPDES permit requirements. Program topics were carefully chosen to reflect the Phase II Program's six priorities: public education, public involvement, detection and elimination of illicit discharges, construction site runoff control, post-construction storm water management, and pollution prevention for municipal operations.

Two special pre-conference workshops were held on February 7. ***Better Site Design and Storm Water Management Techniques for Phase II Communities*** explored the benefits of alternative urban site design approaches, as well as new advances in storm water management to protect water resources. The workshop was led by staff from the Center for Watershed Protection. The second pre-conference workshop, ***Introduction to Urban TMDLs***, examined current and pending requirements for total maximum daily load (TMDL) programs. Instructors for this workshop were staff from Tetra Tech, Inc. Each of the workshops attracted over 135 participants.

This Conference Proceedings includes many of the papers presented during the conference. All papers included were peer reviewed. Additional copies, in either paper or CD-ROM format, are available free of charge from the U.S. Environmental Protection Agency, telephone 800/490-9198, or visit the web site <http://www.epa.gov/ttbnrmrl/>.

Foreword

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory is the Agency's center for investigation of technological and management approaches for reducing risks from threats to human health and the environment. The focus of the Laboratory's research program is on methods for the prevention and control of pollution to air, land, water and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites and ground water; and prevention and control of indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

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Introduction

Stormwater runoff from urban and urbanizing areas is widely recognized as a major cause of water pollution in the United States. The impacts of stormwater runoff are threefold: (1) chemically, contaminants deposited on the land are carried by runoff and infiltration to surface and groundwater; (2) physically, increases in impervious surfaces raise runoff rates which, in turn, increase mass pollutant loadings and contribute to erosion and sedimentation; and (3) biologically, the combined chemical and physical alterations of watershed systems degrade aquatic habitat. Research over the past 20 years consistently shows a strong correlation between the imperviousness of a drainage basin and the health of its receiving waters, with stream health decreasing with increasing impervious coverage of the watershed.[1] The U.S. Environmental Protection Agency cites urban runoff as the second leading cause of impairment to estuaries and the fourth leading cause of impairment to lakes.[2] Increased runoff rates, and the erosion and sedimentation associated with new development and construction, also are significant sources of pollution. In the United States, there are an estimated 522,000 construction "starts" each year, with construction activities disturbing an estimated 5 million acres of land annually.[3]

Connecticut communities, like those in many urbanized states, are confronted with meeting nonpoint source management needs that often conflict with traditional subdivision regulations and construction standards. The challenge of meeting public safety and maintenance requirements in an environmentally sensitive manner is not currently being met, as evidenced by continued water quality impairments associated with new development. Can impervious surfaces be reduced, and curbing and storm drains be eliminated in a way that will not raise objections from municipal boards and commissions? Will homeowners accept cluster housing, natural landscaping, and "greener" home and yard maintenance practices? Most important, will those modifications make a difference in the quality and quantity of nonpoint source runoff under widespread application? Answering these and related questions is the objective of the Jordan Cove Urban Watershed National Monitoring Project.

Project Overview

The primary purpose of the Jordan Cove project is to compare differences in runoff quantity and quality emanating from traditional and "environmentally sensitive" development sites. The 18-acre "Glen Brook Green" subdivision, located in the southeastern Connecticut town of Waterford, is being constructed and monitored to make this comparison. The subdivision is split into two distinct "neighborhoods": one with building lots arranged in a traditional R-20 (half-acre)

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zoning pattern (Figure 1); the other, cluster housing with a variety of best management practices (BMPs) incorporated into the design (Figure 2).

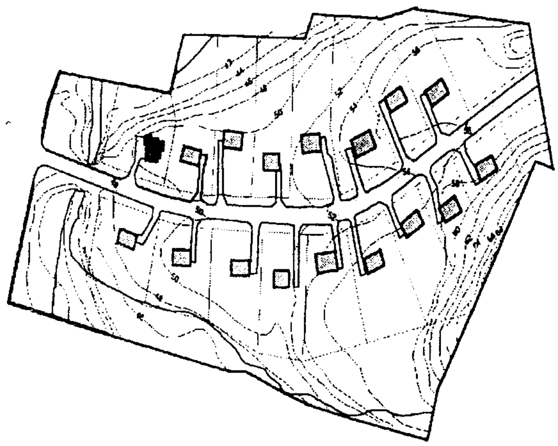

Figure 1. Glen Brook Green "Traditional" Neighborhood.

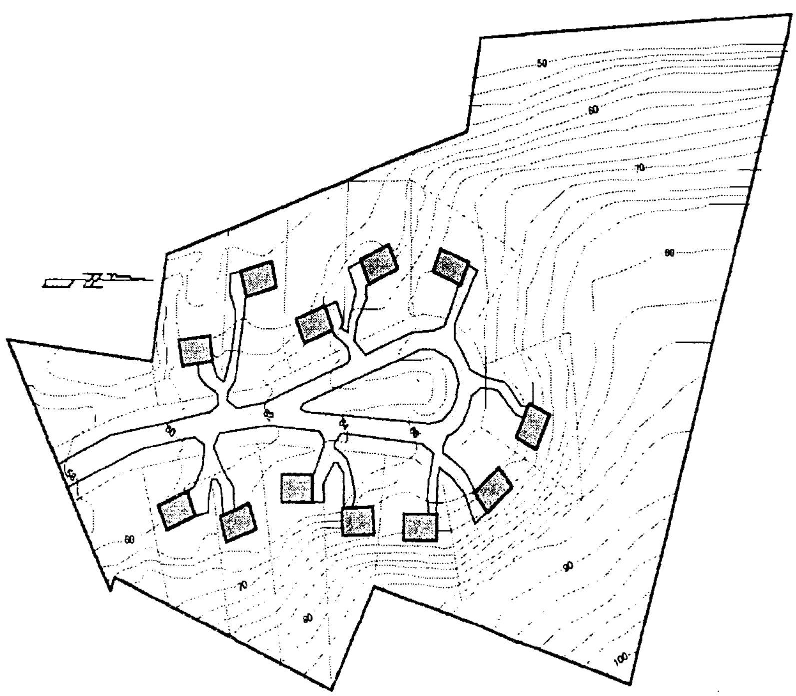

Figure 2. Glen Brook Green "BMP" Neighborhood.

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Stormwater runoff from the traditional section is collected by curbs and catch basins, then piped through a stormwater treatment system before entering Nevins Brook, a tributary of Jordan Brook and, ultimately, Jordan Cove and Long Island Sound. Homeowners will not be subjected to any enhanced environmental education, or restrictions on how they manage their properties.

The BMP neighborhood will feature grass swales; roof leader "rain gardens;" shared, permeable driveways; small building "foot-prints;" deed restrictions on increasing impervious surfaces; "low-mow," "no-mow," and conservation zones; a narrower, permeable road surface (interlocking concrete pavement); and a vegetated infiltration basin, or bioretention area, located inside a "tear-drop" cul de sac. Several different driveway surfaces will be utilized, including interlocking concrete pavement, gravel, concrete tire strips, and permeable asphalt, and monitored for their relative runoff rates. Homeowners and town road maintenance crews will be encouraged to adopt pollution prevention techniques, including controlled fertilizer and pesticide application, pet waste management, street sweeping/vacuuming, and reduced use of deicing agents.

The BMP neighborhood is expected to generate less stormwater runoff and pollution. Monitoring conducted before, during and after construction will document actual results. The Jordan Cove project team comprises a true public/private partnership, with researchers and educators from the University of Connecticut; federal, state, and local government officials; private consulting firms; and the developer.

National Monitoring Program

The Jordan Cove Urban Watershed National Monitoring Project is funded, in part, through the Connecticut Department of Environmental Protection (CT DEP) by the U.S. Environmental Protection Agency's (EPA) Section 319 National Monitoring Program (NMP). It is one of 22 such projects nationwide. The Jordan Cove project is the only NMP project studying the effects of residential subdivision development on runoff quality and quantity, and of BMPs designed to mitigate those impacts.

The Section 319 NMP was established pursuant to section 319(l) of the federal Clean Water Act (Nonpoint Source Management Programs - Collection of Information). Section 319(l) states that EPA shall collect information and make available:

(1) Information concerning the costs and relative efficiencies of best management practices for reducing nonpoint source pollution.

(2) Data concerning the relationship between water quality and implementation of various management practices to control nonpoint sources of pollution.

The objectives of the Section 319 NMP are twofold:

(1) To scientifically evaluate the effectiveness of watershed technologies designed to control nonpoint source pollution.

(2) To improve our understanding of nonpoint source pollution.

To achieve these objectives, the NMP has selected watersheds across the country to be monitored over a 6- to 10-year period to evaluate how improved land management and the application of BMPs reduce water pollution. The results from these projects will be used to assist land use and natural resource managers by providing information on the relative effectiveness of BMPs to control nonpoint source pollution.

Site Selection

In 1993, nonpoint source program staff from EPA and CT DEP, and a University of Connecticut researcher began efforts to identify a site at which to conduct a nonpoint source monitoring project under the auspices of the NMP. Initial site selection involved three criteria: (1) an appropriate hydrologic setting, with distinct drainage patterns amenable to monitoring; (2) a willing land owner or developer who would allow 1-1½ years of advance monitoring before beginning construction; and (3) a municipality willing to adopt innovative site planning and development strategies. Proximity to the coast was also considered as an important factor because of the need to reduce nonpoint source pollution loads to Long Island Sound and coastal waters in general.

CT DEP mailed letters soliciting interest to a number of municipalities recognized for either their progressive approach to land use planning and management, or for experiencing high development rates. After positive responses from several municipalities, and numerous field visits, the "Glen Brook Green" site in Waterford was selected in May 1995. The 18-acre parcel was an active chicken farm, but its owner, who had grown up on the farm, was planning to develop it into a residential subdivision. The property owner wanted to develop the parcel in an environmentally-sound manner, was interested in the NMP solicitation, and was willing to be flexible with his construction schedule to facilitate monitoring.

The hydrology of the parcel featured two distinct drainage areas, an ideal setting for the proposed monitoring design. Poultry houses and several other buildings occupied the area that would become the traditional neighborhood and an old, partially mined gravel pit dominated the future BMP neighborhood. Soil tests determined that the chicken manure had not elevated nutrient levels significantly enough to bias the monitoring. The town of Waterford, and its planning officials, had a reputation as being progressive on land use issues and had served as one of the pilot communities for the University of Connecticut Cooperative Extension System's Nonpoint Education for Municipal Officials (NEMO) project. Because waivers from Waterford's subdivision regulations would be needed to build the BMP neighborhood, the town's cooperation was critical to the project's implementation.

Planning

Proceeding from a conceptual design to actual construction required a concentrated effort by the project team working together toward a common goal. Once an acceptable plan was agreed upon by the project team and committed to paper, the next step was gaining approval from Waterford's conservation, and planning and zoning commissions. As is typical of New England town governments, both commissions paid close attention to planning decisions at a series of public meetings at which many development alternatives were reviewed. Volunteer commissioners and professional staff raised numerous concerns regarding the health, safety and general welfare of the town residents, and the social economic, environmental, and political viability of the proposed plan. Among their concerns were road widths for emergency access, road surface integrity for plowing and de-icing, traffic, drainage, sidewalks, parking, maintenance of common areas, and responsibility should BMPs fail. The rigorous review was enlightening to the project team and commissioners alike. As the ongoing dialogue between the various parties led to further planning details and innovative solutions to problems, enthusiasm and support for the project grew.

After a series of public meetings in late 1996 and early 1997, the project was approved by both commissions. Technical modifications of existing standards were handled in four ways: as waivers, special design/operation controls, mitigation, or discretionary actions. Table 1 lists each of these categories with associated comments and concerns expressed by Waterford's professional staff and commissions. In the end, it was the willingness of all parties involved to work in concert, reaching compromises, that allowed this innovative project to advance to the construction phase.

It is a generally accepted axiom that resource-based site planning can help minimize increases in runoff and reduce the potential for erosion and sedimentation problems typically associated with new development. In this project, goals identified at the outset are helping to direct the choice of practices and strategies for site development toward those that will reduce adverse impacts on hydrology and water quality. These goals include: (1) reproducing pre-development hydrological conditions; (2) confining development and construction activities to the least critical areas; (3) fitting the development to the terrain; (4) preserving and utilizing the natural drainage system; and (5) creating a desirable living environment.

Table 1. Technical Modifications of Existing Development Standards.

Considerations	Traditional Design	BMP/Cluster Design	Comments
waivers needed	specified road surface materials	segmental concrete pavers (permeable)	must be approved by public works; costs more
	typical road width = 28 feet, reduced to 24 feet	reduced road width to 20 feet for travel lane	must be approved by public works, fire, and police
	curbs and storm drains required	no curbs; grassed swales and sheet flow off road	turf stone installed to maintain road edge integrity; costs less
	90 ft paved cul-de-sac radius	one way cul de sac design to reduce road width and turning radius	further reduction in width and less need for snow plowing
special design/ operational control	planning and zoning standards	bioretention "rain gardens"	retains roof runoff on-site
	home owner discretion	vegetative maintenance	reduces fertilizer use; costs less
	home owner discretion	pesticide management	reduces pesticide use; costs less
	home owner discretion	domestic animal management	reduces pathogen runoff
mitigation required	road runoff piped to storm sewer		need to manage storm water entering the site from adjacent public road
	creation of 13,400 sq ft wetland at subdivision entrance		required to mitigate filling of 5000 sq ft of wetlands within subdivision
discretionary actions	R-20 single-family zoning	cluster and zero setback from lot lines	allows more open space and natural landscaping
	open space not contiguous with all lots	open space layout	compact housing; natural landscaping
	a driveway for each home	combined driveways	reduces curb cuts and impervious surface; cost less

Monitoring Design

This study is utilizing the "paired-watershed" monitoring design, which requires a minimum of two watersheds (control and treatment) and two periods of study (calibration and treatment). This approach assumes that there is a quantifiable relationship between paired water quality data for the two watersheds, and that this relationship is valid until a major change is made in one of the watersheds. It does not require that the quality and quantity of runoff be statistically the same for the two watersheds, but that the relationship between the paired observations of water quality and quantity remains the same over time -- except for the influence of the land use changes in the treatment watershed.[4]

The control watershed accounts for annual and/or seasonal climate variations. During the calibration period, no changes in land use occur in the watersheds and paired water quality and quantity data are collected to develop a baseline. The paired data are used to develop regressions for the control and treatment watersheds. The treatment period begins when changes in land use occur in the treatment watershed. A new regression is developed following the treatment period. Analysis of variance (ANOVA) is used to test the significance of the regressions in each period. Analysis of covariance (ANCOVA) is used to test the differences between the two regression slopes and intercepts. The changes between periods are calculated based on a comparison of predicted values, using the calibration regression equation, and observed values during the treatment period.[5]

For the Jordan Cove project, the treatment period will occur in two phases: (1) during construction of the traditional and BMP neighborhoods; and (2) after construction when the BMPs are in effect. The paired-watershed approach is being used to measure the differences in water quality and quantity between the treatment areas (traditional and BMP neighborhoods) and the control area (a nearby 10-year old subdivision) caused by construction in the two treatment areas and the application of BMPs in the BMP neighborhood. Stormwater quality and quantity are measured at the outlets of each of the two treatment neighborhoods, and the control watershed (Figure 3). Water quality is measured by analyzing weekly flow-weighted composite samples for total suspended solids (TSS), total phosphorus (TP), total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_3-N), and nitrate+nitrite nitrogen (NO_3-N). Grab samples are analyzed for fecal coliform and BOD_5. Monthly analyses are conducted for copper, lead, and zinc.

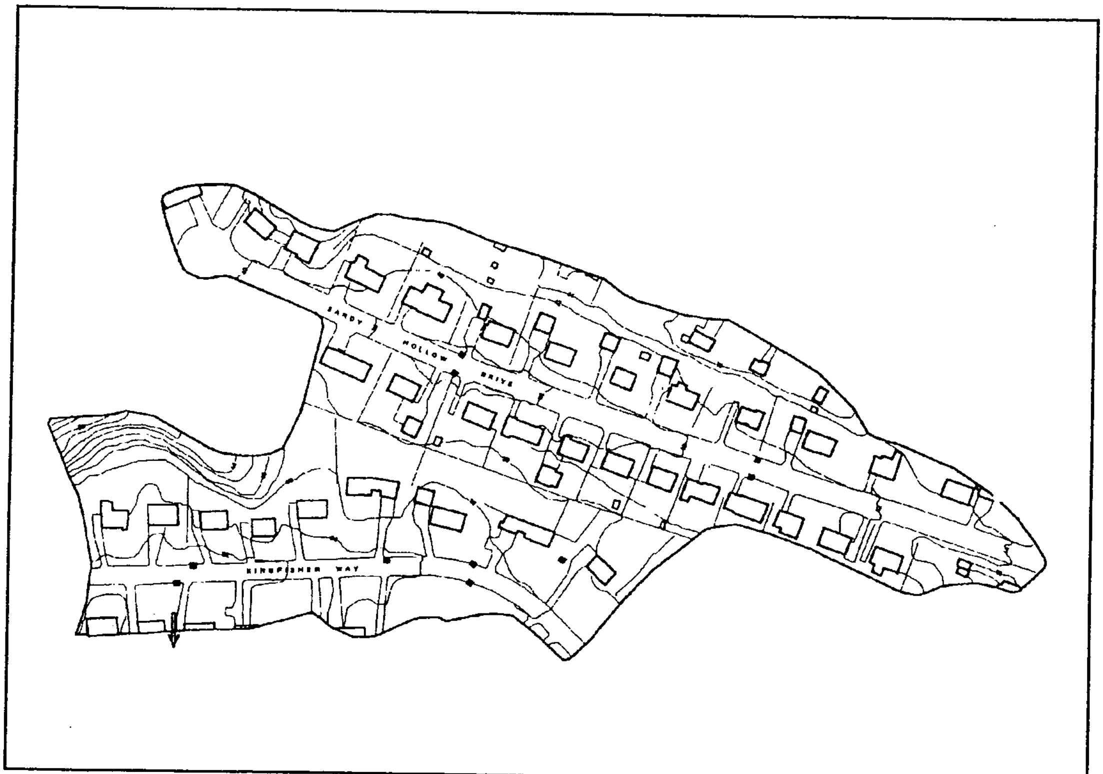

Figure 3. Existing residential (control) watershed.

The calibration period began in January 1996, to establish a baseline for future comparisons. Since the treatment period began in May 1998, runoff monitoring has focused on the effects of construction, and on the relative effectiveness of standard erosion and sediment control practices in the traditional neighborhood. When construction commences in the BMP neighborhood, the focus will be on the effects of construction and the relative effectiveness of enhanced erosion and sediment control practices (e.g., phased grading, stockpile seeding, open space vegetation, cross grading, and detention swales). Post-construction monitoring is scheduled to begin in 2001 and will continue for 3-5 years.

Supplemental monitoring will be conducted on selected BMPs, including different driveway surfaces and enhanced turf management in the BMP neighborhood, and a "state-of-the-art" stormwater treatment device in the traditional neighborhood. This information will be used to evaluate the effectiveness of these specific practices.

Monitoring Results

During the calibration period, 75 runoff events were sampled for the control watershed and 12 runoff events for the two treatment watersheds. In the treatment period to date, 21 and 20 events were sampled for each treatment watershed, respectively. Peak discharge values were obtained for nine paired events in the calibration period and 20 pairs for the treatment period. The total number of samples analyzed was less than the total number of flow observations because not all the samples contained a sufficient volume for analysis[6].

Sampling results to date, as presented in Table 2, indicate that construction of the traditional neighborhood is causing significant impacts on runoff quality and quantity, including observed increases in mean weekly flow volume (99%), runoff frequency (from 16% to 95%), and mean weekly peak discharge (79%).[7] The conversion of the watershed's topography from a "knoll" to a "bowl," combined with an increase in impervious surface, appears to have caused a significant change in hydrologic responses. Concentrations of NO_3-N and Pb in runoff also increased. However, increases in the concentrations of sediment and sediment-associated nutrients, typical of construction sites, did not occur. In fact, TKN concentrations have declined during construction. It is believed that erosion and sediment controls are responsible for TSS concentrations remaining constant before and during construction[8].

Table 2. Summary of means and percent increases of flow, Q_p, nutrient and metal concentrations for the control and traditional watershed in the calibration and treatment periods.

Calibration Period			Treatment Period			
				Traditional		
Parameter	**Control**	**Traditional**	**Control**	**Observed**	**Predicted**	**% Change**
(m^3/week)						
Flow	113.84	0.14	107.76	1.94	0.02	99***
(m^3/sec*week)						
Qp	0.05	3.00E-04	0.04	1.00E-03	3.00E-04	79***
(mg/L)						
TSS	31	132	28	106	121	-15
NO_3-N	0.5	0.3	0.4	0.8	0.3	62**
NH_3	0.15	0.08	0.31	0.18	0.17	2
TKN	1.3	4.0	1.8	2.1	4.5	-113**
TP	0.159	1.009	0.127	0.481	0.758	-58
(ug/L)						
Cu	8	8	14	21	13	38
Pb	6	11	6	17	10	42*
Zn	58	65	79	126	98	22

* P value < 0.05
** P value < 0.01
*** P value < 0.001

Coinciding with the increases in pollutant concentration and flow, the mass export of NO_3-N and Pb increased as well, as did the mass exports of TP, TSS, Cu, and Zn. These increases appear to be attributable to increased stormwater runoff volumes. The preliminary results from this study suggest that increased runoff, rather than erosion, is the cause of increased pollutant export from this construction site. Traditionally, erosion and sediment controls and stormwater management plans focus on the prevention of sediment and, occasionally, peak flow impacts on downstream areas. The preservation of pre-development hydrologic conditions within the watershed where construction is occurring is typically ignored.

Excess runoff, which is the driving force behind nonpoint source pollution, will transport pollutants into waterways and contribute to their degradation. Preliminary monitoring results demonstrate that erosion and sediment controls can reduce sediment and sediment-associated pollutants in construction site runoff. However, current erosion and sediment control practices do not address the increase in runoff from development sites. Consequently, these practices fail at reducing pollutant loads.[9]

Next Steps

By the end of 2000, this combination of traditional and "green" designs for residential subdivisions should be fully constructed. Monitoring of stormwater quality and quantity will be conducted for several years after build-out to determine the overall efficiency of the design. It should demonstrate that careful planning, landscaping, and use of vegetative BMPs can help protect and enhance the environment, while addressing other concerns that local planning and zoning commissions face. Lessons learned from this project have already been, and will continue to be, passed along to other communities through ongoing technical assistance and training programs administered by the CT DEP, the University of Connecticut Cooperative Extension System, and other agencies and organizations.

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Sources of Phosphorus in Stormwater and Street Dirt from Two Urban Residential Basins in Madison, Wisconsin, 1994–95

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Abstract

Eutrophication is a common problem for lakes in agricultural and urban areas, such as Lakes Wingra and Mendota in Madison, Wisconsin. This report describes a study to estimate the sources of phosphorus, a major contributor to eutrophication, to Lakes Wingra and Mendota from two small urban residential drainage basins. The Monroe Basin empties into Lake Wingra, and the Harper Basin into Lake Mendota. Phosphorus data were collected from streets, lawns, roofs, driveways, and parking lots (source areas) within these two basins and were used to estimate loads from each area. In addition to the samples collected from these source areas, flow-composite samples were collected at monitoring stations located at the watershed outfalls (storm sewers); discharge and rainfall also were measured. Resulting data were then used to calibrate the Source Loading and Management Model (SLAMM, version 6.3, copyright 1993, Pitt & Vorhees) for conditions in the city of Madison and determine within these basins which of the source areas are contributing the most phosphorus.

Water volumes in the calibrated model were calculated to within 23% and 24% of those measured at the outfalls of each of the basins. These water volumes were applied to the suspended-solids and phosphorus concentrations that were used to calibrate SLAMM for suspended-solids and phosphorus loads. Suspended-solids loads were calculated to be within 4% and 17%, total-phosphorus loads within 24% and 28%, and dissolved- phosphorus loads within 9% and 10% of those measured at the storm-sewer outfall at the Monroe and Harper basins, respectively.

Lawns and streets are the largest sources of total and dissolved phosphorus in the basins. Their combined contribution was approximately 80%, with lawns contributing more than the streets. Streets were the largest source of suspended solids.

Street-dirt samples were collected using industrial vacuum equipment. Leaves in these samples were separated out and the remaining sediment was sieved into >250 µm, 250-63 µm, 63-25 µm, <25 µm size fractions and were analyzed for total phosphorus. Approximately 75% of the sediment mass resides in the >250 µm size fractions. Less than 5% of the mass can be found in the particle sizes less than 63 µm. The >250 µm size fraction also contributed nearly 50% of the total-phosphorus mass. The leaf fraction contributed an additional 30%. In each particle size, approximately 25% of the total-phosphorus mass is derived from leaves or other vegetation.

Introduction

Eutrophication is a common problem for lakes in agricultural and urban areas, such as Lakes Wingra and Mendota in Madison, WI. Primary productivity in northern temperate lakes is most often limited by phosphorus (Schindler 1974; 1977). Urban runoff has been noted to contain high phosphorus concentrations (U.S. Environmental Protection Agency, 1983) that may be increasing the eutrophication. The focus of the study described in this report was to estimate the sources of phosphorus to Lakes Wingra and Mendota from two small urban residential watersheds in Madison, WI (Figure 1). This study was done in cooperation with the city of Madison and the Wisconsin Department of Natural Resources.

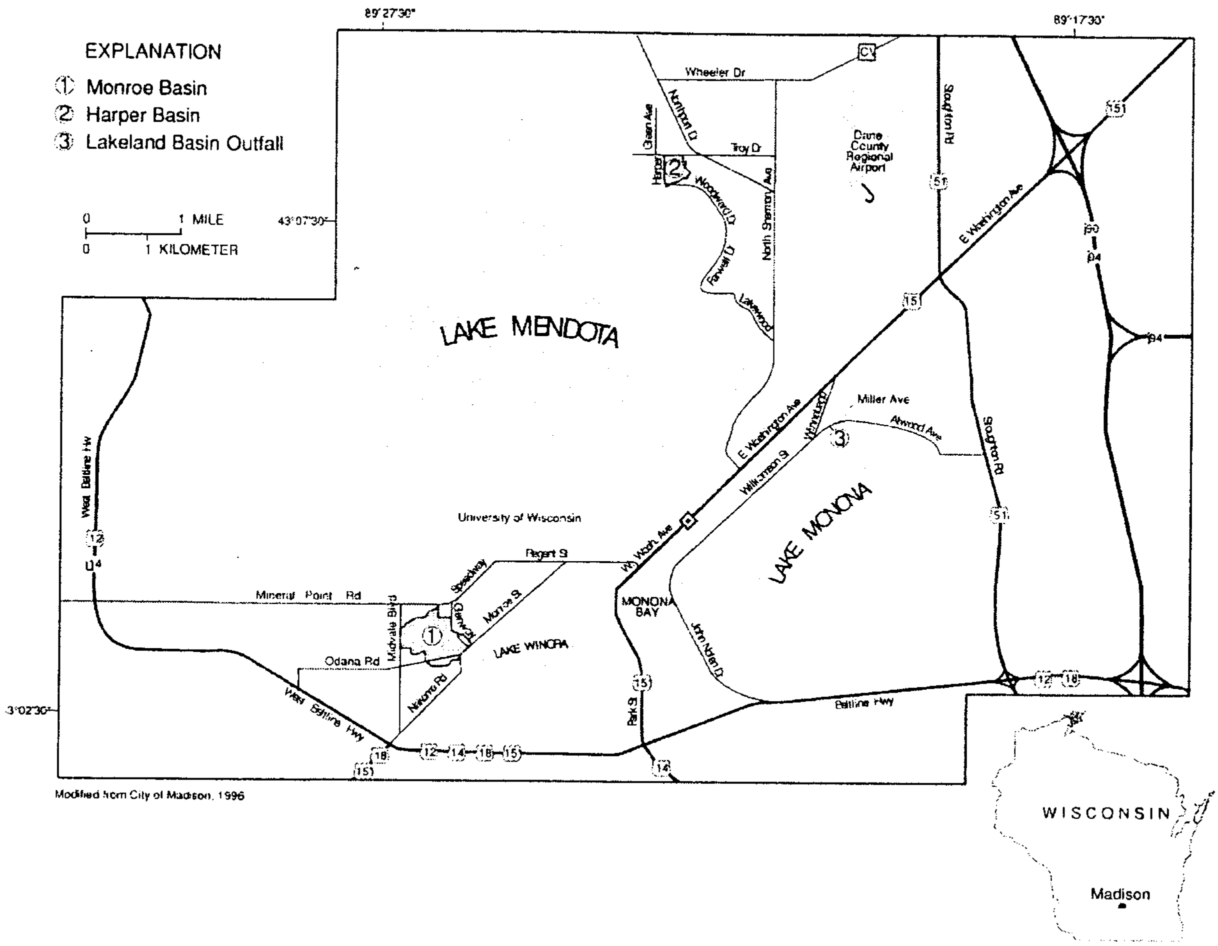

Figure 1. Lakes Wingra and Mendota in Madison, WI.

Lake Mendota and Lake Wingra are both part of the Wisconsin Department of Natural Resources (WDNR) Priority Watershed Program (Betz and others, 1997). State funding is available to help pay for management aimed at reducing the amounts of phosphorus and other pollutants discharged to the lakes. The goal of the Lake Mendota Priority Watershed Project is to reduce the frequency of nuisance algae blooms in the lake from one out of every two days to one out of every five days. To accomplish this goal, it is estimated that a 50% reduction is needed in the amount of phosphorus entering the lake. To help reach this target, the Nonpoint Source Control Plan for the Lake Mendota Priority Watershed Project (Betz and others, 1997) set an objective of reducing phosphorus loading to the lake by 20% from urban areas. The remaining 30% reduction is intended to come from rural phosphorus management.

For this study, phosphorus data were collected from five source areas—streets, lawns, roofs, driveways, and parking lots—within the two drainage basins from urban residential and commercial areas to estimate loads from each source area (Table 1). Resulting data were used to calibrate the Source Loading and Management Model (SLAMM, version 6.3, copyright 1993, Pitt & Vorhees) for conditions in the city of Madison and determine which source areas are contributing the most phosphorus within these basins. The city is planning to use SLAMM to target specific source areas for management efforts to meet the 20% phosphorus-reduction objective of the priority watershed project and to meet requirements of its Wisconsin Pollutant Discharge Elimination System stormwater permit.

Table 1. Land-use Characteristics of the Monroe Basin, 1994, and Harper Basin, 1995, in Madison, WI.
[--, source not present]

Source area	Monroe Basin Residential		Monroe Basin Commercial		Harper Basin Residential	
	Acreage	Percent of basin	Acreage	Percent of basin	Acreage	Percent of basin
Lawn	119.8	51.5	--	--	23.6	57.4
Roof	26.5	11.4	2.3	1.0	5.4	13.2
Street	30.5	13.1	1.6	.7	5.3	13.0
Woodlot	--	--	--	--	3.0	7.3
Driveway	10.6	4.6	--	--	2.1	5.1
Park land	19.3	8.3	--	--	.7	1.7
Sidewalk	12.5	5.4	--	--	.7	1.7
Parking lot	.4	.2	3.4	1.5	.3	.7
Railroad bed	5.3	2.3	--	--	--	--
Total	224.9	96.8	7.3	3.2	41.1	100

Stormwater runoff samples from source areas and the basin outfall were collected from a medium-density residential watershed draining to Lake Wingra from May to November, 1994 and from a medium-density residential watershed draining to Lake Mendota from June to November 1995. These runoff samples were used to estimate the phosphorus and suspended-solids load that each of these source areas and basins contributes. In addition, a third basin, the Lakeland Basin that drains into Lake Monona, was monitored for lawn runoff in 1995. This basin, which encompasses an older section of Madison, was sampled in an attempt to determine whether any difference exists between this section of the city (which has older, smaller lawns) and other areas of the city.

Study-Area Description

The Monroe Basin, monitored during 1994, drains into Lake Wingra. The basin is 232.2 acres, of which 224.9 acres are residential and 7.3 acres are commercial (Figure 2). Lake Wingra has a surface area of 338.9 acres (1.37 km^2) and a drainage area of 3,889 acres (15.74 km^2). About 75% of the Lake Wingra drainage basin is urbanized and about 25% is composed of forest, prairie, and marsh within the University of Wisconsin Arboretum (Oakes and others 1975).

The Harper Basin, monitored during 1995, drains into Lake Mendota. The Harper Basin is 41.1 acres, all of which is residential land use (Figure 2). Lake Mendota has a surface area of 9,859 acres (39.9 km^2) and has a drainage area of 138,823 acres (561.8 km^2) (Lathrop and others, 1992). Approximately 20% of the Lake Mendota drainage area is urban, 57% is agricultural, and the remaining 23% is grassland/woodland/marsh/open-water area (Betz and others, 1997). The Lakeland Basin is approximately 3 miles southeast of the Harper Basin.

In addition to the samples collected from source areas, a monitoring station was located at each basin storm-sewer outfall to collect flow-composite samples and to monitor discharge and rainfall. The total rainfall amounts for the months of June through October 1994 at Monroe and July through October 1995 at Harper were 9.24 and 10.67 in., respectively. These amounts are 64% and 71% of the average from 1961 to 1990 (Brian Hahn, National Weather Service, oral communication, 1997).

Acknowledgments

We thank all of the volunteers that allowed us to install our sampling equipment in their yards, the City of Madison Engineering Division and Department of Public Health for their efforts in making this study possible, Jeff Beck of the USGS for his exceptional field efforts, and Holly Ray and Dr. Bob Pitt at the University of Alabama at Birmingham for their work analyzing the street-dirt samples. Also, we thank Mary Anne Lowndes of the WDNR and

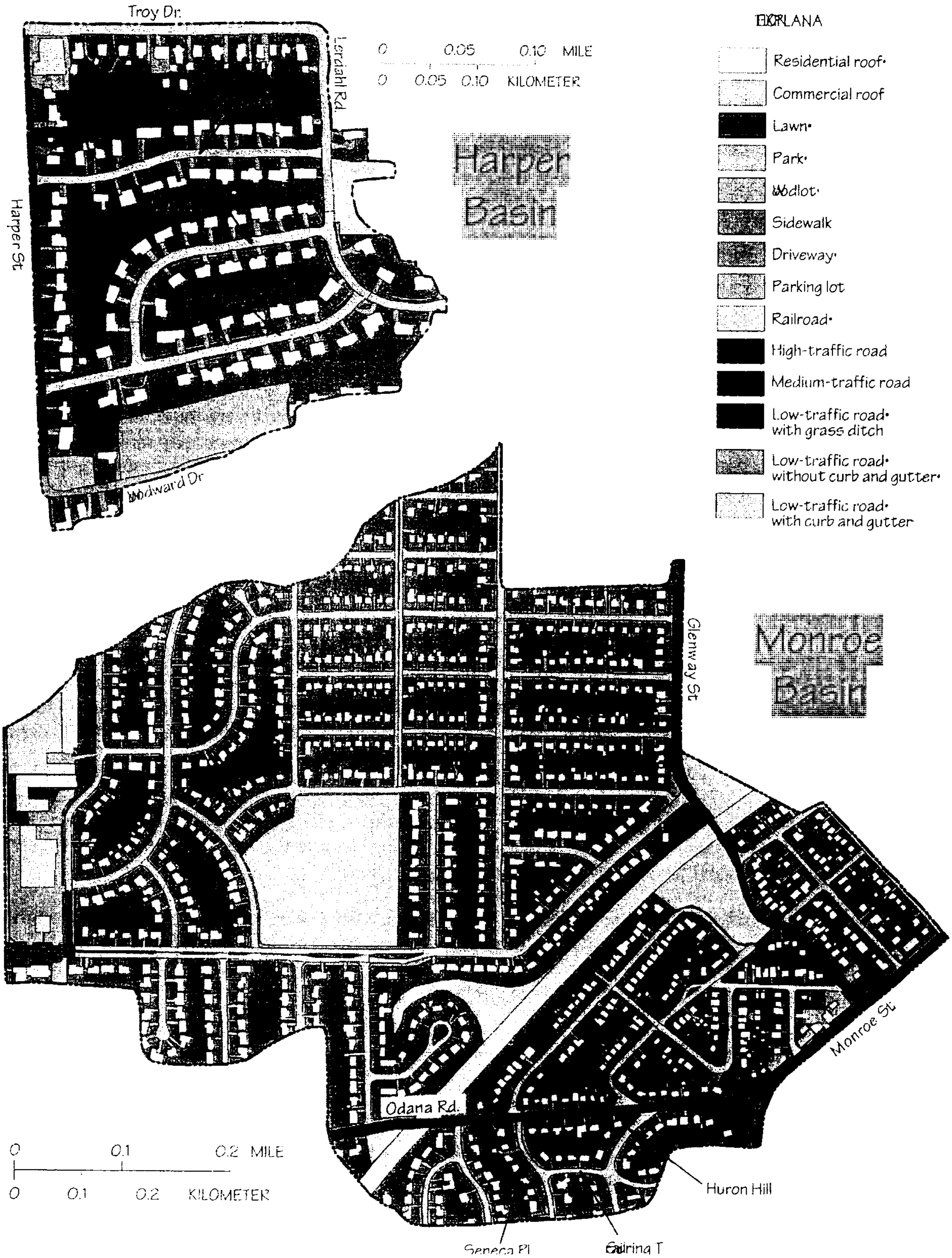

Figure 2. Harper and Monroe Basins.

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Steve Corsi of the USGS for insightful comments that have greatly improved the report. Lastly, we thank Gail Moede and Aaron Konkol at the USGS for their help with the report editing and preparation of illustrations.

Data-Collection Equipment and Methods

Runoff samples were collected from each source area by use of sampling equipment slightly modified from that described by Bannerman and others (1993). Brief descriptions of the sampling equipment follow.

Street samplers. The street samplers were grouted into the street approximately 5 ft from the curb (Figure 3). The sample bottle was covered with a 6-in. concave polycarbonate cap, set flush with the street surface, with a center drain hole. The bottle and cap were placed into a 6-in. diameter polyvinyl chloride (PVC) sleeve. Water flowed over the top of the cap and drained through the center hole into a collection bottle. The drain hole could be constricted by a set screw that controlled the flow rate into the sample bottle.

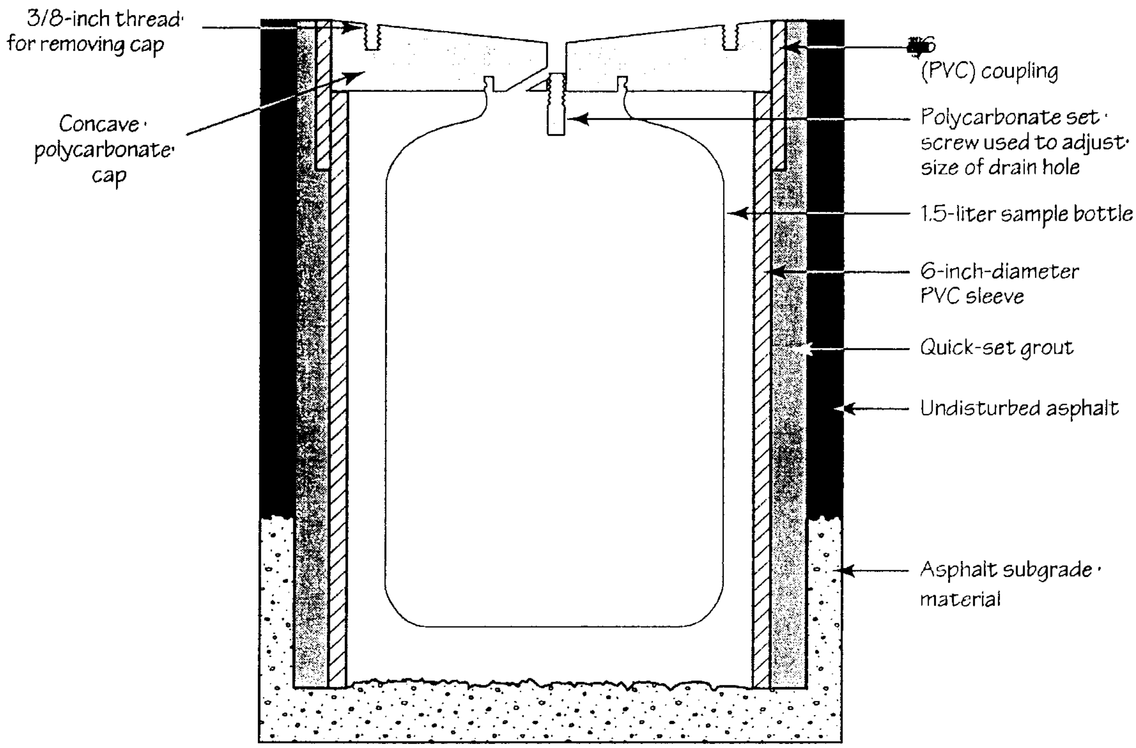

Figure 3. Schematic of street samplers.

Driveway samplers. Runoff water from driveways was diverted into a sampler by means of a flat piece of clear plastic, 1/4 in. high by 1 in. wide by 3 ft long, glued to the surface of the driveway. The sampler consisted of a 1.5-L glass bottle placed in a 10-in.-diameter protective PVC sleeve set into the ground next to the driveway. A 1/2-in.-diameter silicon tube carried the runoff through a plastic cap covering the PVC sleeve and into the sampler. During the 1994 field season, the tubing emptied directly into the sample bottle, causing several sample bottles to overfill. To alleviate this problem, in 1995, the tube emptied onto a polycarbonate cap like those used with the street samplers, so that the volume of water entering the sample bottle could be controlled.

Lawn samplers. Lawn sample bottles received runoff through two 5-ft pieces of 1/2-in.-diameter PVC pipe placed flush with the surface of the ground, on a sloping surface, with an angle of about 150 degrees between the two pipes (Figure 4). Runoff entered the pipes through two slits cut the entire length of pipe. Each pipe was wrapped with fiberglass

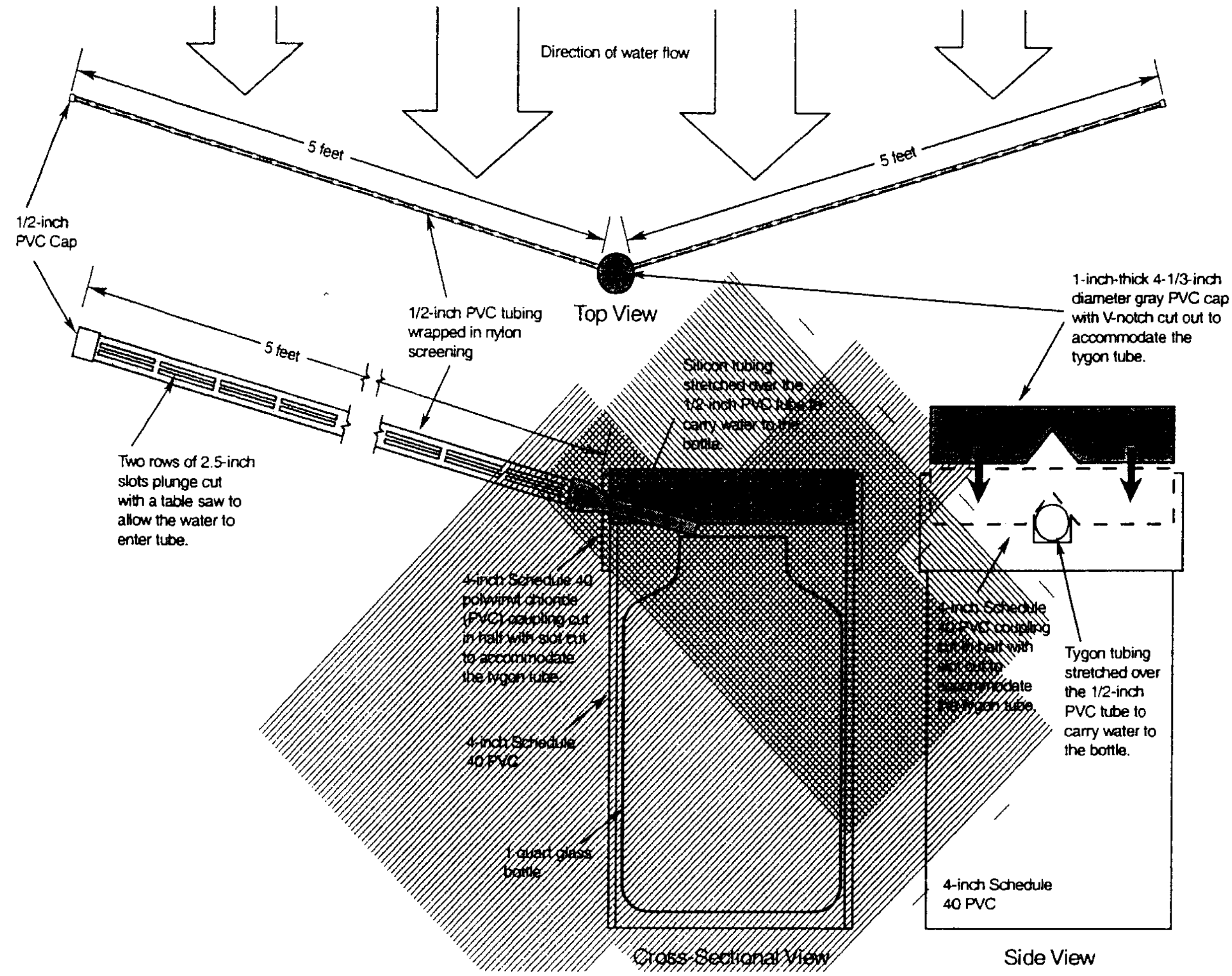

Figure 4. Schematic of lawn samplers.

screen to prevent insects and large debris from entering. Wooden clothespins with small pieces of nylon rope held the pipes in place. Water from the pipes flowed into a sampler through a notched cap. The sampler was a 1- qt glass bottle placed in a 4-in.-diameter protective PVC sleeve. The cap had a notch to accommodate silicon tubing, which ran from the end of the PVC collector pipes to the sample bottle.

Roof samplers. Roof samplers were designed to divert a small portion of the water in the gutter downspout to a sample bottle. A 1/4-in.-diameter vinyl tube was attached to the inside of the downspout by means of plastic wire ties. Each tube went into a 1.5-L glass sample bottle that was placed in a covered 10-in.-diameter protective PVC sleeve. Because of problems with overfilled sample bottles, the design was changed in the same manner as the driveway samplers so that the volume of water entering the sample bottle could be controlled.

Parking Lot sampler. The parking lot sampler collected runoff entering a storm-sewer inlet grate. A small portion of the inlet flow was diverted to a sample bottle by means of a 6-in. trough made of 1/2-in.-diameter PVC pipe cut lengthwise and held in place with stainless steel hose clamps attached to the inlet grating. Water drained from the trough through a tube to a 2.5-gal glass sample bottle hanging from the inlet grate. No samples were collected from parking lots during 1995.

Basin storm-sewer outfall samplers. An automated sampling station was placed at the storm-sewer outfall of both the Monroe and Harper Basins. In 1994, water level in the basin storm- sewer outfall pipe was measured with a pressure transducer as water drained into a detention pond. Velocity was measured with an electromagnetic velocity meter. In 1995, stormwater-runoff volumes were computed using a modified Palmer-Bowlus flume design (Kilpatrick and others, 1985). The water level was measured one pipe diameter (36 in.) upstream from the entrance to the flume using a pressure transducer connected to a nitrogen bubble system. This water level was used in the following equation to calculate the total discharge through the flume:

$$Q = a[H_a/D]^b D^{2.5},$$

where

Q is discharge, in cubic feet per second,
a is a constant, 3.685,
b is a constant, 1.868,
H_a is the water level above the upstream lip of the flume, at a distance of one pipe diameter upstream from the flume entrance, in feet, and
D is pipe diameter, in feet.

Flow-composite water quality samples were collected using programmable, refrigerated automatic samplers with 3/8-in.-diameter Teflon-lined sample tubing. Rainfall was measured using a tipping-bucket rain gage and was recorded by a digital data logger.

Stormwater Sample Collection and Processing Protocols

Sample bottles were placed in the source-area samplers as close to the start of each rain event as possible. As the bottles were being deployed, the sampling equipment was rinsed with deionized water to remove any accumulated surface dirt. Before the lawn sampler pipes were rinsed, they were cleaned with a small test tube brush. As soon as possible after runoff had stopped, the sample bottles were collected and the approximate volume of water in each bottle was recorded.

All the bottles from a given source area were composited by pouring water from each bottle into a 5-gal or 1-gal stainless steel, Teflon-coated churn splitter modified from the type described in Ward and Harr (1990). The City of Madison Department of Public Health Laboratory analyzed a small subsample taken from the churn for suspended solids and phosphorus.

Street Dirt Collection and Analysis

In addition to stormwater-runoff samples, samples of street dirt were collected with a 9-gal wet-dry shop-vacuum using a 6-in.-wide wand. A section of the street was vacuumed from curb to curb, 10 times across each of 3 streets in the basin, similar to the technique described by Pitt (1979) and Bannerman (1983). Monroe Street, Glenway Street, and Seneca Place/Spring Trail/Huron Hill (the latter three are considered one residential street) were sampled during 1994 (Figure 2). Woodward Drive, Nova Way, and Luster Avenue were sampled during 1995. Woodward Drive did not have curbs, so the sample was collected by vacuuming between wooden 4-by 4-in. blocks placed at the edge of the asphalt on each side of the street. During the fall, leaves on the street would often plug the vacuum hose. To alleviate this problem, a 6-in. by 2-ft wooden frame was placed with the 6-in. side abutting the curb. Before vacuuming the inside of the frame, the leaves inside it were collected by hand and placed in the vacuum collection bag. Then the street was vacuumed in the normal manner.

The dirt samples were dried at 105°C, sieved into size fractions of >250 μm, 250-63 μm, 63- 25 μm, and <25 μm and weighed. The sieved samples were sent to the University of Alabama at Birmingham (UAB) for phosphorus analysis. In addition to total phosphorus, samples collected from the Monroe Basin were analyzed for percentage of vegetative material. Two independent methods were used to determine the percentage of vegetative material: thermal chromatography and microscopic examination. In thermal chromatography, dirt samples were placed in ovens at increasing temperatures and the mass that was lost to incineration was determined after each increase in temperature. The mass loss was compared to the standard temperatures where various substances like leaves, rubber, and paper burned off. The sample mass lost at the temperature range corresponding to the leaf standards was assumed to be vegetation. In microscopic examination, samples of the dirt were compared to microscopic pictures of vegetation. More details of these methods can be found in Ray (1997).

Sources of Phosphorus

Measured Concentrations in Runoff from Source Areas

A total of 25 runoff events were monitored at each basin. Runoff samples were collected from May to November of 1994 at Monroe and from June to November of 1995 at Harper and Lakeland. Driveway samples collected from the Monroe Basin were excluded because of problems with the sample bottle overfilling (discussed in the methods section). Summary statistics are listed in Table 2.

Table 2. Concentrations for Suspended Solids, Total Phosphorus, and Dissolved Phosphorus at the Monroe Basin and Harper Basin, 1994–95
[--, concentrations were not used because of problems with the samplers; -, source area not present in basin; mg/L, milligrams per liter]

Statistic	Source area							
	Lawns	Feeder Street	Collector street	Arterial street	Driveways	Parking lots	Pitched roofs	Flat roofs
				MONROE BASIN				
				Suspended solids (mg/L)				
Geometric mean	59	68	51	65	--	51	15	18
Coeff. of variation	.55	1.17	.97	.92	--	1.27	.95	1.21
Mean	85	99	67	83	--	82	85	35
Median	75	60	46	64	--	44	18	20
				Total phosphorus (mg/L)				
Geometric mean	0.79	0.40	0.22	0.18	--	0.10	0.07	0.13
Coeff. of variation	.62	1.24	1.23	1.15	--	1.04	.76	.96
Mean	1.03	.75	.36	.24	--	.14	.09	.2
Median	.99	.31	.16	.17	--	.09	.06	.12
				Dissolved phosphorus (mg/L)				
Geometric mean	0.37	0.16	0.05	0.03	--	0.02	0.02	0.02
Coeff. of variation	.62	1.72	1.47	1.20	--	1.24	1.22	1.24
Mean	.52	.40	.14	.05	--	.04	.03	.04
Median	.61	.14	.04	.03	--	.02	.02	.02
				HARPER BASIN				
				Suspended solids (mg/L)				
Geometric mean	122	69	-	-	34	-	17	-
Coeff. of variation	.37	.68	-	-	.93	-	.96	-
Mean	132	98	-	-	57	-	25	-
Median	154	88	-	-	31	-	17	-
				Total phosphorus (mg/L)				
Geometric mean	1.61	0.24	-	-	0.18	-	0.15	-
Coeff. of variation	1.12	.75	-	-	.80	-	.68	-
Mean	2.34	.31	-	-	.24	-	.19	-
Median	1.54	.22	-	-	.20	-	.15	-
				Dissolved phosphorus (mg/L)				
Geometric mean	0.77	0.08	-	-	0.07	-	0.08	-
Coeff. of variation	1.51	.98	-	-	1.0	-	.83	-
Mean	1.54	.12	-	-	.11	-	.11	-
Median	.81	.08	-	-	.07		.07	-

The concentration data from the Monroe and Harper Basins seem to exhibit log-normal distributions that are consistent with urban-runoff concentration data collected during the Nationwide Urban Runoff Project (U.S. Environmental Protection Agency, 1983). In such cases, the geometric mean is a better estimate of the central tendency than the arithmetic mean because the geometric mean gives less weight to extremes (Helsel, 1992). Several of the coefficients of variation in Table 2 have a value greater than 1, indicating substantial variability in concentrations within a source area.

The large variation seen in the source-area concentration data could cast doubt on the predictability of the data. For lawn runoff, the difference between geometric mean phosphorus concentrations from 1994 to 1995 was greater than a factor of 2; however, the lawn-runoff data collected from the Lakeland Basin are remarkably similar to data collected at Harper (Table 3), indicating that the variation in lawn-runoff phosphorus concentrations is not random. Primary sources of phosphorus, such as tree canopy, also could have a large effect on the source-area concentrations measured between basins. Figure 5 illustrates a trend between the concentration of phosphorus and the percentage of overhead tree canopy on streets for the Monroe and Harper Basins. Canopy in the Monroe Basin tends to be less than 35%, whereas the percentage of canopy in the Harper Basin ranges from 5 to 78%. Variation also could be caused by meteorological factors like rain depth, intensity, or inter-event period or by seasonal variables.

Roof runoff had the lowest geometric mean concentrations of suspended solids, and lawn runoff had the highest total and dissolved phosphorus concentrations in both the Monroe and Harper Basins (Figures 6 and 7). In addition, patterns in geometric mean concentrations between source areas within each basin were similar; however, their magnitudes were very different. The geometric mean concentration of phosphorus for low-traffic streets in the Monroe Basin were about twice those at the Harper Basin. Conversely, geometric mean phosphorus concentrations for lawn and roof runoff in the Harper Basin were more than twice as high as those in the Monroe Basin. The beginning of the sampling periods differed by one month between basins (Monroe Basin in May and Harper Basin in June), and this difference may have caused some of the variability.

Concentration results for suspended solids and phosphorus from earlier source-area studies in Madison, WI, Marquette, MI, and Birmingham, AL (Bannerman and others, 1993; Steuer and others, 1997; Pitt and others, 1995), were compared to the concentration results from this study. Suspended-solids concentrations in street-runoff samples collected during the other studies were considerably higher than those in samples collected for this study. Sandier soils are present in Marquette that could partially account for this difference. Furthermore, some of the same lawns in the Monroe Basin were monitored for phosphorus concentrations in the previous Madison study (Bannerman and others, 1993), and both the dissolved and total phosphorus geometric means calculated for that study were more than three times higher than those in 1994. Because phosphorus concentrations varied highly from Monroe and Harper Basins, did not closely agree with each other, and did not agree well with previous studies, the geometric mean of the combined data collected at Monroe and Harper Basins was used for the modeling phase of this study.

Table 3. Rainfall Amounts and Intensities and Total-phosphorus Concentrations from Lawn-runoff Samples for Harper and Lakeland Basins, Madison, WI, 1995

	HARPER			LAKELAND		
Start of rain event (date)	**Rainfall (inches)**	**Intensity (in/hr)**	**Total-phosphorus concentration (mg/L)**	**Rainfall (inches)**	**Intensity (in/hr)**	**Total-phosphorus concentration (mg/L)**
06/26/95	0.26	0.12	10.72	0.31	0.17	9.05
07/05/95	.36	.62	1.32	.10	.16	2.06
07/15/95	.50	.12	3.61	.80	.10	2.99
07/22/95	.79	.10	1.08	.80	.09	1.35
08/16/95	.61	.43	1.82	.55	.94	2.48
08/16/95	.38	.29	.60	.55	.49	.58
08/28/95	.80	.19	1.39	.67	.15	1.58
10/19/95	.32	.07	2.24	.33	.06	2.59

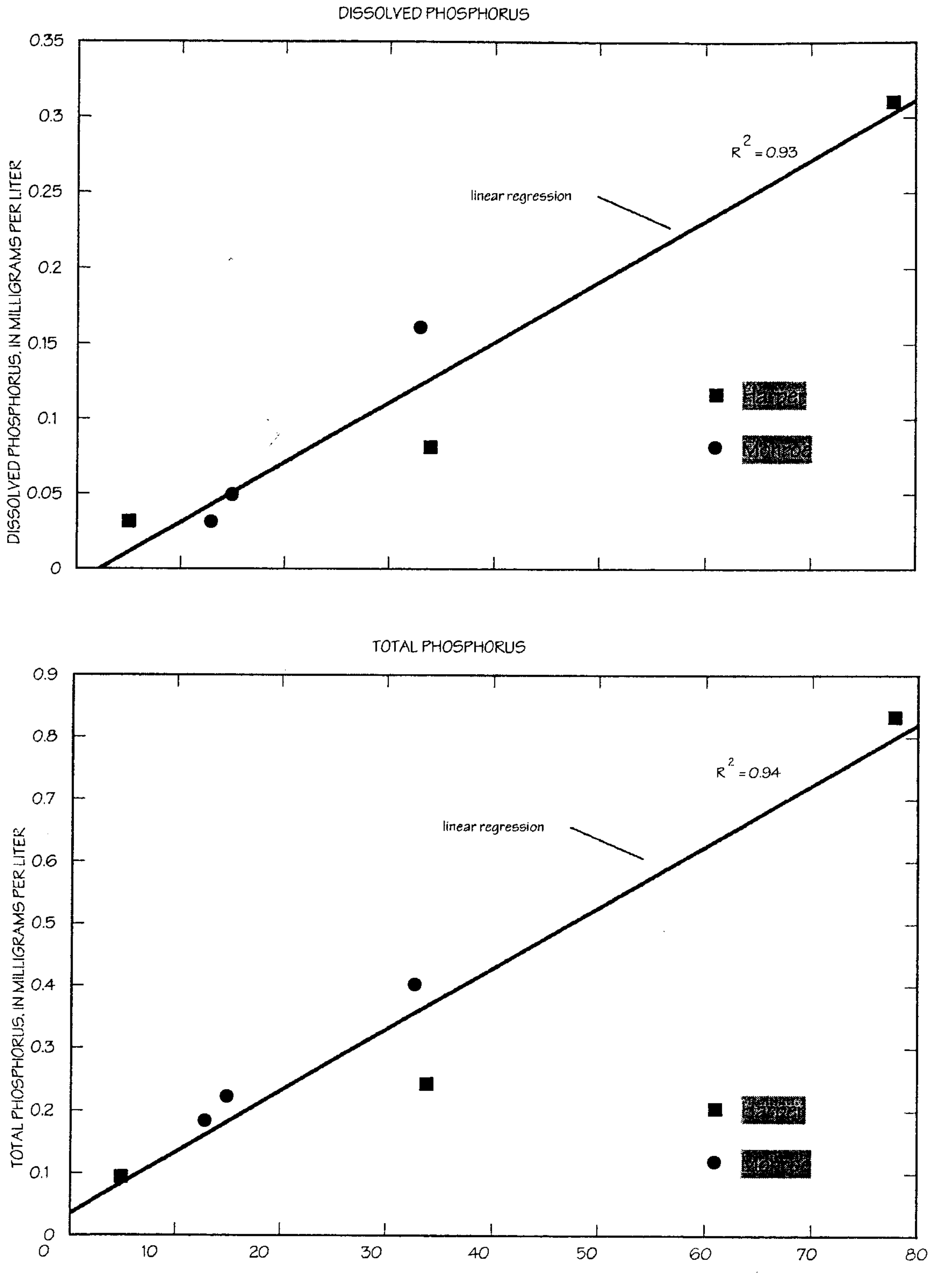

Figure 5. Trend between concentration of phosphorous and percentage of overhead tree canopy on streets for Monroe and Harper Basin.

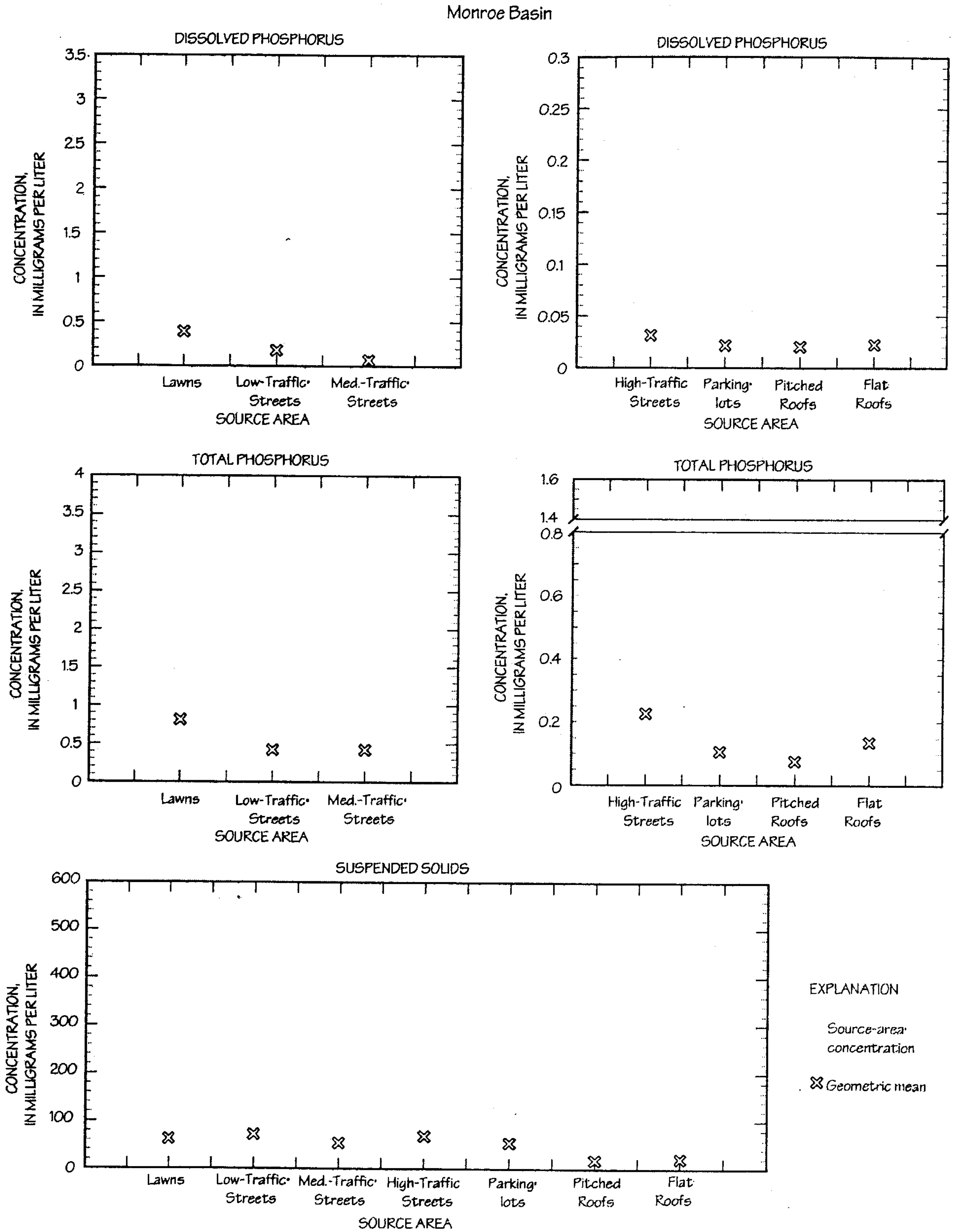

Figure 6. Dissolved phosphorous concentrations in Monroe Basin.

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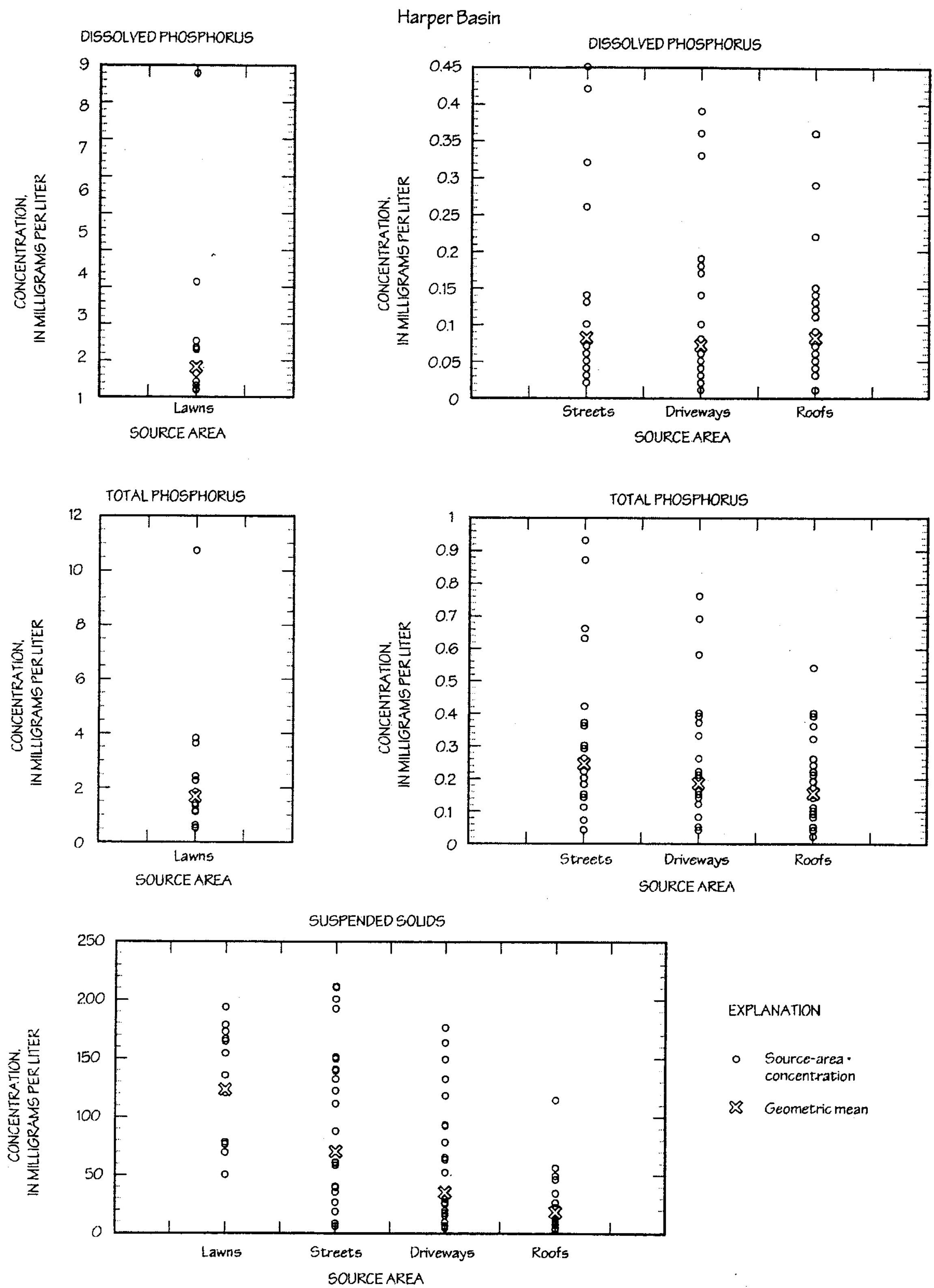

Figure 7. Dissolved phosphorous concentrations in Harper Basin.

Calibration of the Source Loading and Management Model (SLAMM)

A concentration data base to simulate stormwater quality and theoretical runoff coefficients to simulate runoff volumes is used in the Source Loading and Management Model (SLAMM). Because large amounts of concentration data and runoff information were collected during this study, it was an opportunity to calibrate the model's concentration data base and improve the runoff coefficients with data collected from the Monroe and Harper Basins.

Calibrating SLAMM with concentration and water-volume data was a three-step process. First, the runoff volume generated by each source area was calibrated (a critical step because an accurate water volume is essential for estimating all pollutant loads). Second, sediment was calibrated because sediment concentrations and loads are used in SLAMM to estimate phosphorus loads. The final step was to calibrate the model for phosphorus concentrations.

A systematic procedure was used to calibrate suspended-solids and phosphorus concentrations in SLAMM. First, a mass-balance approach compared total measured loads from source areas summed over 25 events to the loads measured at the outfall. Monitored loads from source areas were calculated using SLAMM-generated water volumes. Individual source areas were not equipped to measure runoff volumes during an event. Therefore, the accuracy of source-area volumes, as assigned by SLAMM, was subject to agreement with the actual volumes measured at the outfall. If the sum of all source-area volumes closely matched what was measured at the outfall, the individual source-area volumes assigned by SLAMM were assumed to be correct. Second, source-area concentrations were adjusted to optimize the mass balance. SLAMM was adjusted after agreement between measured source-area and outfall loads was achieved.

Water-Volume Calibration

Water-runoff volume from each source area for each rain event is calculated with the model. These calculations are based on the amount of rainfall and a runoff coefficient developed for various rainfall depths for each source area. Source-area characteristics such as imperviousness, connectedness (amount of impervious area directly connected to the storm sewer), and infiltration rates on pervious areas were used to develop runoff coefficients (Pitt, 1987). The volumetric discharges for each source area are then summed for each event. The total runoff volume can be decreased in the model by using control measures, such as infiltration devices.

SLAMM was used to estimate runoff volume for the 25 storm events from all source areas in each basin. The sum of the volumes from all of these source areas was compared to the volume measured at the basin storm-sewer outfalls for these 25 events. Initially, the model overpredicted the water volumes measured at Monroe by a total of 55% (over the entire study period), whereas it underpredicted those measured at Harper by only 2%. To obtain a balance of overprediction and underprediction between the basins, the runoff coefficients were adjusted. Historically, more measurements have been made for runoff from impervious surfaces (Pitt, 1987) and more than 50% of the area within each basin is pervious, mostly because of residential lawns. Therefore, it was decided that the runoff coefficients for pervious areas were more uncertain and model calibration could benefit from minor adjustments.

Two sets of runoff coefficients are available for pervious areas; one is designed to represent clayey soils, and the other represents sandy soils. The predicted water volumes mentioned above were determined using the runoff coefficients for clayey soils (based on soil maps). Changing the pervious classification from clayey to sandy resulted in SLAMM underprediction of water volumes; approximately a 4% and a 42% underprediction at the Monroe and Harper Basin storm-sewer outfalls, respectively. A much better agreement was achieved at Monroe by assuming that the original soil classification was incorrect. Sandy and clayey runoff coefficients, available to the model, probably represented two extremes, and more realistic runoff coefficients fell somewhere between these two coefficients.

Lawn-runoff data collected from Monroe and Harper Basins were used to create runoff coefficients that more accurately represent the pervious conditions found in Madison. First, the rainfall depth sufficient to initiate runoff in SLAMM was changed using data on the amount of stormwater in the lawn-sample bottles after each event. For rainfall amounts less than approximately 0.3 in., the bottles were less than 10% filled. From this observation, 0.3 in. was established as the minimum precipitation required to initiate runoff. However, the runoff coefficient table for clayey soils

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used in SLAMM resulted in 10% runoff for a rainfall depth of 0.2 in. Hence, SLAMM was changed to initiate runoff at 0.3 in. rather than 0.2 in. of precipitation.

In addition to the change described above, a trial-and-error approach was used to change the coefficients until optimum agreement was reached between water volumes predicted in SLAMM and those measured at the Monroe and Harper storm-sewer outfalls. The resulting coefficients were between those for sandy and clayey soils and were approximately two-thirds the value for clayey soils. Figure 8 shows how the new "Madison" runoff coefficients compare to the sandy and clayey coefficients.

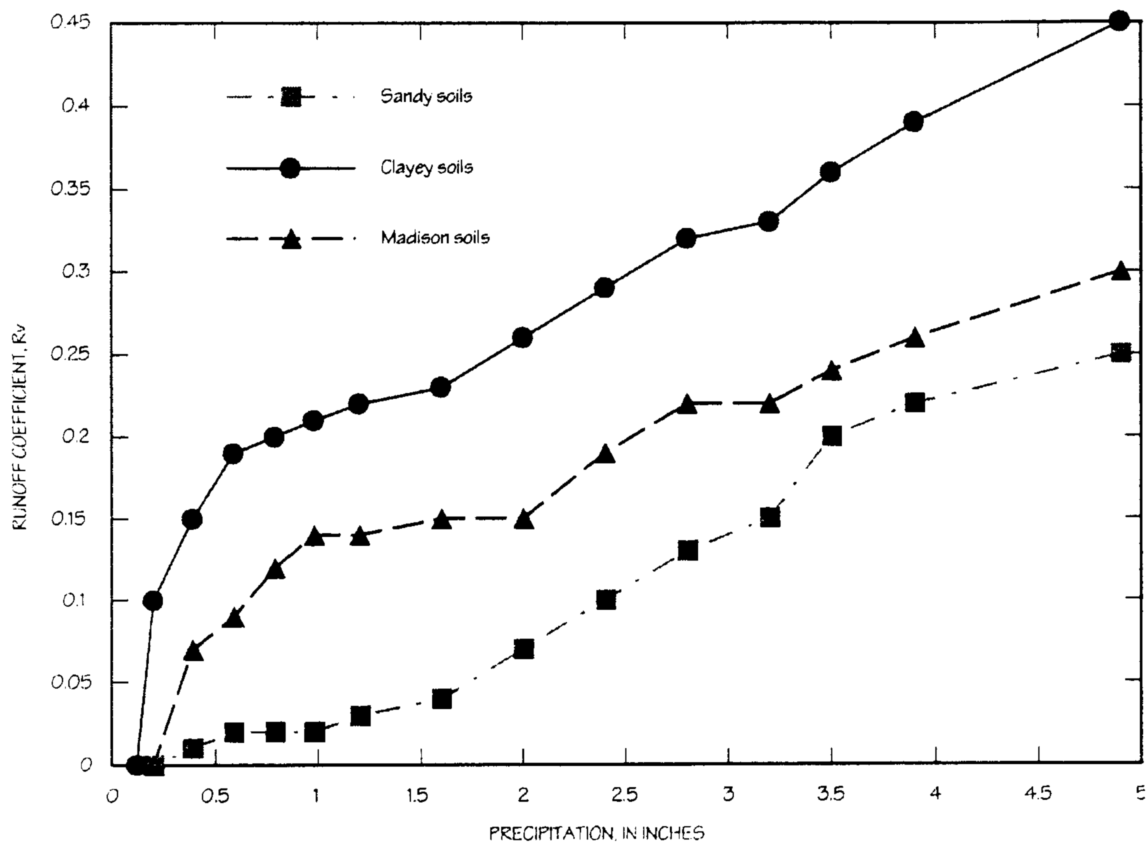

Figure 8. Madison runoff coefficients compared to sandy and clayey coefficients.

Based on the revised Madison runoff coefficients, SLAMM overpredicted storm-sewer outfall volumes at Monroe by 23% and underpredicted Harper storm-sewer outfall volumes by 24% (Table 4). The Madison coefficients also produced consistent lawn-runoff contributions in both basins, approximately 20% of the total volume. It is expected that the percentage of lawn contribution would be similar for both basins because they have nearly the same percentage of lawn area.

Table 4. Percentage Difference in Cumulative Modeled Water Volumes Compared with Measured Outfall Water Volumes Using Three Soil Types, Madison, Wi.

Basin	Sandy soils (%)	Clayey soils (%)	Madison soils (%)
Monroe	-4	55	23
Harper	-42	-2	-24

Sediment Calibration

Once the runoff volumes were calibrated, SLAMM was used to estimate sediment loads for the 25 events in each basin. With the exception of streets, a data base of sediment concentrations for each source area is used in SLAMM and these concentrations are applied to the water volumes to derive a load. Sediment concentrations from streets are computed by a wash-off function that is related to a street-dirt accumulation rate.

A mass-balance approach was used to test the source-area concentrations within each basin with those measured at the storm-sewer outfall. Source-area loads were computed by multiplying the water volumes produced from SLAMM by the concentrations measured at the source areas for each event and then summing these event loads. Sidewalks and woodlots were two of the larger unmonitored source areas in each basin, accounting for 12% and 1% of the water volume produced at Monroe and 7% and 2% at Harper, respectively. To add sidewalks to the load estimates, concentrations measured at driveways were applied to estimates at sidewalks to create a sidewalk load. Woodlot concentrations were estimated by use of data collected in an undeveloped urban site near Superior, WI (Steuer and others, 1997). The source-area loads were 39% lower and 60% lower than the measured load at the storm- sewer outfall in the Monroe and Harper Basins, respectively. This difference between source-area and storm-sewer outfall loads indicates that one or more source areas within each basin were not effectively monitored.

Streets were the most likely source area to be ineffectively monitored. Street samplers were placed approximately 5 ft away from the curb to prevent gutter flow into the sampler because gutter flow usually contains a mixture of water from several source areas. Other street studies (Pitt, 1979) have estimated that 90% of the dirt on residential streets in good condition with little to no parking accumulates within 3 ft of the curb. A larger amount of dirt can sometimes collect along the curb itself rather than in the driving lane. Some of this dirt could have been deposited on the driving lane, and turbulence from passing vehicles and wind may have moved it to the curb. Most street dirt falls within 1 to 2 ft of the curb if the driving lane is next to the curb (Pitt, 1979). This information suggests that the street samplers in the Monroe and Harper Basins were too far from the curb (5 ft) to representatively collect the particulate dirt from the streets.

For the reasons previously described, a trial-and-error approach was used to select a street- sediment concentration that more accurately reflected the street sediment entering the storm sewer. The final suspended-solids concentrations for streets were increased by a factor of 5. Applying this factor to the simulated street suspended-solids concentration during each storm event allowed the sum of source-area loads to be within 7% and 9% of the storm- sewer outfall loads at Monroe and Harper, respectively (Table 5). The geometric means for the revised street suspended-solids concentrations were 340 and 325 mg/L for low- and high-traffic streets, respectively. These values were within 5% of those measured at both Marquette, MI (Steuer and others, 1997), and Madison, WI (Bannerman and others, 1993).

The geometric means of the observed suspended-solids concentrations, excluding streets, for the 25 storm events at Monroe and Harper Basins were placed into the SLAMM data base (Table 6). The suspended-solids concentrations for streets were not as easily altered because they are determined by dirt accumulation and wash-off functions in the model. Entering the geometric means enabled the model to more accurately predict the loads measured at the storm-sewer outfall. After summing the 25 events, sediment loads predicted by SLAMM were 17% lower at Monroe and 32% lower at Harper compared to the measured storm-sewer outfall loads.

To improve the match between measured and simulated storm-sewer outfall loads, the delivery coefficients were removed from SLAMM calculations, essentially assuming 100% delivery from source area to storm-sewer outfall. The delivery coefficients had been added in a previous calibration study to force a match to the storm-sewer outfall numbers. This adjustment resulted in a 4% and 17% undersimulation between storm-sewer outfall loads of suspended solids calculated by SLAMM and those measured at the storm-sewer outfall for Monroe and Harper, respectively (Table 5).

Phosphorus Calibration

One objective in calibrating phosphorus concentrations in SLAMM was to ensure that the Monroe and Harper Basins were accurately represented by the monitored source areas. The sum of source-area loads for total phosphorus for the 25

Table 5. Percentage Difference in Cumulative Source-area Sediment Loads, Before and After Sediment Adjustment, and Modeled and Measured Sediment Loads at the Basin Outfall, Madison, Wi. [Loads computed as suspended solids; %, percent]

Basin	Cumulative source area compared with storm-sewer outfall		
	Suspended solids before adjustment (%)	Suspended solids after adjustment (%)	Modeled compared with measured (%)
Monroe	-39	-7	-4
Harper	-60	-9	-17

Table 6. Suspended-solids Concentrations Used to Calibrate the Source Loading and Management Model for Basins in Madison, Wi. [mg/L, milligrams per liter; --, a series of algorithms and coefficients are used in the model to calculate a suspended-solids concentration for street runoff]

	Suspended solids (mg/L)	
Source area	Residential	Commercial
Driveways	34	34
Lawns	84	84
Parking lots	51	51
Streets	--	--
Woodlots	15	15
Roofs	16	18
Sidewalks	34	34

storm events was nearly identical to the storm-sewer outfall load (Table 7). The difference was larger for dissolved phosphorus, but no information was available to determine what adjustments should have been made to reduce the difference. For this reason, the unadjusted concentrations were entered into the SLAMM data base.

Table 7. Percentage Difference Between Cumulative Source Area Versus Outfall Loads and Modeled Results Versus Outfall Loads, after Calibration of the Source Loading and Management Model for Basins in Madison, Wi. [%, percent]

Basin	Cumulative source area versus storm-sewer outfall		Model results after calibration versus storm-sewer outfall	
	Phosphorus load			
	Dissolved (%)	Total (%)	Dissolved (%)	Total (%)
Monroe	39	-1	-9	-24
Harper	35	4	-10	-28

The model simulates total phosphorus loads by adding the dissolved phosphorus and particulate phosphorus loads. For all source areas except streets, particulate-phosphorus concentrations were calculated using total- and dissolved-phosphorus and sediment concentrations measured at the Monroe and Harper Basins. To be consistent with calibration procedures, particulate-phosphorus concentration for street runoff was calculated using the adjusted value for sediment (an increase by a factor of 5). Changing the phosphorus concentrations resulted in SLAMM undersimulation of dissolved and total phosphorus by 9% and 24% at the Monroe storm-sewer outfall and 10% and 28% at the Harper storm-sewer outfall, respectively.

The dissolved- and particulate-phosphorus concentrations entered into the SLAMM data base are listed in Tables 8 and 9. Significant changes in dissolved-phos-phorus concentrations (Table 8) were observed for lawns (from 0.22 to 0.53 mg/L), streets (from 0.39 to 0.12 mg/L), woodlots (from 0.25 to 0.01 mg/L), and sidewalks (from 0.60 to 0.07 mg/L). With the exception of streets, where the particulate-phosphorus concentrations in runoff decreased, particulate-phosphorus concentrations increased significantly (Table 9).

Table 8. Dissolved-phosphorus Concentrations Used to Calibrate the Source Loading and Management Model for Basins in Madison, Wi. [mg/L, milligrams per liter]

	Dissolved phosphorus (mg/L)	
Source-area	**Residential**	**Commercial**
Driveways	0.07	0.07
Lawns	.53	.53
Parking lots	.02	.02
Streets	.12	.03
Woodlots	.01	.01
Roofs	.04	.02
Sidewalks	.07	.07

Table 9. Particulate-phosphorus Concentrations Used to Calibrate the Source Loading and Management Model for Basins in Madison, Wi. [mg/kg, milligrams per kilogram]

	Particulate phosphorus (mg/kg)	
Source area	**Residential**	**Commercial**
Driveways	2,649	2,649
Lawns	4,943	4,943
Parking lots	1,467	1,467
Streets	569	409
Woodlots	5,000	5,000
Roofs	3,777	7,946
Sidewalks	2,649	2,649

Distribution of Source-Area Loads

The distribution of suspended-solids and total- and dissolved-phosphorus loads for source areas in the Monroe and Harper Basins using measured source-area concentrations multiplied by SLAMM-generated water volumes is shown in Table 10. The distribution of water volumes is nearly identical at Monroe and Harper Basins. The percentage of the total basin represented by each source area is similar for both basins (Table 1); thus, one should expect to see similar relative volumes of water calculated from both basins. Streets contributed most of the suspended-solids loads at both Monroe and Harper Basins, generating 81% and 73%, respectively. Lawns contributed more than 10% of the solids loads at both basins. The phosphorus loading, however, was quite different. Lawns in the Harper Basin generate more than two-thirds of the phosphorus loads, whereas phosphorus in the Monroe Basin is more evenly distributed between lawns and streets. These differences in load distribution are the result of the measured phosphorus concentrations, especially for lawns, which are much higher for the Harper Basin (Table 2).

Table 10. Distribution of Loads Based on Measured Values at Monroe and Harper Basins, Madison, Wi, and Incorporating the Suspended-solids Adjustment [N/A, source area not present; %, percent abundance; --, value less than 0.5 percent]

Source area	HARPER Water volume[1] (%)				MONROE Water volume (%)			
	Water volume[1] (%)	Suspended solids (%)	Total phosphorus (%)	Dissolved phosphorus (%)	Water volume (%)	Suspended solids (%)	Total phosphorus (%)	Dissolved phosphorus (%)
Lawns	21	15	67	71	20	10	44	45
Streets	37	73[2]	14	11	38	[2]81	37	39
Driveways	18	7	9	9	12	2	5	4
Sidewalks	7	3	4	3	14	3	5	4
Parking lots	3	1	1	--	6	2	1	1
Roofs	11	1	3	4	7	--	1	--
Parks	1	--	2	2	3	2	7	7
Woodlots	3	--	--	--	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	1	--	--	--
Total	311,122	3,598	9	5	2,417,341	26,045	70	33

[1]Water volume totals expressed in cubic feet; all other totals expressed in pounds.
[2]Street-runoff concentrations multiplied by 5.

The suspended-solids load distribution at the Monroe Basin in 1994 is similar to the distribution observed in a 1991 study (Bannerman and others, 1993). Streets contributed 80% of the total basin suspended-solids load in 1991 and 81% in 1994. Lawns also were comparable, contributing 7% and 10% of the total basin suspended-solids load in 1991 and 1994, respectively. Total and dissolved phosphorus, however, were very different. During the 1991 study, the proportion of the total-phosphorus load from streets (58%) outweighed that for lawns (14%). The same was true in 1991 for dissolved phosphorus, where streets produced 46% and lawns 22% of the basin load. However, most total- and dissolved-phosphorus loading in 1994 was attributed to lawns rather than streets. Streets and lawns, in 1994, generated 37% and 44% of the total-phosphorus load and 39% and 45% of the dissolved- phosphorus load in the Monroe Basin. The difference in distributions between the two studies is possibly due to differences in sampling methodology. The street-sampler design was modified for the 1994 study to eliminate a first-flush effect, where the sample bottle would quickly fill with stormwater and act as a sediment trap for the remaining duration of the storm event. Also, during the 1994 study, 25 events were monitored, whereas only 10 events were monitored in 1991. This larger sample size in 1994 improves confidence in the loading-distribution estimates.

Distribution of suspended-solids, total-phosphorus, and dissolved-phosphorus loads estimated by SLAMM are given in Table 11. The distribution of loads is consistent with the distribution of measured loads shown in Table 10. For each constituent, slightly less total load was simulated with SLAMM than calculated using the measured concentrations (other than suspended solids from streets), yet the distributions of each constituent were similar. Streets and lawns contribute nearly all of the suspended-solids load for the entire basin. Streets alone contribute more than 75% of the suspended solids at both Monroe and Harper Basins. Additionally, the significance of lawns as generators of phosphorus is again noted in SLAMM simulations. Lawns in the Harper Basin contribute 52% and 61% of total and dissolved phosphorus loads, and lawns in the Monroe Basin contribute 49% and 57%. Streets contribute the second largest phosphorus loads (about 25%), whereas driveways and sidewalks combined contribute approximately 10%.

The distribution of suspended solids and total and dissolved phosphorus for source areas in the Monroe and Harper Basins using measured source-area concentrations multiplied by SLAMM-generated water volumes is shown in Table 12. Only loads for the source areas measured are shown in Table 12; concentrations of suspended solids in street runoff have not been adjusted. These source areas accounted for 82% and 90% of the total water volume from the Monroe and Harper Basins, respectively.

Table 11. Distribution of Loads from Model Simulation Results at Monroe and Harper Basins, Madison, Wi. [N/A, source area not present; %, percent abundance; --, value less than 0.5 percent]

Source area	HARPER Water volume (%)	HARPER Suspended solids (%)	HARPER Total phosphorus (%)	HARPER Dissolved phosphorus (%)	MONROE Water volume (%)	MONROE Suspended solids (%)	MONROE Total phosphorus (%)	MONROE Dissolved phosphorus (%)
Lawns	21	11	52	61	20	12	49	57
Streets	37	81	32	24	38	77	26	22
Driveways	18	4	8	7	12	3	5	4
Sidewalks	7	1	3	3	14	3	6	5
Parking lots	3	1	1	-	6	2	1	1
Roofs	11	1	3	2	7	1	2	--
Parks	1	--	2	2	3	2	8	9
Woodlots	3	--	1	--	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	1	1	2	2
Total	311,122	3,170	7	4	2,417,341	20,814	60	29

[1] Water volume totals expressed in cubic feet; all other totals expressed in pounds.

Table 12. Distribution of Loads from Monitored Source Areas Only, Based on Unadjusted Concentrations at the Monroe And Harper Basins, Madison, Wi. [%, percent abundance; percentage columns may not add up to 100% because of independent rounding]

Source area	HARPER Water volume (%)	HARPER Suspended solids (%)	HARPER Total phosphorus (%)	HARPER Dissolved phosphorus (%)	MONROE Water volume (%)	MONROE Suspended solids (%)	MONROE Total phosphorus (%)	MONROE Dissolved phosphorus (%)
Lawns	23	41	70	75	24	28	56	69
Streets	41	43	20	15	46	53	33	21
Driveways	20	10	7	6	14	9	7	8
Parking lots	4	3	1	0	7	7	2	1
Roofs	12	3	3	4	9	3	2	1

The suspended-solids distributions shown in Table 12 differ from Tables 10 and 11, in that the significance of lawns as a source increases and the significance of streets as a source decreases. Streets are still the largest source of suspended solids in both basins. The phosphorus distributions also change, but not as much as the suspended solids because the measured phosphorus concentrations were used in all three tables (Tables 10, 11, and 12). The significance of lawns as a source increases slightly, and streets are a slightly larger source in some cases, and in others, are slightly smaller sources. Results shown in Table 12 indicate that the adjustments made to suspended-solids concentrations in street runoff do not greatly affect the phosphorus distributions in the basins.

Sediment and Phosphorus Mass in Street-Dirt Samples

Approximately 75% of the total sediment mass in the street-dirt samples originated in the >250 μm size fraction, whereas the smaller fractions (<63 μm) made up less than 5%. Material composed of leaves, twigs, and other organic debris also were measured, contributing, on average, less than 10% of the total sediment mass of the sample (Figure 9).

Like sediment mass, the largest amount of total phosphorus was found in the >250 μm size fraction (nearly 50%) (Figure 9). Combining this size fraction with the leaf fraction, about 80% of the total phosphorus is accounted for. The contribution of total phosphorus mass decreased as the size fraction decreased. Other studies have shown that large phosphorus concentrations correspond with small particle sizes because of the high surface area to mass ratio for small particles (Sartor and Boyd, 1972).

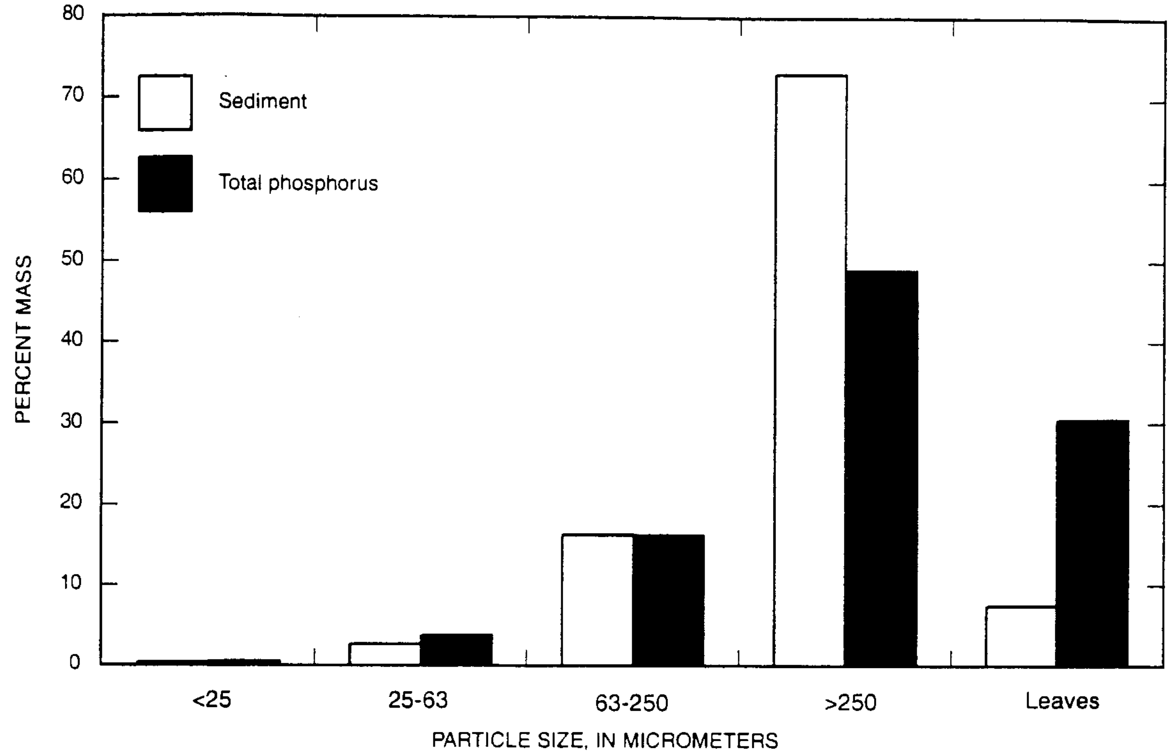

Figure 9. Relations between sediment and total-phosphorus mass from street-dirt samples for five particle-size fractions for basins in Madison, WI.

However, the bulk of the phosphorus phosphorus load results from the greater particle-size fractions (Ray, 1997). Approximately 25% of the total phosphorus mass in each size fraction can be attributed to leaves (Ray, 1997).

A recent study of particle-size distribution in stormwater at the Monroe storm-sewer outfall demonstrated that most of the solids are in the particle sizes <63 ?m (Greb and Bannerman, 1997). This distribution is the opposite of the particle-size distribution observed for the street dirt collected in this study. These results indicate either a loss of the larger particles somewhere between the street and the outfall or a problem in collecting larger particles in the runoff samples. Most of the larger particles (>63 ?m) might settle out before reaching the storm-sewer outfall. Street sweeping, resuspension onto street terraces, and catch basins can remove these particles from the streets before they reach the storm sewer. Also, the transport of large particles in a storm sewer is not as efficient as the transport of smaller, more mobile particles. Large sediment particles may become trapped or part of the bedload before reaching the sampler. Bedload is not sampled efficiently by the automatic samplers described earlier in this report.

Summary and Conclusions

Concentrations of suspended solids, total phosphorus, and dissolved phosphorus were collected from various source areas at two urban residential basins in Madison, WI. To represent a range of source-area concentrations for urban residential basins in Madison, the geometric means of the combined concentration data from the Monroe and Harper Basins were incorporated into the urban-runoff model, SLAMM.

Source-area suspended solids and phosphorus loads from the Monroe and Harper Basins were determined based on measured concentrations that were multiplied by water volume estimated by use of SLAMM. Collected data were used to calibrate and increase confidence in water volumes, suspended solids, and phosphorus source-area loads estimated by SLAMM. The calibrated model calculated water volumes to within 23% and 24% of those measured at the outfalls of the Monroe and Harper Basins. These calibrated water volumes were then applied to the calibrated suspended-solids and phosphorus concentrations entered into the SLAMM data bases. Suspended-solids loads were estimated by the calibrated SLAMM to be within 4% and 17%, total-phosphorus loads within 24% and 28%, and dissolved-phosphorus loads within 9% and 10% of those measured at the storm-sewer outfall to the Monroe and Harper Basins, respectively.

Streets and lawns are the largest contributors of suspended-solids, total-phosphorus, and dissolved-phosphorus loads in a residential urban basin. Lawns are the largest contributors of total and dissolved phosphorus; however, streets contributed nearly 40% of the basin load, as seen in the Monroe Basin. Streets were found to be the largest source of suspended solids.

There was a large difference between geometric mean concentrations of phosphorus in lawn runoff from 1994 to 1995. Phosphorus data collected from lawns in the Harper and Lakeland Basins during 1995 are remarkably similar, which suggests that the phosphorus concentration in lawn runoff is affected by some variable or variables that are not yet understood.

Street-dirt samples indicate that approximately 75% of the sediment mass resides in the >250 μm particle-size fraction. Less than 5% of the mass can be found in the particle sizes less than 63 μm. The >250 μm particle-size fraction also contributed nearly 50% of the total- phosphorus mass, and the leaf fraction contributed an additional 30%. In each particle-size fraction, approximately 25% of the total-phosphorus mass is derived from leaves or other vegetation.

A possible limitation of this study may be that in order for the sum of the source-area loads to match the basin-outfall loads, it was assumed that the concentrations of suspended solids in street runoff were about 5-times higher than the concentrations measured. However, the analysis of load distributions based only on unadjusted monitored concentration data shows little change in the distributions. In addition, samples from more rain events were collected in this study than previous source-area studies. Also, improved data-collection equipment were used during this study. Both of these factors lead to greater confidence in the study results.

Most of the measured suspended-solids concentrations were lower than those measured from previous studies. However, when comparing concentration results in this study to results from earlier studies, it is important to note that with the exception of the Marquette study, previous studies used earlier generation source-area sampling equipment. In Marquette, MI, the soils are considerably more sandy than those in Madison, which may explain why the suspended-solids concentrations determined for the Marquette study are higher than those from Madison even though both studies used the same sample-collection equipment.

The recalibration of the SLAMM model results in an improved model that should more accurately simulate phosphorus and sediment runoff loads in Wisconsin than the earlier version of the model. The newly created lawn-runoff coefficients for Madison represent a compromise between the two previous soil-type options available for model input, which probably represented runoff extremes. The runoff coefficients calculated for Madison should probably be applied to most urban lawns in Wisconsin unless soils are known to be either sandy or clayey. The phosphorus- and sediment-concentration data bases created for this study are the largest to date using the most advanced source-area sample collection technology available.

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Using Biological Criteria to Assess and Classify Urban Streams and Develop Improved Landscape Indicators

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Abstract

This study consisted of a quantitative analysis of the relationship between the Index of Biotic Integrity (IBI), an indicator of urban land use, and a qualitative analysis of overlying stressors in six of the major metropolitan areas of Ohio. A database consisting of 267 sampling locations was extracted from the Ohio EPA statewide biological and habitat database. Most of these sites were sampled between 1990 and 1998 and contained watershed areas less than 50 $mi.^2$, with most draining less than 20 $mi.^2$. A negative relationship between IBI and urban land use was observed in four of the six areas, whereas little or no relationship was seen in two areas. For each area, the highest percentage of urban land use that corresponded to minimum attainment of the applicable warmwater habitat IBI biocriterion ranged from 1% (Cleveland/Akron) to 12% (Dayton) for the regression line, and 15% (Cleveland/Akron) to 58% (Columbus) as the highest %urban land use where the IBI biocriterion was attained at any given site. No significant linear relationship was found in either the Toledo or Youngstown areas, and only a weak relationship was visually apparent for the Toledo streams. The lack of association was due to the strong presence of overlying stressors (e.g., legacy pollutants, sewage discharges, combined sewer overflows) that resulted in very low IBI values at sites with lower levels of urbanization. The percentage of urban land use explained approximately 35% of the variation in IBI scores in the regression model when these impact types were excluded (compared to 11% when included). The maximum %urban land use that commonly corresponded to attainment of the warmwater habitat IBI biocriterion based on inspection of the scatter plot was approximately 26%. Only a very few sites exhibited attainment at urban land uses between 40-60% and none occurred above 60%. These former sites had either an intact, wooded riparian zone, a continuous influx of groundwater, and/or the relatively recent onset of urbanization. These results indicate that it might be possible to mitigate the negative effects of urbanization by preserving or enhancing near and instream habitats, particularly the quality of the riparian buffer zone. The results also suggest that there is a threshold of watershed urbanization (e.g., >60%) beyond which attainment of warmwater habitat is unlikely. This threshold is not the same in all watersheds and it can occupy a rather wide range. It is affected by co-factors such as pollutant loadings, watershed development history, chemical stressors, and watershed scale influences such as the quality of the riparian buffer and the mosaic of different types of land use. Thus, single-dimension urban land use indicators, such as watershed imperviousness, are not sufficiently precise or robust as a single indicator of use attainability. The further development and refinement of multiple indicators of watershed urbanization has merit from a management and decision-making standpoint. We suggest that co-factors, in addition to more refined urban land use indicators, be better developed. More precise definitions of different urban land uses are also needed to better understand and respond to the water quality management challenges posed in existing and developing urban areas.

Introduction

The health and well-being of the aquatic biota in surface waters is an important barometer of how effectively we are achieving the goals of the Clean Water Act (CWA); namely the maintenance and restoration of biological integrity, and the basic intent of water quality standards. States designate water bodies for beneficial uses (termed designated uses) that, along with chemical, physical, and biological criteria, assure the protection and restoration of aquatic life, recreational, and water supply functions and attributes. Biological criteria are the principal tool for determining impairment of designated aquatic life uses as defined by the Ohio WQS (Ohio Administrative Code 3745-1). As such, bioassessments play a central role in the Ohio Nonpoint Source Assessment (Ohio EPA 1990; 1991), the biennial Ohio Water Resource Inventory (305b Report; Ohio EPA 1998), and watershed-specific assessments, of which Ohio EPA completes between 6 and 12 each year. Biological criteria represent a measurable and tangible goal, against which the effectiveness of pollution control and other water quality management efforts can be judged. However, biological assessments must be accompanied by appropriate chemical/physical measures, land use characterization, and pollution source information necessary to establish linkages between stressors and the biological responses (Yoder and Rankin 1998). Biological criteria in the Ohio WQS also supports the determination of appropriate aquatic life use designations for individual water bodies, provides for a "reality check" on the application of surrogate indicators, assesses cumulative impacts, extends anti-degradation concerns to nonpoint sources and habitat influences, defines high quality waters, and serves as a meaningful indicator in the management of regulatory programs for environmental results. This provides a means to incorporate the broader concept of water resource integrity (Karr et al. 1986) in policy and planning while preserving the appropriate roles of the traditional chemical/physical and toxicological approaches developed over the past three decades.

We, and others at Ohio EPA, have previously described the status of Ohio's streams and rivers as affected by watershed urbanization (Yoder et al. 1999; Yoder and Rankin 1997; Yoder 1995). Small watersheds are especially impacted, as illustrated by Yoder and Rankin (1997), where no headwater streams in established urban settings throughout Ohio attained the minimum CWA benchmark use designation of warmwater habitat. This finding has led to the perception that the impairment of beneficial aquatic life uses in these small watersheds is intractable, at least within the constraints of current land use policies, restoration technologies, and funding levels. Together, these factors present potentially significant barriers to the objective of fully restoring degraded watersheds or upgrading urban streams that are presently designated for less than fishable and swimmable uses.

Headwater streams are critical to watershed functioning in that they serve as the principal interface between runoff from land use and receiving streams. The ability of a headwater stream to physically filter and biologically assimilate the primary and secondary effects of pollutants is a function of habitat quality and the structure of the biological system. A healthy headwater stream ecosystem is characterized by good habitat and a well balanced assemblage of aquatic organisms and plants, one which processes external inputs in a manner which promotes high quality downstream exports. These exports include good quality water and high value biomass, both of which positively impact the ability of downstream waters to deliver quality goods and services (e.g., water supply, recreation, waste assimilation, water retention, ecological values). A degraded headwater stream ecosystem is characterized by poor habitat and an assemblage of aquatic organisms and plants that processes external inputs in a manner which promotes low quality downstream exports. Thus in this latter scenario, the effects from urban runoff can accumulate in a downstream direction and adversely affect water quality and ecosystem goods and services in larger water bodies. In Ohio, more than 78% of stream miles drain less than 20 $mi.^2$ and are classified as headwater streams. While these may individually seem less significant than larger water bodies, they are collectively the most numerous and perhaps important stream type. In many ways, and in a collective sense, headwater streams are analogous to the capillaries of the human circulatory system where essential product transport and waste assimilation functions are accomplished. Certainly the finding that a high proportion of headwater streams fail to meet CWA goals in Ohio urban areas translates to the potential for undesirable impacts in downstream waters and obvious consequences for the overall health of the "patient".

There is concern that the attainment of CWA goal uses (e.g., warmwater habitat in Ohio) within small urban watersheds may be precluded by the legacy of urbanization. If this is true, how is this determined and what are the protection endpoints to guide water quality management? Federal water quality standards regulations (40CFR, Part 131) allow for the establishment of a use that is less than the CWA fishable and swimmable goals when it is precluded by the following:

1) the degraded conditions are naturally occurring;

2) restoring the degraded conditions would result in widespread adverse socioeconomic impacts;

3) the degraded conditions are irretrievable and human induced.

Such uses are established on a waterbody-specific basis and are supported by a use attainability analysis. In Ohio, such analyses are routinely conducted as a result of the five-year basin approach to monitoring, assessment, and water quality management. One purpose of this paper is to advance the development of the tools and indicators needed to make use attainability decisions in urban watersheds.

Ohio EPA routinely conducts biological and water quality surveys, or "biosurveys", on a systematic basis statewide. A biosurvey is an interdisciplinary monitoring effort coordinated on a waterbody-specific or watershed scale. Such efforts may be relatively simple, focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites; or much more complex, including entire drainage basins, multiple and overlapping stressors, and tens of sites. Each year, Ohio EPA conducts biosurveys in 10-15 different study areas with an aggregate total of 350-450 sampling sites. Biological, chemical, and physical monitoring and assessment techniques are employed in biosurveys in order to meet three major objectives: 1) determine the extent to which use designations assigned in the Ohio Water Quality Standards (WQS) are either attained or not attained; 2) determine if use designations assigned to a given water body are appropriate and attainable; and 3) determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices. The data gathered by a biosurvey is processed, evaluated, and synthesized in a biological and water quality report. The findings and conclusions of each biological and water quality study may factor into regulatory actions taken by Ohio EPA and are incorporated into Water Quality Permit Support Documents (WQPSDs), State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the Ohio Water Resource Inventory (305[b] Report).

In 1990, the Ohio EPA initiated an organized, sequential approach to monitoring and assessment, termed the Five-Year Basin Approach. One of the principal objectives of this new approach was to better coordinate the collection of ambient monitoring data so that information and reports would be available in time to support water quality management activities such as the reissuance of NPDES permits and periodic revision of the Ohio Water Quality Standards (WQS). Ohio EPA's approach to surface water monitoring and water quality management via the Five-Year Basin Approach essentially serves as an environmental feedback process taking "cues" from environmental indicators to effect needed changes or adjustments within water quality management. The environmental indicators used in this process are categorized as stressor, exposure, and response indicators (Yoder and Rankin 1998). *Stressor* indicators generally include activities that impact, but which may or may not degrade the environment. This includes point and nonpoint source loadings, land use changes, and other broad-scale influences that generally result from anthropogenic activities. *Exposure* indicators include chemical-specific, whole effluent toxicity, tissue residues, and biomarkers, each of which suggests or provides evidence of biological exposure to stressor agents. *Response* indicators include the direct measures of the status of use designations. For aquatic life uses, the community and population response parameters that are represented by the biological indices that comprise Ohio EPA's biological criteria are the principal response indicators.

Previously, our analyses examined the water quality and biological assessment database from watersheds in and near existing and developing urban and suburban areas of Ohio. Yoder and Rankin (1997) compiled their analyses based on sampling conducted at more than 100 stream sampling locations. Yoder et al. (1999) examined more detailed land use and stressor relationships with the Index of Biotic Integrity (IBI), based on fish assemblage data, and the Invertebrate Community Index (ICI), based on macroinvertebrate assemblage data, within two major Ohio urban areas (Akron/Cleveland and Columbus). This study consisted of a quantitative analysis of the relationship between the IBI, an indicator of urban land use, and a qualitative analysis of other stressors influencing this relationship using available data from all six of the major metropolitan areas within Ohio. The importance of understanding these relationships is heightened by contemporary water quality management issues such as combined sewers and stormwater permitting. One challenge we faced was in attempting to separate the influences of these multiple stressors on aquatic life attainment status. Could we sufficiently understand the baseline influence of urbanization apart from these other and better understood stressors?

The principal analysis conducted in this study examined the relationship between urban land cover and the IBI, both visually and by statistical analysis. Some goals were to determine the extent to which biological performance (as expressed by the IBI) was correlated with urban land use, thresholds at which this occurred, and the overlying effects of other stressors.

Methods

A database consisting of 267 sampling locations from the six major metropolitan areas of Ohio was extracted from the Ohio EPA statewide biological and habitat database. Most of these sites were sampled between 1990 and 1998 and contained watershed areas less than 50 mi.^{2}, with most draining less than 20 mi.^{2}. As such, the database represents a collection of discrete watershed units where land uses may have a significant effect on the composition and quality of the instream habitat and biological communities. Urban land use effects have been much more apparent in these smaller watersheds as evidenced by the higher proportion of impaired stream miles compared to larger streams and rivers in Ohio (Yoder 1995; Yoder and Rankin 1997).

Fish communities were sampled using generator-powered, pulsed D.C. electrofishing units and a standardized methodology (Ohio EPA 1987a,b, 1989a,b; Yoder and Smith 1999). Fish community attributes were collectively expressed by the Index of Biotic Integrity (IBI; Karr 1981; Karr et al. 1986), as modified for Ohio streams and rivers (Yoder and Rankin 1995; Ohio EPA 1987b, 1989b). Habitat was assessed at all fish sampling locations using the Qualitative Habitat Evaluation Index (QHEI; Rankin 1989, 1995). The QHEI is a qualitative, visual assessment of the functional aspects of stream macrohabitats (*e.g.*, amount and type of cover, substrate quality and condition, riparian quality and width, siltation, channel morphology, etc.). Ohio EPA also collected macroinvertebrate assemblage data at some of these sites, but it was not included in this study because of the partial coverage and the extensive use of the qualitative method was not always compatible with regression analysis. Some of the analyses in our earlier studies (Yoder et al. 1999) included macroinvertebrate data.

The urban land use indicator was derived from Landsat Thematic Mapper satellite imagery of land cover classification (September 1994) provided by the Ohio Department of Natural Resources. The percentage of land use in the urban classification was calculated for the subwatershed upstream from each fish sampling location to the boundary of the watershed. Because many of the sites included in the statewide data set are subjected to a variety of stressors, each site was qualitatively classified by predominant impact type. Impact types included least impacted sites, estate sites (i.e., subwatersheds with large lot sizes or green space provided by parks), sites reflecting gross instream habitat alterations (i.e., channel modifications or impoundment), sites impacted directly by discharges from combined sewer overflows (CSOs), sites impacted by wastewater treatment plant discharges, sites impacted by instream sewer line placement and construction (Cincinnati area only), sites with evidence of impacts by legacy pollutants, or sites affected by general urbanization only. This latter category included urban land uses not containing any of the other impact types and usually consisted of residential development.

Results

The relationship between the IBI and urban land use was initially characterized by regressing IBI scores against percent urban land use (log_{10} transformed) and QHEI scores using a database of 267 sites for all of the six major metropolitan areas of Ohio (Figure 1). Diagnostic plots (e.g., residuals, normal probability) indicated nonconstancy of error variance. To provide insights into whether the results varied substantially between each metropolitan area, scatter plots of the relationship between urban land use and IBI in each of the six metro areas were also made (Figure 2). A negative relationship between IBI and urban land use was observed in four of the six areas, whereas little or no relationship was seen in two areas. For each area, the highest percentage of urban land use that corresponded to minimum attainment of the WWH IBI biocriterion was determined by inspection of the scatter plot and the intersection of the regression line and the WWH IBI biocriterion were determined (Figure 2). This ranged from 1% (Cleveland/Akron) to 12% (Dayton) for the regression line, and 15% (Cleveland/Akron) to 58% (Columbus) as the highest %urban land use where WWH was attained in each area at a given sampling location. No significant linear relationship was found in either the Toledo or

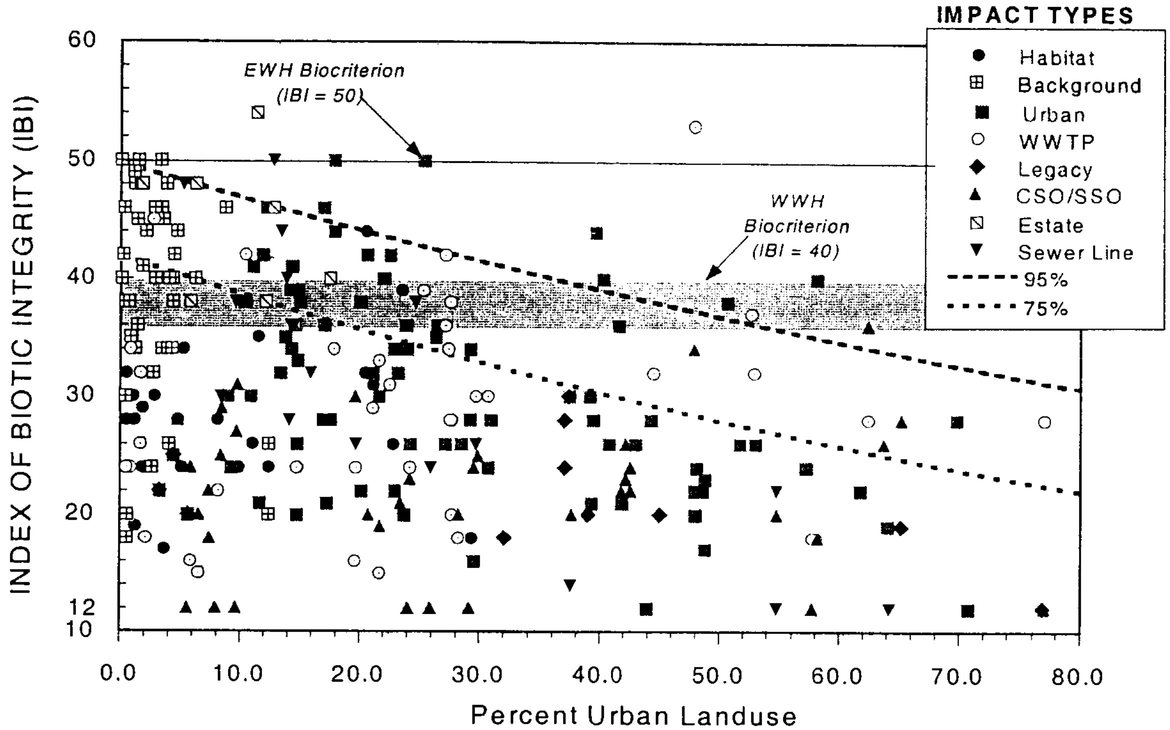


Figure 1. Scatter plot of Index of Biotic Integrity (IBI) scores against percentage of watershed upstream from the site in urban land use at 267 small (<50 mi.^{2}) sampling sites.

Youngstown areas, and only a weak relationship was visually apparent for the Toledo streams. All of the sites in the Youngstown area were impaired, and so severely that no land use relationship was evident (Figure 2). In the Toledo area, the highest urban land use corresponding to WWH attainment was 28%. However, the WWH IBI biocriterion in the Huron/Erie Lake Plain ecoregion is the lowest in the state and almost all of the small streams in the Toledo area have been channel modified to some degree. It was apparent that the lack of a stronger association between IBI and urban land use was due to overlying stressors (e.g., legacy pollutants, WWTPs, CSOs/SSOs), particularly those that resulted in very low IBI values at sites with low levels of urbanization. While some threshold relationships were evident in these results, the resulting variability in IBI scores led to only weak or non-existent linear relationships.

Some of the impact types had a strong effect on the IBI regardless of the effect of urban land use. The IBI results were examined by impact type across all six metro areas (Figure 3). The legacy, CSO/SSO, habitat, and WWTP impact types had the strongest negative effects on the IBI, respectively, and this was independent of the urban land use indicator. While these impact types are common to urban areas, they were removed from the remaining statistical analyses (elimination of these impact types reduced the sample size to 123 sites) to better develop the IBI/urban land use relationship. The entire Toledo and Youngstown datasets were also removed since they are comprised entirely of these impact types. This resulted in a better regression model fit, and diagnostics consistent with regression model assumptions (Neter et al. 1990). This also allowed us to discern the threshold of urbanization at which WWH attainment is lost with greater precision and in the absence of potentially confounding impacts, which was a major objective of our study. The relationship between different levels of urbanization and biotic integrity was further quantified with an analysis of variance model where quartiles of percent urban land use determined factor level (e.g., all sites within the 1st quartile of percent urban land use were coded as factor level 1). Similarly, an analysis of covariance model using QHEI as the covariate was employed to test for further refinements. Multiple comparisons of factor level mean differences were made using Tukey's method (Neter et al., 1990).

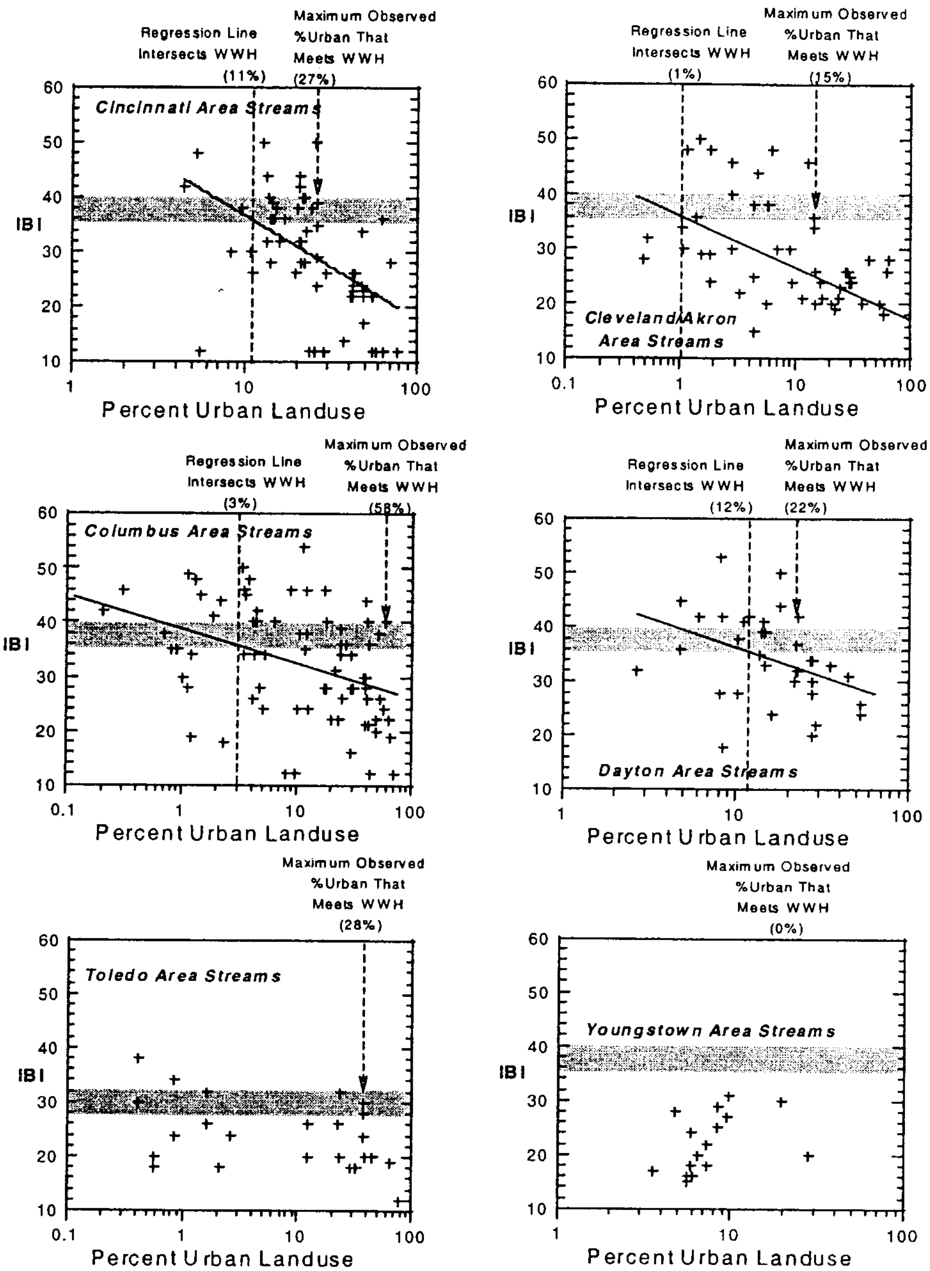
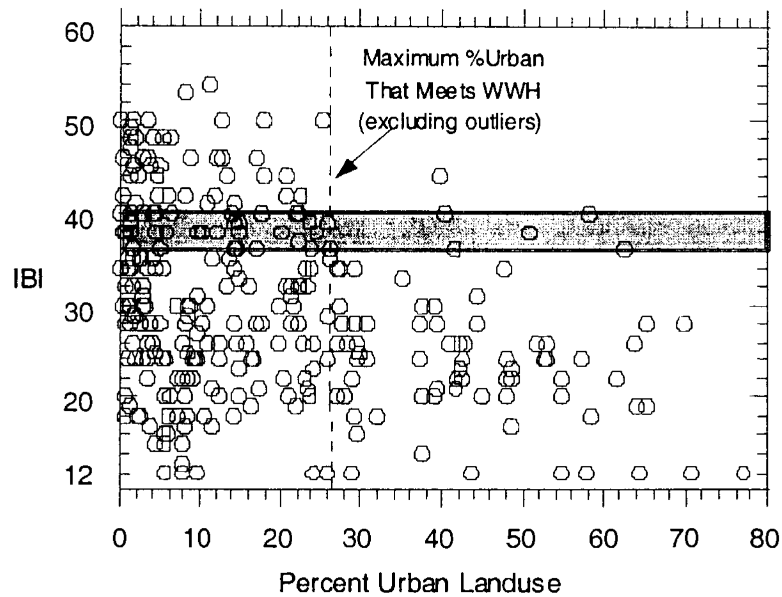


Figure 2. Scatter plots of Index of Biotic Integrity (IBI) scores against percentage of watershed upstream from the site in urban land use at small stream (<50 mi.^{2}) sampling sites in six of the major metropolitan areas of Ohio. Predominant impact types are indicated for each site (see Figure 1) along with the regression line. The warmwater habitat and exceptional warmwater habitat biological criteria for the IBI are also indicated.



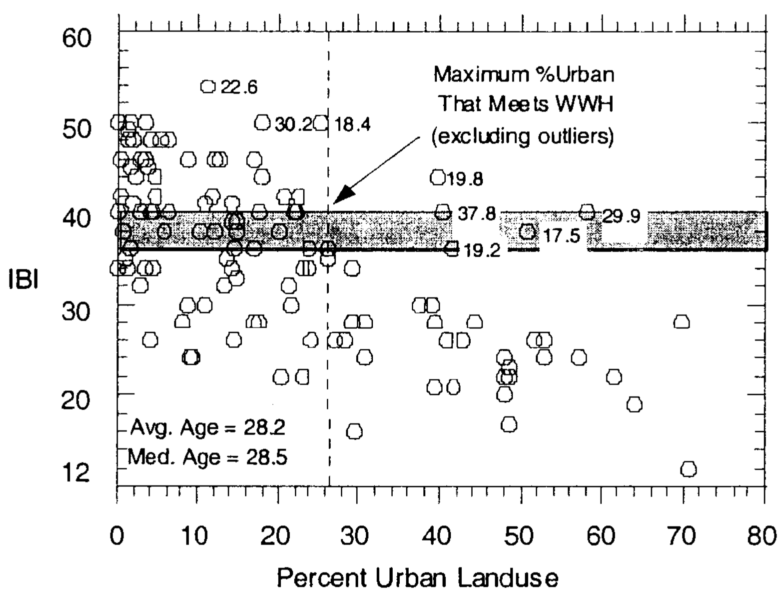


Figure 3. Box-and-whisker plots of Index of Biotic Integrity (IBI) scores by each of the major impact types used in Figures 1 and 2. The warmwater habitat and exceptional warmwater habitat biological criteria for the IBI are indicated.

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The percentage of urban land use explained approximately 35% of the variation in IBI scores in the regression model when the other impact types were excluded. Local habitat quality (as measured by the QHEI) explained an additional 7% of the variation (Table 1). The ANOVA model showed that there were significant differences in mean IBI scores between quartile level of percent urbanization, with sites exceeding 29 % urban land cover having lower IBI scores on average than sites with less urban land cover (Figure 4). Sites characterized by less than 4% urban land cover had higher IBI scores than sites with urban land use exceeding 15% The ANCOVA model provided a slightly better fit, but the additional variation explained was marginal (Table 2), and the results of pairwise comparisons were similar between models (Figure 4).

Table 1. Regression Results for the Model IbI = Log_{10}(Percent Urban Land Use+1)+qhei for All Sites and the Removal of Selected Impact Types.

Effect	Coefficient	SE	t	P(2 Tail)	Adj. R-Squared
All Sites					
CONSTANT	21.9333	2.9450	7.4477	0.0000	
Urban	-6 8323	1.1370	-6.0092	0.0000	0.1179
QHEI	0.2676	0.0418	6.4102	0.0001	0.2388
Impact Types Removed					
CONSTANT	32.4069	4.2184	7.6822	0.0000	
Urban	-11.1496	1.3102	-8.5096	0.0000	0.3500
QHEI	0.2390	0.0605	3.9493	0.0001	0.4199

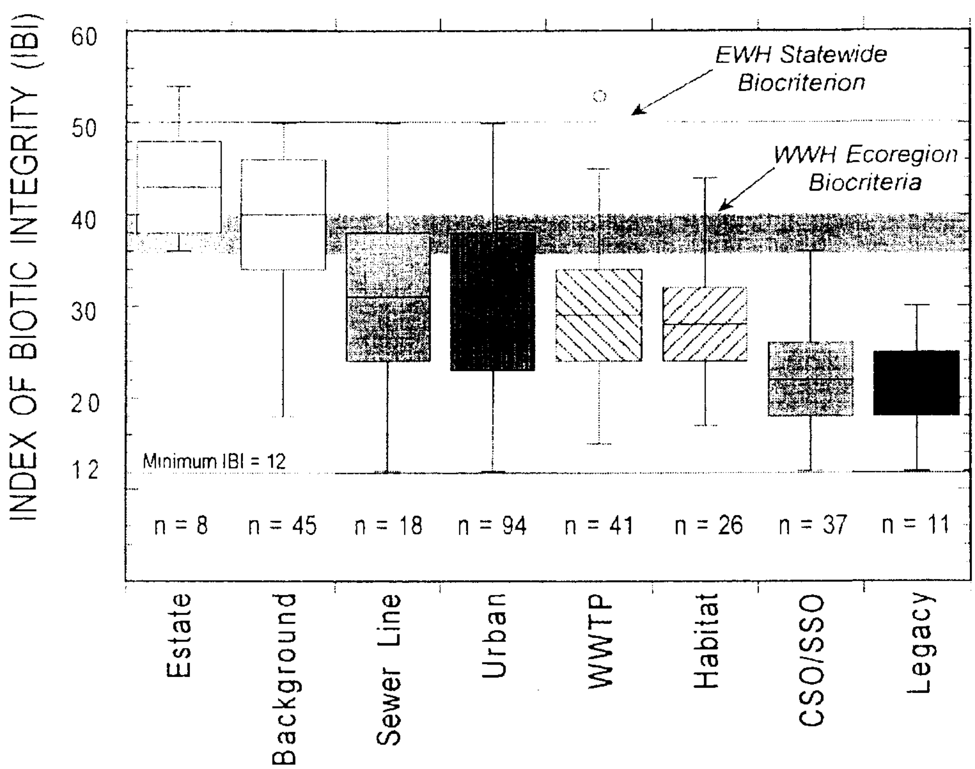

Figure 4. Distributions of Index of Biotic Integrity (IBI) from small streams (<50 mi.^{2}) in the six major metropolitan areas of Ohio plotted by quartiles of percent of urbanization upstream from sampling locations. Horizontal lines spanning adjacent box plots indicate similar means. Levels of percent of urbanization corresponding to the 25th, 50th and 75th percentile are indicated. The shaded areas indicate the applicable warmwater habitat biological criterion and the range of insignificant departure for the IBI.

Table 2. Analysis of Variance Results for the Anova Model, and the Ancova Model Using Qhei as a Covariate.

ANOVA Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	R-Squared
Urban	4248.53	3	1416.18	27.50	0.0000	0.4094
Error	6129.10	119	51.51			
ANCOVA Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Urban	4020.66	3	1340.22	28.81	0.0000	
QHEI	640.71	1	640.71	13.78	0.0003	0.4711
Error	5488.39	118	46.51			

In an attempt to better visualize where attainment of warmwater habitat occurs along the urban land use gradient, the IBI results were plotted against percent of urban land use for all sites used in this study and with the other impact types excluded (Figure 5). The elimination of the other impact types provided for a more precise statistical relationship between urban land use and the IBI (i.e., lower error of regression estimates). For example, the R^2 was higher with the removal of the other impact types and the slope of the regression was steeper, both of which suggest a more meaningful relationship between the IBI and urban land use (Table 1). However, the percent of urban land use that corresponded to attainment of the warmwater habitat IBI biocriterion based on inspection of the scatter plot was the same (approximately 26%) in both plots.

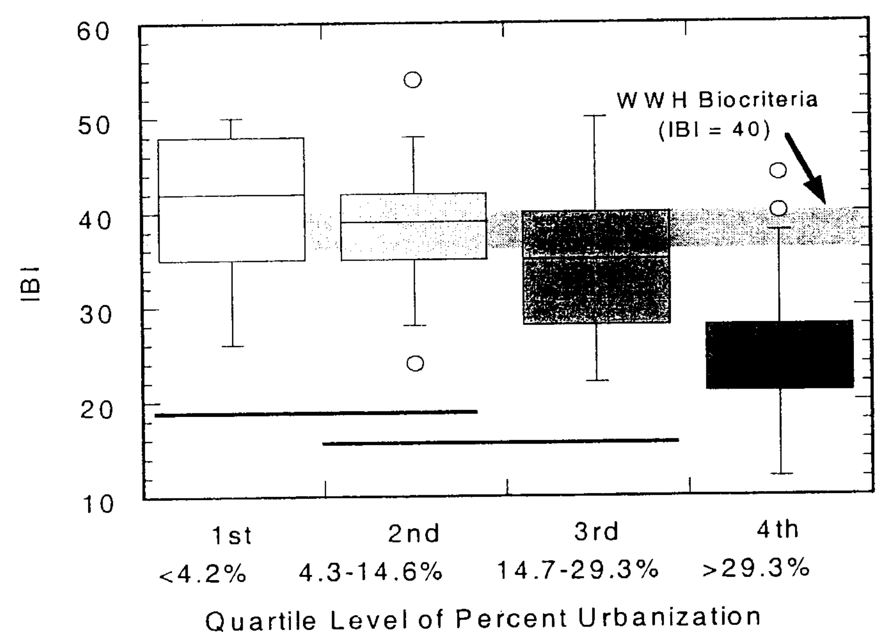

Figure 5. Scatter plots of Index of Biotic Integrity (IBI) scores against percentage of watershed upstream from the site in urban land use at small stream (<50 mi.^{2}) sampling sites in six of the major metropolitan areas of Ohio for all sites (upper) and a subset with non-urban impact types removed (lower). The age of the urbanized area is indicated for selected sites and the mean and median age for entire dataset. The warmwater habitat biological criterion and the range of insignificant departure for the IBI are indicated.

Also apparent in both plots was the occurrence of "outliers" where IBI scores above the warmwater habitat biocriterion occurred at sites with 40% to 60% urban land use. These sites had either an intact, wooded riparian zone, a continuous influx of groundwater, and/or the relatively recent onset of urbanization. Intact riparian buffers can mitigate the effects of urban land use up to a point (Steedman 1988; Horner et al. 1997) and local hydrology can strongly influence the quality of the fish assemblage (Poff and Allen 1995). The three sites with the relatively recent onset of urbanization (all <20 years) may not yet have accrued the types of negative effects that are readily apparent in some of the older urbanized areas of Ohio.

Discussion

Threshold levels of urbanization beyond which biological communities are likely to be impaired have previously been identified in the range of 8% to 20% impervious cover within a watershed (Schuler 1994). Our previous analyses (Yoder et al. 1999) produced results of approximately 8% and 33% urban land use cover for the Cuyahoga River basin and Columbus area streams, as identified by analysis of variance. We also concluded that the threshold level identified by regression for the Cuyahoga River basin was lowered by the presence of other stressors (e.g., CSOs, point sources, legacy pollutants). The elimination of those sites impacted by these other stressors from the regression analysis resulted in a higher threshold of urbanization. Our expanded study seemed to confirm this phenomenon, as the elimination of the other impact types helped clarify the urban land use/IBI relationship in a broader array of urban influenced streams throughout Ohio (Figure 5). The upper threshold of urbanization which corresponded to a loss of warmwater habitat attainment was in the 25-30% range. However, our results show that non-attainment also occurs at lower thresholds of urbanization (Figure 5) due primarily to the co-occurrence of other stressors. This makes both the linear and visual derivation of sufficiently precise indicator thresholds such as percentage of impervious surfaces more difficult.

In terms of understanding the potential effect of urbanization on aquatic life use attainment, the most meaningful results of our analyses are the upper thresholds at which attainment of CWA goal uses are mostly lost (e.g., 25%) and that beyond which it never occurs (>60%). Only a very few sites exhibited full attainment of the warmwater habitat biocriteria at urban land uses between 40-60% (Figure 5). A closer examination of these sites and the watersheds showed the presence of high quality riparian zones, an influx of flow augmenting groundwater, and/or development of the urban land use occurring within the past 20 years. For the latter, we hypothesized that the full effect of negative impacts in an urban setting may take time to accumulate and may not be immediately manifest in the form of instream impairments. This could account for the higher-than-expected urban land use (i.e., 40-60%) correlating with full attainment of the biocriteria. If this is true, then we might expect these sites to exhibit declines in IBI scores over the next one or two decades. It also suggests that newly urbanizing watersheds should be developed with an emphasis on determining which attributes (e.g., riparian zones, wetlands, flow regime) need to be maintained and preserved in order to protect and maintain instream habitat and biological quality.

The results of this study indicate that it might be possible to partially mitigate the negative effects of urbanization by preserving or enhancing near and instream habitats, particularly the quality of the riparian buffer zone. The "outlier" sites that exhibited full attainment of the warmwater habitat biocriteria had more extensive and higher quality riparian zones and good to excellent instream habitat quality. Some streams were nestled in small valleys which were not amenable to development and the accompanying encroachment of urban land uses. This generally agrees with the findings of Steedman (1988) who demonstrated a co-relationship between riparian zone quality and land use in terms of how each affected the fish communities and IBI values of Toronto area streams. Horner et al. (1997) also found that the negative effects of urban land use were mitigated by riparian protection and other management interventions. However, in both studies the quality and extent of the riparian zone ceased to be effective above 45-60% impervious land cover, which generally corresponds to the thresholds identified by our study. Until we better understand the effect of the "age" of the urban effect, it seems prudent to advocate policies that preserve existing riparian zones rather than responding with post-urbanization retrofits.

Yoder et al. (1999) discussed the implications of their findings on the designation of aquatic life uses in state water quality standards, particularly to the use attainability analysis process. Uses designated for specific water bodies are done so with the expectation that the criteria associated with the use are reasonably attainable. If CWA goal uses (*e.g.*, warmwater habitat in Ohio) are found to be unattainable, then lower quality uses may be established and assigned on a case-by-case basis (40CFR, Part 131.10[g]). Recently, the imperviousness of the watershed has been suggested as an indicator that is correlated with use attainability. If the frequently cited threshold of 25% impermeability is used, streams in watersheds with greater than this value could be considered unlikely to ever attain a beneficial use regardless of site- and reach-specific factors. This assumes that the negative effects of urbanization cannot be remediated, which has yet to be extensively tested. However, the results of our study suggest that there is a threshold of watershed urbanization (e.g., >60%) beyond which attainment of the WWH use becomes increasingly unlikely, at least as affected by contemporary practices. This threshold is not the same in all watersheds, as evidenced by the results from the six Ohio metropolitan areas, and it can occupy a rather wide range. In addition, co-factors such as pollutant loadings, watershed development history, chemical stressors, and watershed scale influences such as the quality of the riparian buffer and the mosaic of different types of land use, also act singly and in combination to determine to the resultant biological quality in the receiving streams. Thus, single dimensional urban land use indicators, such as watershed imperviousness, is not sufficiently precise or reliable as a single indicator of use attainability.

The further development and refinement of multiple indicators of watershed urbanization has merit from a management and decision-making standpoint. Because of the many co-factors involved (e.g., water quality, habitat quality, hydrologic regime, etc.), some of which are controllable and amenable to reasonable remediation, this will be a complex undertaking. We suggest that these co-factors, in addition to more refined urban land use indicators, be developed and tested using datasets from broad geographic areas spanning the extremes of the urbanization gradient. Urban land use and its analogs (e.g., % imperviousness) are coarse approximations of the cumulative effect of all negative influences within a watershed. Thus co-factors and more precise definitions of different urban land uses need to be defined in order to better understand and respond to the water quality management challenges posed in existing and developing urban areas.

A management outgrowth of such an effort could be the development of an urban stream habitat use designation. Yoder et al. (1999) previously indicated where the biological criteria for this potential new use designation might occur compared to the already existing hierarchy of aquatic life uses in the Ohio WQS (Figure 6). This designated use would

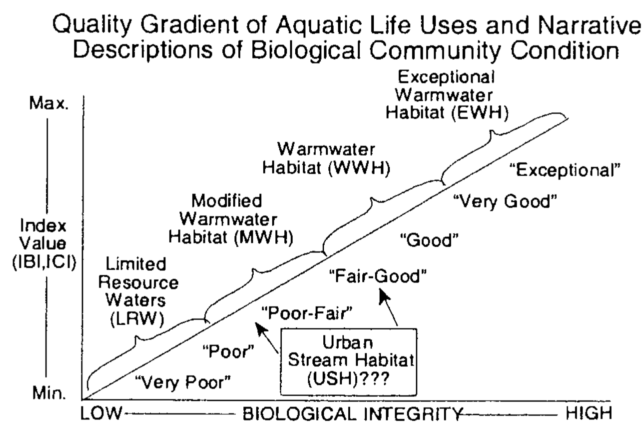

Figure 6. Relationship between the tiered aquatic life uses in the Ohio WQS and narrative evaluations of biological community performance and how this corresponds to a qualitative scale of biological integrity and of the biological indices that comprise the Ohio biological criteria. The position of a potential new Urban Stream Habitat (USH) use designation is indicated (after Yoder et al. 1999).

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satisfy the desire to afford urban streams the maximum protection practicable, while recognizing the inherent limitations that the irretrievable effects of urbanization may impose on stream quality. In the meantime, simplistic regulatory and management approaches should be avoided, particularly in those watersheds where uncertainty about the attainability of CWA goal uses (i.e., WWH and higher) exists. For example, a single indicator of urban development (e.g., proportion of impermeable surfaces) is alone insufficient to drive this process. We envision that more refined, multiple indicators of urban development will provide the necessary sophistication to more appropriately define when this less than CWA goal use should be applied. In the meantime, management strategies such as the nine minimum controls for CSOs seem reasonable analogies for the management of urban watersheds and stormwater runoff. However, proceeding beyond such minimum requirements with long-term remediation plans should be done with deference to the use attainability issues and with the aid of sufficiently robust before-and-after biological and water quality assessments.

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Getting Past the Obvious

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Abstract

Long Leaf Creek is located within an urbanized watershed along coastal North Carolina. The specific stream reach addressed is located in a residential subdivision. Conditions had dramatically changed there due to the continued development of the watershed. The stream had deepened and widened as result of increased runoff and high concentration events, including hurricanes. This increased the loss of aesthetic value, riparian corridor vegetation, and aquatic and terrestrial habitats. Water quality was also degraded.

Before they could decide how best to control flooding and stabilize and restore Long Leaf Creek to a naturally functioning channel within its changed watershed conditions, citizens had to be educated about natural stabilization and restoration technologies and specific methods that would work, including conventional options. Soil bioengineering was agreed upon, with numerous modifications to meet specific needs.

This paper is presented from both the client's and consultant's perspectives. It identifies what worked, what did not work, and what was necessary to improve the process for successful, long-term results. We present the lessons learned from criteria issue development and understanding, educational process alternatives preparation, design, construction, and project results since construction.

Paper

Long Leaf Creek is located within an urbanized watershed along coastal North Carolina. The specific stream reach addressed is approximately 2000 feet in length and is located in a residential subdivision. It is a highly sensitive project with a variety of multi-objective goals specific to its location and function and typical to urbanizing areas. The watershed includes residential, office, institutional, and commercial properties, including 25 homes that line the creek in this area. Residents living along the creek described the former Long Leaf, as a small, picturesque stream that pleasantly flowed through their neighborhood--a stream that could be jumped across. It was enjoyed by many people. The conditions had dramatically changed, however, due to the continued development of the watershed, especially a new road and large shopping center immediately upstream. Residents have seen their stream deepen by almost ten feet and widen by 40 feet in areas, a result of increased runoff and high concentration events, including hurricanes. In many areas, the banks were vertical. Large, woody debris filled much of the channel, and many people were now using the "ditch" as a yard and construction waste dump (see Figure 1). This has resulted in increased the loss of aesthetic value, riparian corridor vegetation, and aquatic and terrestrial habitats. Water quality has also been degraded.

Many people had already lost property due to stream widening and were unwilling to lose more. Flooding was a major problem in the downstream end, while erosion was occurring throughout the project reach. The City of Wilmington was interested in exploring a natural approach to solving the problem. After assessing the site and conditions, and listening to the residents= concerns and desired solutions, it was clear that a strong, continual working relationship had to be formed with the neighborhood to ensure project success.

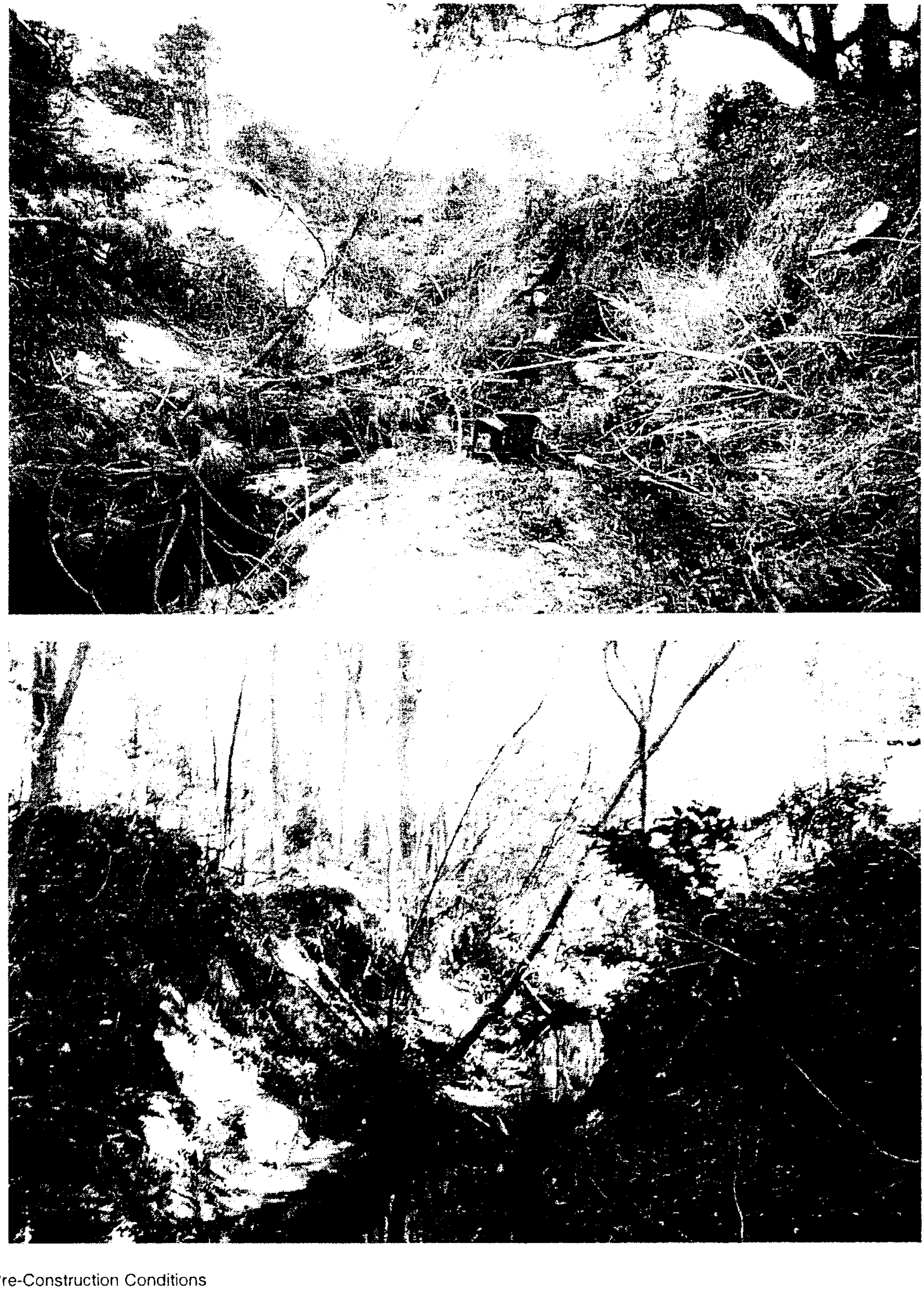

Figure 1. Pre-Construction Conditions

Before they could decide how best to control flooding and stabilize and restore Long Leaf Creek to a naturally functioning channel within its changed watershed conditions, citizens had to be educated about natural stabilization and restoration technologies and the specific methods that would work, including comparative conventional options. To "get past the obvious," it was clear that almost everyone would have to give up some land and existing trees to solve their continued land loss and flooding problems and to improve the environmental and aesthetic values of Long Leaf Creek. How much land and how many trees they would lose would ultimately depend on their selected restoration alternative. A matrix was developed using critical issues and matching these to possible alternatives (Table 1). Soil bioengineering was agreed upon, with numerous modifications to meet specific needs.

Robbin B. Sotir & Associates, Inc., (RBSA), served as the soil bioengineering consultant to the prime, the Kimley-Horn's interdisciplinary team, developed the geotechnical design and hydraulic efficiencies of a soil bioengineering solution to address the desired goals and critical engineering, environmental, and aesthetic issues.

Alternatives were compared with such critical issues as erosion control, streambank stabilization, safer and healthier environment, flood control, timely project completion, environmental and aesthetic improvement, property loss minimization, hydraulic efficiency, and cost feasibility.

After an initial investigation, an alternative analysis was produced in the summer of 1997. This alternative analysis explored numerous approaches to solving each of the project goals, with cost and risk factors assigned to each alternative. Several alternatives were considered, such as box culverts, 3:1 (horizontal : vertical) grassed slopes, 2:1 riprap rock, 2:1 concrete lining, and soil bioengineered slope systems. With input from the residents and permit authorities, the City selected the soil bioengineering approach and commissioned a design team to produce plan and specification documents, including construction cost estimates.

The selected systems employed the use of live fascines, brushlayer/live fascines, joint planting and vegetated geogrids (see Figures 2 through 5).

The majority of the improvement was done using vegetated geogrid, due to its soil reinforcing capabilities and ability to reduce land losses (see Figure 6).

Pre-bid, pre-construction, and permit application services were provided to support the project. Construction was completed by the spring of 1999.

The project has performed well from a biological perspective. Willow, baccharis, and myrtle installed as cuttings in the lower layer had a survival rate of approximately 80%. The rooted stock installed in the upper two layers comprised of spirea bush, carolina allspice, serviceberry, and viburnum, were less successful, with a survival rate of approximately 60% due to an insect infestation (see Figure 7). Hydraulically, we have had some bed scour, accompanied by toe erosion.

The survival rate of the rooted stock would have been higher had the watering maintenance program been followed. It is also possible that the insect infestation would not have occurred if the plants had been kept healthier by better maintenance practices. The rooted plants will be replaced by the contractor under the maintenance agreement. The contractor is also responsible for taking care of the insect infestation. The bed scour in the upper level caused by Hurricane Floyd is being handled with check dams to stop the bank from lowering and to control the toe scour.

TABLE 1

LONG LEAF HILLS / HEWLETTS CREEK ALTERNATIVES AND CRITICAL ISSUES						
CRITICAL ISSUES	ALTERNATIVES					
	1 Intermediate Action	2 3:1 Side Slopes Grass Lining [1]	3 2:1 Side Slopes Riprap Rock [2]	4 2:1 Side Slopes with Concrete Lining [2]	5 Reinforced Box Concrete	6 Soil Bioengineering
Stop Erosion & Stabilize Banks		•	●	●	n/a	●
Clean Out Trash & Debris, Remove Fallen Trees	●	●	●	●	●	●
Safer & Healthier Area		●				●
Control Flooding		●	●	●	●	●
Timely Project Completion	●	●	●	●	●	●
Environmental Improvement		•			●	●
Aesthetically Enhancing		•			n/a	●
Meets Hydraulic Efficiency		•	●	●	n/a	●
COE and Environmental Permits Approval Probability	●					●
Minimize Property Loss	●				●	●
Preliminary Cost Estimate Range	$ 250,000 to $ 400,000	$ 640,000 to $ 800,000	$ 900,000 to $1,400,000	$ 785,000 to $1,200,000	$1,750,000 to $2,300,000	$1,000,000 to $1,300,000

[1] Does not address geotechnical issues of sandy bank material stability and major land loss requirements.

[2] Does not address increase safety concerns or reduction in property values.

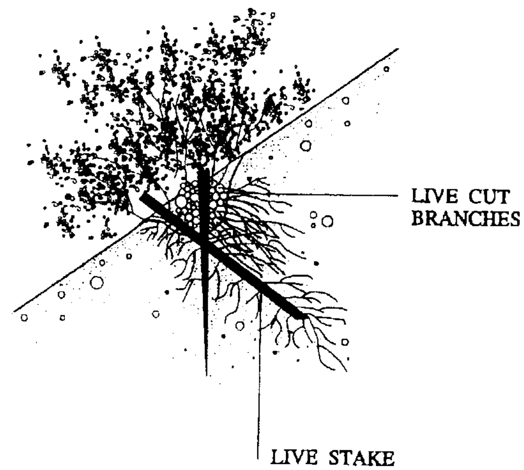

Figure 2. Live Fascine.

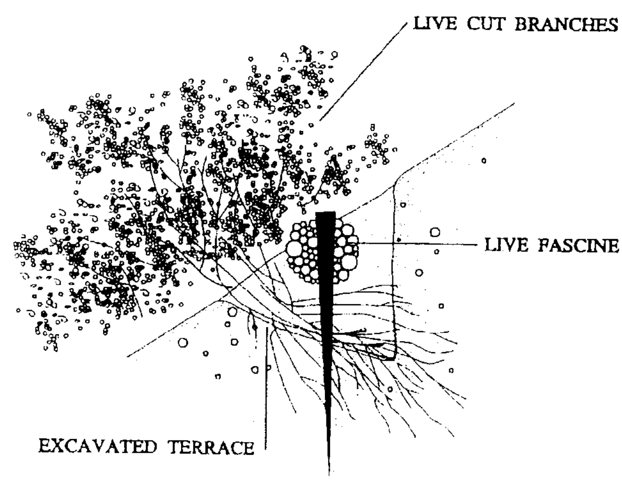

Figure 3. Brushlayer/Live Fascine.

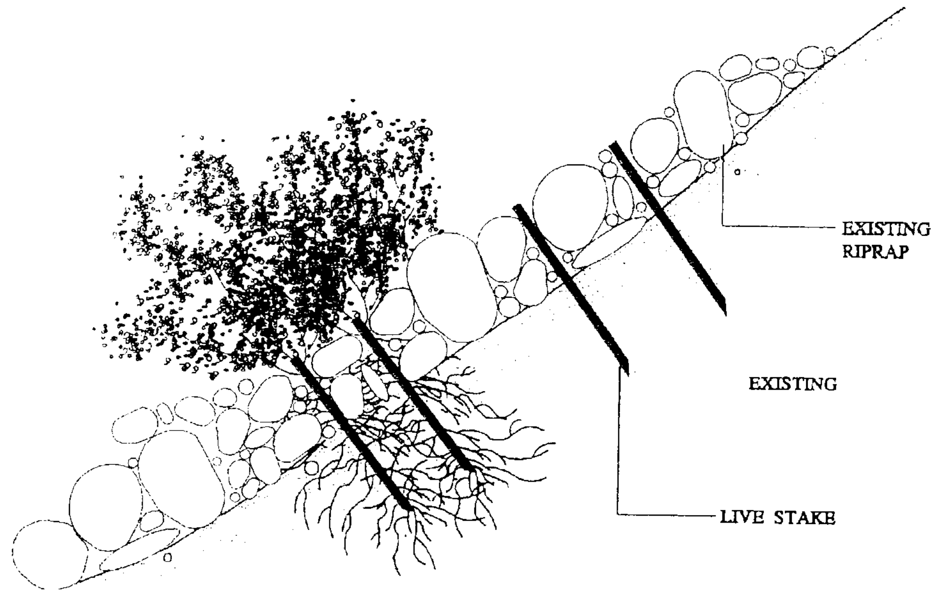

Figure 4. Joint Planting.

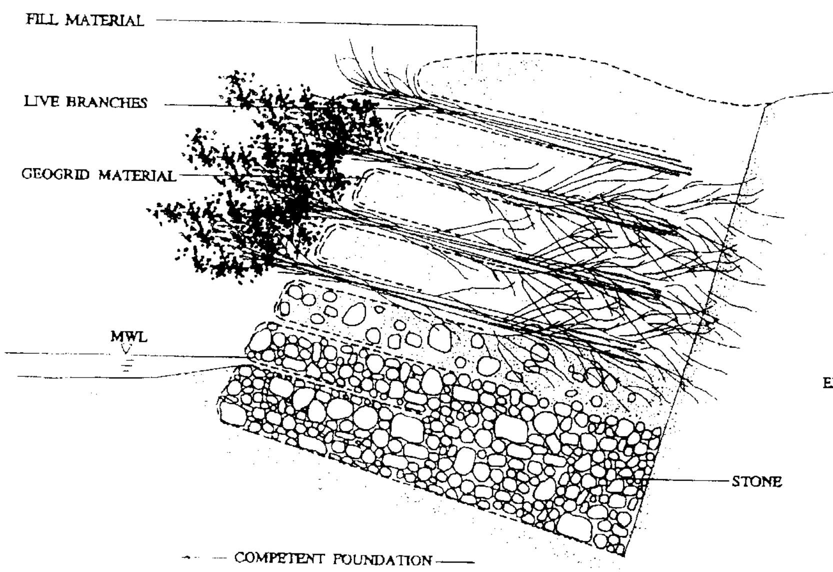

Figure 5. Vegetated Geogri

Figure 6. During Construction.

Figure 7. Three Months After Construction.

The project is functioning well from the bank stability and flood control aspects and the stream is operating within the parameters of the new watershed conditions. It is aesthetically attractive and, over time, should develop some ecological diversity. In summary, it is clear that the soil bioengineering approach is succeeding. The most important lessons learned were as follows:

- Learn more about the bed conditions in areas that have had high deposits of mobile materials
- Employ sophisticated grade control structures
- Ensure installation procedures are followed correctly and that materials are not changed
- Keep tabs on the contractor's maintenance schedule
- There is no substitute for communication and cooperation

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Protecting and Enhancing Urban Waters: Using All the Tools Successfully

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Abstract

Reducing the hydrologic effects and pollutant loadings from urban drainage systems and restoring aquatic habitats to improve the health of our aquatic ecosystems presents many unique challenges. These challenges can be categorized as technical, institutional, financial, and cultural. This paper will examine each of the challenges and the tools that have and are being developed to overcome them. A case study on how the tools are being used in Florida to enhance the health of the Tampa Bay aquatic ecosystem will be presented.

Introduction

Research conducted in Florida during the late 1970s characterized stormwater pollutants, provided cost and benefit information on many types of stormwater treatment practices, and determined the importance of stormwater discharges as a major source of pollution. As a result, in 1979, the Florida Environmental Regulation Commission adopted the state's first stormwater treatment requirements. In 1982, the state's stormwater rule was fully adopted, requiring all new development and redevelopment projects to include site appropriate BMPs to treat stormwater. This technology-based program establishes a performance standard of removing at least 80% of the average annual post-development loading of total suspended solids for stormwater discharged to most waters. Stormwater discharges to the state's most pristine waters, known as Outstanding Florida Waters, are required to reduce pollutant loading by 95%.

Florida's stormwater treatment program, in combination with the state's wetlands protection, land acquisition, and growth management programs, has greatly minimized the effects of Florida's rapid growth on its water bodies. However, land uses and hydrologic alterations that occurred before the mid-1980s has continued to adversely affect the state's vulnerable and valuable aquatic ecosystems. Accordingly, the focus of Florida's watershed management program shifted to cleaning up "older sources" such as existing land uses, whether urban or agricultural, and to integrating program components to eliminate duplication and improve efficiency and effectiveness. This has led to greater emphasis on more holistic approaches to address cumulative effects of land use activities within a watershed and to a greater emphasis on regional structural controls and the purchase or restoration of environmentally sensitive lands. The key institutional components of this watershed approach have been described in detail (WMI, 1997; Livingston et al., 1995).

Development of Florida's Watershed Assessment Tools

Florida's Water Implementation Rule, Chapter 62-40, F.A.C., establishes a performance standard for reducing, on a watershed basis, the pollutant loading from older stormwater systems. The goal is to protect, maintain or restore the beneficial uses of the receiving water body. The amount of needed pollutant load reduction is known as a "Pollutant Load Reduction Goal or PLRG". The rule further specifies that PLRGs be established as part of the states's priority watershed program, Surface Water Improvement and Management (SWIM), which is implemented by the state's five water management districts. Consequently, stormwater PLRGs have been established for several water bodies leading to the development and implementation of watershed plans to reduce pollutants from urban and agricultural stormwater discharges. For example, farms within the Everglades Agricultural Area have implemented BMPs to reduce phosphorus loadings by 40%. Additionally, the federal and state government, SFWMD, and landowners within the EAA are sharing the cost of constructing tens of thousands of acres of wetlands (Stormwater Treatment Areas) to provide for additional reduction of phosphorus.

Having a sound institutional framework, however, is only one of the tools needed to successfully reduce stormwater pollutant loadings from existing land uses. Equally important are funding and public education to promote the cultural change necessary to reduce "Pointless Personal Pollution". A final cornerstone is good science - to establish ecologically meaningful watershed management goals, evaluate the effectiveness of BMPs and management programs, and assess the cumulative effects of wet weather discharges.

Unlike traditional point sources of pollution, the effluent quality and environmental effects of stormwater and other nonpoint sources of pollution are highly variable because of their intermittent, diffuse, land use-specific nature. Of particular environmental concern is the cumulative impact on a water body from the numerous stormwater/nonpoint sources within a watershed. Consequently, traditional water quality monitoring and management efforts used for point discharges generally suffer from several deficiencies when trying to understand and manage stormwater/NPS pollution. These deficiencies include difficulty in:

1. Assessing intermittent, shock loadings of pollutants.
2. Assessing cumulative impacts of multiple sources.
3. Comparing water bodies and establishing priorities for management actions.
4. Assessing hydrologic, geomorphological, and habitat alterations within a watershed.
5. Distinguishing actual or potential problems from perceived problems.
6. Discriminating anthropogenic loadings from natural watershed loadings of metals and nutrients.
7. Establishing cost-effective ways to assess pollution sources and trends on a watershed basis.

To overcome these problems, the Florida Department of Environmental Protection (DEP) has developed cost-effective sediment and biological monitoring tools that are much better suited for assessing cumulative effects than traditional water chemistry monitoring (Livingston et. al, 1995; McCarron et al., 1997). Most stormwater pollutants accumulate over time in sediments, not the water column. Therefore, the sediments and the organisms that reside in them offer an in-situ monitoring opportunity to determine the cumulative effects of watershed stormwater/NPS pollution sources on aquatic systems or to evaluate the effectiveness of management programs.

Sediment quality is a sensitive indicator of overall environmental quality. Sediments influence the environmental fate of many toxic and bioaccumulative substances in aquatic ecosystems (Long and Morgan, 1990). Sediments tend to integrate contaminant concentrations over time and may represent long-term sources of contamination. Specifically, sediment quality is important because many toxic contaminants found in only trace amounts in water can accumulate to elevated levels in sediments. Sediment-associated contaminants can also directly affect benthic and other sediment-associated organisms since sediments provide benthic and pelagic communities suitable habitats for essential biological processes (e.g. spawning, incubation, rearing, etc.).

Sediments provide an essential link between chemical and biological processes. By understanding this link, environmental scientists can develop assessment tools and conduct monitoring programs to more rapidly and accurately evaluate the health of aquatic systems (Pardue et al., 1992). Therefore, sediment quality data provide essential information for evaluating ambient environmental quality conditions in water bodies. Additionally, information about the amount and quality of sediments within stormwater systems, stormsewers and other stormwater conveyances can help trace pollution sources, prioritize areas for implementing control measures, and help to assure proper disposal of accumulated sediments.

Inclusion of biological community monitoring allows a more holistic, systems approach that greatly enhances surface water quality assessment and management (Yoder, 1989; Yoder and Rankin, 1997). In particular, it allows assessment of the degradation of habitat (e.g., channel and bank erosion) and siltation within water bodies, neither of which are detected by water chemistry sampling, and both of which are typically associated with wet weather discharges. While chemical data reflect short-term conditions that exist when a particular sample is collected, biological communities accurately indicate overall environmental health because they continuously inhabit receiving waters where they integrate a variety of environmental influences - chemical, physical and biological.

Biological assessment involves an integrated analysis of functional and structural components of aquatic communities (Karr and Dudley, 1981; Karr, 1991). Bioassessments are best used to detect aquatic life impairments and assess their relative severity. Once an impairment is detected, additional chemical and biological toxicity testing can identify the causative agent and its source. Both biological and chemical methods play critical roles in successful pollution control and environmental management programs. They are complementary, not mutually exclusive, approaches that enhance overall program effectiveness.

A fundamental part of bioassessments is "metrics" (Karr and Chu, 1998). Just as a doctor uses metrics such as blood pressure and heart rate to assess human health, biological metrics allow the ecologist to use meaningful indicator attributes to assess the status of communities in response to perturbation. The definition of a metric is a characteristic of the biota that changes in some predictable way with increased human influence (Barbour et al., in review). By using multiple metrics to assess biological condition, the information available about the elements and processes of aquatic communities is maximized. The validity of an integrated assessment using multiple metrics is supported by the use of measurements of biological attributes firmly rooted in sound ecological principles (Fausch et al. 1990; Lyons 1992).

In 1983, the DEP began developing assessment tools that could be used to assess stormwater and NPS effects and the effectiveness of management programs, practices, and activities. The first efforts focused on estuarine sediment assessment tools (FDER, 1988; Schropp et al., 1989, 1990; MacDonald, 1994). In 1989, efforts began to modify national bioassessment protocols (EPA, 1989) to develop quantitative bioassessment protocols for Florida (Griffith et al., 1994; Barbour et al., 1996, FDEP, 1996). The tools that have been developed and that are under development (noted by a *) include:

A. Sediment assessment tools

   1. Standardized sediment collection and analysis protocols.

   2. Estuarine normalization of metal concentrations to aluminum concentrations ratio.

   3. Estuarine sediment quality assessment guidelines

   4. Freshwater normalization of metal concentrations to aluminum concentrations ratio(*).

5. Freshwater sediment quality assessment guidelines(*).

B. Bioassessment tools:

   1. Stream Condition Index

   2. Lake Condition Index (* - nearly completed)

   3. Wetland bioassessment methods (* - in early stages of development)

   4. Canal bioassessment methods (* - in middle stages of development)

   5. Estuarine bioassessment methods (* - in early stages of development)

Using the Tools for Watershed Management

Sediment assessment, together with watershed characterization, future land use plans, stormwater master plans, and mapping of pollution sources, can be used to screen watersheds and sub-basins to determine potential "hot spots".

Bioassessment and water chemistry sampling can then be done to assess the actual health of the aquatic system in these locations. An important component of the bioassessment is habitat quality, especially since urbanization often leads to dramatic changes in stream hydrology, geomorphology, riparian zones, habitats, and ultimately biological communities. Possible outcomes of the bioassessment are: (1) no biological effects; (2) effects due to habitat degradation; (3) effects due to sediment or water quality; or (4) effects due to a combination of sediment, water quality and habitat degradation. Bioasssessments also allow the establishment of an ecologically-based aquatic resource goal, rather than one based solely on traditional water chemistry standards to which the applicability to wet weather discharges is questionable. Once an aquatic resource goal is established, then relationships between the needs of the biological community and the chemical, sediment, and habitat influences on the community can be established. The next step is to then use all of this information to develop a watershed management plan that includes specific projects, schedules, and funding sources that will ultimately result in the acheïvement of the desired aquatic ecological goal. Much of this effort can be coordinated and implemented using the rotating basin approach that many states are now using in combination with the NPDES stormwater permitting program.

Putting the Puzzle Pieces Together: Tampa Bay Case Study

Puzzle Piece 1: The Assessment - As part of the development of the Tampa Bay SWIM Plan (SWFWMD, 1992) and the Tampa Bay NEP Comprehensive Conservation and Management Plan (TBNEP, 1996), existing environmental information was assessed to determine the ecological health of the bay system. Major findings of these assessments are summarized below.

Habitats

1. Since 1950, about half of the bay's natural shoreline and 40% of its seagrasses have been destroyed.

2. In 1950, the bay's shallow shelf supported about 40,000 acres of seagrasses. By 1982, only 21,600 acres remained and virtually all of Hillsborough Bay's 2,700 acres were gone. Seagrass decline is due to dredging and filling for residential development, turbidity caused by dredging of the main shipping channel, and reduced light penetration caused by shading by algae fueled by excess nutrient discharges.

3. Since the early 1900s approximately 13,200 acres of bay bottom (3.6% of the bay's surface area) were filled, with over 90% of the activity occurring along the bay's shallow shelf where seagrasses once thrived. The surface area of Hillsborough Bay has been reduced by 14%.

4. Upgrading sewage plants in the 1980s to provide advanced wastewater treatment reduced nitrogen loadings, leading to a decline in phytoplankton, an increase in water clarity, and greater light penetration. Consequently, between 1982 and 1992 seagrass coverage increased by about 4,000 acres (18.5%) raising the bay's total acreage to over 25,600 acres.

5. About 43% (9,700 acres) of Tampa Bay's original saltwater wetlands were lost between 1950 and 1990, primarily because of dredging and filling for waterfront development. However, as many as 5,900 acres of new wetlands formed along causeways and other emergent land created by dredged spoil material during this period. Recent estimates of wetland habitat in Tampa Bay indicate that about 18,000 acres of mangroves and saltmarsh remain but many thousands of acres are damaged by invasion by exotic plants such as Brazilian pepper.

Fish and Wildlife

1. Between 1966 and 1990, the harvest of 11 commercial species of fish declined by 24%, primarily because of smaller catches of mullet and sea trout. Each of these species is dependent on seagrass habitats.

2. Harvest of spotted sea trout declined by 86% between 1950 and 1990, from 487,000 pounds to 67,000 pounds. Similarly, red drum harvests plummeted from 80,000 pounds in 1950 to 15,000 pounds in 1986.

3. Tampa Bay's once-thriving shellfish industry has virtually collapsed, except for bait shrimping. Harvests of clams or oysters are restricted or prohibited throughout the bay because of high bacterial levels associated with stormwater discharges and septic tanks. The bay scallop, a highly pollution sensitive organism, all but disappeared from the bay in the 1960s.

Water and Sediment Quality

1. While water quality has improved over the past ten years, primarily as a result of better wastewater treatment, water clarity, nutrients, and toxics continue to be a problem.

2. Because of natural circulation and flushing from the Gulf of Mexico water clarity is greatest in the lower part of Tampa Bay (2.5 m), and naturally decreases moving up the bay, dropping to an average of 2 meters (6.6 feet) in Middle Tampa Bay and Old Tampa Bay. The lowest average water clarity is in Hillsborough Bay (1.5 m) which has poor circulation and receives a larger share of nutrients and sediments from major rivers.

3. Excessive amounts of nitrogen continue to accelerate algal growth which subsequently reduces light penetration to seagrasses and contributes to oxygen depletion. The bay's total annual nitrogen load was estimated to be 2.5 times greater in 1976 than the load computed for 1985 to 1991 (Figure 1).

4. Recent studies by NOAA, in cooperation with FDEP, provide an excellent overview of the levels and distribution of toxics in bay sediments (Long, et. al. 1991, 1994; FDEP, 1994). Compared to other urban estuaries, Tampa Bay has low-to-moderate levels of most toxic parameters. Contamination is centered around large urban centers, ports and marinas, and concentrations generally decrease from the top of the bay toward the Gulf of Mexico.

5. Generally, the highest levels of sediment toxic contamination occur in Hillsborough Bay, the bay's most industrialized area and home to the state's busiest port. Upper Hillsborough Bay has the highest levels of cadmium, copper, mercury, zinc, and lead, as well as the pesticide DDT. Concentrations in sediments at a site in northern Hillsborough Bay were the highest of any toxic pollutant measured in Tampa Bay. Two other bays with heavily urbanized watersheds, Boca Ciega Bay and Bayboro Harbor, also can be considered as hot spots of toxic contamination.

6. Figure 2 shows sites in Tampa Bay where concentrations of toxic contaminants in sediments exceeded Florida's Probable Effects Level (PEL) and No Observable Effects Level (NOEL). Sites above the PEL indicate a high probability for biological impact to marine organisms while those above the NOEL are considered "at risk" to biological impact (MacDonald, 1994).

Puzzle Piece 2: The Goal: A critical component of watershed management is using biological living resources as a measure of a water body's health, with far less emphasis on traditional laboratory-based water quality standards. This approach addresses critical ecological effects that are not seen by water chemistry standards, allows greater flexibility to achieve the desired ecological goals, and provides taxpayers with a better benchmark to judge the return on their expenditures. Through the SWIM Plan and the Tampa Bay NEP CCMP, the primary overall goals have been established for the restoration and protection of Tampa Bay:

1. To reverse the environmental degradation of the Tampa Bay estuarine system.

2. To optimize water quality and other habitat values, thereby promoting the sustained existence or re-establishment of thriving, integrated, biological communities.

3. To ensure the maintenance of a productive, balanced ecosystem complimentary with human needs and uses of the resources.

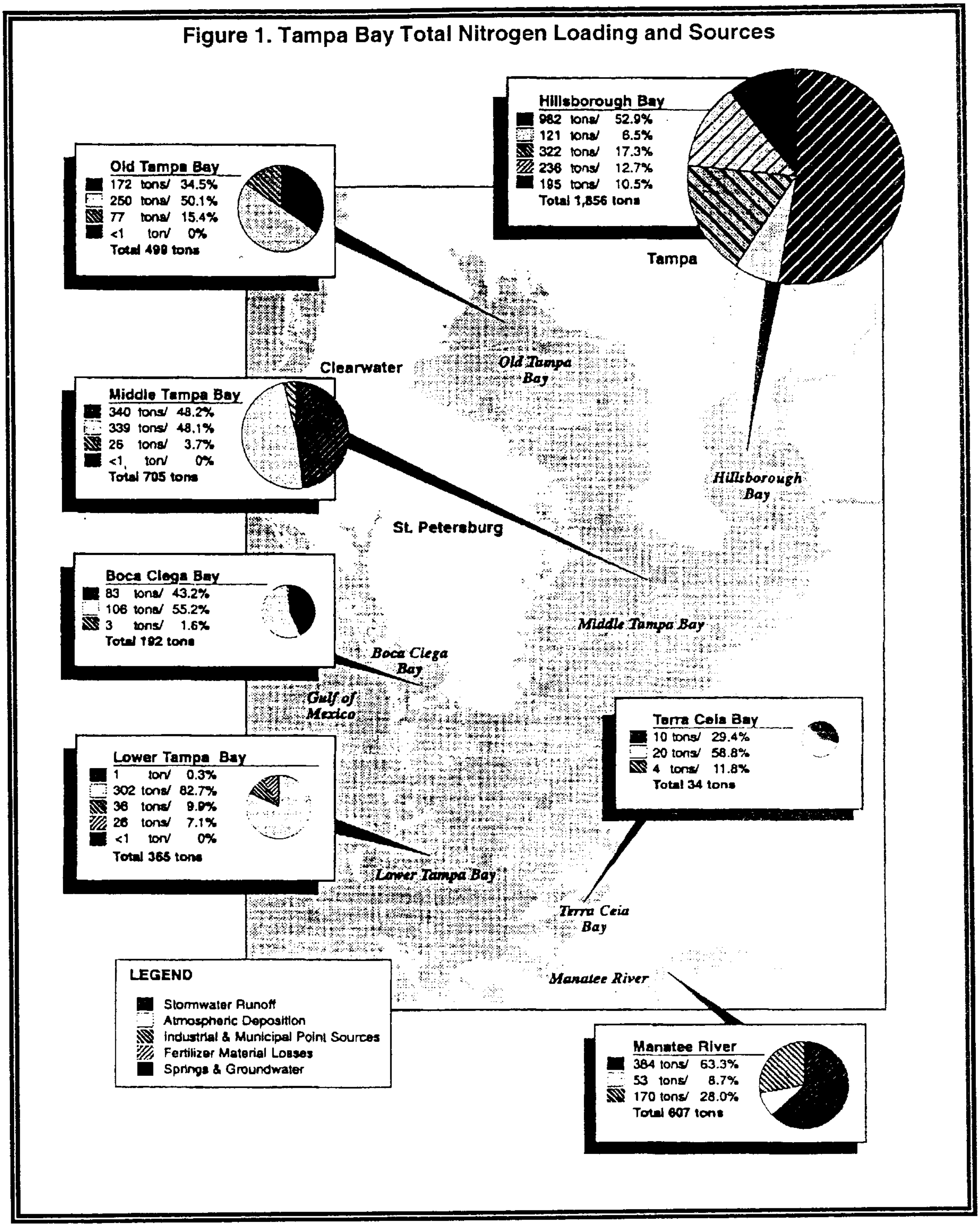

Figure 1. Tampa Bay Total Nitrogen Loading and Sources.

Figure 2. Sediment Toxic Hot Spots in Tampa Bay

Figure 2 shows sites in Tampa Bay where concentrations of toxic contaminants in sediments have exceeded Florida's Probable Effects Level (PEL) and No Observable Effects Level (NOEL) for biological impact. Sites registering above the PEL indicate that some biological impact to marine organisms is likely. Sites registering above the NOEL are "at risk" to biological impact.

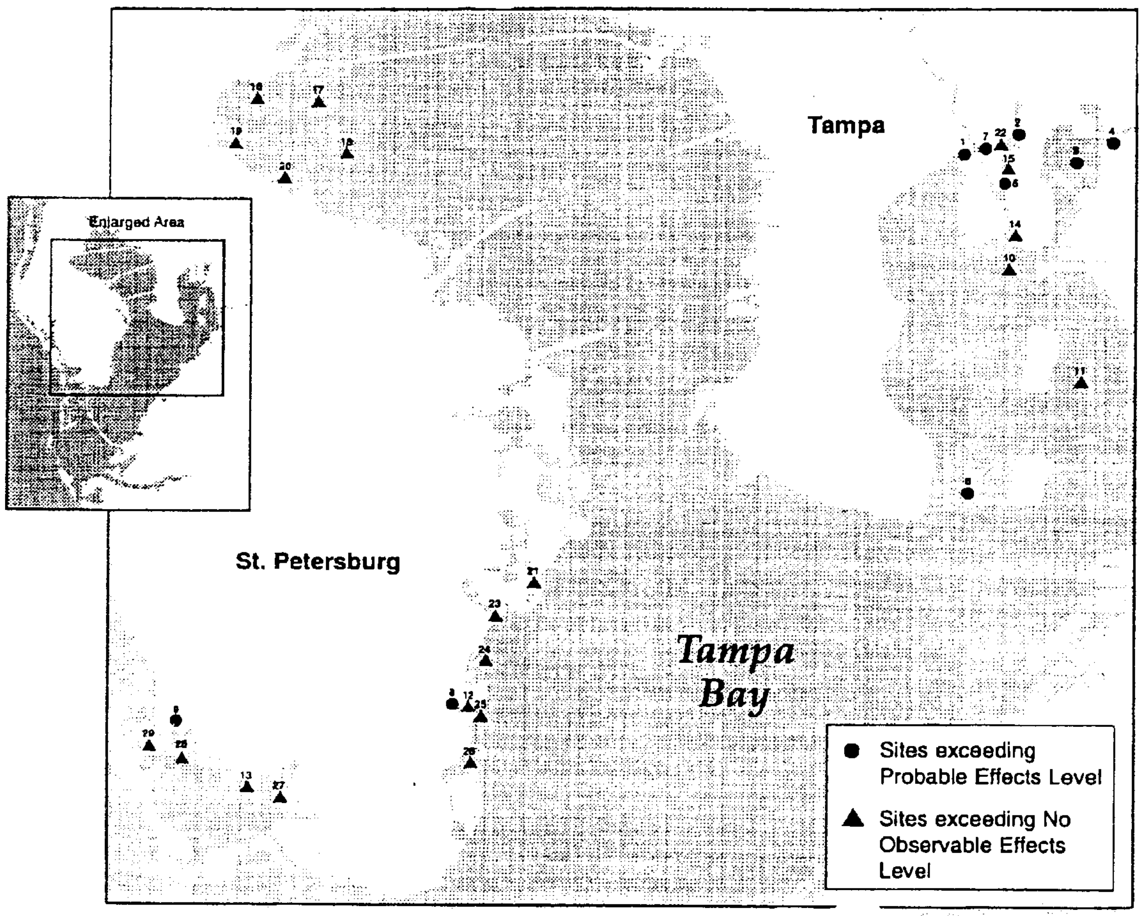

Figure 2. Sediment Toxic Hot Spots in Tampa Bay.

To achieve these overall goals the following specific goals have been established:

1. The overall goal is to restore seagrasses to 1950s levels. This will lead to restoration of commercially important species such as the bay scallop, mullet, sea trout, and red drum.

2. To restore seagrasses to 14,000 acres of the bay. The ability of seagrasses to recolonize the bay depends on the amount of sunlight the grass species require, as well as shading factors such as the amount of drift macro-algae and attached algal growth on grass blades. For most seagrasses in the bay, an estimated 20% to 25% of the light striking the bay's surface must penetrate to target depths to allow seagrass regrowth. Reducing nitrogen loadings will reduce chlorophyll a concentrations thereby increasing the depth of sunlight penetration.

3. As many as 12,000 acres of seagrass can be recovered by maintaining recent water quality conditions. This will require local communities to reduce their nitrogen loadings to the bay by about 10% by the year 2010 to compensate for increases in nitrogen loadings associated with the watershed's population growth.

4. A coastal habitat master plan has been developed for the watershed that will help to coordinate and prioritize existing state, regional, and local restoration programs. The long term goal is to recover 1,800 acres of low-salinity tidal marshes while maintaining and enhancing salt marshes and mangroves at existing levels. A minimum goal is to restore 100 acres of tidal marsh habitat every five years.

5. Reduce sediment toxicity to minimize risks to marine life and humans. Using three tests - evaluation of sediment chemistry, sediment toxicity, and benthic community health - bay sediments will be characterized and prioritized for management.

6. Reduce bacterial contamination to levels safe for swimming and shellfish harvesting.

Puzzle Piece 3: The PLRG: To achieve the ecological goal, nitrogen loadings would need to be held to those occurring in 1992-94 meaning that the 17 tons of nitrogen loading that would accompany projected growth within the watershed would have to be compensated. Reduction of nitrogen would reduce chlorophyll a levels which would increase how deep the minimum levels of light needed for seagrass growth would penetrate the water column.

Puzzle Piece 4: Quantifying Pollution Sources: Before load reductions can be achieved, it is essential that the sources and relative contribution of the sources be quantified.

Figure 3 summarizes sources of nonpoint nitrogen loadings to Tampa Bay.

1. Stormwater runoff from the Tampa Bay watershed contributes about 47% of the bay's total annual nitrogen load with urban runoff accounting for about 16%, or 680 tons. Residential areas, the watershed's largest land use, is responsible for over half of the nitrogen loading while commercial/industrial sites account for about 20%.

2. About 28% of the bay's total nitrogen loadings, or 1,200 tons, are from atmospheric pollutants falling directly on the water. An additional 7,500 tons fall in the watershed, although no one can determine how much enters the bay via stormwater. EPA estimates that as much as 67% of the bay's total nitrogen load may be from the atmosphere.

3. Stationary sources, primarily power plants, contribute an estimated 50% of the anthropogenic NO_x emissions as compared to 35% from motor vehicles.

4. Domestic wastewater discharges still discharge about 8% (340 tons) of the bay's total annual nitrogen loadings, even though all plants provide AWT. Hillsborough Bay receives about two-thirds of the cumulative nitrogen load from the 36 billion gallons of effluent discharged to Tampa Bay each day.

5. Industrial wastewater discharges, primarily fertilizer manufacturing and shipping facilities, are responsible for about 6% of the bay's total annual nitrogen loadings.

Figure 3. Total Nitrogen Loadings

Per-Acre Nitrogen Loadings from Non-Point Sources

	% Loading	% Watershed	Yield lbs/ac/yr
Residential	11	15.5	4.52
Commercial Industrial/Institutional	5	6.4	5.26
Mining	4	3.2	4.97
Range and Pasture	13	28.4	2.81
Intensive Agriculture	6	6.5	5.63
Undeveloped Land	8	39.93	1.15

Total Nitrogen Loadings to Tampa Bay (1992-1994 average)

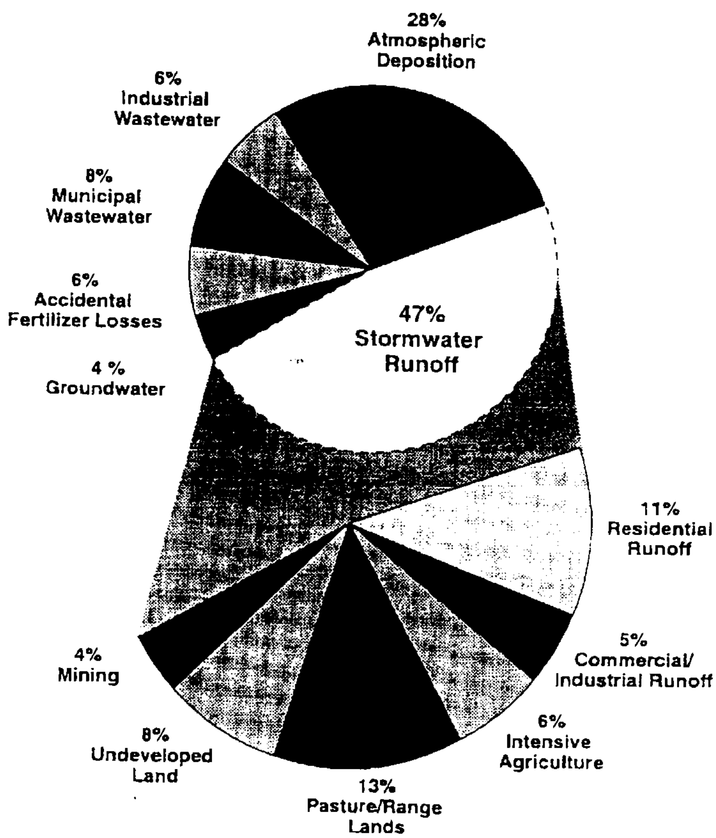

Figure 3. Total Nitrogen Loadings.

6. Septic tanks, which serve about 20% of the watershed's population, are another important source of nitrogen and pathogen loadings, especially in some areas such as Allen's Creek and tributaries to McKay Bay.

7. Another 7% of the bay's total nitrogen loadings had been attributed to losses of fertilizer during ship loading and en route to port. However, this figure has declined substantially since 1991 as source control BMPs were implemented at the port.

8. More than 60% of the bay's annual loadings of chromium, zinc, mercury and lead, as well as significant amounts of petroleum hydrocarbons and pesticides are conveyed by stormwater.

9. Atmospheric deposition also is a major source of toxic substances accounting for 44% of the bay's total cadmium loading and about 17% of the copper and lead loadings. PAHs also enter the bay from the atmosphere.

10. Industrial and domestic point sources also contribute about 30% of the bay's total loadings of aresenic, cadmium, chromium, and copper.

Puzzle Piece 5: The Watershed Management Plan: The state's Surface Water Improvement and Management (SWIM) program was established by the legislature in 1987. Tampa Bay was named in the SWIM Act as a priority waterbody within the Southwest Florida Water Management District and a SWIM Plan was adopted in 1992. In 1990, Tampa Bay was adopted into the National Estuary Program by EPA leading to the development of *Charting the Course,* a Comprehensive Conservation and Management Plan (CCMP) for the bay. Community participation was an essential component of the development of both watershed plans. In particular, many of the agencies, citizen groups, and others long active in the restoration and management of Tampa Bay participated in the development of the CCMP. The CCMP built on many of the region's ongoing environmental programs, from land acquisition to urban stormwater retrofitting to habitat restoration. It also identified where unneccesary duplication existed in current environmental programs and provided recommendations to ensure that limited public funds are spent in the most environmentally effective manner.

Puzzle Piece 6: Setting Priorities: To assure that limited financial resources were used judiciously, restoration projects and programs were prioritized and targeted to specific subbasins. This was done by combining GIS analysis with watershed modeling and characterization with the results of the sediment, biological, habitat, and chemical assessments. For example, an essential early activity of the SWIM program was a watershed-wide assessment of pollution sources, especially stormwater, to identify "hot spots" - subbasins with high stormwater loadings - and to prioritize urban stormwater retrofitting projects (SWFWMD, 1990). Similarly, priority habitat restoration sites were also selected as were projects to reduce overall nitrogen loadings to the bay, including those from atmospheric deposition.

Puzzle Piece 7: Action Plans: A successful watershed management plan must include a specific set of actions that will be taken within a specified time. *Charting the Course* includes 41 specific actions that are needed to achieve the plan's goals. These include the construction of numerous urban stormwater treatment and habitat restoration projects that have been built, are underway, or are planned in priority subbasins (Figure 4). Since vacant land in the highly urbanized area is scarce or extremely expensive, many of these projects are being conducted on existing public lands providing multiple benefits including regional stormwater management, open space, and recreation. Public education is a frequent component of these projects with the placement of signs depicting the effects of urbanization, the importance of wetlands and riparian vegetation, and the need for stormwater treatment and habitat restoration.

Programs and actions that rely upon nonstructural BMPs are also being used to reduce "Pointless Personal Pollution" at its source and increase the effectiveness of existing programs. For example, since surveys showed that up to 70% of the stormwater BMPs serving new development are not being properly maintained, assuring their long-term operation and maintenance can greatly reduce stormwater pollution. Maintenance and operation of BMPs typically is the legal responsibility of private land owners and property owner associations. Unfortunately, DEP, SWFWMD, and local governments do not have enough staff to conduct regular inspections. To improve this deficiency, DEP is implementing, in cooperation with local governments and the WMDs, a training and certification program for public and private sector individuals involved in erosion, sediment, and stormwater inspections. Local governments also are encouraged to implement Stormwater Operating Permit systems which require an annual inspection and certification that the stormwater system has been maintained and is properly operating. As an economic incentive, some local stormwater utilities provide credits for individuals served by a properly maintained and operating system. Additionally, Hillsborough County has implemented the "Adopt a Pond" program to help educate stormwater system owners on how to maintain their systems.

Other nonstructural efforts include assisting businesses in developing and implementing pollution prevention plans and the continued implementation of the Florida Yards and Neighborhoods Program. This program is being expanded to help develop model landscaping guidelines for commercial landscapes, and promote the incorporation of FYN

Figure 4. Active SWIM Habitat Restoration and Stormwater Retrofitting Projects

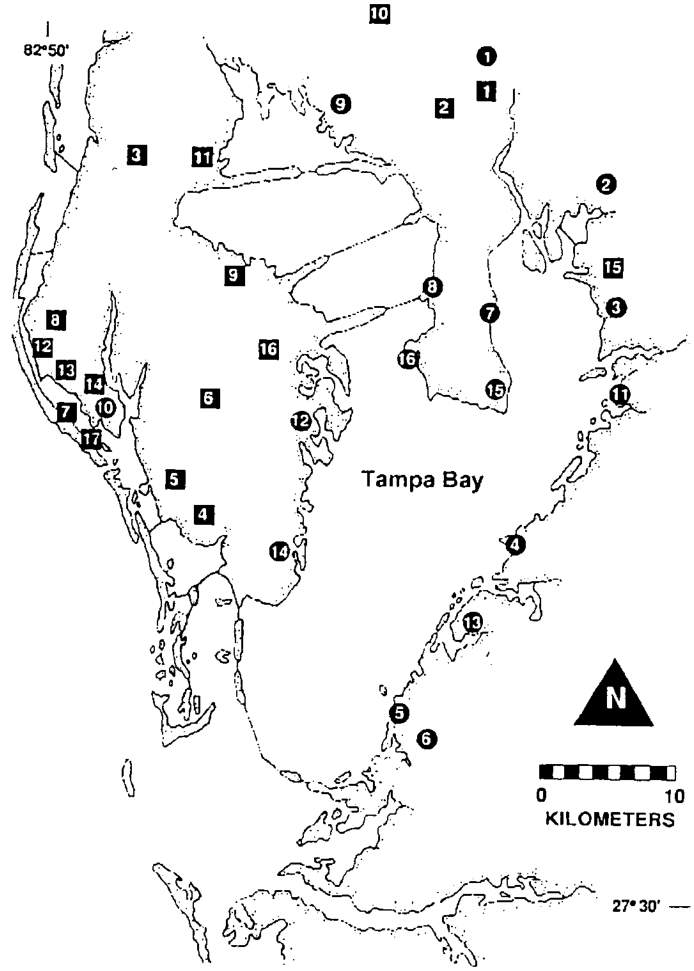

Figure 4. Active SWIM Habitat Restoration and Stormwater Retrofitting Projects.

landscaping guidelines into local government site review processes for new development. The region's continuing rapid growth provides opportunities through local government comprehensive plans and land development regulations to promote compact development and to reduce impervious surfaces, especially parking lots at commercial developments.

Puzzle Piece 8: Assuring Implementation: An important aspect of any watershed management program is an institutional framework that assures that all of the partners will implement their responsibilities. In 1998, an Interlocal Agreement was signed by the Tampa Bay NEP's local government and regulatory implementation partners. The agreement requires the partners to submit detailed plans describing how they will fulfill their responsibitlities for bay restoration and protection. Additionally, all of the local governments within the watershed have been issued, either as individual permittees or co-permittees, NDPES muncipal stormwater permits. These permits include specific requirements that are identified in the CCMP's action plans.

Active Habitat Restoration Projects ●

1. Lowry Park
2. NE McKay Bay
3. Delaney Creek
4. Simmons Park
5. Hendry Fill
6. Peanut Lake
7. Bayshore Blvd.
8. Gandy Park
9. Cabbage Head Bayou
10. Boca Ciega
11. Cargil S. parcel
12. Mangrove Bay
13. Cockroach Bay
14. Little Bayou
15. MacDill AFB
16. Picnic Island

Active Stormwater Retrofitting Projects ■

1. Lowry Park
2. Horizon Park
3. Old Coachman
4. S. Pasadena
5. Jungle Lake
6. Pinellas Park
7. N. Redington
8. EMS Site
9. St. Pete/Clearwater Airport
10. Brushy Creek
11. Safety Harbor
12. 102nd Avenue
13. 94th Avenue
14. Lake Carroll
15. Delaney Creek
16. Haynsworth
17. 141st Avenue

Puzzle Piece 9: Funding Implementation: Partners in the implementation of the CCMP include EPA, Florida DEP, SWFWMD, local cities and counties, and the private sector. Each of the partners has made a substantial commitment of financial resources since 1995 to accomplish the desired aquatic ecological goals. Primary funding sources have included the P2000 (state and local land acquisition funds), the SWIM Program (state and SWFWMD funds), SWFWMD Basin Boards, the private sector, and local stormwater utility fees. In many cases, funding for projects is from a combination of sources that often allow the leveraging of other funds needing nonfederal matching funds such as those from the Section 319 nonpoint source implementation grant program.

Costs associated with the individual actions presented in the Tampa Bay SWIM Plan and the NEP CCMP are considerable. However, these should not automatically be construed as requirements for new sources of revenues, since some of these initiatives can and are being accomplished with existing resources or by redirecting current funding allocations to better address the bay's needs. A number of actions seek to improve coordination, cooperation, and planning among state and local governments, and the private sector. These may actually result in cost savings for currently funded activities.

A 1994 survey by the Tampa Bay NEP attempted to quantify how much money is spent to manage and monitor bay quality and administer environmental programs. Based on FY94-95 budgets, the study indicates that over $260 million is spent annually by federal, state, and local agencies on the restoration and management of Tampa Bay. As seen in Figure 5, the largest part of the funds (65% or $170 million) are spent on wastewater collection, treatment, and reuse.

Figure 5. Funds Spent

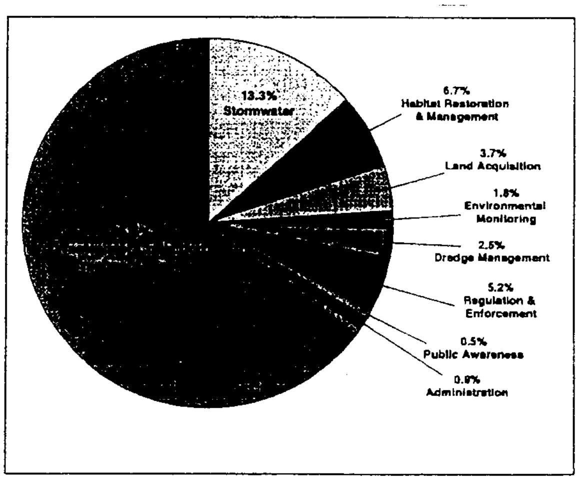

Figure 5. Funds Spent.

Approximately $35 million (13%) is spent by local governments and the SWFWMD on stormwater management. Habitat restoration and land acquisition, two long favored and implemented environmental programs in the Tampa Bay region, account for over $27 million in expenditures.

Puzzle Piece 10: Monitoring Implementation: Since the adoption of *Charting the Course* in 1996, numerous projects and programs have been implemented. The Tampa Bay NEP recently issued the first official progress report on implementation (TBNEP, 1999). It shows that the program's partners are on or ahead of schedule in achieving most of the priority goals for bay improvement. Highlights of implementation activities that occurred between 1995-99 include:

- Goal: Recover an additional 12,350 acres of seagrass over 1992 levels, while preserving the bay's existing 25,600 acres.

  Status: Since 1988, seagrass acreage is increasing at about 500 acres per year meaning the goal will be reached in 25 years.

- Goal: Restoring and protecting bay habitats

  Status: A total of 250 acres of low-salinity habitat will be restored in all bay segments, exceeding the five year target by 150 acres. Additionally, a total of 1,340 acres of mangrove and saltmarsh habitat have been restored. All 28 priority sites identified in the habitat master plan have been given the highest priority for acquisition under the state's land-buying programs.

- Goal: "Hold the line" at nitrogen loadings estimated from 1992-94.

  Status: When fully implemented, the 105 projects constructed, underway, or planned will reduce the amount of nitrogen entering the bay by an average of 134 tons per year, exceeding the target by 60%.

In addition to progress on the above goals, very good progress has been made on other goals. These include:

- The goal of protecting the endangered manatee population in Tampa Bay. The Manatee Awareness Coalition has implemented "Manatee Watch" where trained volunteers help educate and encourage boaters to go slow in waters frequented by manatees.

- The goal of returning bay scallop to Tampa Bay. Stocking programs are adding bay scallops and citizen volunteers are measuring the effectiveness of these efforts through the Great Bay Scallop Search.

- The goal of reducing atmospheric deposition into and onto Tampa Bay. To better understand the linkage between air pollution and water quality, eight research and monitoring programs addressing atmospheric deposition are underway.

- The goal of making Tampa Bay safe for shellfish harvesting and swimming. As part of the "Healthy Beaches Project", research is underway to identify and test better indicators of microbial contamination, the prevalence of the indicators at bay and gulf beaches, and probable sources of the contamination.

- The goal of providing flows necessary to support plant and animal communities below the dam on the Hillsborough River. In February 1999, the SWFWMD approved a draft minimum flow rule for the Hillsborough River that hopefully will provide a basis for resolving conflicts over competing uses of the river.

- The goal of developing a long term dredge material management plan for Tampa Bay. A Dredged Material Advisory Committee is being organized in partnership with the U. S. Army Corps of Engineers.

Discussion and Recommendations

Florida has established a wide variety of laws, regulations and programs at the state, regional and local level to protect, manage and restore the state's incredibly valuable yet vulnerable natural resources, especially its water resources. There is no doubt that these programs have been effective in helping to reduce adverse impacts on natural resources resulting from the state's rapid and continuing growth over the past twenty years. However, even with the implementation of these programs, many of Florida's natural resources have been severely strained or degraded. Some of these adverse effects can be attributed to activities that occurred before the implementation of modern watershed management programs such as the channelization of the Kissimmee River and the creation of the vast drainage canal network south of Lake Okeechobee both of which are contributing to the decline of Lake Okeechobee, the Everglades and Florida Bay. Other adverse impacts, though, are directly related to the state's rapid growth and development during the last twenty years. These include water supply problems, water quality problems, declining habitat and impacts on endangered species such as the manatee and the Florida panther.

Why are these adverse impacts still occurring given the wide range of watershed management programs that have been implemented in Florida? What could be done to reduce these effects and possibly restore already degraded areas? The continuing evolution of Florida's land and water management programs into a more holistic approach which seek to manage cumulative effects can help to overcome many of the current program deficiencies. Cooperative efforts and partnerships, together with citizen education and involvement to improve the stewardship ethic of all Floridians is essential. With increased support and participation by all Floridians, the effectiveness of the state's programs can be improved helping to assure that our natural resources will be able to be enjoyed by future generations.

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Urban Stream Structure And Selection Of Structures To Build Habitat To Support Wild Fish Populations

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Abstract

This paper gives a brief overview of the physical impacts of urbanization on streams and examines the selection of in-stream methods, tools, and devices for stabilizing streams and creating habitat to support native fish species. Although the paper discusses salmonid species in the Pacific Northwest in particular, the methodologies and tools employed to evaluate and support fish habitat can be generally applied to streams and watersheds in other regions.

The effects of urbanization, such as decreased pervious area and vegetative cover and increased stormwater runoff and erosion, destabilize watersheds and streambeds and destroy aquatic habitats. Stable stream environments are necessary if biological systems including fish and their supporting food web are to flourish. Changes to urban streams and watersheds may be so significant, however, that decades may pass before they reach stability. Even then, the resulting Astable environment@ might not provide the type of habitat needed to support species from the natural environments.

The evaluation of channel erosion and sedimentation in urban streams provides one measure to assess the relative stability of streams and, thus, their ability to support fish and amphibian species. For most streams, an evaluation of relative streambed stability can be completed through a visual examination of streambed morphology and minimal supporting calculations. Tools for performing these analyses will be presented in this paper.

Rehabilitation of streams in urban and heavily logged watersheds requires establishing a stream structure that will maintain streambed stability and create the different types of habitats needed to support desired fish species. One size or type of in-stream device cannot meet all stabilization and habitat requirements. The selection of devices should correspond to the relative stability of the individual stream reach. Devices for maintaining streambed stability and creating habitat, as well as the procedures for selecting them, will be discussed in this paper.

Introduction

Salmon populations in the Pacific Northwest are dwindling. One significant cause of this reduction in population is the destruction of small stream (1st to 4th order) habitats.

In order to respond to the destruction of fish habitat in small streams, we must have an understanding of watershed processes and natural stream morphology. Although this paper concerns western Washington streams, which are surrounded by heavy forests and fed by rain and groundwater, the general principles for stabilizing streams discussed here can be applied to most natural small stream systems.

Natural Stream Morphology

Streambed gradients gradually decrease from the upper reaches of a watershed to the outlet of a stream because flow rates increase in the lower parts of the watershed (Leopold, Wolman, and Miller, 1964).

The streambed gradients create different types of fish habitat features (Rosgen, 1994). Figure 1 shows the relationship of habitat type to streambed slope in western Washington streams. Pool/drop habitat is dominant in reaches with smaller flows and steeper valley gradients. The pools are formed by large organic debris or rock formations. As the stream flow rates increase, valley gradients tend to decrease and the streams are dominated by pool/riffle habitats.

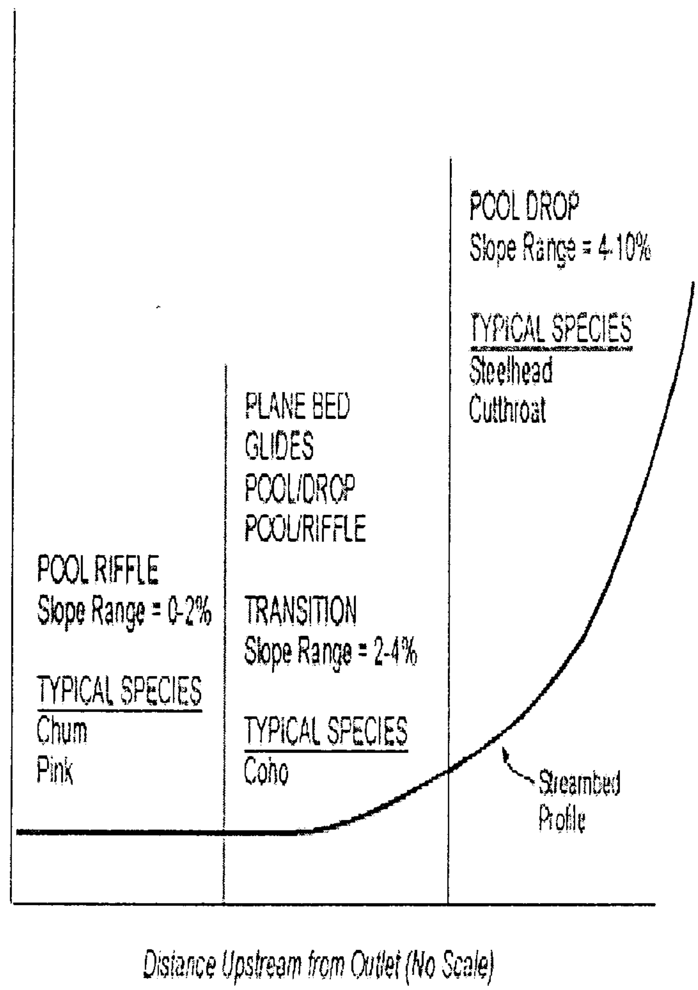

Figure 1. Relationship of Stream Habitat to Streambed Slope in Western Washington Streams.

Pools and riffles form alternately on the outside of stream bends. These alternating pools and riffles are present in practically all perennial channels. In straight or meandering streams, pools and riffles generally form every 5 to 7 channel widths. As the stream widths increase, however, the number of pools decrease (Leopold, Wolman, Miller, 1964).

In each non-rigid, natural stream, a dominant channel is formed by the stream=s dominant discharge. This dominant discharge channel is a component of most fish habitats. The dominant discharge has a recurrence period of approximately once each 1.5 years in natural systems (Simons, Senturk, 1991). In urban systems, the bank-full discharge has a recurrence period of about one year (MacCrae, 1996).

Western Washington Natural Stream Characteristics The small streams of western Washington are fed by rain and groundwater and are found in steep-sided canyons with fairly straight valley bottoms. In their natural (forested) state, small streams have a slightly meandering, low-flow channel in a narrow valley bottom. The vegetation along the stream banks is often dense and provides shade, channel stability, and cover. Debris jams are common and act to slow stream flows during storm events. Western Washington soils are products of glacial activity and consist of smooth cobbles and stones, as well as fine materials. Clayey bank materials, heavy root structures along the banks, and steady base flows create channels with nearly vertical sides and small widths (3 to 6 feet wide, and sometimes as small as 1 foot wide) relative to the width of the valley bottom. Typical old-growth forest streams have low nutrient levels and low annual sediment yields.

Most natural Pacific Northwest streams can be described as sediment starved. Natural watersheds are heavily forested and act as a sponge for rainfall. In natural watersheds, the storm runoff response is slow and the flow rates are low. Because the ratio of the 1.5-year storm to the base flow is quite low (often less than 5), these streams have small width to depth ratios, with most of the dominant discharge channel acting as an aquatic habitat channel. The width of the dominant discharge channel is coincident with the width of the aquatic habitat channel. The aquatic habitat channel is the normally wetted, low-flow part of the streambed (Seattle, 1997). Most small, natural Western Washington streams are dominated by pools and drops formed by large organic debris (Gustav, Sovern, Washington, 1993)

The aquatic biological community in western Washington may include as many as 250 plant and animal species. The aquatic biological community depends on a stable aquatic habitat associated with old growth, coniferous watersheds. Much of this aquatic community functions as a food web, with fish populations representing the mega fauna. Some salmon and trout species are the top aquatic predators (Sovern, Washington, 1996).

Salmon and trout in western Washington evolved to take advantage of these regional stream conditions. Figure 1 lists different species found in the various regions of the watershed. More athletic fish species like coho, steelhead, and cutthroat trout occupy the upper reaches (steeper gradient) of the watershed. The young coho and steelhead reside in the stream for a year before migrating to saltwater. Cutthroat may reside in fresh water for two years before migrating to saltwater. Less athletic species, such as chum and pink salmon, can not migrate through the steeper gradients of the upper watershed to spawn. The fry of these species occur in the lower regions of the watershed and migrate to saltwater shortly after emergence. Young salmon, as well as young and adult trout, will utilize any part of the watershed that meets their habitat requirements. For example, if fish habitat in the upper reaches of a watershed is unsuitable, young coho may seek winter refuge in the lower regions of a watershed (Sovern, Washington, 1996).

Five general categories of habitat occur in natural western Washington streams (Sovern, Washington, 1996):

- Estuaries/Deltas
- Passage
- Refuge
- Rearing
- Spawning and Incubation

Pacific Northwest fish derive most of their food from organisms (benthos) that live in, or on, the substrate of the stream. Most food production occurs in the same stream areas that provide spawning and incubation habitat for fish. An annual surplus of approximately 10 pounds of biomass is required to support one pound of fish in the stream (Washington, 1999).

Assessing Stream Deterioration

Visual inspection of stream morphology can provide rapid and relatively accurate assessments of a stream=s ability to support fish populations. Practical experience working in western Washington streams has shown that visual streambed assessments correlate well with benthic sampling (Seattle, 1999). Although benthic sampling is necessary, visual inspections can reduce the amount of benthic sampling required when quick assessments are needed or extensive benthic testing is cost-prohibitive.

Natural streams are generally non-rigid. Their cross-sections vary with changes in flow rates and yearly rainfall volumes. Stream systems will generally aggrade during low flow periods, and degrade during high flow periods. To assess the deterioration of non-rigid streams, it is necessary to understand the following three concepts:

- Sediment transport

•Effects of urbanization on stream stability

•Effects of urbanization on fish habitat

Sediment Transport Concepts Understanding the dynamics of sediment transport is useful for predicting hydraulic equilibrium conditions in a stream. Any stream will respond to imposed changes. Six basic relationships exist between discharge levels and channel form, regardless of stream size (Simons and Sentürk, 1991):

Depth of flow in the dominant discharge channel is directly proportional to discharge.

- Width of the dominant discharge channel is directly proportional to water discharge and sediment discharge.
- Dominant discharge channel shape is directly related to sediment discharge.
- Channel gradient is inversely proportional to water discharge and directly proportional to sediment discharge and grain size.
- Sinuosity is directly proportional to valley gradient and inversely proportional to sediment discharge (larger valley gradient causes greater meander, larger sediment discharge causes less meander).
- Transport of bed materials is directly related to flow velocity and concentration of fine material, and inversely proportional to the fall diameter of the bed material (greater depths and higher velocities cause larger bed load volume in transport, sediments shaped like kites fall slower than round-shaped sediments).

A stable channel exists when a stream has the bed slope and cross-section which allow its channel to transport water and sediment from upstream without aggradation, deposition, or streambank erosion (Simons and Senturk, 1991).

When natural flow rates are exceeded, sedimentation and erosion can be a dominant limiting factor for fish populations. The exaggerated volumes and rates of stormwater runoff in urban areas increase both the rate of erosion and volume of sediments generated from upland and riparian areas in the watershed. Soil erosion can lead to excess streambed erosion and sedimentation and destroy redds, fish rearing habitats, and food production areas.

Effects of Urbanization on Stream Stability Urbanization permanently alters the hydrologic balance within stream in the following ways:

- Total water passing through urban streams increases.
- Stormwater runoff rates and volumes increase.
- Increased impervious surface areas prevent groundwater recharge; as a result, base flow rates during summer and fall are often less than natural flow rates were.
- Increased stormwater runoff causes erosion and transports significant amounts of sediments and pollutants, including oil, grease, and polluted fine sediments from streets and parking lots, into urban streams.

In urban areas, the ratio of the 1-year storm to the stream=s base flow (dominant discharge) is large, sometimes greater than 100. In many watersheds, terrestrial sediment volumes are dramatically increased by urbanization. Excess sediment increases the width of the dominant discharge channel.

Stable urban streambeds have 1B2% gradients, compared to the 2B10% gradients that support anadromous species in natural watersheds. To reach a stable gradient, the streambed can lower several feet, causing significant bed load sediments from shallow landslides. Measurements taken from several western Washington streams show that streambeds will flatten from a 4% gradient to a 1% gradient as a result of urbanization. A change in streambed gradient from 4% to 1% over the distance of 1,000 feet can result in streambed erosion and an elevation difference of 30 feet at the upper end of the reach. During the transition from steep to flat gradients, fish habitat is in a perpetual state of change (Sovern, Washington, 1996). Unfortunately, it can take decades before stability is again reached.

In unstable streams, braiding occurs at crossover points between bends where stream gradients are steep. At normal stage, a braided section has a divided flow with small, mid-channel bars and a single large channel composed of subordinate channels. The base flow channel often changes location within the bottom of the dominant discharge channel (Sovern, Washington, 1996).

The erosion of the channel bottom along the basin (often called head-cutting) indicates a readjustment of the basin's gradient, the stream discharge, and the sediment load. (Simons and Sentürk, 1991).

Effects of Urbanization on Habitat Stable habitat conditions within the channel have stringent requirements in urban streams, including a sediment-starved condition and minimal movement of spawning-sized gravel (3-inch and smaller) during most storm runoff events.

In urban streams, the benthic system can be limited both by erosion (which provides conditions of constant change) and by sedimentation (which smothers redds and food production areas, and fills rearing habitats with silt). In addition, streams in urban or deforested watersheds experience significant habitat loss and are unable to support the biological diversity that fish species depend upon. In contrast to natural watersheds, where 250 plant and animal species may comprise the aquatic habitat, urban watersheds may have fewer than 50 plant and animal species.

Living systems do not adapt to constantly changing environmental conditions. The changes in aquatic habitats caused by urbanization decrease food production and destroy spawning and incubation areas (Bell, 1990). As flow rates and volumes increase, streambeds become unstable. When streambeds become unstable, the aquatic habitat channel may retain a small width to depth ratio, but it will be substantially less than the width of the dominant discharge channel. In addition, streambed instability causes a constant shifting of the aquatic habitat channel and this limits development of the benthic community and destroys redds.

As an urban stream approaches stability, the resulting aquatic habitat channel will be too wide, shallow, and homogeneous to support fish populations. Streams naturally deposit bed load on the inside of bends and form point bars. Because natural sinuosity is low in western Washington streams, point bars form infrequently or incompletely leaving a wide, shallow, cross section during base flows. Under these conditions, the flow depths of most urban streams are insufficient to submerge returning adult fish. Because small-grained sediments settle as flow rates decrease, redds and food production areas are smothered with silt and pool habitats are filled with sediment.

Perhaps the greatest general impact is the permanent loss of habitat types that sustain coho and steelhead populations. These species prefer pool/drop habitat. Coho, in particular, require quiet pools (Seattle, 1997). Examination of Figure 1 shows that as the streambed gradient lessons, the habitat type shifts from pool/drop to pool/riffle. Pool/riffle habitat does not provide sufficient pool depth for normal fish rearing or urban storm refuge. Because large storms frequently occur after the fry emerge from the streambed gravels, the need for urban storm refuge habitat is critical. Juvenile fish cannot maintain their position in high velocity reaches. In fact, normal urban storm flows often wash juvenile fish into larger bodies of water (salt water or streams) where they cannot survive.

Tools and Methodologies

The methodologies available to assess existing stream conditions and predict future conditions include the use of visual streambed assessments and analytical tools such as simple hydraulic mathematics.

Streambed Assessment

General indicators of habitat degradation in urban streams are visually apparent and include the following elements:

- Dominant discharge channel wider than in natural conditions
- Reduced pool frequency and less diverse habitat
- Increased sediment from terrestrial sources

- Reduced large woody debris

- Drastically reduced aquatic community diversity

Both natural and urban streams fluctuate between stability, degrading, or aggrading. Compared to natural streams, however, streams in urban watersheds exhibit extreme traits of aggradation, degradation, or instability. Urban stream deterioration indicators differ according to the condition of the specific reach (stable, degrading, or aggrading). In a degrading streambed, there is a progressive lowering of the channel due to scour. In an aggrading streambed, there is a progressive buildup or raising of the channel due to sediment deposition. Both degradation and aggradation are indicators that a change in the stream=s discharge and sediment load is taking place (Simons and Senturk, 1991).

Urban stream deterioration indicators differ according to the condition of the specific reach. Table 1 (the following bulleted paragraphs) describes the deterioration indicators in a stable, degrading, or aggrading stream.

Table 1. Urban Stream Deterioration Assessment Indicators

Stable B If an urban stream reach is stable and terrestrial sediment loads are low, the reach may be able to support species that reside temporarily in the stream before moving to salt water. The wide, shallow channel of a stable stream provides little protection from predation, however, and also lacks resting pools. The following are indicators of stable urban streams:

- Apparent changes in channel shape and configuration after large storms are small.
- Width of aquatic habitat channel coincident with width of dominant discharge channel B shallow flow depth, prevents fish passage.
- Head-cutting and nick points are absent or nearly absent.
- Substrate stability:
  - Periphyton stays on streambed after significant storms B streambed is stable.
  - Streambed gravel lack periphyton B gravel is being moved during significant runoff and replaced when the storm flow recedes.
- Small-grained sediments settle when storm flows recede, smothering redds and food production areas.
- Pools (on-stream or off-stream) that can retain newly hatched fry are generally not present.

Degrading B In a degrading urban stream the dominant discharge channel is as wide as in a stable stream, but base flow rarely covers the bottom of the channel except at crossover points between bends. When streams begin to unravel due to degradation, the effects do not appear instantly. Head-cuts move through a stream until it reaches a vertical drop. When enough head-cuts accumulate, the vertical drop will be undercut, releasing large amounts of bed load type sediments. Occasional pools will develop that may support anadromous fish, however, they are often inaccessible.

- Streambed gravel sizes are larger than stable sections of the stream, but are mostly bare of periphyton or other aquatic growth.
- Channel braiding occurs at crossovers between bends.
- The substrate of the base flow channel is not coated with periphyton.
- The base flow channel and dominant discharge channel lack large woody debris.
- Large woody debris that spans the banks of the dominant discharge channel may indicate a recent streambed elevation and may illustrate the amount of degradation that has occurred.
- Stream banks are bare and often nearly vertical.

Aggrading B Aggrading stream reaches may be visually similar to stable reaches. Generally, aggrading streams will have a flatter streambed gradient and accumulate more fine sediment. Disturbing the bed of an aggrading reach usually results in long periods of murky water flow. Aggradation will occur locally in pools, which reduces habitat value, but has less impact on habitat than an entire aggrading stream reach would.

- Head-cuts and nick points do not exist.
- Deltas may be visible at the top of the reach.
- Periphyton covers the substrate.
- Large woody debris in streambed is partially buried.
- Pool/riffle and pool/drop habitat can occur as isolated conditions.
- Substrate surface gravel sizes are small.

The visual indicators described in Table 1 (combined with assessments of fish passage problems and periodic benthic population checks) can be used to describe the potential habitat capacity for a stream reach or, collectively, for an entire stream. Needless to say, habitats for fish species that reside in the stream for one year or longer must be able to support the full life cycle of the species. In addition, fish need to have full access to these habitats.

A methodology based on visual streambed assessment was developed for rapid stream assessments in Longfellow Creek and Pipers Creek in Seattle, Washington (it was also used within six watersheds in Snohomish County, Washington). The streambed assessments provided an accurate measurement of the ability of the watershed or stream in question to support fish. An example of the summary rating for Longfellow Creek is shown in Table 2.

Table 2. Summary Rating for Longfellow Creek

Creek Segment	Description	Map Sheet	Habitat*	Bank Erosion*	Sediments Sources*	Other Pollutants*	Total
1	Pipe from outfall to Andover Street	1,2,3	5	3	3	2	13
2	Open channel from Andover Street to Genessee Street	4,5	10	1	1	2	14
3	Open channel from Genessee Street to confluence of unnamed tributary in West Seattle Golf Course	5,6,7	10	2	2	2	16
4	Unnamed tributary in West Seattle Golf Course	6,7	6	2	2	2	12
5	Open channel from confluence with West Seattle Golf Course tributary to Brandon Street	7,8,9	9	1	1	2	13
6	Open channel from Brandon Street to Findlay Street. Contains confluence of Juneau Street bypass via "biochannel."	9	9	2	2	2	15
7	Open channel from Findlay Street to Juneau Street. Also contains piped high flow bypass starting at Juneau Street and rejoining Creek in Segment 6.	9,10	8	2	2	2	14
8	Open channel from Juneau Street to Graham Street	10,11	11	2	3	2	18
9	Open channel from Graham Street to Willow Street	11,12	8	2	1	2	13
10	Open channel from Willow Street to Myrtle Street	12,13	8	2	2	2	14
11	Piped channel Webster Basin; open channel to Holden Street. Contains "K-Mart bypass."	13,14	7	2	2	2	13
12	Open channel from Holden Street to Thistle Street	14,15,16	8	2	1	2	13
13	Pipe from Thistle Street to head of basin at Roxbury Street	16	6	3	1	2	12

Notes:

Ranking Codes:

1 = Poor condition
2 = Moderate
3 = Relatively good
* = The value in the "habitat" column is the result of another ranking process. The total "habitat" volume for each Creek segment is transferred into this table to complete the ranking process. The habitat rank has a range of 0-18 which is developed from evaluating bed erosion, fine sediment accumulation, gravels (clean/stable), benthic (quantity, quality), habitat structure, and riparian vegetation. All other columns in this table are ranked from 1 (poor condition) to 3 (relatively good condition).

Analytical Tools Simple hydraulic mathematical tools can be applied to analyze existing conditions and are needed to check passage conditions for channel rehabilitation projects. In addition to depth and velocity, the amount of turbulence in a stream has significant impact on the amount of sediment that can be moved. Greater turbulence increases the amount and size of sediments that can be moved. Maximum turbulence occurs when the Froude number is equal to 1.0. The Froude number is defined by Equation 1:

$$F_N = V/(gY)^{1/2} \qquad \text{(Equation 1)}$$

Where

F_N = Froude number

V = average velocity in the cross-section

g = acceleration force due to gravity

Y = the hydraulic depth, which is the cross-sectional area divided by the top width

The Froude number should not exceed 0.8 for large storms (like the 25 or 100-year event) except at channel drops. This criterion is the same for rigid, grass, and dirt lined channels in most stormwater manuals. For frequently occurring storm flows (1 to 2 year events), the Froude number has to be much less in order to meet the criteria for larger flows. Spawning-size gravel will generally be stable if this Froude number criterion is met.

In the author's experience, backwater analysis (HEC-2 or HEC-RAS) may not be strictly applicable to analyze natural streams, but is a useful tool to analyze deteriorated channels and to model proposed improvements for stream rehabilitation. For stream rehabilitation backwater analysis is done for large and small events (base flow, 1-year flow, and one point in between) to ensure passage of juveniles throughout their life-cycle habitat within the stream. To provide accurate results, more cross-sections are needed to conduct backwater analysis on non-rigid, urban streams compared to conventional backwater analysis.

Selecting Rehabilitation Devices

Unless excess stormwater from both frequent and rare storm runoff events can be eliminated, it is the author=s opinion that some form of structural intervention is needed to create fish habitat in urban streams. In western Washington, streams become unstable and significant fish habitat is lost when the impervious area reaches 10 to 15 percent (Booth, 1996). The dominant discharge channel will respond to hydrologic changes (Simons and Senturk, 1991). As a result, modifying how land is urbanized can reduce the effects of urbanization, but it will not obviate the hydraulic impact on the dominant discharge channel. Stream rehabilitation measures will still work best where there are fewer disturbances to the watershed and where wide riparian corridors are maintained.

The goal of urban stream rehabilitation is to stabilize the streambed with devices that also create a habitat for fish populations. The stream must develop sufficient food mass and diversity to support desired fish species. Quality salmon and trout habitat can exist in urban streams when hydraulic/habitat criteria are met, the streambed is stable, and the base flow channel is confined (Sovern and Washington, 1996).

Establishing stable streams in urban watersheds is often a moving target. As more urbanization occurs, hydrologic and biological changes accumulate. The extent that the dominant discharge channel spreads is a direct function of the amount of pavement in a watershed.

The New Urban Stream. Restoring an urban stream to pre-development conditions is not possible (National Research Council, 1992). It is the author's opinion that too many stream rehabilitation projects emphasize stream bank rehabilitation rather than focusing on the root causes of stream habitat destruction. Often, that root cause is streambed instability, which is a natural response to increased flow rates and volumes in the stream.

To maintain pre-development species in urban and deforested streams, a "new urban stream" is needed that can provide a variety of fish habitats including pools. Without intervention, the urban streams will convert pool/drop habitat into pool/riffle habitat, eliminating the diversity of habitat required to support a variety of fish species (Sovern and Washington, 1996).

The goal is to stabilize the stream and return it to its original sediment-starved condition. While bed load and suspended sediment are readily available, the object is to sculpt sediment deposition to form bars and banks and confine the aquatic habitat channel within a single location. Concentrating flows in the aquatic habitat channel helps keep the substrate size optimal and clears the stream of fines.

Urban stream rehabilitation must focus on historic conditions that can be re-created, rather than on the conditions that cannot be meaningfully restored. Except for the following three exceptions, historic environmental conditions can be re-created in urban streams:

- The width of the dominant discharge channel will always be greater in urban streams.
- The banks of the aquatic habitat channel cannot be coincident with the dominant discharge channel (in pool/riffle habitat).
- High flood flows, deep flow depths, and large velocities are more frequent.

In form, the resulting channels resemble snowmelt type streams, where flow rates significantly exceed base flows for several weeks each year. Most urban streams lack large woody debris that can be incorporated into the stream's structure when a reach attains stability. Most reaches will take decades to reach stability. Just because the channel will not look "natural", doesn't mean that we will have failed or that anadromous species cannot be supported. Many eastern Washington snowmelt type streams support anadromous species.

A rehabilitated stream has five primary needs:

- A dominant discharge channel sized to carry the 1-year to 1.5-year storm (depending on the degree of urbanization) at full bank. It is important to recognize this need because the stream will reshape the dominant discharge channel and may undo much of the rehabilitation effort.

- Within the dominant discharge channel, hydraulic conditions must provide biologic and stream stability (keep most of the spawning sized gravel and rock from moving during frequent storms).

- Within the dominant discharge channel, habitat must be provided for the entire life cycle of the desired species.

- Because fine-grained sediment falls out last and needs to be kept in transport, the base flow channel has to be narrow, deep, and stable.

- Stream banks need to be stable to support riparian vegetation. Bio-stabilization techniques can help reduce the width of the dominant discharge channel.

Ideally, long reaches of unstable streams will be stabilized. Near the spanning structures, aggradation will replace degradation (as long as a sediment supply is available). If only short reaches are stabilized, large storms will deposit substantial sediments within the stabilized reach, particularly at the upstream end of the reach. The sediment sizes most likely to accumulate during the stabilization of a reach are the larger sizes that are moved as bed load. Once stable streambed gradients are attained, the amount of sediment that can move and cause aggradation is finite. After a few larger storms, bed load movement will be minimal.

Rehabilitation Devices A variety of devices may be used to confine the base flow channel and provide streambed stability. The author has experience with several types of bed control structures, glides, lunkers, and confining devices. In small streams, these devices may be a well-placed piece of timber, a boulder, or randomly placed stones and rootwads (to increase roughness). In larger streams, stabilization and confining devices are much more complex.

Selection and siting of devices is dependent on the stream condition in a specific area and the type of habitat that is to be provided. It is important to realize that one type of structure is not suitable for all applications. Selection of a stream rehabilitation device depends on the type of habitat needed and the device's perceived hydraulic attributes. Both non-rigid channel design and biologic skills are required to be successful.

This section will address issues related to the selection of three types of structures: timber stepdown structures, boulder bed control structures, and deflectors.

Timber Stepdown stepdown. Sometimes referred to as a "K-structure". A form of timber is shown in Figure 2. The logs, which are set at 45 degrees to the channel, are called weir logs and create pools during high storm flows. The weir logs need to have a steep pitch (the bank end higher than the center of the stream). In dense, urban western Washington watersheds, storms with high yearly return frequencies produce flows 20 to 50 times the base flow. Timber stepdown structures form large, quiet pools during storms, allowing newly emerged fish juveniles to find refuge. In

Figure 2. Timber Stepdown K-Structure (shown with weir logs).

addition, the K-type stepdown creates rollers. Rollers assist fish passage upstream for less athletic adults and juveniles during higher flow rates (Kerr Wood Leidal Associates, LTD, 1980).

Common variations of the K-structure include a straight timber stepdown (no weir logs) and a vortex structure (with weir logs). In creating a diverse habitat environment, both types can be used.

While the straight timber stepdown does not form an upstream pool, the substrate above the stepdown is turned-over, even for frequently occurring storm flows. The Washington Department of Fisheries and Wildlife has successfully installed many straight timber stepdowns in logged watersheds and those with minimum to moderate urbanization. For lower flow rates, the substrate above the stepdown remains stable and provides excellent spawning habitat.

The vortex type timber stepdown does not form storm refuge pools as well as the k-structure and the log configuration stymies formation of a roller. The structure can help develop confined low flows, however, and creates good fish-rearing habitat for many northwest species (not Coho).

Boulder Bed Control Structure. Figure 3 shows a boulder bed control structure. Like the K-structure, the boulders that form the structure are on the upstream side, but these boulders could also be on the downstream side to form a vortex-type structure. In the author's experience, changing the configuration and the angles of the boulders provides slightly different habitat characters, all of which are acceptable. While wood is usually preferred in small streams, boulder bed control structures are flexible and can adjust to channel degradation in unstable streams. Boulder bed control structures are most beneficial at the downstream end of a reach where no streambed control is established in the reach below.

Deflectors. Deflectors can be made of either wood or boulders. Figure 4 shows a timber deflector with a bank log on the opposite bank. Point bars form on the insides of bends. Deflectors should be installed on the insides of bends to help build larger point bars and to confine the base flow channel. The reach in Figure 4 is nearly straight (sinuosity about 1.0). To develop point bars in straight reaches, several deflectors may be needed and could be on one side of the channel, or on alternating sides. The reach shown in Figure 4 has a large bed load, and point bar formation would have occurred if the deflector installations were correctly located and implemented. Without modification, however, the deflector shown in Figure 4 will not form a point bar.

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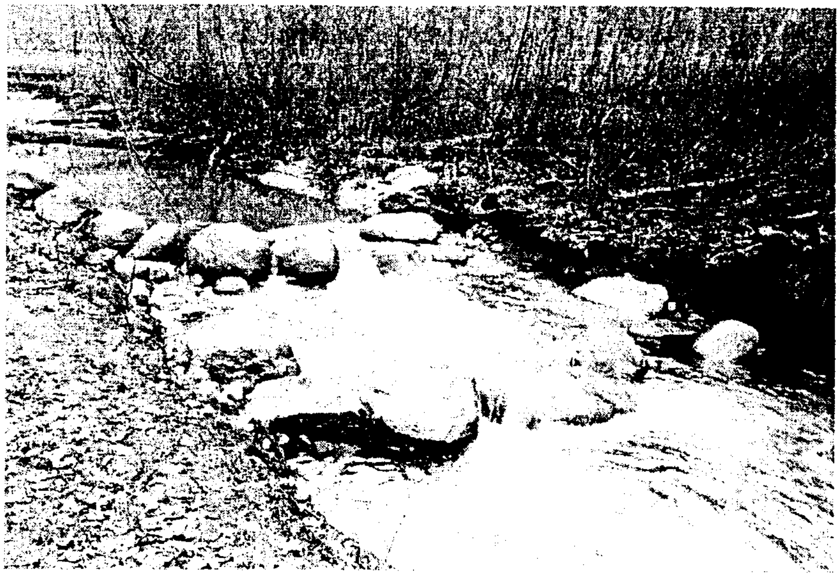

Figure 3. Boulder Bed Control Structure.

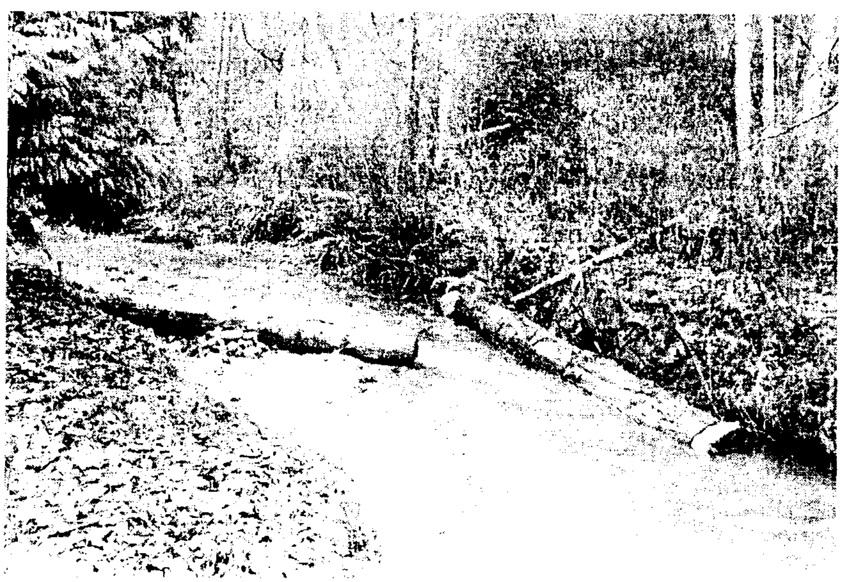

Figure 4. Deflector.

Conclusions

Streambed assessment based on sediment transport principles can be a useful tool to rapidly determine a stream's capability to support fish populations. Standard engineering analytical tools can be used with streambed assessment to support hydraulic design for stream rehabilitation projects. Although the stream will not have the same appearance as a natural stream, stream rehabilitation can be successful and urban streams can support anadromous fish populations in western Washington. Hydraulic design is needed to develop the dominant discharge channel and properly place structures to attain the desired habitat conditions. Selection of the rehabilitation devices must consider design needs of non-rigid channels, as well as habitat requirements. Finally, one size or type of habitat rehabilitation device cannot serve

Another benefit of infiltration practices is their ability to serve multiple uses since they are temporary storage basins. Recreational areas (e.g., ballfields, tennis courts, volleyball courts), greenbelt areas, neighborhood parks, and even parking facilities provide excellent settings for the temporary storage of stormwater. Such areas are not usually in use during periods of precipitation and the ponding of stormwater for short durations does not seriously impede their primary functions.

Longevity of Infiltration Systems

One of the problems with infiltration BMPs that has been consistently identified, either quantitatively or qualitatively, is their high rate of failure. Maryland's Stormwater Program produced one of the most comprehensive quantitative reviews of the longevity of infiltration systems (Pensyl and Clement, 1987; Lindsey et al, 1992). This information is summarized in Table 1, where it can be seen that the overall condition and functioning of infiltration systems declined over time. In 1986, about two-thirds of all surveyed facilities were functioning as designed, while in 1990, only about half were. Only 42% of the facilities were functioning as designed in both 1986 and 1990, while about 27% were not functioning as designed in both years. About 24% of the systems were functioning in 1986, but not in 1990; while only 7% of those not working in 1986 were working in 1990. Maintenance was needed at more facilities in 1990 (66%) than in 1986 (45%). Additionally, 38% of facilities that needed maintenance in 1986, still needed maintenance in 1990, while 32% of the facilities that did not need maintenance in 1986, did need it in 1990. Only 10% of the systems that needed maintenance in 1986 did not need maintenance in 1990. These data suggest that little effort is expended on maintaining the operational capabilities of stormwater management systems.

Additional quantitative information on the success and failure of infiltration systems was collected in the Puget Sound, Washington, area (Klochak, 1992; Gaus, 1993; Hilding, 1993; Jacobson and Horner, 1993). Of 23 infiltration basins evaluated, 12 did not comply with the region's guidelines for either infiltration rate or time for the basin to recover its storage volume. Interestingly, the authors found no relationship between lack of basin maintenance and failure, with examples of basins with and without maintenance that did not function properly. Some basins were functioning properly even though they had never been maintained, while 43% of the 23 basins had been scarified to enhance performance.

The above data, when combined with qualitative information from Florida and Delaware (Baldwin, 1999, personal communication), seem to indicate that infiltration basin failures are associated with:

1. Inaccurate estimation of infiltration rates
2. Inaccurate estimation of the seasonal high water table
3. Excessive compaction during the construction process
4. Excessive sediment loadings either from improper erosion and sediment control during the construction process or a lack of pretreatment BMPs
5. Lack of maintenance

Factors Influencing Successful Use of Infiltration Systems

Factors that influence the successful use of any stormwater BMP can be categorized as institutional, technical, and implementational. This section of the paper will examine the components of each of these categories that must be included in a stormwater program if the causes of infiltration system failure are to be minimized.

Institutional Components

The "BMP Golden Rule" states that stormwater BMPs should never be required unless the stormwater program includes components that will assure that the BMPs are correctly designed, approved, constructed, inspected, maintained,

Table 1. Results of Maryland Infiltration Practices Surveys

	Basins		Trenches		Dry Wells		Perv. Paving		Veg. Swale	
	1986	1990	1986	1990	1986	1990	1986	1990	1986	1990
# facilities	63	48	94	88	30	25	14	13	6	3
(% of total)	30%	27%	45%	30%	14%	14%	7%	7%	3%	2%
Facility Evaluations										
Functioning	30	18	75	47	23	18	7	2	3	2
	48%	38%	80%	53%	77%	72%	50%	15%	50%	67%
OM Needed	41	39	28	64	9	4	10	8	6	3
	65%	81%	30%	73%	30%	16%	71%	62%	100%	67%
Performance and Maintenance Criteria										
Buffer strip	20	4	65	35	24	0	14	3	1	0
inadequate	32%	8^	69%	39%	80%		100%	23%	17%	
Stabilization	12	23	11	13	1	3	1	1	3	1
needed	19%	48%	12%	15%	3%	12%	7%	8%	50%	33%
Sediment	24	28	32	58	0	2	9	9	4	1
entry	38%	58%	34%	66%		8%	64%	64%	67%	33%
Inappropriate	41	25	25	20	9	3	7	4	4	0
ponding	65%	52%	27%	23%	30%	12%	50%	31%	67%	
No observed	na	na	45	58	4	7	10	11	na	na
well			45%	56%	13%	28%	71%	85%		

and operated (Livingston, 1997). Specifically, the program must have stormwater treatment and management goals, performance standards, education, and an institutional framework that includes plan approval, inspections during and after construction, legal operation and maintenance entity requirements, effective compliance mechanisms, and dedicated funding mechanisms.

Program goals: Experience has shown that stormwater programs need to have multiple objectives that are important to the general public in order to gain the support of the community. Typically, these will include flood protection, erosion and sediment control during construction, water quality and habitat protection, and open space and recreation. Infiltration systems can help achieve all of these goals.

Performance standards: Nearly all stormwater treatment programs in the United States are technology-based, relying upon a performance standard (minimum level of treatment) and design criteria for various BMPs that assure that they achieve the desired treatment goal. A review of 32 stormwater programs around the country showed that the most common performance standard is removing at least 80% of the average annual loading of total suspended solids (WMI, 1997a). Some programs require higher levels of treatment for stormwater discharges to sensitive waters, such as Florida's requirement that discharges to Outstanding Florida Waters remove at least 95% of the average annual pollutant load. Technology-based performance standards such as these provide water quality goals for nonpoint sources that create equity with the minimum treatment requirements for domestic wastewater point sources (Livingston, 1988).

Institutional framework: The stormwater program must have a strong institutional framework that assures that all BMPs are (1) properly designed, (2) reviewed and approved, (3) inspected during and after construction, and (4) operated and maintained. The components of this institutional framework are set forth in Figure 1. One of the most important components especially for infiltration practices, is a feedback mechanism among system inspectors, plan reviewers, and designers about what is working and what is not. This information can then be used to revise the design criteria for infiltration BMPs and improve their potential for long-term success.

Technical Components:

Successful implementation of any BMP depends on a thorough understanding of the factors that determine the BMP's treatment effectiveness, a strong scientific basis for the BMP's design criteria, and an understanding of the site conditions that are required or that limit the utility of a specific BMP. Infiltration practices are also commonly called retention practices because they retain the runoff on-site and are designed to infiltrate a design volume (treatment volume) of stormwater. Factors that influence the treatment effectiveness and feasibility of infiltration practices include (1) precipitation patterns, (2) whether the system is designed as an on-line or off-line system, (3) whether pretreatment via the BMP treatment train is provided, and (4) site characterisitcs such as land use, soil type, geology, water table elevation, topography, and vegetation.

Infiltration areas, especially off-line ones, can be incorporated easily into landscaping or open space areas of a site. These can include natural or excavated grassed or landscaped depressions and recreational areas. Parking lots, with their landscape islands, offer an excellent opportunity for the use of this concept since even the infiltration of a quarter inch of runoff will greatly reduce sediments, metals, oils and greases. Placing storm sewer inlets within recessed parking lot landscape areas, raising the inlet a few inches above the bottom, and using curb cuts to allow runoff to enter this area represents a highly effective treatment train. If site conditions prevent the exclusive use of infiltration, then off-line retention areas should be used as pretreatment practices in a stormwater treatment train. This is especially true if detention lakes are the primary component of the stormwater system and the lakes are intended to serve as a focal point of the development.

Pollutant removal efficiency factors: Average annual pollutant removal efficiency is calculated considering the annual mass of pollutants available for discharge and the annual mass removed. The primary removal mechanism for infiltration practices is the volume of stormwater that is infiltrated, since this eliminates the discharge of stormwater and its associated pollutants. In addition, the system's vegetation and the surficial soils play an important role in binding and transforming pollutants as the water infiltrates. As with any type of stormwater management practice, actual field efficiency will depend on a large number of factors. For infiltration practices, such factors include:

1. Long-term precipitation characteristics; such as mean number of storms per year, their intensity and volume, and average inter-event time.

Figure 1. Stormwater Program Institutional Framework Components

Inspections
- Erosion/sediment controls
- Stormwater system construction
- Stormwater system operation

Stormwater system operation/maintenance
- Public facilities
- Private facilities
- Adopt a pond program

Plan review and approval
- Site plans
- Erosion control plans
- Stormwater plans
- Feedback evaluation process

Education programs
- General public
- Elected officials
- School curriculum
- Designers
- Developers
- Builders
- Practitioners
- Inspectors

Structural BMPs
- Design criteria
- Research/performance
- Proper construction
- Proper operation
- Maintenance

Performance standards
- Peak discharge rate
- Volume
- Treatment

Administration
- Lead agency?
- Separate agency?

Staffing
- Engineers
- Inspectors
- Planners
- Scientists
- Maintenance
- Clerical

Compliance/enforcement
- Stop-work orders
- Fines
- Civil or criminal

Nonstructural BMPs
- Site planning
- Source controls
- Land acquisition
- Street sweeping

Program Evaluation
- Citizen surveys
- Bldg. community surveys
- BMP monitoring
- Water body monitoring

Stormwater Retrofitting
- Watershed goal
- Targeting/prioritization
- Capital improvements
- Regional BMPs

Local land use plan | **Stormwater master planning** | **Watershed planning**

Integration with other federal, state, regional, and local programs

Adopt program laws/regulations | **Adopt stormwater utility ordinance/fees**

Legal	**Funding**	**Staffing**	**Public**	**Govt. Roles Responsibilities**

2. The occurrence of first flush, which is related to the amount of directly connected impervious area; type of stormwater conveyance system; and the pollutant of interest

3. Whether the system is an "on-line" or an "off-line" design

4. Cumulatively, the above three factors determine the minimum treatment volume and maximum storage recovery time

The U. S. Weather Bureau has measured weather statistics at many locations around the country. Long-term precipitation records, including such information as day and duration of event, intensity, volume, etc., are available from either the Federal government or private vendors. Statistical analysis of these records can develop probability frequencies for storm characteristics such as the mean storm volume and the mean inter-event period between storms.

"First flush" describes the washing action that stormwater has on accumulated pollutants in the watershed. In the early stages of runoff, the land surfaces, especially impervious ones like streets and parking areas, are flushed clean by the stormwater. This flushing creates a shock loading of pollutants. However, the occurrence and prevalence of first flush depends largely on precipitation patterns, the degree of imperviousness of the contributing drainage area, the size of the drainage area, and the type of stormwater conveyance system. Florida studies have determined that for highly impervious urban land uses with drainage areas under 100 acres, there is a first flush for many pollutants, especially particulates (Yousef et al., 1985; Miller, 1985). In areas such as Oregon and Washington, however, where rainfall consists of low intensity, long-duration "events," first flush is not very prevalent.

On-line stormwater practices store runoff temporarily before most of the volume is discharged to surface waters. These systems capture all of the runoff from a design storm. This mixes all stormwater within the system, thereby masking first flush and reducing pollutant removal. They primarily provide flood control benefits, with water quality benefits usually secondary--although on-line wet detention systems provide both.

Off-line practices are designed to divert the more polluted first flush stormwater for water quality treatment, isolating it from the remaining stormwater that is managed for flood control. In infiltration systems, the diverted first flush is not discharged to surface waters, but is stored until it is gradually removed by infiltration, evaporation, and evapotranspiration. Vegetation, such as grass in the bottom and sides of infiltration areas, helps to trap stormwater pollutants and reduce the potential for transfer of these pollutants to groundwater. Off-line retention practices are the most effective for water quality enhancement of stormwater.

Since an off-line retention area primarily provides for stormwater treatment, it must be combined with other BMPs for flood protection to form a comprehensive stormwater management system. Figure 2 is a schematic of an off-line system, commonly referred to as a "dual pond system." In these systems, a smart weir directs the first flush stormwater into the infiltration area until it is filled, with the remaining runoff being routed to the detention facility for flood control.

A more recent investigation of the influence of long-term rainfall characteristics on the efficiency of retention practices included inter-event dry periods, leading to the development of diversion volume curves for inter-event dry periods of varying length (Wanielista et al., 1991a). Figure 3 shows an example diversion volume curve for the Orlando area. It is important to note that first flush is not considered in these curves. If a first flush effect does exist, the design curves would be conservative in that the percent treatment efficiency of the infiltration system would increase. Furthermore, these curves are based on precipitation-interevent-frequency (PIF) curves that also include consideration of the probability that a storm greater than the design storm will occur. The PIF analysis looked at exceedance probabilities storms with a return period of 2, 3, 4, or 6 months, representing a chance that the storm will exceed the design volume 6, 4, 3, or 2 times per year. Other useful products from this project are Rate-Efficiency-Volume charts and curves that can be used to design wet detention ponds that reuse runoff and thereby help to balance pre- and post-development volume (Livingston et al., 1999).

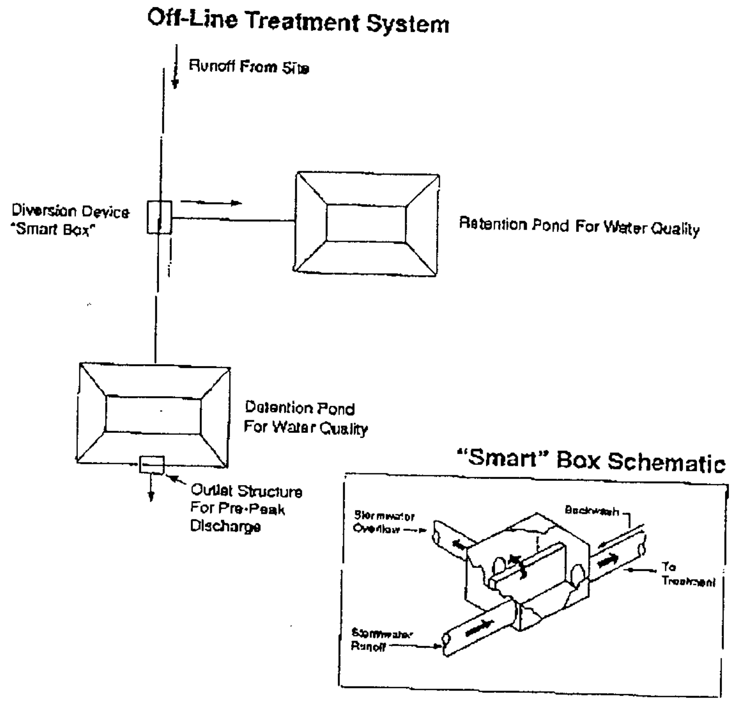

Figure 2. Schematic of an Off-line Stormwater System.

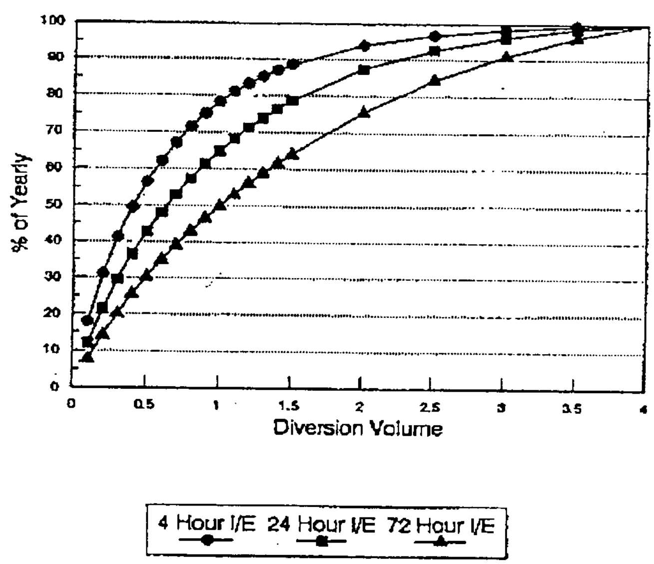

Figure 3. Diversion Volume Curve for Orlando, Florida.

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Site Characteristics: The suitability of a site for using infiltration practices will depend on a careful evaluation of the site's natural attributes. Proposed infiltration areas should be evaluated for feasibility on any particular site or project by examining the following:

SOILS - Must be suitable for infiltration. Nationally, most states recommend that soil textures should not have more than 30% clay content or 40% silt content. Most importantly, they need to be able to percolate the diverted volume to infiltrate within 72 hours, or within 24-36 hours for infiltration areas that are planted with grasses. Therefore, soils that have been classified by the NRCS as HSG A are recommended for infiltration practices, although they can be successfully used with HSG B soil types.

INFILTRATION RATES - In recent years, the minimum permeability rate recommended for infiltration practices has been raised by implementing agencies. Shaver (1986) recommended a minimum rate of 0.25 inches per hour, but Maryland's regulations now recommend 0.52 inches per hour. One of the most difficult aspects of designing infiltration practices is obtaining reliable information about the actual infiltration rate of the soil where the practice will be constructed. Unfortunately, such information is not easily obtainable. Avellaneda (1985) conducted 20 hydrologic studies of vegetated swales constructed on sandy soils with a water table at least one foot below the bottom during dry conditions. Infiltration rates were measured using laboratory permeability tests, double ring infiltrometers, and field mass balance experiments. The field mass balance method measured a minimum infiltration rate of 2-3 inches/hour. This measured rate was much less than lab permeabilities, rates measured by double ring infiltrometer tests (5-20 in/hr), or rates published in the Detailed Soil Survey.

The following should be considered for determining the infiltration rate for retention practices:

1. Since the infiltration rate is the key to designing any retention practices, conservative estimates should be used, and safety factors incorporated into the design to ensure that the design volume will actually be percolated into the soil and not discharged downstream.

2. It is important that on-site infiltration measurements be taken at the locations where retention practices will be located. More importantly, since soil characteristics and infiltration rate change with depth, it is crucial that the measurements be made at the depth of the design elevation of the bottom of the retention practice.

3. Infiltration rates should be determined by mass balance field tests if possible. They provide the most realistic, accurate estimate of the percolation rate. If field tests are not possible, infiltrometer tests should be used, with lab permeability tests a third option. In either of these latter two tests, the design infiltration rate should be half of the lowest measured rate. As a last resort, information from Detailed Soil Surveys can be used to estimated the infiltration rate. However, the lowest rate should be used--as should a safety factor of two.

A recent assessment of infiltration practices in Carroll County, Maryland, quantified the infiltration rates for six basins and six trenches of differing ages (Nelson et al., 1999). They found that 64% of the systems had an average infiltration rate below the state's minimum recommended rate. However, 70% of the practices were still recovering their storage volume within the required 72 hours. Interestingly, for some facilities (mainly trenches), the infiltration rate met or exceeded the minimum state rate for a large percentage of the volume of water infiltrated, while the remaining water persisted for much longer periods of time before infiltrating. This may indicate that (1) the infiltration rate is related to the hydraulic head, where the higher depth of the stormwater in the BMP creates a higher pressure pushing water into the ground, or (2) the bottoms of the systems accumulate fines that impede percolation, while the sides of the systems are still infiltrating runoff rapidly.

WATER TABLE - The seasonal high water table should be at least three feet beneath the bottom of the infiltration area to assure that stormwater pollutants are removed by the vegetation, soil, and microbes before contacting the groundwater. Jacobson and Horner (1993) recommend a minimum of five feet if the seasonal high water table cannot be estimated accurately. When considering the groundwater elevation, it is important to remember that the retention area can cause a mounding effect on the water table, thereby raising it above the predevelopment level. The Southwest Florida Water Management District (SWFWMD) has developed a model that can be used to more accurately determine the seasonal high water table and the effects of mounding (SWFWMD, 1998).

GEOLOGY - Bedrock should be at least three feet beneath the bottom of the infiltration area. In those parts of the country where limestone is at or near the land surface, special precautions must be taken when using infiltration practices. The potential for groundwater contamination in such areas is quite high, especially in "Karst Sensitive Areas" (KSA) where sinkhole formation is common. In KSAs, solution pipe sinkholes may form in the bottom of infiltration areas creating a direct conduit for stormwater pollutants to enter the groundwater. Solution pipes often open in the bottom of retention areas because the natural soil plug capping the solution pipe is thinned by partial excavation to create the retention area and because the stormwater creates a hydraulic pressure which can wash out the plug.

In KSAs, a site-specific hydrogeologic investigation should be undertaken that includes geologic borings wherever infiltration areas are proposed and mapping limerock outcroppings and sinkholes on site. Infiltration systems in KSAs should (1) include several small off-site areas, (2) use swale conveyances for pretreatment, (3) be as shallow as possible, (4) be vegetated with a permanent cover such as sodded grasses, and (5) have flat bottoms to keep the stormwater spread out across the entire area.

TOPOGRAPHY - Infiltration practices should not be located on areas with slopes over 20% to minimize the chance of downstream water seepage from the subgrade. Sloping sites often require extensive cut and fill operations. Infiltration practices should not be sited on fill material, since fill areas are very susceptible to slope failure, especially when the interface of the fill/natural soil becomes saturated.

VEGETATION - To reduce the potential for stormwater pollutants to enter groundwater, and to help maintain the soil's capacity to absorb water, infiltration practices should be vegetated with appropriate native vegetation, especially grasses. However, this type of vegetation cannot tolerate long-term inundation, so the retention area must be capable of infiltrating all of its runoff within a relatively short time period (i.e., 24 to 36 hours). The design of "bioretention" systems incorporates soils and vegetation that are proficient in trapping stormwater pollutants within them and takes advantage of microbial processes that help transform and trap pollutants in the terrestrial environment.

SET BACKS - Infiltration areas should be located at least 100 feet from any water supply well and at least 12 feet down-gradient from any building foundations. Additionally, they should be set back at least 50 feet from on-site wastewater systems, especially drain fields.

LAND USE RESTRICTIONS - Certain infiltration practices can only be applied to particular land uses. For example, some sites are so small or intensively developed that space is insufficient for surficial practices (e.g., retention basin), but they may allow for infiltration or exfiltration trenches if pretreatment can be provided. A concern with any infiltration practice is the potential for hazardous or toxic wastes to enter the system and migrate into the groundwater. Land uses where such substances are used should implement comprehensive pollution prevention, spill containment, and emergency response plans that will prevent dangerous materials from getting into the infiltration system.

POTENTIAL FOR GROUNDWATER POLLUTION - A possible concern about infiltration practices is whether they simply are transferring the stormwater pollution problem from surface waters to groundwaters. Stormwater pollutants, especially heavy metals, quickly bind to soil particles and vegetation is effective in filtering pollutants, thereby minimizing the risk of groundwater contamination (Harper, 1985; Yousef et al, 1985b). However, groundwater beneath swales, and retention areas located in highly sandy soils with low organic content, did show elevated levels of heavy metals down to depths of 20 feet (Harper, 1988).

Design Criteria

Once all of the above factors have been quantified using state, regional, or local data as appropriate, specific design criteria can be established. Table 2 summarizes the design criteria for infiltration systems set forth in Florida's stormwater regulations. St. John's River Water Management District (SJRWMD, 1992).

Table 2. Florida's Design Criteria for Infiltration Practices

BMP	80% Treatment Effectiveness Diversion Volume
Swales	Infiltrate 80% of the runoff from a 3-yr, 1-hr storm (2.5 inches)
Retention - Off-line	Infiltrate the larger of 0.5 inches of runoff or 1.25" X % impervious
Retention - On-line	Infiltrate an additional 0.5 inches of runoff
DESIGN FACTOR	CRITERIA
Soil type	HSG A or B with < 30% clay or < 40% silt/clay
Treatment volume recovery time	72 hours, 24 to 36 hours if grassed
Water table or bedrock	At least 3 feet beneath bottom after mounding
Topography	On slopes < 20%, not on fill soils
Vegetation	Recommended to reduce potential for groundwater pollution and to maintain soil permeability
Land use	May not be appropriate at sites where hazardous materials spills may occur

Swales: Traditionally, swales are used primarily for stormwater conveyance and, as such, are considered an on-line practice. The removal of stormwater pollutants by swales can occur by infiltration or vegetative filtration. Investigations in Florida (Yousef et al., 1985a; Harper, 1985) have concluded that swale treatment efficiency largely depends on the volume of stormwater that can be infiltrated through the filtering vegetation and into the soil.

Avellaneda (1985) developed the following equation for a triangular-shaped swale to estimate the length of swale necessary to infiltrate the design stormwater treatment volume:

$$L=\frac{KQ^{5/8}S^{3/16}}{n^{3/8}i}$$

where:

L = swale length (m)
Q = average runoff flow rate (m3/S)
S = longitudinal slope (m/m)
K = constant which is a function of side slope that varies from 4,722 to 10,516
n = Mannings roughness coefficient
i = infiltration rate (cm/hr)

For most residential, commercial, and highway projects, the length of swales necessary to percolate the stormwater needed to achieve the 80% performance standard was found to be excessive, or at least twice the distance available. Thus, some type of swale block (berm) or on-line detention/retention may be more helpful. Swales make excellent pretreatment practices by providing for the infiltration of some stormwater and for some vegetative filtration. By using a raised storm sewer inlet, swales can provide water quality enhancement via retention and still serve as effective conveyances for flood protection. Swales can incorporate retention by using swale blocks, small check dams, or elevated driveway culverts to create storage; thereby reducing runoff velocity, reducing erosion, and promoting infiltration. In highway designs for high speed situations, safety must be considered; thus, a maximum depth of water equal to 1.5 feet and flow line slopes on the berms of 1 vertical/20 horizontal are recommended. Along lower speed highways or in some residential/commercial urban settings, steeper flow line berm slopes (1 on 6) are acceptable (Wanielista et.al., 1986).

Unlike Florida, investigations in Washington State (Horner, 1988; WPCD, 1992) indicate that swales can also act as a biofilter, with removal of particulate pollutants without infiltration of stormwater. The following recommendations were made to improve their water quality benefits:

1. Maximum design velocity should not exceed 27 cm per second.

2. A hydraulic residence time of at least 9 minutes is recommended for removal of about 80% of the total suspended solids. Longer residence times will provide higher removal effectiveness.

3. Swale width should be limited to 6 to 8 feet, unless special measures are provided to assure a level swale bottom, uniform flow spreading, and management of flows to prevent formation of low-flow channels.

4. Swale slopes should be between 2 and 4%.

5. Water depth should be limited to no greater than one half the height of the grass, up to a maximum of 3 inches of water depth.

6. Swale length will be a function of the hydraulic residence time, swale width, and stormwater volume and velocity.

Implementation Components

Even if effective design criteria have been established for an infiltration system, the design has been reviewed and approved, and the institutional framework to assure performance has been established, an infiltration system may still not work correctly. In fact, assessments of the success or failure of infiltration systems have determined that poor construction is a major factor in system failure (Pensyl and Clement, 1987; Lindsey et al., 1991). We will discuss five considerations that are essential to proper implementation of infiltration practices including (1) education, (2) erosion and sediment control, (3) construction, (4) inspections, and (5) maintenance.

Education: The stormwater program needs to include an extensive education program that targets BMP designers, plan reviewers, inspectors, contractors, and maintenance personnel. Each of these practitioners is an important part of the stormwater team. They must each understand their role in BMP design and implementation, as well as the technical factors discussed above. Additionally, a communication mechanism needs to be established among all of these practitioners so that in-the-field knowledge of what works, and what does not work, is transferred back to all other team members. With respect to BMP installation, the plan reviewers and inspectors should meet with the project engineers and contractors on-site to review the site plan, construction sequencing, erosion and sediment control plan and details, and the infiltration system's detailed standards and specifications.

Erosion and sediment control: Infiltration practices must be protected from sediment loadings, especially during the project's construction phases. Infiltration practices should never be used as part of the erosion and sediment control system, nor should they be put into operation until all contributing drainage areas are fully stabilized. Although sediment loads drop sharply after construction is completed, gradual clogging of infiltration practices can still occur. Pre-treatment practices such as swale conveyances or vegetated buffer strips can help to filter out sediments and extend the life of retention practices. Do not forget the treatment train concept.

Construction considerations: To prevent clogging of infiltration areas, special precautions must be taken during the entire construction phase of a project to prevent reduction of the system's infiltration capacity. In particular, two areas need to be stressed, including preventing sedimentation during construction and preventing compaction of the soil. Areas that are selected for infiltration use should be well marked during site surveying and protected during construction. Specifical construction recommendations are as follows (WMI, 1997b):

1. If possible, schedule construction so it does not occur during the rainy season but does occur during the vegetation growing season. For example, in Auckland, New Zealand, construction sites are shut down during the winter when long, prolonged rains make erosion and sediment controls ineffective and when vegetation does not grow well. Unfortunately, in the United States, these seasons often overlap and the economics of development dictate the time frame for starting construction.

2. Before the development site is graded, areas planned for use as infiltration systems should be well marked during site surveying, and all traffic and heavy equipment kept away from the area to prevent compacting the underlying soils.

3. Construction should be overseen by someone who is trained and experienced in the installation of infiltration practices, and who is knowledgeable about their purpose and operation.

4. The design team should inspect the exposed soil after excavation to confirm that soil conditions are as expected and are suitable for the approved design. If they are not, work should not proceed and the situation should be analyzed to determine whether or not design or construction changes should be made to the approved design.

5. Construction of the infiltration system should not begin until after the site has been completely stabilized. If this is not possible, then:

   a. Diversion berms should be placed around the perimeter of the infiltration area during all phases of construction to divert runoff and sediment away from it.

   b. Sediment and erosion control plans for the site should be oriented to keep sediment and runoff completely away from the area.

   c. The facility should not be excavated to final grade until after the contributing drainage area is stablilized. Leave at least two feet of native soil during the initial excavation.

6. Infiltration areas should never be used as a temporary sediment basins during the construction phase. Unfortunately, it is common for infiltration areas, especially basins, to be used as a sediment trap, with initial excavation to within two feet of the final design elevation of the basin floor. If the facility is to be used during construction, this soil can be removed in layers as it clogs. Once construction is completed, sediment that accumulated during the construction phase can then be removed when the basin undergoes final excavation to its design elevation. However, recent experience indicates that even with this type of construction practice, infiltration areas used as sediment traps have a higher rate of failure.

7. Infiltration areas/basins should be excavated using light earth-moving equipment with tracks or over-sized tires. Normal rubber tires should be avoided since they compact the subsoil and reduce its infiltration capabilities. For the same reason, the use of bulldozers or front end loaders should be avoided.

8. During construction, place excavated material at least 10-15 feet away from the infiltration area.

9. Since some compaction of the underlying soils is still likely to occur during excavation, the floor of the basin should be deeply tilled with a rotary tiller or disc harrow at the end of the excavation process.

10. Rock used in infiltration or exfiltration trenches should be washed clean of sediments. Rock should be placed in lifts and compacted after each lift.

11. Trenches should be clear of any protruding objects and carefully inspected before installing geotextile fabrics. The fabrics should have the proper permeability and be installed with at least a 12-inch overlap, in a shingle-like manner

12. Trenches should be covered and not put into operation until the contributing drainage area is completely stabilized and all pretreatment BMPs installed.

13. Pervious asphalt and concrete should be installed only by certified personnel who are specifically trained in their batching, pouring, and finishing.

14. The basin should be stabilized with vegetation within a week after construction. Use of low maintenance, rapidly germinating native grasses are recommended. The condition of the newly established vegetation should be checked several times over the first two months, and any necessary remedial actions taken (e.g., reseeding, fertilization, and irrigation).

Inspections: Like all stormwater treatment practices, infiltration systems need to be inspected during construction and on a regular basis after construction. Inspections during construction are needed to assure that the infiltration system is built in accordance with the approved design and standards and specifications. Five inspections are recommended: (1) pre-construction, (2) during excavation, (3) during construction of the embankment (if applicable), (4) after final excavation, and (5) after construction is completed. During this final inspection, the inspector should have a copy of the "As-built or record drawings." In addition, infiltration systems should be inspected semi-annually after construction (before and after wet seasons) to ensure that they continue to function. Two site trips are recommended: one during or immediately after a rainfall, so that conditions during operation can be observed, and a second from 24 to 72 hours after the rainfall, to determine whether the system is recovering its storage volume as designed. Inspection forms are highly recommended. Examples of inspection forms (WMI, 1997b) can be downloaded from the EPA web site located at http://www.epa.gov/owow/NPS/orderform.html.

Maintenance: All infiltration practices will require regular and non-routine maintenance to maintain their ability to infiltrate stormwater. The frequency and need for maintenance will depend primarily on the loading of particulates and whether pre-treatment practices have been employed. Routine maintenance includes revegetating eroding areas, removing materials that accumulate in pretreatment BMPs, and removing materials from inlets and outlets. Non-routine, restorative maintenance activities should be conducted whenever inspections reveal that stormwater remains in the system beyond the designed time. These may include structural repairs to the inlets or outlets and restoration of the infiltration capability of the system.

Additional Concerns and Recommendations

Concerns with Pervious Pavement: Local land development codes typically specify the type of material for a parking lot (i.e., paved, grass, gravel) and determine the number and size of parking spaces within a parking lot. These requirements should be reviewed carefully to ensure that they are necessary (is paving really required in every case) and that the number of spaces is related to actual traffic demands. After these requirements have been reviewed and verified, the use of pervious pavement within a parking lot should be examined. Pervious pavement materials include pervious asphalt, pervious concrete, turf blocks, and even Geoweb covered with sod.

Overall, experiences with pervious pavements have not been very good. Pervious pavements have been prone to clogging. Causes include poor erosion and sediment control during construction, unstabilized drainage areas after construction, improper mixing and finishing of the pavement, and poor maintenance. However, field investigations of pervious concrete that has been in use for up to 15 years in Florida indicate that these parking lots can continue to infiltrate rainfall and runoff if they were installed and maintained properly (FCMA, undated). Pervious concrete not only helps reduce site imperviousness, but also reduces hydroplaning and road noise.

Recommendations: Specific recommendations and other important information about infiltration systems that will help increase their successful implementation are summarized in Table 3. This table includes essential information about the advantages, disadvantages, maintenance, and other aspects of successfully using infiltration practice. To improve evaluation of site conditions for the suitability of infiltration practices, Jacobson and Horner (1993) recommended a quan titative rating system. The factors used in the system included: (1) soil till layer (presence and location), (2) location of seasonal high water table, (3) removal efficiency of the pretreatment BMPs, (4) degree of siltation protection, (5) soil type, and (6) infiltration rate. Different degrees of acceptability are possible: (1) disqualifying (characteristics that eliminate design or location from further consideration), (2) passable (characteristics that allow consideration but not ideal), and (3) ideal (optimum characteristics for design or siting of facility). Table 4 illustrates the proposed rating system factors.

Table 3. Additional Information About Infiltration Systems to Enhance Successful Implementation

Infiltration Bmp Type	Advantages	Disadvantages	Maintenance	Comments
Surface Basin (Typically recessed areas or, in Mid-Atlantic States, rock filled)	•Integrate into land-scaping, open space, parking lot islands •Use for recreation •Easier inspection and maintenance	•Land area required •Potential mosquito problem if not designed or maintained properly	•Vegetated basins should be mowed and clippings removed •Remove sediments when dry and cracked •Non-vegetated basins require annual disking	•Can serve larger drainage 3:1 or flatter side slopes, flat bottom •Bottom and side slope vegetation recommended
Infiltration Trench (Typically a rock filled trench)	•Can be used where land or space is limited	•Easily clogged •Difficult to unclog •Difficult to monitor performance	•Removing sediments that accumulate in rocks	•Pretreatment essential •Use observation well •Keep covered until drainage area stabilized
Exfiltration Trench (Typically a perforated pipe with a gravel envelope)	•Can be used where land or space is limited	•Easily clogged •Difficult to unclog •Difficult to monitor performance	•Remove materials that enter pipe •High pressure wash perforated pipe •Removing sediments that Accumulate in rocks, replace rocks	•Pretreatment essential •Source controls useful •Geotextile is limiting infiltration factor •Inf. rate 0.5"/hr if use sides and bottom •Inf. rate 1"/hr if use bottom
Pervious Pavement	•Reduces impervious-ness •Reduces hydroplaning and highway noise •Higher recharge rates	•Easily clogged •Lack of trained practitioners •Anaerobic conditions may develop in soils	•Regular vacuum street sweeping •High pressure cleaning •Drilling holes to restore infiltration •Replacement	•Proper batching and placement is crucial •Education programs needed for practitioners •Post signs to inform users and keep dir and mud out
Swale (Typically a shallow, grassed conveyance system)	•Can be incorporated into site 's landscaping/ open areas •Great car in BMP Train •Aesthetically pleasing	•Not for flood control •May "disappear" from residential back yards •May become depository for trash, yard wastes	•Mow and remove grass clippings •Hydroscope accumulated sediments and resod •Repair erosion areas	•Wet swales (wetland plants) work great too •Use swale blocks, raised driveway culverts to retain runoff

Table 4. Possible Rating System to Evaluate the Suitability of Infiltration BMPs

Factor	Disqualifying Characteristic	Passable Characteristic	Ideal Characteristic
Soil till layer	Impenetrable, thick layer near surface	Layer present but at >5' depth, or easily penetrable	No till layer present
Seasonal High Water Table	Close to surface, within 5'	At intermediate depth, at least 5' below BMP bottom	Very deep, well below BMP bottom
Pretreatment	None provided	Some,minimum 50% TSS removal	Pretreatment provides >80% TSS removal
Siltation Protection	None provided	Any silt or construction sediment removed before final BMP construction	Fully protected from silt during construction
Soils	Saturated or with >30% clay or >40% silt/clay content	Coarse, highly infiltrative soil that can be modified to produce proper inf. rate	Loam or loamy sand
Infiltration Rate	<0.5"/hr	>2.5"/hr but with very deep water table or modified to slower rate	0.5 to 2.5"/hr

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Potential New Tools for the Use of Tracers to Indicate Sources of Contaminants to Storm Drainage Systems

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Abstract

This paper is a description of previously developed methods used to identify sources of contaminants in storm drainage systems, plus a review of emerging techniques that may also be useful. The original methods, along with selected new procedures, were tested using almost 700 stormwater samples collected from telecommunication manholes from throughout the U.S. About 10% of the samples were estimated to be contaminated with sanitary sewage, using these methods, similar to what is expected for most stormwater systems. The original methods are still recommended as the most useful procedure for identifying contamination of storm drainage systems, with the possible addition of specific tests for *E. coli* and enterococci and UV absorbance at 228 nm. Most newly emerging methods require exotic equipment and unusual expertise and are therefore not very available, especially at low cost and with fast turn-around times for the analyses. These emerging methods may therefore be more useful for special research projects than for routine screening of storm drainage systems.

Introduction

Urban stormwater runoff includes waters from many other sources which find their way into storm drainage systems, besides from precipitation. There are cases where pollutant levels in storm drainage are much higher than they would otherwise be because of excessive amounts of contaminants that are introduced into the storm drainage system by various non-stormwater discharges. Additionally, baseflows (during dry weather) are also common in storm drainage systems. Dry-weather flows and wet-weather flows have been monitored during numerous urban runoff studies. These studies have found that discharges observed at outfalls during dry weather were significantly different from wet-weather discharges and may account for the majority of the annual discharges for some pollutants of concern from the storm drainage system.

There have been numerous methods used to investigate inappropriate discharges to storm drainage systems. Pitt, *et al.* (1993) and Lalor (1994) reviewed many of these procedures and developed a system that municipalities could use for screening outfalls in residential and commercial areas. They are currently updating these earlier methods under funding from the U.S. EPA and the University of New Orleans. In these areas, sewage contamination, along with low-rate discharges from small businesses (especially laundries, vehicle repair shops, plating shops, etc.) are of primary concern. One of the earliest methods used to identify sewage contamination utilized the ratio of fecal coliform to fecal strep. bacteria. This method is still in use, but unfortunately has proven inaccurate in most urban stormwater applications. The following discussion reviews the methodology developed by Pitt, *et al.* (1993) and Lalor (1994), and some new approaches that were investigated.

Use of Tracers to Identify Sources of Contamination in Urban Drainage Systems

This research investigated inappropriate discharges into storm drainage systems. It was of most concern to identify toxic or pathogenic sources of water, typically raw sewage or industrial wastewaters, that were being discharged accidentally into the storm drainage system.

Investigations designed to determine the contribution of urban stormwater runoff to receiving water quality problems have led to a continuing interest in inappropriate connections to storm drainage systems. Urban stormwater runoff is traditionally defined as that portion of precipitation which drains from city surfaces and flows via natural or man-made drainage systems into receiving waters. In fact, urban stormwater runoff also includes waters from many other sources which find their way into storm drainage systems. Sources of some of this water can be identified and accounted for by examining current National Pollutant Discharge Elimination System (NPDES) permit records for permitted industrial wastewaters that can be legally discharged to the storm drainage system. However, most of the water comes from other sources, including illicit and/or inappropriate entries to the storm drainage system. These entries can account for a significant amount of the pollutants discharged from storm sewerage systems (Pitt and McLean 1986).

Permits for municipal separate storm sewers include a requirement to effectively prohibit problematic non-stormwater discharges, thereby placing emphasis on the elimination of inappropriate connections to urban storm drains. Section 122.26 (d)(1)(iv)(D) of the rule specifically requires an initial screening program to provide means for detecting high levels of pollutants in dry weather flows, which should serve as an indicator of illicit connections to the storm sewers. To facilitate the application of this rule, the EPA's Office of Research and Development's Storm and Combined Sewer Pollution Control Program and the Environmental Engineering & Technology Demonstration Branch, along with the Office of Water's Nonpoint Source Branch, supported research for the investigation of inappropriate entries to storm drainage systems (Pitt, *et al.* 1993). The approach presented in this research was based on the identification and quantification of clean baseflow and the contaminated components during dry weather. If the relative amounts of these components are known, the importance of the dry weather discharge can be determined.

The ideal tracer to identify major flow sources should have the following characteristics:

- Significant difference in concentrations between possible pollutant sources;
- Small variations in concentrations within each likely pollutant source category;
- A conservative behavior (i.e., no significant concentration change due to physical, chemical or biological processes); and,
- Ease of measurement with adequate detection limits, good sensitivity and repeatability.

In order to identify tracers meeting the above criteria, literature characterizing potential inappropriate entries into storm drainage systems was examined. Several case studies that identified procedures used by individual municipalities or regional agencies were also examined.

Parameters Suitable for Indicators of Contamination by Sanitary Sewage

Tracer Characteristics of Local Source Flows. Table 1 is a summary of tracer parameter measurements for Birmingham, Alabama. This table is a summary of the "library" that describes the tracer conditions for each potential source category. The important information shown on this table includes the median and coefficient of variation (COV) values for each tracer parameter for each source category. Appropriate tracers are characterized by having significantly different concentrations in flow categories that need to be distinguished. In addition, effective tracers also need low COV values within each flow category. The study indicated that the COV values were quite low for each category, with the exception of chlorine, which had much greater COV values. Chlorine is therefore not recommended as a quantitative tracer to estimate the flow components. Similar data must be collected in each community where these procedures are to be used. Recommended field observations include color, odor, clarity, presence of floatables and deposits, and rate of flow, in addition to the selected chemical measurements.

Simple Data Evaluation Methods to Indicate Sources of Contamination

Indicators Implying Contamination. Indicators of contamination (negative indicators) are clearly apparent visual or physical parameters indicating obvious problems and are readily observable at the outfall during the field screening

Table 1. Tracer Concentrations Found in Birmingham, Alabama, Waters (Mean, Standard Deviation and Coefficient of Variation)

	Spring water	Treated potable water	Laundry wastewater	Sanitary wastewater	Septic tank effluent	Car wash water	Radiator water
Fluorescence	6.8	4.6	1020	250	430	1200	22,000
(% scale)	2.9	0.35	125	50	100	130	950
	0.43	0.08	0.12	0.20	0.23	0.11	0.04
Potassium	0.73	1.6	3.5	6.0	20	43	2800
(mg/L)	0.070	0.059	0.38	1.4	9.5	16	375
	0.10	0.04	0.11	0.23	0.47	0.37	0.13
Ammonia	0.009	0.028	0.82	10	90	0.24	0.03
(mg/L)	0.016	0.006	0.12	3.3	40	0.066	0.01
	1.7	0.23	0.14	0.34	0.44	0.28	0.3
Ammonia/Potassium	0.011	0.018	0.24	1.7	5.2	0.006	0.011
(ratio)	0.02	0.006	0.050	0.52	3.7	0.005	0.011
	2.0	0.35	0.21	0.31	0.71	0.86	1.0
Fluoride	0.031	0.97	33	0.77	0.99	12	150
(mg/L)	0.027	0.014	13	0.17	0.33	2.4	24
	0.87	0.02	0.38	0.23	0.33	0.20	0.16
Toxicity	<5	47	99.9	43	99.9	99.9	99.9
(% light decrease after	n/a	20	<1	26	<1	<1	<1
25 minutes, I_{25})	n/a	0.44	n/a	0.59	n/a	n/a	n/a
Surfactants	<0.5	<0.5	27	1.5	3.1	49	15
(mg/L as MBAS)	n/a	n/a	6.7	1.2	4.8	5.1	1.6
	n/a	n/a	0.25	0.82	1.5	0.11	0.11
Hardness	240	49	14	140	235	160	50
(mg/L)	7.8	1.4	8.0	15	150	9.2	1.5
	0.03	0.03	0.57	0.11	0.64	0.06	0.03
pH	7.0	6.9	9.1	7.1	6.8	6.7	7.0
(pH units)	0.05	0.29	0.35	0.13	0.34	0.22	0.39
	0.01	0.04	0.04	0.02	0.05	0.03	0.06
Color	<1	<1	47	38	59	220	3000
(color units)	n/a	n/a	12	21	25	78	44
	n/a	n/a	0.27	0.55	0.41	0.35	0.02
Chlorine	0.003	0.88	0.40	0.014	0.013	0.070	0.03
(mg/L)	0.005	0.60	0.10	0.020	0.013	0.080	0.016
	1.6	0.68	0.26	1.4	1.0	1.1	0.52
Specific conductivity	300	110	560	420	430	485	3300
(μS/cm)	12	1.1	120	55	311	29	700
	0.04	0.01	0.21	0.13	0.72	0.06	0.22
Number of samples	10	10	10	36	9	10	10

activities. These observations are very important during the field survey because they are the simplest method of identifying grossly contaminated dry-weather outfall flows. The direct examination of outfall characteristics for unusual conditions of flow, odor, color, turbidity, floatables, deposits/stains, vegetation conditions, and damage to drainage structures is therefore an important part of these investigations. Table 2 presents a summary of these indicators, along with narratives of the descriptors to be selected in the field.

Table 2. Interpretations of Physical Observation Parameters and Likely Associated Flow Sources

Odor - Most strong odors, especially gasoline, oils, and solvents, are likely associated with high responses on the toxicity screening test. Typical obvious odors include: gasoline, oil, sanitary wastewater, industrial chemicals, decomposing organic wastes, etc.
sewage: smell associated with stale sanitary wastewater, especially in pools near outfall.
sulfur ("rotten eggs"): industries that discharge sulfide compounds or organics (meat packers, canneries, dairies, etc.).
oil and gas: petroleum refineries or many facilities associated with vehicle maintenance or petroleum product storage.
rancid-sour: food preparation facilities (restaurants, hotels, etc.).

Color - Important indicator of inappropriate industrial sources. Industrial dry-weather discharges may be of any color, but dark colors, such as brown, gray, or black, are usually of most common.
yellow: chemical plants, textile and tanning plants.
brown: meat packers, printing plants, metal works, stone and concrete, fertilizers, and petroleum refining facilities.
green: chemical plants, textile facilities.
red: meat packers.
gray: dairies.

Turbidity - Often affected by the degree of gross contamination. Dry-weather industrial flows with moderate turbidity can be cloudy, while highly turbid flows can be opaque. High turbidity is often a characteristic of undiluted dry-weather industrial discharges.
cloudy: sanitary wastewater, concrete or stone operations, fertilizer facilities, automotive dealers.
opaque: food processors, lumber mills, metal operations, pigment plants.

Floatable Matter - A contaminated flow may contain floating solids or liquids directly related to industrial or sanitary wastewater pollution. Floatables of industrial origin may include animal fats, spoiled food, oils, solvents, sawdust, foams, packing materials, or fuel.
oil sheen: petroleum refineries or storage facilities and vehicle service facilities.
sewage: sanitary wastewater.

Deposits and Stains - Refer to any type of coating near the outfall and are usually of a dark color. Deposits and stains often will contain fragments of floatable substances. These situations are illustrated by the grayish-black deposits that contain fragments of animal flesh and hair which often are produced by leather tanneries, or the white crystalline powder which commonly coats outfalls due to nitrogenous fertilizer wastes.
sediment: construction site erosion.
oily: petroleum refineries or storage facilities and vehicle service facilities.

Vegetation - Vegetation surrounding an outfall may show the effects of industrial pollutants. Decaying organic materials coming from various food product wastes would cause an increase in plant life, while the discharge of chemical dyes and inorganic pigments from textile mills could noticeably decrease vegetation. It is important not to confuse the adverse effects of high stormwater flows on vegetation with highly toxic dry-weather intermittent flows.
excessive growth: food product facilities.
inhibited growth: high stormwater flows, beverage facilities, printing plants, metal product facilities, drug manufacturing, petroleum facilities, vehicle service facilities and automobile dealers.

Damage to Outfall Structures - Another readily visible indication of industrial contamination. Cracking, deterioration, and spalling of concrete or peeling of surface paint, occurring at an outfall are usually caused by severely contaminated discharges, usually of industrial origin. These contaminants are usually very acidic or basic in nature. Primary metal industries have a strong potential for causing outfall structural damage because their batch dumps are highly acidic. Poor construction, hydraulic scour, and old age may also adversely affect the condition of the outfall structure.
concrete cracking: industrial flows
concrete spalling: industrial flows
peeling paint: industrial flows
metal corrosion: industrial flows

Correlation tests were conducted to identify relationships between outfalls that were known to have severe contamination problems and the negative indicators (Lalor 1994). Pearson correlation tests indicated that high turbidity and obvious odors appeared to be the most useful physical indicators of contamination when contamination was defined by toxicity and the presence of detergents. High turbidity was noted in 74% of the contaminated source flow samples. This represented a 26% false negative rate (indication of no contamination when contamination actually exists), if one relied on turbidity alone as an indicator of contamination. High turbidity was noted in only 5% of the uncontaminated source flow samples. This represents the rate of false positives (indication of contamination when none actually exists) when relying on turbidity alone. Noticeable odor was indicated in 67% of flow samples from contaminated sources, but in none of the flow samples from uncontaminated sources. This translates to 37% false negatives, but no false positives. Obvious odors identified included gasoline, oil, sewage, industrial chemicals or detergents, decomposing organic wastes, etc.

False negatives are more of a concern than a reasonable number of false positives when working with a screening methodology. Screening methodologies are used to direct further, more detailed investigations. False positives would be discarded after further investigation. However, a false negative during a screening investigation results in the dismissal of a problem outfall for at least the near future. Missed contributors to stream contamination may result in unsatisfactory in-stream results following the application of costly corrective measures elsewhere.

The method of using physical characteristics to indicate contamination in outfall flows does not allow quantifiable estimates of the flow components and, if used alone, will likely result in many incorrect determinations, especially false negatives. These simple characteristics are most useful for identifying gross contamination: only the most significantly contaminated outfalls and drainage areas would therefore be recognized using this method.

Detergents as Indicators of Contamination. Results from the Mann-Whitney U tests (Lalor 1994) indicated that samples from any of the dry-weather flow sources could be correctly classified as clean or contaminated based only on the measured value of any one of the following parameters: detergents, color, or conductivity. Color and high conductivity were present in samples from clean sources as well as contaminated sources, but their levels of occurrence were significantly different between the two groups. If samples from only one source were expected to make up outfall flows, the level of color or conductivity could be used to distinguish contaminated outfalls from clean outfalls. However, since multi-source flows occur, measured levels of color or conductivity could fall within acceptable levels because of dilution, even though a contaminating source was contributing to the flow. Detergents, on the other hand, can be used to distinguish between clean and contaminated outfalls simply by their presence or absence, using a detection limit of 0.06 mg/L. All samples analyzed from contaminated sources contained detergents in excess of this amount (with the exception of three septage samples collected from homes discharging only toilet flushing water). No clean source samples were found to contain detergents. Contaminated sources would be detected in mixtures with uncontaminated waters if they made up at least 10% of the mixture.

Flow Chart for Most Significant Flow Component Identification. A further refinement is the flow chart shown on Figure 1. This flow chart describes an analysis strategy which may be used to identify the major component of dry-weather flow samples in residential and commercial areas. This method does not attempt to distinguish among all potential sources of dry-weather flows identified earlier, but rather the following four major groups of flow are identified: (1) tap waters (including domestic tap water, irrigation water and rinse water), (2) natural waters (spring water and shallow ground water), (3) sanitary wastewaters (sanitary sewage and septic tank discharge), and (4) wash waters (commercial laundry waters, commercial car wash waters, radiator flushing wastes, and plating bath wastewaters). The use of this method would not only allow outfall flows to be categorized as contaminated or uncontaminated, but would allow outfalls carrying sanitary wastewaters to be identified. These outfalls could then receive highest priority for further investigation leading to source control. This flow chart was designed for use in residential and/or commercial areas only.

In residential and/or commercial areas, all outfalls should be located and examined. The first indicator is the presence or absence of dry-weather flow. If no dry-weather flow exists at an outfall, then indications of intermittent flows must be investigated. Specifically, stains, deposits, odors, unusual stream-side vegetation conditions, and damage to outfall structures can all indicate intermittent non-stormwater flows. However, frequent visits to outfalls over long time periods, or the use of other monitoring techniques, may be needed to confirm that only stormwater flows occur. If intermittent flow is not indicated, then the outfall probably does not have a contaminated non-stormwater source. The other points on the flow chart serve to indicate if a major contaminating source is present, or if the water is uncontaminated. Component contributions cannot be quantified using this method, and only the "most contaminated" type of source present will be identified.

If dry-weather flow exists at an outfall, the flow should be sampled and tested for detergents. If detergents are not present, the flow is probably from a non-contaminated non-stormwater source. The lower limit of detection for detergent should be about 0.06 mg/L.

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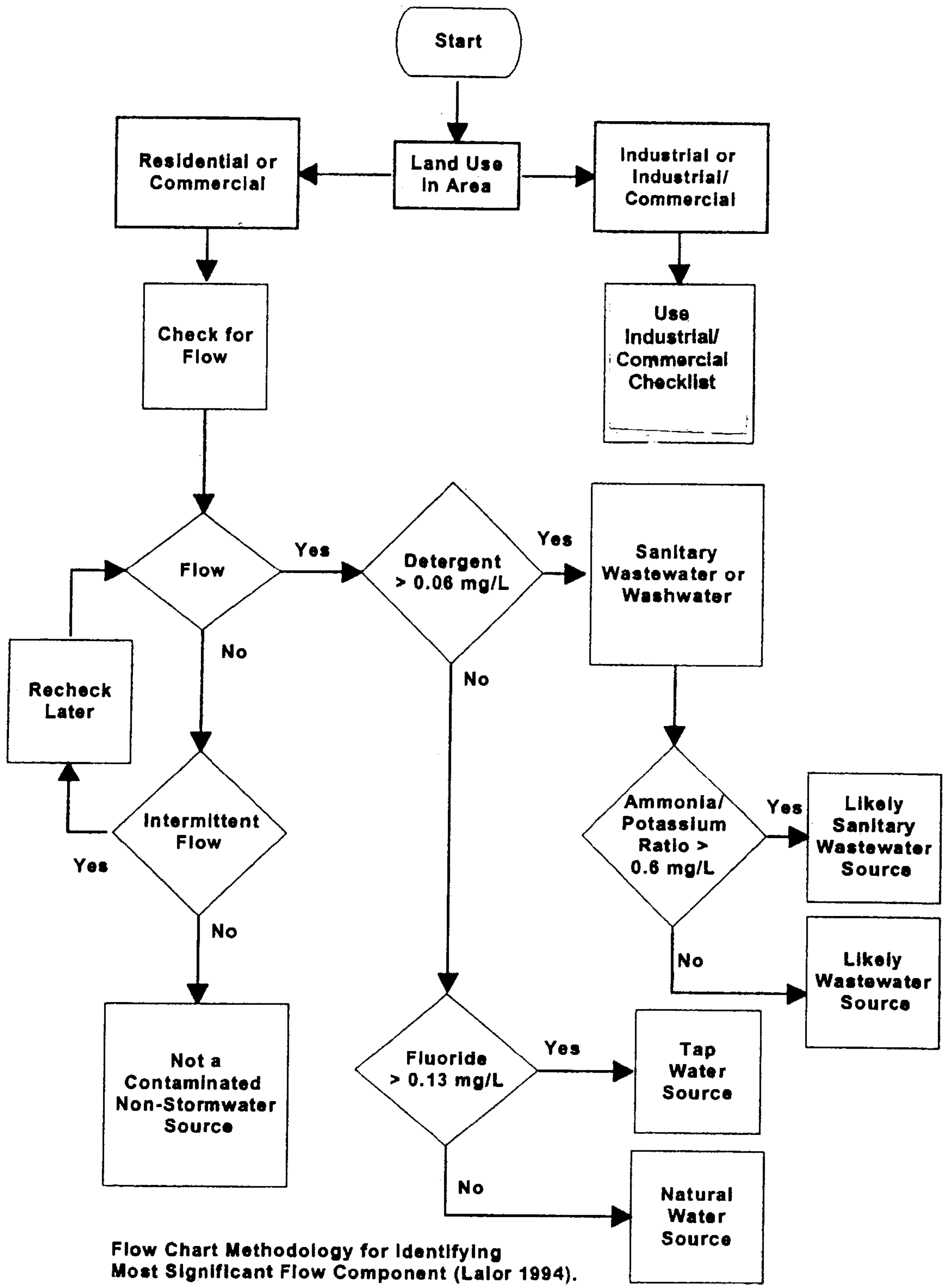

Figure 1. Simple Flow Chart Method to Identify Significant Contaminating Sources

If detergents are not present, fluoride levels can be used to distinguish between flows with treated water sources and flows with natural sources in communities where water supplies are fluoridated and natural fluoride levels are low. In the absence of detergents, high fluoride levels would indicate a potable water line leak, irrigation water, or wash/rinse water. Low fluoride levels would indicate waters originating from springs or shallow groundwater. Based on the flow source samples tested in this research (Table 1), fluoride levels above 0.13 mg/L would most likely indicate that a tap water source was contributing to the dry-weather flow in the Birmingham, Alabama, study area.

If detergents are present, the flow is probably from a contaminated non-stormwater source, as indicated on Table 1. The ratio of ammonia to potassium can be used to indicate whether or not the source is sanitary wastewater. Ammonia/potassium ratios greater than 0.60 would indicate likely sanitary wastewater contamination. Ammonia/potassium ratios were above 0.9 for all septage and sewage samples collected in Birmingham (values ranged from 0.97 to 15.37, averaging 2.55). Ammonia/potassium ratios for all other samples containing detergents were below 0.7, ranging from 0.00 to 0.65, averaging 0.11. One radiator waste sample had an ammonia/potassium ratio of 0.65.

Non-contaminated samples collected in Birmingham had ammonia/potassium ratios ranging from 0.00 to 0.41, with a mean value of 0.06 and a median value of 0.03. Using the mean values for non-contaminated samples (0.06) and sanitary wastewaters (2.55), flows comprised of mixtures containing at least 25% sanitary wastes with the remainder of the flow from uncontaminated sources would likely be identified as sanitary wastewaters using this method. Flows containing smaller percent contributions from sanitary wastewaters might be identified as having a wash water source, but would not be identified as uncontaminated.

Emerging Tools for Identifying Sources of Discharges

Coprostanol and Other Fecal Sterol Compounds Utilized as Tracers of Contamination by Sanitary Sewage. A more likely indicator of human wastes than fecal coliforms and other "indicator" bacteria may be the use of certain molecular markers, specifically the fecal sterols, such as coprostanol and epicoprostanol (Eaganhouse, *et al.* 1988). However, these compounds are also discharged by other carnivores in a drainage (especially dogs). A number of research projects have used these compounds to investigate the presence of sanitary sewage contamination. The most successful application may be associated with sediment analyses instead of water analyses. As an example, water analyses of coprostanol are difficult due to the typically very low concentrations found, although the concentrations in many sediments are quite high and much easier to quantify. Unfortunately, the long persistence of these compounds in the environment easily confuses recent contamination with historical or intermittent contamination.

Particulates and sediments collected from coastal areas in Spain and Cuba receiving municipal sewage loads were analyzed by Grimalt, *et al.* (1990) to determine the utility of coprostanol as a chemical marker of sewage contamination. Coprostanol can not by itself be attributed to fecal matter inputs. However, relative contributions of steroid components can be a useful indicator. When the relative concentrations of coprostanol and coprostanone are higher than their 5? epimers, or more realistically, other sterol components of background or natural occurrence, it can provide useful information.

Sediment cores from Santa Monica Basin, CA, and effluent from two local municipal wastewater discharges were analyzed by Venkatesan and Kaplan (1990) for coprostanol to determine the degree of sewage addition to sediment. Coprostanols were distributed throughout the basin sediments in association with fine particles. Some stations contained elevated levels, either due to their proximity to outfalls or because of preferential advection of fine-grained sediments. A noted decline of coprostanols relative to total sterols from outfalls seaward indicated dilution of sewage by biogenic sterols.

Other chemical compounds have been utilized for sewage tracer work. Saturated hydrocarbons with 16-18 carbons, and saturated hydrocarbons with 16-21 carbons, in addition to coprostanol, were chosen as markers for sewage in water, particulate, and sediment samples near the Cocoa, FL, domestic wastewater treatment plant (Holm and Windsor, 1990). The concentration of the markers was highest at points close to the outfall pipe and diminished with distance. However the concentration of C16-C21 compounds was high at a site 800 m from the outfall indicating that these compounds were unsuitable markers for locating areas exposed to the sewage plume. The concentrations for the other markers were very low at this station.

The range of concentrations of coprostanol found in sediments and mussels of Venice; Italy, were reported by Sherwin, *et al.* (1993). Raw sewage is still discharged directly into the Venice lagoon. Coprostanol concentrations were determined in sediment and mussel samples from the lagoon using gas chromatography/mass spectroscopy. Samples were collected in interior canals and compared to open-bay concentrations. Sediment concentrations ranged from 0.2-41 .0 µg/g (dry weight). Interior canal sediment samples averaged 16 µg/g compared to 2 µg/g found in open bay sediment samples. Total coprostanol concêntrations in mussels ranged from 80 to 620 ng/g (wet weight). No mussels were found in the four most polluted interior canal sites.

Nichols, *et al.* (1996) also examined coprostanol in stormwater and the sea-surface microlayer to distinguish human versus nonhuman sources of contamination. Other steroid compounds in sewage effluent were investigated by Routledge, *et al.* (1998) and Desbrow, *et al.* (1998) who both examined estrogenic chemicals. The most common found were 17β-Estradiol and estrone which were detected at concentrations in the tens of nanograms per liter range. These were identified as estrogenic through a toxicity identification and evaluation approach, where sequential separations and analyses identified the sample fractions causing estrogenic activity using a yeast-based estrogen screen. GC/MS was then used to identify the specific compounds.

Estimating Potential Sanitary Sewage Discharges into Storm Drainage and Receiving Waters using Detergent Tracer Compounds. As described above, detergent measurements (using methylene blue active substance, MBAS, test methods) were the most successful individual tracer to indicate contaminated water in storm sewerage dry-weather flows. Unfortunately, the MBAS method uses hazardous chloroform for an extraction step. Different detergent components, especially linearalkylbenzene sulphonates (LAS) and linear alkylbenzenes (LAB), have also been tried to indicatesewage dispersal pattems in receiving waters. Boron, a major historical ingredient of laundry chemicals, can also potentially be used. Boron has the great advantage of being relatively easy to analyze using portable field test kits, while LAS requires chromatographic equipment. LAS can be measured using HPLC with fluorescent detection, after solid phase extraction, to very low levels. Fujita, *et al.* (1998) developed an efficient enzyme-linked immunosorbent assay (ELISA) for detecting LAS at levels from 20 to 500 µg/L.

LAS from synthetic surfactants (Terzic and Ahel 1993) which degrade rapidly, as well as nonionic detergents (Zoller, *et al.* 1991) which do not degrade rapidly, have been utilized as sanitary sewage markers. LAS was quickly dispersed from wastewater outfalls except in areas where wind was calm. In these areas LAS concentrations increased in freshwater but were unaffected in saline water. After time, the lower alkyl groups were mostly found, possibly as a result of degradation or settling of longer alkyl chain compounds with sediments. Chung, *et al.* (1995) also describe the distribution and fate of LAS in an urban stream in Korea. They examined different LAS compounds having carbon ratios of Cl 2 and Cl 3 compared to Cl 0 and Cl 1, plus ratios of phosphates to MBAS and the intemal to external isomer ratio (I/E) as part of their research. Gonález-Mazo, *et al.* (1998) examined LAS in the Bay of Cádiz off the southwest of Spain. They found that LAS degrades rapidly (Fujita, *et al.*, 1998, found that complete biodegradation of LAS requires several days), and is also strongly sorbed to particulates. In areas close to shore and near the untreated wastewater discharges, there is significant vertical stratification of LAS: the top 3 to 5 mm of water had LAS concentrations about 100 times greater than found at 0.5 m.

Zeng and Vista (1997) and Zeng, *et al.* (1997) describe a study off of San Diego where LAB was measured, along with polycyclic aromatic hydrocarbons (PAHs) and aliphatic hydrocarbons (AHs) to indicate the relative pollutant contributions of wastewater from sanitary sewage, nonpoint sources, and hydrocarbon combustion sources. They developed and tested several indicator ratios (alkyl homologue distributions and parent compound distributions) and examined the ratio of various PAHs (such as phenanthrene to anthracene, methylphenanthrene to phenanthrene, fluoranthene to pyrene, and benzo(a)anthracene to chrysene) as tools for distinguishing these sources. They concluded that LABs are useful tracers of domestic waste inputs to the environment due to their limited sources. They also describe the use of the internal to extemal isomer ratio (I/E) to indicate the amount of biodegradation that may have occurred to the LABs. They observed concentrations of total LABs in sewage effluent of about 3 µg/L, although previous researchers have seen concentrations of about 150 µg/L in sewage effluent from the same area.

The fluorescent properties of detergents have also been used as a tracer by investigating the fluorescent whitening agents (FWAs), as described by Poiger, *et al.* (1996) and Kramer, *et al.* (1996). HPLC with fluorescence detection was used in these studies to quantify very low concentrations of FWAs. The two most frequently used FWAs in household detergents (DSBP and DAS 1) were found at 7 to 21 µg/L in primary sewage effluent and at 3 to 9 µg/L in secondary effluent. Raw sewage contains about 10 to 20 µg/L FWAs. The removal mechanisms in sewage treatment processes is by adsorption to activated sludge. The type of FWAs varies from laundry applications to textile finishing and paper production, making it possible to identify sewage sources. The FWAs were found in river water at 0.04 to 0.6 µg/L. The FWAs are not easily biodegradable but they are readily photodegraded. Photodegradation rates have been reported to be about 7% for DSBP and 71% for DAS 1 in river water exposed to natural sunlight, after one hour exposure. Subsequent photodegradation is quite slow.

Other Compounds Found in Sanitary Sewage that may be used for Identifying Contamination by Sewage. Halling-Sørensen, *et al.* (1998) detected numerous pharmaceutical substances in sewage effluents and in receiving waters. Their work addressed human health concerns of these low level compounds that can enter downstream drinking water supplies. However, the information can also be possibly used to help identify sewage contamination. Most of the research has focused on clofibric acid, a chemical used in cholesterol lowering drugs. It has been found in concentrations ranging from 10 to 165 ng/L in Berlin drinking water samples. Other drugs commonly found include aspirin, caffeine, and ibuprofen. Current FDA guidance mandates that the maximum concentration of a substance or its active metabolites at the point of entry into the aquatic environment be less than 1 µg/L (Hun 1998).

Caffeine has been used as an indicator of sewage contamination by several investigators (Shuman and Strand 1996). The King County, WA, Water Quality Assessment Project is examining the impacts of CSOs on the Duwamish River and Elliott Bay. They are using both caffeine (representing dissolved CSO constituents) and coprostanol (representing particulate bound CSO constituents), in conjunction with heavy metals and conventional analyses, to help determine the contribution of CSOs to the river. The caffeine is unique to sewage, while coprostanol is from both humans and carnivorous animals and is therefore also in stormwater. They sampled upstream of all CSOs, but with some stormwater influences, 100 m upstream of the primary CSO discharge (but downstream of other CSOs), within the primary CSO discharge line, and 100 m downriver of the CSO discharge location. The relationship between caffeine and coprostanol was fairly consistent for the four sites (coprostanol was about 0.5 to 1.5 µg/L higher than caffeine). Similar patterns were found among metals; chromium was always the lowest and zinc was the highest. King Co. is also using clean transported mussels placed in the Duwamish River to measure the bioconcentration potential of metal and organic toxicants and the effects of the CSOs on mussel growth rates (after 6 week exposure periods). Paired reference locations are available near the areas of deployment, but outside the areas of immediate CSO influence. *US Water News* (1998) also described a study in Boston Harbor that found caffeine at levels of about 7 µg/L in the harbor water. The caffeine content of regular coffee is about 700 mg/L, in contrast.

Kratch (1997) summarized several investigations on cataloging the DNA of *E. coli* to identify their source in water. This rapidly emerging technique seems to have great promise in addressing a number of nonpoint source water pollution issues. The procedure, developed at the Virginia Polytechnic Institute and State University, has been used in Chesapeake Bay. In one example, it was possible to identify a large wild animal population as the source of fecal coliform contamination of a shellfish bed, instead of suspected failing septic tanks. DNA patterns in fecal coliforms vary among animals and birds, and it is relatively easy to distinguish between human and non-human sources of the bacteria. However, some wild animals have DNA patterns that are not easily distinguishable. Some researchers question the value of *E. coli* DNA fingerprinting believing that there is little direct relationship between *E. coli* and human pathogens. However, this method should be useful to identify the presence of sewage contamination in stormwater or in a receiving water.

One application of the technique, as described by Krane, *et al.* (1999) of Wright State University, used randomly amplified polymorphic DNA polymerase chain reaction (RAPD-PCR) generated profiles of naturally occurring crayfish. They found that changes in the underlying genetic diversity of these populations were significantly correlated with the extent to which they have been exposed to anthropogenic stressors. They concluded that this rapid and relatively simple technique can be used to develop a sensitive means of directly assessing the impact of stressors upon ecosystems. These Wright State University researchers have also used the RAPD-PCR techniques on populations of snails, pill bug violets, spiders, earthworms, herring, and some benthic macroinvertebrates, finding relatively few obstacles in its use for different organisms. As noted above, other researchers have used DNA profiling techniques to identify sources of *E. coli* bacteria found in coastal waterways. It is possible that these techniques can be expanded to enable rapid detection of many different types of pathogens in receiving waters, and the most likely sources of these pathogens.

Other Tracer Methods for Identifying Sources of Water. Stable isotopes had been recommended as an efficient indicator of illicit connections to storm sewerage. A demonstration was conducted in Detroit as part of the Rouge River project to identify sources of dry weather flows in storm sewerage (Sangal, *et al.* 1996). Naturally occurring stable isotopes of oxygen and hydrogen can be used to identify waters originating from different geographical sources (especially along a north-south gradient). Ma and Spalding (1996) discuss this approach by using stable isotopes to investigate recharge of groundwaters by surface waters. During water vapor transport from equatorial source regions to higher latitudes, depletion of heavy isotopes occurs with rain. Deviation from a standard relationship between deuterium and 18O for a specific area indicates that the water has undergone additional evaporation. The ratio is also affected by seasonal changes. As discussed by Ma and Spalding (1996), the Platte River water is normally derived in part from snowmelt from the Rocky Mountains, while the groundwater in parts of Nebraska is mainly contributed from the Gulf air stream. The origins of these waters are sufficiently different and allow good measurements of the recharge rate of the surface water to the groundwater. In Detroit, Sangal, *et al.* (1996) used differences in origin between the domestic water supply, local surface waters, and the local groundwater to identify potential sanitary sewage contributions to the separate storm sewerage. Rieley, *et al.* (1997) used stable isotopes of carbon in marine organisms to distinguish the primary source of carbon being consumed (sewage sludge vs. natural carbon sources) in two deep sea sewage sludge disposal areas.

Stable isotope analyses would not be able to distinguish between sanitary sewage, industrial discharges, washwaters, and domestic water, as they all have the same origin, nor would it be possible to distinguish sewage from local groundwaters if the domestic water supply was from the same local aquifer. This method works best for situations where the water supply is from a distant source and where separation of waters into separate flow components is not needed. It may be an excellent tool to study the effects of deep well injection of stormwater on deep aquifers having distant recharge sources (such as in the Phoenix area). Few laboratories can analyze for these stable isotopes, requiring shipping and a long wait for the analytical results. Sangal, *et al.* (1995) used Geochron Laboratories, in Cambridge, Massachusetts.

Dating of sediments using 137Cs was described by Davis, *et al.* (1997). Arsenic contaminated sediments in the Hylebos Waterway in Tacoma, WA, could have originated from numerous sources, including a pesticide manufacturing facility, a rock-wool plant, steel slags, powdered metal plant, shipbuilding facilities, marinas and arsenic boat paints, and the Tacoma Smelter. Dating the sediments, combined with knowing the history of potential discharges and conducting optical and electron microscopic studies of the sediments, was found to be a powerful tool to differentiate between the different metal sources to the sediments.

Conclusions

Recent tests examined several potential tracer parameters during a project characterizing stormwater that had collected in telecommunication manholes, funded by Tecordia (previously Bellcore), AT&T, and eight regional telephone companies throughout the country (Pitt and Clark 1999). Numerous conventional constituents, plus major ions, and toxicants were measured, along with candidate tracers to indicate sewage contamination of this water. Boron, caffeine, coprostanol, *E. coli*, enterococci, fluorescence (using specific wavelengths for detergents), and a simpler test for detergents were evaluated, along with the use of fluoride, ammonia, potassium, and obvious odors and color. About 700 water samples were evaluated for all of these parameters, with the exception of bacteria and boron (about 250 samples), and only infrequent samples were analyzed for fluorescence. Coprostanol was found in about 25% of the water samples (and in about 75% of the 350 sediment samples analyzed). Caffeine was found in very few samples, while elevated *E. coli* and enterococci (using IDEXX tests) were observed in about 10% of the samples. Strong sewage odors in water and sediment samples were also detected in about 10% of the samples. Detergents and fluoride (at >0.3 mg/L) were found in about 40% of the samples and are expected to have been contaminated with industrial activities (lubricants and cleansers) and not sewerage. Overall, about 10% of the samples were therefore expected to have been contaminated with sanitary sewage, about the same rate previously estimated for stormwater systems.

Additional laboratory tests, funded by the University of New Orleans and the EPA, were conducted using many sewage and laundry detergent samples and found that the boron test was a poor indicator of sewage, possibly due to changes in formulations in modern laundry detergents. Other laboratory tests found that fluorescence was an excellent indicator of sewage, especially when using specialized "detergent whitener" filter sets, but was not very repeatable. We also examined several UV absorbance wavelengths as sewage indicators and found excellent correlations with 228 nm, a wavelength having very little background absorbance in local spring waters, but with a strong response factor with increasing strengths of sewage. We recommend that our originally developed and tested protocol still be used as the most efficient routine indicator of sewage contamination of stormwater drainage systems, with the possible addition of specific *E. coli* and enterococci measurements and UV absorbance at 228 nm. The numerous exotic tests requiring specialized instrumentation and expertise reviewed in this paper do not appear to warrant their expense and long analytical turn-around times, except in specialized research situations.

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Elimination of Illicit Connections in Coastal New Hampshire Spurs Cooperation and Controversy

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Introduction

Discharging stormwater runoff into our waterways has long been an accepted practice. In theory, storm drainage pipes should only discharge during and after storm events unless the source is groundwater or surface water piped underground. Therefore, the dry weather discharge should be relatively free of contaminants. However, many communities across the country are finding out this is not always true. Some cities and towns are discovering illegal connections of residential and commercial sewer lines to storm water collection systems. Illicit connections have been identified by the New Hampshire Department of Environmental Services (DES) as the point source of high fecal coliform levels in the New Hampshire coastal basin (Jones, 1995). These illegal connections pose a health risk to those recreating in the coastal waters and have forced the closure of shellfish growing waters to harvesting.

Goals of the Coastal Investigations Programs

Determining the extent of dry weather contamination in storm drainage systems is the first step an investigator should take when researching stormwater pollution. Dry weather flows in storm drainage systems are often the result of groundwater infiltration, but can also result from inappropriate connections from commercial, industrial, or residential buildings. In 1996, the New Hampshire DES published the Coastal Basin Nonpoint Source Pollution Assessment and Abatement Plan (NHDES, 1996) that directed coastal investigations of each community's storm drainage system during dry weather. This decision to conduct dry weather investigations in the coast was made after 300 illicit connections were identified in the northern New Hampshire city of Berlin. State environmental officials were convinced that illicit connections were always present in storm drainage systems that were once considered a pollution threat only during wet weather.

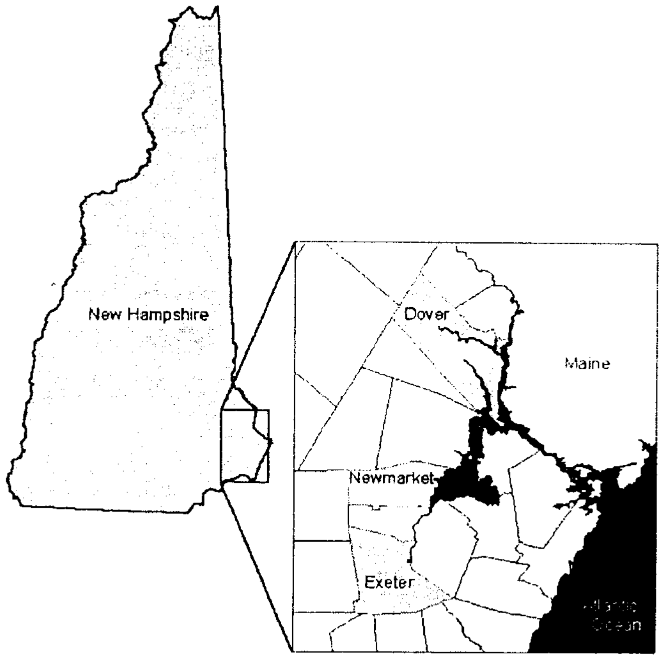
DES initiated a multi-year effort that focused on identifying and abating the sources of the bacterial violations found in the state's coastal waters with the goal of opening shellfish growing waters during dry weather (Landry, 1997). About the same time, the New Hampshire Estuaries Project (NHEP) began a three-year process of developing a comprehensive management plan aimed at restoring, protecting and enhancing the water quality and living resources of the state's estuaries. The major goal of the NHEP was to address the sources of pollution currently impacting the estuaries and prevent future problems through effective land use planning and shoreline protection of the coastal resources (NHEP, 1996). To accomplish this goal, part of the NHEP strategy was to locate and remediate the sources of the water quality violations, primarily bacterial violations, found in the estuaries and coastal waters (Landry, 1997). DES and NHEP combined resources and developed an investigation strategy with the overall goal of improving and protecting estuarine water quality.

Specific Program Objectives

The main objectives of the investigation strategy were to identify inappropriate connections in the storm drainage systems of urban, coastal communities and to eliminate the illicit connections through the available means, which include voluntary compliance and enforcement.

A Brief Look at Coastal New Hampshire

The eighteen miles of New Hampshire coastline do not begin to tell the story of the state's abundant marine resources. The relatively modest coastline is only a small part of the coastal basin. The estuarine resources include the Great Bay Estuary and seven associated tidal rivers, Hampton Harbor, and Rye Harbor. These waters are used by residents and many visitors for swimming, boat touring, shellfish harvesting, surfing, and angling. Forty-two communities



comprise the coastal basin watershed, with a population density just under 300 residents/mile^2 (Jones, In Review). The upper watershed is generally undeveloped and forested while the more urban centers are situated in the lower watershed as the rivers approach the coast.

Ten wastewater treatment facilities are situated on the tributaries of Great Bay and Hampton Harbor and two facilities discharge directly into the Atlantic Ocean. Coastal communities are working diligently to upgrade the wastewater treatment facilities and sewage collection systems. Inflow/infiltration problems and undersized pump stations plague the treatment facilities and have resulted in financial hardships for affected municipalities. Shellfish growing waters have been temporarily closed after heavy rainstorms when bacteria levels rise due to sewage by-passes. Sewage is a well-recognized threat to the marine environment because it often contains harmful chemicals, disease-causing bacteria and viruses, dissolved material and solid matter. Pathogens can cause a variety of illnesses and humans are exposed to these organisms through contaminated water, shellfish, and fish (Sea Grant, 1999).

Investigating Illicit Connections

Recently, more and more watershed studies are investigating inappropriate discharges in storm drainage systems. This pollution source originates from an identifiable point and flows through the storm drainage system to the outfall pipe. For example, instead of connecting to the sewer system, a direct connection of sewer service discharges into the storm drainage system. Other inappropriate sources include floor drains and laundry pipes. These inappropriate connections are also referred to as illicit or illegal cross connections. The health threat and the potential to interfere with stormwater contamination assessments elevate illicit connections to priority status for watershed managers to investigate.

Pitt et al. (1993), in cooperation with the Center of Environmental Research Information, U.S. Environmental Protection Agency, published a user's guide for conducting investigations of illicit connections. Several of the methods suggested in this guide were implemented during the New Hampshire coastal investigations. Detailed surveys to determine the extent of contamination through specific water quality monitoring and careful observation of storm drainage outfalls are recommended for each type of land use in the watershed. Pitt recommends an initial phase of investigative protocol that includes the initial mapping and field surveys. The initial activities are followed by more detailed watershed surveys to locate and correct the sources of the contamination in the identified problem areas. After corrective action has been taken, repeated outfall field surveys are required to ensure that the outfalls remain uncontaminated.

Surveys of Storm Drainage Systems

Over the course of the investigations, several methods were used, ranging from the initial screening process of surveying storm drainage discharges to dye testing the indoor plumbing of suspected sources. Steps between the initial survey and the final determination of the source, included analyzing the discharge for water quality; visual and odor observations at outfalls, manholes, and catchbasins; smoke testing; and video inspection of the storm drainage and sewer systems.

Tidal rivers and coastal waters were divided into study sections by community. The urban, downtown centers of these communities were targeted based on the existence of the storm drainage infrastructure. The investigators compiled maps and as-built drawings of the storm drainage and sewer infrastructure. If the maps were inaccurate, insufficient, or unavailable, information on the storm drainage system was developed based on field investigations by the staff, typically with the assistance of public works employees.

Communities with maps based in a geographic information system (GIS) saved staff time and were generally more accurate than record drawings that are not updated regularly (Landry, 1997). Tuomari (1996) applied the Rouge Watershed Geographic Information System to the Wayne County Illicit Connections Detection Program and concluded that the new GIS strategy eliminated the need to use maps and graphics from disparate reports and sources, significantly reducing the time and effort once spent on research, field data acquisition, and interpretation.

Beginning in the summer of 1996, the coastal shorelines were surveyed at low tide, on foot or by canoe, depending on access, for potential pollution sources. All pipes, seeps, streams, and swales with flow were sampled for bacteria. In addition, temperature was measured and observations relating to the condition of the pipe (stained or structurally damaged), odor, evidence of untreated wastewater (toilet paper, etc.), turbidity, color, debris, estimated flow, and any other observations were noted. Dry pipes were rechecked on several occasions for intermittent flow. Evidence indicating the presence of wastewater and/or elevated bacteria levels prompted further investigation of these locations.

Upstream catchbasins and manholes associated with the outfall pipes that were identified in the screening process previously described, were surveyed for evidence of wastewater and sampled for bacteria. Smoke testing (using non-toxic smoke blown into catch basins) was then used to identify buildings connected to the storm drainage system by canvassing the neighborhood for vents emitting smoke. Final confirmation of an illicit connection from the buildings that emitted smoke was accomplished with dye testing of indoor plumbing and observing the storm drainage and sewer systems for the presence/absence of the dye.

Feeder streams were surveyed for outfall pipes with dry weather flow. Other potential bacteriological sources (e.g., pigeon roosting sites on bridges) were bracketed with water quality sampling stations. Where contaminated seeps and swales were suspected, the drainage area was surveyed for potential sources such as broken sewer mains.

Water Quality Results

Bacteria data (1997/98) from outfall pipes with confirmed cross connections ranged from 1,700 - >1,000,000 *E. coli* counts/100 ml during dry weather in Dover, New Hampshire. Many outfall pipes with cross connections had a gray biomat comprised of filamentous bacteria coating the inside of the pipe and, often, the rocks or sediment below. These biomats were used as a wastewater indicator based on the presence of these mats at more than 50% of the outfalls with confirmed cross connections.

Dr. Stephen Jones of the University of New Hampshire Jackson Estuarine Laboratory conducted a twelve-month study that examined the significance of all flow coming from urban storm drainage systems in the downtown Dover watershed of the Cocheco River (Jones, 1998). Jones found that storm drains were consistent sources of relatively high concentrations of bacterial indicators and pathogens at concentrations that exceeded state standards for recreational and shellfish-growing waters during both dry and wet weather.

Flow from a damaged stormwater outfall pipe was determined to have a geometric mean *E. coli* concentration of 1,047,199 cfu/100 ml and a dissolved inorganic nitrogen (DIN) concentration of 22.4 mg/l. The data were brought to the attention of DES and an investigation revealed a cross connection from a commercial building. Dr. Jones continued to monitor the quality of flow after the cross connection was eliminated and the results show a significant decline in both bacteria and DIN geometric means. The post-repair results were 93 *E. coli* cfu/100 ml and 7.2 DIN mg/l.

Although no public health problems were known to have occurred as a result of exposure to bacterial pathogens in the Cocheco River, the contamination may be a significant contribution to the fecal-borne bacteria that are presently the reason for closing the area's shellfish growing waters in New Hampshire and restricting harvests in Maine (Jones, 1998).

Remedial Actions

Once confirmed, illicit connections in coastal New Hampshire have been eliminated in different ways. The most desired course of action from the regulatory perspective is voluntary compliance and many fixes have been accomplished through this process. Economics and prioritization of the many demands on public works departments sometimes compel the state and federal environmental agencies to initiate regulatory action to eliminate raw wastewater discharges into surface waters. Lawsuits, although not common, have been filed against municipalities after cross connections were discovered.

Voluntary Compliance: Town of Exeter Case Study

In 1994, researchers at the UNH Jackson Estuarine Laboratory (Jones and Langan, 1995) reported elevated dry-weather bacterial levels collected in Norris Brook, a tributary to the Squamscott River in Exeter, New Hampshire. In 1996, DES collected bacteria samples at various locations on Norris Brook (NHDES, 1997) and found relatively low *E. coli* concentrations of <150 counts/100 ml. In 1998, an Exeter official urged DES to investigate the watershed for contamination based on the 1994 data that showed a fecal coliform concentration of 600 counts/100 ml. In April of 1998, DES and a town official conducted a survey of the lower watershed and discovered a storm drainage outfall discharging a large volume of flow even though the weather had been dry. Upon closer inspection, toilet paper was observed in the outfall pipe and the immediate area.

The town public works department was notified of the survey results and, following reminders by DES, began investigations to determine the sources of untreated wastewater. Progress was slowed because several of the residences were rental properties which involved contacting the owner, who was in some cases from out-of-state, and gaining permission to access the building for dye testing. By November, the town reported that a few of the cross connections still remained. DES considered enforcement action and an administrative fine but did not take that action to maintain the spirit of cooperation. In January of 1999, the town reported that the owner of the last remaining property to be dye tested was not responding to requests for access. More prodding by DES followed and in February 1999, DES received notification that the cross connections were eliminated. A follow up inspection confirmed the absence of untreated wastewater in the storm drainage outfall.

A lesson learned from this experience is that a persistent, local advocate is often the key to maintaining attention on a local water quality problem. In addition, local advocates, whether a conservation commissioner, selectmen, or citizen, often have detailed knowledge of the complaint and the locale, which provides valuable and time-saving information to the state investigators.

Time and resource demands on local officials as well as state investigators can cause this process to be distressingly slow. Budgeting for 2-3 cross connection investigations and fixes per year is recommended at approximately $6,000 per fix, to help alleviate the unexpected financial burdens on urban communities when illicit connections are found.

Bacteria alone should not be the determining factor of the presence or absence of an illicit connection for a variety of reasons. Chlorine or other toxins in untreated wastewater may depress bacteria levels and bacteria lack conservative behavior, which deem it a poor indicator (Pitt, 1993). Investigators have found that a careful and thorough outfall survey is usually more informative than just collecting water samples.

Enforcement Action: City of Newmarket Case Study

Enforcement is another tool available to DES to achieve compliance. For example, setting timetables for compliance milestones in a legal document is a method that, while typically thought of as a burden to a community, may actually provide the impetus for action in a positive way. Public works departments of New Hampshire coastal communities are not equipped with large, discretionary budgets to address unplanned remediation of illicit connections. When faced with this dilemma, an enforcement action against the community provides public works departments with the validation to support a request for additional funding from the officials who approve the allocation of funds.

As the mill Town of Newmarket, New Hampshire, developed over the years, a small watercourse named Moonlight Brook was built over and culverted in the center of downtown. In 1996, DES investigated Moonlight Brook based on historic elevated bacteria levels. The DES investigation revealed dry weather *E. coli* concentrations as high as 41,600 counts/100ml in the brook. DES encouraged the town to initiate dye testing of the structures in the vicinity of Moonlight Brook but, at that time, the town was reluctant to allocate staff and funding for clean up efforts (NHDES, 1997).

An administrative order was issued by the US Environmental Protection Agency for various violations of permitted effluent limitations in October, 1997 and included a requirement that the town eliminate the raw sewage discharges from the storm sewer system (USEPA Docket No. 97-78). The order required a plan and schedule for eliminating any pollutants discharging during dry weather. The order also specified sampling of each active dry weather discharge that remained following elimination of the illicit connections to the system identified by the town's fieldwork.

In response to the order, the town hired an environmental consultant to address the problems at the wastewater treatment facility and the illicit connections. During the summer of 1997, the consultant and the town performed a dye study of the subdrainage area that the town suspected was the likely source of bacterial contamination identified at the discharge. The dye study resulted in the identification of a total of four untreated discharges to the storm drainage system from three properties. A subsequent video inspection of the sewer lines adjacent to these properties revealed that the sewer service connections from these properties might have been installed at the time the original sewer was constructed. The consultant then concluded that this would indicate the sources of sewage discharging to the storm drainage are broken sewer service connections rather than direct connections. The town stated that the remedial work would be completed by June 1998 (Plante, 1998).

Another storm discharge pipe servicing this area was separated in 1985 and 1986, at which time dye testing was performed to identify sanitary services that were connected to the sewer. The consultant determined that it would be unlikely that direct sanitary service connections to the storm drain were present in this area, however, broken service connections could result in sewage entering the storm drain culvert along Main Street. A dye study was planned for May 1998.

A total of 59 properties were included in the dye-testing program. Four of the properties were confirmed to be cross-connected to the storm drainage system. Two of the four were the result of direct connections of sewer laterals to the drainage system. The remaining two were a result of exfiltration from the sewer lateral through the ground to the drain line (Town of Newmarket, 1999). The town reports a 90% reduction in the *E. coli* counts following the elimination of the illicit discharges.

Legal Action: City of Dover Case Study

In the 1970's, the City of Dover, New Hampshire, constructed a new sewage collection system and treatment facility. In 1997, DES investigators began surveying the storm drainage outfalls for contamination. Around this same time, University of New Hampshire researcher Dr. Stephen Jones initiated a study in Dover to determine the significance of flow (both dry and wet weather) coming from urban storm drainage systems (Jones, 1998). Jones identified a source of bacterial contamination to be a cross connection later confirmed by DES and the City of Dover Public Works Department. The city fixed the illicit connection by connecting the sanitary service into the sewer main, at no charge to the building owner, while noting substantial flow from this service due to a hair salon in the building.

After learning about the existence of the cross connection, the building owners made an unsuccessful request to the city for an abatement of the sewer fees they had paid since 1981 and initiated legal proceedings. The city alleged that the case law mandated a decision in its favor and filed a motion for summary judgement (Strafford Superior Court, Order #98-C-207). In a responding order from the judge, the case law was said to illustrate that the Court had considered a variety of factors in related cases including (1) whether the new and old system were integral to one another, (2) whether the benefit provided to the plaintiff under the new and old systems was comparable, and (3) whether the property owner had access to the new system. The motion for summary judgment was denied because the Court found that these were issues for a jury and that summary judgment at that stage would be premature.

A trial date was set. One week before the trial was to occur, the two parties settled out of court. The terms of the settlement were confidential. If the property owners were successful in seeking a tax abatement and damages for unjust enrichment, implied contract, and negligent misrepresentation, as sought, the pollution investigations could have been in jeopardy of becoming ineffective. Such a precedent could have led to other similar suits and would effectively remove the incentive for municipalities to be proactive in fixing cross connections.

Conclusions

The Department of Environmental Services, in conjunction with the New Hampshire Estuaries Project, has systematically identified illicit connections in the urban communities of coastal New Hampshire. Applying both voluntary compliance and enforcement has resulted in the removal of cross connections to the storm drainage systems and a decrease in the contamination reaching the coastal surface waters. DES is currently monitoring the shellfish growing waters to determine the extent of water quality improvement resulting from the removal of illicit connections.

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Using Collaborative Problem-Solving to Protect North Carolina's Coastal Resources: The Experience of the White Oak River Advisory Board*

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Introduction

In North Carolina coastal estuarine systems, land use change has been implicated as a significant cause of water quality impairment (NC Department of Environment and Natural Resources, 1997; White, et al., 1998). Such development processes change surface hydrology, pollutant delivery, and, as a consequence, adjacent water quality. Decisions regarding placement, density, and type of development are controlled by policy implementation at the local level. Furthermore, while the degree of impact may vary with each location, it is the cumulative effects throughout a watershed that can be most damaging to water quality. Hence, there is a need to develop and enact policy locally, but on a multi-jurisdictional, watershed basis.

Increasingly, local communities and governments are showing interest in playing a role in developing and implementing solutions to water quality problems (NC Department of Environment and Natural Resources, 1997). However, logistical complications arise upon implementation of this concept. First, a mechanism for effectively involving local citizen stakeholders in the policymaking process may not exist and/or is difficult to establish (Danielson, 1998). Second, technical data needed to address local issues and concerns are often not readily available, or are in a form not easily understood. Third, programs for addressing water quality problems on a watershed-basis may not exist, suggesting a need to develop, coordinate, and deliver multi-jurisdictional education on water quality issues and policy alternatives. Through a project entitled *Watershed Education for Communities and Local Officials (WECO)*, the North Carolina Cooperative Extension Service has worked with a number of state and federal agencies, along with citizens and local governments within a coastal watershed to address these needs.

The goal of this project is to improve water quality in all of the White Oak River Watershed through involvement and education of citizens and government officials who live and work in the watershed. The project's main thrusts are : 1) the delivery of technical information and educational material on water quality, management strategies, and policy options that support watershed-based planning; 2) the empowerment of local citizens by facilitating collaborative partnerships between communities, local officials, and state agencies within the watershed; and 3) the facilitation of the development

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of local stakeholder - driven policy recommendations for the entire watershed. This paper discusses the application of these concepts to an issue of critical importance to local citizens.

Background

The White Oak River watershed is one of four rivers in the White Oak River Basin (Figure 1). It is 48 miles long and encompasses 320 mi^2. The watershed begins in freshwater creeks and swamps of Jones County, NC, and contains portions of three other counties--Craven, Onslow, and Carteret. Along its route to Bogue Sound and the Atlantic Ocean, the river traverses between 30 ft. banks, which are relics of ancient dune ridges. This river is home to five threatened or endangered organisms, including alligators; loggerhead, green, and leatherback turtles, and the Croatan crayfish. The river and its estuarine waters have extensive primary nursery waters and provide habitat for several anadromous species--herring, shad, striped bass, and sturgeon. The majority of the river is classified as SA, or saltwater suitable for commercial shellfish harvesting.

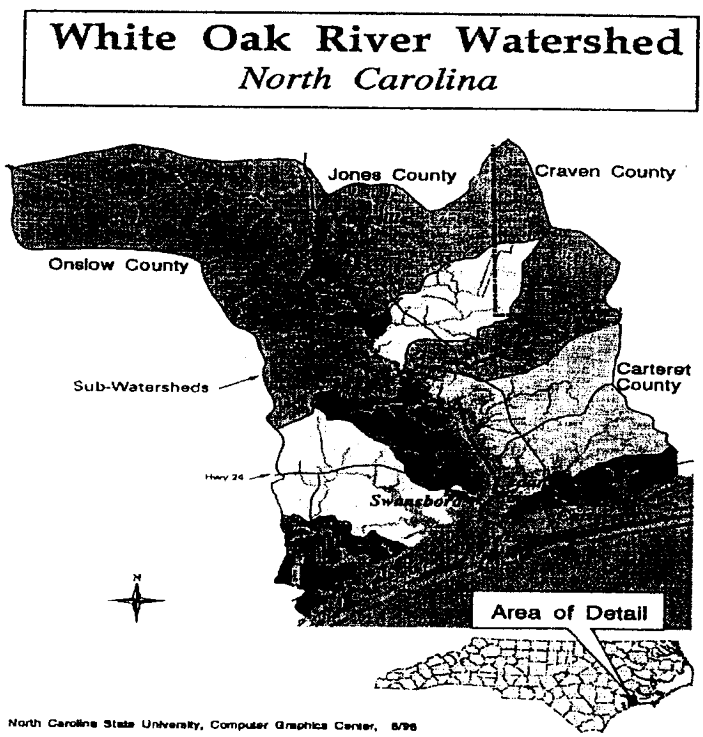

Figure 1. General map of White Oak River Watershed in North Carolina.

The White Oak River watershed has six major land cover/land use classes with wetlands encompassing the largest single type at 52% of the total. Forests are the second largest land cover type constituting the majority of the headwaters in the Croatan National and Hoffman State Forests (22%). A very small portion of the watershed is urban (2%) and agricultural (11%) (NC Department of Environment and Natural Resources, 1997).

Despite the low level of urbanization, the North Carolina Division of Water Quality's basinwide management plan notes an increase in shellfish closures in the river (North Carolina Division of Environmental and Natural Resources, 1997). At state-sponsored public meetings, over 100 citizens expressed concern and called for more public education on water quality.

Recognizing the interest of their constituencies in water quality education, local NC Cooperative Extension Service leaders assembled a project team involving members from the North Carolina Division of Water Quality, North Carolina Division of Coastal Management, North Carolina Division of Environmental Health - Shellfish Sanitation Branch, North Carolina Cooperative Extension, and 25 citizens who comprise the stakeholder-based Advisory Board for the White Oak River Watershed. This group includes crop farmers, livestock farmers, fisherpersons, developers, foresters, tourism directors, teachers, scientists, and local government officials from the watershed (see Table 1). The citizen advisory board is the decision-making entity. The government agency representatives and Cooperative Extension personnel function as support staff to the Board. Support staff provide resources, perform research and reviews, make reports, serve as technical advisors, and provide formal facilitation and consensus-building services.

The White Oak Advisory Board's Primary Issue of Concern

The Board began meeting in August of 1996. Their first task was to prioritize water quality issues upon which to focus their efforts. Board members expressed concern that past bridge and road construction across the mouth of the river had contributed to a decline in water quality. Furthermore, this road, Highway 24, was slated for expansion, and they were concerned that this would exacerbate the problems. The Board acknowledged the need for expansion of the road, but recognized a unique opportunity to mitigate its impact if they could move quickly to work with the North Carolina Department of Transportation (NC-DOT)

At the time that the Board was convened and identified the highway and its expansion as an issue, NC-DOT was in the process of conducting an Environmental Assessment of the project and were anticipating a Finding of No Significant Impact. During a meeting between the Extension Project Team and NC-DOT, DOT representatives were made aware of the Board's concerns and expressed an interest in working with the Board to address those concerns. However, timing was an issue because in several months, NC-DOT was planning right of way acquisition to begin the expansion project. Because of the urgency of the matter, the Board resolved to meet twice monthly and work to develop their comments and recommendations.

Technical Information Gathered by the Board

In response to the Board's inquiry, the Project Team reviewed, summarized, and presented scientific studies that had been conducted on the river that related to sedimentation and flow patterns in the river and the possible effects of highway construction over the mouth of the river. Results from the following four studies were especially useful in understanding the science behind this policy issue.

Table 1. White Oak River Watershed Advisory Board – Stakeholder Composition.

Stakeholder Groups	Carteret	Jones	Onslow	At Large	Total
Fishing, Commercial	····				4
Fishing, Recreational			·		1
Real Estate or Development	·				1
Environment/ Conservation	·				1
Farming, Crop	·	·			2
Farming, Livestock			·		1
Forestry, Private			·		1
Business & Industry	·	··			3
Local Government	··	·			3
Academia/ Public Schools	··		··		4
Travel & Tourism					
NC Shellfish Sanitation				·	1
Soil & Water Cons.		·			1
Public Forestry				··	2
Totals	12	5	5	3	25

One study (Martens and Goldhaber, 1978) determined that the metabolic pathways by which bacteria degrades organic matter in the sediments differ depending on whether the overlying aquatic environment is salty or fresh. Chemistry analyses done on soil cores taken at various locations in the river found framboidal pyrite at upstream samples, which indicated that saltwater wedges had previously penetrated further upstream than current patterns in soil chemistry showed. These results provided evidence to the Board that saltwater flows in the river had changed over time.

Adams, Benniger, Hosier, Overton, and Reed (1982) studied water circulation and sedimentation patterns in the White Oak Estuary and found that sedimentation in the estuary varies from 0.3 cm/yr to 5 cm/yr. approximating the annual rate of submergence along the Atlantic coast. Their study confirmed for the Board that the system is a flood tide dominated system with sediment transport primarily occurring during storms with strong on-shore winds. The study also noted that the construction of the Intracoastal Waterway (ICWW) in 1930-32 in conjunction with the construction of Highway 24 in 1933 altered channel flow from one channel (adjacent to Huggins Island) to another (adjacent to the mainland near Highway 24). Spoil deposition from dredging operations may also be responsible for decreased channel flow in the west channel of the Inlet. The authors noted no evidence of a declining fishery based on the fact that it was comparable to other fisheries in the area and in line with historical production rates for the estuary. This study also quantified the extent of fill and alteration to the estuary caused by the original construction of the ICWW and the road in 1932 and 1933, respectively. Historical maps, when compared to current data, showed that two inlets were closed and that more than 80% of the river was obstructed by these projects.

Benniger and Martens (1983) investigated the age and the sources of organic matter in the estuary. This study characterized the organic matter degradation rates, which is important in understanding the estuary's capability to process organic inputs. The researchers determined that the upstream organic matter inputs were primarily terrestrial and the downstream organic inputs were primarily marine. However, they found that microbial processes acted preferentially to remove recently produced organic matter. This implies that recently produced or partially treated organic matter could substantially increase sediment oxygen demand and the rate of nutrient regeneration. This would increase the vulnerability of the estuaries to anoxia and algal blooms.

Kelley, Martens, and Chanton (1990), by collecting and analyzing sediment cores, characterized the relative remineralization rates of sedimentary carbon for the fresh and saltwater environments in the river. They found that the upstream environment, which is dominated by terrestrial inputs and the process of methane reduction, remineralized at a rate three times faster than the downstream site, which is dominated by marine inputs and uses sulfate reduction as the energy pathway for organic matter remineralization. As indicated in the previously described paper by Martens and Goldhaber (1978), saltwater circulation patterns, as well as freshwater inputs, appear to have changed such that the estuarine ecology has shifted towards a more freshwater system. Since freshwater facilitates rapid remineralization of organic carbons, this, over time, can reduce the river's buffering capacity and result in nutrient enrichment.

Initial Conclusions of Board

Based on these and other related studies, the Board concluded the following:

- Salt wedges that used to extend upstream have not occurred in recent history.
- Organic inputs upstream are from terrestrial sources and downstream are from marine sources.
- Salinity regimes in the river are highly variable seasonally and spatially.
- Salinity helps buffer the river from nutrient inputs.
- Sedimentation at the mouth of the estuary was considered normal for coastal estuary systems.
- There was no evidence to support a perceived decline in the fishery.
- Increased fresh water inputs from the expanded impervious surface area related to the highway expansion may have a negative impact.

- Higher salinity reduces concentrations of fecal coliform bacteria.

- Ditching and other means of moving water faster off the land causes problems with increased freshwater to the river as well as increased bacterial contamination in shellfish beds.

- There is a significant shellfish resource at the mouth of the river that has historically remained open.

Next, the Advisory Board convened a panel of specialists to discuss this information and potential mitigation strategies. The panel participants included:

- Dr. Larry K. Benninger, Geologist, University of North Carolina at Chapel Hill (UNC-CH);

- Archie Hankins, Biologist, NC-DOT;

- Tom Jarrett, Hydraulic Modeling, United States Army Corps of Engineers (USCOE);

- Dr. Chris Martens, Marine Sciences, UNC-CH;

- Dr. Paul Hosier, Biologist, UNC-CH;

- Dr. Rick Leuttich, Sedimentary Geologist, UNC-CH; and

- Howard Varnam, Hydrologist, USCOE.

The panel reviewed the scientific information presented to the Board, and they agreed that there has been an impact on the circulation and flushing of the White Oak River since the construction of the causeway and the ICWW, but quantification of those effects would require intensive modeling that would take a minimum of 1.5 to 2 years. The panel felt that any action to increase circulation and salt water inputs to the river would have an overall positive effect on water quality. However, the best manner in which to accomplish those goals and the particular effects on fisheries, sedimentation, or other water resource values would be difficult without modeling studies. The panel concluded that due to changes in land use, hydrology in the watershed had been altered. As a result, runoff volume during storm flows has increased. This increases pollutant loading and increases erosion processes during storms. The panel noted that a reduction in freshwater runoff would not have any significant effect on the diversity and density of species, but on their distribution. This would have little effect on flora and fauna in the river, but might improve water quality. The panel also noted that the most effective strategy for protecting water quality is to involve all of the communities impacting the system and to implement overall land use planning in the watershed. It was suggested that the group needed to define their water quality goals and how they want to manage the river and watershed to achieve those goals. Individual actions for localized effects would require some additional modeling and research to determine the best options.

The panel concluded with a list of mitigation recommendations listed below:

- Pursue a study of the river to determine what, if any, actions should be taken to improve circulation up and downstream of the highway.

- Examine options to manage stormwater in new and existing developments.

- Pursue the maintenance of buffers along creeks and streams.

- Pursue stricter enforcement of sediment and erosion control at construction sites.

- Endorse, encourage, and facilitate the use of BMPs in forests and farms.

- Work to develop a mechanism for watershed - based or coordinated land-use planning to address all of the suggestions.

- Explore alternative waste management strategies for both single users and municipalities to reduce nutrients.

The Board's Recommendations

Over the next several meetings, and as a consequence of these findings, the Board recommended the following actions;

1. To reduce freshwater inputs to the estuary and possible negative impacts of highway runoff on water quality, the Advisory Board recommended storm water runoff from bridge and highway expansion not be discharged into the river and that the Department of Transportation (DOT) explore options to eliminate discharge into the waterways. At a minimum, discharge from Highway 24 should be directed south (downstream) of the causeway to prevent impacts to shellfish. In addition, it was recommended that amelioration of the velocity, volume, and quality of that runoff be implemented; if feasible.

2. Historic maps showed that, prior to the 1930's, the mouth of the White Oak River was open and unrestricted, allowing free tidal flow. In 1932 and 1933, Department of Transportation and US Army Corps of Engineers (ACOE) projects closed approximately 80% of the mouth of the river and altered physical processes. The Advisory Board recommended that to restore salinity regimes, increase tidal circulation, and reduce sedimentation, DOT take actions to reopen the mouth of the river to the maximum extent possible. One option would be the creation of a north-south channel connecting the estuary with the sound near the current location of the Flying Bridge Restaurant on the Carteret County side of the river spanned by a bridge or connected by a culvert. Additionally, the Board recommended that DOT and ACOE access ACOE ecological restoration funds and collaborate with each other to mitigate the impacts of this expansion and past actions.

3. Since efforts to open the channel would not remain effective unless the State of North Carolina initiates an ongoing maintenance program, the Advisory Board recommended that a long-term maintenance program supporting improved circulation, reduced sedimentation, and restored salinity regimes be developed and implemented by responsible agencies.

These recommendations were presented to and adopted by commissioners for Carteret and Jones Counties in May and June of 1997. In addition, the White Oak River Watershed Advisory Commission of Onslow County (a group appointed by the Onslow County Board of Commissioners to address water quality issues in Onslow County) endorsed the recommendations of the Board at their May of 1997, meeting. This collaborative, consistent, watershed-based policy statement became part of the public record for the NC-DOT hearings in May of 1997, and a preliminary draft was included in the NC Division of Water Quality's Basinwide Water Quality Management Plan for the White Oak River Basin (North Carolina Division of Environmental and Natural Resources, 1997).

Response to the Recommendations of the Board

At a joint meeting that included representatives of the NC-DOT, the White Oak River Advisory Board, the Extension Project Team, and USCOE, the DOT agreed to support the Board's recommendations and revise their stormwater plans to direct runoff away from the shellfish resource in the river.

Blueprints for construction were redrawn reflecting the following features. In the vicinity of the bridges carrying Highway 24 over the White Oak River at Swansboro, NC-DOT agreed, to the extent possible, to direct the stormwater runoff from the roadway to the Bogue Sound side of Highway 24 and away from the river. In Swansboro (west of the island causeway), the existing stormwater collection system (which has outfalls on both the river and sound side of Highway 24) will continue to be used for the runoff following roadway expansion, thus preventing the need for additional outfalls in the river.

From the island causeway eastward for approximately 2.5 miles, the stormwater runoff from the highway will be collected and piped to outfalls on the sound side of Highway 24. Also, NC-DOT has designed special channelization islands for commercial driveways to accommodate some of the stormwater runoff from the highway and bridges. These water quality islands are depressed inside the curb to allow the first inch of highway runoff to pond within these islands and filter through the grassed areas located there. The filtered runoff from these islands is then collected and piped to outfalls on the sound side of Highway 24.

In addition to the stormwater design changes, it was agreed that DOT would cooperate with other state and federal agencies in any efforts to improve circulation and tidal flushing. Currently, the Board is continuing to work on adding a section to the Congressional *Water Resources Development Act* that would authorize the USCOE to conduct the study necessary to determine what, if any, actions could be taken to improve flushing in the river.

Conclusions

Local stakeholder-based citizen groups can impact policies that affect their environment. Support for gathering, summarizing, and delivering technical information to local citizens and governments is an important aspect of the success of these processes. Knowing who to approach for answers to specific questions, and where to look for scientific information is an important function of the group's technical support. In addition, translating the information gathered into digestible and usable material is also critical.

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Community Responses to Stormwater Pollution: Case Study Findings with Examples from the Midwest

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Stormwater runoff threatens the nation's waterways and public health, and costs Americans hundreds of millions of dollars each year. Concerns about urban runoff and interest in proposed new federal stormwater regulations prompted the Natural Resources Defense Council (NRDC) to document existing, effective stormwater strategies. Our report aims to encourage municipal action and empower communities to address this critical issue. More than 150 case studies from across the nation were compiled and evaluated to highlight effective pollution prevention, administrative, and financing strategies for addressing stormwater runoff. The case studies show, on a practical level, that stormwater management can be environmentally effective, economically advantageous, and politically feasible. The report also forms the foundation of a comprehensive outreach effort. Together, they help guide communities as they implement or improve stormwater management programs by providing detailed examples of proven tools and approaches used to prevent stormwater pollution. Collectively, the case studies offer an outline for further successful stormwater management strategies. Elements critical to the effectiveness of these programs include: a pollution prevention emphasis with structural treatment measures when needed; a focus on preserving natural features and processes; programs that inform and involve the public; a framework that creates and maintains accountability; a dedicated and equitable funding source to ensure long-term viability; strong leadership; and effective administration. These broad themes translate into a set of nine local actions for addressing the technical, social, and political issues associated with stormwater runoff. The case studies show that following these actions will help communities form a sound stormwater policy.

Key Terms: urban stormwater runoff, impervious surfaces, pollution prevention, best management practices, diffuse pollution, accountability.

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Introduction

Currently, there is substantial concern about the impacts of urban and suburban runoff. Pollution from diffuse sources, including urban stormwater, is the leading source of contamination in the nation's waters (U.S. Environmental Protection Agency, 1997a). Stormwater runoff pollution is a particularly important issue since most of the population of the United States lives in urban and coastal areas. Water resources in urban and coastal areas are highly vulnerable to and are often severely degraded by stormwater runoff. Specifically, urban and suburban runoff is the second most prevalent source of water quality impairment in the nation's estuaries after industrial discharges (U.S. Environmental Protection Agency, 1998b).

Economic impacts are an important aspect of this concern. Even a partial accounting shows that hundreds of millions of dollars are lost each year through added government expenditures, illness, or loss in economic output due to urban runoff pollution and damages (U.S. Environmental Protection Agency, 1998a). The ecological damage is also severe and is at least as significant. In particular, uncontrolled urban runoff contributes to hydrologic and habitat modification, two important sources of river impairment identified by the U.S. Environmental Protection Agency (EPA).

The polluted stormwater runoff problem has two main components: the increased volume and rate of runoff from impervious surfaces and the concentration of pollutants in the runoff. Both components are closely related to development in urban and urbanizing areas (Booth and Reinelt, 1993; Schueler, 1994; U.S. Environmental Protection Agency, 1997b). When impervious cover (roads, highways, parking lots, and roof tops) reaches between 10 and 20 percent of the area of a watershed, ecological stress becomes clearly apparent (Klein, 1979; Booth and Reinelt, 1993; Schueler, 1994). Everyday activities can deposit on these surfaces a coating of various harmful materials. When it rains or when snows melts, many of these pollutants are washed into receiving waters, often without any treatment.

The deposition of pollutants and the increased velocity and volume of runoff together cause dramatic changes in hydrology and water quality (Klein, 1979; Jones and Clark, 1987; Booth, 1990; Galli, 1990; U.S. Environmental Protection Agency, 1997b). These changes affect ecosystem functions, biological diversity, public health, recreation, economic activity, and general community well-being (Bannerman *et al.*, 1993; Novotny and Olem, 1994; Haile *et al.*, 1996; Carpenter *et al.*, 1998). Urban stormwater is not alone in polluting the nation's waters. Industrial and agricultural runoff are often equal or greater contributors. But the environmental, aesthetic, and public health impacts of diffuse pollution will not be eliminated until urban stormwater pollution is controlled.

While urban and suburban runoff continues to be a critical issue, there is substantial evidence that the problems are not intractable. Increasingly, communities are recognizing the causes and consequences of uncontrolled urban runoff and taking action to control and prevent runoff pollution, often without any mandate. These innovative communities are realizing the environmental, economic, and social benefits of preventing stormwater pollution. However, neither the extent of these efforts nor the specific actions being taken have been well documented.

There is also a growing interest in proposed new federal stormwater regulations. Comprehensive stormwater regulation is required under Section 402(p) of the Clean Water Act. Since 1992, cities with populations over 100,000, certain industries, and construction sites over 5 acres have been required to develop and implement stormwater plans under Phase I of the National Pollutant Discharge Elimination System (NPDES) stormwater regulations (U.S. Environmental Protection Agency, 1990). In October 1999, EPA is expected to promulgate a new rule requiring municipalities with populations fewer than 100,000 people located in "urbanized areas" (where population density is greater than 1,000 persons per square mile) to develop stormwater plans. Under what is known as the "Phase II" rule, the EPA and states will develop "tool boxes" from which the smaller local governments can choose particular stormwater strategies to develop their stormwater plans (U.S. Environmental Protection Agency, 1998a).

To address all of these issues and concerns, the authors developed a study to examine, document, and disseminate information on environmentally effective and economically advantageous stormwater pollution prevention strategies. The study resulted in a report, *Stormwater Strategies: Community Responses to Runoff Pollution*, that highlights some of the most effective existing stormwater strategies from around the country (Lehner *et al.*, 1999). The report provides substantial evidence that such programs exist and highlights a variety of innovative strategies actually being used. The report also aims to provide guidance to communities addressing stormwater issues, encourage municipal action, and help empower communities to be involved in this critical issue. This paper summarizes the study and presents its primary findings and recommendations.

Study Design and Approach

The study was exploratory in nature, with the intent of presenting information on existing effective stormwater management programs. To achieve this goal, we collected examples of environmentally beneficial and cost-effective stormwater programs from across the country. We compiled this information into the case-study-based report described above. This information and report have become the basis for a comprehensive outreach effort.

The first step was to gather information on programs and projects by examining existing programs (several begun under Phase I as well as many that started earlier), reviewing literature, contacting regional and local stormwater management experts and researchers, and interviewing representatives from stormwater management or other local government agencies. We gathered information on over 250 programs. The information was then examined in detail and narrowed down to a set of case studies that demonstrated elements of success. Three fundamental criteria for selection were used: environmental gains, economic advantages, and community benefits. Environmental gains included biological, hydrological, or chemical improvements resulting from stormwater management. Economic advantages included cost savings to the municipality or developers, or increases in property values related to the pollution prevention measure. Community benefits included aesthetic or recreational enhancement, administrative or institutional successes, or community relations improvements.

Seventy-seven programs and projects were selected as case studies for the final report. Another 88 programs were annotated to provide additional programs/locations not fully evaluated for the report. The case studies represent communities of all sizes, types, and regions throughout the United States. To help ensure accuracy, local experts or people familiar with the program, called "groundtruthers," were contacted to review the case studies and add information from their own knowledge and experience.

The case studies were first organized geographically by dividing the United States into six regions based in part on general rainfall patterns. Within each of the regions, case studies were then further subdivided into five categories of stormwater management measures including, (1) addressing stormwater in new development and redevelopment, (2) promoting public education and participation, (3) controlling construction site runoff, (4) detecting and eliminating improper or illegal connections and discharges, (5) and implementing pollution prevention for municipal operations. These categories roughly parallel those measures that large municipalities address under existing Federal regulations (40 CFR parts 122.26 and 123.25) and small municipalities will address under pending Federal regulations (U.S. Environmental Protection Agency, 1998a).

Case Study Findings

Through reporting over 150 examples of actual programs, the full report provides substantial evidence that stormwater pollution can be reduced or prevented with proper planning and implementation in growing or re-developing areas. The examples presented in the report also demonstrate that if some communities can measurably and cost-effectively reduce stormwater pollution, so can other communities and states (Lehner, et al., 1999).

The Five Categories of Stormwater Management Measures

Individually, the case studies provide detailed examples of substantial water quality improvement, effective or innovative stormwater control strategies to protect the natural environment, significant cost-savings, and important ancillary benefits to the community. The programs and strategies highlighted come from communities of all sizes, types, and regions. They include efforts by municipal agencies, developers, and community groups. In many cases, several of these groups worked together to create win-win outcomes. The case studies highlight a variety of strategies for addressing the five categories of stormwater management measures previously enumerated, and are described in more detail as follows.

Addressing Stormwater in New Development and Redevelopment. By far the most important category of stormwater strategies focuses on land use and development. It encompasses a wide range of measures including regional or watershed planning, buffers and open space preservation, infill development, conservation design, and the use of site-specific structural and nonstructural treatment measures. One of the best strategies a municipality or developer can employ is to minimize the aggregate amount of new impervious surfaces. For example, developers of the Prairie Crossing project in Grayslake, Illinois, prevented runoff pollution and saved money by using conservation design strategies. The developers first reduced impervious cover by clustering 317 residences on only 132 acres of the site, which left 80 percent as open space. They then designed the developed area around a natural drainage system consisting of vegetated swales, restored prairie, and wetlands. Modeling indicates that this stormwater treatment drain system will remove approximately 85% of nutrients, metals, and suspended sediments and reduce peak flows by 68%. Eliminating curbs and gutters resulted in savings of $1.6 to $2.7 million. The development is also very appealing to homebuyers, with sales comparable to or better than conventional developments in the area (see Lehner *et al.*, 1999, p. 224).

Promoting Public Education and Participation. Individuals play a key role in reducing stormwater impacts both in their own day-to-day activities and in showing support for municipal programs and ordinances. The most successful highlighted programs accomplished three goals: they educated the public about the nature of the problem, they informed the people about what they can do to solve the problem, and they involved citizens in hands-on activities to achieve pollutant reduction or restoration targets. One example of this success is in Minneapolis, Minnesota, where a decline in water quality motivated the Lake Harriet Watershed Awareness Project. Monitoring revealed that lawn-care chemicals were a significant contributor to the problem, which suggested focused education efforts. In turn, the project developed two approaches: a volunteer master gardener program and the distribution of educational materials. Evaluation showed that 67% of watershed residents reported using the information presented and 30% reported a change in behavior. As a result, concentrations of lawn-care pesticides have dropped by 50% or more since the program began (see Lehner *et al.*, 1999, p. 231).

Controlling Construction Site Runoff. The case studies demonstrate that effective construction site pollution prevention is politically and economically feasible and can dramatically reduce pollution. The most effective programs rest on four cornerstones laid in pairs: enforcement and education; erosion prevention and sediment control. However, the first and over-arching necessity is a clear set of requirements. For example, Herzog *et al.* (1998) found that in Geauga County, Ohio, and St. Joseph County, Indiana, aggressive, widespread seeding and mulching reduced construction site erosion by up to 86% and reduced phosphorus loadings by 80%. These measures can also benefit developers financially. They found that homebuyers perceive these "green" lots to be worth $750 more than comparable "brown" lots (see Lehner *et al.*, 1999, p. 236). While existing programs employ a wide variety of erosion and sediment control practices, virtually all successful strategies require proper planning and phasing of construction activities to minimize land disturbance.

Detecting and Eliminating Improper or Illegal Connections and Discharges. Local governments have found that identifying and eliminating illicit connections and discharges is a remarkably simple and cost-effective way to address some of the worst stormwater pollution. The case studies show that two factors are critical to success of this element of stormwater programs: finding illicit connections and discharges, and enforcement. In Washtenaw County, Michigan, the Huron River Pollution Abatement project resulted in a 75% reduction in the river's fecal coliform levels in just 4 years. The project focused on eliminating existing illicit connections and preventing future incidents through chemical storage surveys, industrial inspections, water-quality monitoring, public education, and complaint and spill response. Over a six-year period, the program dye-tested more than 3,800 facilities, after which 328 of the 450 illicit connections found were removed (see Lehner *et al.*, 1999, p. 239).

Implementing Pollution Prevention for Municipal Operations. A wide range of municipal operations can affect stormwater quantity and quality. The case studies reveal that some local governments have been able to manage their municipal operations to reduce stormwater pollution. The municipalities highlighted have done so in a variety of ways including reducing the use of harmful chemicals in the maintenance of municipal properties and vehicles, improving the maintenance and cleaning of roads and stormwater infrastructure, and training staff in pollution prevention practices. Several municipalities have taken these steps at their golf courses. For example, the Village Links Golf Course in Glen Ellyn, Illinois, is preventing runoff pollution by incorporating integrated pest management, water conservation, stormwater detention, native planting, recycling, and public outreach into its day-to-day management. The golf course relies on both mechanical and biological pest controls and has significantly increased natural areas. The course collects runoff from nearby streets and neighborhoods in its system of ponds and spillways. These ponds provide approximately 60% of the course's irrigation water, and the course itself passively treats and filters all excess runoff from irrigation (see Lehner *et al.*, 1999, p. 243).

Themes Common to Success Stories

Collectively, over 150 case studies present a clear model for success. Evaluation of the case studies revealed several common elements among the highlighted programs. We distilled those elements into the seven broad themes listed below to help guide communities as they develop or improve stormwater programs. Since they are based on actual programs, these themes form a solid foundation for successful programs.

Preventing pollution is highly effective and saves money. Pollution prevention measures dramatically and cost-effectively reduce the quantity and concentration of pollutants "winding up" in stormwater. Common pollution prevention measures include reducing or eliminating the use of harmful products, preventing erosion, reducing the amount of pavement in new developments, and changing maintenance practices. In highly urbanized areas, however, such measures may be difficult. In such cases, several communities have found treatment of runoff with structural measures or retrofitting existing structures to be effective alternatives.

Preserving and utilizing natural features and processes have many benefits. Many communities and developers have found strategies that rely on natural processes to be highly effective and economically advantageous. Undeveloped landscapes absorb large quantities of rainfall and snowmelt and vegetation helps to filter out pollutants from stormwater. Buffer zones, conservation-designed development, sensitive area protection, or encouragement of infill development all enhance natural processes.

Educating and informing the general public and municipal staff improves program effectiveness. Providing information and training to the general public and local businesses is a key component to many of the highlighted programs. Since many sources of stormwater pollution are derived from individual activities such as driving and maintaining homes, educating the public goes a long way to reducing stormwater pollution. Several communities involve the public in civic activities, such as monitoring water quality or stenciling storm drains, which not only provide educational opportunities but also save the municipality money.

Strong incentives, routine monitoring, and consistent enforcement establish accountability. Enforcement, or more broadly accountability, is a key element to improving water quality. All actors need a clear statement of performance goals, and they need to be held accountable by others for accomplishing these goals. We found that programs with high accountability were the most effective, often achieving pollutant reductions of 50% or greater.

Financial stability helps ensure effective programs. Effective stormwater programs are financially viable and affordable. Dedicated funding sources, such as stormwater utilities or environmental fees are equitable ways to build stability into stormwater programs. Stability and equity are also important in gaining public support. Nearly 200 communities across the nation are already realizing the benefits of implementing stormwater utilities as dedicated and equitable funding sources.

Strong leadership is often a catalyst for success. Success, at least initially, often requires an individual to champion the project and make it happen.

Effective administration is critical. Regardless of which strategies a community chooses, those programs with clear goals and objectives are the most successful. Such clarity enhances accountability, responsibility, and trust. Furthermore, an established and understood institutional framework often improves administration by fostering collaboration among different parts and levels of government, neighboring communities, and local citizens. Effective administration allows implementation of broad-based, multi-faceted programs, which are often the most effective at controlling the diffuse problem of stormwater pollution.

Authors' Recommendations for Local Action

To further guide communities addressing stormwater runoff issues, we translated the broad themes presented above into an action plan based on nine key recommendations. These actions roughly parallel the broad themes presented above. The case studies demonstrated that following the nine local actions outlined below will help build a strong framework for effective, efficient, and successful stormwater management over the long term.

1) *Plan in advance and set clear goals.* Carefully plan programs, as opposed to simply reacting to provided opportunities, crises, or transient pressures. Planning allows development of more effective and cost-effective actions. An essential outcome of planning is addressing the issues and concerns of all stakeholders involved.

2) *Encourage and facilitate broad participation.* Program planning, development, and implementation should involve multiple levels of government, key members of the community, and professionals from a variety of related disciplines. A key to success is the public's understanding of the issue, how it relates to them, and what they can do about it.

3) *Promote public education opportunities.* Implement broad-based programs that reach a range of audiences and solicit different levels of public involvement. Remain committed to the education program and take advantage of existing community organizations to enhance participation.

4) *Work to prevent pollution first; rely on structural treatment only when necessary.* Focus on prevention-based approaches, through regional and watershed planning, local zoning ordinances, preservation of natural areas, stormwater-sensitive site design, and erosion prevention as these are significantly more effective than treatment of polluted runoff.

5) *Establish and maintain accountability.* Essential components of this process are setting clear standards, creating strong incentives and disincentives, conducting routine monitoring and inspections, keeping the public informed, promoting public availability of stormwater plans and permits, and consistently enforcing laws and regulations. Strong enforcement is often key to significant water quality improvements.

6) *Secure financial resources.* Consider establishing a dedicated funding source such as a stormwater utility. Combine with it budget-saving measures such as creative staffing, public-public and public-private collaboration, and building off existing programs.

7) *Tailor strategies to the region and setting.* Recognizing that every case will be different, consider strategies that are particularly tailored to the region, the specific audience, and the problem.

8) *Evaluate and allow for evolution of programs.* Set clear goals and priorities, and allow programs to develop over time. Establish clear ways to check and see that goals and objectives are being met. This opens opportunities for improvements and helps ensure long-term success.

9) *Recognize the importance of associated community benefits.* Stormwater pollution prevention measures usually offer ancillary quality-of-life benefits in addition to targeted improvements. For example, preserved areas offer parks, ponds offer beauty and habitat, clean streets are more attractive, education helps empower people, and sediment control improves fisheries and prevents flooding.

Conclusion

Many fine handbooks provide theoretical and technical guidance concerning the design and implementation of effective stormwater pollution prevention and control measures. This study took a different approach and focused on existing effective programs in a variety of settings. In doing so, it accomplished two key goals. First, the study demonstrates that stormwater management is quite possible. The case studies show on a practical level that stormwater management can be environmentally effective, economically advantageous, and politically feasible. Second, the case studies enable communities developing or improving stormwater programs to learn from their peers. In doing so, the case studies offer an outline for future successful stormwater management strategies.

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Integrated Urban Stormwater Master Planning

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Abstract

Urban stormwater management agencies are increasingly being called upon to address water quality and natural resources issues in addition to their traditional focus on flood conveyance. In response to this, stormwater drainage master plans have been increasingly addressing stormwater quality and, in limited cases, natural resources and habitat. This paper will describe some of the problems with traditional stormwater master planning approaches, including those where water quality and natural resources have been included as "add-ons," and the urban stormwater problems we are now trying to address which have resulted from these approaches. A framework for how communities can develop integrated stormwater master plans that address multiple objectives, as increasingly mandated by public concern as well as by regulations, will be presented. Given that the tools available for master planning are not equivalent in their numerical evaluations, new procedures and project approaches are required. Especially important is how the hydrology/hydraulic methods are performed, including both flood evaluations and evaluation of the smaller channel-forming storms.

Communities are often not institutionally organized to address multiple objectives. Master planning has traditionally been led and performed by engineers trained in hydrology and hydraulics, and they are usually in different departments from those who are responsible for other environmental aspects of the drainage system. This paper will focus on the technical, institutional, and process-oriented aspects of how master planning can be improved. Several case studies from the Pacific Northwest of the United States will be discussed.

Introduction

The purpose of this paper is to discuss some of the attributes of urban stormwater master planning and how those master plans can be improved to more fully address issues besides conveyance capacity and flood control. Stormwater master plans go by a number of names, including storm drain master plans, stormwater infrastructure plans, and urban catchment management plans. These plans are usually very focused on flood control and, until just recently, address water quality minimally. This paper will discuss some of the attributes of traditional urban stormwater master planning and its results, regulatory programs (which in the US and New Zealand are requiring a different approach), how integrated master planning can be accomplished, and institutional barriers which often prevent integrated master planning from being accomplished. In this paper, an Integrated Stormwater Master Plan is an infrastructure and management plan that not only addresses flood control and property protection issues, but also considers stream stability and habitat, along with water quality and aesthetics.

Urban Stormwater Drainage Problems

It has long been recognized that in urban areas, unplanned stormwater management systems result in damage to property and sometimes people. As it will be well demonstrated by other papers in these proceedings, urbanization of watersheds and the resulting impervious areas also cause changes to the hydrology and water quality of receiving waters which ultimately result in other impacts to aquatic life and humans. Even some of our measures to control impacts can have unplanned detrimental effects. Especially sensitive to these changes are stream systems and coastal embayments that are not well flushed. Almost always there are also direct impacts to stream riparian areas which also increase these changes through canopy removal and channel modifications.

Urbanization usually includes impervious areas directly connected to efficient stormwater conveyance systems (including roof drains and driveways connected to streets and curbs to inlets to pipes) which then are discharged to streams directly or through engineered channels. This has resulted in stormwater being conveyed as fast as possible to receiving waters (and away from properties). Increasingly, it is being recognized that because stormwater is drained to streams in this manner, small storm hydrological changes that result in increased runoff flows can significantly increase the frequency and duration of elevated flows. This energy change within the normal wetted channel often results in channel cutting, widening, and/or sedimentation, which in turn can cause severe habitat and water quality degradation (MacRae 1996; Sovern and Washington, 1996). Often to "fix" these channel problems, streams are enclosed, hardened, and/or straightened. Even without considering the water quality of stormwater, our stormwater systems are severely impacted from a physical habitat standpoint, including habitat loss, higher velocities, and temperature changes. Figure 1 shows an example of how stream runoff can change with urbanization, including much higher and peaky flows as well as increased volumes of runoff.

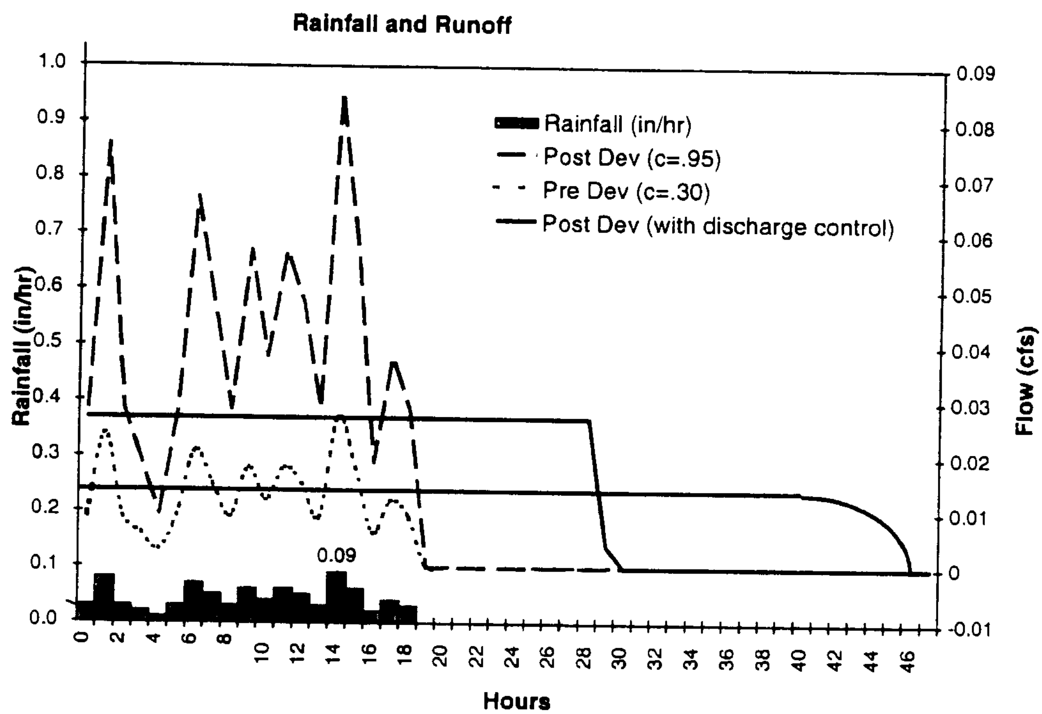
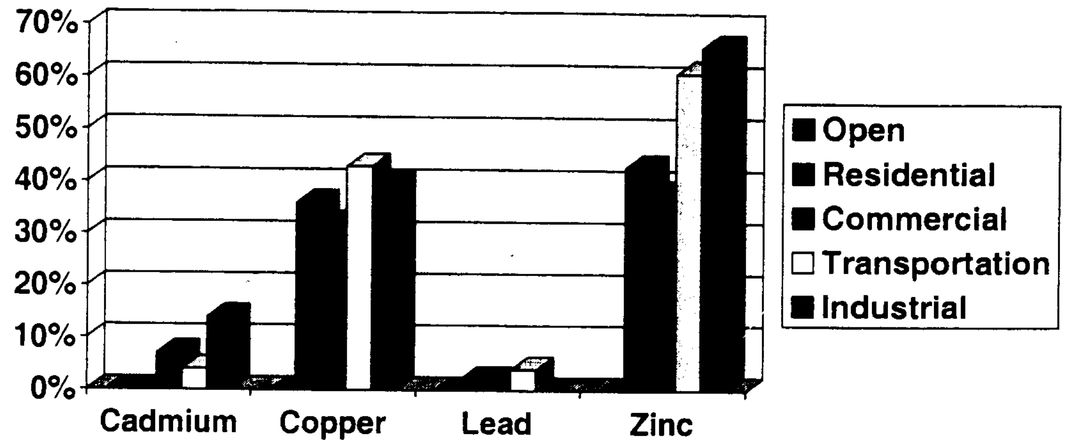


Figure 1. Example Schematic of Changing Rainfall/Runoff Relationships with Development.

With urbanization also comes a dramatic change in water quality. Urban stormwater systems are the efficient conveyance system of urban pollutants, both those discharged during storm events and those occurring during dry-weather discharges. There are numerous ways that pollutants enter stormwater from those in the rainfall itself to commonly thought of sources such as street dirt and car drippings. Stormwater often exceeds US EPA water quality criteria. Figure 2 is a graph of the frequency that stormwater runoff from identified land uses in Oregon exceed US EPA acute dissolved metals water quality criteria in runoff from identified land uses (Strecker et al., 1997). It should be noted that most of this runoff was measured in pipes, while the criteria are meant to apply to receiving waters. A data set of flow-weighted composite samples (representing average storm concentrations) from over 40 land use stations from various areas of the Willamette Valley was utilized to develop the information displayed in the figure. The stations included an open land use station in an urban area (Forest Park in Portland) for comparison. Note that dissolved copper and zinc in developed land uses exceeded criteria for 30 to 65% of the storm events. Similar findings have been found in other programs, including the San Francisco Bay area programs (Cooke and Lee, 1993).



Based upon Oregon NPDES Stormwater Monitoring Data Compiled by ACWA. Developed areas: 27 to 67 storm events; Open space: 9 storm events

Figure 2. Frequency that Flow-weighted Composite Urban Stormwater Runoff Samples Metals Concentrations Exceeded US EPAs Acute Criteria for Aquatic Life.

The water quality impacts together with the physical hydrology changes described above have caused our urban stream systems to become severely degraded. Our traditional systems have not protected the resources nearly as well as they have protected property. As many have now recognized, at about 10 to 25% imperviousness, the health of the aquatic system is severely degraded (May et al., 1997; Schueler, 1994). In many cases because of the longer-term channel stresses, property has been damaged as well, including under cutting of headwalls, etc. The plans typically only identified solutions that solved large flooding problems, sometimes just temporally until what has been considered "maintenance" problems such as head wall failures, occur.

Environmental Concerns and Regulatory Requirements

In the US, Congress has recognized that urban stormwater plays a major role in affecting receiving waters when it mandated in the revised Clean Water Act that urban stormwater water quality be addressed through a permitting (consent) program. New Zealand has similar requirements through its Resources Management Act of 1991. Both these programs are still evolving. The stormwater permit program in the US specifically requires that larger cities (over 100,000) and soon smaller cities address stormwater quality issues as they conduct flood control projects. New Zealand's program also requires that municipalities obtain consents for stormwater discharges.

Under the overall program, one area that has been slow to change is how urban stormwater master plans are developed and implemented. Although there are requirements to consider water quality in conducting flood control efforts, for a number of reasons (including institutional inertia) agencies have been somewhat slow in actually giving water quality and habitat protection equal weight with flood control in master planning. Some of this is due to the fact that stormwater master plans are typically the responsibility of engineers who are experienced in hydraulics, but that often lack experience and knowledge in other aspects of environmental stormwater management. To be fair, engineers have been told to plan for managing stormwater based upon land-use zoning that was selected without considering stormwater issues. Another major issue is the resources allocated to conduct integrated planning efforts which are more expensive; often agencies do not recognize the value of better up-front planning compared to capital and maintenance costs.

Increasingly though, the public has started to demand that more environmentally sound and/or aesthetically pleasing stormwater management approaches be utilized. For example, with the endangered species act (ESA) listings and proposed listings of salmon and trout species in the US Pacific Northwest, many neighborhood organizations are pressuring municipal agencies to change their stormwater management approaches. Some of these efforts are having more success than the regulatory programs.

Stormwater Management Agency Functions

Understanding a stormwater management agency's function and history is important to understanding its approach to stormwater management. Stormwater management agencies typically fulfill the following roles:

1. Stormwater System Maintenance
2. Development Standard
3. Stormwater Master Planning
4. CIP Design and Construction
5. Funding-Utilities/System Development Charges
6. Stormwater System Permitting and Environmental Impact Minimization
7. Education

The last two elements are the most recent. Many agencies began by responding to emergencies and problems, and were then tasked to develop onsite design conveyance standards. Stormwater master plans for the most part were developed in response to problems that arose after watersheds were developing with little or no stormwater planning. They also were typically focused on just flood control and property protection. Most often they focused on the piped systems and road culverts. Often creeks away from culverts were not evaluated unless there had been a particular problem identified. In the US, the Federal Emergency Management Agency (FEMA) had separately developed flood plain maps for larger systems, which communities relied upon for protecting structures from larger river and stream flooding. This was done to meet requirements for participation in FEMA's flood insurance program. Therefore, flood plains and the creeks themselves have not been a focus of master plan (e.g., creek sections were typically not evaluated to a great extent).

Stormwater Drainage Master Plan Goals and Results

The traditional purposes of the Stormwater Drainage Master Plan were to:

- Guide a city's stormwater drainage system capital improvement project (CIP) program. (e.g., identify, select, cost, and prioritize stormwater system construction projects.)
- Establish a maintenance program for the stormwater system (recommended stormwater system maintenance practices and frequencies)
- Establish onsite conveyance requirements (design standards for level of peak flow conveyance by an engineered stormwater system and, sometimes, requirements for street conveyance of stormwater beyond the onsite requirements)

Master plans seldom included requirements for development with regard to stormwater system impacts (e.g., downstream flow and/or water quality impacts). Master plans were sometimes utilized to assess potential future problems as well as to fix existing problems. Often systems were evaluated under current conditions and future planned zoning to be able to assess costs to current rate/tax payers or new developments. Because master plans were not usually completed prior to some significant level of development, attributing these costs was important to the development community as well as to the residents.

The traditional approach to stormwater master planning has been to focus on hydrology and hydraulics of the existing stormwater systems, and proposed larger trunk systems to determine whether there is enough capacity. This is usually is accomplished by the following steps:

- Route a designated large storm through system, assume worst case conditions (saturated, etc.) and determine capacity deficiencies

- Develop an enlarged (or more efficient) system to handle larger flows or, when necessary, reduce peak flows by detention (if the cost of detention is less than a conveyance upgrade)

- Sometimes consider water quality as a "add-on" (e.g., if detention is required, claim a water quality benefit)

This approach has certainly significantly reduced property damage (sometimes only for short-term), but has led to more damage in streams. The damage has been a result of a significant increase and duration in small storm runoff flows. The result of not planning for this increased energy, which is primarily contained within the stream channel, has often been an increase in maintenance and property damage. For example, channel cutting that occurs upstream of culverts often causes headwall and culvert failures. In other areas where channel cut sediments settle out (often in over-designed or poorly designed culverts), areas are filled in with sediments. When this occurs (especially in a culvert), it can lead to flooding. These problems (headwall failures, culverts filled in, etc.) are often called maintenance issues, when they are in fact really failures of the master plan to adequately address stream impacts of development.

Typically smaller urban stormwater systems (e.g., 10 to 50 acre catchments) are dominated from a flooding standpoint by shorter-duration, more-intense storms (thunderstorms), whereas, the larger urban watersheds are often impacted by larger, but less-intense storms of longer duration. Master plans typically utilize a single large design storm event based upon a rainfall depth (mm of rain over a watershed) for a specified duration and return period. This depth is then assigned a conservative shape such as the SCS type IA shape shown in Figure 3). The storm shown is the 25-year, 24-hour storm depth for Eugene, Oregon, with the SCS distribution applied to it. As an example of how overly conservative the peak of

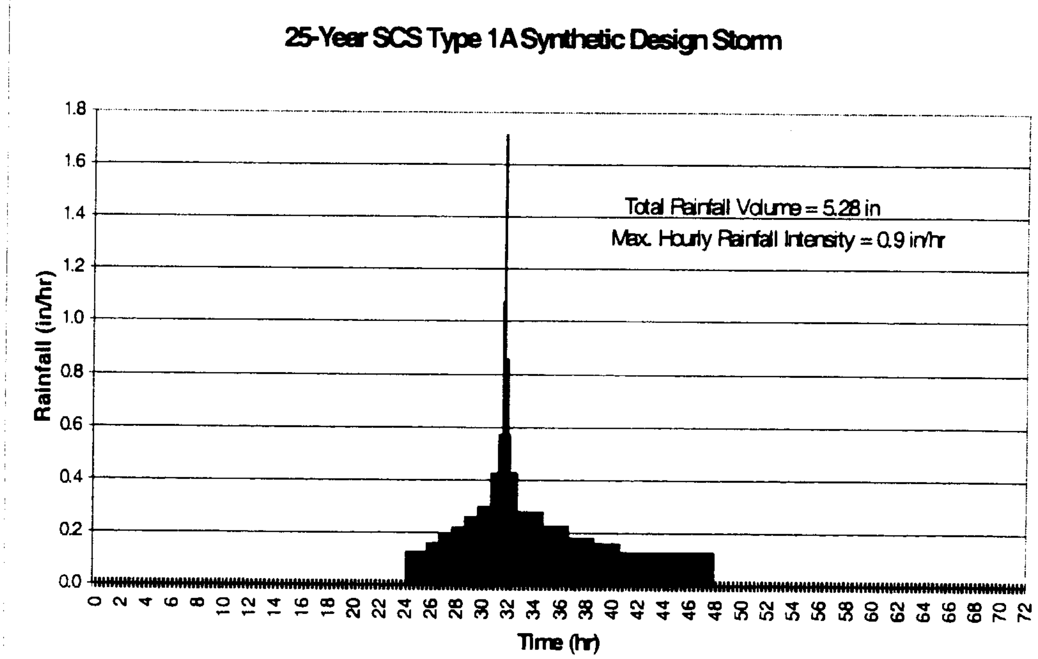


Figure 3. 25-Year, 24-Hour SCS Type 1A Synthetic Design Storm for Eugene, Oregon.

the "design" hydrograph is, Figure 4 shows an actual 25-year storm hydrograph (based upon analysis of the Eugene Airport rain gage). This storm was confirmed by long-term simulation modeling to have caused approximately the 25-year return-period flows in the larger stormwater systems in the city. In reality, the 25-year return-period storm depth seldom if ever arrives with the peaky "shape" given it in master plans.

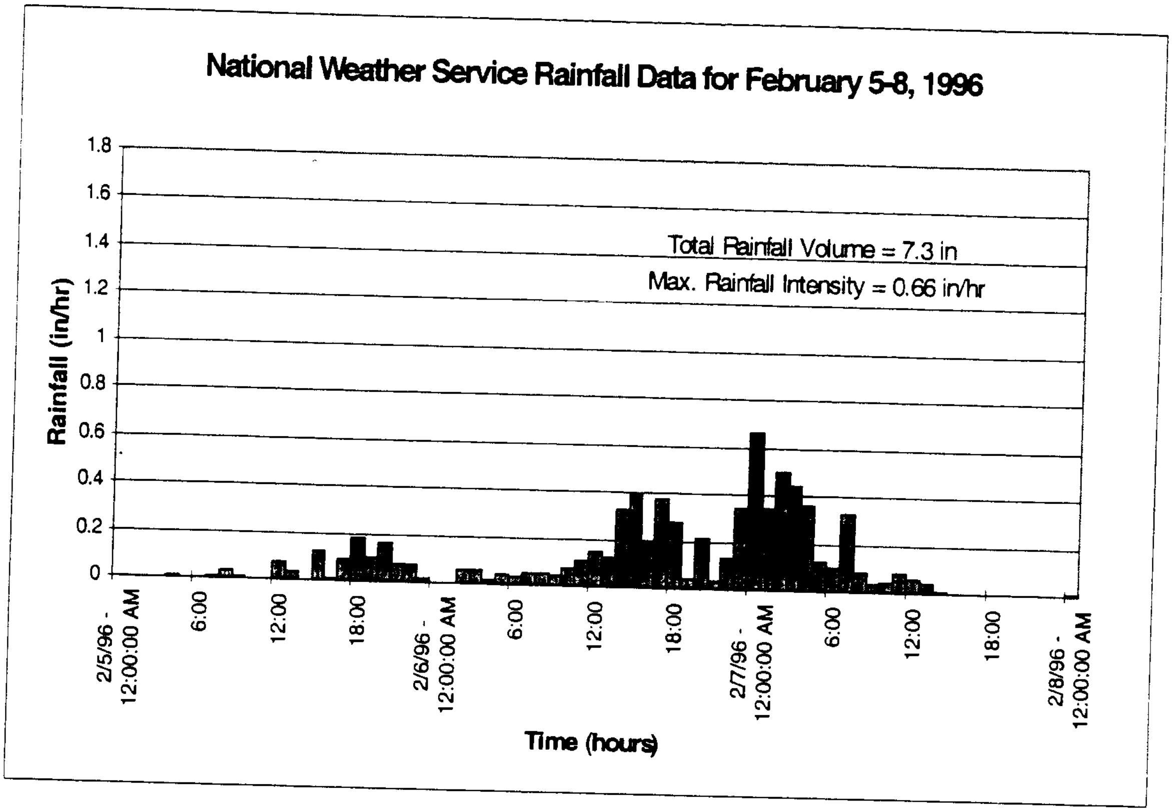


Figure 4. Rainfall Event that was Considered to Cause the Approximately 25-Year Return Period Peak Runoff Flows in Eugene, Oregon.

Many have justified this shape as being one that will also allow flood control effects of smaller thunderstorms on the smaller stormwater systems to be adequately evaluated. When the peak is modeled in this fashion on a larger watershed during an already large rainfall, the peak may greatly affect the larger system design. This conservative design approach we believe has led many communities to determine that streams are undersized and must be widened, channeled, and/or piped.

Of course in communities where there is the potential for combined phenomenon to cause severe flooding (e.g., snowmelt and frozen ground combined with a hard rain), there may be good reason to over size facilities. However, in most cases, it may be more appropriate to utilize methods that account for this and to strive to preserve open channels in more natural ways (e.g., larger stream buffers) to the extent possible.

Another assumption that is often made is that the watershed is saturated before the design storm arrives. This assumption is made to be "conservative." However, it results in an uneven level of conservatism. This assumption would tend to lead to the most over-designed conveyance systems in the least paved areas. That is, the saturation assumption would tend to make systems most over-designed in low-density, single-family areas vs. less over-designed in the downtown core area. The point here is that the levels of over-design are not consistent, nor targeted to the areas where the greatest level of protection is desired (highest property value).

Finally, water quality, and sometimes habitat, is only now being considered in master planning. This is most often accomplished by adding water quality to a detention feature or specifically selecting and locating several demonstration water quality projects. Some communities have chosen to not emphasize habitat by engineering their streams with the purpose of providing flood conveyance as recreational amenities. The Denver area is a good example of this type of design. In arid areas, where streams are seasonal or even just storm driven, this may be a good choice for communities. However, some communities are considering the value of seasonal streams play for downstream resources from a biological and water quality perspective. For example in Eugene, Oregon, the city has determined that seasonal streams contain a rich fauna of aquatic invertebrates (WCC, 1995) which likely would benefit the health of downstream systems.

There are a number of reasons why the above approaches have continued to be employed. First, planning that considers multiple objectives is much more difficult to accomplish, from the technical approaches, due to the need to involve more parties in decision making. The traditional technical approach described above is straightforward, while design of more natural systems is not (e.g., pipe flow equations are much easier to utilize then open channel flow in natural streams). In addition, there are many more people to involve in making decisions than dealing only with engineered physical structures within the stormwater system. Second, most municipalities are not organized well for the purpose of urban watershed planning. The City of Portland, Oregon (which has been very progressive in many ways) still has four separate departments (all in one bureau) that do: 1) facilities planning (stormwater system master planning), 2) site stormwater standards, 3) stormwater quality (permit compliance), and 4) watershed management. Each of these groups has developed its own plans and programs that have understandably not been very well-coordinated or integrated. Finally, and probably most important, is that integrated planning studies cost significantly more (on the order of 2 to 4 times as much).

Integrated Storm Drainage Master Plans - Approach

The new approach to stormwater master plans is the integration of flood control, water quality, natural resources, and aesthetics of stormwater systems. This approach requires significantly more effort and should be thought of as one that will entail adaptive management. That is, the master plan must include components that allow for changing conditions as development occurs and the downstream systems react.

In completing a stormwater master plan, it is difficult to achieve "maximums" of flood control, water quality, natural aquatic habitat, and aesthetics. It is somewhat analogous to the rule that it is hard to get a cheap price, good service, and high quality. It is our belief that one of the problems with master plans has been a lack of recognition that streams will change and that the plans should be developed to manage change in a positive fashion.

One of the keys to successful integrated master planning is that the planning approach places the proper emphasis on the technical and decision-making processes employed. As mentioned above, master plans typically have been driven by the hydrologic/hydraulic modeling of large storm(s) and usually begin with model data collection and analysis. Figure 5 presents a suggested flow diagram for an alternative way of sequencing the development of a master plan. It begins by conducting an inventory of all aspects of the stormwater system, including all attributes related to the multiple objectives mentioned above. The approach suggests utilizing multi-disciplinary teams to review conditions in the field to look for opportunities for meeting objectives, as well as reviewing existing and suspected future problems. Next, before any modeling is done, the project team and decision-makers should utilize the collected information to develop goals and objectives for the plan. Then additional technical analyses, including where and what type of detailed hydrologic/hydraulic modeling is appropriate, can be decided upon based upon these objectives. We have found this approach sharpens the focus of modeling so that the model is not "driving" the master plan into solutions that focus primarily on conveyance upgrades.

In developing an integrated master plan, it is generally understood that the right mix of multi-disciplinary technical specialists should be involved. In addition, it is important to involve the "right" decision-makers and stakeholders early in the process. It is also important to agree up-front upon the decision-making process that will be utilized. We have found that utilizing an agreed upon set of factors to evaluate, select, and rank projects is very useful not only for guiding the process more objectively, but also to serve as a history of why certain projects were recommended and why others were not. This is very useful for future decision-makers for two reasons. First, when questioned by others, there will be

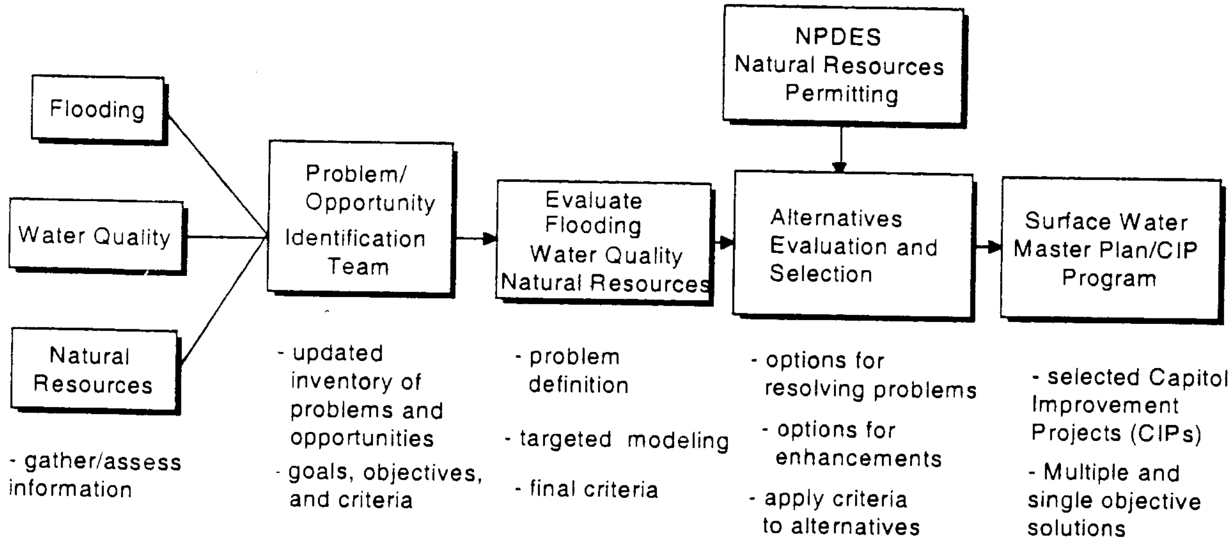


Figure 5. Suggested Integrated Stormwater Master Plan Project Approach.

some backing for why certain decisions were made. Second, as conditions that affect the factors change, selection of projects can also change in a logical fashion.

The approach we recommend is to evaluate solutions that are primarily single objective rather than those that are multiple objective. That is, a two-stage decision process is employed to make sure that good single-objective solutions are not ignored because of the multi-objective nature of the factors. The factors employed include:

- Addresses flooding problems
- Addresses water quality pollutants of concern
- Meets community amenity objectives
- Habitat value
- Life-cycle costs
- Meets regulatory requirements
- Implementability
- Reliability/sustainability
- Other environmental impacts
- Equability

Integrated Storm Drainage Master Plans - Hydrology

Integrated stormwater master planning includes evaluating and considering smaller storm hydrological impacts. Figure 6 presents a storm-depth frequency curve for Portland, Oregon. The figure demonstrates that storms of a depth of 1.5 inches and less dominate both the number of storms (more than 95%) and the volume of runoff (over 90%). It is the smaller storms of about 0.3 to 0.8 inches in depth that change the most in their characteristics. In natural areas of the Northwest, these often did not result in appreciable runoff or resulted only in slightly elevated flows for a long duration. However, after urbanization, these storms are causing severe and rapid changes in flow levels with each storm. This kind of analysis can be used to assist decision makers in deciding what level of water quantity and water quality control is going to be the most cost-effective in reducing the impacts of urbanization.

The best hydrologic and hydraulic modeling approach for assessing and designing stormwater systems is likely the use of continuous simulation models using long-term rainfall records to evaluate a system under a wide range of varying hydrologic conditions. However, this is quite expensive. One of the approaches that we have been taking is to utilize long-term simulations of stormwater systems to select design storms. We believe that this improves the consistency in providing design storms that are closer to the level of protection that is being "advertised," without having to run long-term simulations. This approach involves using real rainfall data with continuous simulation models (e.g., SWMM) to define the resulting return frequency of runoff peaks in various parts of the stormwater system. Then, real storms are selected

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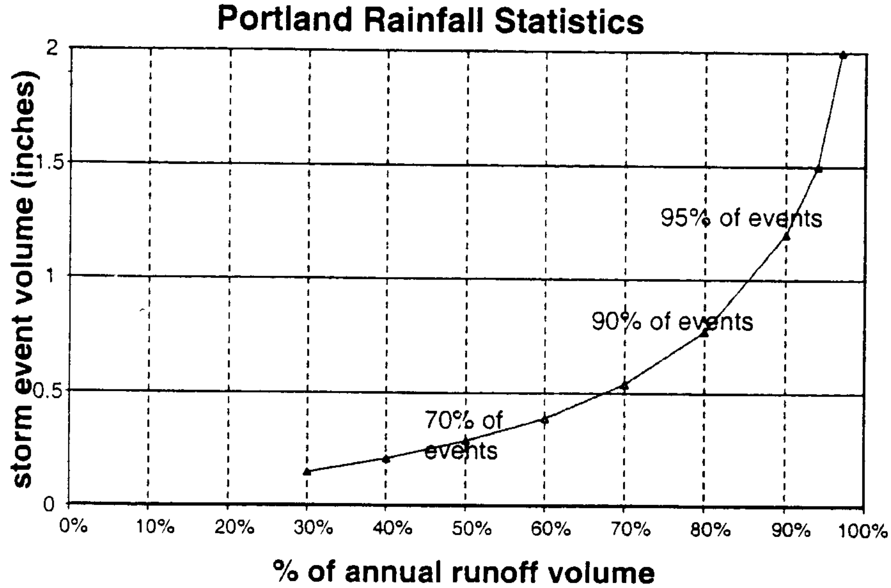


Figure 6. Cumulative Storm Event Rainfall Depth Analysis for Portland, OR Airport.

that resulted in the return period of interest (using a partial duration frequency analysis). These "real" storms are then utilized to design the system. Figure 7 presents an example of partial-duration frequency evaluation of peak flows in one of the basins in the Eugene, Oregon area. From this frequency distribution, the storm that was closest to the intended design level (25-year) was selected for design analysis of the system. Figure 8 shows a similar analysis for another basin in Eugene, along with the design flows from an earlier master plan (which utilized the traditional SCS storm method with saturated conditions).

What Figure 8 demonstrates is that in this basin, the more traditional approach would have resulted in what is likely a significant over-design of the system. In most basins, this was found to be the case. However, there were several basins that were close and a few where the real storm approach resulted in larger designs. Figure 9 and 10 compare the resulting designs in the Flat Creek basin in Eugene. Note that the real storm approach resulted in fewer and smaller projects in this basin. This means that the city can utilize more of its scarce resources to complete other types of multi-objective projects. One of the advantages of the use of real storms is that the concept is very easy to communicate to citizens. In addition, the city has found that some of its channels are over-designed compared to the stated level of protection, and that they may be able to relax vegetation maintenance requirements to allow for more natural channels. Overall, the city is finding that allocating sufficient resources to conduct an integrated plan will likely lead to a more cost-effective program overall, in terms of multiple benefits.

Integrated Storm Drainage Master Plans – Water Quality

There are a number of stormwater quality models and approaches (Donigian and Huber, 1991). Some are quite simple and straightforward, while others are much more complex. In general, water quality models currently cannot accurately predict how pollutants get into stormwater. Although some researchers have made great strides in establishing sources of pollutants in the urban environment (Pitt, 1993), there still are numerous pollutant sources that are not fully understood. Most models rely on either some land-use-based concentrations to drive water quality predictions or they use a build-up/wash-off function to describe pollutant concentrations (Donigian and Huber, 1991).

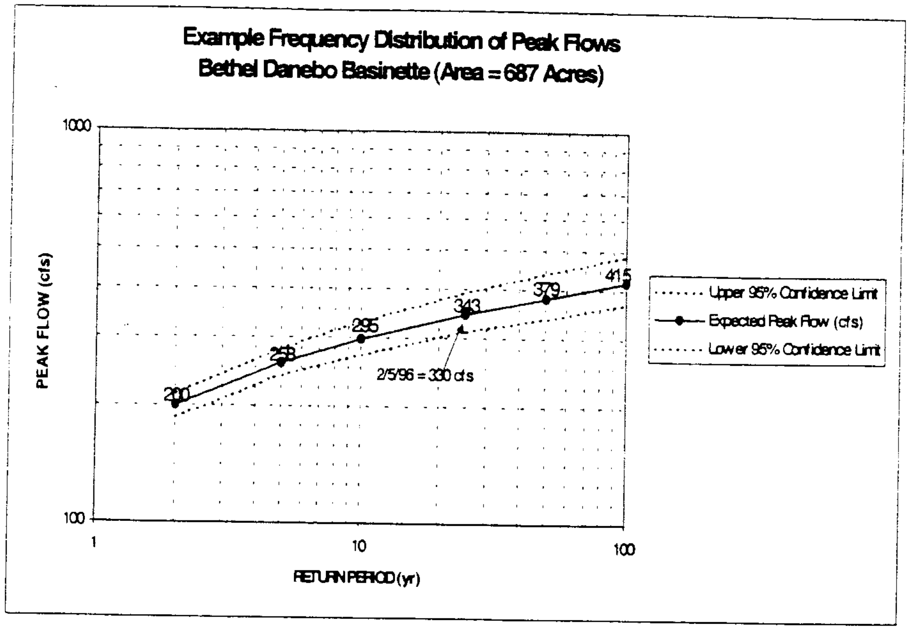


Figure 7. Example Frequency Distribution of Peak Flows in Eugene, OR.

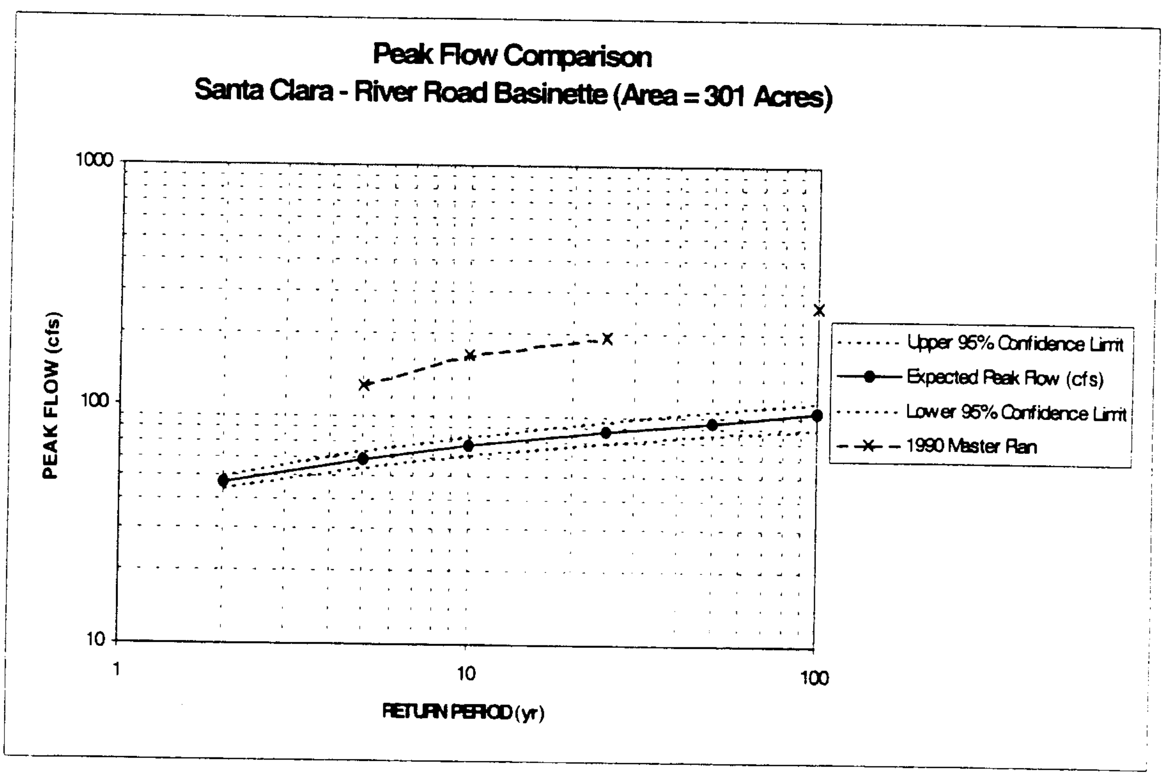
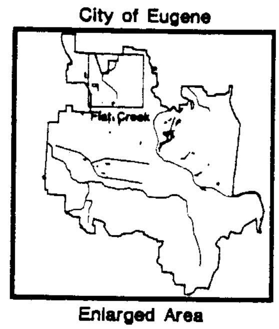


Figure 8. Peak Flow Comparison in Urban Runoff from Eugene, OR.

Flat Creek Drainage System

Capital Improvements Proposed in 1990 Master Plan

Using 10-year SCS Synthetic Design Storm



— Open Channel

— Pipe or Culvert

● Transition Between Section

	CIP Proposed in 1990 Master Plan	Cost
①	30" RCCP replaced by 4'x3' RCBC	$27,300
②	open channel replaced by 2-36" RCCP	$175,400
③	30" RCCP replaced by 2-3'x3' RCBC	$31,800
④	existing channel expansion	$9,100
⑤	existing channel expansion	$3,900
⑥	existing channel expansion	$21,000
⑦	3-43"x27" CMP replaced by 2-6'x3' RCBC	$87,100
⑧	2-36" RCCP replaced by 2-4'x3' RCBC	$81,100
⑨	58"x36" and 24" CMP replaced by 2-5'x3' RCBC	$117,100
	Total	$553,800

Figure 7

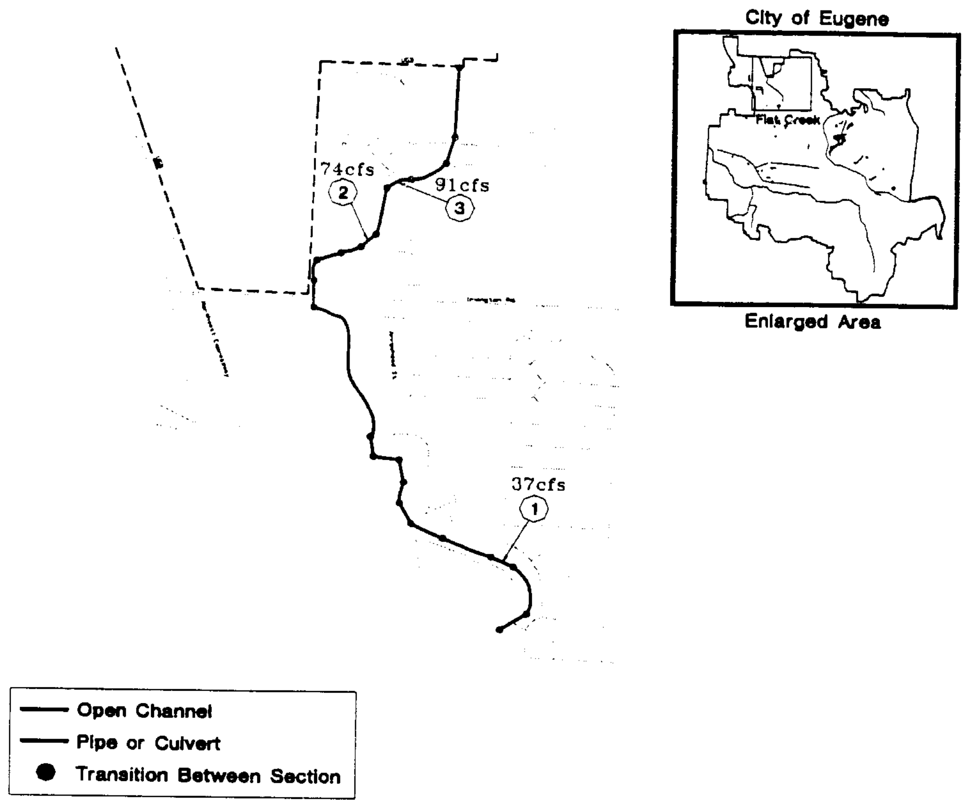
Figure 9. Proposed Conveyance System Improvements Utilizing the SCS Type 1A Synthetic Design Storm and Assuming Saturated Conditions.

The build-up/wash-off of suspended solids (TSS) is modeled and then TSS concentrations are utilized to predict other concentrations for such parameters as phosphorus and heavy metals. The first problem with this approach is that it assumes that the build-up/wash-off of TSS is much greater than any other source pathway. This has not been found to be the case (Pitt, 1993). When build-up based/wash-off models are calibrated to real data, the build-up/wash-off function must be set to be much larger than it really is in order to match actual data. When a source control such as street sweeping is applied, the model will then significantly overestimate its effectiveness no matter what the assumed street sweepingefficiency is. This may explain why street sweeping has seldom if ever been found to be as effective as predicted. The second problem with these models is the assumption that other constituent concentrations can be related

Flat Creek Drainage System

Capital Improvements Proposed by Woodward-Clyde

Using 10-year Design Storm of November 23, 1960



	CIP Proposed by WCI	Cost
①	30" RCCP replaced by 36" RCCP	$11,200
②	2-36" RCCP Replaced by 2-4'x3' RCBC	$85,200
③	2-36" RCCP Replaced by 2-4'x3' RCBC	$81,100
	Total	$178,000

Figure 6

Figure 10. Proposed Conveyance System Projects Utilizing Selected Real Storms for Design.

to TSS concentrations. Strecker (1997) presented data on TSS vs. metals relationships for Portland, Oregon stormwater data. Although the correlations were significant (r^2 of .3 to .4), we do not believe that they are high enough to be utilized without some stochastic functions employed. We believe that many master plans have utilized over-complicated stormwater pollutant load models that have not represented the actual processes well and have not resulted in better plans compared to their cost.

Based upon the above, we believe that the proper approach to assessing water quality in master planning is to utilize land-use based, simpler spreadsheet-based statistical models for water quality assessments and planning. If hydrologic/hydraulic based solutions are being contemplated then more complex models (such as SWMM) can evaluate detention times might be called for.

There have been a number of attempts to develop a better understanding of how stormwater quality BMPs work and why (Strecker, 1992; Brown and Schueler, 1997). However, what we know about the effectiveness of stormwater best management practices in improving water quality and ultimately aquatic health has been questioned with good reason (Strecker 1994; Urbonas 1995; Maxted and Shaver, 1996). Some of the questions arise from the actual studies and how they have not been completed as to be very useful in assessing effectiveness. In addition, there have been suggestions that pollutant removal efficiencies may not be the best way to assess effectiveness (irreducible concentrations, etc.).

Finally, there have been some studies that have shown that downstream of some BMPs (e.g., detention systems), aquatic invertebrate populations are no different from systems that do not have such in-stream ponds (Maxted and Shaver, 1996).

What we know is the application of BMPs is an evolving science and that the exact cause and effect relationships are not well known. However, we do know that BMPs have been effective at reducing concentrations. In cases where there has been no downstream improvement in aquatic invertebrate health from BMPs, we should ascertain what the limiting factors are and whether the BMP was able to mitigate some if not all of them before we dismiss a BMP. In addition, we need to understand whether other attributes of the BMP may be contributing to downstream problems such as demonstrated downstream temperature impacts (Galli, 1991) of on-line ponds, as well as the interruption of drift of aquatic invertebrates downstream. It is becoming increasingly clear that within-stream detention systems need to be very carefully evaluated before they are selected as BMPs. What we will need to do in master planning is to make good subjective decisions regarding the appropriate application of BMPs for water quality. We do not have the data and models to do otherwise.

Integrated Storm Drainage Master Plans – Stream Stability/Habitat

Unless a watershed has a great ability to infiltrate stormwater or evaporation is a viable technique, stream hydrology will change (increased runoff) with development. While there are some great techniques to reduce the changes (e.g., Prince Georges Department of Environmental Resources. 1997), in many cases these techniques will not be able to reduce the increased energy within a stream enough to stop channel cutting and downstream sedimentation from occurring. A technique that has been employed in an attempt to prevent downstream damage is the requirement that new development controls runoff from a one- or two-year event such that pre- and post- development peak flows for that event are equaled. MacRae (1996) has demonstrated that this approach may actually cause more problems then it solves. It usually leads to shifting over-bank flow energy to the wetted channel, further exacerbating channel down cutting. Figure 1 demonstrates this. Suppose that the peak in hour 14 was the one-year pre-development flow for this creek. Maintaining post-development flows to this level would significantly lengthen the time the creek is subject to this channel-forming flow condition, while reducing over-bank flows. Even setting post-development peak runoff rates to one-half pre-development, results in significant extended energy in the channel. One would likely have to set a requirement that the flow rate be one-fourth or one-fifth to have a positive effect. This would require very large detention areas.

In many, if not most cases, we believe that the master plan must include within-stream structures to assist it in changing with development (Sovern, 1996). That is, the plan must move beyond just getting runoff to a stream and making sure any culverts in the stream are "right-sized." Master plans should include a component to design in-stream structures (habitat friendly ones, of course) and have an adaptive management program for them. This approach has been successfully applied to the Pipers Creek and Thorton Creek watersheds in Seattle, both heavily urbanized watersheds. What this can accomplish is much faster and more postive equilibrium for the stream system (e.g., the increased energy can be utilized to create deeper pools and increased spawning gravels in the pool tailway).

Integrated Storm Drainage Master Plans – Capital Improve Projects (CIPs)

The above integrated stormwater master planning elements will result in changing the traditional definition of what a CIP is. Traditionally it has been structural controls located within the municipally owned stormwater systems (e.g., the streets and street drainage structures and at creek crossings, etc.) Now CIPs can include property or property rights acquisition, buffer areas, protection and enhancement of natural resource sites and preservation of the open channel drainage system.

Integrated Storm Drainage Master Plans – Public vs. Private Solutions

Another element of master planning can include the evaluation of the trade-off of requiring private solutions (e.g., on-site design requirements) versus implementing public stormwater system measures. Figure 11 shows schematically that on a watershed basis, one could employ a combination of both to achieve the overall most cost-effective system. This can be addressed in modeling and cost-estimation for both approaches and then one or some combination employed.

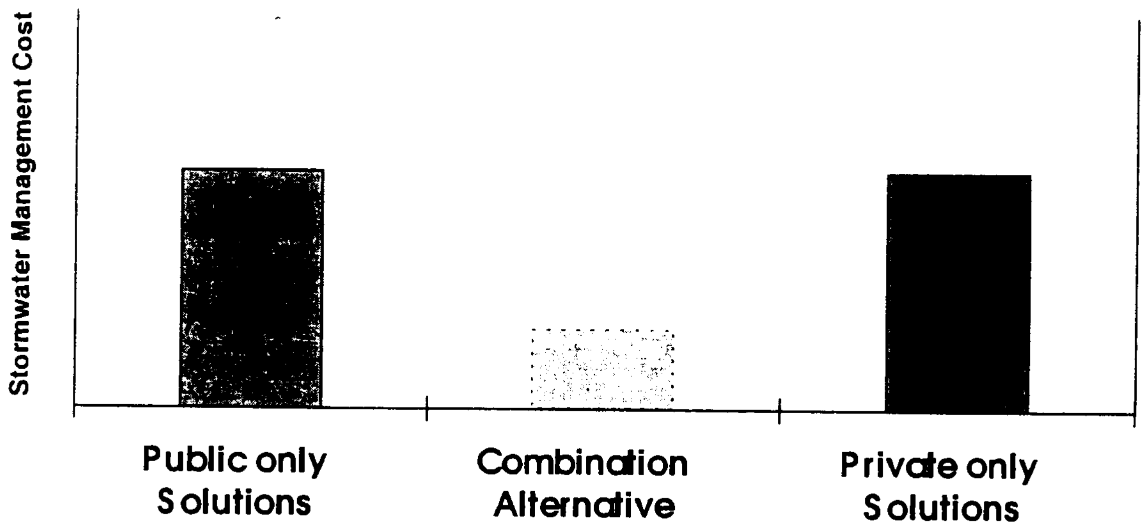


Figure 11. Conceptual Comparison between On-site Private Stormwater Solutions and Public Solutions.

Summary

In summary, urban stormwater management involves a complex set of phenomenon to manage and our stormwater science is lacking to support solely science-based decisions. Urban stormwater master planning needs to be conducted as an integrated planning and implementation process that considers water quality, habitat, and aesthetics along with urban flooding in order to meet increasing regulatory and environmental demands of the public. Typically, BMPs will only reduce the increase in small-storm hydrology that impacts physical stream habitat and stormwater pollutants; in-stream stability measures are needed as a part of master planning and urban system. Master planning and implementation needs to be thought of as an iterative process that will require adaptive management over time. A balanced approach that places the proper emphasis on problem definition, priority and goal setting, selection of measures/controls, participation by stakeholders, implementation, and monitoring/feedback/plan refinement is needed.

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Conservation Design: Managing Stormwater through Maximizing Preventive Nonstructural Practices

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Abstract

Unlike conventional methods of stormwater management that prioritize peak rate control to mitigate post-development downstream flooding effects, Conservation Design first aims to prevent or minimize the creation of stormwater from the outset. *Preventive* Conservation Design methods are defined in this paper as those that integrate stormwater management into the initial stages of project design, instead of waiting to consider them in the final steps of the site planning process. *Mitigative* Conservation Design techniques will be explored that use natural processes performed by vegetation and soil to mitigate unavoidable stormwater runoff impacts once prevention has been maximized to the greatest extent possible. Underlying these techniques—whether preventive or mitigative in nature—is a comprehensive perspective of water resources that views stormwater as an asset to be managed, not a waste for disposal.

This paper summarizes a recent project which the Brandywine Conservancy undertook for the Delaware Department of Natural Resources and Environmental Control, with support from USEPA Section 319 funding. For interested readers, *Conservation Design for Stormwater Management: A Design Approach to Reduce Stormwater Impacts from Land Development* (Delaware Department of Natural Resources and Environmental Control with Brandywine Conservancy, 1997) further details all aspects of the Conservation Design program described here. This manual is referenced throughout this paper and is available by contacting DNREC at 302-739-4411 in Dover DE.

Introduction

Most Stormwater management programs place a heavy reliance on implementation of structural stormwater management facilities: detention basins, conveyance piping and inlet/outlet structures. These facilities—though created to mitigate negative stormwater impacts by controlling flooding—cannot in and of themselves eliminate adverse impacts of urban development throughout a watershed. In fact, because these systems fail to acknowledge and plan for critical system-wide water cycle processes, stormwater management itself can become a problem, rather than a solution. This is especially true when conventional stormwater management systems are combined with conventional large-lot subdivision designs.

The negative effects of this type of development and conventional stormwater management have been described in a variety of recent studies and reports, including the *Pennsylvania Handbook of Best Management Practices for Developing Areas* (CH2MHill, 1998) and a variety of other state stormwater manuals; Center for Watershed Protection publications such as *Better Site Design: A Handbook for Changing Development Rules in Your Community* (Center for Watershed Protection, 1998) and *Planning for Urban Stream Protection* (Schueler, 1995); the Northeastern Illinois Planning Commission's *Reducing the Impacts of Urban Runoff: The Advantages of Alternative Site Design Approaches* (Northeastern Illinois Planning Commission, 1997), and *Urban Stormwater Best Management Practices for Northeastern Illinois* (Northeastern Illinois Planning Commission, 1993). These effects include:

- Altered site hydrology and reduced groundwater recharge
- Reduced stream base flows
- Altered stream geomorphology (resulting in damaged aquatic habitat)

- Loss of site area for other uses (e.g.; recreation)
- Single purpose: disregards site resource conservation benefits
- Lack of attention to water quality
- High construction costs
- Maintenance burdens and costs
- Negative visual appearance (e.g., basins often fenced off)
- Limited number of stormwater discharge points
- Less flexibility in design

Conservation Design reflects a totally different philosophy toward land development that integrates stormwater management into the very core of site design, as opposed to considering it a problem to be resolved after the design has been completed. This philosophy regards stormwater as a key component of the hydrologic cycle and critical to maintaining the water balance—and groundwater reserves—for a particular watershed.

Recently we have come to realize that land development's impacts to water resources are not one-dimensional. They include, in addition to flooding, the multiple concerns of water quality, groundwater quantity, stream and wetland characteristics, in-stream habitat, and biodiversity. Therefore, stormwater management and site design must be approached much more comprehensively. At the foundation of this comprehensive approach lies an understanding of the relationship between land development and our water resources. In order to better comprehend this relationship, we must understand the water cycle itself—the amount of rainfall, evapo-transpiration, groundwater infiltration, and runoff—and how this cycle is affected by the characteristics of an individual site such as soil types, topography, and vegetation.

The Water Cycle and Landscape Dynamics

Appreciation of the water cycle is especially important to achieve successful, comprehensive stormwater management (Figure 1). In fact, only through understanding full water cycle dynamics, can we hope to achieve some sort of system balance and minimize negative stormwater impacts. Figure 2 displays a generic flow chart of the water cycle that highlights the various components of this cycle and how they are interconnected **(Conservation Design for Stormwater Management, 1997)**. It is important to appreciate that the system itself is a closed loop: what goes in, must come out. If inputs to infiltration are <u>decreased</u> by 10 inches, then inputs to surface runoff and/or depression storage must be <u>increased</u> by this same amount. Furthermore, infiltration <u>outputs</u> must also be decreased: following along on the flow diagram, the groundwater reservoir, evapo-transpiration and soil moisture elements together will be reduced by this 10 inches, which will reduce stream baseflows.

The logical first step in any discussion of the water cycle is *precipitation*—in all its various forms. In southeast Pennsylvania, and indeed throughout much of the Mid-Atlantic states, the climate is relatively humid **(*Conservation Design for Stormwater Management* 1997, based on Hydrosphere 1992 database).** Substantial precipitation tends to be distributed throughout the year in frequent events of modest size. This consistency in rainfall throughout the year indicates that this region does not have a defined wet or dry season as do other areas of the country. This rainfall potential throughout the year has significant implications for consideration of stormwater runoff. For example, having rainfall throughout the year indicates that sediment laden runoff can occur at any time; therefore, it is important to establish some sort of erosion-controlling groundcover during all seasons of the year.

Also important is the distribution of rainfall by size of event. Based on analysis of 35 years of data from a Wilmington, Delaware rain gage (***Conservation Design for Stormwater Management* 1997**), it is clear that the precipitation occurs mostly in small "events" or storm intensities. Ninety-eight percent of the total *number* of events during this extended period were classified in the "less than 2 inches" category. Even more important from a water cycle perspective, 96% of the average annual rainfall *volume* occurred in storms of less than 3 inches (which is less than the 2-year, 24 hour

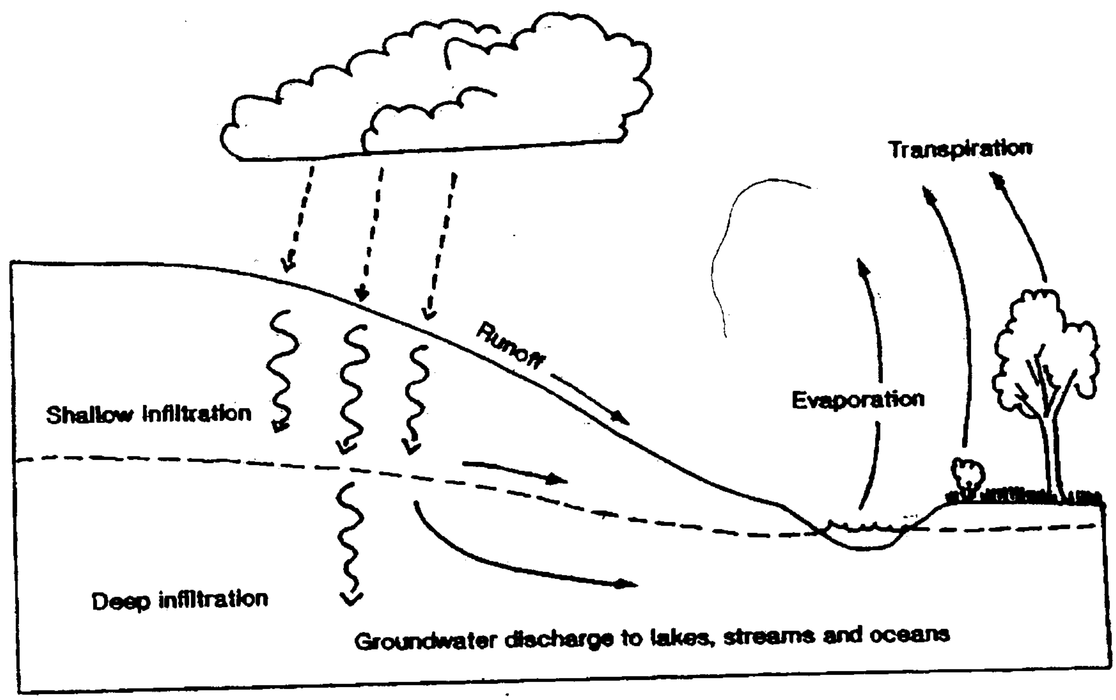

Figure 1. The Water Cycle.

storm). This understanding of storm size distribution is critical for a variety of reasons in stormwater management. For example, if our concern is keeping the water cycle in relative balance, capturing and recharging the 1- or 2-year storm as the basis for design will encompass the vast bulk of precipitation and stormwater runoff volumes in the average year and provide adequate water cycle balance. This leads to very different design criteria than if flooding (peak runoff rates) is the only concern addressed.

Another key component of the water cycle is the linkage between stormwater infiltration, groundwater recharge and stream baseflow. As land is developed and impervious coverage increased, less water is recharged to groundwater aquifers **(Thomas Dunne and Luna Leopold's *Water in Environmental Planning* [Dunne and Luna, 1978] is an excellent background text in addition to the above referenced reports).** As these subtractions continue acre-by-acre, development-by-development, their cumulative effects grow larger. Also, as development occurs, more water is often withdrawn from the underground reserves for drinking, irrigation, or commercial uses. As subtractions are made from the groundwater reservoir flow, the impact will be seen in the form of a lowered water table and reduced stream baseflow discharge. Headwater springs and first-order streams—the lifeblood of our stream systems—may even dry up. The baseflow from headwater zones is critical to maintaining a diversity of aquatic plant and animal life, as well as terrestrial animals dependent on certain aquatic species for survival. In some cases the groundwater reservoir does not discharge to a stream, but rather to a wetland. In these instances, reduced infiltration and a lowered water table ultimately translate into a loss of wetlands themselves, and an elimination of their rich and vibrant ecological function.

A final component of the water cycle that must be addressed is overland runoff. This is the component most frequently addressed in conventional stormwater management approaches, for it is the cause of increased downstream flooding. Three major elements determine the volume and character of stormwater runoff for a given storm intensity: soil type, land cover (including vegetation and debris), and slopes. Soils vary widely in their ability to infiltrate stormwater and

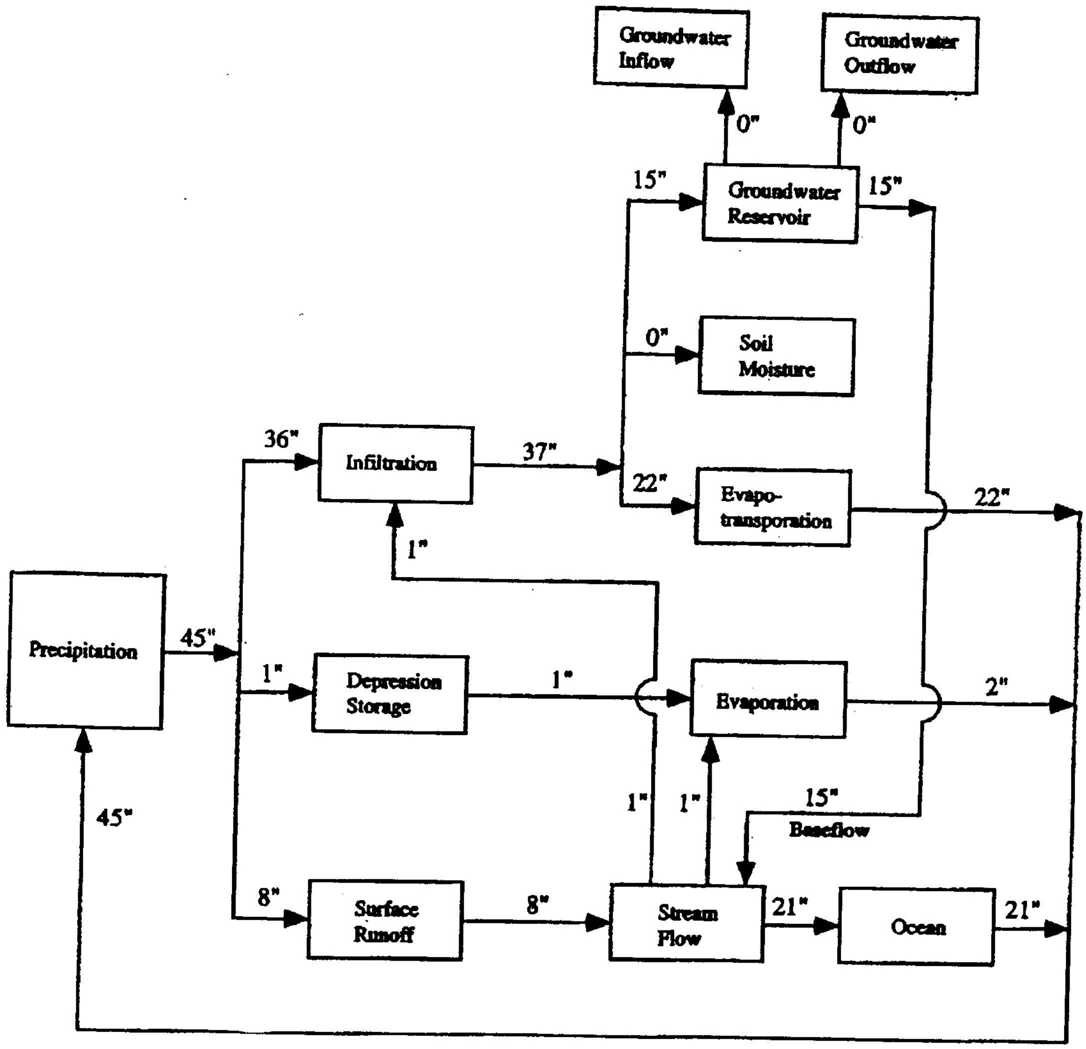

Figure 2. Water Cycle System Flow Chart.

minimize runoff and are classified accordingly by the USDA Natural Resources Conservation Service (NRCS) into four categories based on their permeability rates (Hydrologic Soil Groups A through D, with A having best permeability).

Land cover greatly affects the rate and volume of stormwater runoff and has significant water *quality* impacts as well. Obviously, the landcover of greatest concern for stormwater management is impervious coverage created through the development process. Interestingly, compacted lawns and cultivated fields can have significant runoff rates as well, especially when no crop covers the bare soil. The landcover in this region best suited to retard stormwater runoff and assist in its infiltration is the natural one: the piedmont forest. A mature forest can absorb much more water than an equivalent area of turf grass due to the presence of an organic litter layer and herbaceous and woody plant material. The organic litter layer on the forest floor provides a physical barrier to sediments, maintains surface soil porosity, and assists in denitrification and other water quality functions. The vegetation, both herbaceous and woody, physically retards runoff and erosion with its spreading root mats and also assists in maintaining soil permeability and water quality by taking up nutrients through its root systems.

Finally, slopes are another critical component of the stormwater runoff equation. Steeper slopes can accelerate runoff and increase the erosive force of the water. Therefore, removing vegetation on steeper slopes can have dramatic impacts on downslope aquatic systems.

As seen above, the water cycle and the implications for stormwater management are complex and comprehensive. The process of urbanization dramatically impacts the functioning of this water cycle. Conservation Design has been developed to address the issues of comprehensive stormwater management and to address the land use patterns that impact it.

Land Use and Site Development Impacts

Throughout much of the United States, farmland and natural areas are converted to suburban development at an ever accelerating pace. In fact there is hardly a city in America that does not occupy at least two to three times more land area than in 1970, even if population has not increased proportionately. This history of land use change is certainly true of the Mid-Atlantic states, where communities continue to grapple with the effects of unmitigated suburban sprawl.

The dynamic nature of wet-weather flow regimes and landscape ecology make it difficult to assess the impact of urbanization on aspects of the water cycle such as groundwater reserves and aquatic habitat. However, studies have indicated that the biological community in urban streams is fundamentally changed to a lower ecological quality than what was there before development occurred. In one study in Delaware, approximately 70% of the macroinvertebrate community found in streams of undeveloped forested watersheds was comprised of pollution sensitive mayflies, stoneflies, and caddisflies, compared to 20% for urbanized watersheds (Maxted and Shaver 1996). Other studies suggest that the decay in stream quality is very rapid in the early stages of watershed urbanization; watersheds with less than 10% impervious cover are the most susceptible to the adverse effects of urbanization. Therefore early intervention as a watershed begins to develop is critical, and furthermore, this intervention should include measures to address stormwater management and land use in a connected, comprehensive manner.

In addition to in-stream habitat impacts, the issue of land development and water resources also has great implications for our human communities well beyond the issue of flooding. Reduced stream baseflows and groundwater resources means decreased availability of drinking water supplies. Also, reduced baseflows result in less available water for diluting the pollution output from industrial or municipal waste systems. As stormwater runoff increases, water quality can be greatly impacted by stream bank erosion, re-suspension of sediment, runoff of chemicals and fertilizers from lawns and fields, and increased stream temperatures. Stormwater-linked pollutants vary with type of land use and intensity of use and have been shown to include bacteria, suspended solids, nutrients, hydrocarbons, metals, herbicides and pesticides, toxins and organic matter. Not only are these pollutants increased, but the landscape's natural capacity for filtering and chemical uptake through vegetation is decreased as land is cleared and paved. All of these pollutants can impact both drinking water supplies and natural aquatic systems.

Thus it becomes evident that if the negative effects of land development on our water resources are to be minimized, we must find alternatives to the conventional structural approach to stormwater management. Moreover, these alternatives must address the issue of land use and patterns of development in a comprehensive fashion, one that strives to maintain a hydrologic balance on site and replicate the pre-development hydrologic regime to the greatest extent possible. One approach—or collection of approaches—that can accomplish these goals is *Conservation Design.*

Conservation Design Principles

Stormwater management throughout the Commonwealth (and elsewhere) can be markedly improved by approaching stormwater differently than has been the practice in the past, where "stormwater management" has been defined largely as stormwater disposal. This different perspective challenges us to maximize prevention, even before stormwater becomes a problem, and to avoid highly engineered structural solutions that are expensive to build and maintain. In their place, Conservation Design focuses on utilization of natural systems and processes to achieve stormwater management objectives where feasible. At the same time, this new approach is intended to work with site resources—woodlands, soils, wetlands, etc.—to enhance their stormwater functions. The end result is a site design which minimizes stormwater generation and then mitigates the remaining stormwater in a low-impact manner, with an emphasis on groundwater recharge. Conservation Design is not so much a singular approach or solution as it is a *collection* of approaches and practices that are flexible enough to effectively address any given site and development program. Common to all these approaches and practices are several basic principles.

Achieve multiple objectives. Stormwater management should be comprehensive in scope, with techniques designed to achieve multiple stormwater objectives. These objectives include both peak rate and total volume control (i.e., balance with the hydrologic cycle), as well as water quality control and temperature maintenance. These objectives should include maintaining or improving the pre-development hydrologic regime.

Integrate stormwater management early into the site design process. Stormwater management tacked on at the end of the site design process almost invariably is flawed. To optimize comprehensive stormwater management objectives, stormwater management must be integrated into the first stages of the site planning. Stormwater impacts may even be a factor in determining type of use, extent of use, and location of the development on a site.

Prevent first, mitigate second. Approaches to site design which can reduce stormwater generation from the outset are the most effective approach to stormwater management. For example, effective clustering of units significantly reduces length of roads when compared to conventional development. Reduction in street width and driveway length can minimize impervious coverage. These type of approaches are rarely thought of as stormwater management practices, yet they achieve powerful stormwater quality and quantity benefits.

Manage stormwater as close to the source of generation as possible. From both an environmental and economic perspective, redirecting runoff back into the ground as close to the point of origin as possible, is preferable to constructing elaborate conveyance systems that increase flows and suffer from failures over time. Avoid concentrating stormwater. Disconnect, rather than connect, where feasible.

Engage natural processes in soil mantle and plant communities. The soil mantle offers critical groundwater recharge conveyance and pollutant removal functions through physical filtration, biological action, and chemical processing. Understanding how much of what type of soil is in place on any given site is essential when assessing stormwater management/water quality impacts and opportunities. Vegetation similarly provides substantial pollutant uptake/removal potential and can assist in infiltration by maintaining soil porosity and retarding runoff. In addition, naturally vegetated areas improve their stormwater functions over time as leaf litter and debris builds a richer organic soil layer. Areas of good soil permeabilities (A and B soils) and intact vegetative communities should be prioritized in prevention strategies.

A Conservation Design Procedure

The Conservation Design principles outlined above, though greatly simplified, can offer valuable guidance when approaching a particular land development project. In fact, these five principles form the basis for a Conservation Design Procedure. This Design Procedure incorporates both Preventive Approaches and Mitigative Practices. Preventive Approaches tend to be broader in geographic scope than other techniques and typically may influence some of the major decisions regarding a particular development project. Approaches may even transcend the site itself, involving an entire planning jurisdiction or area, or even an entire region. Also, Preventive Approaches attempt to reduce impervious coverage or minimally disturb the existing vegetation and soils in prime recharge areas. For example, a reduction in road width from 30 feet to 18 feet means an immediate 33.3% reduction in roadway imperviousness, which typically comprises a large portion of site imperviousness.

Mitigative Practices include mitigative techniques which are often more structural in nature. These practices encompass a rapidly growing array of biofiltration and bioretention methods that maximize the stormwater management potential of soils and vegetation. Mitigative Practices include vegetated swales for stormwater conveyance, vegetated filter strips and riparian buffers, grading, berming, terrraforming, and level spreading stormwater in natural areas. These practices should mitigate as close to the source as possible and achieve multiple objectives. For example, a berm, which is used to retain stormwater runoff on a forested slope, can double as a walking trail, thus decreasing the expense of two separate individual systems.

Figure 3 graphically displays the Design Procedure as a flow diagram. The procedure itself can be thought of as a series of questions which must be asked as Conservation Design is applied to each site. If site designers rigorously address all of these questions, the "answers"—the Conservation DesignPreventive Approaches and Mitigative

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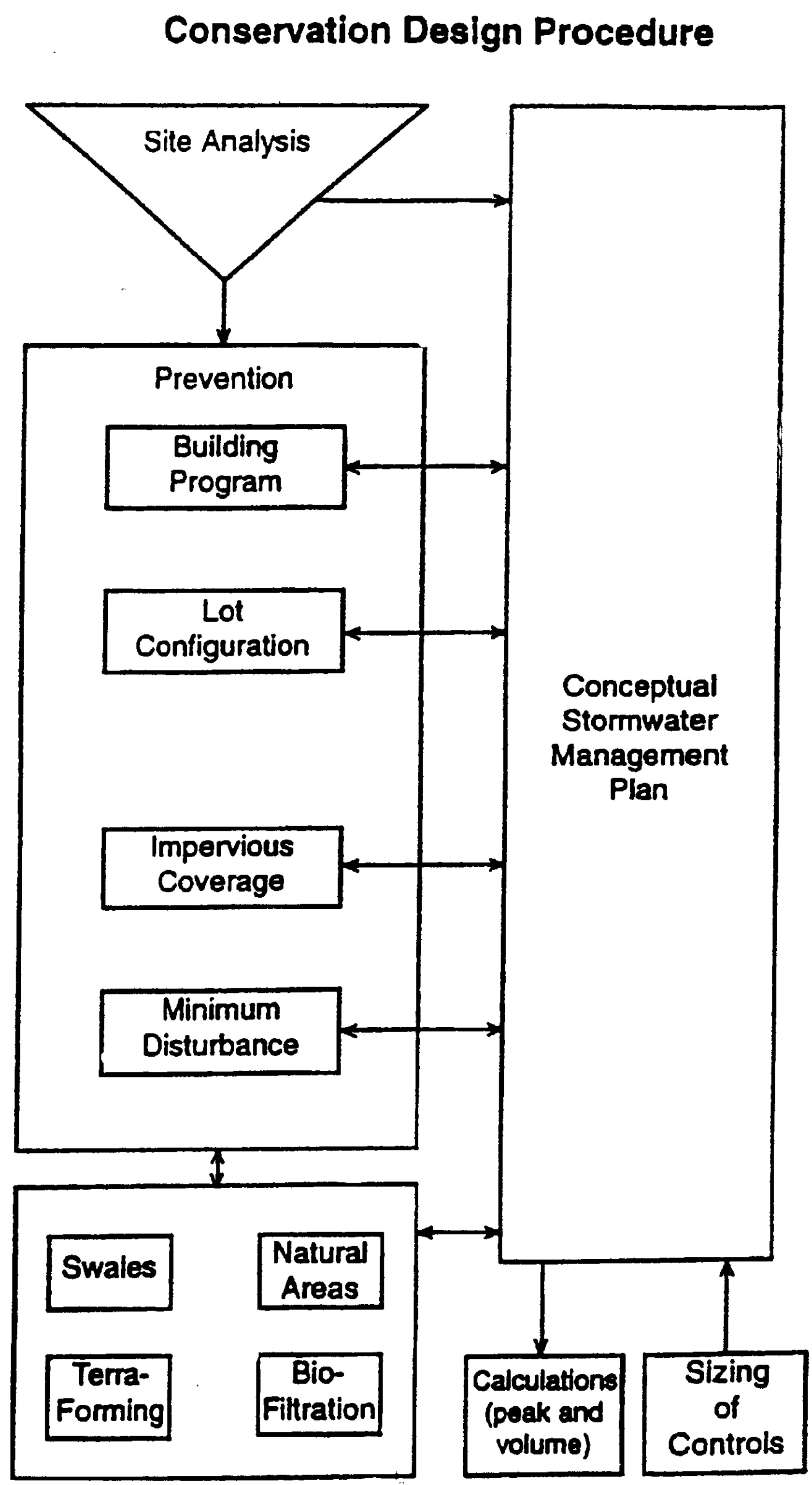

Figure 3. A Conservation Design Procedure.

Practices—will successfully be identified for each site. The overriding objective ultimately is to achieve a new way of thinking about site design. The procedure begins with an effective and complete Site Analysis, which can help identify both areas of concern and resources for opportunity in regard to stormwater management. The procedure then flows from macro, larger-scale preventive questions (i.e., how can the design be clustered to reduce site disturbance) to micro, small-scale mitigative questions (i.e., can stormwater be infiltrated in bioretention areas?). Probably the most important aspect of the procedure in Figure 3 is its positioning of the Conceptual Stormwater Management Plan as a concurrent task with the entire site design process. This reinforces the notion that stormwater management should be an integral part of the entire design process, including the site analysis.

In order to better understand the Conservation Design Procedure, each of its components (the Preventive Approaches and Mitigative Practices) is discussed in more detail below.

Site Analysis

Three major aspects need to be addressed in the Site Analysis process:

Site Background and Context

What is the surrounding context?

What is its location in the watershed?

In which geologic/geographic region is it located?

What is the site size?

What are adjacent uses and landcover?

Critical Natural Features

Existing hydrology?

Wetlands? Floodplains? Riparian buffers?

Steep slopes? Special habitat areas?

Stormwater Opportunity Areas

Where are soils that are best suited for stormwater recharge? Worst?

Where is existing landcover optimal to prevent stormwater?

What opportunities exist to use vegetation and soils in mitigation?

On what soils and slopes is this vegetation?

What is depth to bedrock or water table?

Preventive Approaches

The Preventive Approaches include a range of hierarchical questioning:

Building Program

What is the current zoning and density for this tract?

Is there currently an open space design option for the site?

Can the proposed building program be reduced in terms of density?

Can the type of unit or lot size be modified to promote open space?

What are the possibilities for water and sewer supply?

Lot Configuration

Have lots been reduced and open space been maximized?

Have lots been clustered to avoid critical areas of recharge?

Have lots been configured to take advantage of mitigative practices?

Impervious Coverage

Has development been clustered to reduce impervious surfaces?

Have road widths been minimized?

Have building setbacks been minimized to reduce driveway lengths?

Have parking ratios and needs been carefully examined?

Have needs and sizes of walkways been examined?

Minimum Disturbance

Has maximum total site area, including soils and vegetation, been protected from clearing and disturbance?

Are zones of undisturbed open space maximized?

Have buildings been sited carefully to reduce vegetation removal?

Can no-disturbance buffers be installed to limit zones of soil compaction?

Mitigative Practices

The Mitigative Practices include a tool box of options that promote groundwater recharge and improve water quality. These practices have been assigned to several groupings, although in many cases the practices overlap. Virtually all of these techniques make maximum use of vegetation and soil functions, so although they are all technically structures, they are of lower complexity and more rooted in natural process than conventional approaches.

Vegetated Swales

Vegetated swales are effective means of stormwater conveyance. At low slopes, they can recharge modest amounts of stormwater, filter it through vegetative processes, and slow it down.

Terraforming

Terraforming comes in a variety of techniques. These include constructing subtle berms along contour below undisturbed areas. The berms act as modest "dams" retaining the water for up-slope recharge. Also, subtle grading of depression areas promote retention and recharge throughout a site.

Level Spreading/Natural Areas

With a level spreader, stormwater spills over the lip of a long trench or berm, creating sheet flow across a broad area. The level spreaders slow down the intensity of runoff and discharge it over a large, adjoining vegetated area with good soils, which in turn filter it and assist in groundwater recharge. Filter strips are planted vegetated strips through which runoff passes that filter it and slow it down. Riparian buffers are vegetated zones along stream corridors that filter the stormwater passing through it and help minimize erosion. These techniques are most valuable when used in conjunction with preventive strategies that leave larger natural areas undisturbed in order to handle these additional stormwater inputs.

Bioretention/biofiltration

Bioretention is a popular name given to just about any type of device that utilizes vegetation and soil to manage stormwater flows. They can be subtle depressions that exist naturally and receive stormwater or depending on soil conditions, they may be physically constructed "pits" that are filled with permeable soils and planted with native vegetation that adapt to both wet and dry conditions. These systems can either be "on-line" (part of the stormwater conveyance flow) or "off-line" (separate from the rest of the stormwater management/mitigation system). In either case, they have modest ponding storage that is recharged over the course of time.

Other mitigative devices

Not all of the required volume storage to meet peak rate requirements for a given site may be attained through the practices outlined above. At times, it may be necessary to put in "structural" systems such as in-ground infiltration trenches, infiltration pipes, or stormwater wetlands. However, these systems should be explored only after both Preventive Approaches and Mitigative Practices of Conservation Design have been maximized to the greatest extent possible.

Conclusion

The Conservation Design Procedure is perhaps best characterized as a "check list" or protocol of questioning during the site design process. The key to this approach is its range of innovative, yet effective options, not afforded in conventional systems which tend to be standardized irrespective of the particular site. With Conservation Design, the approaches and practices can be combined in a variety of ways to minimize the impacts of development on the water cycle and still meet regulatory stormwater management criteria such as peak rate control. Often, because these approaches and practices tend to favor multiple objectives and nonstructural techniques, Conservation Design can be less expensive to install and maintain than conventional systems. Also, because they are largely based on soil and vegetative processes, conservation design techniques tend to improve in function over time, while conventional detention basin systems tend to diminish in function over time. In terms of water quality, Conservation Design Approaches and Practices can outperform conventional systems. For example, filter strips and biofiltration areas can remove over 90% of the suspended solids, 40% of the phosphorous, and 20% of the nitrates (Dillaha et al. 1986 and 1989; Yu et al. 1993). In addition, reduced yard areas and increased forested zones prevent chemical runoff from lawns—a great contributor to non-point source pollution—at the outset.

Conservation Design is limited only by the creativity of the designer and the flexibility of the developer and regulatory agencies. It must be emphasized that the Conservation Design approach will not eliminate a need for structural systems in all cases; however, more often than not, Conservation Design can replace or reduce the need for structural practices while providing attractive site amenities. And in the process, the water cycle will be balanced, and forests and other sensitive resources will be preserved. In short, Conservation Design can do more with less, and more for less, than conventional approaches to stormwater management.

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Low–Impact Development Design: A New Paradigm for Stormwater Management Mimicking and Restoring the Natural Hydrologic Regime An Alternative Stormwater Management Technology

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Abstract

Whether complying with federal or state regulations or addressing local vital watershed protection/restoration objectives, local jurisdictions are confronted with the daunting task of developing, administering and funding complex effective multi-objective stormwater management programs. Today's comprehensive stormwater program not only has to deal with runoff quantity and quality control but, may also have to address such complicated issues as ecosystem restoration, combined sewer overflow reduction, fisheries protection, potable surface/ground water source protection, and wetland, riparian buffer and stream protection. As our understanding of the technical and practical limitations of conventional stormwater management technology has increased over the past two decades, and as watershed protection objectives have changed, many jurisdictions have begun to question the efficacy and cost-effectiveness of conventional stormwater approaches in meeting today's complex environmental/water resources objectives. Older communities with existing extensive stormwater management infrastructures are also struggling with the economic reality of funding the high costs of maintenance, inspection, enforcement and public outreach necessary to support an expanding and aging infrastructure. Still more challenging are the exceptionally high costs of retrofitting existing urban development using conventional stormwater management end-of-pipe practices to restore and protect receiving waters and living resources.

With growing concerns about the limitations of conventional technology and to address the changing objectives of watershed protection, in 1990 Prince George's County's Department of Environmental Resources (PGDER) began exploring alternative stormwater management practices and strategies. The development of bioretention or "Rain Gardens" (using the green space to manage runoff within small depressed landscaped areas) led to an understanding of how to optimize and engineer the landscape to restore hydrologic functions by uniformly integrating micro-scale management practices and impact-minimization measures into the development landscape. In 1997 PGDER released the Low Impact Development (LID) Design Manual demonstrating the principles and practices of LID to create a hydrologically functional landscape (PGDER, 1997).

LID stormwater management technology can maintain or restore a watershed's hydrologic regime by fundamentally changing conventional site design to create an environmentally and hydrologically functional landscape that mimics natural hydrologic functions (volume, frequency, recharge and discharge). This is accomplished in four ways. First: minimizing impacts to the extent practicable by reducing imperviousness, conserving natural resources and ecosystems, maintaining natural drainage courses, and reducing the use of pipes and minimizing clearing/grading. Second: recreating detention and retention storage dispersed and evenly distributed throughout a site with the use of open swales, flatter slopes, depression storage, rain gardens (bioretention), water use (rain barrels), etc. Third: maintaining the predevelopment "time of concentration" by strategically routing flows to maintain travel time. Fourth: providing effective public education and socioeconomic incentives to ensure property owners use effective pollution prevention measures and maintain management measures. With LID, every site feature is multifunctional (green space, landscaping, grading, streetscapes, roads and parking lots) and helps to reduce stormwater impacts or provide/maintain beneficial hydrologic functions. The cumulative beneficial impact of using the wide array of distributed LID techniques allows the site designer to maintain or restore watershed's natural relationship between rainfall, runoff, infiltration and evaporation.

The effective use of LID site design techniques can significantly reduce the cost of providing stormwater management. Savings are achieved by eliminating the use of stormwater management ponds, using less pipe, inlet structures, curbs

and gutters, less roadway paving, less grading and clearing. Where LID techniques are applicable, and depending on the type of development and site constraints, stormwater and site development design construction and maintenance costs can be reduced by 25 % to 30% compared to conventional approaches.

The creation of LID's wide array of micro-scale management principles and practices has led to the development of new tools to retrofit existing urban development. Micro-scale management practices that filter, retain and detain runoff can be easily integrated into the existing green space and streetscapes as part of the routine maintenance and repair of urban infrastructure. LID retrofit techniques may lead to drastic reductions in the cost of retrofitting existing urban development. Reducing urban retrofit costs will increase the ability of cities to implement effective retrofit programs to reduce the frequency and improve the quality of CSOs and improve the quality of urban runoff to protect receiving waters. LID represents a radically different approach to controlling stormwater runoff that provides effective tools to restore or maintain a watershed's hydrologic functions for new or existing development.

In 1998 EPA provided grant funding to assist PGDER in their efforts to develop a general manual describing LID principles and practices, and share this technology with other local governments throughout the nation. Efforts are currently underway with EPA to further advance LID technology by improving the sensitivity of current hydrology and hydraulic analytical models for application with small watersheds and sites and to develop new micro-scale control approaches and practices for urban retrofit. Additional efforts are also underway to demonstrate how LID micro-scale management and multifunctional infrastructure principles and practices can be used to control highway runoff within existing rights-of-way. It is hoped that the LID national manual will help to stimulate debate on the state of current stormwater, watershed protection and restoration technology and its future direction. The lessons learned about LID planning, principles, practices and research are described in detail in the reference documents listed at the end of this paper. Copies of these reference documents can be obtained by calling the Prince George's County's Department of Environmental Resources at (301) 883-5832.

Background

Typically, adverse stormwater impacts are mitigated through conservation of natural resources (forests, streams, floodplains and wetlands); zoning restrictions to direct densities and increase open space; and the use of structural or non-structural control technologies (best management practices - BMP's) to treat and manage runoff quantity and quality. Many conventional stormwater mitigation approaches, such as management ponds, exhibit a number of inherent practical, environmental and economic limitations including inability to replicate predevelopment watershed hydrology, elevated water temperatures, costly maintenance burdens, and accelerated stream erosion due to the increased duration and frequency of runoff events. Furthermore, because current mitigation practices only lessen development impacts, there is concern about the cumulative impacts of the widespread use of conventional mitigation practices that may fundamentally alter a watershed's hydrologic regime and water quality, adversely affecting receiving waters and the integrity of their ecosystems. Many highly urbanized jurisdictions are beginning to question the efficacy of current technology and are finding it harder to ensure, enforce or fund stormwater programs and maintain the massive infrastructure created by conventional approaches.

Currently every site is designed with one basic overriding goal - to achieve good drainage. As we develop a site reshaping the landscape inch by inch, its hydrologic functions are altered on a micro-scale level. The cumulative impacts of micro-scale changes to the landscape drastically alter watershed hydrology. If sites can be designed to achieve good drainage, destroying natural hydrologic functions, why not design sites with the opposite objective to maintain predevelopment hydrologic functions? If inch by inch, sites are carefully and intelligently engineered to maintain hydrologic functions, would the cumulative beneficial affects result in the preservation of a watershed's hydrology? Can a site be designed in a way to remain as a functional part of a watershed's hydrological regime? To achieve a hydrologically functional development there must be a radical change in our thinking. We must not think in terms of impact mitigation as the stormwater management objective, but rather preservation of hydrologic and environmental functions. We should design sites to maintain hydrologic functions not just to mitigate impacts. Can our current stormwater management technology adequately meet our regulatory objectives and water resources/ecosystem protection needs? No one can answer that question for sure. However, it has not been shown that conventional ponds replicate predevelopment hydrology nor is there any evidence to suggest that conventional technology can ensure the ecological integrity of ecosystems. In fact, recent studies suggest that conventional approaches can not meet our water/natural resources and ecological objectives.

Introduction

With growing concerns about the economics and efficacy of conventional technology, in 1990 Prince George's County Maryland's Department of Environmental Resources began exploring alternative stormwater management practices. The success that was achieved through the development and use of bioretention (filtering or infiltration runoff in small depressed landscaped areas) led us to understand that perhaps changing the form and function of the developed landscape could be important in mitigating urban stormwater impacts. Later it was realized that through intelligent site design and uniform distribution of LID micro-scale management controls it was possible to maintain or restore hydrologic functions in a developed watershed. What is not known is how much of a watershed's hydrologic functions can be maintained or restored within a given development type (residential, commercial or industrial)? The one limiting factor to maintaining/restoring the hydrologic regime for highly urbanized development is the lack of available micro-management tools. Much of the current research underway is to expand the number of practices applicable in highly urbanized areas.

LID's objective is to preserve the natural predevelopment hydrologic regime. If predevelopment hydrology and water quality can be maintained, this would provide the best level of protection possible to receiving waters and aquatic living resources. Experience over the last 20 years has demonstrated that maximizing the efficiency of conventional conservation measures and the use of conventional end-of-pipe stormwater management practices can not reasonably be used to restore watershed functions. What is needed is a new philosophical approach to site development, an approach that will allow the designer to retain a site's hydrologic functions.

The approach used in LID designs is really an old one. LID borrows its basic principles from nature - uniform distribution of micro-management controls. In a natural setting, stormwater is controlled by a variety of mechanisms (interception by vegetation, small depression storage, channel storage, infiltration and evaporation) uniformly distributed throughout the landscape. LID mimics these mechanisms by uniformly distributing small infiltration, storage, and retention and detention measures throughout the developed landscape. What we soon began to see is that every development feature (green space, landscaping, grading, streetscapes, roads, and parking lots) can be designed to provide some type of beneficial hydrologic function.

Low - Impact Development General

LID controls stormwater at the source creating a hydrologically functional landscape that mimics natural watershed hydrology. Low impact development (LID) achieves stormwater management controls by fundamentally changing conventional site design to create an environmentally functional landscape that mimics natural watershed hydrologic functions (volume, frequency, recharge and discharge). LID uses four basic management planning and design principles. First: minimize impacts to the extent practicable by reducing imperviousness, conserving natural resources/ecosystems, maintaining natural drainage courses, reducing use of pipes and minimizing clearing and grading. Second: provide runoff storage measures dispersed uniformly throughout the landscape with the use of a variety of small decentralized detention, retention and runoff practices such as bioretention, open swales and flatter grades. Third: maintain the predevelopment time of concentration by strategically routing flows to maintain travel time and control discharge. Fourth: implement effective public education and incentive programs to encourage property owners to use pollution prevention measures and maintain on-lot landscape management practices. A developed site can be designed to become a hydrologically functional part of the watershed with comprehensive and intelligent use of LID practices and principles.

LID Basic Site Planning Strategies

The goal of LID is to design the site in a way that mimics hydrologic functions. The first step is to minimize the generation of runoff (reduce the change in the runoff curve number (CN)). In many respects, this step is very similar to traditional techniques of maximizing natural resource conservation, limiting disturbance and reducing impervious areas. The major difference with LID is you must carefully consider how best to make use of the hydrologic soil groups and site topography to help reduce and control runoff. These considerations would include how to:

1. maintain natural drainage patterns, topography and depressions,
2. preserve as much existing vegetation as possible in pervious soils; hydrologic soil groups A and B,
3. locate BMP's in pervious soils; hydrologic soil groups A and B,
4. where feasible construct impervious areas on less pervious soil groups C and D,
5. disconnect impervious surfaces,
6. direct and disburse runoff to soil groups A and B,
7. flatten slopes within cleared areas to facilitate on-lot storage and infiltration and
8. re-vegetate cleared and graded areas.

Where ground water recharge is particularly important (to protect well, spring, stream and wetland flows) it is important to understand the source and mechanisms for ground water recharge. When using the LID design concepts to mimic the hydrologic regime you must determine how and where ground water on the site is recharged and where necessary, protect and utilize the recharge areas in the site.

LID Hydrologic Analysis/Response

The objective of LID site design is to minimize, detain and retain the post development runoff volumes uniformly throughout the site close to the source to simulate predevelopment hydrologic functions. Widespread use and uniform dispersion of on-lot small retention and/or detention practices to control both runoff discharge volume and rate is key to better replicating predevelopment hydrology. Using LID practices also produces runoff frequencies that are much closer to existing conditions than can be achieved by typical application of conventional BMP's. Management of both runoff volume and peak runoff rate is included in the design. This is in contrast to conventional end-of-pipe treatment that completely alters the watershed hydrology regime.

The LID site analysis and design approach focuses on four major hydrologically based planning elements. These fundamental factors affect hydrologic and are introduced below.

1. Curve Number (CN) - A factor that accounts for the effects of soils and land cover on amount of runoff generated. Minimizing the change in the post development CN by reducing impervious areas and preserving more trees and meadows to reduce runoff storage requirements, all to maintain the predevelopment runoff volume.
2. Time of Concentration (Tc) - This is related to the time runoff travels through the watershed. Maintaining the predevelopment Tc reduces peak runoff rates after development by lengthening flow paths and reducing the use of pipe conveyance systems.
3. Permanent storage areas (Retention) - Retention storage is needed for volume and peak control, water quality control and to maintain the same CN as the predevelopment condition.
4. Temporary storage areas (Detention) - Detention storage may be needed to maintain the peak runoff rate and/or prevent flooding.

Minimizing the Change in CN

Reducing the change in CN will reduce both the post development peak discharge rate and volume. Calculation of the LID CN is based on a detailed evaluation of the existing and proposed land cover so that an accurate representation of the potential for runoff can be obtained. This calculation requires the engineer/planner to investigate the following key parameters associated with LID including:

1. land cover type,

2. percentage of and connectivity of impervious cover,

3. hydrologic soils group (HSG), and

4. hydrologic conditions (average moisture or runoff conditions).

The following are some of the LID site planning practices that can be utilized to achieve a substantial reduction in the change of the calculated CN:

1. narrower driveways and roads (minimizing impervious areas),

2. maximized tree preservation and/or afforestation,

3. site finger-printing (carefully siting lots/roadways to avoid disturbance of streams, wetlands and other resources), greater use of open drainage swales,

4. preservation of soils with high infiltration rates to reduce CN,

5. location of BMP's on high-infiltration soils and,

6. construction of impervious features on soils with low infiltration rates.

Maintaining the Predevelopment Time of Concentration Tc

The LID hydrologic evaluation requires that the post development Tc be close to the predevelopment Tc. Minimizing the change in pre and post Tc will help maintain the same frequency of runoff discharges, assuming there is uniform distributed micro-scale retention and detention of LID practices. The following are some of the site planning techniques can be used to maintain the existing Tc:

1. maintain predevelopment flow path length by dispersing and redirecting flows using open swales and vegetated drainage patterns,

2. increase surface roughness (e.g., preserving woodlands, vegetated swales),

3. detain flows (e.g., open swales, rain gardens, rain barrels etc.),

4. minimize disturbances (minimizing soil compaction and changes to existing vegetation /drainage patterns),

5. flatten grades in impacted areas,

6. disconnect impervious areas (e.g., eliminating curb/gutter and redirecting down spouts) and,

7. connect pervious areas to vegetated areas (e.g., reforestation, afforestation).

The combined use of all these techniques results in cumulative impacts that modify runoff characteristics to effectively shift the post development peak runoff time and frequencies to that of the predevelopment condition, and lower the peak runoff rate.

Maintaining the Redevelopment Curve Number and Runoff Volume

Once the post development Tc is maintained at the predevelopment conditions and the impact of CN is minimized, any additional reductions in runoff volume must be accomplished through distributed micro-scale on-site stormwater management techniques. The goal is to select the appropriate combination of management techniques that simulate the hydrologic functions of the predevelopment condition to maintain the existing CN and corresponding runoff volume. The target design volume is equal to the initial abstraction of rainfall that would have occurred in the predevelopment condition.

LID site designs maximize the use of small retention practices distributed throughout the site at the source to provide the required volume storage. The required storage volume will be reduced when the change in the pre and post CN is minimized.

Retention storage allows for a reduction in the post development volume and the peak runoff rate. The increased storage and infiltration capacity of retention LID BMP's allow the predevelopment volume to be maintained. The most appropriate retention BMP's include:

1. bioretention cells (rain gardens),
2. infiltration trenches,
3. water use storage (rain barrels and gray water uses) and,
4. roof top storage.

Other possible retention BMP's include retention ponds, cisterns and irrigation ponds but it may be difficult to distribute these types of controls throughout a development site.

As retention storage volume is increased there is a corresponding decrease in the peak runoff rate, in addition to runoff volume reduction. If a sufficient amount of runoff is stored, the peak runoff rate may be reduced to a level at or below the predevelopment runoff rate. This storage may be all that is necessary to control the peak runoff rate when there is a small change in CN. However, when there is a large change in CN, it may be less practical to achieve flow control using volume control only.

Potential Requirement for Additional Detention Storage

In cases where very large changes in CN cannot be avoided, retention storage practices alone may be either insufficient to maintain the predevelopment runoff volume or peak discharge rates or require too much space to represent a viable solution. In these cases, additional detention storage will be needed to maintain the predevelopment peak runoff rates. A number of traditional detention storage techniques are available that can be integrated into the site planning and design process for a LID site. These techniques include:

1. swales with check dams, restricted drainage pipes, and inlet/entrance controls,
2. wide, low gradient swales,
3. rain barrels/cisterns,
4. rooftop storage and
5. shallow parking lot/road storage.

Determination of Design Storm Event

The hydrologic approach of LID is to retain the same amount of rainfall within the development site as was retained prior to any development (e.g., woods or meadow in good condition) and then release runoff as the woods or meadow would have. By doing so, it is possible to mimic, to the greatest extent practical, the predevelopment hydrologic regime to maximize protection of receiving waters, aquatic ecosystems and ground water recharge. This approach allows the determination of a design storm volume that is tailored to the unique soils, vegetation and topographic characteristics of the watershed. This approach is particularly important in watersheds that are critical for ground water recharge to protect stream/wetland base flow and ground or surface water supplies.

LID BMP's

Site design techniques and BMP's can be organized into three major categories as follows; 1) runoff prevention measures designed to minimize impacts and changes in predevelopment CN and Tc, 2) retention facilities that store runoff for infiltration, exfiltration or evaporation and 3) detention facilities that temporarily store runoff and release through a measured outlet. Table 1, below, lists some of a wide array of LID BMP's and their primary functions. Placing these BMP's in series and uniformly dispersing them throughout the site provides the maximum benefits for hydrologic controls.

Table 1. Examples of LID BMP's and Primary Functions

BMP	Runoff Prevention	Detention	Retention	Conveyance	Water Quality
Bioretention		X	X		X
Infiltration Trench			X		X
Dry Wells		X	X		
Roof Top Storage		X	X		X
Vegetative Filter Strips				X	X
Rain Barrels		X	X		
Swale and Small Culverts		X		X	X
Swales		X		X	X
Infiltration Swale		X	X	X	X
Reduce Imperviousness	X				
Strategic Clearing / Grading	X				
Engineered Landscape	X				
Eliminate Curb and Gutter	X				X
Vegetative Buffers	X				X

Water Quality

LID maximizes the use of the developed landscape to treat stormwater runoff. Not only can the landscape be used to store, infiltrate and detain runoff, the unique physical, chemical and biological pollutant removal/ transformation/immobilization/detoxification capabilities of the soil, soil microbes and plants can be used to remove pollutants from runoff. For example, bioretention basins or rain gardens are designed to use the upland soil/microbe/plant complex to remove pollutants from runoff. Rain gardens which look and function like any other garden except they treat runoff are designed with a layer of 2–3 inches of mulch, 2–3 feet of planting soil and vegetation (trees shrubs and flowers). Figure 1 shows a parking lot landscape island rain garden (bioretention practice) that uses a high rate filter media with plants to filter and treat 90% of the annual volume of runoff from the parking lot.

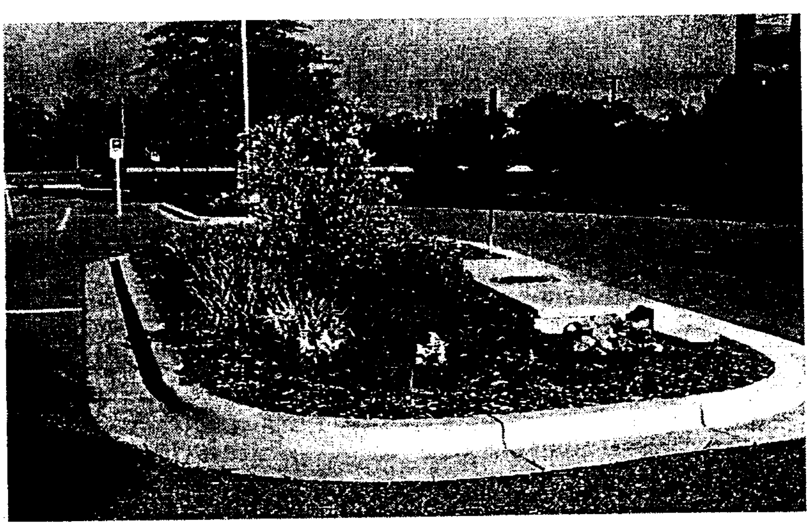

Figure 1. Parking Lot Rain Garden.

Studies conducted by the University of Maryland have shown rain gardens to be very effective in removing pollutants. The percent pollutant removal of various contaminants is shown below in Table 2. The results shown represent the average removal rates under a wide variety of flow rates and pollutant concentrations.

Table 2. Percent Pollutant Removal by Rain Gardens

Cu	Pb	Zn	P	TKN	NH4+	NO3-	TN*
%	%	%	%	%	%	%	%
93	99	99	81	68	79	23	43

* Removal varied as a function of depth in the soil. Percent removal shown is at a depth of approximately 3 feet.
Testing Conducted by the University of Maryland, Department of Engineering

The variety of physical, chemical and biological pollutant removal mechanisms available in the complex rain garden system is staggering. A description or explanation in any detail of these mechanisms is beyond the scope of this paper. A more detailed description can be found in the 1998 "Optimization of Bioretention Design" study conducted by the University of Maryland. Mulch has been found to be very effective in removing heavy metals through organic complexing with the hydroxyl and carboxyl sites on the organic molecules. Soil bacteria can metabolize (use as a carbon energy source) oil, grease and gasoline into C02 and water in the presence of adequate nutrients and oxygen. Soil bacteria have been used for years for the remediation of contaminated soils. Plants are known to uptake, transpire, accumulate and detoxify heavy metals and many other toxic compounds. The physiologic and metabolic processes of plants are used to clean contaminated soils through phytoremediation. A goal of LID is to maximize the use of upland landscape with its soil/ microbes/ plant complex to treat runoff. Using upland systems to trap and remove pollutants allows one to more easily control the fate of contaminants and prevent them from entering the water column where they are almost impossible to contain and remove.

Public Outreach and Pollution Prevention

Pollution prevention and maintenance of on-lot LID BMP's are two key elements in a comprehensive approach. Effective pollution prevention measures can reduce the introduction of pollutants to the environment and extend the life of LID treatment BMP's. Public education is essential to successful pollution prevention and BMP maintenance. Not only will effective public education complement and enhance BMP effectiveness, it can also be used as a marketing tool to attract environmentally conscious buyers, promote citizen stewardship, awareness and participation in environmental protection programs and help to build a greater sense of community based on common environmental objectives and the unique character of LID designs.

Costs

LID case studies and pilot programs show that at least a 25% reduction in both site development and maintenance costs can be achieved by reducing grading and the use of pipes, ponds, curbs and paving. In one subdivision called Somerset which used the rain garden LID technique for water quality controls, the developer saved $4,500 per lot or a total of $900,000 by eliminating the need for curbs, ponds and drainage structures. Maintenance costs are also reduced in scale and magnitude by using the small LID practices. LID site designs require only routine landscape care and maintenance of the vegetation. This eliminates the high costs of pond maintenance associated with dam repairs and dredging.

Road Blocks to LID

In the development and acceptance of the LID site planning approach, a number of roadblocks had to be overcome. Regulating agencies, the development community and the public all had concerns about the use of new technology. The

LID design manual represents the culmination of four years of work to address all of these concerns and issues. Some of the major components of the LID approach, which addressed the many concerns, include:

1. develop an hydrologic analytical methodology to demonstrates the equivalence of LID to conventional approaches,
2. develop new road standards which allow for narrow roads, open drainage and cluster techniques,
3. streamline the review process for innovative LID designs which allow easy modification of site, subdivision, road and stormwater requirements,
4. develop a public education process which informs property owners on how to prevent pollution and maintain on lot BMP,
5. develop legal and educational mechanisms to ensure BMP's are maintained,
6. demonstrate the marketability of green development,
7. demonstrate the cost benefits of the LID approach,
8. provide training for regulators, consultants, public and political leaders and,
9. conduct research to demonstrate the effectiveness of bioretention BMP's.

Summary

LID is a viable economically sustainable alternative approach to stormwater management and the protection of natural resources. LID provides tangible incentives to a developer to save natural areas and reduce stormwater and roadway infrastructure costs. LID can achieve greater natural conservation by using conservation as a stormwater BMP to reduce the change in CN. As more natural areas are saved, less runoff is generated and stormwater management costs are reduced. This allows multiple use and benefits (environmental and economical) of the resource.

Additionally, developers have incentives to reduce infrastructure costs by reducing impervious areas, and eliminating curbs/gutters and stormwater ponds to achieve LID stormwater controls. Reduction of the infrastructure also reduces infrastructure maintenance burdens making LID designs more economically sustainable. Superior protection of aquatic and riparian ecosystems can be achieved since a LID developed watershed functions in a hydrologically similar manner as the predevelopment conditions. Recreating the predevelopment hydrological regime is a better way to protect the receiving waters than the conventional end-of-pipe mitigation approaches.

LID promotes public awareness, education and participation in environmental protection. As every property owner's landscape functions as part of the watershed, they must be educated on the benefits and the need for maintenance of the landscape and pollution prevention. LID developments can be designed in a very environmentally sensitive manner to protect streams, wetlands, forest habitat, save energy, etc. The unique character of a LID green development can create a greater sense of community pride based on environmental stewardship.

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A National Menu of BMPs for the Phase II NPDES Storm Water Program

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Introduction

Implementation of the Phase II NPDES Storm Water Program, which is presently "proposed," will be enhanced by the development of several tools used to help reduce discharges of pollutants from regulated small construction activities and from regulated small municipal separate storm sewer systems (MS4s). One of the tools being developed by EPA is a national menu of best management practices (BMPs), from which regulated Phase II municipalities can select as they develop their stormwater management programs.[1] The purpose of the national menu of BMPs is to provide a list of options available to regulated Phase II municipalities as they develop a stormwater programs. The national menu of BMPs may be adopted or modified by each NPDES permitting authority, or the permitting authority may develop its own menu of BMPs for use by the Phase II municipalities under its jurisdiction. This paper describes the process of developing the national menu of BMPs and measurable goals for each of the six minimum measures required to be in the stormwater management programs.

Process of Development

The process used in developing the menu was to first list appropriate BMPs for each minimum control measure, with subcategories under certain control measures.[2] Then, a basic format for presenting the information about each BMP was established. Information being provided for each BMP in the menu consists of BMP name, description, an illustration, applicability and design considerations, limitations, operation and maintenance, effectiveness, cost, and references. The menu is being prepared by EPA, with support from Tetra Tech, Incorporated, and the Center for Watershed Protection. A peer involvement/peer review group has been selected and will provide review and input to the process of developing the menu over the course of the next year. The menu is currently being reviewed and developed as a traditional hard copy document. Following development, there are plans to make the menu available as an interactive Web-based tool. The menu of BMPs is scheduled to be released by October, 2000.

Descriptions of Six Minimum Control Measures, with Lists of BMPs

1) Public Education and Outreach

This measure in the proposed rule calls for the creation of a public education program to inform citizens about the impacts that stormwater runoff can have on water quality. It includes the preparation and distribution of educational materials to the community, describing these impacts and steps that can be taken to reduce pollution from discharges of stormwater. Examples of such steps include proper septic system maintenance, limitations on use and runoff of household and garden chemicals, proper disposal of used motor oil or household hazardous wastes, and involvement in local stream restoration activities. The following BMPs have been identified (in the Draft Rule) under four major subcategory groups in the menu for the Public Education and Outreach minimum measure:

Public outreach/education for homeowners

- Lawn and garden activities, including proper pesticide use and disposal practices

- Water conservation practices
- Proper disposal of used materials or household hazardous wastes
- Pet waste management

Targeting public outreach/education

- Education/outreach for commercial activities (parking lots, gas stations, etc.)
- Tailoring outreach programs to communities, including minority and disadvantaged, as well as children
- Classroom education on stormwater
- Distributing stormwater educational materials (how, to whom)

Public Outreach Programs for New Development

- Low-impact development (includes buyer awareness, legal documents, and settlement documents)

Pollution Prevention Programs for Existing Development

- Educational display, pamphlet, booklet, utility stuffer
- Using the media (includes newspaper, magazine, radio, television, public service announcements, and Internet messages)
- Promotional giveaway

2) Public Participation/Involvement

This measure in the proposed rule includes compliance with state and local public notice requirements, but goes beyond that to encourage municipalities to seek public involvement in the development and review of their stormwater programs. Opportunities for members of the public to participate in the development of their municipality's stormwater management program may include serving as citizen representatives on a local stormwater management panel, attending public hearings, working as citizen volunteers to educate others about the program, assisting in program coordination with other pre-existing programs, or participating in volunteer monitoring efforts. The following BMPs have been identified under two major subcategory groups of practices in the menu for the Public Participation/Involvement minimum measure:

Activities/Public Participation

- Storm drain stenciling
- Stream cleanup
- Volunteer monitoring
- Reforestation program
- Wetland plantings
- Adopt-A-Stream program

Involvement/Public Opinion

- Watershed organization

- Stakeholder meetings (includes local stormwater management ponds)
- Attitude surveys
- Community hotlines

3) Illicit Discharge Detection and Elimination

This measure envisions the creation of an illicit discharge detection and elimination program. Specific program elements include developing a demonstrated knowledge base of the MS4, using maps or other documents to identify major outfalls and pipe networks on a topographic basis; developing a plan to address illicit discharges into the MS4, including appropriate enforcement procedures to the extent allowable by law; and developing a process for informing the public about the hazards associated with illicit discharges and the improper disposal of waste. For example, recycling programs and other public outreach activities could be developed to address sources of illicit discharges, including used motor oil, antifreeze, pesticides, herbicides, and fertilizers. The following BMPs have been identified for the menu for the Illicit Discharge Detection and Elimination minimum measure:

- Failing septic systems
- Industrial connections
- Recreational sewage
- Sanitary sewer overflows
- Identifying illicit connections
- Wastewater connections to the storm drain system

4) Construction Runoff Control

This measure provides for the enforcement of a program to reduce pollutants in storm water runoff from construction activities resulting in the disturbance of one acre to five acres of land. The program would apply to the individuals responsible for activities at construction sites and should include an ordinance to control sediment and erosion; a mechanism to ensure control of other wastes at construction sites, such as discarded building materials, concrete truck washout, and sanitary waste that could impact water quality; requirements for the implementation of appropriate BMPs, such as silt fences, temporary detention ponds and hay bales; provisions for preconstruction review of site management plans; procedures for receipt and consideration of comments and other information provided by the public; regular inspections during construction; and penalties to ensure compliance. The following BMPs have been identified under 11 major subcategory groups of practices in the menu for the Construction Runoff Control minimum measure:

Minimize Clearing

- Land grading
- Permanent diversion
- Preservation of natural vegetation (includes tree preservation and protection)

Stabilize Exposed Soils

- Chemical stabilization
- Mulching

- Permanent seeding
- Sodding
- Soil roughening

Protect Steep Slopes

- Geotextiles
- Gradient terraces
- Soil retention (includes slope stabilization, retaining wall, reinforcement)
- Temporary slope drain (a.k.a. - pipe slope drain)
- Temporary storm drain diversion

Stabilize Drainage Ways

- Check dam (a.k.a. grade stabilization structure)
- Filter berm
- Grass-lined channel
- Riprap

Protect Waterways

- Temporary diversion
- Temporary stream crossing (bridge, culvert)
- Vegetated buffer

Phase Construction

- Construction sequencing
- Dust control

Install Perimeter Controls

- Temporary diversion dikes, earth dikes, and interceptor dikes (includes temporary fill diversions)
- Sand fence and wind fences
- Silt fence
- Brush barriers

Install Sediment Trapping Devices

- Sediment basin/rock dam
- Sediment filters and sediment chambers

- Sediment traps

Inlet Protection

- Stabilized construction entrances
- Storm drain inlet protection (includes block and gravel, excavated drop, fabric drop, and sod drop inlet protection)

Education and Awareness

- Contractor certification and inspector training
- BMP inspection and maintenance

5) Post-Construction Runoff Control

This measure uses post-construction controls as part of a program to address stormwater runoff from new development and redevelopment projects using appropriate structural and non-structural BMPs. Non-structural BMPs are preventive actions using management and source controls, such as policies and ordinances that result in protection of natural resources and prevention of runoff. Non-structural BMPs might include requirements that encourage growth in identified areas while protecting sensitive areas such as wetlands and riparian zones, minimizing impervious surfaces, maintaining open space, and minimizing clearing, grading, or other disturbance of soils and vegetation. Some of the typical structural BMPs include storage practices (wet ponds, extended-detention dry ponds, or other storage facilities with outlets); infiltration practices (infiltration basins, infiltration trenches, and porous pavement); and filtration practices (grassed swales, sand filters, and vegetated filter strips). This measure should also ensure effective and reliable performance by providing for the long-term operation and maintenance of the selected BMPs. The following BMPs have been identified under eight major subcategory groups of practices for the Post-Construction Runoff Control minimum measure:

Ponds

- Extended detention dry basin or pond (with or without permanent pools or shallow marshes near the outlet), includes tank storage
- Wet pond

Infiltration Practices

- Infiltration basin (a.k.a. - recharge basin)
- Infiltration trench (a.k.a. - infiltration galley)
- Porous pavement

Filtration Practices

- Bioretention
- Filters, including organic media filter (peat sand or compost-type), sand filter, multichamber treatment train (MCTT) system, and inlet filtration systems

Vegetative Practices

- Constructed wetland, shallow marsh
- Grassed swale

- Vegetative filter strip

Runoff Pretreatment Practices

- Catch basin
- In-line storage, includes flow regulator information
- Manufactured systems for water quality inlets

Experimental Practices

- Alum injection system

On-lot Treatment

- On-lot treatment includes information on dry wells, roof downspout systems, rain barrels, exfiltration storage systems, french drains, and dutch drains

Better Site Design

- Conservation easements
- Infrastructure planning
- Buffer zones/setbacks
- Open space development
- Narrow streets
- Curb elimination
- Green parking lot
- Alternative turn-around
- Urban forestry
- Alternative pavers

6) Pollution Prevention/Good Housekeeping

This measure in the proposed rule envisions the creation of an operation and maintenance/training program to prevent or reduce pollutant runoff from municipal operations. The program should include training for municipal staff to address prevention measures in government operations, such as park and open space maintenance, fleet maintenance, planning, building oversight and stormwater collection system maintenance. Other possible pollution prevention activities that might be relevant include controls for reducing or eliminating the discharge of pollutants from streets, roads, highways, municipal parking lots, maintenance and storage yards, and waste transfer stations; programs to promote recycling and pesticide use information; procedures for proper disposal of waste removed from municipal systems and public areas (such as streets) including dredge spoil, accumulated sediments, floatables, and other debris; and new flood management projects to assess the impacts on water quality and examine exiting projects to determine if they need additional water quality protection devices or practices. The following BMPs have been identified under two major subcategory groups of practices in the menu for the Pollution Prevention/Good Housekeeping minimum measure:

Source controls

- Animal waste collection
- Automobile maintenance
- Car washing
- Illegal dumping control
- Landscaping and lawn care
- Pest control
- Parking lot and street cleaning
- Roadway and bridge maintenance
- Septic system controls

Materials Management

- Alternative products
- Hazardous materials storage
- Household hazardous waste collection
- Road salt application and storage
- Spill response and prevention
- Used oil recycling

Conclusion

As part of the Stormwater Phase II Tool Box, the Menu of BMPs should help municipalities develop, implement, and enforce the Phase II program. The menu will be available in time for regulated municipalities to use in complying with stormwater management program requirements under Phase 2 permits and might also benefit other jurisdictions and individuals.

References

USEPA, 1999. Storm Water Phase II Fact Sheet Series 1-4. April 1999. EPA 833-F-99-001 through 015.

USEPA, 1998. 40 CFR Parts 122 and 123; National Pollutant Discharge Elimination System—Proposed Regulations for Revision of the Water Pollution Control Program Addressing Storm Water Discharges; Proposed Rule. Friday January 9, 1998. 63 FR 1536.

Determining Urban Stormwater BMP Effectiveness

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Abstract

The overall purpose this US EPA funded cooperative research program with the American Society of Civil Engineers (ASCE) is to develop a more useful set of data on the effectiveness of individual best management practices (BMPs) used to reduce pollutant discharges from urban development. BMP performance data gathered at a particular site should not only be useful for that site, but also be useful for comparing studies of similar and different types of BMPs in other locations. Almost all BMP effectiveness studies in the past have provided very limited data that is useful for comparing BMP design and selection among individual BMP types (e.g. sand filters). This paper overviews some of the problems of past BMP effectiveness studies from the perspective of comparability between studies. It suggests some of the ways that data should be collected to make it more useful for assessing factors (such as settling characteristics of inflow solids and physical features of the BMP) that might have led to the performance levels achieved. It briefly presents the database that has been developed by this project, which not only serves as a tool for storing data from existing studies, but as a tool for entering and storing data collected from future studies. Discussed are considerations that affect data transferability, such as effectiveness estimations, statistical testing, etc. It overviews the efforts to establish and analyze the data base for existing studies and overviews proposed analyses for the future, when more studies that have followed the protocols are available. The database has specifically pointed out the need for additional BMP performance studies, as the current data is very sparse in terms of studies that have recorded enough information to be useful in assessing BMP type performance.

Introduction

Many studies have assessed the ability of stormwater treatment BMPs (e.g., wet ponds, grass swales, stormwater wetlands, sand filters, dry detention, etc.) to reduce pollutant concentrations and loadings in stormwater. However, in reviewing and summarizing the information gathered from these individual BMP evaluations, it is apparent that inconsistent study methods and reporting make wider-scale assessments difficult, if not impossible. For example, individual studies often included the analysis of different constituents and utilized different methods for data collection and analysis, as well as varying degrees of information on BMP design and inflow characteristics. Just the differences in monitoring strategies and data evaluation alone contribute significantly to the range of BMP "effectiveness" that has been reported. These differences make combining these individual studies almost impossible to assess what design factors may have contributed to the variation in performance (Strecker et al., 1992). Urbonas (1994 and 1995) and Strecker (1994) summarized information that should be recorded regarding the physical, climatic, and geological parameters that likely affect the performance of a BMP and considerations regarding sampling and analysis methods.

Efficiency, Effectivness, and Performance

In order to better clarify the terminology used to describe the level of treatment achieved and how well a device, system, or practice meets its goals, definitions of some terms often used loosely in the literature are provided here. These terms help to better specify the scope of monitoring studies and related analyses:

- Best Management Practice (BMP) - A device, practice, or method for removing, reducing, retarding, or preventing targeted stormwater runoff constituents, pollutants, and contaminants from reaching receiving waters

- BMP System - A BMP system includes the BMP and any related bypass or overflow. For example, the efficiency (see below) can be determined for an offline retention (Wet) Pond either by itself (as a BMP) or for the BMP system (BMP including bypass)

- Performance - measure of how well a BMP meets its goals for stormwater that is treated by the BMP

- Effectiveness - measure of how well a BMP system meets its goals in relation to all stormwater flows

- Efficiency - measure of how well a BMP or BMP system removes pollutants

The ASCE project team is working with available data to determine efficiency of BMPs and BMP systems. In addition, effectiveness and performance are being evaluated, acknowledging the limitations of existing information about the goals of specific BMP projects. Quantification of efficiency only evaluates a portion of the overall performance or effectiveness of a BMP or BMP system. Calculation of the efficiency helps to determine additional measures of performance and effectiveness, for example the ability of a BMP to meet any regulatory goals. A list of typical goals and the current ability of the ASCE/EPA project to help evaluate them is shown in Table 1.

Problem: BMP Performance Study Inconsistencies

Studies of BMP effectiveness have utilized significantly different:

- sample collection techniques (e.g., from sample collection types--grab, composite, etc., flow measurement techniques, to how the sample was composited, etc.);

- water quality constituents, including: chemical species, methods (detection limits), form (e.g., dissolved vs. total, vs. total recoverable, etc.), and treatment potential;

- data reporting on tributary watershed and BMP design characteristics (e.g., tributary area or watershed attributes such as percent impervious, land use categories, rainfall statistics, etc.);

- effectiveness estimation techniques (there are at least four common techniques that have been utilized to assess effectiveness that can cause significant differences in pollutant removal reporting, with the same set of data), and potential alternatives to reporting just concentration/loading reductions; and

- statistical validation of results (typical lack of statistical tests to determine if the reported removal efficiency can in fact be shown to be statistically different than zero).

Monitoring strategies that could be employed to monitor BMP effectiveness include:

- New BMP installation with new development- input/output (e.g., monitor new detention pond of newly developed watershed and evaluate inflow concentrations/loads vs. outflows) or conduct a "control" watershed comparison

- Retrofit of existing or new single BMP within existing watershed--input/output, and/or, before/after (e.g., retrofit of an existing flood control basin for water quality)

- Watershed-wide new structural or non-structural--"control" watershed comparison (e.g., new BMP catch basins in developing area)

- Watershed-wide structural retrofit or application of non-structural - before/after, and/or, "control" watershed comparison (e.g., catch basin retrofit on watershed scale)

Input/output monitoring is the typical approach utilized. However, control watersheds and before/after approaches have also been employed. All of the other potential factors that could be contributing to differences in performance must identified and accounted. On the other hand, it is beneficial to be able to show that a watershed-wide difference is or is

Table 1. Goals of BMP Projects and the Ability of the National Stormwater BMP Database to Provide Information Useful for Determining Performance and Effectiveness

Goals of BMP Projects Category		Ability to Evaluate Performance and Effective
Hydraulics	•Improve flow characteristics upstream and/or downstream of BMP	-
Hydrology	•Flood mitigation, improve runoff characteristics (peak shaving)	✓
Water Quality (Efficiency)	•Reduce downstream pollutant loads and concentrations of pollutants	✓
	•Improve/minimize downstream temperature impact	✓
	•Removal of litter and debris	✓[1]
Toxicity	•Reduce acute toxicity of runoff	✓[1]
	•Reduce chronic toxicity of runoff	✓[1]
Regulatory	•Compliance with NPDES permit	-
	•Meet local, state, or federal water quality criteria	✓[2]
Implementation Feasibility	•For non-structural BMPs, ability to function within management and oversight structure	-
Cost	•Capital, operation, and maintenance costs	✓[1]
Aesthetics	•Improve appearance of site	-
Maintenance	•Operate within maintenance, and repair schedule and requirements	✓[1]
	•Ability of system to be retrofit, modified or expanded	✓
Longevity	•Long-term functionality	-
Resources	•Improve downstream aquatic environment/erosion control	-
	•Improve wildlife habitat	-
	•Multiple use functionality	-
Safety, Risk and Liability	•Function without significant risk or liability	-
	•Ability to function with minimal environmental risk downstream	-
Public Perception	•Information is available to clarify public understanding of runoff quality, quantity and impacts on receiving waters	✓

✓ can be evaluated using the ASCE/EPA Database as information source
✓[1] will be able to be evaluated using the database as primary source of information after enough studies have been submitted
✓[2] can be evaluated using the database the primary source of information combined with a secondary source of comparative data

not being detected with BMP implementation. These differences in monitoring approach certainly effect the ability to compare studies.

Any of the above topics would require an in-depth discussion beyond the scope of this paper. Therefore, this paper will present only a brief overview of each and some potential solutions for improving how data is collected. The ASCE project team has developed a set of protocols and a database on BMP performance studies with the purpose of improving the consistency of BMP monitoring information. The project includes:

- Developing protocols for BMP monitoring and reporting
- Developing a database on BMP performance studies
- Conducting an evaluation of existing information to assist EPA in providing guidance to the regulated community

The database specifies a chosen set of reporting information, but does not guide users on how to develop such information. For example, it does not specify in detail what a flow-weighted composite sample is and how it should be collected. The next step beyond the EPA protocols and database effort should be a guidance document on monitoring data collection strategies and techniques to improve their consistency and ultimate transferability. A few of the issues related to proper guidance are discussed in the next two sections. It should be recognized that, with the development of the database and the protocols, it will be a number of years (5 to 10) before a significant number of new studies on BMPs are conducted utilizing the protocols. Therefore, a rigorous evaluation of BMP selection and design factors will need to take place in the long-term future.

Recommended Parameters for Assessing BMP Performance

In developing a method for quantifying BMP performance, it is helpful to look at the objectives of previous studies seeking such a goal. BMP performance studies usually are conducted to obtain information regarding one or more of the following objectives:

- What degree of pollution control does the BMP provide under typical operating conditions?
- How does performance vary from pollutant to pollutant?
- How does performance vary with various input concentrations?
- How does performance vary with large or small storm events?
- How does performance vary with rainfall intensity?
- How do design variables affect performance?
- How does performance vary with different operational and/or maintenance approaches?
- Does performance improve, decay, or remain the stable over time?
- How does the BMP's performance compare relative to other BMPs?
- Does the BMP reduce toxicity to acceptable levels?
- Does the BMP cause an improvement in downstream biotic communities?
- Does the BMP have potential downstream negative impacts?

The monitoring efforts implemented most typically seek to answer a subset of the above questions. This often leaves larger questions about the performance of the BMP, and the relationship between design and performance, unanswered. Standardization of BMP data collection and evaluation methods (i.e., guidance and the ASCE/EPA database) allows this broader set of questions to be examined.

There has been a very wide variety of pollutants analyzed in BMP and characterization studies. The protocols established under the EPA-funded cooperative research program recommend a standard set of constituents for BMP testing programs. Table 2 presents the recommended constituents developed from the review of previous studies with an understanding of costs and likelihood of providing meaningful results. A discussion of how these constituents were selected and a detailed description of each can be found in Strecker (1994).

There are some practical and technical considerations regarding data reporting which would facilitate data usefulness, including consistent formatting of data, the clear indication of QA/QC results, standard comparisons to water quality criteria, reporting of tributary watershed characteristics, and BMP design information. The last two items are considered critical for evaluation of what contributed to BMP effectiveness in one location over another.

Data Reporting. It is recommended that all constituent concentration data be reported as event mean concentrations (EMCs). These statistics should be based on use of the lognormal distribution. The NURP and FHWA studies (EPA,

Table 2. Recommended Standard Analytical Tests for Urban Stormwater BMP Assessment

Lab Analysis	EPA Method Number	Detection Limit (mg/l)
Conventional		
TSS	EPA 160.2	1
TDS	EPA 160.1	1
TOC	EPA 415.1	3
COD	EPA 410.4	1
Total Hardness	SM 314-A	1
Nutrients		
(NH^3 - N)	SM 417-AD	0.1
Total phosphorus (as P)	SM 424-CE	0.005
Ortho-phosphate (as P)	SM 424-E	0.05
Nitrate + nitrite (NO_3 + NO^2 - N)	EPA 353.1 or .2	0.05
Total Metals		
Cd (cadmium)	EPA 7131	0.0002
Pb (lead)	EPA 7421	0.0003
Cu (copper)	EPA 6010	0.001
Zn (zinc)	EPA 6010	0.001
Dissolved Metals		
Cd (cadmium)	EPA 7131	0.0002
Pb (lead	EPA 7421	0.0003
Cu (copper)	EPA 6010	0.001
Zn (zinc)	EPA 6010	0.001

1983a; Driscoll et al., 1990) identified that the lognormal distribution is suitable for characterizing EMC distributions. The high degree of variability is why proper statistical techniques should be employed to evaluate whether a measured difference between BMP before/after or input/output is significant. The recommended inclusion of outlet data as a part of any paper or report will allow comparisons of typical outlet concentrations and may allow the determination of the lowest or average expected concentration from a particular type of BMP. For example, it may be that wet ponds may only be able to treat to some minimum concentration range at the outlet and the "effectiveness" is greatly impacted by the inlet concentrations.

Quality Assurance/Quality Control (QA/QC). All monitoring studies should include a QA/QC program. The details and results of the QA/QC program should be reported in monitoring study reports and summarized in papers. It is especially important to discuss when data are characterized as estimates due to QA/QC results and when detection limits were affected. Too often this information is not included.

Comparisons to Water Quality Criteria. A method to gage effectiveness could be to monitor how the BMP affects the number of times (frequency) that EPA water quality criteria are exceeded in both the inflow and the outflow, to assess how the BMP reduces (or does not reduce) the frequency of potentially toxic events. For heavy metals analyses, it is recommended that hardness be collected for all storms monitored and that comparisons to criteria be made utilizing the dissolved fraction with the computed aquatic criteria as modified by EPA (1993b).

Watershed and BMP Design Parameters. Table 3 presents a summary of these parameters. These parameters (more detailed parameter lists are available on ASCE's Web page at http://www.asce.org/peta/tech/ nsbd01.html) have been selected with the purpose of being able to utilize this information to evaluate what BMP design attributes and tributary watershed characteristics can be linked to BMP effectiveness information.

The primary goals of the ASCE/EPA database development process were to facilitate efficient data entry, provide useful queries of stored data, and output information in a comprehensive and applicable manner through a user-friendly interface. The database was written in Microsoft® Access incorporating Access relational database engine and features and the Visual Basic® for Applications programming language for customization of the functional aspects of the front end. Distribution will take place initially as an Access run-time version on CD-ROM, but will be available in the near future over the Internet.

Table 3. Parameters to Report with Water Quality Data for Various BMPs

Parameter Type	Parameter	Retention (Wet) Pond	Extended Detention (Dry) Basin	Wetland Pond Basin	Grass Swale/ Wetland Channel	Sand/Leaf Compost Filter	Oil & Sand Trap/ Hydro-dynamic Device	Infiltration and Perc..
Tributary Watershed	Tributary watershed area, average slope, average runoff coefficient, length, soil types, vegetation types	•	•	•	•	•	•	•
	Total tributary watershed impervious percentage and percent hydraulically connected	•	•	•	•	•	•	•
	Details about gutter, swer, swale, ditches, parking, roads in watershed	•	•	•	•	•	•	•
	Land use types (res., comm., ind., open) and acreage	•	•	•	•	•	•	•
General Hydrology	Date and start/stop times for monitored storms	•	•	•	•	•	•	•
	Runoff volumes for monitored storms	•	•	•	•	•	•	•
	Peak 1-hr intensity	•	•	•	•	•	•	•
	Design storm/flood recurrence intervals and magnitude	•	•	•	•	•	•	•
	Peak flow rate, depth, and Manning's roughness coefficient for the 2-year storm				•			
	Depth to seasonal high groundwater/impermeable layer		•		•			•
	Saturated hydraulic conductivity, infiltration rate, soil group				•			•
	Average annual values for number of storms, precipitation, snowfall, min./max. Temp., from appropriate weather station	•	•	•	•	•	•	•
Water	Alkalinity, hardness and pH for each monitored storm	•	•	•	•	•	•	•
	Water temperature	•	•	•	•	•	•	•
	Sediment settling velocity distribution, when available	•	•	•	•	•	•	•
	Facility on- or off-line?	•	•	•	•	•	•	•
	Bypassed flows during events	•	•	•	•	•	•	•

General Facility	Type and frequency of maintenance	•	•	•	•	•	•	•
	Types and location of monitoring instruments	•	•	•	•	•	•	•
	Inlet and outlet dimensions, details, and number	•	•	•	•	•	•	•
	Media or granular material depth, type, storage volume, and porosity					•		•
Wet Pool	Volume of permanent pool	•		•		•	•	
	Length of permanent pool	•		•		•	•	
	Permanent pool surface area	•		•		•	•	
	Littoral zone surface area	•						
	Solar radiation, days of sunshine, wind speed, pan evaporation, from appropriate weather station	•	•	•	•			•
Detention Volume	Detention (or surcharge) and flood control volumes	•	•	•		•	•	•
	Detention basin's surface area and length	•	•	•		•	•	•
	Brimful and half-brimful emptying time	•	•	•		•	•	•
	Bottom stage/infiltrating surface area and type			•	•			•
Pretreatment Plant	Forebay volume, surface area	•	•	•		•	•	•
	Relationship to other BMP's upstream	•	•	•	•	•	•	•
Wetland Plant	Wetland/swale type, surface area, and length, side slope lbottom width for swales and channels)			•	•			
	Percent of wetland surface between 0-12", 12-24", and 24-48"			•	•			
	Plant species and age of facility	•	•	•	•			

Estimation of BMP Pollutant Removal Effectiveness and Effectiveness

BMP pollutant removal effectiveness estimations are not straightforward and a wide variety of methods have been employed. Martin and Smoot (1986) discussed three types of methods to compute efficiencies, including an efficiency ratio, sum of loads, and regression of loads. Many researchers have utilized an efficiency measure based upon storm pollutant loads into and out of the BMP on a storm-by-storm basis. This weights the effectiveness considering that all storms are "equal" in computing the average removal. However, it is readily apparent that all storm volumes and their associated concentrations are not equal.

One factor that complicates the estimation of the effectiveness is that for wet ponds and wetlands, (and other BMPs where there is a permanent pool), comparing effectiveness on a storm-by-storm basis neglects the fact that the outflow for a particular event being measured may have little or no relationship to the inflow for that same event. Based upon a national characterization of rainfall (Driscoll, et. al., 1989), if a basin were sized to have a permanent pool equal to the average storm, about 60 to 70% of the storms would be less than this volume. Therefore, in many cases, flows leaving may have little or no relationship to flows entering the pond. Storm-to-storm comparisons are probably not valid. It is probably more appropriate to utilize statistical characterizations of the inflow and outflow concentrations to evaluate effectiveness or, if enough samples are collected (i.e., almost all storms monitored), to utilize total loads into and out of the BMP.

Table 4 compares three of the methods, including percent removal by storm with a statistical characterization of inflow/outflow concentration and a simple comparison of total loads in and out for the sampled storms for an example site. The removals estimated differ by up to 18 percentage points. In this record, there are several storm events where inflow concentrations were relatively low and therefore the system was not "efficient." However, it was effective at maintaining the effluent quality.

Table 4. Comparison of BMP Pollutant Removal Efficiency Techniques

Storm	Volume of Flow (ft^3) Inflow = Outflow	Concentration (mg/l) In	Concentration (mg/l) Out	Load (lbs) In	Load (lbs) Out		% Removal by storm
1	445,300	352	24	9780	670		93%
2	649,800	30	25	1220	1010		17%
3	456,100	99	83	2820	2360		16%
4	348,111	433	141	9410	3060		67%
5	730,261	115	63	5240	2870		45%
	Med	139	65			A	
	Cov	1.48	.86	28,470	9,970	V	48%
	Mean	249	85			G	
		Conc 66%		Loads 65%			

note: 1 lb_m = 2.2046 kg and 1 ft^3 = 0.028317 m^3

Based on these factors, it is recommended that a statistical characterization of inflows vs. outflows be utilized. Use of the log-transform of EMCs is recommended. Tests of the applicability of a log transform should be made to support the transform of data when sufficient data is available. Standard descriptive statistics, box-and-whisker plots, and normal probability plots of the transformed data for both the inflow and outflow should be employed to clearly demonstrate not only the differences in the mean EMCs, but also the effectiveness of the BMP throughout the range of influent and effluent EMCs. This approach provides the ability to determine whether any apparent differences in inflow and outflow EMC populations are statistically greater than zero. If enough data on storms is collected, (e.g., continuous samples over an extended period including base flow measurements where significant), the total loads in and out may also be an acceptable method. A graphical look at the distribution of contributing storms will often provide insight into the applicability of the method, (e.g., do a small number of large storms dominate the resulting effectiveness value).

The variability in runoff concentrations from event to event is large. In attempting to statistically characterize a BMP influent concentration (and outflow), the more data the better. As mentioned above, there are a number of types of BMP evaluations that can be conducted: (1) standard evaluation of a single BMP, testing input and output, (2) evaluation of multiple BMPs within a basin (before/after or control basin), and (3) evaluation of a BMP with multiple inlets (where it might be very difficult and expensive to evaluate the BMP utilizing input/output). All methods should require that a rigorous statistical approach be applied in selecting the number of samples to be collected to help assure detection of a given level of change.

As an example of the number of samples required to detect a "true" difference, Table 5 presents an analysis of two of the Portland monitoring stations (WCC, 1993) where 10 flow-weighted composite samples were collected. The Fanno Creek station is a large (about 1,200 acres) residential catchment that is in an open channel, while the M1 station is a smaller (about 100 acres) mixed land use station that is in a pipe. An analysis of a variance-based test was utilized with the existing data to determine how many samples are estimated to be needed to detect a 5%, 20%, and 50% change in the mean concentration at the station. The test was performed considering an 80% probability that the difference will be found to be significant, with a 5% level of significance (Sokal and Rohlf, 1969). This analysis does not consider potential seasonal effects on the collection of data as a factor. Even so, quite a large number of samples would be required to detect a 5% to 20% difference in concentrations. In many locations, given that there may be only 10 to 20 storm events per year that are large enough to monitor, it would take a number of years of sampling all storm events to be able to detect small differences.

Table 5. Analysis of Sample Sizes Needed to Statistically Detect Changes in Mean Pollutant Concentrations from 2 Stations in Portland, Oregon

		Number of Samples Required to Detect the Indicated % Reduction in Site Mean Concentration*		
Monitoring Site	Parameter	5%	20%	50%
R1 - Fanno Creek	TSS	202	14	4
Residential	Copper	442	29	6
	Phosphorus	224	16	4
M1 - NE 122nd	TSS	61	5	2
Columbia	Copper	226	15	4
Slough Mixed Use	Phosphorus	105	8	3

*80% certain of detecting the indicated % reduction in mean of the EMCs.

There are numerous examples in the literature where small differences (2 to 5%) have been reported based upon fewer samples than indicated by this analysis. This highlights the need to be more rigorous with regard to statistical testing of reported effectiveness estimates. To detect larger changes, the number of samples becomes reasonable. The mixed land use catchment in Portland is currently being studied for the effectiveness of the implementation of a number of source controls and other controls that do not lend themselves to input/output testing. Examples include maintenance changes (catch basin cleaning, street sweeping); education (business and residences); tree planting, and others. Post-BMP monitoring will be conducted along with qualitative evaluations.

Another approach that this study will be evaluating is the use of effluent data to compare to design criteria. It has been suggested by some researchers that BMPs may be able to treat only to a given concentration and therefore, if relatively clean water is entering a BMP, performance based upon efficiency may not fully characterize whether a BMP is well-designed. An example of this is based upon Rushton et al. (1997). The pond was located at the Southwest Florida Water Management District service office in Tampa. The drainage basin is 6.5 acres with about 30% of the watershed covered by roof tops and asphalt parking lots, 6% by a crushed limestone storage compound and the remaining 64% as a grassed storage area. The pond was modified twice after initial construction; therefore, there are three periods of performance data for three different designs. The first pond had an average retention time of 2 days, the second 5 days and the third 15 days. The second design added wetland features, while the third utilized deeper and larger pools.

Figure 1 shows the input and output median concentrations in log based 10 scale as well as the 95% confidence limits. The study reported that performance of the pond (defined as removal efficiency) decreased after the first modification. What appears to be evident is that the average inflow concentrations were much lower during the second period, while the outflow concentrations were about equal (less, but not statistically different from the first design). It appears that with the original and first modified designs that the effluent level was not decreased. However, one could not say that the BMP was any poorer in efficiency. The last design appears to have lowered the potential effluent concentration, but the major difference in efficiency came from the significantly higher inflow concentrations during the sampling period. This example points out the need to carefully think about whether pollutant removal efficiency is an accurate representation of how well a BMP works or does not.

In many cases, there is a need to conduct dry weather analyses between storms on BMPs with dry weather flows. It may be that pollutants captured during storms are slowly released during dry weather discharges.

Biological and downstream physical habitat assessments such as aquatic invertebrate sampling and habitat classification should be explored as an alternative to just utilizing chemical measures of effectiveness (Maxted, 1999). Long-term trends in receiving water quality, coupled with biological assessments, would likely be a much better gage of the success of the implementation of BMPs, especially on an area-wide basis.

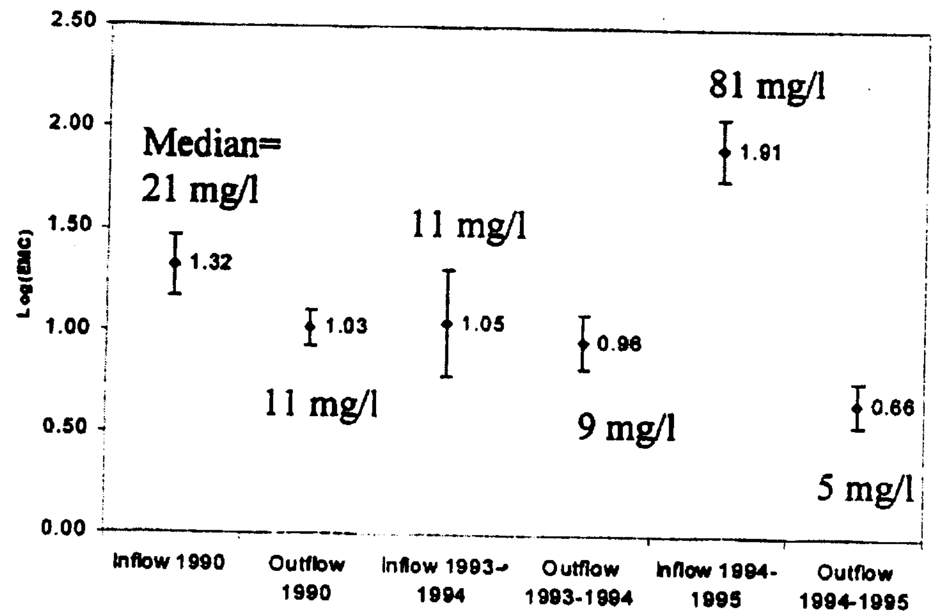

Figure 1. Inflow and Outflow Log Mean TSS Concentrations (mg/l) and 95% Confidence Limits for Different Designs of a Wet Pond Located at SWFWMD Service Office in Tampa, Florida.

Summary and Recommendations

There is a great need to have consistency with the constituents and methods utilized for assessing BMP effectiveness. This paper has presented only some of the consistency issues. It is recommended that researchers who undertake BMP effectiveness studies consider the recommendations suggested here, by Urbonas (1995) and other recommendations based upon further analysis of this subject. It is the authors' opinion that EPA should require studies receiving federal funding to conduct BMP effectiveness studies that utilize standard methods as suggested here, together with much still-needed detailed guidance on data collection and sampling methods to improve data transferability.

Acknowledgments

The authors wish to thank Gene Driscoll, Jonathan Jones, Bob Pitt, Bill Snodgrass, and Larry Roesner for their helpful discussions and comments on the subject. Jonathon Jones, Jane Clary, and John O'Brien from Wright Water Engineers developed the Database Structure and Platform as members of the ASCE project team. The Urban Water Resources Research Council has provided very beneficial support and feedback. Finally, the assistance by EPA in funding this cooperative agreement is acknowledged as well as the helpful participation of Eric Strassler and Jesse Pritts in reviewing our work.

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Texas Nonpoint SourceBOOK Is Now On-Line!
http://www.txnpsbook.org

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Summary

The *Texas Nonpoint SourceBOOK* is an Internet-based resource that has been developed to assist public works officials across Texas with storm water management. The *SourceBOOK* provides basic information about storm water quantity and quality impacts, outlines how to develop and implement a local storm water management program, identifies localized water quality issues, and provides an interactive database of more than 100 Best Management Practices (BMP's) to use in a variety of situations.

The *Texas Nonpoint SourceBOOK* provides information for the novice as well as the experienced storm water manager. The project was funded by the Environmental Protection Agency and matching funds from 20 local governments across Texas. The North Central Texas Council of Governments (NCTCOG) served as project administrator. The *SourceBOOK* was developed by a consulting team lead by Camp Dresser & McKee Inc. (CDM). A Project Management Committee of local governments provided project oversight. After extensive review via the Internet, the *SourceBOOK* was officially endorsed by the Executive Committee of the Texas Chapter – American Public Works Association (APWA). Five training workshops were conducted across the state. The *SourceBOOK* is intended to be a living resource, with additions and changes occurring continually in response to input from users. A feedback page allows direct input from the Internet.

Why a *Texas Nonpoint SourceBOOK*?

Recognizing the need for improved communication, cooperation, and education statewide on stormwater issues, a *Statewide Storm Water Quality Task Force* was established by the Executive Committee of the Texas Chapter - American Public Works Association. At an organizational meeting in February 1994, a Steering Committee and subcommittees were formed. The various subcommittees immediately tackled the task of identifying current issues and needs regarding storm water quality and nonpoint source pollution, particularly with respect to the needs of public works officials across Texas.

Already known was that nonpoint sources, including stormwater, contribute to water pollution problems. The Water Quality Subcommittee began to review data from the Texas Clean Rivers Program, available nonpoint source monitoring data, and the State's Nonpoint Source Water Pollution Assessment Report. They presented this assessment at subsequent meetings of the Task Force. Water quality problems were known, but not how best to address them.

What was not known was the applicability and cost-effectiveness of Best Management Practices (BMPs) for addressing many of the typical water quality pollutants: bacteria, pesticides, nutrients, metals, toxic chemicals, and others. The Best Management Practices (BMP) Subcommittee surveyed local governments across Texas on BMP implementation but found little technical data. It was evident that until questions such as applicability and cost-effectiveness could be answered, local governments would not invest limited public funds on storm water controls.

A project was formulated that would provide the assistance local governments needed by developing an internet-based resource of storm water management information. At the time it was a striking idea, since the Internet was very new and few local governments had any "on line" experience. Using the emerging Internet would provide ready electronic access and would allow for the use of new technologies in communication. This resource was to be called the *Texas Nonpoint SourceBOOK*, and would be developed in both "hardcover" and electronic form. A grant application, submitted to the Texas Natural Resource Conservation Commission under the Section 319(h) Nonpoint Source Program, was awarded in the spring of 1996. Work on the project began in September, 1996.

How Was the *Texas Nonpoint SourceBOOK* Developed?

The North Central Texas Council of Governments provided staff support and general administrative oversight. To guide the development of the *SourceBOOK*, a Project Management Committee was established from the Texas Chapter-APWA membership. Among its first tasks was issuing a Request for Proposals for professional consultant assistance, and selecting the consultant finalists. From the finalists the Committee selected a consultant team led by the firm Camp Dresser & McKee Inc., in association with Espey Huston & Associates, Inc.; Center for Watershed Protection; Booth, Ahrens & Werkenthin, P.C.; Carter Burgess; and Pavlik & Associates. Together, the committee and consultants used the State's Nonpoint Source Water Assessment Report and supporting information to identify particular pollutants from priority watersheds and related pollution prevention BMPs.

During FY97, the Project Management Committee worked with the consultant to establish the format of the *Texas Nonpoint SourceBOOK* on the Internet. Presentations on local BMP experiences were made at the TX-APWA Short Course at Texas A&M in February, 1997. Initial consultant materials were reviewed by the TX-APWA general membership at its summer, 1997, Annual Meeting. A draft of the *Texas Nonpoint SourceBOOK* was presented to the TX-APWA general membership at the February 1998 Short Course, and local government comments were solicited.

The TX-APWA Executive Committee endorsed the *Texas Nonpoint SourceBOOK* in February, 1999. It is available through the Internet and on CD-ROM for use by local governments across Texas. The Committee and consultant conducted technology transfer and training workshops on storm water management and the *Texas Nonpoint SourceBOOK* at five regional one-day workshops across Texas during February and March of 1999.

How is the *Texas Nonpoint SourceBOOK* Organized?

The *SourceBOOK* is designed to make use of the capabilities of the Internet. This includes the ability to organize and present textual and graphical information through common browser formats, as well as providing active links to related sites. The design of the content of the *SourceBOOK* maximized the use of existing web sources wherever possible.

The content of the *SourceBOOK* consists of a set of modules:

Introduction and Overview

- About This Site
- Frequently Asked Questions (FAQs)
- Related Links
- Nonpoint Source News

- Post Your Feedback

Module 1 -- Nonpoint Source Management 101

- History of Nonpoint Source Management
- Urban Nonpoint Source Primer
- Controlling Urban Runoff--Guidance for Beginners
- Selecting the Right BMP -- Guidance for Beginners
- Planning Your Stormwater Management Program - Guidance for Beginners
- Glossary

Module 2 -- Urban Runoff Management Programs

- Introduction
- The Planning and Goal Setting Process
- Planning and Program Approaches
- Funding Mechanisms
- Measuring Effectiveness of Management Programs
- Implementation Strategies
- Case Studies
- Bibliography
- Additional Resources

Module 3 -- Characterizing Urban Waterways

- Urban Runoff Flow and Water Quality
- Assessing Urban Waterways
- Water Quality and Other Watershed Physical Characteristics in Texas

Module 4 -- Runoff Quality Best Management Practices

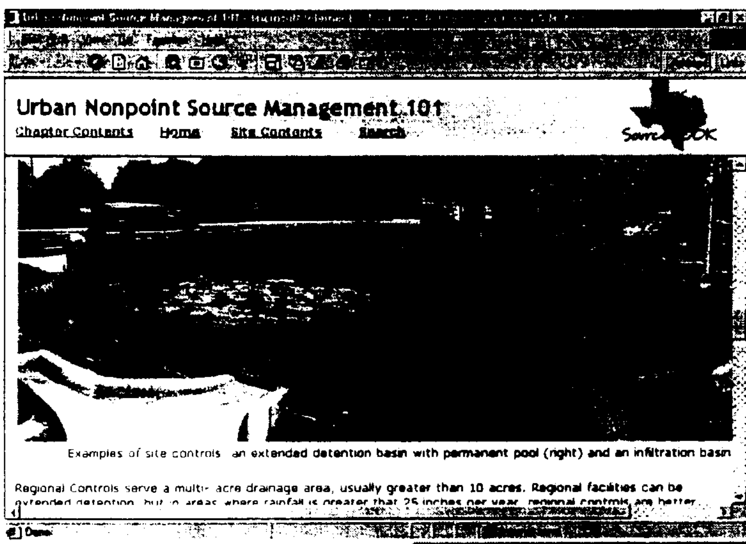
- Selecting Management Practices
- Housekeeping Practices
- Source Control Practices
- Treatment Control Practices
- Interactive BMP Selector

What Does Each Module Provide in the *Texas Nonpoint SourceBOOK*?

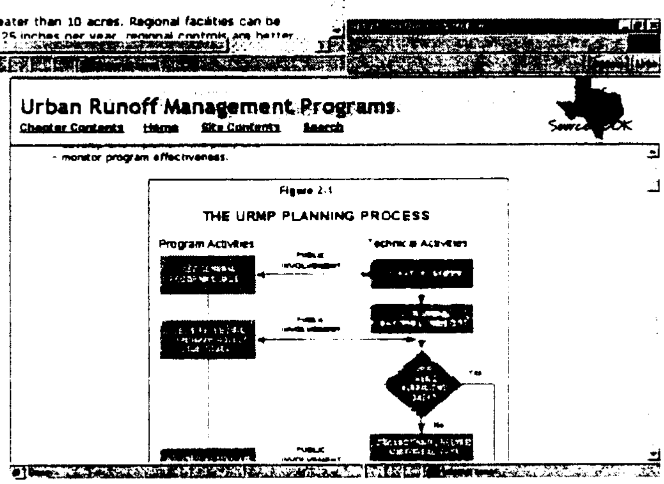
Module 1, "Nonpoint Source Management 101," is a primer for beginners on urban stormwater management. It quickly establishes that storm water quality <u>and</u> quantity management need to be addressed as one integrated program within a local government. It provides guidance on regulatory issues, basic axioms of runoff control, and the use of pollution prevention, source and treatment controls.

Module 2, "Urban Runoff Management Programs," describes the process to be used to manage urban runoff within the overall framework of the city, county, or special district. Particular attention is placed on the key institutional and financial components necessary for a successful ongoing program.

Module 3, "Characterizing Urban Waterways," begins with a generic discussion of urban runoff flow and water quality relationships. Considerable attention is then given to proper techniques for monitoring urban waterways and stormwater runoff. The majority of the module focuses on Texas-specific information. Descriptions of known water quality problems can be accessed for the entire state. Each regional planning area and basin has specific information on water bodies,



Module 1



Module 2

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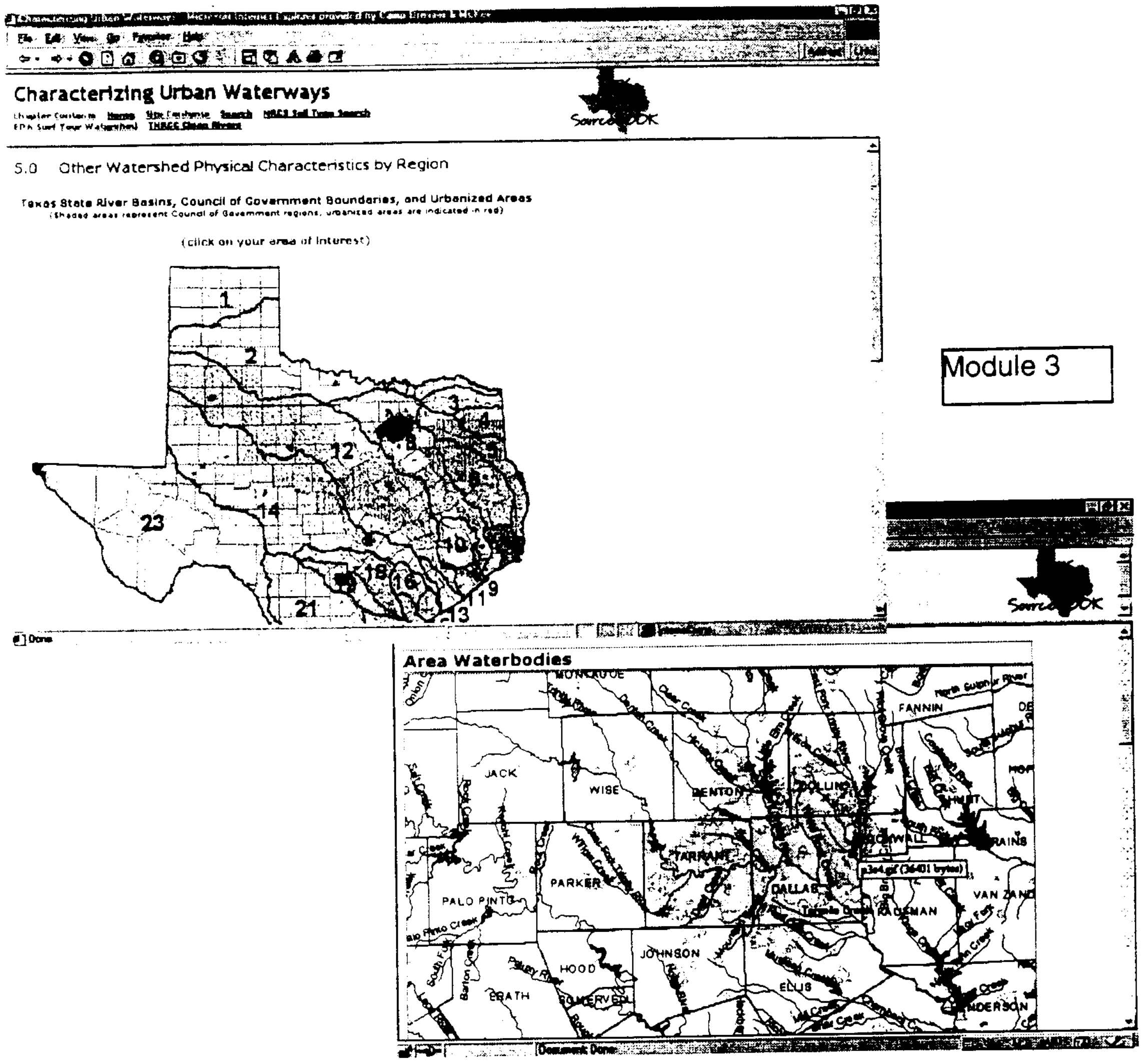
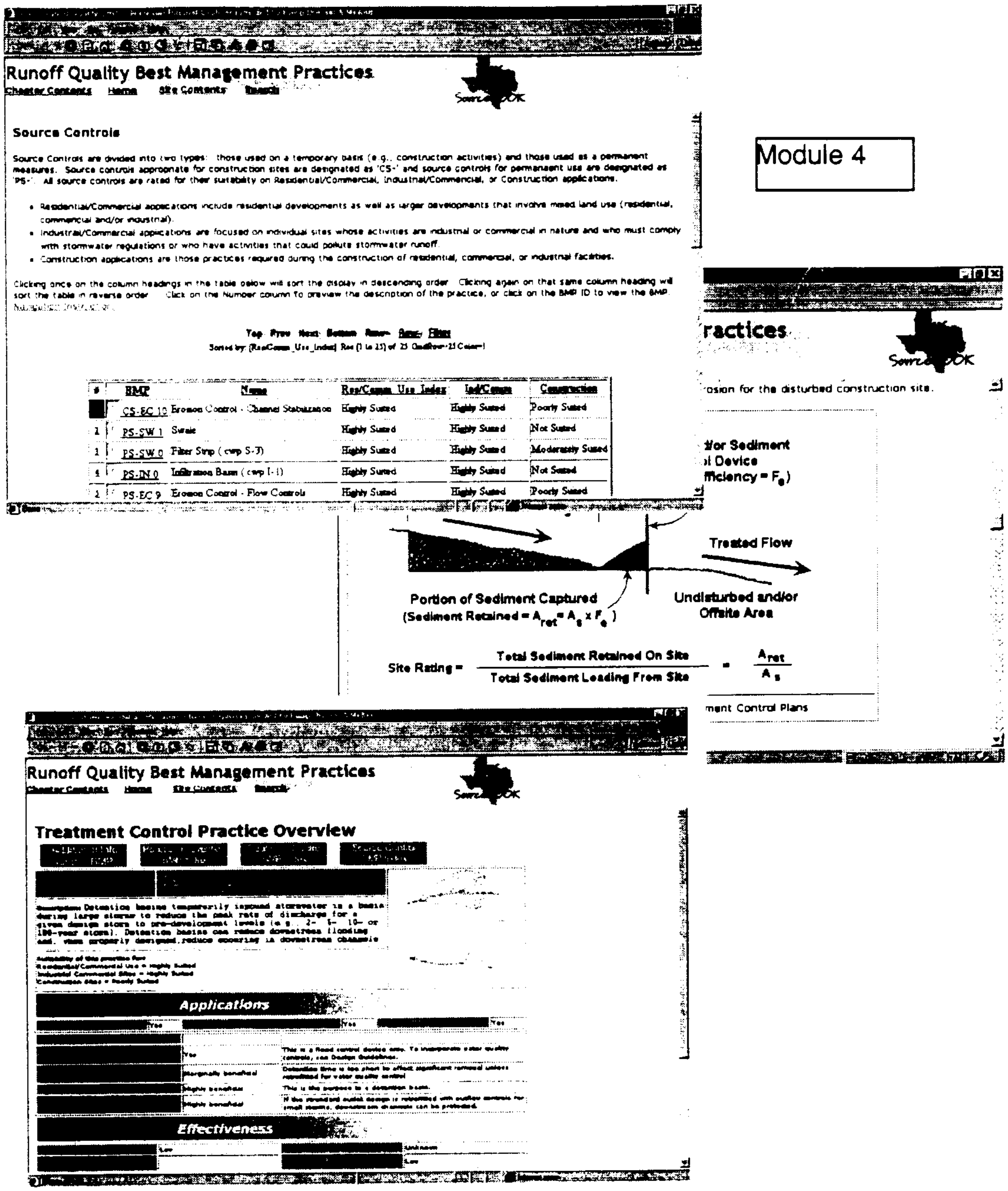


watershed characteristics, annual precipitation and runoff, major soil types, and the like. There are many "hot" links to real-time gauging stations, local programs, and state/federal sites, such as EPA's *Surf Your Watershed*.

Module 4, "Runoff Quality Best Management Practices," provides guidance on the selection of Best Management Practices for pollution prevention, source control, and treatment control. Considerable effort was placed on gathering the most current information on more than 100 BMPs and review by the Project Management Committee of local governments. Each BMP includes detailed information, such as performance data, photographs, and relevant reference citations. An innovative BMP Interactive Selector was developed for the *SourceBOOK*. It enables the user to peruse BMP's in each category, or to input several characteristics specific to their situation and request a set of the most applicable BMPs.

Module 4



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A Comparison of the Long-Term Hydrological Impacts of Urban Renewal versus Urban Sprawl

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Abstract

Recent concern over environmental and economic impacts of urban sprawl has focused renewed attention on the importance of making full use of existing urban areas. Revitalizing former industrial, commercial, and residential areas often involves changes in land use type or intensity of use. It is important to have the ability to evaluate the long-term hydrological impacts of such changes. These impacts can then be placed within the context of impacts that similar land uses would have if a decision were made to place them in the urban fringe (urban sprawl) rather than in existing urban areas (urban renewal).

In this study, we illustrate how the Long-Term Hydrological Impact Analysis (L-THIA) tool can be used to compare the hydrological impacts of land use change in existing urban areas versus change in the urban fringe. L-THIA is a simple, comparative tool that requires the user to provide information on land use and soil type for existing and future/planned conditions. The tool combines this information with local rainfall data to calculate long-term average annual surface runoff under existing and future/planned conditions. L-THIA analyses can be run directly at our web site for locations throughout the U.S. where the curve number technique is already routinely used (http://danpatch.ecn.purdue.edu/~sprawl/L-THIA). By performing analyses of renewal versus conversion of agricultural land at the urban fringe, it is possible to provide a comparative assessment of impacts. This initial comparison can be helpful in educating the general public and decision-makers, thereby raising awareness of this element of the set of variables that are considered in land use decisions.

Introduction

Because almost every major North American city had been founded by 1900, the dominant form of urban development during the 20th Century has been growth on the outer edges of existing cities, or just beyond city limits (Orum, 1995). With improvements in transportation and communications, the need for people to be clustered in high-density central areas has decreased (Chinitz, 1991), encouraging decentralization, suburbanization, and sprawl. In the United States, 87% of the population now lives in metropolitan areas and their hinterlands (Angotti, 1995), and steady infilling between urban areas has resulted in the development of megalopolises such as the Philadelphia - Boston - Washington DC - New York urban corridor. Even metropolitan areas which are stagnating or declining in terms of total population are still growing in terms of total built area because of low-density suburban growth (Johnston, 1982).

Decentralization and suburbanization have changed the relative importance of the core areas of cities (Richardson, 1982). Although these central areas were the sites of initial city growth and development, many cities are now faced with the challenge of revitalizing these once vibrant central industrial, commercial, and residential areas that have been in decline in recent decades:. The following quote reflects efforts to slow the tide of migration from urban centers.

"To combat the number of people fleeing [Chicago] for the suburbs, developers have lured middle-class home buyers back with promises of safe neighborhoods and affordable homes. Chicago also leads the nation in converting office and warehouse property into residential space such as condominiums and rental units, often targeted to low- and moderate-income buyers." (Heavens, 1999)

At the same time that city administrations have been coping with the challenges of urban core renewal, suburban and rural communities have become increasingly concerned about the environmental, economic, social, and aesthetic impacts of continued urban growth at the fringes of developed areas (these later concerns are often grouped under the term urban sprawl). Preservation of prime farmland and protection of rural areas have become important concerns, alongside a growing emphasis on combating the impacts of continued sprawl on flooding, groundwater recharge, air pollution, climate, ecology, and habitat fragmentation (Schueler, 1994). Although there is considerable interests in revitalizing urban cores, especially if this reduces urban sprawl, to accomplish this requires that the decision-making process for urban and suburban planning include consideration of the environmental as well as the economic aspects of land use.

Land use decisions are highly complex, involving consideration of economics, infrastructure, politics, labor and population dynamics, and the environment. The planning process requires collection and comparison of a wide array of data, usually with the goal of providing a planned solution that meets goals based on sustainable growth in industry and commerce. However, increasing public and political concern over the environmental aspects of urban development has raised the profile of efforts to develop efficient and environmentally sustainable urban environments. The key components of environmentally sound urban development include land use patterns that minimize environmental impacts (Arendt, 1996), efficient automobile and pedestrian traffic, and the use of energy saving and environmentally sound building designs. When attempting to balance economic and environmental concerns, it is important to quantify the differential environmental impacts of alternate land-use scenarios. Objective measures of differential impacts provide a rational basis for decision-making. In addition, they can be used to educate the public and key decision-makers in government and the private sector about the level of environmental benefit that can be gained from alternative land-use decisions.

The aim of the work presented here is to demonstrate the application of an impact assessment tool in evaluating the long-term hydrologic impact of development consistent with urban renewal versus the impact of an identical development located at the urban fringe. Although the general outcome of such a comparison is unlikely to surprise anyone, the advantage of quantifying differential impacts is in providing an objective numeric measure that is much easier to include in decision-making than vague subjective assessments of environmental benefits.

Long-Term Hydrologic Impact Assessment (L-THIA)

In response to concerns from local planners that they had no simple, objective way to assess the impacts of alternate development plans on surface water runoff and groundwater recharge, a Long-Term Hydrologic Impact Assessment tool (L-THIA) has been developed (Harbor, 1994; McClintock et al., 1995; Ogden, 1996; Grove, 1997; Bhaduri et al., 1997; Bhaduri, 1998; Minner, 1998; Minner et al. 1998; Lim et al., 1999; Leitch and Harbor, in press). L-THIA uses readily available data on soils, climate, and land use to estimate long-term surface water runoff. By running the model for current conditions, and then with changed land uses, the user can simulate the potential impact of land use change. The method, initially developed as a simple spreadsheet application (Harbor, 1994), is based on the U.S. Department of Agriculture's curve number (CN) method for relating precipitation and runoff as a function of land use and soil type (USDA, 1983, 1986). The CN method was selected because it forms the basis of other commonly used hydrologic models, thus the data required for its use is readily available in most planning settings. Because of the reliance on the CN method, L-THIA applies directly to those areas where the CN method is routinely used. Subsequent development of the L-THIA method has included provision of a Geographic Information System (GIS) version (Grove, 1997), addition of nonpoint source pollution loadings to land uses (Bhaduri, 1998), and development of an Internet-accessible version of the method (Lim et al., 1999).

In the curve number technique, the land use and hydrologic soil type of an area are used to derive a CN value (values typically range from 30 to 98). For any given daily precipitation, surface runoff is then computed from empirically based relationships between rainfall, CN, and runoff. Although most commonly used to estimate runoff for extreme storm events, in L-THIA the CN technique is used to determine daily runoff for a 30-year time series of daily precipitation values.

Average annual runoff is calculated for each CN to provide a measure of long-term average impact, rather than simply impact on isolated extreme storm events. To compare different land use change options, pre-development and post-development average annual runoff can be calculated for each scenario. The L-THIA method is freely available at http://danpatch.ecn.purdue.edu/~sprawl/LTHIA. This site includes information on the technique and its application, as well as access to US climate and soils data necessary to run analyses. Users can submit land use and soil information through a spreadsheet-style interface (Figure 1). Analyses are performed on a server at Purdue University and results are delivered back to the user in the form of tables and graphs.

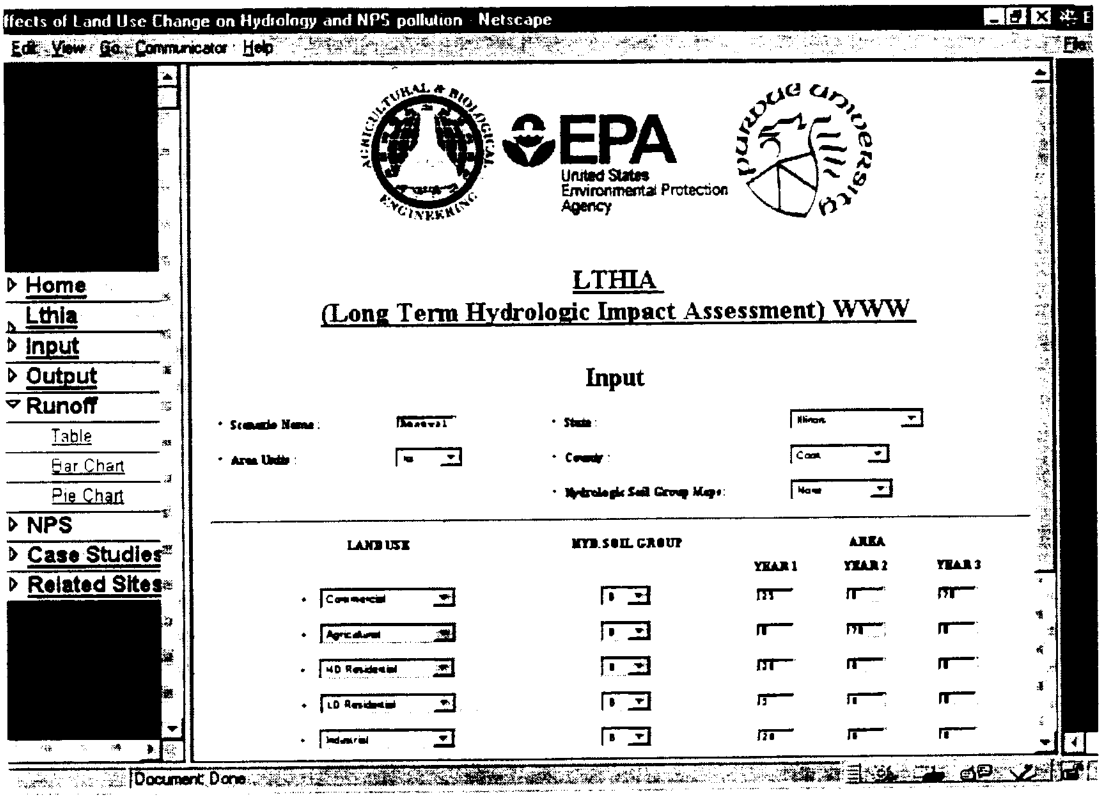

Figure 1. L-THIA WWW Input Screen at http://danpatch.ecn.purdue.edu/~sprawl/LTHIA.

A Comparison of Core Renewal versus Fringe Development

Study Scenario

The L-THIA tool can be used to examine the relative impact of land use change in the form of an urban renewal project; replacing underused or abandoned commercial, residential, and industrial buildings in an urban core region; versus an urban sprawl project; replacing agricultural land at the edge of a city. For the sake of illustration, consider planning a 70 Ha major commercial development with urban core and urban fringe location alternatives. Although the location decision-making process will be driven by economic and infrastructure concerns, also assume that differential environmental impact is important in decision-making, perhaps as a result of political or regulatory pressure. In the context of improving urban environments then, an important question is the extent to which placing this development in an urban core region would have different hydrologic impacts than placing it at the city fringe.

To simulate this situation, consider two possible sites in the Chicago area. The first is in the urban core, and currently consists of a mix of residential, industrial, and commercial properties that are unused or underused (Figure 1). The second possible site is on the urban fringe, and currently is used for agriculture. For simplicity we assume that both sites are on the same type of soil (from a hydrologic perspective), although in a real world example this might not be the case. In each case, we use the L-THIA web tool to analyze how average annual runoff will change if the site is converted to solely commercial use (Figure 1). In the L-THIA input and output, the urban core site is labeled "YEAR 1", the urban fringe agricultural site is labeled "YEAR 2" and the commercial land use for both sites is labeled "YEAR 3." The L-THIA web tool uses the "YEAR" designation for different scenarios because analyses are typically for land use changes over time.

Results

For the example described here, placing a commercial development in an urban core region, replacing an existing mix of urban land uses, increases average annual runoff by 58% compared to the initial situation (Table 1 and; Figure 2). Note that the levels of impact given in Table 1 do not depend on the size of the commercial development; the same percent increase applies regardless of area. Runoff increases because land uses with less impervious cover, such as residential, are replaced by commercial land use that has a higher percentage of impervious area. In contrast, for the urban fringe location, replacing agriculture with commercial use increases runoff by 670% (Table 1 and Figure 2), a ten-times greater impact. Runoff increases so dramatically because agricultural use on relatively permeable soil is replaced by very extensive impervious surfaces.

Table 1. Average annual runoff depths and change for commercial development (post-development) in the urban core versus the urban fringe. Results are for the specific example described in the text.

	Pre Development Average Annual Runoff (mm)	Post Development Average Annual Runoff (mm)	Increase in Runoff (%)
Urban Core	81.8	129.3	58
Urban Fringe	16.8	129.3	670

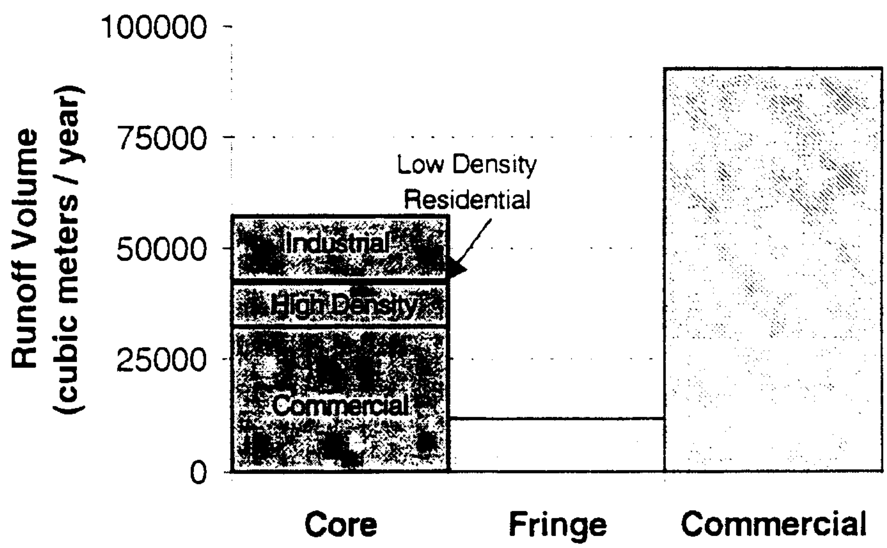

Figure 2. Average annual runoff volumes for commercial development, the urban core mixed-use, and the urban fringe agricultural use. The much larger difference between the fringe location runoff volume and the commercial case indicates that fringe development will have the largest hydologic impact. Note that the runoff volume is simple the average annual runoff depth (Table 1) multiplied by the site area. Results are for the specific example described in the text.

Discussion and Conclusions

The straightforward example presented here indicates that developing a commercial site in an urban core versus and urban fringe location can have a very significant impact on the level of disturbance of the hydrologic regime. For the Chicago example presented here, the urban fringe location produces an approximately ten times larger impact than the urban core location. Clearly, from a solely hydrological standpoint, the urban core location is a better choice than the fringe location. Although this is a hypothetical example, it illustrates the relative ease of use of the L-THIA tool, and more importantly demonstrates an accessible way to provide a quantitative estimate of the relative impacts of different land use decisions. More complex land use mixes and soil types can be run on the L-THIA web tool, either in the spreadsheet version or in a GIS version also available at the web site. Thus, more sophisticated comparative analyses can be performed.

In most cases, an L-THIA analysis provides a result that shows that renewal of existing areas has less hydrologic impact than development of an area with rural use. This is not a surprise, rather the value of the tool is that it provides a context for understanding and considering the magnitude of this difference in the decision-making process. For areas where problems such as groundwater supply and downstream flooding are important, the scale and magnitude of the hydrologic impact can be of considerable importance and can be considered alongside other concerns, such as infrastructure and economic viability. We suggest use of tools such as L-THIA as part of the planning process, to ensure that land use decisions are made after consideration of a full range of concerns, including environmental parameters as well as economic, infrastructure, and political issues.

Acknowledgements

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Comparative Nutrient Export And Economic Benefits of Conventional And Better Site Design Techniques

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Better site design describes a fundamentally different approach to the design of residential and commercial development projects. It seeks to accomplish three goals at every development site: to reduce the amount of impervious cover, to increase the amount of natural land set aside for conservation, and to use pervious areas for more effective stormwater treatment.

When designing new residential developments, planners have the opportunity to reduce stormwater runoff and pollutant export through better site design techniques. The better site design techniques applied to these developments are referred to here as "open space design," and present an alternative to conventional residential subdivisions. Also known as cluster development, open space design concentrates density on one portion of a site in order to conserve open space elsewhere by relaxing lot sizes, setbacks, frontages and road section and other lot geometry. Open space design also consists of:

- installing narrower streets and shorter driveways
- spreading stormwater runoff over pervious areas
- using open channels rather than curb and gutter
- clustering development to conserve forests and natural areas
- reducing the area devoted to turf
- protecting stream buffers
- enhancing the quality of septic system effluent in areas where sewage is disposed of on-site

When these techniques are applied together, the cumulative benefits of better site design can be impressive. Documenting the precise benefits is difficult, however, since few developments incorporating better site design techniques have been built, let alone monitored.

As most better site design techniques are non-structural in nature, the achievable benefits will vary depending on the unique characteristics of each development site and the actual site planning practices applied. Also, since better site design techniques are commonly applied together, it has been difficult to accurately quantify their individual nutrient removal benefits. Many local governments, consultants, and developers have expressed a strong desire for clear documentation of these presumed benefits.

To help meet this need, the Center for Watershed Protection (CWP) recently completed a study to document the comparative nutrient export and economic benefits of conventional and better site design techniques. The simple assessment methodology analyzed both the residential and commercial environment through four real-world development case studies in the Chesapeake Bay watershed. This paper presents the results of the residential component of that project, including the incorporation of open space design techniques into the redesign of two residential case studies; the resultant hydrologic, nutrient export, and economic benefits; and finally, the implications of our findings for the watershed manager.

Methodology

The basic method used in the *Nutrient Loading from Conventional and Innovative Site Development* project (Caraco, et al., 1998) conducted by CWP is a redesign analysis that compares conventional and better site design at actual project sites using a simplified model.

CWP first assembled plans of previously developed sites representative of typical development scenarios across the Chesapeake Bay, including a medium-density residential development from Virginia's Piedmont, a large-lot single family residential subdivision from Maryland's Eastern Shore, a retail strip mall from Frederick County, Maryland, and a commercial office park located outside of the District of Columbia in suburban Maryland. Each site was then "redesigned" using better site design techniques.

The Simplified Urban Nutrient Output Model (SUNOM) was then used to compare each conventionally designed site to the redesign. SUNOM is a spreadsheet model that computes the hydrologic budget, infrastructure cost and nutrient export from any site, using common site planning variables. The model provides watershed practitioners with a simple tool to compare the costs and benefits of better site design. It is not meant to be used as a method for determining actual stormwater runoff and nutrient loading from a development site. To obtain accurate numbers for this, a more detailed model should be used or on-site monitoring should be conducted.

Model input includes basic site planning variables that can be directly obtained or measured from a typical development submittal to a land use authority, including total drainage area, length of sidewalks, total impervious cover, linear feet of roads, lawn cover, utilities (length and type), forest cover, size, type, and length of stormwater conveyance, riparian forest cover, size and type of stormwater practices, soil type(s), and method of wastewater treatment. Default data are provided for many parameters and many of these assumptions can be changed based on site specific information.

SUNOM is governed by the principles of a simplified water balance. In addition to annual runoff and infiltration, SUNOM computes the annual nutrient load from each development site in pounds. In brief, the surface nutrient export from each site is estimated using the Simple Method (Schueler, 1987). This export is then adjusted to reflect the mean removal capability of stormwater BMPs where present (Schueler, 1997). The subsurface component of the model utilizes annual subsurface recharge rates (based on the site's prevailing hydrologic soil group) and monitored baseflow nutrient concentrations in the receiving water to estimate the annual subsurface nutrient export from urban areas. These values are then adjusted for the area of the site that cannot recharge (i.e., impervious cover) or are hindered from infiltrating by other conditions (e.g., compacted urban turf). The model also calculates the cost of development utilizing previously published or user-specified unit costs and predictive equations for infrastructure, stormwater management, landscaping, and septic systems.

For each case study, SUNOM was used to compare the annual hydrologic budget and annual nutrient export under five development scenarios: pre-developed conditions, conventional design without stormwater practices (uncontrolled), conventional design with stormwater practices (controlled), design incorporating better site design techniques without stormwater practices (uncontrolled), and design incorporating better site design techniques with stormwater practices (controlled). The cost of development associated with each design was also estimated.

Case Study #1: Duck Crossing, A Low Density Residential Subdivision

Duck Crossing, a large-lot residential development, is located in Wicomico County on Maryland's Eastern Shore. Prior to development, the parcel was representative of the typical terrain on Maryland's coastal plain, with very little gradient. The site contained tidal and non-tidal wetlands, natural forest, meadow, the 100-year floodplain, as well as three existing dwellings with on-site sewage disposal.

The large-lot subdivision of single family homes, constructed in the 1990's, (Figure 1) contains eight new residential lots, each of which are 3 to 5 acres in size with houses set far back from the street. The street is wide given the few homes that are served, ends in a large cul-de-sac, and is lined with a sidewalk. Each lot has an on-site private septic

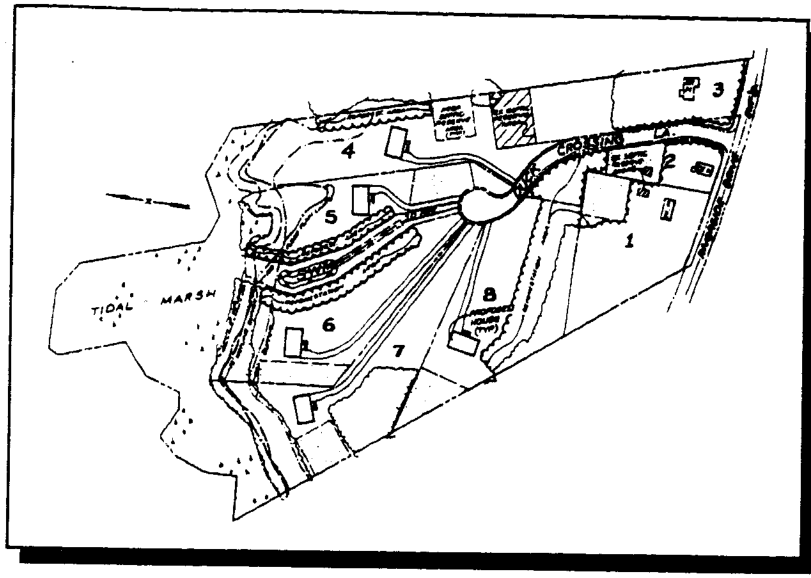

Figure 1. The conventional design of Duck Crossing, a low density residential subdivision on Maryland's Eastern Shore.

system, with a septic reserve field of about 10,000 square feet. Individual home property lines extend to the protected tidal marsh, which is the only common open space on the site. Stormwater management consists of street runoff conveyed by curb and gutter to a storm drain system that discharges to a small wet pond.

The major better site design techniques applied when redesigning this site (Figure 2) included:

- conservation of tidal and non-tidal wetlands and forested areas
- a 100-foot buffer along tidal and non-tidal wetlands
- clustering development to provide additional open space
- identification of potential development and open space areas based on location of sensitive areas, 100-year floodplain, and potential septic field areas
- distribution of stormwater treatment practices throughout the site
- use of a narrower access road; shorter, shared driveways; and wood chip paths through community open space instead of sidewalks along the road
- use of shared septic systems utilizing more advanced re-circulating sand filter technology

The open space design resulted in reduced impervious cover, reduced stormwater runoff, increased stormwater infiltration, and reduced infrastructure cost over the conventional design.

Case Study #2: Stonehill Estates, A Medium-Density Residential Subdivision

Stonehill Estates is located in Stafford County just north of Fredericksburg, Virginia. The original site was almost entirely forested in a mix of mature deciduous hardwoods, with perennial and intermittent streams, and non-tidal wetlands. An existing network of public water and sewer lines serves the site and road access to the subdivision is by two existing streets.

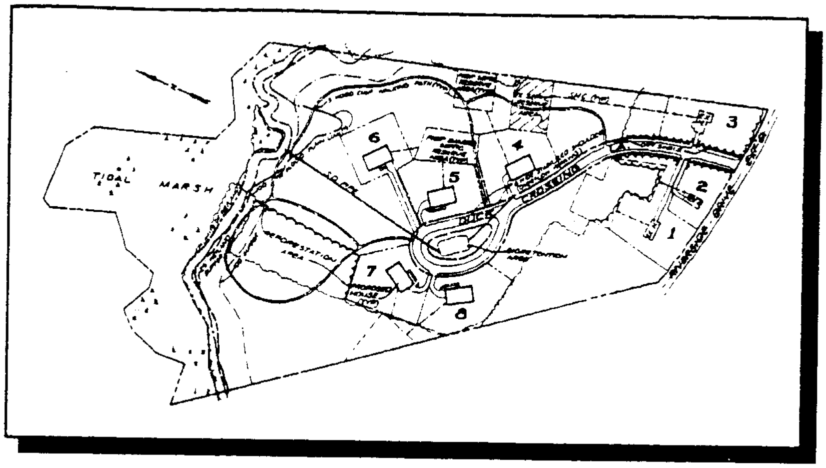

Figure 2. The open space design of Duck Crossing.

The conventional design produced a total of 108 house lots, each of which are about 9000 square feet in size (Figure 3). The subdivision is quite typical of a medium-density residential subdivision developed in the last two decades in the Mid

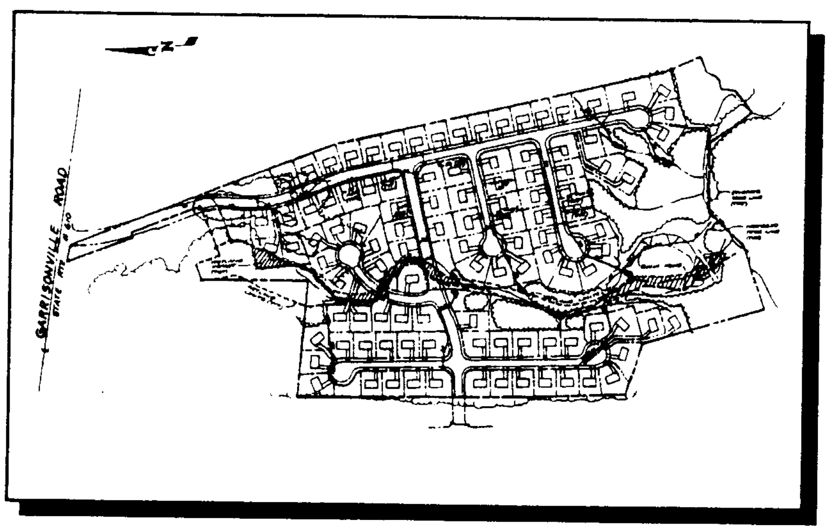

Figure 3. The conventional design of Stonehill Estates, a medium density residential subdivision in Stafford County, Virginia.

Atlantic with uniform lot sizes and shapes, and generous front setbacks. The streets were 34 and 26 feet wide, numerous cul-de-sacs were used as turnarounds, and sidewalks were generally installed on both sides of the street. With the exception of a small tot-lot, the majority of the open space is unbuildable land, such as floodplains, steep slopes, wetlands, and stormwater management areas. Street runoff is conveyed by curb and gutter to a storm drain system that discharges to the intermittent stream channel. It then travels to a dry extended detention pond, which is primarily used to control flooding, but also provides limited removal of stormwater pollutants.

The open space design also results in 108 lots, but these were slightly smaller with an average size of 6,300 square feet. The design also incorporates many techniques of open space design as advocated by Arendt (1994). The design techniques employed in the redesigned site (Figure 4) include:

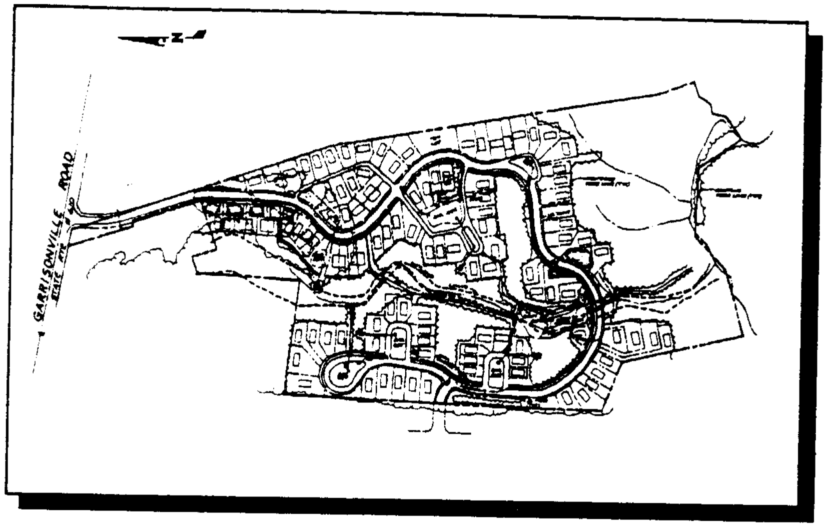

Figure 4. The open space design of Stonehill Estates.

- identify sensitive natural features, including mature forest and wetland, to be protected
- incorporate a minimum 100-foot buffer along all perennial and intermittent streams
- maximize the amount of community open space and preservation of natural areas
- maintain the same number of lots as the conventional design
- provide open space adjacent to as many lots as possible
- incorporate stormwater management attenuation and treatment throughout the site
- use narrower streets, loop roads, shorter driveways, and fewer sidewalks
- allow for irregular shaped lots and shared driveways
- manage stormwater in a "treatment train" with bioretention facilities that discharge to a small but more effective wet pond

The open space design resulted in reduced impervious cover, reduced stormwater runoff, increased stormwater infiltration, and reduced infrastructure cost over the medium density subdivision conventional design (Table 1).

The Benefits of Open Space Design

For both of these case studies, application of the open space design techniques resulted in reduced impervious cover, which translates directly to reduced stormwater runoff. Other "redesign" studies recently conducted in Delaware, Maryland, and Virginia have provided similar results. These combined results consistently demonstrate that better site design can reduce impervious cover by 25 to nearly 60% and stormwater runoff by 4 to over 60% for a range of subdivisions (Table 1).

Table 1. Redesign Analyses Comparing Impervious Cover and Stormwater Runoff from Conventional and Open Space Subdivisions

Residential Subdivision	Conventional Zoning for Subdivision	Impervious Cover at the Site			% Reduction in Stormwater Runoff
		Conventional Design	Open Space Design	Net Change	
Duck Crossing	3 - 5 acre lots	8%	5%	- 35%	23%
Stonehill Estates	1/3 acre lots	27%	21%	- 24%	24%
Remlik Hall [1]	5 acre lots	5.4 %	3.7%	- 31%	20%
Tharpe Knoll [2]	1 acre lots	13%	7%	- 46%	4%
Chapel Run [2]	½ acre lots	29%	17%	- 41%	31%
Pleasant Hill [2]	½ acre lots	26%	11%	- 58%	54%
Prairie Crossing [3]	½ - 1/3 acre lots	20%	18%	- 20%	66%
Buckingham Greene [2]	1/8 acre lots	23%	21%	- 7%	8%
Belle-Hall [4]	High Density	35%	20%	- 43%	31%

Sources: [1] Maurer, 1996; [2] DE DNREC, 1997; [3] Dreher, 1994; and [4] SCCCL, 1995.

For both Duck Crossing and Stonehill Estates, the conventional design results in the highest annual volume of runoff and the lowest volume of infiltration, as was expected. Of particular interest is the fact that the controlled conventional design results in a higher annual runoff volume and a lower infiltration rate than the uncontrolled open space design. This, however, should not imply that better site design alone, without structural stormwater management, is sufficient in controlling stormwater runoff from this site since the open space designs do not come close to replicating pre-developed hydrology.

Less impervious cover and stormwater runoff, in turn, translates directly to smaller pollutant loads. Reducing the impervious cover, preserving natural areas, and providing multiple stormwater practices in series reduced nutrient export for both case studies. However, neither open space design meets pre-development nutrient loads.

One area of particular interest for Duck Crossing is the implication of on-site sewage disposal systems. The conventional design included a standard septic tank and field for each lot, which resulted in phosphorus and nitrogen loads that far exceeded pre-development levels. Recirculating sand filters were used in the open space design, instead of conventional septic systems, because they yield better nitrogen removal efficiencies and are actually less expensive to construct. This resulted in a much lower nutrient output from the entire site. However, even in the open space design, the septic systems are the predominant source of nutrients.

For both case studies, the total infrastructure costs include the sum of the estimated costs of stormwater management, storm drainage, paving, sidewalk, curb and gutter, landscaping and reforestation, water, sewer and septic systems. In both cases, the open space design resulted in a cost savings. Costs associated with grading, erosion and sediment control, building construction and other incidental costs associated with land development were not analyzed. In general, these costs should be comparable between the two development options. If anything, the grading and erosion and sediment control costs should be lower with the open space design since less land is disturbed.

Several other studies have also shown that open space development can be significantly less expensive to build than conventional subdivision developments. Most of the cost savings are due to savings in road building and stormwater management conveyance costs. The use of open space design techniques at a residential development in Davis, California provided an estimated infrastructure construction costs savings of $800 per home (Liptan and Brown, 1996). Other examples demonstrate infrastructure costs savings ranging from 11 to 66%. Table 2 lists some of the projected construction cost savings generated by the use of open space redesign at several residential sites.

Table 2. Projected Construction Cost Savings for Open Space Designs from Redesign Analyses

Residential Subdivision	% Construction Savings	Notes
Duck Crossing	12%	Includes roads, stormwater management, and reforestation
Stonehill Estates	20%	Includes roads, stormwater management, and reforestation
Remlik Hall [1]	52%	Includes costs for engineering, road construction, and obtaining water and sewer permits
Tharpe Knoll [2]	56%	Includes roads and stormwater management
Chapel Run [2]	64%	Includes roads, stormwater management, and reforestation
Pleasant Hill [2]	43%	Includes roads, stormwater management, and reforestation
Buckingham Greene [2]	63%	Includes roads and stormwater management

Sources: [1] Maurer, 1996; [2] DE DNREC, 1997.

Implications for the Watershed Manager

Better site design reduces impervious cover, conserves larger contiguous natural areas, and incorporates more advanced stormwater treatment, which results in reduced stormwater runoff, increased infiltration, and reduced nutrient export. Hopefully, the results of this study, as well as other redesign analyses, will answer some of the questions of local governments, consultants, and developers as to the benefits of better site design.

However, there may still be difficulties to overcome before better site design becomes a reality and common practice in many communities. Once there is a willingness to incorporate better site design techniques into new developments, many communities may find that their existing development codes and ordinances are in conflict with the goals of better site design. For example, many local codes and ordinances require excessive impervious cover in the form of wide streets, expansive parking lots, and large-lot subdivisions. In addition, there are generally few, if any, incentives or requirements for developers to conserve natural areas. When obstacles to better site design are present, it is a sign that a community may want to reevaluate and consider changing some of its local codes and ordinances.

In 1997, CWP convened a national site planning roundtable to address this very issue. During the 18-month consensus-building process, a diverse cross section of national planning, environmental, home builder, fire and safety, and public works organizations (as well as local planning officials) crafted 22 model development principles to help further better site design at the local level. This national roundtable is serving as a model for local government implementation of better site design principles.

Recently, Frederick County, Maryland, initiated a local roundtable to take a critical look at its own development rules. Members of the development community in partnership with local planning and zoning and public works staff are meeting to identify and overcome impediments to better site design that are embedded in the county's codes and ordinances. The outcome of the consensus process should be development rules that encourage rather than discourage the application of better site design techniques.

Changing local development rules is not easy. Progress toward better site development will require more and more local governments to examine their current practices in the context of a broad range of concerns, such as how changes will affect development costs, local liability, property values, public safety, and a host of other factors. Advocates of better site design will have to answer some difficult questions from fire chiefs, lawyers, traffic engineers, developers, and many others in the community. Will a proposed change make it more difficult to park? Lengthen response times for emergency vehicles? Increase risks to the community's children? True change occurs only when the community addresses these and other questions to the satisfaction of all interests.

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Predicting Erosion Rates on Construction Sites Using the Universal Soil Loss Equation in Dane County, Wisconsin

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Abstract

The Universal Soil Loss Equation (USLE) was developed for estimating sheet and rill erosion from agricultural fields under specific conditions. Parameters used to estimate erosion include rainfall energy, soil erodibility, slope length, steepness, surface cover, and management practices. Traditionally, urban conservation planners have not used the USLE for estimating soil loss and evaluating conservation measures and have relied on intuition alone to locate erosion control practices on constructions sites. The results of this process are often subjective and may vary with the skill of the planner. A USLE-based equation would provide a valuable, objective method for all planners, regardless of skill, to tailor specific construction site practices to existing conditions. A method to predict soil loss from construction sites was developed by adapting existing data for USLE erosion calculations to construction site conditions. In addition, the construction site procedure was used to create a user-friendly computer-based program to assist planners in developing erosion control plans. The computer program was distributed to engineers responsible for erosion control planning in Dane County, Wisconsin. Implementation of the USLE-based equation has proven to be a valuable tool for assessing alternatives for site management and erosion control. Planners are able to uniformly implement the equation on construction sites throughout the county, decrease the time necessary to complete a USLE calculation, and reduce human error.

Keywords:

Universal Soil Loss Equation (USLE), urban erosion control.

Background

Soil erosion, detachment of soil particles from the soil surface, results when soil is exposed to the power of rainfall energy and flowing water. Soil erosion causes a loss of productivity in the land, delivers millions of tons of sediment into waterways, and provides a substrate for toxic chemicals which are carried into receiving waters. Construction site erosion has been identified as a significant source of suspended solids in runoff in many parts of the United States (Hagman, et al., 1980; Yorke and Herb, 1976; Becker, et al., 1974). In the State of Wisconsin, sediment is the largest pollutant by volume (Wisconsin Department of Natural Resources, 1994). When erosion is compared on a rate basis, construction site erosion generates more erosion in a short period of time than any other land disturbing activity (Johnson and Juengst, 1997). While it is not possible to urbanize a watershed without exposing soil to erosive forces, it is possible to plan construction to control the production of sediment through the use of erosion prevention and reduction practices.

The Universal Soil Loss Equation (USLE) (Equation 1) was developed by the United States Department of Agriculture (USDA) for estimating sheet and rill erosion from agricultural fields under specific conditions (Wischmeier and Smith, 1978). The USLE enables planners to predict the average annual rate of soil erosion for combinations of seeding and management practices in association with a specified soil type, rainfall pattern, and topography. The equation groups interrelated physical and management parameters influencing erosion rate into six major factors whose site-specific values can be expressed numerically. More than a half century of erosion research in many states has supplied information from which the USLE factors were determined.

The Universal Soil Loss Equation.

$$A = R \times K \times (LS) \times C \times P \qquad \text{(Equation 1)}$$

Where:

A = average annual soil loss
R = rainfall and runoff factor
K = soil erodibility factor
L = slope length
S = steepness factor
C = cover and management factor
P = support practice factor

A The computed soil loss in tons/acre/year.

R The rainfall and runoff factor is the number of erosion-index units in an average year's rain. The erosion index is the storm energy in hundreds of foot tons times the 30 minute storm intensity.

K The soil erodibility factor is the soil loss rate (tons per acre) of a specific soil type and horizon as measured on a standard plot of land.

L The slope/length factor is the ratio of soil loss from the actual land slope length to that from a standard plot (726 feet in length) of land. Slope length is defined as the distance from the point of origin of overland flow to the point where either the slope gradient decreases enough that deposition begins or runoff water enters a well defined channel that may be part of a drainage network or a constructed structure.

S The slope/steepness factor is the ratio of soil loss from the actual land slope gradient to that from a standard plot of land (9%).

C The cover and management factor is the ratio of soil loss from an area with specified cover and management to the corresponding loss from a clean-tilled, continuously fallow condition.

P The ratio of soil loss with a support practice such as contouring, stripcropping, or implementing terraces compared to up and down the slope cultivation. The support practice factor does not usually apply to soil loss on construction sites.

Soil losses computed with the USLE are best available estimates, not absolutes. The USLE will generally be most accurate for medium-textured soils, slope lengths of less than 400 feet, gradients of 3 to 18%, and consistent seeding and management systems represented in the USDA erosion studies. The USDA research shows that in comparing actual soil loss to computed soil loss, 84% of the differences in long-time average soil losses were less than 2 tons/acre/year (Wischmeier and Smith, 1978). The accuracy of a predicted soil loss depends on how accurately physical and management conditions on the particular site are described by the parameter values. Large-scale averaging of parameter values on mixed drainage areas reduces accuracy.

Traditionally, urban conservation planners have not widely used an equation similar to the USLE for estimating soil loss and evaluating conservation measures. They have relied on intuition alone to locate erosion control practices on construction sites. A USLE-based equation provides a valuable, objective method for all planners, regardless of skill, to tailor specific construction site practices to existing conditions. Erosion control is more efficient when it focuses erosion control practices in areas on the site identified by the USLE as being the most susceptible to erosion.

The objectives of this project were to: 1) develop a method to predict soil loss from construction sites by adapting existing data for USLE erosion estimation to construction site conditions and 2) create a user-friendly computer-based program to assist planners in developing construction site erosion control plans with the USLE.

Implementation Area

The project was conducted in Dane County, located in south-central Wisconsin. Dane County has extremely diverse and vast water resources with 475 miles of rivers and streams and 37 lakes, but these resources are threatened by rapid urban growth. Within the next twenty years, it is conservatively estimated that an additional 72,000 people will live in the county. Residents recognize how impacts to water quality affect their standard of living, and are interested in protecting water resources.

Due to the value that the citizens of Dane County place on water quality, a very restrictive erosion control ordinance was adopted in 1995. Any land disturbance greater than 4000 square feet must comply with the Dane County Erosion Control Ordinance (Dane County, 1999). As part of this ordinance, applicants must prove that the erosion rate on their project will not exceed 15 tons per acre over the construction period for non-sensitive areas. In sensitive areas, including sites adjacent to, or directly draining to, lakes, streams, and wetlands, the soil loss is limited to 7.5 tons per acre over the construction period. In order to prove the soil loss rate is below the county standard, applicants need to calculate the USLE for their site from the start of construction until the site is stabilized. The Dane County Land Conservation Department reviews erosion control plans for accuracy of the plan and compliance with the ordinance.

Methods

Adapting USLE to construction site conditions

Our first objective was to develop a method of predicting soil loss from erosion on construction sites based on the guidelines given by the USDA for the USLE. In order to adapt the USLE to urban conditions, each variable in the equation was examined (see Equation 1).

The rainfall factor, R, is the first factor modified. Published R values represent erosivity during an average year. Most construction sites do not remain disturbed for exactly one year. In addition, the time of year that the site is open is critical in determining the amount of rainfall energy that will occur. In the Midwest, over half of this rainfall energy occurs during July, August, and September. Projects that take place in the summer will experience higher intensity storms than projects constructed in the winter. For these reasons, the R factor needs to be adapted to the construction schedule of the project (Table 1).

Table 1. Percent of R occurring after January 1st for Dane County, Wisconsin.

	January	February	March	April	May	June
1st	0	0	2	4	9	20
15th	0	1	3	6	14	28
	July	**August**	**September**	**October**	**November**	**December**
1st	39	63	80	91	97	99
15th	59	72	87	94	98	100

Once the percent R is calculated for the interval of time that the land will be open, it is multiplied by the annual R factor for Dane County (150).

$$R = (\% \text{ of } R \text{ to date}) \times (\text{Annual } R \text{ factor})$$

The soil erodibility factor, K, represents a soil's ability to resist erosion. The factor is determined by documenting erosion of a soil in a bare condition on a unit test plot. The higher the erosion rate, the higher the K factor. On construction sites, the subsoil K factor is often used because the topsoil is usually stripped. Subsoil K factors can be found in USDA

Soil Interpretation Records. The soil properties that affect erodibility include: soil structure, soil particle size distribution, permeability, organic matter content, and iron content.

The slope length/steepness factor, LS, relates the length and steepness of the slope (Equation 2). The rate of erosion increases exponentially as the length of the slope becomes longer. Erosion rates rise even more drastically as the steepness of the slope increases. The percent slope is a representative portion of the disturbed area, representing overland flow, not channel flow. The slope length is measured along the flow path from the top to the bottom of the slope of the disturbed area.

Formula used to calculate the LS factor.

$$LS = (L/76.6)^M(65.41\sin^2\theta+4.56\sin\theta+0.065) \qquad \text{(Equation 2)}$$

Where: L = slope length in feet

θ = angle of slope (in degrees)
M = 0.2 for slopes < 1%
M = 0.3 for slopes 1.0 to 3.0%
M = 0.4 for slopes 3.0 to 4.5%
M = 0.5 for slopes > 4.5%

The cover and management factor, C, is based on the type and condition of the cover on the soil surface. In construction site erosion control, the cover is extremely important. The vegetative cover provides protection from rainfall impact and runoff water. If the condition of the cover is poor, the C factor will be high. Conversely, when the vegetation is well established, the erosion and C factor will be reduced. C factors for construction sites can be found in *Predicting Rainfall Erosion Losses* (Wischmeier and Smith, 1978). The C factors for seeding, seeding and mulching, and sod represent the average cover over the establishment period. Once the site is seeded or sod is installed, a period of sixty days during the growing season is automatically assumed for cover establishment. If the end of the sixty-day cover establishment period falls after the recommended seeding dates, the calculation must be carried out to the following spring to allow for adequate growth.

Commonly Used C Factors:	Bare ground	1.00
	Seeding	0.40
	Seeding and Mulching	0.12
	Sod	0.01

The support practice factor, P, is not used to calculate soil loss on construction sites.

The product of the R, K, LS, and C factors equals the computed soil loss per acre over the construction period. In Dane County, if this number is greater than the required standard, the project must reduce erosion below the standard by using erosion control practices or by changing the management schedule. This assumes that 100% of soil loss is transported and deposited off-site for relatively small areas of less than 40 acres with no intervening obstructions or flattening of the land slope.

Developing the Spreadsheet to Calculate the USLE

Implementation of the USLE in erosion control plans was required for all land-disturbing activities greater than 20,000 square feet in Dane County after January, 1995. The calculation of soil loss was difficult for the consulting engineers responsible for submitting plans. In addition, the USLE calculations were often done incorrectly or the wrong data were used as inputs. For these reasons, a user-friendly computer-based program was developed to assist erosion control planners with the USLE calculation. The program uses Microsoft Excel 97*, a spreadsheet program that is commonly used among the engineering community.

The worksheet (Figure 1) uses the following variables and inputs (Table 2) which are either entered by the user or automatically calculated in the non-shaded rows.

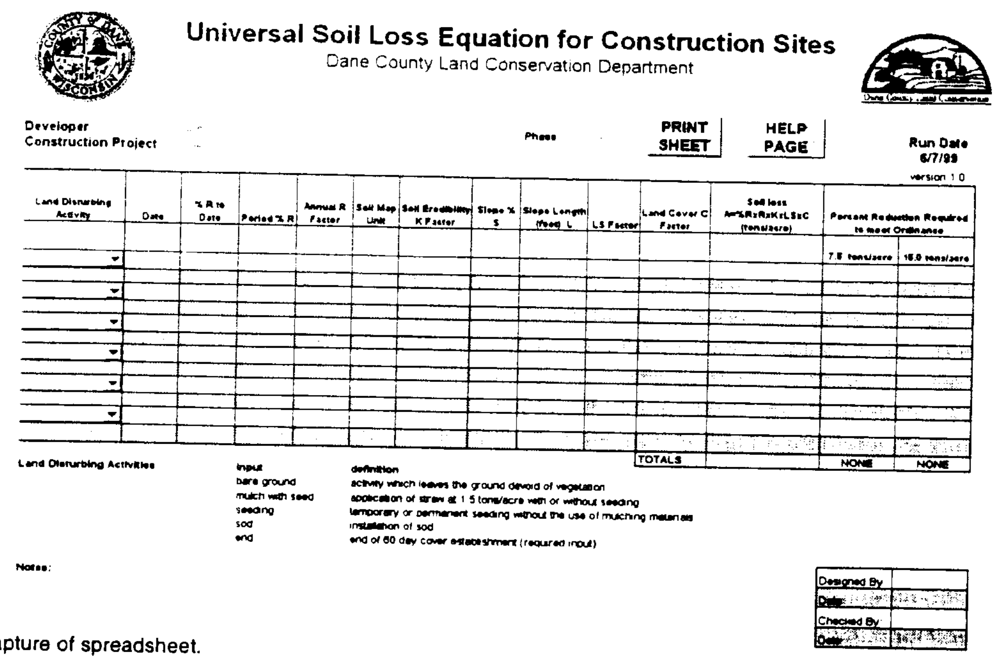

Figure 1. Screen-capture of spreadsheet.

Table 2. Variables used in the spreadsheet.

Column #	Variable	Type
1	Land Disturbing Activity	entered by user
2	Date	entered by user
3	% R to Date	automatically calculated
4	Period % R	automatically calculated
5	Annual R Factor	automatically calculated
6	Soil Map Unit	entered by user
7	Soil Erodibility K Factor	automatically determined
8	Slope % S	entered by user
9	Slope Length L	entered by user
10	LS Factor	automatically calculated
11	Land Cover C Factor	automatically determined
12	Soil Loss	automatically calculated
13	Percent Reduction to Meet Ordinance	automatically calculated

Variable/Input Descriptions:

Land-Disturbing Activity

The land-disturbing activity relates to the type of disturbance that is occurring on the ground and must be selected by using a pull down menu. Activity Inputs:

*Use of the commercial product name is for the convenience of the reader and does not imply endorsement of the product by either the Dane County Land Conservation Department or the University of Wisconsin.

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bare ground	Usually the initial disturbance and occurs when the ground is left bare due to stripping vegetation, grading, or other actions that leave the ground devoid of vegetation.
seeding	The application of permanent or temporary seeding without the use of mulch. Seeding requires that the user allows 60-days during the growing season for cover establishment.
mulch with seed	The application of a minimum of 1.5 tons/acre straw or other comparable mulching. This input is entered if the seeding and mulching are done at the same time. It is not necessary to also enter *seeding* if this input is used. This input also requires a 60 day cover establishment period during the growing season.
sod	The installation of sod for cover establishment.
end	*End* is a required input at the end of the 60-day cover establishment period. If the site is stabilized by a method other than vegetative cover, *end* should also be entered.

Date

The date the planned land disturbing activity begins, e.g. 5/15/99. The activity is assumed to continue until the next activity is entered. When seeding dates are later than the dates recommended for permanent cover establishment, the *end* date must be carried out to the next spring, rather than 60 days.

% R to Date

The percentage of the annual R factor from January 1st to the entered date.

Period % R

The percentage of the annual R factor calculated for the period from one land disturbing activity to the next.

Annual R Factor

The rainfall factor, R, is the number of erosion-index units in a normal year's rain. The erosion index is a measure of the erosive force of a specific rainfall. In Dane County, Wisconsin the rainfall factor is 150.

Soil Map Unit

The soil map unit for the predominant soil type in the area of the land disturbing activity.

Soil Erodibility K Factor

The erosiveness factor of the subsoil for the specified soil map unit.

Slope % S

The percentage slope for the representative portion of the disturbed area, representing overland flow and not channel flow.

Slope Length L

Slope length (in feet) is measured along the overland flow path from the top to the bottom of the slope of the representative disturbed area.

LS Factor

The LS factor is calculated using the equation for LS described previously (see Equation 2).

Land Cover C factor

The cover and management factor is the ratio of soil loss from an area with a specified cover and management practice to that of a unit plot of bare land. The input for the land disturbing activity corresponds to this factor.

Soil Loss

The predicted value of soil loss (tons/acre) which corresponds to the time period of each land disturbing activity. This value is calculated using the equation:

$$A = \%R \times R \times K \times (LS) \times C$$

Percent Reduction Required to Meet Ordinance

The percentage value in the total row corresponds to the reduction of soil loss necessary to comply with the Dane County Erosion Control Ordinance. It is required that the cumulative soil loss rate not exceed 15 tons/acre for non-sensitive areas and 7.5 tons/acre for sites that are located adjacent to or directly drain to sensitive areas.

Typical Spreadsheet Example for Dane County, Wisconsin

Figure 2 shows a sample USLE calculation using the spreadsheet. The assumptions are that construction will begin on July 17, 1999, and the site will be seeded and mulched on October 31, 1999. The representative pre-existing slope is 10% over 100 feet and the slope after grading will be 5% over 250 feet. The soil type is Dresden Silt loam (DsC2). The estimated soil loss rate for this site is 15.9 tons/acre. If this site is located near a sensitive area, the soil loss must be reduced by 53% to comply with the 7.5 tons/acre standard; on the other hand, if the site was not located near a sensitive area, the soil loss only needs to be reduced by 6% (15 tons/acre standard).

Universal Soil Loss Equation for Construction Sites
Dane County Land Conservation Department

Developer
Construction Project Example Calculation

Phase —

PRINT SHEET | HELP PAGE

Run Date 7/7/99
version 1.0

Land Disturbing Activity	Date	% R to Date	Period % R	Annual R Factor	Soil Map Unit	Soil Erodibility K Factor	Slope % S	Slope Length (feet) L	LS Factor	Land Cover C Factor	Soil loss A=%RxRxKxLSxC (tons/acre)	Percent Reduction Required to meet Ordinance 7.5 tons/acre	Percent Reduction Required to meet Ordinance 15.0 tons/acre
bare ground	7/17/99	53.3%	26.2%	150	DsC2	0.28	10.0%	100	1.38	1.00	15.2		
	To												
mulch with seed	8/31/99	79.5%	17.3%	150	DsC2	0.28	5.0%	250	0.85	0.12	0.7		
	To												
end	10/31/99	96.8%	3.2%	150	DsC2	0.28	5.0%	250	0.85				
										TOTALS	15.9	53%	6%

Land Disturbing Activities

input	definition
bare ground	activity which leaves the ground devoid of vegetation
mulch with seed	application of straw at [illegible] tons/acre with or without seeding
seeding	temporary or permanent seeding without the use of mulching materials
sod	installation of sod
end	end of 60 day cover establishment (required input)

Notes:

Designed By	
Date	
Checked By	
Date	

Figure 2. Sample USLE calculation.

R0019580

Results and Discussion

There are several advantages to using the adapted USLE for erosion control planning on construction sites. One advantage is being able to locate areas with the highest erosion rates, which results in more effective erosion control. If one portion of a construction site is predicted to have a higher erosion rate, more or larger erosion control practices may be targeted in that area, while less intensive practices may be required elsewhere on the site. The adapted USLE also facilitates the design of sediment ponds and other erosion control practices. The predicted amount of soil loss exceeding the standard can be used to calculate the percent reduction necessary to comply with the ordinance.

Another advantage is that the adapted USLE brings in the important element of time. In Wisconsin, the majority of the year's rainfall erosion occurs during the summer months. Summer is also the time of year that most construction is occurring. The USLE accounts for the date and duration the development project occurs and predicts the soil's vulnerability to erosion at that time. The USLE may show that staging the construction project will help to reduce the soil loss on the site.

The spreadsheet program has proven to be a valuable tool for calculating the soil loss. The program has been distributed for more than a year, free of charge, to the planners and consultants in Dane County. The County's review of the calculation in the erosion control plans has become easier and quicker by having a printout that summarizes the variables used. An advantage of having tables and formulas included in the spreadsheet, is the consistency that is achieved by everyone using the same parameters. Not only have the calculations of soil loss been more precise and time schedules more realistic, but planners and consultants have stated that it has saved them time and simplified the calculation process.

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Public Involvement Programs That Support Water Quality Management

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The Rouge River, a tributary to the Detroit River, in southeast Michigan, has been documented as a significant source of pollution to the Great Lakes System. The Rouge River Watershed spans approximately 438 square miles in 48 communities and three counties and is home to over 1.5 million residents. The eastern portion of the watershed contains much of the older, industrial areas of Detroit and Dearborn. The western and northern portions contains newer suburban communities and areas under heavy development pressure.

This paper discusses the programs used by the Public Involvement Team of Wayne County's Rouge River National Wet Weather Demonstration Project (Rouge Project) to (1) increase watershed awareness of Rouge River Watershed residents and business owners, (2) educate them about pollution sources to the Rouge River and (3) involve them in restoration of the Rouge River by showing them that small changes in their daily activities can help improve water quality and restore the river.

The Rouge Friendly Neighborhood Program was piloted over a two year period in watershed neighborhoods in three distinctly different areas of the watershed. All neighborhoods were surveyed to determine the initial level of knowledge about water quality issues, lawn care maintenance, and pollution prevention practices. Survey results were used to fashion a neighborhood program for each area. All three neighborhoods received Rouge Friendly brochures, newsletter articles, and other materials.

The Rouge Friendly Business Program, a companion program to the neighborhood effort, sought to educate small-to-mid-sized businesses about how they can positively impact the Rouge River by making small changes to daily business practices. Since auto-related businesses are very common in the Rouge River Watershed, an automotive services roundtable was convened. The partners included representatives of automotive service associations, the local chamber of commerce, and businessmen who met periodically for a year to review draft materials, make suggestions about the program's promotion, and to help mold the program before it was implemented. Once implemented, the industry representatives promoted the program in their publications and recruited businesses to participate in the program.

This paper will describe both of these pollution prevention programs and discuss how the Brightmoor neighborhood in the Rouge River Watershed was impacted by the Rouge Friendly Neighborhood and the Rouge Friendly Business Programs.

The Rouge Friendly Neighborhood Program

The Rouge Friendly Neighborhood Program was designed to be carried out by responsible neighborhood organizations. Preferred prerequisites were:

1. The group participating in the program must represent a defined area or neighborhood.

2. The group would participate in the Friends of the Rouge River Watch Program. The river system need not pass directly through the neighborhood for participation. An assigned segment could be identified for the group by Friends of the Rouge.

3. The group would participate in the Friends of the Rouge Storm Drain Stenciling Program. The stenciling of storm drains should include, but is not limited to, all the storm drains within their designated neighborhood or area.

4. The group should actively participate and/or encourage proper household hazardous waste management. This could occur through:

   - Reduced purchasing of hazardous house chemicals
   - Proper use of household hazardous chemicals
   - Proper disposal of hazardous household chemicals
   - Use of less-toxic alternatives to household hazardous chemicals

   The group can accomplish this requirement by distributing information concerning proper household hazardous waste management to their designated neighborhood.

5. The group would facilitate education of residents regarding non-point source pollution. Information would be provided by the Rouge Project Team for distribution to the designated neighborhoods.

6. Submittal of semi-annual reports discussing the activities that have been taking place could be a requirement to maintain Rouge Friendly Neighborhood status.

Three Rouge Project area neighborhoods representing different demographics and development history were chosen as pilots for the Rouge Friendly Neighborhood Program. They were the (1) Brightmoor area of Detroit, an older, developed area of the watershed along the Main Branch of the Rouge River; (2) Golfview Manor subdivision in Dearborn Heights, a newer subdivision along the Middle Branch of the Rouge River; and (3) West Bloomfield Place, a subdivision in West Bloomfield Township, a developing area along the Upper Branch of the Rouge River. These three pilots represented communities with diverse demographics and concerns.

The Brightmoor neighborhood was a deteriorating area with strong community activism regarding neighborhood problems and concerns. The neighborhood also showed strong stewardship for the Rouge River, which serves as a western boundary to the neighborhood and flows through a nearby park. Golfview Manor in Dearborn Heights was a more upscale, manicured neighborhood that was very active through its subdivision association, but did not have a real connection to the River. West Bloomfield Place in West Bloomfield Township was an upper income, less urban area bounded by a wetland.

Meetings were held with a core group of representatives from each neighborhood to garner support from the neighborhoods' leadership and to discuss what the program was and what the expected outcomes were.

The residents of all three pilot areas were sent a survey, distributed by mail or door-to-door, to document their knowledge of Rouge River water quality, storm water issues, and household hazardous waste disposal. In addition, respondents were asked for demographic information. The survey information was used to determine what the Rouge Friendly Neighborhood Program should focus on in each particular neighborhood.

Educational materials that had been developed about storm water pollution, household hazardous waste (and its disposal), and watershed awareness were reviewed by each group. Each core group helped develop the particular program that would be implemented in their neighborhood, because Rouge Project staff knew that no program would be a success without the core groups' support and endorsement. These core group members were relied on to explain the program at neighborhood meetings.

The Rouge Friendly Business Program

The Rouge Friendly Business Program was developed as a partnership between Wayne County, local government, and the business community to restore and protect the Rouge River. To accomplish this goal, information and assistance are provided to small business owners to teach them how they can positively affect the water quality of the Rouge River by changing some of their everyday practices. The education process is not about major contaminants, but those little things that slip the mind, such as keeping the dumpster lid closed and storing materials under cover. These simple actions can affect water quality because they stop pollutants from entering the storm system. As an incentive to participate, Wayne County embraced the concept that businesses in the watershed that demonstrate stewardship and a strong environmental ethic should be recognized by the community for their voluntary participation. As such, these businesses should enjoy greater name recognition through the efforts of the local and regional media as well as specific program materials, such as decals and magnets that identify the business as Rouge Friendly.

The Rouge River Watershed has approximately 42,000 businesses in its 48 communities and three counties. To design program materials that would have the greatest impact, three criteria were developed to target business types. They are:

- The business has a high incidence of illicit connections to storm drains
- The business conducts a significant number of pollutant-generating activities outdoors
- The business is found in large numbers in the watershed

Using these criteria, six types of businesses were selected and specific activities identified. They are:

- Vehicle Service Industry
- Food producers, grocers, and eating establishments
- Metal Machining
- Earth Disturbing Construction
- Remodeling and Repair Contractors
- General Business

Pollution control criteria were established for each kind of business. These criteria were used to create a self-assessment form to be used by business owners to evaluate how "Rouge Friendly" their businesses are. Best Management Practices (BMPs) were also written that correspond to each activity and this information was put into the booklet along with a self-assessment form for distribution.

Representatives of various trade organizations were invited to participate in a Vehicle Service Industry Roundtable. The roundtable was asked to review and comment on the educational materials, the self-assessment form, the BMPs, and the best way to conduct program outreach. Rouge Project staff sought to engage businesses in an ongoing dialogue to determine what approach would work best, with a secondary goal of determining how to get businesses to participate. Feedback from this group resulted in a name change from the "Clean Business Program" to the "Rouge Friendly Business Program." This was not a quick process, but took approximately six months of meetings to (1) form a Vehicle Service Industry roundtable, (2) explain the purpose of the Rouge Friendly Business Program, and (3) refine the program and products. The Rouge Friendly Business Program elements were finalized as follows:

- Self-assessment form and action plan
- Best Management Practices

- Site visits by technical staff
- Recognition materials for participating businesses (stickers and magnets)
- Business pledge and newspaper recognition

After these materials were finalized, Wayne County and Rouge Project staff promoted the Rouge Friendly Business on a pilot basis and recruited businesses through the following mechanisms:

- Business Roundtable contacts
- Letter and telephone contacts
- Door to door contact with businesses
- Contact through homeowner/neighborhood associations
- Integration of Business and Residential Programs

By the end of the pilot period, the Wayne County Department of Environment had recognized 20 businesses as Rouge Friendly.

The Brightmoor Community Pilot

The Brighmoor area of Detroit was developed in the 1920s as a neighborhood for working-class families. Most houses are frame, with the newer areas of the neighborhood (1940s and 1950s) of brick construction. Over the past 15 years, the Brightmoor area has deteriorated. Its once vibrant business strip is dotted with boarded, vacant buildings, graffiti, trash, and debris. Whole blocks of residential land are vacant and overgrown and illegal dumping is abundant. Environmental abuses ranged from a myriad of abandoned vehicles to illegal car repair businesses on residential streets. The Rouge Friendly Neighborhood Survey (Attachment A), distributed in Brightmoor in 1996, showed that the top two environmental concerns in the area were illegal dumping and abandoned housing.

Despite these challenges, the Brightmoor neighborhood had two characteristics that made it a viable pilot for the Rouge-Friendly Programs. One, Eliza Howell Park, located on its western edge, was traversed by two branches of the Rouge River. Second, Brightmoor had a wealth of grassroots organizations who were working to make the neighborhood better. Some annually removed log jams and other debris from the Rouge River in Eliza Howell Park during Rouge Rescue, sponsored by Friends of the Rouge, a grassroots organization serving the whole watershed.

Initial contact was made with the Brightmoor Concerned Citizens and other neighborhood representatives in January, 1996. The group agreed that they would like to participate as a Rouge Friendly Neighborhood pilot. A month later, the same group met again with Rouge Project staff. This time, city parks staff were present. They were told about the possibility of grant funding for storm water projects by the Rouge Project. The group brainstormed the kinds of things they would like to see happen at the park, which had suffered from spotty maintenance. They agreed that they would like to see wildflowers and prairie grass planted, nature trails restored, and a community garden created. The parks department later applied for and was awarded a $180,000 grant to plant wildflowers and prairie grasses and to install nature trails in the lower end of the park, near the Rouge River

The next step in the program was to survey residents about their knowledge of pollution entering the river and household hazardous waste disposal, their neighborhood environmental concerns, and demographic information. The survey was created with input by the core neighborhood group. The major data extracted from the survey were:

- 78% thought the Rouge River was polluted or very polluted, and 20% thought the river was getting worse.
- 38% did not know that the storm drains lead directly to the Rouge River. However, 56% understood that sanitary sewers go to the wastewater treatment plant.

- 18% correctly answered that industry pollutes the Rouge River the least and 66% thought stormwater pollutes the least.
- 87% maintained their own lawn. There was an even distribution among those who never fertilize their lawns and those who fertilize 1-2 times per year.
- 75% did not change their own motor oil.
- 80% took their cars to a car wash instead of washing it themselves.
- 92% claimed indicated that they know what household hazardous waste is, and 73% correctly identified motor oil as a household hazardous waste. However, 54% did not properly dispose of their wastes.
- 83% said they were committed/very committed to make small changes to prevent pollution.

Following are neighborhood issues, in order of importance:

1. Abandoned buildlings
2. Illegal dumping
3. Household hazardous material disposal
4. Infrequency of street sweeping and storm drain cleaning
5. Recycling
6. Do-it-yourself car repair/illegal car lots on residential streets
7. Overuse of garden/lawn pesticides
8. Overuse of fertilizer
9. Composting

Wayne County Rouge Project staff, Friends of the Rouge, and Brightmoor Concerned Citizens leadership made a presentation, including survey results, to the general membership in May, 1996. The general membership was enthusiastic about the program. The annual Rouge Rescue held in Eliza Howell Park on June 1, 1996, was expanded to include other activities, including storm drain stenciling, a tour of a newly constructed combined sewer overflow basin, and children's games.

Subsequent meetings with the Brightmoor group were used to brainstorm what the specific program elements should be and what outcomes were expected. The following elements were supported by the core group:

- Urban gardens on vacant lots
- Composting education
- Attempting to get rid of the massive log jam at the confluence of the Upper and Main Rouge River in Eliza Howell Park
- A tour of the area for the Detroit Environmental Court judge
- Lawn signs that read "I support the Rouge Friendly Neighborhood Program"
- Early recognition of well-maintained lawns and gardens; Brightmoor's "Resident of the Month"

- A Brightmoor Rouge-Friendly Business Program
- A renters' workshop to educate tenants about their rights and responsibilities and the responsibilities of landlords
- Educational materials in the various neighborhood newsletters

All of the activities were implemented except the lawn signs, the recognition of well-maintained gardens, and the renters' workshop. By the fall of 1996, the focus had shifted to conducting a monthly combined resident/business owners' meeting to include businesses, which were primarily vehicle service oriented, into the Rouge-Friendly initiative.

Results and Outcomes

Rouge-Friendly Neighborhood Program: Because of the enthusiasm and commitment of Brightmoor residents and business owners, many activities were conducted. They were:

- Thousands of educational brochures and children's materials were distributed in community centers, businesses, schools, and newsletters.
- A local business owner successfully sued a public utility that was pumping hundreds of gallons of polluted stormwater into the Rouge River.
- The local community organization not only enthusiastically participated in the annual Rouge Rescue event, but conducted another such event on its own.
- Through a partnership with the city parks department, the Greening of Detroit, and the Brightmoor Concerned Citizens, 100 trees were planted in Eliza Howell park by 200 local elementary school students.
- City officials agreed to conduct an environmental ticket blitz in the neighborhood, which resulted in the following tickets being written: 179 parking tickets, 71 abandoned cars tagged for removal, 8 stolen cars being towed, 15 public works tickets for bulk garbage being put at the curb too early, 2 environmental protection tickets, and 47 tickets for inoperable vehicles.
- A monthly meeting that included neighborhood residents, business owners, non-profit organizations, city officials (including police commanders), and county officials focused on environmental issues.

Rouge-Friendly Business Program: While many outstanding initiatives were accomplished by meeting with the Brightmoor stakeholders monthly, only one Brightmoor business was recognized as Rouge Friendly after ten months of monthly meetings. The meetings were well-attended and business owners felt comfortable discussing their environmental concerns. In June, of 1997, the approach for recruiting Brightmoor businesses as Rouge Friendly was changed. A community leader was paired with a technical staff member and they proceeded to visit neighborhood businesses. They visited 14 neighborhood businesses several times over a two-month period. Information about the program was left with the business owners, as well as an offer from the technical staff member to help the business owner with the self-assessment form. Through this effort, Wayne County recognized six additional Brightmoor businesses as Rouge-Friendly. This was a successful (43% participation), but labor intensive, method of recruiting businesses.

ATTACHMENT A

THE ROUGE RIVER PROJECT
A WORLD CLASS EFFORT

BRINGING OUR RIVER BACK TO LIFE

Are you willing to **prevent pollution** in your **neighborhood**?

Start **today** by filling out this questionnaire.

We are working with the **Rouge River National Wet Weather Demonstration Project** to make our subdivision a more attractive place to live. We have been chosen as one of three pilot neighborhoods in the Rouge River Watersheds to participate in a pollution prevention program that may be used as a model for other urban watersheds across the country. In order to design a program that best fits our needs, we need you to answer a few questions. The following survey is voluntary and confidential. Use the enclosed pre-stamped envelope to return the questionnaire by **April 22, 1996**.

1. Do you think the Rouge River is polluted?
   Very polluted 5 — 4 — *Somewhat polluted* 3 — 2 — *Not polluted* 1
2. Do you think the Rouge River is getting cleaner,staying the same, or getting worse?
   Getting cleaner 5 — 4 — *Staying the same* 3 — 2 — *Getting worse* 1
3. Where does water go when it enters an outside storm drain in your neighborhood?
   - ☐ To a storage tank under the ground
   - ☐ To the Rouge River
   - ☐ To the waste water treatment plant
   - ☐ Don't know
4. Where does water go when it is flushed down the toilet or sink?
   - ☐ To a storage tank under the ground
   - ☐ To the Rouge River
   - ☐ To the waste water treatment plant
   - ☐ Don't know
5. What pollutes the Rouge River the LEAST?
   - ☐ Combined sewer overflows *(a mixture of sewage and stormwater that flows into the river when it rains.)*
   - ☐ Stormwater *(water that runs off the ground and enters the river)*
   - ☐ Industry
6. How do you maintain your lawn?
   - ☐ Paid professional company
   - ☐ Paid neighbor
   - ☐ Someone in the household maintains it
7. How often is your lawn fertilized?
   - ☐ 1 to 2 times per year
   - ☐ 3 to 4 times per year
   - ☐ More than 4 times per year
   - ☐ Never
8. Where do you change the oil in your car?
   - ☐ Auto Repair Shop/Quick Oil Chnage
   - ☐ Yard ☐ Street ☐ Driveway
9. Do you usually wash your car or take it to a car wash?
   - ☐ Wash it myself
   - ☐ Car wash
10. If you change your oil at home, how do you dispose of it?
    - ☐ In the garbage
    - ☐ In the sewer
    - ☐ Don't know
    - ☐ On the ground
    - ☐ Take to facility that accepts used oil
11. Do you know what household hazardous materials are?
    - ☐ Yes
    - ☐ No
12. Which of the following is a household hazardous material?
    - ☐ Baking soda
    - ☐ Motor Oil
    - ☐ Lemon oil
    - ☐ Vinegar

13. How do you dispose of your household's hazardous materials?

- ☐ Put it in the trash
- ☐ Dump it down the sink
- ☐ Dump it on the ground
- ☐ Don't know
- ☐ Take it to a Household Hazardous Drop-off Area

14. Indicate whether the following environmental issues are very important, important, or not important to your subdivision.

	Very important		*Important*		*Not important*
Overuse of fertilizer	5	4	3	2	1
Composting	5	4	3	2	1
Abandoned buildings	5	4	3	2	1
Frequency of street sweeping and storm drain cleaning	5	4	3	2	1
Overuse of garden/lawn pesticides	5	4	3	2	1
Recycling	5	4	3	2	1
Household hazardous waste	5	4	3	2	1
Illegal dumping	5	4	3	2	1
Do-it-yourself car repair / Illegal car lots on residential streets	5	4	3	2	1
Other (specify: ______________________)	5	4	3	2	1

15. You can make small changes to prevent pollution (i.e. the type of fertilizer you purchase, how you dispose of your motor oil, etc.). What is your level of commitment to make these changes?

Very committed		*Somewhat committed*		*Not interested*
5	4	3	2	1

16. How many people, including yourself, live at this address?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ More than 6

17. How many of these are children?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ More than 4

18. How many pets do you own?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ More than 4

19. What is your gender?

- ☐ Female
- ☐ Male

20. What is your age group?

- ☐ Under 18 years
- ☐ 18–30 years
- ☐ 31–45 years
- ☐ 46–60 years
- ☐ Above 60 years

21. What was the last grade you completed in school?

- ☐ Some high school
- ☐ Completed high school
- ☐ Post-high school training
- ☐ Some college
- ☐ Completed college
- ☐ Graduate or professional school

Thank you for doing your part in cleaning up our subdivision! Remember, return the questionnaire in the pre-paid envelope by **April 22, 1996**.
Any questions should go to John or Shelley Mlynarczyk at 533-3453

The Water-Wise Gardener Program: Teaching Nutrient Management to Homeowners

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Introduction

The Water-wise Gardener program was developed by Virginia Cooperative Extension (VCE) seven years ago with funding from the Cooperative State Research, Education, and Extension Service (CSREES) of the U.S. Department of Agriculture (USDA). It is an educational program aimed at reducing non-point source pollution from suburban residential areas. The educational focus is upon nutrients, especially nitrogen and phosphorus from lawn fertilizer over-application or misuse. The program seeks to reduce such nutrient pollution to Virginia waterways, and eventually the Chesapeake Bay, through the recruitment of homeowner participants from impaired watersheds. Participating homeowners attend educational seminars on lawn best management practices, are partnered with a Master Gardener volunteer, and are expected to keep accurate records and implement recommended practices. The program, which is currently being implemented in 12 urban/suburban Virginia counties, is supported by a combination of local county funds, grants from the Virginia Water Quality Improvement Act, and funds from USDA. Cooperative Extension Units in North and South Carolina have replicated the program.

How the Program Works

The Water-wise Gardener program begins by recruiting homeowners from watersheds with impaired streams or other identified problems to participate in a year-long lawn care educational program. The most successful recruitment method to-date has been to conduct a "reverse search" on the Internet by street name. Once names and addresses are identified, a recruitment letter is sent personalized for the watershed; e.g., "Dear Resident of the Bull Run Watershed." The letter invites the homeowner to participate in the program and lists the benefits of participation, such as free seasonal seminars with regional experts, visits from a Master Gardener (volunteers trained by VCE in various aspects of horticulture), a free soil test, and Virginia Tech publications. In order to be enrolled in the program, the homeowners must return a completed pre-survey and a signed agreement form that details their obligation to the program. The pre-survey asks questions about their lawn care practices and attitudes before program involvement, as well as demographic information such as race, gender, income, and education levels. A stamped, self-addressed envelope is included for ease of return. For every 100 letters sent out, between 20-30 are typically returned. A simple database program keeps track of participants and their lawn care data. A reporting system on the Virginia Tech Intranet is currently being designed to record this information on a statewide basis by hydrologic unit.

Once enrolled, participants are assigned a personal Master Gardener. The Master Gardener schedules a visit with the homeowner to discuss his or her lawn. All Master Gardeners are instructed to stay outside on the lawn and not to go inside anyone's home. Some choose to bring along a spouse, friend, or another Master Gardener. At this visit, the Master Gardener works with the homeowner to correctly measure the square footage of lawn area, determine the type and variety of grass, collect a soil sample, and ascertain previous fertilization practices and amounts previously applied, if known. This information forms the basis of a personalized lawn care plan for the homeowner. Master Gardeners also answer other questions the participant may have; common questions include weed and pest identification, what plant grows best where, and why certain plants are not thriving. The Master Gardener leaves a business card with a phone number or e-mail where he or she can be reached for further questions throughout the program year. All Master Gardeners receive 50 hours of classroom training as well as supplemental field training before being assigned to homeowners. Typically, a Master Gardener will be assigned to between 5-10 homeowners.

In addition to the one-on-one visits from Master Gardeners, homeowners attend seasonal seminars on timely topics of interest to those with lawns. In Northern Virginia, where cool-season grasses like Fescue and Bluegrass predominate, fall topics include soil testing, fertilization, core aeration, and over seeding. Spring topics include mowing and pruning, integrated pest management, and proper watering and planting. Popular locations for seminars include parks with covered pavilions, school auditoriums, county buildings, and libraries. Any easily accessible public location large enough to hold 50 to 100 people comfortably, and accessible to wheel chairs, will work. If held inside, cold temperatures, rain, or wind are not a problem; however, an outside area for demonstration purposes is essential. State and regional Cooperative Extension experts are recruited for the seminars to answer questions. Master Gardeners are also present, with various displays, to answer questions and to meet with their assigned participants.

A professional-quality newsletter is sent to all participants approximately six times per year. A grant-paid editor solicits articles that reinforce or complement topics taught at the seminars. Articles on various aspects of watershed management are also introduced. The newsletter is made available electronically to other Extension Agents for editing and reproduction elsewhere.

After participants have attended fall and spring seminars, they are visited again by their Master Gardener to collect final lawn data and conduct a post-survey of practices and attitudes. The most important piece of data collected is the amount of fertilizer now being applied. Square footage of turf can be re-checked, if needed, and questions answered.

The homeowner may chose to participate again the following year, or to offer their lawn as a demonstration lawn, and erect a sign in their yard to promote the program in the community. The post-surveys and data sheets are collected from all participants annually. Results are compiled and analyzed by a grant-paid technician and a final report generated for each Cooperative Extension unit as well as an overall report for statewide efforts.

Results

Data for the period March 1998 to June 1999 for the Virginia counties of Arlington, Loudoun, and Prince William shows 326 individual homeowner participants. These 326 homeowners managed 57.1 acres of turf in 11 different hydrologic units in the Northern Virginia area. Between 100-200 additional individuals attended seminars but did not participate in the pre- and post-survey and data collection.

Accurate information on amounts of nitrogen and phosphorus applied by participants before program involvement is difficult to get. Most did not remember how much fertilizer they had applied in the previous year. Many stated the reason they joined the program was in order to understand how much fertilizer to apply. A total of 72 participants reported pre-program fertilizer application of 1,062 pounds of nitrogen. The same 72 participants reported 762 pounds of nitrogen applied after program involvement, or a reduction of 300 pounds. Information on pre- and post-phosphorus was not collected.

Pre-surveys indicated that only 12% of all participants had soil tested for their lawns prior to applying fertilizer. Homeowners not testing soil are more likely to apply excess fertilizer. For this reason, Virginia Tech recommends soil testing as a nutrient management practice for home lawns. Post surveys show 95% of participants returning surveys tested soils after program involvement. Another important nutrient management practice for homeowners with cool-season turf is to fertilize in the fall, when uptake by roots occurs best. Pre-surveys indicated that only 32% were fertilizing at this time of year, while post surveys indicated that 64% were fertilizing in the fall. Similar increases were also observed for recommended practices such as aeration (from 34% to 83%), and over-seeding (from 35% to 76%). An increase in the number of participants not watering the lawn at all in the summer also increased (from 18% to 44%) (Figure 1).

Demographics from the program indicate that 72% of participants were male and 28% female. Participants were overwhelmingly white (89%); followed by black (7%), Asian (4%), and Hispanic (1%). The majority (42%) had a four-year college degree and a gross family income of over $70,000 a year (54%). More than one-third of the lawns were between 5,000 and 10,000 square feet (35%).

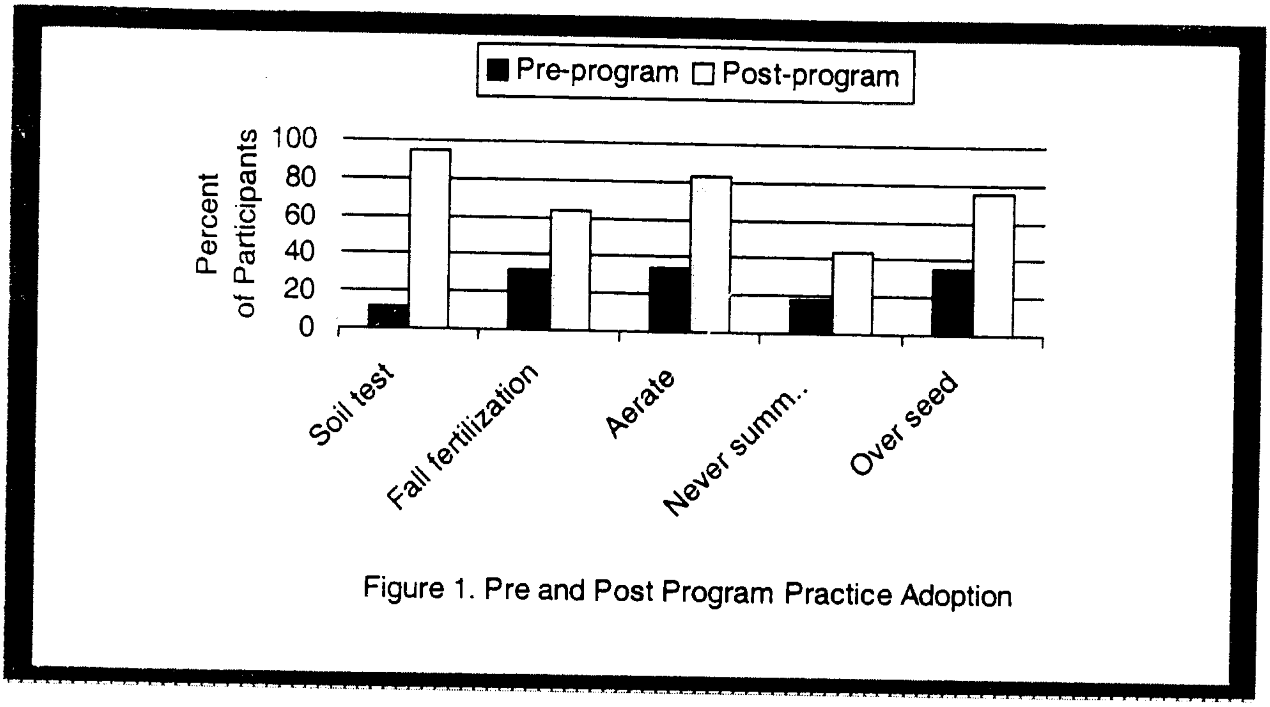

Figure 1. Pre and post program practice adoption.

Conclusions and Lessons Learned

The Water-wise Gardener Program was successful at reaching the intended audience and achieving adoption of nutrient management practices. Based on the success of the program, it appears that suburban homeowners can be recruited to maintain their lawns according to recommended practices. Homeowners are willing, with the help of Master Gardener volunteers in some cases, to keep records on their nutrient use as a part of program participation. Although 326 individuals and 57 acres of turf may seem low for an area like Northern Virginia, it is significant for a populace that does not traditionally participate in water quality educational programs. Considering that most lawns in suburban subdivisions have a turf area of around 5,000 square feet, clearly many individuals will need to be enrolled to reach meaningful numbers.

The study showed that it is difficult to obtain information on pre-program nutrient use for most participants. Most homeowners cannot provide accurate nutrient use data from the previous 6-12 months. They simply do not remember how much nitrogen and phosphorous was in the fertilizer bag applied last spring or fall. However, after program involvement, they do appear to understand how much nitrogen they applied and the square footage of their turf. From a water quality public policy perspective, it may be preferable to record nutrient use after program involvement and consider participants' turf square footage as the urban nutrient management measurement. In this way, the focus could be upon recruiting more and more individuals to participate in nutrient management educational programs like the Water-wise Gardener, thus increasing the number of acres addressed by urban nutrient management efforts. Such an approach could easily be integrated into local Geographic Information Systems, providing localities a simple method of accounting for and reporting on urban nutrient management. Localities interested in a program like the Water-wise Gardener should contact their local Cooperative Extension office to see if a similar project is already occurring or could be developed. As this program is being continued and expanded in the 1999-2001 time frame, the opportunity to better define what is realistic as an urban nutrient management measurement for homeowners will hopefully occur.

Chicago Wilderness; Toward an Urban Conservation Culture

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Chicago Wilderness - Origin and Purpose

We in the Chicago conservation community have been using the word "wilderness" in a highly unconventional context since 1996. We have coined the term "Chicago Wilderness" to refer to the rich biodiversity which resides in and around this huge, sprawling metropolitan area, extending from southeast Wisconsin, through the six-county metropolitan area in Illinois, and around Lake Michigan to northwest Indiana. This is a region which most people think of as anything but "untrammeled by man, where man is a visitor who does not remain," in the words of the Wilderness Act, which has defined our modern concept of wilderness.

This is an area that is associated with--indeed, defined by--humans and their cultural footprint. Although the "wilderness" is scattered throughout the region, mostly in parcels that would be considered slivers of land by conventional wilderness standards, it totals over 200,000 acres of land protected within a complex of national tallgrass prairie, national lakeshore, county forest preserves, city and township parks, and similar preserved public lands. Its protected lands and waters range from half-acre remnants to the 15,000-acre Midewin National Tallgrass Prairie,

Within this system of preserves can be found some of the largest and best woodlands, wetlands, and prairies in the Midwest. These lands are set in a much larger matrix of public and private, developed and undeveloped lands that support nature and the region's 8 million people.

We have called these lands "wilderness," in part to draw the attention of people who are focused on Chicago's cultural attractions to the existence of these lands in their own metropolis, and in part to deliberately blur the distinction, or conversely, emphasize the connections between formal wilderness in remote and inaccessible places and wild lands in the places where people live and work. The biotic connections exist on the land, and they ought to exist in people's minds, as well.

The boundaries of the Chicago Wilderness region do, in fact, capture a spectacular concentration of rare ecosystem types. These ecosystems harbor a high diversity of species, including a large number of those listed as threatened or endangered in the states of Illinois, Indiana, and Wisconsin. Outside of the metropolitan area, particularly in rural Indiana and Illinois, diversity decreases sharply as agriculture dominates the landscape.

"Chicago Wilderness" is also the name we have given the collaboration of over 90 organizations in the Chicago region that have banded together to better protect, restore, celebrate, promote, and publicize our rich biodiversity. An unfortunate and perhaps somewhat inevitable consequence of urban life is a detachment from the land; thus, a principal goal of the partnership is to reconnect a landless urban population, in Aldo Leopold's words, to the "raw material out of which we have hammered that artifact called civilization."

Despite the richness of nature and opportunity for conservation in the region, evidence suggests the Chicago region is experiencing a decline in native species and communities. Prior to protection, much of the region's current base of protected land was subject to agriculture, drainage, and other human influences which reduced or eliminated native plant and animal communities. These areas are often fragmented and isolated from healthy lands which could otherwise serve as immigration sources for native species.

Small fragments are also subject to influences beyond their boundaries, such as urban runoff. Keystone species like wolves and mountain lions, predators which formerly kept prey species like whitetailed deer in check, have been eliminated, and deer now threaten to destroy some of our finest lands through overbrowsing. Many of our protected sites are too small to sustain populations of area-sensitive species, or to retain their full complement of species in the face of random population processes like immigration and emigration. Exotic plant and animal species pose major threats to nearly all of our native communities. Landscape level processes, like fire, that shaped the fundamental character of our ecosystems do not occur with the frequency or to the extent they once did, resulting in shifts in community composition that usually result in a decline in biodiversity.

Chicago area residents are the beneficiaries of farsighted leaders early in the 20th century who established a tradition of setting aside natural land in the urban matrix for the public good, a tradition that our forest preserve districts continue today. The early model was not based on sophisticated concepts of biodiversity conservation, or of ecological processes, but on the museum approach of setting nature aside and not meddling. We now are the beneficiaries of the science of ecology, which begins to tell us how the land mechanism is constructed and how it operates. It is dynamic, not static, and changes occur when landscape processes are interrupted. The science of ecology also reinforces the connections between humans and the rest of nature.

This allows us to reexamine the old model of setting nature aside and leaving it alone. That removes the most immediate threat of development, but it does not address the aforementioned degenerative loss of biodiversity due to fragmentation and alteration of landscape processes. These processes clearly must be reintroduced into our preserves if biodiversity is to be preserved or restored. Prescribed fire must be intelligently applied, invasive species must be controlled, plant and animal species must be reintroduced where they have been eliminated, hydrology must be restored where altered, and science must be improved where our understanding of ecosystem processes is deficient. Perhaps most fundamentally, the people who must support the greatly increased levels of land management and research necessary to restore and maintain our public lands in a healthy condition must have a basic understanding of land health and the value system to commit public resources toward attaining it. Chicago Wilderness, the coalition, is committed to working on all of these fronts.

Quite understandably, the Chicago region's system of public lands was, and perhaps still is, the core of Chicago Wilderness, the initiative. It is what members rallied around during the coalition's formation in 1996. But the vision quickly expanded beyond public lands, for two reasons.

First, our public lands do not exist in isolation. They are part of a much larger land base, and the protected 200,000 acres are affected by what happens on the remaining 6 million acres of the Chicago metropolitan land area. The preserves form the core, but they cannot preserve all the biological parts by themselves since much biodiversity resides on private unprotected land and because they are subject to outside influences.

Biodiversity considerations need to infuse all of the region's land use decisions much more extensively that they do now. Private lands work either in harmony or discordantly with our network of preserves. The link between the two is most apparent in the case of wetland or aquatic habitats, which in many cases are sustained or impacted by runoff from distant areas. Streams, rivers, lakes, and wetlands defy the "protect by fencing" approach. Overall watershed characteristics determine aquatic and wetland habitat quality quite independently of whether the habitat is in a formal preserve or not.

Second, many high-quality, biologically rich pieces of nature persist outside of our preserve system and are threatened by development, along with other stresses like lack of management. Identifying these biologically important areas within proposed developments, redflagging them, designing development with their sustainability in mind, and doing all this with equity for the landowner, is one of our greatest challenges. Nature in the places where we live contributes so much to quality of life, yet maintaining it through the development process resists standard regulatory approaches. There are questions now asked routinely in the subdivision design process: does the plan conform to drainage code, are storm water basins sized properly, is it consistent with surrounding development, does it have proper standards of landscaping? A standard question should be: does it leave the land biologically richer or poorer? We are not yet routinely asking this question, although there are development approaches available that can allow us to answer this question affirmatively.

This question could properly be asked for aesthetic reasons alone, but there are practical reasons for doing so. Native landscapes hold enormous potential for managing storm water and preventing flooding. They hold enormous potential for cleaning up surface waters so that urban waters become fishable and swimmable, instead of the neighborhood joke or eyesore. Finding and applying the template for development that preserves and restores biological diversity, and which serves both aesthetic and utilitarian purposes, is one of the objectives of Chicago Wilderness.

Chicago Wilderness - Structure and Function

Chicago Wilderness formally began as an initiative with the signing of a memorandum of understanding (MOU) by 34 founding members. Members included landowners and land managers; local, state, and federal agencies; centers for research and education; and conservation organizations, among others. These institutions pooled their resources and strengths to form the Chicago Region Biodiversity Council, which has grown to include nearly 100 members.

By signing the MOU, the members of this innovative partnership have pledged a commitment to the protection, restoration, and management of biodiversity in the Chicago region. Four teams focus on central lines of action: science, land management, policy and strategy, and education and communication. The teams attract the participation of many non-member institutions, which adds to the scope and strength of the coalition. Chairs of the teams and other member organization staff form the nucleus of a coordinating group that develops central strategies and maintains momentum. A steering committee of executives oversees the direction of the overall initiatives. Despite this organizational structure, Chicago Wilderness has not become legally incorporated under state law, but remains a loose partnership bound by common goals and objectives.

The potential for Chicago Wilderness to serve as a model for urban conservation attracted the early attention of several federal agencies, including the U.S. Forest Service, U.S. Fish and Wildlife Service, and U.S. Environmental Protection Agency, who have provided significant operating grants. State and private grants have supplemented federal dollars. Direct grants have totaled over 4 million dollars since 1996. This total does not include members' matching funds or funds attracted by members for projects catalyzed, but not directly supported by, Chicago Wilderness.

Chicago Wilderness Accomplishments

The Chicago Region Biodiversity Council funds projects on an annual cycle. The Council's four teams set priorities for these projects; core staff ensure broad participation from team members. Reviewed and approved by a proposals committee, funded projects result from collaboration between member institutions and address critical conservation needs in the region. Since its launch in April 1996, Chicago Wilderness has funded over 130 collaborative projects. In addition to projects funded directly by the Council, the work of our individual member organizations in their own initiatives is central to the success of Chicago Wilderness. Projects completed or underway fall into six categories: characterization and information management; ecological inventory and monitoring; ecological restoration; planning and policy; education, outreach, and public participation; and communications and publications.

Individual projects have included a NASA-supported land cover mapping project; development of models of pre-settlement savannas, woodlands, and forests to guide restoration; assessment of restoration effects on bird communities; a vegetation monitoring workshop; assessment of garlic mustard impacts on native woodland ground flora; development of model restoration interpretive programs; a biodiversity educators workshop; and creation of a Chicago Wilderness Atlas of Biodiversity. An early pilot project supported by Chicago Wilderness was the launching of Chicago Wilderness magazine, a glossy, popular publication on nature in the Chicago area which since has been incorporated as a 501(c)(3) and has over 7,000 paid subscribers.

Chicago Wilderness Biodiversity Recovery Plan

In 1909, the Commercial Club of Chicago released the "Burnham Plan," a landmark of urban planning that proposed, among other things, a network of public parklands to be set aside for nature and passive recreation. This led to the legislative establishment of a system of such publicly owned preserves for the Chicago region which has continually expanded, and now forms the core of the protected lands that currently comprise Chicago Wilderness.

The Biodiversity Recovery Plan, completed in late 1999, takes the open space component of the Burnham Plan to the next step by creating a vision of sustainability, not only for the core of protected land, but for all of nature and its human inhabitants in the urban area. The recovery plan is a comprehensive statement of what Chicago Wilderness is about, and it is clearly the most ambitious and significant accomplishment of the coalition to date.

This plan is the result of three years of assessment and planning by representatives of the Chicago Region Biodiversity Council. The plan identifies the ecological communities of the greater Chicago region, assesses their condition, identifies major factors affecting them, and provides recommendations for actions needed to restore and protect them into the future in a sustainable condition. In short, the recovery plan outlines the steps necessary to achieve the overall goal of the Chicago Wilderness collaboration, which is to protect the natural communities of the Chicago Region and to restore them to long-term viability, in order to enrich the quality of life of its citizens and to contribute to the preservation of global biodiversity.

To achieve this goal, the recovery plan identifies the following objectives: 1) involve the citizens, organizations, and agencies of the region in efforts to conserve biodiversity; 2) improve the scientific basis of ecological management; 3) protect globally and regionally important natural communities; 4) restore natural communities to ecological health; 5) manage natural communities to sustain native biodiversity; 6) develop citizen awareness and understanding of local biodiversity to ensure support and participation; 7) foster a sustainable relationship between society and nature in the region; and 8) enrich the quality of the lives of the region's citizens.

The plan has many recommendations, some specific and some general, and identifies roles and specific actions for Chicago Wilderness members and the greater public that must be engaged to help implement the plan. The plan's intended intended audiences include the many staff members and general members of Chicago Wilderness institutions, public agency decision-makers, large landowners, and all concerned and active citizens who vote and otherwise influence biodiversity conservation in the region.

The recovery plan is both a plan and a process guided by its many sponsors. It is intended as a living document that will continue to evolve as new ideas and information arise. It is intended to complement the many other planning efforts completed or underway in the Chicago metropolitan area that are guiding the region to a better and more productive future. Its ultimate success probably rests on its successful integration into a broader, mainstream regional planning framework that has economic, cultural, social, and environmental components.

Strategic Visioning

After the second year of operation, the Biodiversity Council saw the opportunity to step back and evaluate the structure and function of the coalition during the first two years, consider expectations of members at the outset and evaluate to what extent they were met, and reprioritize its work for the next two years. This process consisted of development of a member questionnaire, convening of a focus group representing a cross-section of members, and a weekend retreat by Chicago Wilderness Steering Committee members and other leaders. It culminated with the development of six priority functions for the next two years, and associated budget requirements.

Some of these functions represent an intensification and refinement of activities the Council is already involved in; in other cases, they represent new endeavors. They include 1) facilitate networking among Chicago Wilderness members, including new orientation materials, workshops, symposia, and lectures; 2) establish an integrated information clearinghouse, including the development of regionwide resource databases, enhancement of the existing web site, and development of more communication resources; 3) increase publicity and outreach to broader audiences; 4) influence key actors outside Chicago Wilderness, including the establishment of a Conservation Policy Committee to develop position statements on regional issues; 5) develop and implement a funding strategy, focusing on large grants from foundations; and 6) implement, promote, and monitor the Recovery Plan.

The Urban Conservation Culture

Conservation efforts in urban areas are often frustrated by the complexity of land use issues, countless players, tangled politics, ecologically wrecked land, and a public dispossessed of nature. Yet it is crucial that we focus on urban areas because of the strong political forces concentrated in urban centers that need to be engaged in national conservation decision-making, and because there is no other way to engage the great majority of people other than to take the messages to them. Moreover, urban residents are still plain members of Leopold's land community, regardless of how obscure the connections, and these connections are best illustrated in the places where they live. Fortunately, the Chicago region has an added bonus of harboring world-class biodiversity, which creates a local, immediately compelling reason for public involvement and action.

Some writers have argued that the American ideal of wilderness has tended to shape our dominant view of nature itself as a place that can only be corrupted by human influence. In urban areas, this has created an assumption that "real" nature cannot exist in these places and it tends to absolve urban residents from local responsibility. Thus, it seems that Chicagoans are much more aware of the plight of Brazilian rain forests that they are of the plight of oak savannas, a globally rare community, in local forest preserves. In remote areas, the standard approach has been to specifically designate areas as wilderness, and then maintain as complete a separation between people and these areas as possible. Chicago Wilderness proposes to redefine wilderness to include local plant and animal communities, which can only be sustained through direct, creative human intervention. A premise of the recovery plan is that if we do not adequately enlist people to directly or indirectly support management and restoration of our lands, they will not become or remain healthy.

It is appropriate to recognize that humans in the Midwest always <u>have</u> influenced landscapes, for better or worse, and that people can be a positive force in maintaining ecosystem health. It may be that by calling a 200-acre patch of prairie in a sea of development wilderness, and by involving people in its stewardship, we can promote a correct sense of unity between the places that we live and remote places we may never see except as pictures on calendars. Restoration and stewardship can be the antidote to dualistic thinking. Remote wilderness and Chicago Wilderness can perhaps then be seen as simply examples of nature, as part of a single system that includes people.

From a relatively straightforward beginning that focused on public land management issues, this, I think, has become the broader goal of Chicago Wilderness--to reconnect people with nature and to make a societal commitment to sustain and nurture nature--for utility, for aesthetics, for spirituality, for all of the equally valid reasons for doing it, on all of our urban lands and in all of our land-use decisions. It begins with a process of educating the public about the natural wealth in the Chicago area, and hopefully ends sometime in the future with the development of an urban conservation culture of concern and personal responsibility for the health of all of our lands, both public and private.

A Survey of Resident Nutrient Behavior in the Chesapeake Bay Watershed

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In recent years a handful of communities have attempted to craft education programs to influence our watershed behaviors. These initial efforts have gone by a confusing assortment of names, such as public outreach, source control, watershed awareness, pollution prevention, citizen involvement, and stewardship, but they all have a common theme -- educating residents on how to live within their watershed.

Many communities will need to develop watershed education programs in the coming years to comply with pending EPA municipal stormwater NPDES regulations. Indeed, half of the six minimum management measures prescribed under these regulations directly deal with watershed education – pollution prevention, public outreach and public involvement. Yet, many communities have no idea what kind of message to send, or what media to use.

In the following presentation, we review the prospects for changing our behaviors to better protect watersheds. We begin by outlining some of the daunting challenges that face educators who seek to influence deeply rooted public attitudes. Next, we profile research on the outreach techniques that appear most effective in influencing watershed behavior. Special emphasis is placed on media campaigns and intensive training programs. Lastly, recommendations are made to enhance the effectiveness of watershed education programs.

Challenges in Watershed Education

Watershed managers face several daunting challenges when they attempt to influence watershed behaviors. Some of those challenges include:

A lot of minds to change

The most pressing challenge is that there are simply a lot of minds to change. Some notion of the selling job at hand can be grasped from Table 1, which contains provisional, but conservative, estimates of potential residential "polluters" in the United States by various categories. It is clear that we are attempting to change deeply rooted attitudes held by millions of people. While most people profess to support the environment, only a fraction actually practice much of a watershed ethic on the small parcels of the environment where they live.

Table 1. Provisional Estimates of Potential Residential Polluters in the United States

Watershed Behavior	Prevalence in Overall Population	Estimates of Potential Residential Polluters
Over-Fertilizers	35%	38 million
Bad Dog Walkers	15 %	16 million
Chronic Car washers	25%	27 million
Septic Slackers	15%	16 million
Bad Mechanics	1 to 5%	3 million
Pesticide Sprayers	40%	43 million
Hosers	15%	16 million

Notes: estimates are based on 1999 U.S. population of 270 million, 2.5 persons per household, and average behavior prevalence rates based on numerous market surveys (See references).

Most Residents are Only Dimly Aware of the Watershed Concept.

It stands to reason that if citizens are asked to practice a watershed ethic, they will need to know what a watershed is. Surveys indicate, however, that the average citizen is unaware of the watershed concept in general, and does not fully understand the hydrologic connection between their yard, the street, the storm sewer, and (finally) local streams. Resident surveys also continue to show limited or incomplete understanding of terms such as "watershed", "stormwater quality" or "runoff pollution". For example, a recent Roper survey found that only 41% of Americans had any idea of what the term watershed meant (NEETF, 1999). The same survey found that just 22% of Americans know that stormwater runoff is the most common source of pollution of streams, rivers, and oceans.

At the same time, most of us claim to be very environmentally aware. For example, a Chesapeake Bay survey reported that 69% of respondents professed to be very active or at least somewhat active in helping to reduce pollution in the environment (SRC, 1994).

Resources Devoted to Watershed Education are Inadequate.

In recent years, several communities have developed education programs to influence the watershed behaviors practiced by their residents. Most of these efforts, however, are run on a shoestring. For example, CWP recently surveyed 50 local programs that have tried to influence lawn care, septic cleaning and pet waste behaviors (Swann, 1999). These education programs are typically run by the cooperative extension services, local recycling or stormwater agencies, or urban soil and water conservation districts. Most are poorly staffed (0.1 to 0.5 staff years), relatively new (within last five years), and have tiny annual budgets ($2,000 to $25,000). Given these limited resources, most watershed education programs have no choice but to practice *retail*, rather than *wholesale*, outreach techniques. Consequently, most watershed educators rely heavily on low-cost techniques such as brochures, posters, workshops, and demonstration projects to send their message out.

The Marketing Techniques We Can Afford Don't Reach Many People

Watershed managers need to send a clear and simple educational message that can attract the attention of the average citizen who is simultaneously bombarded by dozens of competing messages every day. A number of surveys have asked residents which outreach techniques are most influential in attracting their attention (Table 2). Messages sent through television, radio and local newspapers are consistently more influential in reaching residents than any other technique, with up to 30% recall rates by the watershed population for each technique. By contrast, messages transmitted through meetings, brochures, local cable and videos tend to be recalled by only a very small segment of the watershed population.

Table 2. Most Influential Methods of Getting Messages to Citizens, in 8 Citizen Surveys

	WA (Elgin, 1996)	OR (AMR, 1997)	CA (Assing, 1994)	CA (Pellegrin, 1998)	MI (PSC, 1994)	WI (Simpson, 1994)	MN (Morris et al., 1996)
TV	TV ad	Direct Mail	TV Ad	TV	TV	TV	Newspaper
TV ad	TV.	TV ad	Stencils	Paper	Paper	Paper	Direct Mail
Newspaper	Newspaper	Newspaper	Billboard	Radio	Cable TV	Newsletter	TV
Local paper	Radio Ad	Radio	Local paper	Magazine	Local paper	Brochure	Neighbors
Video	Brochure	TV	Brochure	Neighbors	News-letter	Site Visit	Ext Service
Brochure	Radio news	Bill Insert	Radio Ad	School	Video	Video	Radio
Local cable	Paper Ad	Newsletter	Bus Sign	Billboard	Meetings	Meeting	Meeting
Meeting	Billboard	Local paper	Direct Mail	Brochure	Brochure	- -	Local cable

One clear implication is that watershed education efforts must utilize a mix of outreach techniques if they are going to get the message across to enough residents to make a difference in a watershed. Most existing watershed education programs, however, cannot afford to use the more sophisticated *wholesale* outreach techniques that are most effective

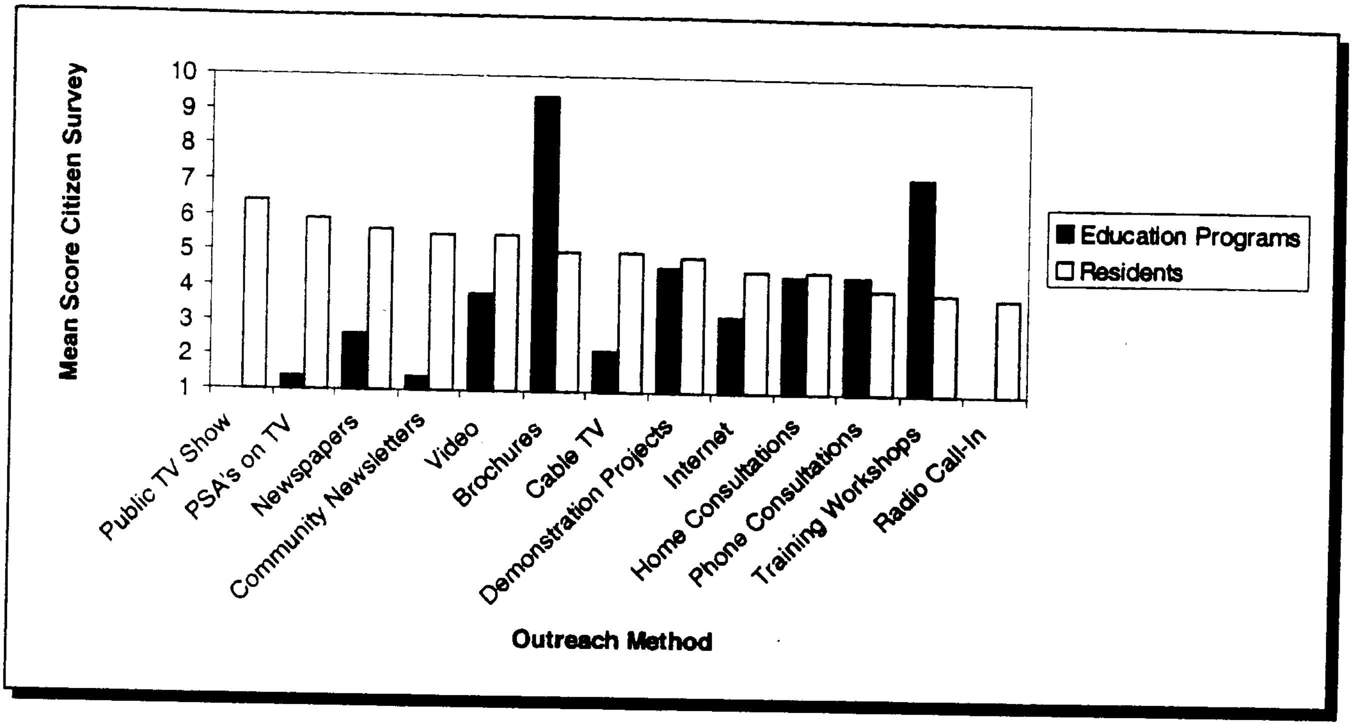

Figure 1. Outreach Methods Preferred By Residents Compared to Those Used by Education Programs.

at reaching the public with their watershed message. This gap is evident in Figure 1, which compares the outreach methods actually used by local watershed education programs with the outreach methods that residents prefer, based on responses from the Chesapeake Bay survey (Swann, 1999).

Crafting Better Watershed Education Programs

The first step in crafting better watershed education programs is to compile some baseline information on local awareness, behaviors and media preferences. Some of the key questions watershed managers should consider are:

Is the typical individual **aware** of water quality issues in the watershed they live in?

- Is the individual or household **behavior** directly linked to **water quality problems** ?
- Is the behavior widely prevalent in the watershed **population** ?
- Do specific **alternative(s)** to the **behavior** exist that might reduce pollution?
- What is the most clear and direct **message** about these alternatives?
- What **outreach** methods are most effective in getting the message out ?
- How much **individual behavior change** can be expected from these outreach techniques?

The best way to elicit this information is to conduct a market survey within the watershed. These market surveys are useful for two purposes: to gauge the level of watershed awareness and interest within the general population, and to determine if there is a segment of the population where education efforts should be focused to achieve the best returns in behavioral changes for the money spent.

Perhaps the most critical step in crafting an education program is to select the right outreach techniques to send the watershed message. Several communities have recently undertaken before and after surveys to measure how well the public responds to their watershed education programs. From this research, two outreach techniques have shown some promise in actually changing behavior – media campaigns and intensive training. *Media campaigns* typically use a mix of radio, TV, direct mail, and signs to broadcast a general watershed message to a large audience. *Intensive training* use workshops, consultation and guidebooks to send a much more complex message about watershed behavior to a smaller and more interested audience. Intensive training often requires a time commitment of several hours from residents.

Both media campaigns and intensive training can produce up to a 20% improvement in selected watershed behaviors among their respective target populations (Tables 3 and 4). Both outreach techniques are probably needed in most watersheds, as each complements the other. For example, media campaigns cost just a few cents per watershed resident reached, while intensive training can cost a few dollars for each resident that is actually influenced. Media campaigns are generally better at increasing watershed awareness, and sending messages about negative watershed behaviors. Intensive training, on the other hand, is superior at changing individual practices in the home, lawn and garden.

Table 3. Effectiveness of Media Campaigns in Influencing Watershed Behaviors: Four Surveys

Location and Nature of Targeted Campaign	Effectiveness of Campaign
San FranciscoRadio, TV and Buses (BHI, 1997)	Awareness increased 10-15% Homeowners who reduced lawn chemicals shifted from 2 to 5%
Los Angeles Radio and Newspapers (Pellegrin Research Group, 1998)	Best recall: motor oil and litter (over 40%) Worst recall: fertilizer and dog droppings (<10 %) Drop in car washing, oil changing, radiator draining of about 5 to 7% Greater self-reporting of polluting behaviors: dropping cigarette butts, littering, watering and letting water run on street, hosing off driveways into the street (10% or more)
Oregon Radio, TV (Advanced Marketing Research, 1997)	19% reported a change in "behaviors"–changes included being more careful about what goes down drain, increasing recycling and composting, using more nature-friendly products etc.
Oakland County, MI Direct Mail (Public Sector Consultants, 1994)	44% of mail respondents recalled lawn care campaign 50% desired more information on lawn care and water quality 10% change in some lawn care practices as a result of campaign (grass recycling, fertilizer use, hand weeding). No change in other lawn care practices as a result of campaign

Table 4. Effectiveness of Intensive Training in Changing Watershed Behaviors

Location and Nature of Training Campaign	Effectiveness of Intensive Training
Maryland Direct Homeowner (Smith, 1996)	10% shift from self to commercial car washing. No change in fertilizer timing or rates Better claims of product disposal.
Florida Master Gardener (Knox, 1995)	No significant change in fertilization frequency after program. Some changes in lower rates, labels, slow release (8 to 15%). Major changes in reduced pesticide use (10 to 40%).
Virginia Master Gardener (Aveni, 1998)	30 to 50% increase in soil testing, fertilizer timing and aeration. 10% increase in grass clippings and 10% decrease in fertilizer rate.

Both techniques work best when they present a simple and direct watershed message, are repeated frequently, utilize multiple media and are directly connected to local water resources that are most important in the community.

Other important suggested considerations for effectively marketing a watershed message are to:

Develop stronger connections among the yard, the street, the storm sewer, and the stream. Outreach techniques should continually stress the link between a particular watershed behavior and the undesirable water quality it helps to create (i.e., fish kills, beach closure, algae blooms). Several excellent visual ads that effectively portray this link are profiled in our watershed outreach award winners.

Form regional media campaigns. Since most communities operate on small budgets, they should consider pooling their resources to develop regional media campaigns that can use the outreach techniques that are proven to reach and influence residents. In particular, regional campaigns allow communities to hire the professionals needed to create and deliver a strong message through the media. Also, the campaign approach allows a community to employ a combination of media, such as radio, television, and print, to reach a wider segment of the population. It is important to keep in mind that since no single outreach technique will be recalled by more than 30% of the population at large, several different outreach techniques will be needed in an effective media campaign.

Use television wisely. Television is the most influential medium for influencing the public, but careful choices need to be made on the form of television that is used. Our surveys found that community cable access channels are much less effective than commercial or public television channels. Program managers should consider using cable network channels targeted for specific audiences, and develop thematic shows that capture interest of the home, garden and lawn crowd (i.e., shows along the lines of "This Old Watershed"). Well-produced public service announcements on commercial television are also a sensible investment.

Understand the demographics of your watershed. The middle-aged male should usually be the prime target for watershed education, as he is prone to engage in more potentially polluting watershed behaviors than other sectors of the population. Indeed, the most important audience for the watershed message includes men in the 35 to 55 year age group with higher incomes and education levels. Specialized outreach techniques can appeal to this group, such as radio ads on weekend sports events.

Another target group worth reaching includes what Pellegrin (1998) terms the "rubbish rebels"-- 18 to 25 year olds who tend to have low watershed awareness, engage in potentially polluting behaviors, and are often employed in lawn care and other service industries. This age group is hard to reach using conventional techniques, but may respond to ads on alternative radio, concerts, and other events that celebrate the watershed.

As communities become more diverse, watershed managers should carefully track the unique demographics of their watersheds. For example, if many residents speak English as a second language, outreach materials should be produced in other languages. Similarly, watershed managers should consider more direct channels to send watershed messages to reach particular groups, such as church leaders, African American newspapers, and Spanish-speaking television channels.

Watershed educators should also be careful about using the traditional environmental education model that uses schools to educate children who in turn educate their parents. While this model was instrumental in achieving greater rates of recycling, it may not be as effective in changing watershed behaviors. While it is important to educate the next generation of fertilizers, dog walkers, septic cleaners, and car washers, we need to directly influence the "boomer" generation now.

Keep the watershed message simple and funny. Watershed education should not be preachy complex, or depressing. Indeed, the most effective outreach techniques combine a simple and direct message with a dash of humor.

Make information packets small, slick, and durable. Watershed educators should avoid the ponderous and boring watershed handbook that looks great to a bureaucrat but ends up lining the bottom of a bird cage. One solution is to create small, colorful and durable packets that contain the key essentials about watershed behaviors, with contact information to get better advice. These packets can be stuck on the refrigerator, the kitchen drawer or the workbench for handy reference when the impulse for better watershed behavior strikes.

Educate private sector allies. A wide number of private sector companies may potentially stand to benefit from changes in watershed behavior. Better watershed behavior can drum up more sales for some companies, such as septic tank cleaners, commercial car washes, and quick oil change franchises -- although they may need some help in crafting their watershed marketing pitch.

Clearly, the potential exists for lawn care companies and landscaping services to shift their customers toward more watershed-friendly practices. Nationally, lawn care companies are used by up to 50% of consumers, depending on household income and lot size. Lawn care companies can exercise considerable authority over which practices are applied to the lawns they tend, as long as they still produce a sharp looking lawn. For example, 94% of lawn care companies reported that they had authority to change practices, and that about 60% of their customers were "somewhat receptive to new ideas" according to a Florida study (Israel et al, 1995). De Young (1997) also found that suburban Michigan residents expressed a high level of trust in their lawn care company.

Indeed, a small, but growing proportion of lawn care companies feel that environmental advertising makes good business sense and can increase sales (Israel et al, 1995). Clearly, intensive training and certification will be needed to ensure that watershed-friendly ads reflect good practice and not just slick salesmanship. It needs to be acknowledged that lawn care companies strongly committed to practices that reduce fertilizer and pesticide inputs need to be strongly endorsed by local government. Right now, it is not likely that such companies would be selected by the average consumer, as consumers primarily rely on direct mail, word of mouth, and cost when choosing a lawn care company (Swann, 1999 and AMR, 1997). For example, in the Chesapeake Bay survey, only two percent of residents indicated that they had chosen a lawn care company primarily on the basis that it was "environmentally friendly" (Swann, 1999).

Lawn and garden centers are another natural target for watershed education. Study after study indicates that product labels and store attendants are the primary and almost exclusive source of lawn care information for the average consumer. At first glance, national retail chains should be strongly opposed to better watershed behavior, since it would sharply cut into lawn and garden product sales and the lucrative profits they produce (even at the expense of the community and environmentally friendly image they often market). The key strategy is to substitute watershed-friendly products for ones that are not, and to offer training for the store attendants at the point of sale on how to use such products.

Summary

For the watershed manager faced with new regulatory requirements under Phase II of the NPDES program, the creation of an effective watershed education program should be a high priority. Not only is public education a mandated component of an NPDES permit, but in urbanized areas it may the most cost-effective tool available to achieve water quality goals. For smaller communities with scant budget and staff resources, it is imperative that these education programs be productive in terms of changing behaviors and raising awareness of individual actions on local water quality.

Perhaps the most important factor in creating an effective watershed education program is selecting the right outreach methods. Market surveys will often answer questions regarding the level of environmental awareness of watershed residents, what forms of informational outreach attract their attention, and resident willingness to change pollutant producing behaviors. This information allows the watershed manager to tailor outreach methods to specific target groups where behavior change is most likely. These surveys will also establish the demographics of the residents and determine whether multilingual outreach is required.

Watershed managers should also consider innovative approaches to sending out their pollution reduction messages. Pooling resources with other communities to create regional media campaigns and the use of outreach opportunities through private sector education are just two ways that program managers can reach broader audiences without spending large amounts of money.

Continued development of productive outreach methods and innovative techniques is necessary to relay the basic premise of watershed education - that we live in a watershed and how to properly live within it - in the most economical and effective manner.

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Lawn Care and Water Quality: Finding the Balance

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Abstract

When land is converted from natural areas to developed urban areas, pavement and rooftops replace grass and trees. Water flows over driveways, streets and parking lots taking with it particles and debris in its path and depositing them, via storm sewers, into nearby lakes, creeks and rivers. This non-point source pollution can contain sediment, debris, fertilizers, pesticides, leaves, grass clippings, motor oil, or pet wastes. Small amounts of these materials entering a lake or river are not generally considered harmful. But when small amounts are multiplied by thousands or tens of thousands they can cause serious water quality problems.

Since 1993, the Minnesota Department of Agriculture, in cooperation with several other organizations, has been gathering information on homeowner use of pesticides and fertilizers in the Twin Cities metropolitan area. This information includes the amounts of lawn care products used by homeowners, where they are purchased, how they are applied, and whether or not they have an effect on nearby lakes, creeks or rivers.

Residents living in two watersheds were selected to participate in a focused study. Lake Harriet represents urban watersheds and Lake Alimagnet represents suburban watersheds. Based on survey results and water quality monitoring, education materials were developed to promote public awareness of lawn practices and their potential to affect water quality. These educational materials incorporate the concept that "everyone lives in a watershed" and that everyone has the potential to affect water quality, whether or not they actually live on a lake shore.

What are the Lake Harriet and Lake Alimagnet Watershed Awareness Projects?

The projects have two purposes: (1) to inform urban and suburban homeowners about living in a watershed, and (2) to help them learn how their lawn care habits can affect the quality of Twin Cities water. The project's goal is to improve water quality by reducing the quantity of pesticides and nutrients through responsible use of those materials.

How has this goal been achieved?

Project members have:

- Surveyed the current lawn care habits of homeowners and measured the effects of those habits by monitoring pesticide and nutrient runoff into Lake Harriet
- Informed homeowners about how their lawn care habits affect Twin Cities waters
- Asked homeowners how the projects have affected their lawn care practices
- Monitored runoff into Lake Harriet to quantify changes brought about by homeowner actions
- Drawn on detailed Lake Harriet experience to design urban watershed education materials for use throughout Minneapolis and Minnesota--these materials were tested in the Lake Alimagnet watershed

What is a watershed?

It is an area of land over which rain and melted snow flows to lakes, rivers, and wetlands. There are 46 major watersheds and 255 sub-watersheds in the Minneapolis-St. Paul metropolitan area.

The Lake Harriet watershed is a 1,139-acre area in a well-established residential neighborhood with almost 6,000 homeowners. The Lake Harriet study area is a 148-acre portion of the watershed. About 40% of the study area is covered with hard surfaces, such as pavement and rooftops. About 700 homeowners live in the study area, most in detached, single family houses built in the early 1900s. The water quality in Lake Harriet is very good for a Twin Cities lake.

A survey of 105 Lake Harriet watershed residents most familiar with lawn care done on their own properties, showed that:

- They are highly educated (college or post-graduate degrees predominate)
- Their average age is 47
- They have middle- to upper-level incomes
- They care for their lawns by mowing regularly and using fertilizers and herbicides
- A few use professional lawn care services

The Lake Alimagnet watershed has approximately 3600 suburban households. Of this number, a large proportion is made up of townhouse residents. The Lake Alimagnet watershed was developed in the 1960s. Homeowners are well-educated and have middle- to upper-middle incomes. The water quality in Lake Alimagnet is considered poor, algae blooms are common, and the predominant fish species is bullhead.

Why are we studying the Lake Harriet and Lake Alimagnet watersheds?

Because they provide good examples (respectively) of how urban and suburban development affect our water resources and because they are sources of year-round recreation for many Twin Cities residents. These residents are vitally interested in keeping the water clean.

What are we finding out?

Though Lake Harriet had some of the highest quality water in the Twin Cities, that quality has also declined over time. Lake Harriet has poor quality water and area residents want to reverse the trends.

These projects and others have monitored storm water, rainfall, and lake water to determine the levels of non-point source pollutants in Lake Harriet. Specifically, this project monitored two types of pollutants: pesticides, which can affect water quality, and phosphorus, which can increase lake algae growth and reduce water quality.

Pesticide monitoring

The Lake Harriet project monitored storm runoff, rainfall, and lake water. The water quality monitoring consisted of a permanent automatic sampling station installed in a storm drain outlet which carried watershed runoff into Lake Harriet; samples were taken during storm events, from which mass loading of pesticides and nutrients were calculated. In addition, a rainfall monitoring station sampled rain events. Finally lake monitoring samples were collected during the growing season. Several hundred samples were analyzed for more than 30 pesticides.

The education program included several methods of education, including homeowner meetings, direct mail, flyers, billboards, utility bill inserts, local newspaper articles and visits by Master Gardeners. Because monitoring preceded the education, and also followed it,reductions in pesticides can be measured. There was a decrease in average pesticide loads between the earlier and later monitoring periods. Therefore, the annual storm sewer runoff load of pesticides to Lake Harriet was reduced during the Lake Harriet project. The largest decreases came from the four compounds listed on this table:

Lawn Herbicides	Percent Decrease (1992-1995)
MCPA	86%
Dicamba	59%
2,4-D	58%
MCPP	56%

The most prevalent pesticides found during monitoring were herbicides (weedkillers). The eight herbicides listed on the following table accounted for 95% of all pesticide detections.

Lawn Herbicides	Agricultural Herbicides
MCPA	Alachlor
Dicamba	Atrazine
2,4-D	Cyanazine
MCPP	Metolachlor

- **Storm water runoff monitoring summary:**
  - Lawn herbicides were found in 80% of the storm runoff events sampled between April and October.
  - Agricultural herbicides were detected in 35% of the storm events sampled
- **Rainfall monitoring summary:**
  - The agricultural herbicides listed above (the only herbicides found in rainfall samples) were atmospherically deposited by wind and rainfall onto the watershed and the accompanying water bodies.
  - Lawn herbicides were not detected in rainfall samples.
- **Lake monitoring summary:**
  - The three most commonly detected compounds in lake water were MCPP, Atrazine, and 2,4-D. They were also the most frequently detected compounds in stormwater entering Lake Harriet.
- **Phosphorus monitoring:**

Analyses revealed the phosphorus in runoff peaks twice a year, in the spring and in the fall.

- In the spring, melting snow carries phosphorus attached to tiny particles of grit, sand, and organic matter as it enters the storm sewers.

- In the fall, phosphorus in leaves, grass clippings, and other organic debris enters the storm sewers. Studies conducted by other researchers established that only a small percentage of phosphorus in runoff results from appropriate use of fertilizer on lawns.

- **Water Quality Education**

Lake Harriet and Lake Alimagnet project participants have concluded that educating homeowners living in the watershed is one of the best ways of reducing pollution in the lake. Billboards, brochures, and water bill inserts have carried messages based on the following two concepts:

- **A healthy lawn and landscape promotes healthy waters.** Home landscaping with regionally adapted, healthy plants can help absorb and filter rainfall, irrigation, and runoff from melted snow.

- **Keep your lawn and landscape healthy as follows:**

  - Apply pesticides and nutrients according to recommendations
  - Aim roof downspouts onto lawns and gardens to filter and absorb runoff
  - Keep grass clippings and leaves off streets, sidewalks, and driveways
  - Leave grass clippings on the lawn or compost them
  - Use fallen leaves as winter or summer mulch, compost them, or shred them and leave them on the lawn
  - Keep lawn care products on the lawn and always follow label instructions
  - Clean up and reuse granular lawn care products that fall on streets, sidewalks, and driveways

Project Evaluation

- Based on feedback from homeowners living in the Lake Harriet and Lake Alimagnet watersheds, we have concluded the following:

  - Most homeowners in the Lake Harriet watershed apply significantly less lawn fertilizer than the University of Minnesota's recommended guidelines.
  - Most homeowners compost grass clippings or leave them on their lawns.
  - Homeowners would rather spot-treat weeds than apply herbicide to their entire yard or use non-chemical weed control methods.
  - Top soil in the Lake Harriet watershed is significantly deeper than that found in the Lake Alimagnet watershed. In many cases when suburban areas are developed, top soil is removed, but not replaced. This results in decreased plant vigor, and an increase in the need to fertilize, water, and maintain turf.
  - Most homeowners feel the educational initiative has increased their understanding of how lawn care habits affect water quality. Neighborhood newspapers and direct mail, the most common source of lawn care and water quality information, have the greatest impact.
  - Messages that are quick to read and easy to understand are the most effective in changing lawn care habits.
  - These messages are best delivered over an extended period. Homeowners have been reached through fliers, newspaper articles, brochures, direct mail, handouts, and personal contacts.

Feedback also shows that homeowners still need to hear the following messages:

- You can preserve water quality and have a healthy lawn by applying lawn care products in appropriate amounts, at the right times, and during suitable (or appropriate) weather conditions.
- By keeping leaves out of storm sewers, you can help reduce the amount of phosphorus carried to the lake in runoff water.
- Fall is the best season to apply turf fertilizers and lawn care products that control broadleaf weeds. The primary growth of turf grasses is early fall until late spring.
- Erosion, leaves, grass clippings, yard waste, pet waste, and rainfall all contain pollutants that can end up in lake water.

Lake Alimagnet Project Results

During the project period, the water quality in Lake Alimagnet improved significantly.

- Project cooperators achieved improvements in total phosphorus and chlorophyll-a.
- The best secci disk reading ever on Lake Alimagnet was recorded.
- The Citizens Assisted Monitoring Program improved the ranking of Lake Alimagnet from a "D" to a "C."

These results may be a result of the project, a curly leaf pond weed cutting, or may be credited to El Nino.

For more information on the Lake Harriet or Lake Alimagnet Watershed Awareness Projects and samples of homeowner education materials, please contact the Minnesota Department of Agriculture at (651) 297-7269.

San Francisco Bay Area's Pesticide Toxicity Reduction Strategy

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Introduction

Water quality research conducted by San Francisco Bay Area stormwater programs and wastewater treatment plants over the last several years has identified widespread toxicity in local creeks and wastewater treatment plant effluent (California Regional Water Quality Control Board, 1997; San Francisco Bay Area Pollution Prevention Group, 1998). The toxicity problem was ultimately traced to diazinon and chlorpyrifos–commonly used organophosphate pesticides available in hundreds of consumer products (Alameda Countywide Clean Water Program, 1997). Study results indicated that pesticide use according to label instructions could not be ruled out as a cause of wastewater and stormwater toxicity (Regional Water Quality Control Plant–Palo Alto, 1996). In May 1999, San Francisco Bay and 35 Bay Area urban creeks were listed by the U.S. Environmental Protection Agency (USEPA) as impaired by diazinon (USEPA, 1999).

Impact of 303(d) Listing on Local Governments

In its action, USEPA listed 53 waterbodies in California as impaired due to diazinon in urban runoff and 7 waterbodies as impaired due to chlorpyrifos in urban runoff. By definition under the Clean Water Act, this action means that there is a water quality problem, regardless of the problem definitions under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) (i.e., "unreasonable adverse effect") or the Food Quality Protection Act (FQPA). The listing action put over 100 municipalities in the San Francisco Bay Area and Central Valley at immediate regulatory, legal, and financial risk.

- Regulatory risk - The State Water Resources Control Board and USEPA can take enforcement action against, and fine, these municipalities for violating their NPDES (National Pollutant Discharge Elimination System) stormwater permits.
- Legal risk - Citizen and environmental groups can sue municipalities for the same reasons.
- Financial risk - These municipalities must now spend local public tax dollars proactively addressing this problem, and potentially reacting to fines and lawsuits.

Municipalities' Response

To comply with their NPDES stormwater permits, municipalities must meet two broad goals:

1. Effectively prohibit non-stormwater discharges into storm sewers.
2. Reduce the discharge of pollutants to the maximum extent practicable (MEP).

To meet these goals and to address the 303(d) listing, there are a number of actions Bay Area stormwater programs have taken or plan to take that may reduce pesticide-related toxicity in surface waters. These actions are packaged in a Pesticide Toxicity Reduction Strategy (BASMAA, 2000). The Strategy is a multi-faceted effort including:

- Education/outreach including:

- limiting or prohibiting pesticide use by municipal staff and contractors and/or requiring use of best management practices (BMPs) such as Integrated Pest Management (IPM)
- providing adequate and convenient options for disposal of unused pesticides and pesticide containers through household hazardous waste collection programs
- educating residents about pesticide-related toxicity and proper use and disposal through distribution of educational materials, and development and implementation of media and advertising campaigns
- educating residents about alternative methods and products through such programs as demonstration gardens and point-of-purchase campaigns in hardware stores and nurseries
- educating businesses about proper use and disposal, as well as alternative methods and products for use around their own properties and facilities
- educating pest control operators and working with them to develop BMPs protective of surface waters
- Regulatory – Identifying opportunities to reduce toxicity and advocating state and federal agencies to seize these opportunities through regulation and re-registration
- Monitoring - Investigating the extent and causes of toxicity, and assessing impacts on beneficial uses

The IPM Store Partnership

One exemplary part of the Pesticide Toxicity Reduction Strategy worth describing in more detail is the IPM (Integrated Pest Management) Store Partnership. In 1997, the Central Contra Costa Sanitary District (CCCSD), a wastewater treatment plant located in Martinez, California, jointly developed and successfully piloted the IPM Store Partnership with the Regional Water Quality Control Plant (Palo Alto, California) in four locally owned garden centers and hardware stores. In 1998, the Bay Area Stormwater Management Agencies Association (BASMAA) and the San Francisco Bay Area Pollution Prevention Group (BAPPG) joined together to fund the expansion of the IPM Store Partnership to more stores in the San Francisco Bay Area. By spring 1999, 116 stores in eight Bay Area counties were participating in the Partnership.

The Partners

BASMAA is a consortium of seven San Francisco Bay Area municipal stormwater programs. These programs represent more than 90 agencies, including 79 cities and 6 counties, and the bulk of the watershed immediately surrounding San Francisco Bay. BASMAA agencies agree to a memorandum of understanding and each year collect dues, prorated by population, from their members for a "baseline" program that provides for staff and finances projects–like the IPM Store Partnership–that are endorsed by all member agencies.

The BAPPG is a voluntary association of 39 wastewater treatment plants working together to prevent water pollution in the San Francisco Bay. These agencies represent all of the publicly owned municipal wastewater agencies that discharge into San Francisco Bay in the nine Bay Area counties, and almost all of the watershed immediately surrounding San Francisco Bay. BAPPG's decision-making is done by consensus. Each year, a work plan–with an associated budget–is developed. The budget is allocated among the 39 plants based on the average amount of treated wastewater discharged each day. Contributions are voluntary, although all agencies do contribute. These contributions are used to fund projects like the IPM Store Partnership.

Integrated Pest Management

There are many definitions of Integrated Pest Management. The definition used to guide the IPM Store Partnership was the following:

Integrated Pest Management is an approach that uses regular monitoring and cultural, biological, and physical methods to keep pests at acceptable levels. Only less toxic chemicals are used and only as needed.

IPM was used as the basis for the program because it: (1) focuses on effective alternatives to traditional chemical pesticides; (2) does not substitute another pesticide that may become tomorrow's problem, and (3) does not preclude the use of chemicals in all situations.

Although promotion of IPM was the basis for the program, the term itself is somewhat problematic. The terms "IPM" and "Integrated Pest Management" were used in speaking with experts and agencies familiar with the jargon, but these terms were avoided in communications with the non-initiated (e.g., general public). In addition, the term IPM was not very representative of the situation in the store between the customer and the store employee. Most customers go to a store for help when pests have already reached unacceptable levels, so store employees must start with controlling a pest problem, rather than preventing it, which is the first step in IPM. Despite this challenge, customers were exposed to the full range of IPM methods through the fact sheets and display materials, as well as less-toxic products.

Goals

The goals of the IPM Store Partnership are to:

- Educate the public about the value of IPM approaches to pest control and safe use and disposal of pesticides, when used
- Deliver IPM-related messages without negative messages about any products
- Develop partnerships with retailers so that they can help spread the word about water quality problems related to residential pesticide use
- Provide consistent messages
- Capitalize on economies of scale
- Prepare the stage for regional program expansion into chain stores

Program Elements

The IPM Store Partnership is an education program for employees and customers of locally owned garden centers and hardware stores. The project elements include:

- development and production of eight fact sheets on less-toxic pest management strategies for the public (*Naturally Managing Pests, Controlling Ants, Controlling Aphids in Your Garden, Keeping Cockroaches Out of Your House, Keeping Fleas Off Your Pets and Out of Your Yard, Living with Spiders, Tips for a Healthy Beautiful Lawn, and Safe Use and Disposal of Pesticides)*
- development of an extensive list of less-toxic methods and products preferable to diazinon and chlorpyrifos for various applications
- training sessions for store employees focusing on principles of Integrated Pest Management and successful application strategies for products on the less-toxic list
- design and production of a program logo and in-store promotion materials including "end cap" displays, posters, shelf-talkers, shelf signs, and vinyl banners
- program evaluation by a San Francisco State University-affiliated survey research and data analysis firm

Results and Discussion

Although the final evaluation will not be complete until the end of the 1999 in-store promotion season (late 1999), the sponsoring agencies expect it to be successful based on preliminary findings and on the success of the pilot project. Feedback from store owners and employees that participated in the pilot was uniformly positive. The sales data in the pilot IPM Store Partnership showed variations from store to store. One store found that sales of all but one diazinon and chlorpyrifos product dropped. At the same time, less-toxic product sales experienced an overall 17% increase and profits were not affected.

It is the hope of the participating agencies that the final evaluation and report on the 1999 Partnership will be useful as a model and primer for other agencies and jurisdictions concerned about pesticide-related toxicity in surface waters and interested in building educational partnerships with local businesses. While Bay Area water pollution prevention agencies have been coordinating their public education efforts since the early 1990s, the IPM Store Partnership is the first point-of-purchase program implemented regionally. All of the general benefits of inter-agency coordination (support for smaller agencies, cost savings, options for pooled advertising and media relations) are magnified in such a large undertaking.

Based on the partnership's success, all of the agencies that participated in the 1999 Partnership allocated funds for continuation of the program in 1999-2000. BASMAA and the BAPPG again contributed funds to regional coordination. Brainstorming sessions were held in late summer 1999 to determine how to improve the program, and minor modifications were made for 2000.

The IPM Store Partnership is one example of BASMAA and the BAPPG's commitment to use public resources efficiently. Given that philosophy, materials developed by the IPM Store Partnership are available to agencies interested in implementing a similar program.

Other Aspects of the Strategy

Despite the success of the IPM Store Partnership and many of the other educational aspects of the Pesticide Toxicity Reduction Strategy, it is clear to Bay Area water pollution prevention agencies that their efforts alone will not be enough to solve the problem. Study results indicate that less than 1% of applied diazinon runs off, yet it takes less than a fluid ounce of active ingredient flushed into stormwater runoff to cause toxicity in urban creeks (Regional Water Quality Control Plant–Palo Alto, 1996). Educational programs run by Bay Area water pollution prevention agencies are some of the most developed in the country and they have won numerous awards for their quality and effectiveness. Nevertheless, even the best education programs are not 100% effective. It is clear that education alone will not solve this problem.

San Francisco Bay Area stormwater programs are and will continue to address the problem of pesticide-related toxicity in surface waters by way of meeting the MEP requirement in their NPDES permits. These agencies have gone so far as to develop the Pesticide Toxicity Reduction Strategy described above that includes three elements–education, regulatory, and monitoring. The authority and ability of local governments to implement the strategy varies with each element. The most cost-effective and appropriate aspect for local governments to implement is education. For the regulatory and monitoring elements, local governments can, and have, identified the issues and opportunities to reduce pesticide-related toxicity, but they have limited ability or authority to actually implement corrective actions.

Regulatory

Regulation of pesticides including their registration for use in the Unites States is the responsibility of USEPA. California's Department of Pesticide Regulation (DPR) has responsibility for regulating the sale and use of pesticides in California. California DPR, with few exceptions, registers pesticides only after they have been registered by USEPA. California DPR can not register pesticides which have been denied registration by USEPA. At the local government level, the California Food and Agriculture Code grants some authority to county agricultural commissioners for local enforcement of pesticide regulations, record keeping, and outreach to applicators. However, with the exception of county agricultural commissioners, local governments are prohibited from regulating the registration, sale, transportation, or use of "economic poisons." This regulatory structure means that the ability and authority of local governments is limited to:

- identifying opportunities to reduce toxicity, such as eliminating potentially problematic uses, and advocating that state and federal agencies seize these opportunities through regulation and re-registration

- in the case of wastewater and stormwater agencies, regulating the discharge of pesticides to the sewer or storm drain to ensure local agencies' compliance with state and federal laws (e.g., Clean Water Act)

Monitoring

Local governments have some ability, authority, and responsibility to use monitoring to address the problem of pesticide-related toxicity of surface waters. To-date, San Francisco Bay Area municipalities have used monitoring to:

- identify and define the problem (Alameda County Urban Runoff Clean Water Program, 1995; Regional Water Quality Control Plant–Palo Alto, 1996; California Regional Water Quality Control Board, 1997; San Francisco Bay Area Pollution Prevention Group, 1998)

- characterize sources (Alameda Countywide Clean Water Program, 1997)

- recommend corrective actions (Alameda County Flood Control and Water Conservation District, 1997)

A review of monitoring data from around the country shows that municipalities in the San Francisco Bay Area and California Central Valley are not alone in their identification of this environmental problem.

- Orange County, California (Lee, et al., 1999) – Multi-year studies of stormwater runoff in San Diego Creek as it enters Upper Newport Bay have shown that the problem is not restricted to Northern California. Runoff from each stormwater event has been shown to be toxic, and about half of the observed toxicity is due to diazinon and chlorpyrifos used in urban areas for structural termite and ant control, and lawn and garden pest control.

- NAWQA (USGS, 1998) – Results from the United States Geological Survey's (USGS) National Water Quality Assessment Program from 1992 through 1996 show that the problem is in fact a national one. Over 300 samples have been taken from eleven urban streams scattered across the country, from Florida to Connecticut to Oregon, as part of the Pesticides National Synthesis Project. In a recent report on the first cycle of the program, USGS concluded that "urban and suburban areas are substantial sources of pesticides to streams" and that "most urban areas have similar pesticides in streams...and many urban areas may benefit from similar strategies for reduction."

- Publicly-Owned Treatment Works survey (USEPA, 1989) – Results from a survey done 10 years ago by USEPA show that pesticide-related toxicity is a wastewater problem as well as a stormwater problem. USEPA's Environmental Research Laboratory in Duluth, working through the National Effluent Toxicity Assessment Center (NETAC), reported on the occurrence of diazinon in 28 POTW effluents. Diazinon was found in sixteen (62%) of the effluents, and levels were greater than or equal to 250 ng/L for nine (32%) of the effluents. NETAC concluded in part "The frequency with which we have observed diazinon in the past, in this survey, and continue to find it in effluents is indicative of a widespread problem."

Clearly this is a national problem caused by products that are registered at the national level and sold across the country.

The pesticide registration process provides a built-in mechanism to use monitoring and science to address this national problem. During the registration process, USEPA must review and summarize the findings of studies conducted on each pesticide. During this step, USEPA may request that "registrants" (e.g., pesticide manufacturers) submit specific studies for review. Based on its review, USEPA can confirm, deny, or change the pesticide's registration including approved uses, sites of application, formulations, and label directions.

Local governments are willing to use monitoring and science to further investigate local impacts and sources, and to host case studies, if USEPA will provide financial and other support, with the goal of conducting representative case studies whose results can be extrapolated across the country. But given the established mechanism in the pesticide registration process, it would be inappropriate and ineffective for local governments to do more. USEPA must exercise its federal authorities and use monitoring and science information to make more informed, up-to-date registration decisions.

Conclusion

Rather than being a tool in and of itself, the Pesticide Toxicity Reduction Strategy is really a toolbox. It includes a number of effective tools for reducing pesticide-related toxicity of surface waters–an increasingly important part of urban water resource management and protection. Every job has its tool and in the right pair of hands, the job can be easy and cost-effective to complete. The wrong tool or the wrong hands can make the job difficult, if not impossible to finish. It is the responsibility of government agencies to be clear and disciplined about which tool and which pair of hands go with which job when fixing environmental problems. The extent to which they implement that concept will determine how successful the work of environmental protection will be.

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Administering the NPDES Industrial Storm Water Program at the Municipal Level

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Abstract

As part of the EPA Phase 1 stormwater requirements, certain classes of industries are required to obtain Industrial Storm Water permits. The EPA, or a state agency that has been delegated by EPA, administers these permits. The Phase 1 regulations also require that municipalities develop a program to monitor and control pollutants in storm water runoff from industrial facilities. These are potentially non-coordinated requirements and can result in redundant efforts and a less than efficient program. In addition, EPA and/or state agencies may not have the resources to adequately administrate and enforce the permitting program while leaving the municipality liable for the discharges from the municipal separated storm sewer system (MS4).

The City of Portland, Oregon (City), met the requirement in its municipal storm water permit to control industrial stormwater sources of pollution by developing a Memorandum of Agreement (MOA) with the Oregon Department of Environmental Quality (DEQ), (which is the delegated authority) to administer the permit program. The MOA provided the City with the mechanism to administer the industrial stormwater permits for those facilities that discharge to the City's MS4. The City pursued this approach since it was responsible for the discharge from the MS4 and wanted to ensure that it had adequate oversight of these discharges. By coordinating this effort with other ongoing industrial water quality programs, the City could provide a more cost-effective program, considering the regulatory costs as well as cost to the industry. City Code was developed to support this approach.

When the City took over the administration of the permits in 1994, over 50% of the facilities with a permit had not met the requirements for the development of a storm water pollution control plan, the main requirement of the permit. In addition, nearly 60% of the permitted facilities had not performed the required stormwater sampling. Of the samples taken, approximately 30% violated standards in the permit. It was also evident that not all facilities required to obtain a permit had done so. Efforts since 1994, have shown that only 25–30% of the facilities required to obtain a permit had applied. A benefit of the local administration of the program is the detection of illicit discharges to the MS4. Approximately 15% of all industrial inspections have identified illicit discharges.

The City has also identified certain classes of industries and activities that can be significant sources of pollutants to the MS4. This has helped streamline the program efforts and redirect resources to where the greatest cost benefit will be realized.

Introduction

Stormwater discharges have been increasingly identified as a significant source of water pollution in numerous nationwide studies on water quality. To address this problem, the Clean Water Act Amendments of 1987 required EPA to publish regulations to control storm water discharges under NPDES. EPA published storm water regulations (55 FR 47990) on November 16, 1990 which require certain dischargers of storm water to waters of the United States to apply for NPDES permits. These regulations established NPDES permit application requirements for storm water discharges associated with large- and medium-size MS4s. The regulations also established NPDES permit application requirements for storm water discharges associated with industrial activity. EPA has defined this phrase in terms of 11 categories of industrial activity.

A requirement of the City's application process was "A description of a program to monitor and control pollutants in storm water discharges to municipal systems from municipal landfills, hazardous waste treatment, disposal, and recovery facilities, industrial facilities that are subject to Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA), and industrial facilities that the municipal permit applicant determines are contributing a substantial pollutant loading to the municipal storm sewer system." (40 CFR 122.26(d)(2)(iv)(C). This creates the potential for redundant efforts and a less than efficient program.

The stormwater regulations envision that NPDES permitting authorities and municipal operators will cooperate to develop programs to monitor and control pollutants in storm water discharges to MS4 from certain industrial facilities. The NPDES permits for industrial facilities establish requirements such as controls, practices, and monitoring of stormwater discharges, as well as provide a basis for enforcement actions. An integral part of the requirement is the adequacy of legal authority. This will allow the municipality to implement its program, which should include inspections, review of stormwater pollution control plans, monitoring, and implementation of control measures.

The municipality is ultimately responsible for discharges from its MS4. To meet the requirement in its municipal stormwater permit, and to provide the oversight necessary to protect itself from liability, the City developed new legal authority and entered into an MOA with the authorized NPDES state authority (DEQ), to administer the permits for those discharges to the MS4.

Program Elements

Legal Authority

The City did not have adequate legal authority to oversee discharges to the MS4. In response to this, the City developed code in February 1994. Some of the major provisions of the code are:

- Authority of the Director of Environmental Services to Adopt Rules
- General Discharge Prohibitions
- Discharge Limitations
- Reporting Requirements
- Storm Water Pollution Control Plan (SWPCP)
- Storm Water Discharge Permits
- Inspection and Sampling
- Enforcement

Key elements of the code include the requirement for permit holders to submit their SWPCP and monitoring results to the City, the authority for the Director to adopt administrative rules, make inspections, and undertake enforcements.

Memorandum of Agreement

The City entered into a MOA with the DEQ in March 1994. The MOA delineates the responsibilities for the implementation of the program between the two agencies. The MOA also prioritizes the implementation of the program to address those facilities that are of most concern first. Key elements of the City's responsibilities include:

- Development of an inspection and monitoring program
- Informing DEQ of any new or existing facilities that require a permit
- Enforcement of City Code

Key elements of DEQ's responsibilities include:

- Issuance of NPDES Industrial Storm Water permits upon referral or approval by the City
- Denial of permit applications for process wastewater discharge into the MS4
- Enforcement where the City lacks authority

Inspections and Monitoring

The section responsible for the implementation of the program is an autonomous work group. It is housed in the Source Control Division, which includes the pretreatment program. In November 1994, two inspectors were hired to implement the program under an existing supervisor. DEQ, which had been issuing permits since September 1992, provided a list of facilities with stormwater permits. A letter was sent to the permit holders requesting that they submit their SWPCP and all monitoring results. The letter referenced the MOA and included code citing the City's authority. Inspections were prioritized based on problematic outfalls as determined from information gathered in the Part 1 and 2 application process.

Inspections are usually scheduled in advance with the facility operator but can be performed without notice. Inspection forms are filled out during the inspection and any readily noticeable issues addressed during a post inspection meeting. Technical assistance is provided and information on Best Management Practices given in the form of verbal suggestions and reprints. Facilities are also evaluated for the presence of illicit discharges. All inspections are followed up with correspondence outlining the findings of the inspection and expectations of the industry. Any item where the industry is not in compliance with the permit is highlighted with a deadline to meet compliance before escalating enforcement is pursued. It is the goal of the program to perform annual inspections, at a minimum, of all permitted facilities.

Industries are also inspected if they are identified as potentially needing a permit. These facilities are identified through a systematic search using storm water outfall basins prioritized based on problematic outfalls. The basins are delineated for drainage, the industrial facilities identified within the basin using our database, and facilities selected by SIC Code. Inspections are also performed in response to referrals, drive-bys, complaints, and responses to an industrial survey performed in support of the pretreatment program. Prior to an inspection, building records, existing files from the pretreatment program, and plumbing records are reviewed.

Stormwater sampling of permitted facilities is performed by collecting grab samples at the sample point(s) identified in the facility's SWPCP. Analyses are performed by the City lab. This sampling does not relieve the facility of its stormwater sampling responsibilities. Files are developed on the facilities and maintained separately from the pretreatment files. An electronic database has been developed and is used by both pretreatment and storm water staff.

Enforcement

Enforcement capability was developed in City Code. Where the City does not have enforcement authority, it seeks voluntary compliance and refers enforcement to the permitting authority when necessary.

Funding

The program is entirely funded through a surcharge on the storm water fee for industrial and commercial accounts. The storm water fee is currently based on impervious area. This surcharge also funds portions of other programs that have work related activities because of industrial and commercial storm water discharges. The current staffing level is one supervisor and three technicians. Program costs amount to approximately $280,000 per year. This is primarily composed of salaries and benefits, but also includes approximately $25,000 for sample analyses. The budget also contains funds for the development of BMPs and educational materials.

Findings

Legal Authority

It is essential that legal authority be developed in order to be able to implement and support a municipal program. However, what is contained in the enabling legal authority (code) can vary drastically. It is important that the municipal permit holder review the NPDES Industrial Storm Water permit to determine its adequacy in meeting the municipal permit requirements. Most industrial storm water permits are general permits and they may not adequately address issues for which the municipal permit holder is responsible.

For instance, if the municipality is responsible for meeting TMDLs for a particular water body, the industrial permit may not even require that the facility monitor for these pollutants in its discharge. Provisions should be placed in code that allow the municipality to require the facility to conduct this monitoring. Another example would be the requirement to submit SWPCP and monitoring results to the municipality if this is not included in the permit. Nothing in federal regulations prohibits the municipality from requiring additional controls beyond the permit requirements. A review of the industrial stormwater permits can help identify elements that should be included.

Another provision that should be considered is the ability of the municipality to require a facility to obtain a permit. Currently, federal regulations base the requirement for a permit on SIC Code and exposure. There is a caveat that allows the permitting authority to require a facility to obtain a permit regardless of its SIC Code if that facility is impacting water quality. However, this could require that the municipality undertake sampling and additional work to prove an impact. This reduces the efficiency of the program in terms of resources and uniformity. It may even be necessary to include provisions in the code that allow the municipality to develop its own permit. Such a tactic is time consuming, however, and could create confusion for the regulated community.

Memorandum of Agreement (MOA)

The MOA should be developed to clearly outline the responsibilities between the permitting authority and the municipality. Language should be broad enough not to constrict how the municipality implements the inspection and monitoring program. This allows the municipality to alter the program as information is obtained from inspections without having to alter the MOA. Probably the most important element of the MOA is the delineation of enforcement. Since the municipality does not have authority to enforce permit conditions, language should specify that the municipality will enforce applicable requirements of the Code and seek voluntary compliance where it has no independent enforcement authority. If compliance is not obtained using these methods, enforcement would be referred to the permitting authority.

Inspections

The City has placed the responsibilities for implementation of the program within the Industrial Source Control Division. The section also houses the pretreatment program. It was felt that the responsibilities needed to be separate because of the large number of facilities that are to be addressed. The City has over 24,000 commercial and industrial facilities. Of these, nearly 3,000 have the SIC Code that potentially places them in the permitting program. In addition, a Stormwater Work Group is responsible for addressing other discharges to the MS4, such as pumped groundwater, boiler blow-down, water supply line flushing, washwater, and others.

For the City's situation, this arrangement has worked very well. The Work Group is able to develop expertise in the area while having access to existing information from the pretreatment program. Other municipalities have adopted this approach while others have incorporated the responsibility into the pretreatment program or other existing programs including fire and safety inspections. The municipality needs to consider several items when determining who will be responsible for implementing the program.

- The number and type of industries
- Existing oversight of the industries (pretreatment, hazardous materials,...)
- Existing programs within the municipality

If the municipality decides to place the responsibility in a Work Group that is not dedicated for this purpose, it needs to ensure that adequate resources exist to implement the program and meet the conditions of the MOA. The stormwater program may not be the priority of the assigned work section and if resources become inadequate, this work may be viewed as low priority and may not be addressed at the level that makes it effective.

The City has developed several "partnerships" to expand the inspection program. Informational flyers and a poster were developed for county sanitarians to use when they inspect restaurants. A simple storm water checklist was developed for City commercial recycling staff to use when inspecting retail establishments. In both of these cases, it is important to note that the facilities targeted would not ordinarily be inspected for storm water issues (unless a complaint was received) and that any issues of consequence would be addressed by storm water staff.

Permits

The DEQ has been issuing permits since September 1991. When the City took over administration of the permits in the fall of 1994, 63 facilities that discharged to the MS4 had permits. Since that time, an additional 65 facilities have been identified through inspections of non-permitted facilities. Non-permitted facilities are inspected based on SIC Code and prioritized by outfall basins that have been identified as problematic. This approach was necessary due to the large number of industries within the City that have the SIC Code included in the federal regulations. To perform a general survey of all facilities would have generated much more work than resources allowed. Each site would have to be evaluated prior to the issuance of a permit as the City is a mixture of combined sewers, sumps, and separated storm sewers. Staff members spend a considerable amount of time determining where stormwater drainage discharges. A municipality may be able to utilize this approach if the industrial base is smaller. Federal guidance states that a system-wide approach to establishing priorities for inspections should be developed.

Based on inspections of non-permitted industries to date (approximately 15% require a permit), and the remaining facilities that require inspections, it is estimated that an additional 50-100 facilities will be permitted. Based on these numbers, only 25-30% of facilities requiring a permit had applied when the City took over administration of the program. However, a large percentage of the facilities not requiring permits still had issues that needed to be addressed or were given BMPs that they were requested to implement.

SWPCP

The original general permit developed by DEQ did not require that the permit holder submit the SWPCP. When the City took over administration of the permits, the plans were to be submitted using provisions of the City Code. Over 50% of the facilities (33 of 63) had not developed a plan within the 180 days allowed in the permit, and of these, 14 (22%) had not even developed a plan. It is imperative that the municipality includes provisions in the code to obtain these plans if the provision does not exist in the permit. The requirement to submit the plan allows the City to track its development and review the plan prior to an inspection. Currently, only 5% of facilities have not met the requirement to develop the plan in the required time period.

Unfortunately, there is no requirement in the permit that the plans need to be approved. As long as they contain the necessary elements required in the permit they would be in compliance. This has proven problematic in the quality of some plans. It also restricts the City's ability to require that the facility implement certain pollution control activities. This emphasizes the need to include these provisions in the legal authority. The City has taken the approach of strongly suggesting that certain activities be implemented and incorporated into the plan. Once it is in the plan, it becomes part of the permit and provides a mechanism to require the facility to implement these measures. The City is then able to take the position of providing assistance in evaluating compliance with the permit. By noting these deficiencies and seeking voluntary compliance, the City believes it is assisting the industry in meeting the conditions of their permit and benefiting the environment through the implementation of the SWPCP.

Monitoring

When the City took over administration of the program in 1994, monitoring results were requested from permitted facilities. Nearly 60% (36) of the facilities had not performed the required monitoring for the previous year. Of these, 22 had not taken the required two samples, while the remaining 14 did not perform the complete analyses. Of the samples taken, 30% violated standards in the permit. Within the first year, the City was able to raise compliance on sample collection to over 80% and reduce violations of standards from 30% to 23%. Currently, over 90% of the facilities are in compliance with sample collection. It is more difficult to compare compliance with standards because a new permit was issued in 1998, that includes benchmarks for metals that were not in the original permit.

Monitoring results have limitations because they are grab samples taken from a discharge that is short-term in nature and highly variable. However, they can be used as a tool to measure effectiveness of BMPs and to identify sources of pollutants. Based on sample results, the City has identified several classes of industries that pose significant pollution concerns. These are, in order:

- Automotive recyclers (SIC Code 5015) – metals, oil and grease;
- Recycling industry (5093) - metals, oil and grease;
- Transportation facilities (various 4000) – metals, oil and grease, TSS;
- Heavy manufacturing (33--, 34--) – metals;
- Food industry (20--) – TSS, BOD, oil and grease.

Other SIC Code groups either represent a lower threat as a whole or are not present in the MS4. The City is now using this information to reprioritize their efforts in identifying industries that require a permit. While the City is still pursuing efforts based on outfalls, they are also developing a parallel effort to inspect all the facilities in these classes. In addition, investigation efforts by the City identified the Wholesale Distribution of Construction Equipment (5082) and Heavy Construction Equipment Rental (7353) as significant sources of pollutants. These classes are not included in the federal regulations, but any municipal program should evaluate these facilities.

Enforcement

Enforcement capabilities have been developed in code for those discharges to the MS4. However, the City does not have enforcement capability on permit provisions. The City must seek voluntary compliance and refer those matters to the permitting authority for which they don't have enforcement capability. This has worked to date, but requires coordination between the City and DEQ. When seeking voluntary compliance, the City uses the threat of referral to the permitting authority or third party lawsuits to obtain compliance. To make this effective, the permitting authority must be ready to follow up with enforcement upon the municipality referral.

Funding

As with a number of environmental programs, especially regarding storm water, it is very difficult to measure the cost/benefit until the program has been in place for a period of time. Costs have been identified, and certain benefits have been realized. Compliance with permit conditions, for both industry and the City, have been, for the most part, met. However, has this resulted in a benefit to the environment? City data have shown that industrial land use areas have significantly higher concentrations of pollutants than other land uses. Whereas the industrial land area in the MS4 is only 4%, it accounts for 11% of TSS, 15% of oil and grease, and 24% of metals. It would reason that a program aimed at the highest concentration of pollutants would produce a good return on the investment. Another benefit of the program has been the identification and removal of non-stormwater discharges. Approximately 15% of the inspections have identified non-stormwater discharges, primarily washwater, that were of concern.

Conclusions

The development of a program to monitor and control pollutants from industrial facilities is not one of the six BMPs that Phase II permit holders will be required to be developed. This may be due, in part, to the assumption that all industrial permits would be in place because of Phase I requirements. However, our efforts have shown that only 25-30% of the industries requiring permits had applied prior to the administration of the program by the City.

If a municipality decides to develop and implement a program, it is recommended that it utilizes the accomplishments of Phase 1 applicants. Phase 1 applicants can provide inspection forms, BMPs, MOAs, code language, and other necessary components to develop the program. They can also share results of their work to help prioritize the efforts of the municipality and help decide how to incorporate the work into existing programs. A municipality may also become a co-applicant with Phase 1 permit holders. If this occurs, the applicant will become subject to an industrial control program but may be able to utilize the existing program of the permit holder.

If a municipality does not develop a program, it is recommended that it at least work with the permitting authority to identify who has a permit and the status of their compliance. The municipality should also evaluate the industrial base in the MS4 and provide this information to the permitting authority if it identifies a facility that may be subject to the program. It may be prudent to incorporate these activities into the illicit discharge elimination program, which is a requirement of the permit. Whatever the municipality chooses, it needs to understand that it is ultimately responsible for discharges from its MS4.

Lessons Learned from Three Watershed-Sensitive Development Demonstration Projects in the Great Lakes Basin

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Introduction to The Conservation Fund

The Conservation Fund (TCF) is a national, non-profit conservation organization that purchases and protects land – more than 1.6 million acres since 1985. TCF also assists local communities, private landowners and government agencies with programs that balance conservation with economic development. TCF works with communities to improve water quality, build sustainable economic opportunities, and develop leadership skills, activities that put it at the forefront of conservation across America.

TCF has been active in the Great Lakes Basin since it opened a regional office in 1995. The initial focus of its work was the Great Lakes Watershed Initiative. This basin-wide effort was designed to raise the local visibility of the nonpoint source water pollution issue. The Initiative adapted many of the innovative solutions showcased in the National Forum on Nonpoint Source Pollution. TCF worked with many local partners to launch a network of community-based projects addressing nonpoint source water pollution in urban and rapidly urbanizing areas in eight states and Canada. The Initiative was conducted in partnership with the Council of Great Lakes Governors with major funding from the Great Lakes Protection Fund and Kraft Foods.

TCF expanded several projects as an outgrowth of the Initiative including the watershed-sensitive development work outlined in this paper and a sustainable development effort in Michigan. In Michigan, TCF facilitates a broad, community-based sustainable development effort in the Saginaw Bay watershed. The goal of the initiative, which engages local businesses, community groups, and government agencies, is to better link the environmental and economic well being of Saginaw Bay communities in order to sustain and improve the region's overall quality of life. This year, the project received the National Award for Sustainability from the President's Council for Sustainable Development and Renew America.

Introduction to Conservation Development Project

Currently, TCF is targeting one of the remaining threats to natural resource quality, enhancement, and preservation in urbanizing areas – conventionally designed subdivisions. In partnership with local developers, community groups, and government agencies, TCF is working in the Great Lakes Basin on the Conservation Development project. This project is designed to demonstrate the environmental and economic benefits of watershed-sensitive design through a series of model developments. In particular, we are working to demonstrate the benefits of watershed-sensitive site-planning and best management practices that reduce impervious cover and conserve open space. The current model projects are being developed in Huron, OH, Germantown, WI, and Niles, MI. The George Gund Foundation and the Great Lakes Protection Fund have provided major funding for this project.

We define watershed-sensitive development to include: open space design, significant reduction in impervious coverage, natural stormwater conveyance and storage to the greatest extent possible, and appropriate construction mitigation measures. Watershed-sensitive design can be used to build the same number of houses and still preserve a significant portion of the subdivision's original landscape. These open spaces serve important community and environmental functions. Agricultural land can be farmed, residents can enjoy recreational and aesthetic benefits, and important natural areas and systems can be preserved. Alternative designs also reduce the amount of impervious cover.

Techniques including narrower streets, porous surface parking areas, stream buffers, and open channels for stormwater conveyance minimize runoff from new development and its negative impacts on water resources.

When evaluating potential conservation development projects, The Fund considered the following criteria:

- Local community must be interested and open to new techniques, including flexibility on zoning and subdivision code issues;
- Property already slated for development and conventional development would have significant negative impacts on the site itself or adjacent natural resources;
- Project partners represent one of the dominant development paradigms in the Great Lakes (i.e., professional developer building homes in farm fields, lay developer seeking to hold and protect family or other special lands, government agency seeking to encourage sound practices); and
- Project site is suitable for demonstrating broad array of site design techniques and best management practices (BMPs).

Through TCF's work in the Great Lakes, we gathered many lessons-learned that may be applied to other regional and national efforts. This paper will review many of these lessons with the hope that other communities and organizations will be able to benefit from our experiences. The paper is organized into the four sections listed below:

I. Overall Lessons Learned

1. Not "One Size Fits All"
2. Measurable Criteria for Watershed-Sensitive Development
3. Adequate Oversight and Inspection
4. Incentive System Needed
5. Relationship to Other Smart Growth Movements

II. Lessons Learned about the Development Process

1. Pace of Development Often Incompatible with Innovative Site Design
2. A Greater Initial Investment in the Baseline Information is Necessary
3. Initial Cost of Watershed-Sensitive Developments
4. Deed Restrictions
5. Need Additional Lay Developer Education
6. Aesthetics Do Not Equal Ecology

III. Lessons Learned about Engineering/Site Design

1. Educate the Engineers
2. Lot Size Often Dictated by Septic Issues
3. Need Hard Science

IV. Lessons Learned about Working with Communities

1. Community Initiative
2. Local Official Knowledge Varied
3. Strong Local Partner is Key
4. Final Lessons Learned

Overall Lessons Learned

Not "One Size Fits All"

The approach used to create a watershed sensitive development must be tailored to the individual, organization, or developer creating it. The assistance needed by a private landowner that is seeking to preserve portions of family lands, for example, is quite different from that needed by a professional developer. We found that the models we developed need to take the different skills and goals of the project's initiator into account very early in the process. For example:

Lay developers (i.e., the individual landowners), not surprisingly, need help with the business aspects of the project, and are more inclined to make frequent changes to the preliminary site plan and architectural style of the development. These changes often reflect something the developer has "just learned" or "just considered." These new ideas can add value to the project, but they also require the technical assistants (e.g., landscape architects and engineers) to be more patient, more flexible, and firmer than they might be with professional developers.

Professional developers demand immediate turnaround on requests for assistance, and are looking for "the facts" on what is required to make a development watershed-sensitive. They can be somewhat impatient with the notion that there are not a fixed and specified set of best management practices and site design practices that, if employed, will "always" result in an "environmentally friendly" development.

Measurable Criteria for Watershed-Sensitive Development

As we began to design the model projects, it became apparent that there were no specific criteria available to measure the benefits of the watershed-sensitive design. A tool was needed to encourage developers to fashion environmentally friendly site designs, to help communities add flexibility to their local ordinances, and to provide a standard that can be understood by both homebuyers and existing community residents.

In response to this, TCF developed the Conservation Development Evaluation System (CeDES) as a rating system to evaluate a conservation development over the development's lifetime with emphasis on water quality and landscape impacts. The purpose of CeDES is to encourage developers to think about environmental concerns earlier in the planning process and to provide consumers and communities with a means of assessing the impact of better site design practices. It was developed with input from over thirty national professionals skilled in planning and evaluating conservation developments. It may be viewed at http://www.conservationfund.org/conservation/sustain/gloindex.html.

Adequate Oversight and Inspection

One of the biggest challenges is ensuring that the contractors are building in an environmentally responsible manner. Even if the developer is committed to minimizing the impact of the development on the environment, if contractors are not educated and committed it may not happen. This is a challenge for many local agencies and municipalities who have limited staff for constant inspections. Even if the communities have ordinances that require construction erosion controls etc., without constant inspection many contractors do not follow the requirements. The nonpoint source pollution from construction, especially the sediment loadings, can negate any benefits from the alternative site design. One recommendation is for the community to require that an environmental inspector be hired specifically for the site. The inspector may be from a consulting firm or from a local Soil and Water Conservation District.

Incentive System Needed

We expect that this process will proceed much more quickly in communities that have recognized the threats conventional developments pose and have begun developing strategies to address them. In order to expand conservation development practices to a broader constituency, state or county agencies may need to develop incentive programs that prompt local developers to undertake these projects. With each community, we encouraged the creation of incentives for watershed-sensitive development. These included density bonuses for the developer through credits for land preservation and minimization of impervious coverage. We also investigated the use of the Clean Water Act State Revolving Fund (SRF). Among other uses, these funds are used to reduce nonpoint source pollution and could encourage watershed-sensitive development. The State of Ohio has successfully used the SRF for this purpose and we hope to pilot the same use of the SRF loans in other states. Incentives such as Ohio's loan program, coupled with the higher financial returns these developments are expected to generate, are making watershed sensitive developments more the norm in the Great Lakes Basin.

Relationship to Other Smart Growth Movements

There are many "Smart Growth" movements currently being debating and promoted throughout the country. Watershed-sensitive development is just one part of the equation. At times, we were challenged to show how this fits into overall community sustainability efforts. The work that the National Site Planning Roundtable completed to develop "Better Site Design" principles has been invaluable in demonstrating how these different movement can work together (Center for Watershed Protection, 1998). We often say that watershed-sensitive development is one option for Smart Growth but that a community needs to find the correct planning principles to work for their residents and issues. Those in the Traditional Neighborhood Design (TND) movement challenge putting sidewalks only on one side of the street, which we recommend for reducing impervious coverage. We also suggest that if sidewalks are on both sides of the street at least one should be made of pervious materials. There also are environmental groups that challenge us for encouraging greenfield development instead of infill development. Again, watershed-sensitive development is only one option of many and if the market is going to demand suburban fringe growth, at least we can work with the communities and developers to ensure that it is done with maximum possible protection and enhancement of the natural resources.

Lessons Learned about the Development Process

Pace of Development Often Incompatible with Innovative Site Design

The pace of development and the pace of government decision-making often are absolutely incompatible. Developers with outstanding loans on land need to move quickly to ensure a development is economically viable. Government agencies, on the other hand, are very concerned about the impacts of development, but move very cautiously, especially when they are undertaking something new. The result is that it is easier for both government and developer to create conventional, environmentally harmful developments than to do something better.

On the demonstration projects, TCF took special care at the outset of the process to communicate the timelines of each participant to the other. In this way, we hoped to keep the parties from throwing up their hands and giving up. For the region, however, we explored possibilities to get communities to adopt "fast track" approvals for watershed-sensitive communities. The first need is to show municipal authorities that these developments deliver tangible benefits, then we can help them develop mechanisms such as a streamlined review process and updated subdivision and zoning ordinances that encourage their creation.

A Greater Initial Investment in the Baseline Information is Necessary

Before planning a watershed-sensitive development, fairly detailed baseline information including topography, soils, and wetlands delineations is needed. Although developers hope that they get enough of the baseline site information before beginning design work, inevitably the risk/benefit of doing extensive baseline work (e.g., soil borings) may preclude the developer from getting all of the necessary baseline data. The common practice is to use "engineering judgment" based on existing data and extrapolation to the rest of the site. Unfortunately, especially when the drainage plan is an integral part of the initial site design, relying on "engineering judgment" simply is not sufficient. For example, on the Ohio site we relied on the existing soils information to design the swale system. After presenting a preliminary site plan, the developer discovered through additional research and sampling that the available soil information did not accurately represent the existing soil conditions and the drainage plan had to be reconstructed.

Initial Cost of Watershed-Sensitive Developments

Planning and developing a watershed-sensitive development takes time and costs money. Both lay and professional developers often underestimate these initial costs. Professional developers often leave site planning to their engineers. The engineers typically obtain a wetlands delineation and examine soil and topography maps, but do not evaluate the site from a watershed or ecological perspective. Although lay developers may be more familiar with the special features of their properties than professional developers, both need help to catalog all the features and to understand the site's role in the surrounding landscape. Quite reasonably, professional developers often are unwilling to undertake these expenses until they have a sense of the project's scale and niche in the market. We believe, and existing watershed-sensitive developments indicate, that the costs of evaluating a property from an ecological and a watershed perspective will be recovered when the development is sold out.

Deed Restrictions

The deed restrictions (i.e., covenants, conditions, and restrictions) necessary to ensure that the development will continue as a watershed-sensitive development in perpetuity are a lot more extensive than typical deed restrictions. Early in the process, sample restrictions for various developments should be presented to the developer and to the community so that they understand the consequences of using some of the watershed sensitive techniques. The developer will gain an appreciation for the long-term commitment necessary for a successful development and local officials may be put at ease when they recognize that major additional responsibilities (e.g., swale maintenance) rest with the homeowners association and not the local government.

Need Additional Lay Developer Education

Private landowners need to be assisted and educated through the process. Although these initiators often have a deeper environmental commitment than professional developers, they often do not understand what kinds of activities on their properties will have negative watershed impacts. For example, on one of our projects, the lay developer suggested that a pond be built each time an area of low-lying ground is found to be wet most of the year. Once informed about the relationship of these areas to more prominent wetlands on the site, the developer agreed to treat these areas more appropriately (i.e., preserving and enhancing the existing wetlands). The professional developers understand stormwater and wetlands issues better because they operate in the regulatory arena. The lay developers may need to be educated about the significance of these issues and other issues that are common knowledge to professional developers.

Aesthetics Do Not Equal Ecology

Another aspect of landowner education is the principle that aesthetics do not equal ecology. Just because a development preserves or creates attractive green spaces does not necessarily indicate that it is not harmful to the surrounding watershed. Accordingly, the criteria we developed for watershed-sensitive development (see discussion above under Measurable Criteria) incorporate appropriate baseline evaluation of the site to insure key resources are protected, and a thorough analysis of the stormwater impacts after development.

Lessons Learned about Engineering/Site Design

Educate the Engineers

If any of the county, township, or city engineers are not comfortable with the techniques being used, they can turn down the project at any point in the review process. In all three of our projects, the "old-timer" engineers were extremely conservative and feared change more than any other local officials. We found that the developers' engineers need constant oversight and education to design the sites using the watershed-sensitive techniques. Unfortunately, without a broad effort to educate engineers, they will have to be educated one community or county at a time. Once these techniques become more commonplace, we assume that such a great initial effort will not be necessary.

Lot Size Often Dictated by Septic Issues

Wastewater issues often control the form, location, and economic feasibility of a new residential subdivision. In many parts of the Great Lakes region, heavy clay soils strictly limit the functioning of conventional septic systems. For this reason, lot size is frequently dictated by septic issues as much as by local zoning. Although there are some alternate systems (e.g., constructed wetlands and community systems) being piloted and used in the region, local health officials are very cautious about permitting them. This caution arises both from concerns about their technical functioning and about long term maintenance issues. Communities already feel burdened by the need to monitor individual septic systems. They are skeptical about a homeowner association's ability to reliably maintain a community treatment system.

Wastewater treatment issues should be considered up front in evaluating the feasibility of clustering homes on a particular site. If a public sewer does not serve the site, clustering probably will not work as well (i.e., the individual lot sizes will not be able to be reduced as much). There is the possibility of placing the leach fields in the common property to increase the overall open space percentage.

Need Hard Science

Although there is a great deal of national literature detailing watershed-sensitive development techniques, there is not a lot of research documenting the extent of the water quality benefits they provide in the field. The Center for Watershed Protection (CWP) recognizes that there is a lack of water quality monitoring data that evaluates the techniques in varied site conditions and is working to develop and encourage more studies. Through consultation with the CWP, the Northeastern Illinois Planning Commission, and the Wisconsin Department of Natural Resources (WDNR), we found that funding for long-term monitoring of these techniques is scarce. Without this data, many of these techniques may be challenged successfully by skeptical local officials. With the assistance of Old Woman Creek Estuarine Research Reserve, one of our local partners, we are monitoring the water quality at the Ohio site. We hope that they will be able to continue the monitoring after our grants are over. We also are working with the WDNR to secure funding for long-term water quality monitoring at the Germantown site. It is our hope that this information will continue to back up many of the claims of watershed-sensitive development and that funding will continue to support these efforts.

Lessons Learned about Working with Communities

Community Initiative

Without community buy-in and interest in these concepts, even the most enlightened developer is not going to be able to get a project approved. When we first started this project, we thought that the developers were going to be the "hard sell." In two out of three of the communities, it actually has been the communities that needed more education. In the Huron project, the developer was sold on many of the alternative site design techniques until he kept getting negative feedback from the township board. This site was chosen because of the commitment of the developer and the obvious benefits to the surrounding water resources. What was not realized was how much resistance there would be in the political arena. At this project, we had several informal meetings with local officials prior to presenting a conceptual plan, but because the process was developer-initiated, they continued to be resistant throughout the process.

Local Official Knowledge Varied

Municipal, county, and state officials with similar regulatory responsibilities often have very different views about the appropriateness of new techniques. Although there are no hard and fast rules about who is likely to be more progressive, disagreements are common and a primary cause of frustration among developers.

As development is now regulated, it is more expensive and time-consuming for a lay or professional developer to create a watershed-sensitive development. The only way for a developer to address this situation is to inform local regulators and planning officials about the project early on, and to involve them in the process. Unfortunately, this involvement will probably not speed up the process for the individual developer, but after a few such projects are launched, we believe the barriers for these kinds of developments will be lowered.

Getting everyone with a regulatory or permitting role on a project involved at the very beginning is absolutely vital. If a project that includes techniques that have not been implemented in the region before gets too far along before all the regulators and municipal officials are brought in, the "stranger to the deal" can feel left out and derail the project. Much of this problem will be allayed once a few watershed-sensitive developments are built, but until then, developers and regulators pushing for these practices need to make special efforts to get everyone to the table early. Of course, this process increases the costs of doing the development initially, but it can keep it from falling apart after significant site planning and related costs are incurred.

Strong Local Partner is Key

Throughout this project, TCF acted as a facilitator between the communities and developers and as a representative of the silent third party, the environment. We believe that as each community begins to look at this type of development, this third party is key to the success of a project. Although there are many merits to approaching communities as a national organization, without a primary local partner who is well-versed in the trials and tribulations of the development process (or willing to learn them), it is difficult to proceed. A preferable arrangement would be a local organization, such as a land trust, leading the effort with support from a regional or national organization or technical assistance center. A local organization will have a greater vested interest in and knowledge of the local environment, will know the local officials and political and personal histories, and will be able to track and monitor the day-to-day activities surrounding the development. In the long term, local land trusts may become a key player in this area. They understand land conservation and watershed issues, frequently have close ties with both local landowners and local government officials, and have some comprehension of the development industry.

Final Lessons Learned

Several realities of the development process that have little to do with the challenges of watershed-sensitive development are important to mention for groups and communities considering this type of project. One is that the personalities and reputations of the developers can make or break a project. On our project in Ohio, the developer apparently had a "history" with several of the plan commissioners. Our partners in the community think that the plan commission and the engineers were being unduly unfair during the review process. Also, one of the developers in Wisconsin has a reputation for "low-end" development. Because of this reputation, the Village is afraid that the developers will do their typical development in their town.

Another reality of the development process is that the Village Planner of Germantown estimated that 60% of submitted development plans are reviewed by the plan commission and less than 50% of zoning requests are approved. All of our projects include a zoning request because the current local ordinances do not include a provision for watershed-sensitive development.

Conclusion

At all three of our model sites there are already signs of new developments being proposed with many of the watershed-sensitive techniques. In Wisconsin, the developer was approached by neighboring communities to design similar subdivisions. In Michigan, several local officials have stated interest in adding language in their new ordinances that would encourage this type of development. In Ohio, our local agency partner, Old Woman Creek National Estuarine Reserve, was approached by a developer who has been watching the process and is interested in using some of the techniques at an adjacent site. While the review processes for all three projects have not been as easy as anticipated, it is expected that the next round of developments will have an easier time because of the trailblazing work done before them.

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Continuous Deflection Separation (CDS) for Sediment Control in Brevard County, Florida

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Abstract

In July 1997, Brevard County's Stormwater Utility Program installed a new type of trash and sedimentation control device called a Continuous Deflection Separation (CDS) unit. This was the first American installation to use the CDS technology, which was developed in Australia. After installation, autosamplers were placed upstream and downstream of the CDS unit and a year's duration of sampling data collected. Monitoring has shown that the CDS unit has provided an average 52% removal efficiency for total suspended solids and 31% removal efficiency for phosphorus.

Introduction

Stormwater sedimentation is a primary source of pollution to Florida's Indian River Lagoon. Suspended solids and turbidity reduce sunlight penetration in the lagoon which negatively impacts seagrass growth. Where land is available, detention ponds effectively reduce most of the suspended solids from stormwater flows. When land is not available, alternative, less effective, treatment methods must be used.

The CDS technology was initially developed in Australia to provide an effective method for trash and solids removal from stormwater flows. The screening action within the unit provides for 100% removal of trash and particles down to 4700 microns. In addition, the unique circular design creates centrifugal action within the round concrete box which propels suspended solids to the center of the box and down into the storage chamber.

Methods

The location chosen for the CDS unit installation was along a ditch at the north end of Brentwood Drive, south of Port St. John. The drainage basin for this location was 24.87 hectares (61.45 acres) in area. This basin has Type A soils along a sand ridge. The land uses are 24.87 hectares (6.7 acres) of roadway (US Highway 1), 8.04 hectares (19.87 acres) of industrial park, 9.47 hectares (23.39 acres) of vacant land, and 4.65 hectares (11.49 acres) of commercial property. The industrial area has a permitted stormwater system. A significant land feature is a 2.02 hectares (5 acre) dirt parking lot, 152.4 meters (500 feet) upstream of the site around a local restaurant. This parking lot has a steep slope and is composed of fine white base material. There is evidence of heavy silt buildup in the inlets and pipes downstream of this parking lot, along US 1.

There is an earthen ditch running eastward 76.2 meters (250 feet) upstream from the project location. At the project site, there is an existing 122 centimeter (48 inch) RCP driveway culvert in the ditch which discharges to a concrete channel running 152.4 meters (500 feet) eastward to the Indian River. The time of concentration to the site is 63 minutes, with a 10-year flow of 1,557.2 L/sec (55 cfs) and mean annual flow of 1,177.9 L/s (38.2 cfs). In Brevard County, the 10-year storm is 20.1 centimeters (7.9 inches) of rainfall and the mean annual storm is 13.97 centimeters (5.5 inches) of rainfall. There is no base flow at this location.

A diversion weir 68.58 centimeters (27 inches) tall is placed in front of the 122 centimeter (48 inch) culvert so as to divert flows over 254.8 L/sec (9 cfs) around the unit. In 18 months of observations, the water level has risen over the weir one time.

A 76.2 centimeter (30 inch) concrete pipe was constructed adjacent to the existing 122 centimeter (48 inch) pipe in order to divert flows to the CDS unit. The 76.2 centimeter (30 inch) pipe enters the CDS unit tangentially to start the circular flow within the unit.

The CDS unit consists of three circular, concrete chambers stacked on top of each other. The top chamber, where the water enters the unit, has a 1.524 meter (5 feet) inner diameter and is 188 centimeters (74 inches) tall. The middle chamber has a 2.44 meter (8 feet) inner diameter and is 127.54 centimeters (51 inches) tall. In the middle chamber is a 1.524 meter (5 foot) diameter stainless steel screen matching the walls of the top chamber. The screen has 4700 micron holes to filter larger materials. The bottom chamber has a 1.22 meter (4 foot) inner diameter by a 1.22 meter (4 foot) tall sediment sump.

Water enters the unit in a clockwise rotation. When the water passes through the screen, it flows counter-clockwise between the screen and outer wall until it reaches a 76.2 centimeter (30 inch) concrete pipe. This exit pipe is tangentially placed for smooth exit flows. The elevation of the exit pipe rises 96.52 centimeters (38 inches) from the lower chamber to the outflow channel downstream of the 122 centimeter (48 inch) culvert. This rise in elevation keeps the normal water level in the unit near the top of the second chamber at all times. There is no base flow at this location.

The top of the unit is flush with the surrounding ground and has a 0.91 meter (3 foot) square, lockable, stainless steel access cover. This feature allows for easy access with a vacuum truck for cleaning purposes.

The CDS unit was installed on July 17, 1997. Installation took two days with the precast structures. A large crane was required to lift the chambers into place. A 4.57 meter (15 foot) deep hole was excavated for the structure.

In conjunction with the CDS unit installation, County forces cleaned the ditch upstream of the unit. Two days later, a significant rainfall event occurred and 2,294 kilograms (6,600 pounds) of sediment from the upstream ditch was trapped in the unit. After that storm, the ditch was reworked and sod was laid. The sod greatly reduced the volume of sediment washing into the unit.

Cleanouts were also performed on November 17, 1997, removing 626.84 kilograms (1,382 pounds) of sediment and 2.88 meters (34 cubic feet) of trash and debris, and again on May 6, 1998, with 998 kilograms (2,200 pounds) of sediment. The solids removed from the unit are taken to the Brevard County landfill for disposal. The volume of water stored in the unit is greater than the vacuum truck capacity, so decanting is performed on nearby sandy soils to avoid a second trip to the landfill for disposal.

Evaluation of the CDS Unit During Storm Events

The intent of the sampling was to evaluate the effectiveness of the CDS unit in removing pollutants from a storm event prior to discharging stormwater into the Indian River Lagoon.

Five storm samples were collected at the CDS unit between April 1998 and March 1999. The storm events occurred after dry periods ranging between 7 and 75 days. Protocol for this program dictated that if the sample collection devices (autosamplers) were triggered at intervals of less than three days between storms, the samples were to be discarded. This situation did not occur during the year, and near-drought conditions were observed in the sample area throughout most of the year-long monitoring program.

Rainfall was measured at the sampling site by a tipping bucket rain gauge, and additional rainfall data obtained from the Orlando Utilities Commission (OUC) power generating plant 5.6 km (3.5 miles) to the north of the CDS installation.

Review of the rainfall data collected indicates that the majority of the water passing through this BMP was from precipitation falling on the upland, 18.72 hectare (46.25 acre) watershed. The variation noted in both coverage and amount of rainfall helps illustrate the localized nature of the storms occurring along the Lagoon coastline. During this sampling period, water flowing off the drainage basin contributed much more flow through the CDS unit than would have been expected based on the rainfall recorded at the sample site.

Samples were collected through the use of automated storm water samplers; one at the inlet and another at the outlet pipe of the CDS unit. All samples, associated blanks, and duplicates were collected in accordance with our state-certified Comprehensive Quality Assurance Plan.

The stainless steel intake strainers for the samples were mounted on the reinforced concrete pipe, slightly off center bottom, and both angled away from the flow. This was to prevent the strainers from becoming silted over by sediments and allow collection of representative water samples. Flow rates during the storm events were measured initially utilizing water level meters (ISCO bubbler type) in conjunction with a 90-degree V-notch weir, but eventually replaced with a Doppler area-velocity flow meter which provides a more accurate flow assessment. Initially, two bubbler meters were installed with both bubbler tubes mounted on the upstream weir. However, this led to difficulties in estimating just when to trigger (time delay) the downstream sampler in order to collect samples from the same "plug" of water.

During the first three sample events, water levels recorded were correlated to flow, and the samples were manually composited to give a flow-weighted composite sample from each sampler. Both inlet and outlet sample sets were composited identically, in accordance with the EPA NPDES Stormwater Sampling Guidance Document (July 1992). Discreet samples were collected for the fourth and fifth events.

It was intended that the third sample event would include a mass balance calculation. The CDS unit sump was thoroughly cleaned utilizing a VAC-truck to ensure that the material collected was a result of the one storm to be evaluated. Inlet and outlet stormwater composite samples were again collected, with the addition of a sediment (Table 1) and water column sample from the sump. Sediment depths were measured at five locations; four from the corners of the lid opening and one in the center. Based on a depth of 13.21 centimeters, a sump diameter of 1.22 meters (4 feet) and an estimated 1,410.6 kg/m3 (88 lb/ft^3), (based on previous sediment weight evaluation), approximately 217.3 kilograms (479.2 pounds) of sediment was collected in the unit from storm three. Based on the concentrations measured, 126.07 grams (4.443 ounces) BOD 5, 33.587 grams (1.184 ounces) of metals, and 122.81 grams (4.33 ounces) of Total Kjeldahl Nitrogen (TKN) were removed.

Table 1. Sediment Chemical Analysis For Storm #1

Parameter	Sediment Grab	Grab Duplicate	Average Value	Detection Limit	Units
Arsenic	0.096	0.11	0.103	0.069	Mg/Kg
Barium	3.4	2.9	3.15	0.14	Mg/Kg
Benzo(b)fluoranthene	260	ND*	250*	240	Ug/Kg
BOD5	650	510	580	2.7	Mg/Kg
Cadmium	0.03	0.033	0.0315	0.014	Mg/Kg
Chromium	1.1	1.1	1.1	0.027	Mg/Kg
Copper	1.2	0.95	1.075	.0.027	Mg/Kg
Iron	220	260	240	0.55	Mg/Kg
Lead	2	2.2	2.1	0.041	Mg/Kg
Nickel	0.4	0.36	0.38	0.069	Mg/Kg
Silver	0.16	0.059	0.1095	0.014	Mg/Kg
Total Kjeldahl Nitrogen	450	680	565	37	Mg/Kg
Total Phosphorus	79	230	154.5	9.2	Mg/Kg
Zinc	14	14	14	0.27	Mg/Kg

Notes:
Equipment Blank Water Yielded ND for all listed analytes.
*The benzo(b)fluoranthene mean value was calculated with the RDL as the lower value for the duplicate.

Only parameters with values above detection limit are listed. Many others were tested below detection limits.

For this third sample event, the upstream, or intake flowmeter bubble tube was mounted on the 90-degree V-notch inlet weir, as it was for previous sample events. The downstream bubbler, however, was moved and attached to the downstream discharge pipe. This change was necessary to account for the lag time between when the first sampler received flow at the beginning of the storm, the time required to fill the sump with 8,115 liters (2,144 gallons), and discharge to flow past the second sampler several minutes later. The problem encountered with this revised setup was that the upstream V-notch weir used to determine the flow was overtopped, allowing flow around and over it, preventing an accurate flow measurement. This led to disparity in the estimation of actual flow through the unit. Due to the questionable flow measurements, it was not possible to calculate the mass balance.

For the fourth sample event, an ISCO Doppler area-velocity flow meter was mounted in the bottom of the outfall pipe of the CDS unit. Upon registering a water level rise of one inch, this unit triggered both upstream and downstream autosamplers. The autosamplers were synchronized, collecting a bottle set in each ISCO at the same time. With this methodology and placement, overtopping the weir, flow bypassing, and pressurization were no longer potential sources of error. Since the samplers now triggered only when the sump was full, it was also somewhat easier to accept the premise of "what went in, must have come out."

Appropriate trigger points were selected in order to allow sufficient water depth for the velocity meter probe to operate properly. We found that the Doppler area-velocity flow meter probes appear to function erratically when covered by less than one inch of water, and believe that measurements taken when the water was at this depth are suspect. Two-bottle sample sets were collected at sampler initiation, and at 10-minute intervals during the storm. During previous sample excursions, samples were manually composited. Due to a high suspended solids content, (heavy particles including sand) that rapidly settled in the sample container, it was questioned whether the composite samples were truly representative of the solids collected. Therefore, discrete two-bottle sets collected every 10 minutes were sent to the laboratory without being composited.

For the fifth sample event, two-bottle sample sets were again collected at sampler initiation, and at 10-minute intervals during the storm. As with the previous sample event, sample sets were not composited but sent for analysis as six individual, two-bottle sets. The sample bottles for bottle sets six were not collected due to insufficient water to cover intake strainers, as the storm was not of adequate duration to produce the last 10-minute sample. Because of numerous problems encountered in the previous storm event samplings, along with refinements in sampler setup and flow measurement, the fifth storm sample event is considered the most accurate to determine what pollutant reduction is provided by the CDS unit for that storm. The individual two-bottle sets showed the variation in pollutant loadings throughout the storm event and the corresponding removal under the varying loads. Unfortunately, this was the lowest flow storm encountered, which may account for higher than normal removal efficiency. Maximum flow was estimated to be only 136 liters/sec (2.16 gpm). The average pollutant reduction between inlet and outlet samples for this event was: BOD5 53%, COD 52.6%, TP 36%, TSS 56%, and Turbidity 74.8%.

Sample results are presented in Tables 2 through 4 for the five sample events. Storm event 2 showed a 23% reduction in turbidity, but no reduction in the other parameters. Storm 4 showed an increase in most parameter concentrations between inlet and outlet that could not be attributed to resuspension due to a full sump, since the sump had been cleaned prior to the third event. Data for these two storms are therefore suspect. For events 1, 3, and 5, the average removal efficiencies for those parameters that showed a reduction were: TSS 52%, Turbidity 46.9%, BOD 34.2%, COD 35%, and TP 30.6%

After each sample event, field observations were made of the appearance of the sample jars, each containing a water sample that had been collected at progressive ten-minute intervals throughout the storm flow. Outlet samples typically appeared to be less turbid than the corresponding inlet samples, and also had less sediment on their bottoms. An observation was also made of the water surface inside the CDS unit proper. There was typically a thick layer of floating grass and other vegetation, an oil sheen, glass and plastic bottles, plastic sheets and bits, seeds and nuts, sticks, and a surprising amount of Styrofoam cups and particles.

Table 2. Storm #1-#3 Test Results - Composite Samples

STORM 1	pH SU	Total Suspended Solids mg/l	Turbidity NTU	BOD5-Day mg/l	COD mg/l	Total Phosphorous mg/l
CDS Inlet	7.6	220	180	28	150	1.4
CDS Outlet	7.4	110	100	23	110	1
Change	0.2	100	80	5	40	0.4
Percent Reduction	3%	50%	44%	18%	27%	29%

Maximum flow rate = 5.488 liters/sec (87 GPM, 0. 19 cfs)
Storm Duration = 67 minutes
Rainfall @ OUC 0.254 cm (0. 1 inch), @ SITE not recorded

STORM 2	pH SU	Total Suspended Solids mg/l	Turbidity NTU	BOD5-Day mg/l	COD mg/l	Total Phosphorous mg/l
CDS Inlet	8.4	350	440	8.2	20	0.86
CDS Outlet	8.2	350	340	8.2	20	0.86
Change	0.2	0	100	0	0	0
Percent Reduction	2%	0%	23%	0%	0%	0%

Maximum flow rate = 8.39 liters/sec (133 GPM, 0.3cfs)
Storm Duration = 68 minutes
Rainfall @ OUC 1.778cm (0.7 inch),.@ SITE 0.0762 cm (0.03 inch)

STORM 3	pH SU	Total Suspended Solids(mg/1)	Turbidity NTU	BOD5-Day mg/l	COD mg/l	Total Phosphorous mg/l
CDS Inlet	7.6	300	110	12	71	1.3
CDS Outlet	7.6	150	86	8.2	53	0.95
Change	0	150	24	3.8	18	.35
Percent Reduction	0%	50%	21.8%	31.7 %	25.4	27%

Maximum flow rate = 149.75 liters/sec (2374 GPM, 5.29cfs)
Storm Duration = 113 minutes
Rainfall @ OUC 4.064 cm (1.6 inch), @ SITE 1.27 cm (0.5 inch)

Table 3. Storm #4 Test Results - Discrete Samples

Set 1 @ initiation	BOD5-Day (mg/1)	COD (mg/1)	pH (SU)	Total Phosphorous (mg/1)	Total Suspended Solids (mg/1)	Turbidity (NTU)
Inlet 1	2.1	2	8	0.32	690	99
Outlet 1	5.4	2	7.8	0.19	320	120
Change	+3.3	0	-0.2	-0.13	-370	+21
Percent Reduction,/Gain	+61%	0"%	-3%	41%	-54%	+18%
Inlet 2	6.6	15	8.3	1.2	1400	1800
Outlet 2	7	18	8.4	0.94	1600	1000
Change	+0.4	-3	+0.1	-0.26	+200	-800
Percent +/-	+6%	+17%	+1%	-22%	+13%	44%
Inlet 3	6.7	25	8.2	1.2	830	530
Outlet 3	6.7	24	8.3	1.5	550	430
Change	0	-1	+0.1	+0.3	-280	-100
Percent Reduction/Gain	0%	-4%	+1%	+20%	-34%	-19%
Inlet 4	6.3	45	8.1	1.6	330	200
Outlet 4	NT	NT	NT	NT	NT	NT
Change	Na	Na	Na	Na	Na	Na
Percent Reduction/Gain	Na	Na	Na	Na	Na	Na
Inlet 5	5.6	33	8	1.6	290	300
Outlet 5	6.4	30	8.2	1.6	170	260
Change	+0.8	-3	+0.2	0	-120	40
Percent Reduction/Gain	+13%	-9%	+2%	0%	41%	-13%
Inlet 6	6	39	7.9	1.6	220	120
Outlet 6	6.3	33	8.2	1.5	270	230
Change	+0.3	-6	+0.3	-0.1	+50	+110
Percent Reduction/Gain	+5%	-15%	+4%	-6%	+19%	+48%

Maximum flow rate = 60.30 liters/sec (956 GPM, 2.13 cfs)
Storm Duration = 55 minutes
Rainfall @ OUC 2.794 cm (1.1 inch), @ SITE 0.006 cm (0.002 inch)

Table 4. CDS Storm #5 Test Results - Discrete Samples

	BOD5-Day (mg/1)	COD (mg/1)	pH (SU)	Total Phosphorous (mg/1)	Total Suspended Solids (mg/1)	Turbidity (NTU)
Inlet 1	4.6	68	7.8	0.23	49	16
Outlet 1	4.0	18	7.9 1	0.18	11	4.3
Change	-0.6	-50	+.1	-0.05	-38	-11.7
Percent Reduction/Gain	13%	74%	1 %	22%	78%	73%
Inlet 2	10	51	7.8 1	0.25	59	38
Outlet 2	3.8	23	7.9	0.18	19	6.9
Change	-6.2	-28	+.1	-0.07	-40	-31.1
Percent	62%	55%	1%	28%	68%	82%
Inlet 3	13	55	8.2	0.3	23	23
Outlet 3	4.7	33	7.6	0.18	21	12
Change	-8.3	-22	-0.6	-0.12	-2	-11
Percent Reduction/Gain	64%	40%	7%	40%	9%	48%
Inlet 4	9.9	53	9.2	0.35	39	61
Outlet 4	3.9	29	7.7	0.18	15	7.2
Change	-6	-24	-1.5	-0.17	-24	-53.8
Percent Reduction/Gain	61%	45%	16%	49%	62%	88%
Inlet 5	9.6	53	9.4	0.29	35	56
Outlet 5	3.4	27	7.6	0.17	13	9.4
Change	-6.2	-26	-1.8	-0.12	-22	-46.6
Percent Reduction/Gain	65%	49%	19%	41%	63%	83%
Average Percent Change	53%	52.6%	- %	36%	56%	74.8%

Maximum flow rate 0.136 liters/sec (2.16 GPM, 0.005 cfs)
Storm Duration =50 minutes
Rainfall @ OUC 1.016 cm (0.4 inch), @ SITE, 0.5842 cm (0.23 inch)

Conclusions

While none of the sample events were a perfect combination of a good flow and everything working right, the data collected, and our observations, certainly indicate that the CDS unit is operating as intended and removing significant quantities of debris and suspended materials prior to discharge to surface waters. It was quite impressive to prevent this trash and sediment from washing out into the lagoon during a normal rain.

The phosphorus removals observed for the CDS Unit, as with any BMP of this type, will not have a high degree of accuracy, due to leaching of nutrients from grass, leaves, and other organic debris. If there are no base flows, these leached nutrients will be washed out with runoff and skew sample readings. A much more comprehensive analysis is available in the library of the web site www.stormwater-resources.com.

Future Evaluations

More data are necessary to further evaluate this BMP. Due to the inherent inaccuracies in water quality sampling, additional determination of the efficiency of this type of BMP could be made by conducting a mass loading and sediment evaluation. Much of the sediment collected in this type of BMP is invisible to current testing techniques since it is comprised of large particles that roll along the bottom of the pipe. Yet, known quantities of sediment are being collected.

A previous study of baffle boxes resulted in the same conclusion. Future sediment analysis from the CDS unit could be compared to the baffle box data previously collected. Brevard County will be conducting a sediment evaluation at three baffle box sites over the next 12 months that will provide additional comparison. As time permits, Brevard County will also collect additional sediment data from he CDS unit.

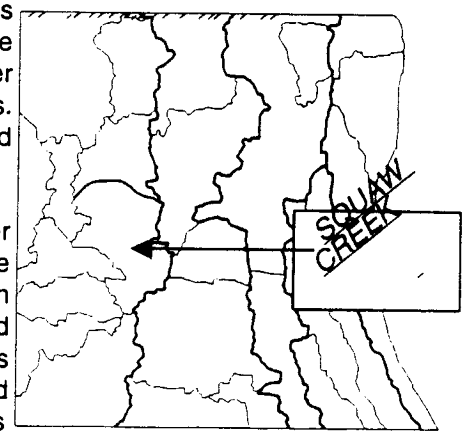
Use of Automated Technologies in Watershed Management Planning

Lake County Stormwater Management Commission (SMC)
Libertyville, IL

Introduction

The Lake County Stormwater Management Commission's (SMC) is working with many agencies to develop comprehensive watershed plans. These watershed plans involve data collection and collation, problem analysis, alternative solutions identification and action plan development. The watershed assessment includes hydrologic and hydraulic modeling; floodplain and floodway mapping; and water resource assessment. As part of a watershed management plan, one of the end results is to update floodplain maps and to map depressional storage areas. Other end products of this effort include location maps of water resources, including wetlands and regional detention sites, with identification of those needing preservation, enhancement or restoration. With this information, projects can be prioritized and cost estimates determined in order to assist local governments in implementing the action plans.

Lake County, Illinois is located in the northeastern corner of Illinois and is one of the fastest growing counties in the country. The county has 61,000 acres of wetlands (12) and 400 miles of streams and rivers throughout its 480 square miles. The combination of growth and the need to protect natural resources is driving the Lake County Stormwater Management Commission's (SMC) comprehensive watershed planning efforts. Plans are currently being developed for urbanizing watersheds between 2 and 50 square miles in area.



Map 1: Lake County, Illinois, Sub-Watershed

With limited personnel and funding, SMC is utilizing in-house computer capabilities and staff technical expertise to save time and money as we increase our ability to model and display watersheds. The Squaw Creek Plan is an example of how SMC is currently utilizing automated technology for watershed planning purposes. The Squaw Creek watershed is 25.5 square miles and is 75% undeveloped (includesagriculture, vacant and open space). The watershed is 17.3 percent wetlands. TheNorthern Illinois Planning Commission forecasts a 155% population change between 1990 and 2020. The Squaw Creek Watershed is located in the western portion of the county and drains into Fox Lake, on the Fox River.

SMC is integrating Geographic Information System (GIS) (2) technology with Computer Aided Design (CAD) and the Army Corps of Engineer's HEC-1 (10) and HEC-RAS (11) models to create an "automated" watershed closely resembling the existing Squaw Creek watershed characteristics. SMC used a variety of vendor software packages that include Environmental Systems Research Institute, Inc.'s (ESRI) ArcView (1) and its Spatial Analyst and Hydrologic Extensions, and Bentley's MicroStation.

Data Collection

It is very important to determine the methodologies for collecting, calculating, and analyzing data early in the automation process. Methodologies were determined for mapping floodplains, inventorying and analyzing water resources (8), and estimating runoff water quality. The floodplain mapping variables included time of concentration, precipitation runoff, stream storage, stream routing, sub-basin boundaries, and water surface elevations. These variables had to be determined before final data could be formatted and collated. We also had to determine how data could be documented in the report early in the study process.

Since considerable map data was available digitally, it was economical to perform many tasks on the computer rather than on hard copy. The Northern Illinois Planning Commission (NIPC) provided the digital land use map. Lake County Map Services provided digital copies of the Soil Conservation Service (SCS) hydrologic soil groups (HSGs) map, hydric soil map, United States Geological Society (USGS) orthophotos, Lake County Wetland Inventory boundary map, and Lake County parcel boundaries. In addition to this digital data, SMC contracted to obtain 2-foot topographic contours, detailed orthophotos, stream cross-sections, and field-surveyed hydraulically significant structures. Bridge and culvert information and stream cross-sections were also delivered digitally from Illinois Department of Natural Resource's (IDNR) land survey crew using Global Positioning System (GPS) and conventional surveying. Photogrammetry and cross-section control points were collected in the field utilizing a GPS with accuracy of 1:50,000 horizontal and +/- 0.03 feet vertical (5). Each USGS digital orthophoto map covers one quarter of a quadrangle and used 45 MB of computer storage. The topographic maps were delivered in GIS and CAD formats. Contracted data were delivered by square mile. This created a reasonable size data file, including:

Two foot topographic contours and breaklines	1.2 to 3 MB per square mile.
Orthophotos	35 MB per square mile
Digital Elevation Model	1 MB per square mile

The cost for the two foot contours overlaid on an orthophoto varied between $2200 and $3300 per square mile. Additional record drawings of hydraulically significant structures, such as road crossings and detention basin outlets, were collected from county and state highway departments and local communities. The townships and communities seldom had detailed information, so field investigations were undertaken, where necessary, using topographic mapping to establish a reference elevation.

The water resources inventory included a stream assessment, wetland inventory, and a wetland restoration assessment. The stream assessment data were collected in the field along with short community interviews. The stream inventory used an existing methodology created by NIPC (8). SMC created a methodology to identify potential wetland restoration locations.

Surface runoff water quality was estimated using typical measured pollutant loading data for several general land uses. NIPC had an existing procedure that assigned non-point runoff pollutant loads to general NIPC land uses. The typical pollutant loadings were entered into a worksheet so this procedure could be automated.

Creating Hydrologic and Hydraulic Data

Several hydrologic and hydraulic parameters and other data were used to analyze the surface water runoff and generate floodplain boundaries. These included delineating sub-basin boundaries; determining a runoff curve number, time of concentration and Clark's coefficient of runoff for each sub-basin; calculating reservoir data; formatting HEC-1 model; and creating HEC-RAS model geometry.

Sub-basin Delineations

The sub-basin boundaries were produced automatically using the following steps. First, a Digital Elevation Model (DEM) was produced from photogrammetry by a consultant. A DEM is a list of equally spaced data points with a defined easting, northing, and elevation. A spacing of the DEM points of 10 and 30 feet was evaluated. The 10-foot spacing would slightly increase the accuracy of the automated sub-basin boundary's but it used ten times the disk storage as the 30-foot spacing. Therefore, a 30-foot grid DEM was used to determine the sub-basin boundaries due to storage space limitations. Second, the DEM was loaded into ArcView and converted to a DEM grid using ArcView's Spatial Analyst. Third, the flow paths and the preliminary sub-basin boundaries were created using ArcView's Spatial Analyst and Hydrologic Extension along with the DEM grid, which delineated 180 preliminary sub-basin boundaries in 2.5 hours.

Fourth, these preliminary boundaries were edited with the digital contour map in the background to better model storage areas and road crossings. This editing entailed splitting basin boundaries and joining basins together to produce more accurate boundary lines. Editing was performed on portions of approximately 50% of the preliminary sub-basins that were automatically created and ultimately reduced the number of sub-basins. Edited boundaries were checked against hard copy maps and a field investigation of storm sewers and field tiles. A check of maps and field investigation identified three boundaries that needed additional modifications including the addition of one sub-basin. Finally, ArcView was used to automatically calculate each sub-basin's area and a sub-basin identification was assigned to each of the 140 sub-basin areas.

Runoff Curve Number

SMC created a methodology to estimate precipitation runoff. This required converting SMC defined land use categories to Soil Conservation Service (SCS) runoff curve numbers (RCNs) (9) using ArcView and Excel (6). RCNs were calculated using the following sequence. First, the 1990 NIPC land use polygons were converted to SMC land use categories based on land cover using 1996 orthophotos as a backdrop. Land cover was divided into six categories: 1) impervious, 2) graded grass, 3) natural grass, 4) graded forest, 5) natural forest, and 6) agriculture. Typically graded grass and graded forest land cover categories have increased runoff compared with their natural conditions as soils are compacted and depressions are removed during grading. A SMC land use was created for the calibration year of 1996 and for the model year of 2000. Second, concurrently with the land use conversion, the digitally mapped soil numbers were converted to HSGs using GIS queries. Third, the HSG map was intersected with the SMC land use categories to automatically create a land cover map. Fourth, the land use categories table and a land cover conversion table were joined so there was one RCN for each of the four HSGs.

Runoff Data

HEC-1 requires specific input data to generate runoff volumes for each sub-basin. The minimum input parameters for each sub-basin were identification, area, the time of concentration (Tc), Clarks Coefficient of Runoff (R), and weighted RCN. Sub-basin area was delineated as previously described.

The weighted RCN was determined in two steps. First, intersecting the finalized sub-basin boundaries with the RCNs boundaries using ArcView. This splits the RCN polygons with the sub-basin boundaries. This calculation took just twenty minutes. Then this table of RCN attributes for each sub-basin was exported from ArcView into Excel where the weighted curve number for each sub-basin was calculated in one day.

In addition, each sub-basin requires a length and slope of travel to generate the Tc and R. To determine the length and slope, a line with two points were needed, one upstream and one downstream. The line represented the direction of runoff from the farthest ridge to the outlet of the sub-basin. GeoAnalytics, Inc., a consultant, created a program to automatically generate a distance point 10% and 85% from the sub-basin outlet along this digitized line in 30 seconds. The point locations along the line were determined by the methodology used to estimate Tc and R. These points were queried individually with the DEM grid and checked against the topographic map to determine their elevation, which was entered into a table. ArcView calculated all sub-basin line lengths in less than a minute. The stream line and its two elevation points were associated with the sub-basin identification throughout this process. Next, the sub-basin boundaries, the associated line, and two points were joined into one table and exported as a database file. This database file was imported to an Excel worksheet where the slope, Tc, and R were calculated for each sub-basin.

Reservoirs

To model reservoir routing, the reservoir volumes were determined using ArcView and the 2-foot digital contours. The reservoirs consisted of a series of polylines in ArcView after conversion of the CAD contour map. The polylines were modified so they were completely connected and then converted to a polygon in ArcView. This documented the location of every reservoir that was modeled explicitly, as not all reservoirs could be modeled within the scope of our project. Second, the elevation for each contour was entered into a table. The topographic contractor now performs steps one and two. After all the elevation polygons were created, ArcView calculated the area of the polygons with one command.

Finally, the elevation and area tables were opened in an Excel worksheet to calculate the elevation versus storage relationship. This worksheet was referenced by the HEC-1 formatted worksheet described in the next section. Stage versus discharge relationship was determined for each reservoir when data was available using HEC-RAS or HY-8.

Hydrology Model Development

All of this data was combined into one Excel workbook to generate the input needed for HEC-1. The sub-basin data entry included: identification, area, weighted RCN, Tc, and R. Most sub-basins also needed reservoir or stream routing data. An Excel worksheet was edited with HEC-1 formatted column widths so the data could be saved into a file that the HEC-1 FORTRAN program can accept. Sub-basin data were entered automatically by referencing other worksheets in the same workbook. Once the first sub-basin referenced the other worksheets properly, the first formatted sub-basin data were copied to create another set of HEC-1 data for the next sub-basin. After the sub-basin identification was entered for this new HEC-1 input data set, the remaining data were automatically retrieved in the worksheet and correctly formatted, to avoid data translation errors.

Hydraulic Data

The stream cross-section data were initially generated in MicroStation. Each section was digitized as a series of connected line segments that were exported to a comma-delimited file of easting, northing, and elevation which was then imported into HEC-RAS's "Import/Export Files for Geospatial Data." The culvert and bridge data had to be coded in separately. The channel stationing was determined automatically using Intergraph In-Roads. This procedure not only provided data formatted to be exported directly in HEC-RAS, but also created a 3D map of the channel cross-sections and stream centerline to document the model spatially using MicroStation and ArcView. The cross-section segments had to be manually identified for use in the automated floodplain mapping.

Floodplain Development

Stream cross-sections and hydraulic structures were modeled using HEC-RAS to determine the water surface elevation along the stream. ArcView's Spatial Analyst Extension or ArcInfo could be used to delineate the floodplain from the HEC-RAS output. Final maps were generated in ArcView.

The HEC-RAS generated water surface profiles were exported by HEC-RAS's "Import/Export Files for Geospatial Data." GeoAnalytics Incorporated, Madison, Wisconsin, imported this data into an ArcInfo project that uses a 10-foot DEM grid. ArcInfo needs a line and an elevation for each cross-section to map the floodplain. The cross-section line and its identification were created in MicroStation, exported as comma delimited points, and then referenced into ArcView to create the cross-section line. The line with its cross-section identification was associated with the water surface elevation. The grid was then "flooded" between the two cross-sections with a linear slope between the appropriate water surface elevations. This creates a grid of the flooded area. For each flood profile that was to be mapped, a separate grid of the flooded area must be completed.

Reservoirs, such as lakes, ponds, and depressions, that have their Base Flood Elevations determined using HEC-1, were mapped automatically. The storage areas had the water surface elevation defined using HEC-1 then the grid was "flooded" for all points at or below that elevation.

The flooded grids were then converted to polygons and "smoothed" in ArcInfo for use in ArcView. Last the polygons were reviewed against the digital two-foot contours and adjusted as needed before final map production. Every reservoir outlet had to be manually mapped between its outlet and the downstream reservoir or stream floodplain.

Water Resource Assessments

A water resources inventory was completed that included a stream assessment, a wetland inventory, and potential wetland restoration site identification. All of the stream assessment data were collected in the field along with short community interviews and entered into a database. Several key stream characteristics were mapped using GIS. The stream inventory data were queried for specific stream conditions and key characteristics were mapped such as degree of bank erosion or sediment accumulation.

A county wetland Advanced Identification (ADID) study was completed in 1992 prior to the assessment. One of the criteria reviewed for each wetland was its storage potential, which was related to the area of the wetland. Querying the spatial data for specified wetland areas and creating a new set of data easily identified these wetlands. The wetland restoration and mitigation bank site identification methodology was developed by SMC in 1999. Several data sets were queried to identify the former wetland sites that have the greatest number of characteristics necessary to make them restorable and usable as a wetland bank. A less stringent set of criteria was used to define all former wetland sites with restoration potential. The potential wetland restoration sites included all Advanced Identified (ADID) wetlands. Potential wetland banking sites excluded ADID wetlands and restorable sites less than 20 acres.

Surface water quality 'hot spots" were estimated using non-point pollutant loading rates for several general land uses via NIPC methodology. Twelve pollutants were evaluated. The pollutant "hotspots" analysis employed land use, impervious surface area, annual runoff coefficients, and storm sewer conditions as surrogates to determine the annual pollutant loading by sub-watershed. The pollutant loading database was attached to the land use map database. It was then mapped in ArcView resulting in 12 maps, one for each pollutant.

The watershed advisory committee and NIPC identified which level of pollutant loadings should be labeled as detrimental. The pollutant load data were then grouped, using natural breaks in the data set, as low, medium or high. These were mapped and queried to determine where water quality enhancement projects would be most beneficial and highest priority.

Summary

The Lake County Stormwater Management Commission has invested a significant amount of time and funding in developing the hardware, software, and database necessary to perform floodplain analysis. By making this commitment and establishing the methodologies for manipulating data and analyzing watershed parameters, we have created a powerful analysis tool. Mapping accuracy, display flexibility and a wide range of GIS analysis ability has been created through this process. This technology coupled with other resource assessment efforts has created a strong foundation for future watershed planning in this watershed. The technology is transferable and will be used throughout Lake County as our agency resources allows.

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Sediment and Runoff Control on Construction Sites Using Four Application Methods of Polyacrylamide Mix

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Abstract

Fifteen small bare plots (1 meter x 1 meter) on a 10% slope were analyzed for runoff and sediment yield on a construction site. A rainfall simulator applied 6.32 centimeters of rainfall per hour to each plot after a polyacrylamide mix (PAM-mix CFM 2000*) treatment was applied. The following treatments: No PAM-mix applied to dry soil (control), PAM-mix in solution applied to dry soil, dry PAM-mix application to dry soil, PAM-mix in solution with mulch/seeding applied to dry soil, and PAM-mix in solution applied to moist soil. Each treatment was repeated on three plots. When a solution of PAM-mix with mulch/seeding was applied to dry soil and compared with the control (no PAM-mix application to dry soil), we found an average reduction of 93% in sediment yield. An average reduction of 77% in sediment yield was the worst performing PAM treatment, and occurred when PAM-mix in solution was applied to moist soil. The application of dry PAM-mix to dry soil reduced sediment by 83% and decreased runoff by 16% when compared to the control. Our results show that regardless of the application method, PAM-mix was effective in reducing sediment yield in the test plots. The ease of application, low maintenance, and relatively low cost associated with PAM make it a practical solution to the costly methods being implemented today

Keywords:

Soil binders, soil erosion, polyacrylamides, flocculation, infiltration, water retention.

*Use of a product name is for the convenience of the reader and does not imply endorsement by the authors, Dane County Land Conservation, or the University of Wisconsin.

Introduction

One effect of rainfall is the initiation of the erosion process where individual raindrops fall and impact the soil surface. Soil detachment and particle transport by raindrop splash can lead to serious soil deterioration. Once soil is eroded and transported by surface runoff to lakes, rivers, and streams, a degradation of the aquatic habitat occurs. Sediment is the largest pollutant, by volume, in the State of Wisconsin (WDNR, 1994). In order to maintain a healthy watershed, it is critical to control erosion and sediment yield.

Maintaining soil structure and aggregate stability helps control erosion by increasing infiltration and maintaining less erodible-sized aggregates. Stable soil structures also help maintain a healthy environment. The use of polyacrylamides and polyacrilamide mixes (PAMs and PAM-mix) is a new tool to help maintain soil aggregate stability and reduce erosion caused by surface runoff. Such materials can be applied at a rate of 20 to 30 lbs per acre on construction sites, to stabilize such sites against erosion until they can be permanently protected through vegetation.

Water-soluble polymers and water polymer mixes do not create aggregates when applied to soil. However, they can stabilize existing aggregates when the aggregates are saturated with a solution of water soluble polymer mix. Increasing the aggregate stability with polymers reduces the effect of raindrop impact on the soil, thereby reducing erosion. Polymer application to the soil may also retard surface sealing, reduce particle soil detachment, reduce sediment in suspension, and compensate for low residue.

Objectives

The objectives of this study are to determine the optimum application methods and the effectiveness of the PAM-mix under moist and dry soil conditions. The different application methods were applied to a construction site in Middleton, WI. Data were collected to determine the most effective method of application and the effectiveness of the PAM-mix on construction sites.

Literature Review

The use of polymers as soil conditioners has been studied for decades. The most conclusive studies, done by Lentz et al. (1992), determined that negatively charged PAM is an excellent soil erosion deterrent for furrow irrigated fields. It was found to be a cost-effective and safe technology. Sojka and Lentz (1994) found that PAM, when applied in irrigation waters at rates greater than 0.7 kg/ha, reduced furrow erosion by an average of 80 to 90% and increased infiltration on Portneuf silt loam by an average of 15%. Trout et al. (1995) reported a 30 to 110% increase in cumulative infiltration. Roa et al. (1996) found that soils treated with PAM had infiltration volumes more than double that of untreated soils over a two-hour period. The infiltration volumes for the untreated soils averaged 231 ml/38.5 square centimeters while those for treated soils averaged 490 ml/38.5 square centimeters, or 98% of the volume of water to be infiltrated. Roa et al. (1996) also found that the high infiltration rate of the treated sample was associated with low concentration of sediment in the effluent or infiltrated water.

Nadler et al. (1994) found that PAM mobility in sandy loam, as well as clay loam soils, was limited to the top 25 cm 10 months after application. Clays were attached to anionic polymers more easily when salts were present in solution. With anionic polymers, flocculation was easier and more complete. When polysaccharides are present with anionic polymers in solution, fixation was also easier and more complete. Khamraev et al. (1983) reported that clay fixation is best achieved for PAMs with 30% anionic charges. The cementation provided by the clay flocculation stabilizes the aggregate at the surface. Roa et al. (1997) found that using polysaccharides, a calcium source with anionic polymers or polysaccharides with calcium nitrate and anionic PAM, increased the infiltration rate in saturated cores 5 times greater than with no soil treatment.

PAM use for erosion control provides a potent environmental benefit by halting furrow erosion by about half a ton of soil per ounce of PAM used. PAMs remove most sediment, phosphorus, and pesticides from return flows, and greatly reduce return flow BOD (Sojka and Lentz, 1996). The consequences of reducing sediment and nutrient loading of construction areas can ultimately be expected to reduce the frequency and intensity of algae blooms and reduce turbidity and sedimentation of stream channels.

Lentz et al (1992) in Kimberly, Idaho, reported that when applied at 10 ppm, PAM provided a 94% reduction in runoff-sediment in three years of testing. When used properly, PAM has no measurable toxicity to humans, plants, or aquatic organisms. Molash et al. (1997) state that the Polyacrylamide Allocation Standard for Reduction of Soil Loss is necessary because other best management practices (BMPs) are available and have varying degrees of effectiveness.

Sojka and Lentz (1996) summarized several advantages of PAMs over other erosion control BMPs: (1) PAM can be applied using irrigation equipment and can be effective for controlling erosion over large areas, as demonstrated in eastern Washington and Idaho; (2) PAM is very effective on fine silt/clay soils; (3) preliminary research conducted in

Kansas and California has indicated that PAM is effective at abating wind erosion; (4) PAM enhances precipitation of fine silts and clay particles, providing water quantity benefits; (5) PAM increases soil infiltration capacity that reduces runoff volumes; and (6) high benefit to cost ratio.

The types of PAM used for erosion control should have an approximate molecular weight of 12-15 Mg/mole, with an 8-35% negative charge density, and contain no greater than 0.05% Acrylamide monomer (Sojka and Lentz 1996).

A recent study done by King et al. (1996) focused on comparing the uses of polyacrylamides and straw mulch on dry bean yields. It was shown that the sediment loss was reduced for both straw mulch and the PAM treatment.

In three years of studies in construction sites using PAM for controlling soil loss, PAM has provided a 60-97% reduction in runoff-sediment (Roa et al. 1997).

Method

Five treatments were applied to soil test plots: (1) No PAM-mix application to dry soil [control], (2) PAM-mix in solution applied to dry soil, (3) Dry PAM-mix application to dry soil, (4) PAM-mix in solution with mulch/seeding applied to dry soil, and (5) PAM-mix in solution applied to moist soil. Three replications of each treatment were performed using a randomized block design on 1m x 1m non-vegetated plots in the Middleton Hills Development, Middleton, WI. The soil was a Dodge silt loam. The average slope of the test site was 10%.

Plot preparations included large boulder, cobble, and excess debris removal. The surface was raked prior to testing. Soil moisture prior to testing was about 9%.

The PAM-mix is a high molecular weight anionic granular polymer. The PAM-mix (2.25 g of PAM-mix added to 5 liters of water) was applied at a rate of 22.5 kg/ha, to the appropriate plots using a garden sprinkler. For the dry PAM-mix application, 2.25 grams of the PAM-mix was applied using a sifter. For the PAM-mix applied to moist soil treatment, the soil was pre-moistened by a 6.4 cm rainfall six hours before testing.

The sprinkler infiltrometer (Bubenzer and Patterson, 1982) was used to collect data for this study. A rainfall simulator was used that produces 6.4 cm per hour. Actual rainfall depths were recorded using eight rain gauges for each replication. Runoff from each plot was collected into a tank where the depth of the water was recorded at approximately 2-minute intervals during each test. The average trial time was 40-50 minutes or until the runoff collection tank was filled.

Runoff samples were extracted at approximately 10-minute intervals by diverting runoff into a collection container during each replication to determine sediment yield. A representative sample was also taken at the end of each replication from the tank. The samples were dried at 110°C for 24 hours and weighed to determine an average sediment load for each trial.

Results and Discussion

Mean sediment yield, infiltration, and runoff depth for the three replications and the controls are presented in Tables 1, 2, 3 and 4. For Replication 1, the PAM-mix solution was prepared the evening before field testing. It was noted that the viscosity of the solution decreased throughout the day. This change may have been due to UV light, reaction with the mix, and/or oxidative and photolytic interaction. Thereafter, the solution was prepared immediately before the rainfall simulation. After analyzing the results, a lower viscosity of the PAM-mix solution was determined to be less effective in controlling sediment yield. This difference is presented in Table 4. Future recommendations for commercial applications may need to take into account the time of preparation of the solution and handling before application.

During the first replication of testing, the largest sediment reduction occurred when PAM-mix in solution was applied to moist soil. The control yielded 184.4 grams per square meter and the PAM-mix in solution applied to moist soil yielded 36.4 grams per square meter resulting in a reduction of 80% in sediment yield (Table 1). The sediment yield reduction for the dry PAM-mix application to dry soil and PAM-mix in solution with mulch/seedling applied to dry soil were

Table 1. Summary of rainfall, infiltration runoff, and sediment yield for Replication #1.

Treatment	Rainfall (cm)	Infiltration (cm)	Runoff (cm)	Sediment (gm)	Soil Loss % of Control	Runoff Rainfall % of rainfall
Control	5.64	1.70	4.01	184.4	100%	71%
Dry PAM-mix/Dry Soil	5.79	1.91	3.89	68.3	37%	67%
Solution PAM-mix/Dry Soil	5.64	1.60	4.11	103.7	56%	73%
Solution PAM-mix/Moist Soil	5.72	0.05	5.66	36.4	20%	99%
Solution PAM-mix/Mulch/Dry Soil	5.72	1.57	4.14	67.3	36%	72%

approximately 64%. The sediment yield for PAM-mix in solution applied to dry soil was reduced by 44% when compared to the control.

In Replications #2 and #3, the lowest sediment yield occurred for the treatment of PAM-mix in solution with mulch/seeding applied to dry soil. A sediment reduction of 97% and 89% occurred, respectively. A sediment reduction for the treatment of PAM-mix in solution applied to dry soil was 87% and 57% respectively (Table 2 and 3).

Table 2. Summary of rainfall, infiltration runoff, and sediment yield for Replication # 2.

Treatment	Rainfall (cm)	Infiltration (cm)	Runoff (cm)	Sediment (gm)	Soil Loss % of Control	Runoff Rainfall % of rainfall
Control	4.57	0.51	4.06	377.67	100%	88%
Dry PAM-mix/Dry Soil	5.72	1.57	4.14	178.36	47%	73%
Solution PAM-mix/Dry Soil	4.72	0.61	4.11	48.77	13%	87%
Solution PAM-mix/Moist Soil	4.14	0.13	4.01	242.4	64%	97%
Solution PAM-mix/Mulch/Dry Soil	4.55	0.38	4.17	12.04	3%	92%

Table 3. Summary of rainfall, infiltration runoff, and sediment yield for Replication # 3.

Treatment	Rainfall (cm)	Infiltration (cm)	Runoff (cm)	Sediment (gm)	Soil Loss % of Control	Runoff Rainfall % of rainfall
Control	5.05	1.12	3.94	231.34	100%	78%
Dry PAM-mix/Dry Soil	5.38	1.96	3.43	43.29	19%	64%
Solution PAM-mix/Dry Soil	4.50	0.61	3.89	98.59	43%	86%
Solution PAM-mix/Moist Soil	4.42	0.28	4.14	47.65	21%	94%
Solution PAM-mix/Mulch/Dry Soil	4.39	0.38	4.01	26.58	11%	92%

When Replication #1 is excluded from the results, the average sediment reduction for PAM-mix in solution with mulch/seeding applied to dry soil increased from 87% to 94% (Table 4). The sediment reduction for PAM-mix in solution applied to dry soil was 76%. For dry PAM-mix applied to dry soil, the sediment reduction was 17%, and the sediment reduction of PAM-mix in solution applied to moist soil was 77%.

Conclusion

Our results show that, regardless of the application method, PAM-mix was effective in reducing sediment yield in the test plots. The most effective method of soil treatment throughout this study in reducing sediment yield is PAM-mix in solution with mulch/seeding applied to dry soil. The ease of application, low maintenance, and relatively low cost associated with PAM-mix makes it a practical solution to costly existing methods being implemented. The evidence from the field application in this study reflects that PAM-mix is a tool to reduce soil loss on bare soil until vegetation cover is established.

Table 4. Average summary of rainfall, infiltration runoff, and sediment yield for Replications 1, 2, and 3 and Replications 2 and 3, excluding Replication 1.

Treatment	Runoff (cm)	Sediment (gm)	Soil Loss % Replication 1, 2, and 3	Sediment (Gm) Excluding Replication 1	Soil Loss % Replication 2 And 3	% of Rainfall
Control	4.01	264.51	100%	304.51	100%	79%
Dry PAM-mix/Dry Soil	3.81	96.65	37%	110.83	36%	66%
Solution PAM-mix/Dry Soil	4.04	83.71	32%	73.68	24%	81%
Solution PAM-mix/Moist Soil	4.60	108.82	41%	145.03	48%	97%
Solution PAM-mix/Mulch/Dry Soil	4.11	35.32	13%	19.31	6%	84%

The primary factor that must be considered in future studies is the time of polymer solution preparation and application. It was noted that the optimal application procedure is to prepare the solution immediately prior to application. This procedure is necessary in order to limit the amount of degradation and maximize the performance of the PAM-mix.

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Construction Site Planning and Management Tools for Water Quality Protection

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California is seemingly a developer's paradise. Population is on the rise, the economy is good, and there is little or no rain to interfere with construction for nearly eight months of the year. To top off these benefits, the California Regional Water Quality Control Board, San Francisco Bay Region (Regional Board) has a comprehensive Construction Site Planning and Management Program (Program). It is based on the integration of a strong regulatory and enforcement posture, an outreach and education strategy, and technical assistance. The keys to the success of the program are the balance of actions among these elements and implementation tools for actions within them.

Background

The Regional Board is the state agency in California responsible for protection of water quality and enforcement of water pollution control regulations, including National Pollutant Discharge Elimination System (NPDES) permits. The California Water Code provides the Regional Board with strong enforcement authority. This authority ranges from a notice to comply, to a notice of violation, to enforcement orders, to monetary penalties. Penalties can be as high as $10,000 per day of violation or $10 for each gallon of waste discharged. The Regional Board may also suspend part of a penalty in exchange for an environmentally beneficial project.

In the San Francisco Bay Region, the Regional Board is responsible for enforcement of a general NPDES permit for stormwater discharges from construction sites of five acres or greater. The general permit requires implementation of an effective Stormwater Pollution Prevention Plan (SWPPP) that includes best management practices (BMPs) for erosion and sediment prevention and control and management of equipment, materials, and wastes. The Regional Board is also responsible for enforcement of NPDES permits for municipal stormwater discharges that have been issued to all municipalities (regardless of population) in the urban areas of the region. These permits include requirements to control discharges from construction sites (regardless of size). There is an inherent overlap of Regional Board and municipality authority over construction of five acres or greater. The Regional Board's Program recognizes and takes advantage of this overlap of authority.

Inspections

The Regional Board initiated an aggressive construction site inspection and enforcement effort in 1997. This resulted in discovery of significant water quality problems associated with sediment discharges caused by minimal or token erosion and sedimentation control actions. Some of the most common observations were:

- No permit.
- SWPPP not developed, not implemented, or deficient, especially in terms of timing.
- Mass grading allowed to continue throughout winter months until rain and muddy conditions make further work impossible.
- Mass grading continues past the time when grasses will grow and germinate; first rains simply carry seed/mulch away with eroded soil.
- No erosion control measures; reliance solely on sediment basins.
- Sediment basins are frequently undersized, improperly designed, and not maintained.

- Site not monitored to assess BMP effectiveness.
- SWPPP not updated to reflect changes in site conditions.
- Hillsides stabilized with hydroseed, but no mulch (resulting in rains carrying seed material away with eroded soils).
- Control measures driven by "tokenism" with control measures intended to demonstrate good intentions rather than real effectiveness.
- Willingness to risk fines in order to maximize work during winter (rainy season) months.
- Local agencies, specifically planners and engineers with plan-approval authority, often unaware of "best" management practices.
- Sites approved by local authorities for mass grading during rainy season.
- Local authorities review and approve erosion control plans but do not inspect sites.

Enforcement Actions

Several types of enforcement actions evolved from these findings. The first consisted of the development and issuance of a "Notice to Comply" (Figure 1). Often (25 - 35 % of the time) operators at a site are unaware of their requirements or appropriate BMPs. The Notice to Comply is essentially a "fix-it" ticket that results in no further enforcement action if corrective action is implemented. Regional Board inspectors are authorized to issue Notices to Comply in the field, and use of this simple enforcement tool has proven to be an effective mechanism to gain timely corrective action at construction sites.

Other enforcement tools are used in circumstances where the severity of the problem warrants more intensive enforcement action. These include, in terms of progressive severity: a Notice of Violation, a Cleanup and Abatement Order, and a Cease and Desist Order. Violations of any of these actions typically lead to more aggressive enforcement action. The most aggressive enforcement action is imposition of administrative civil liability (monetary penalties).

During the 1997/98 rainy season the Regional Board imposed over $1 million in penalties, ranging from $10,000 to $230,000. A major consideration in determining penalty amounts is ensuring that it does not pay to pollute. Due to the economic and time pressures associated with many development projects, minor penalties may simply constitute a cost of doing business. The Regional Board has clearly stated its intolerance to this circumstance and intends to severely penalize repeat offenders. Clearly, such penalties not only get the attention of the violator, but the building industry as a whole. Substantive penalties have also provided opportunities to fund environmental education projects in lieu of direct payment of penalties. The Regional Board has favorably accepted development of technical assistance tools as appropriate mitigation projects.

Education and Outreach

The Regional Board recognizes that regulation without education is ineffective. Consequently, its program includes extensive outreach efforts. These include:

- Mass mailing to construction projects of more than five acres and projects permitted for winter grading summarizing requirements and findings on inadequate performance
- Meeting with development community and local agencies prior to the rainy season (August through September) to better communicate concerns and requirements and to establish a dialogue
- Providing detailed guidance and training for both developers and municipalities on their responsibilities and on effective control approaches

San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400, Oakland, CA 94612 / Phone (510) 622-2300 - FAX (510) 622-2460

NOTICE TO COMPLY

You are hereby notified that____________________(hereafter Discharger) has violated provisions of: ☐ Order No. ____________________

☐ NPDES Permit No. (if applicable)____________________

☐ California Water Code Section ____________________

☐ Other____________________

Federal, State, and Local Agency Contacts:

____

I. FACILITY INFORMATION

Inspection Date: __________ Time: __________ Prior Notification: ☐ Yes ☐ No ☐ Unknown

Discharger Contact: __________ Title:__________ Phone: (___)__________

Site Name & Location: __________ County:__________

Headquarters/Owner Name & Address : ____________________

II. NON-COMPLIANCE INFORMATION

Nature of Violation :	Recommendation to Correct :	Time to Comply (Not to exceed 30 days)

III. SIGNATURE SECTION

I acknowledge receipt of this Notice (must be owner, operator, or duly designated representative of facility):

RECIPIENT NAME (print): __________ TITLE: __________

SIGNATURE: __________ DATE: __________

STAFF NAME:__________ PHONE : (___)__________

SIGNATURE:__________ DATE: __________

IV. CERTIFICATION OF COMPLIANCE

Sign and return by mail or fax within **5 working days** of achieving compliance

I certify under penalty of perjury that the above violation(s) have been corrected.
I am aware that there are significant penalties for submitting false information.

Recipient Signature: __________Date:__________

Print Name: __________Title: __________

FOR REG. BD. USE ONLY

Receipt Date: / /

Reviewed by:

Date:

Acceptable:
☐ No
☐ Yes

Recommendation:

Figure 1. Notice to Comply

The objectives of these outreach efforts are:

- Commitment from the construction industry to include erosion control in their planning, scheduling, and (most importantly) project implementation

- Commitment from municipalities to play a greater role in SWPPP review and implementation, including training inspectors so that builders, municipal staff, and Regional Board staff are all on the same page - thereby allowing for consistent regulation of construction activities by applying a uniform standard.

In response, the building industry and municipalities have collaborated with the Regional Board on the production of training workshops on construction site planning and management for both building industry and municipal staffs. The workshops provide a review of regulations and responsibilities including:

- State responsibilities
- Permits for work in or near streams
- Local agency responsibilities
- Plan approval authority and requirements
- On-Site responsibilities (plans, permits,inspections)
- Inspector responsibilities
- Enforcement
- Field inspection coordination (i.e., state agency/municipality)

The workshops also include training on BMPs for erosion and sediment control (principles, tools, corrective measures, inspections, monitoring, reporting), non-stormwater discharge prevention and management, and a field trip to an active construction site where vendors demonstrate both proper and improper installation practices.

Production of the workshops has been funded in part through mitigations associated with administrative civil liability fines. Similarly, penalty mitigation funds have been used to develop education tools including:

- An 18 minute training video entitled "Hold on to Your Dirt: Preventing Erosion from Construction Projects" which provides information on BMPs for grading projects and for stabilizing disturbed land

- An 18 minute training video entitled "Keep it Clean: Preventing Pollution from Construction Projects," which provides information on BMPs to prevent water pollution from non-stormwater discharges from activities such as painting, stucco, concrete washout facilities and saw cutting

- A booklet of "Guidelines for Preparing a Storm Water Pollution Prevention Plan"

Erosion and Sediment Control Field Manual

The centerpiece of the Regional Board's Program is an *Erosion and Sediment Control Field Manual* (also developed with penalty mitigation funds). The *Field Manual* was produced in response to a common complaint by "field" personnel that there is a need for information on cost-effective and proven BMPs, and that existing references were too technical and difficult to read. The *Field Manual* contains concise descriptions of BMPs for erosion and sediment control and site management (Table 1). Overviews of regulatory requirements and inspection and monitoring responsibilities are also provided.

Table 1. Erosion and Sediment Control Field Manual BMPs

Erosion and Sediment Control Field Manual BMPs	
Erosion and Sediment Control Practices	
• Scheduling • Preservation of Existing Vegetation • Slope Grading • Temporary Seeding and Mulching • Permanent Seeding and Mulching • Hydromulching – Hydroseeding • Dust Control • Erosion Control Blankets and Geotextiles • Fiber Rolls • Temporary Stream Crossing • Stabilized Construction Entrance • Entrance/Exit Tire Wash	• Outlet Protection – Energy Dissipation • Check Dams • Silt Fencing • Temporary Straw Bale Dike • Sand/Gravel Bag Barrier or Rock Filter • Storm Drain Inlet Protection • Catch Basin Inlet Filters • Sediment Basin • Sediment Traps • Dewatering: sediments/toxic pollutants • Secondary Filtration
General Site and Materials Management Practices	
• Water Conservation Practices • Solid and Demolition Waste Management • Hazardous Waste Management • Spill Prevention and Control • Vehicle and Equipment Service • Material Delivery, Handling, and Storage • Paints and Liquid Materials	• Handling and Disposal of Concrete and Cement • Pavement Construction Management • Contaminated Soil and Water Management • Sanitary/Septic Waste Management • Landscaping Management

BMPs are described in a user-friendly format that features full-color graphics, including do and don't illustrations (Figure 2). Each BMP description includes its purpose, application, limitations, practices, inspection, and maintenance. There is a section on Corrective Measures that discusses what can go wrong and common installation problems. This latter section is essentially a troubleshooting guide that contains a table of common problems and corresponding corrective measures. Overviews of regulatory requirements and inspection and monitoring responsibilities are also provided. The *Field Manual*'s waterproof 9" x 9" binder and coated pages make it ideal for use in the field. As such, it provides the essential connection between the enforcement, outreach, and technical assistance components of the Regional Board's Program.

Overlap of State and Municipal Authorities

The Regional Board's Program provides a clear demonstration of how the Storm Water Phase II Program's construction requirements may be implemented. The Phase II rule allows states to recognize compliance with municipal program construction requirements as equivalent to compliance with a state-issued NPDES permit for construction, if it can be demonstrated that the municipal program requirements are equivalent. In such situations, a construction site deemed in compliance with a municipality's requirements would be deemed in compliance with the state-issued NPDES permit. The key is demonstration that the municipal program qualifies as equivalent.

In the San Francisco Bay area, as previously noted, the Regional Board has issued NPDES permits for municipal stormwater discharges that include requirements to control discharges from construction sites. In essence, there is an overlap of Regional Board and municipal authority where municipalities are in compliance with their permit requirements.

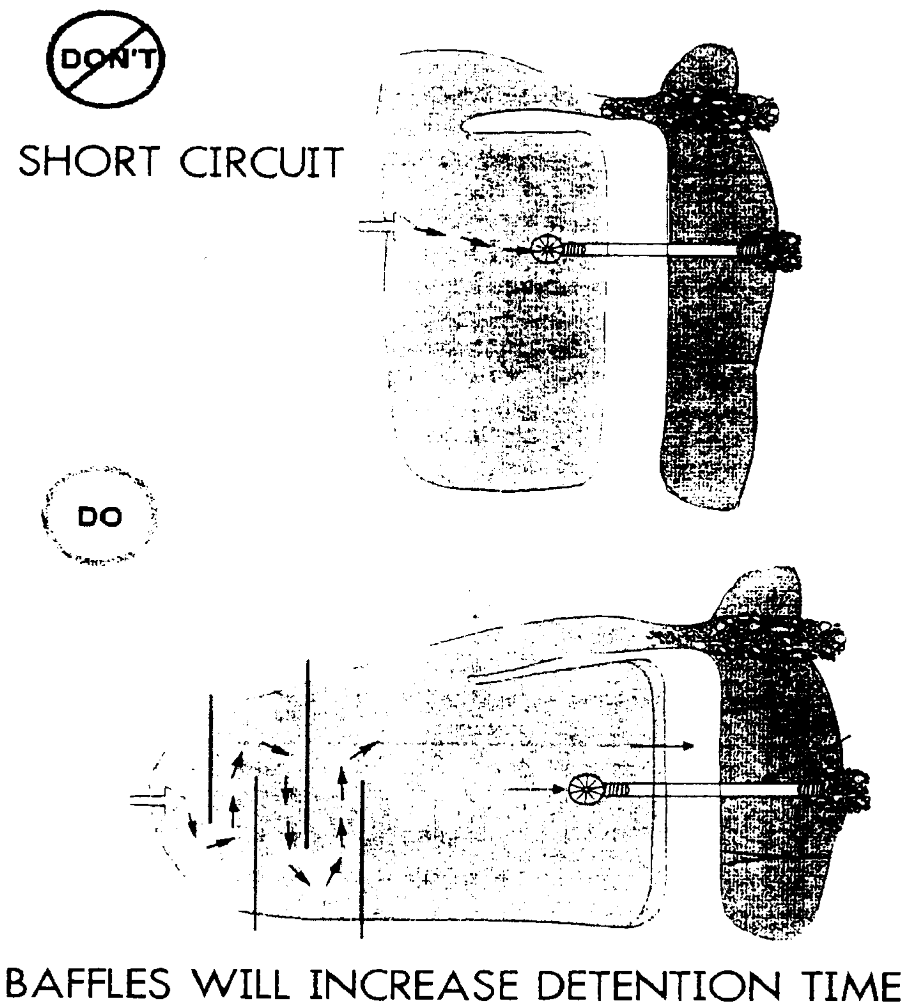

Figure 2. Sediment Basin Design.

Unfortunately, what may seem equivalent on paper may not be equivalent in practice. The case in point is that the Regional Board's inspection program noted above identified many construction sites out of compliance with their construction NPDES permits. Consequently, these same construction sites would be deemed in non-compliance with municipal requirements. In addition, the same inspection findings can be applied to the municipality. Since the municipality's NPDES permit requires it to control discharges from construction sites, construction site non-compliance means the municipality is not in compliance with its NPDES permit. In these circumstances, the Regional Board may (and has) taken enforcement action against both the construction site and the municipality.

To date, the primary enforcement tool used for the municipalities has been Notice to Comply. The Notice to Comply requires the municipality to report on the failure of its construction control program and to implement timely corrective actions. Most municipalities have been very responsive to this "wake-up-call," and have made improvements to demonstrate the desired "equivalency." The net result is a negative turning into a positive. The Regional Board's Program, with its balance between enforcement and education, has provided a *de facto* mechanism for recognizing municipal program equivalency allowed by the Phase II rule. By its design and implementation, the program essentially requires municipalities to demonstrate such equivalency. Consequently, the Regional Board will significantly reduce or eliminate its inspections in municipalities where Regional Board inspections find construction sites in compliance, thus providing incentive and reward to both the building industry and municipalities.

Lessons Learned

Lessons learned in the development and implementation of the Regional Board's Program are summarized in the following points:

- The only effective means of controlling erosion is erosion prevention, which requires careful planning and adherence to seasonal time-lines. Sediment capture should be used only as a secondary or back-up plan.
- Regulation without education is ineffective. Often, noncompliance is due to lack of awareness of the regulatory requirements and cost-effective, proven BMPs.
- Education without enforcement is impotent. Despite good intentions, the building industry is constantly trying to maximize its investment dollars, and environmentally sound BMPs are often superseded by time pressures to complete a project.
- Enforcement actions must be severe enough that they cannot be accepted as a cost of doing business.
- The balance between regulation and education is dependent on readily available technical assistance and implementation tools.
- Outreach and technical assistance needs to be directed to the right audiences. Workshop agendas and attendance were initially misdirected toward planners and local decision makers. Key attendees are municipal staff who actually review SWPPP plans and perform on-site inspections and building industry staff who are onsite. Evaluations revealed attendees wanted more technical information on installation and less time spent on municipal general plan/environmental plug. Audiences are especially responsive to builders discussing their experiences in implementing BMPs.
- Both the building industry and municipalities have historically short shrifted training. Workshop attendees expressed relief that practicable training is finally available - especially information on vendors, cost comparisons, and practical BMPs. The building industry and municipalities now realize costs of training are minimal relative to the benefit.

Conclusions

The bottom line is that environmental regulators, municipalities, and the building industry have different priorities that must be reconciled. Regulators seek no adverse impacts to waters. Municipalities seek economic growth. Builders want unfettered development. In the case of construction-related erosion, the means to each end is the same...effective erosion and sediment control. A little more work on the part of each party involved has proven that their different priorities are attainable and even harmonious.

Since the Regional Board made enforcement a top priority and began a collaborative effort with the building industry and municipalities to provide cost-effective outreach and training, construction site compliance with NPDES permit requirements has risen from 20% three years ago to greater than 90% today. Municipal compliance has risen similarly.

Regulating Sedimentation and Erosion Control into Streams: What Really Works and Why

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Abstract

The overall objective of this project was to determine the effectiveness of different environmental policies, regulations, and incentives in reducing the ecological risks and consequences of sedimentation to streams. We were trying to learn which sets of regulations, enforcement strategies, and landscapes result in effective protection of stream communities from degradation, resulting from erosion and sedimentation from construction sites. By connecting erosion control efforts to environmental impacts, our aim was to create more effective management strategies that ultimately provide environmentally sustainable social and economic development in our watersheds.

We chose four replicate construction sites in each of three regulatory jurisdictions that varied in stringency of regulations and enforcement activities. At each site, we conducted instream assessments of water quality and biomonitoring of macroinvertebrates and fishes to determine the success of the regulators in protecting stream ecosystem health. We combined these results with evaluations of the regulatory environment to link the policies and management styles of the regulators to the effectiveness of protection of the streams. While all construction sites did some damage to the steams, we found that enforcement style and frequency of inspections were far more important than the nature of the regulations in preventing sediment pollution of streams.

Keywords: Development, enforcement, rivers, sedimentation, streams, regulations, regulatory effectiveness.

Introduction

A critical problem in American rivers and streams is sedimentation. Sedimentation degrades water quality, alters habitat for fish and macroinvertebrates, limits ecosystem functions and services, and reduces the aesthetic and economic value of rivers and streams. Many regulations and policy incentives have been devised to control sediment pollution of our rivers and streams. Yet there has rarely been an attempt to reconnect the policies with the ecology of the rivers. That was the goal of this research. This work integrates the regulatory environment, sediment ordinances, and policies with resultant ecological impacts of sedimentation on rivers and streams. The question the ressearch sought to answer was "What combinations of policies, regulations and on-site interactions between regulators and developers really work to enhance stream biota and stream ecosystem health?"

Research goals were accomplished by comparing similar streams in different regulatory jurisdictions (a comparative watershed approach). We tested the effectiveness of different intensities of sediment control regulations and enforcement. We used the streams to tell us what matters ecologically. The selected political jurisdictions differed in the stringency of their erosion and sediment control requirements and the nature and intensity of enforcement of the regulations. We chose 17 construction sites along streams in three different jurisdictions. We interviewed the regulators and developers at each site and we studied the regulations and the attitudes of the regulators and developers. At each site, we sampled the streams being impacted. Some projects are still unfinished. Therefore, we will present only the results of the 'before construction' and 'during construction' samplings.

We asked "Which erosion and sediment control regulations really work and why?" We have analyzed the erosion and sedimentation control regulations and compared them among the respective jurisdictions. Then we surveyed the attitudes and enforcement activities at all levels within each jurisdiction. This paper will briefly outline our findings and focus on what can be done to minimize sedimentation into streams from construction sites.

Methods

Site Selection

We selected three regulatory jurisdictions so they would vary across a range of two critical variables: (1) stringency of regulations (how strict and how rigorous the rules are) and (2) stringency of enforcement (i.e. frequency of inspections, severity of punishment of violations). A summary of some of the salient characteristics of the three regulatory jurisdictions is given in Table 1. Construction sites were selected from the array of applications for grading permits filed with the erosion and sediment control offices in each jurisdiction. The biggest constraint in locating study sites was the availability of construction sites on streams with riffle zones. One jurisdiction (District IV) extends eastward into the coastal plain as does Eastern Wake County. Therefore, many otherwise promising sites, which had sandy bottomed, slow flowing streams, were eliminated from our study. To be selected for this study, the construction sites had to have certain critical characteristics. For example, streams had to be within 100m of the site. There also had be a significant slope from the construction site down to the stream, so that if erosion occurred it would impact the stream. These factors made site selection extremely difficult. In this paper, we will discuss only the impact of large construction sites (>100 acres disturbed). We have located and sampled ten large sites.

Table 1. Selected Characteristics of Erosion and Sediment Control Jurisdictions Used for this Project

	Minimum Disturbed Area Requiring Erosion Plan	# Field Staff	Total Area (Miles^2)	# Active Projects	Site/Staff Ratio
Orange County	0.5 Acres	3	400	~100	33.3
Wake County	1.0 Acres	4	858	~400	100
District 4* (16 Counties)	1.0 Acres	4	8,116	~1000	250

* District 4, of the NC Division of Land Quality oversees all construction projects in all 16 counties without a Local Erosion and Sediment Control Program. It covers all governmental construction in the District 4 area, including Orange and Wake Counties. So, a single stream can have adjacent construction sites along the banks, one supervised by District 4 and the other by the Local Program.

Stream Sampling Procedures and Variables Sampled

We monitored at least three replicate sites per jurisdiction for the large construction sites. We sampled before, during, and after construction. We cannot control the timing of the construction projects, and since sampling must follow a rain of >1/2" in 24 hours (i.e., a rain with the potential to produce erosion and sedimentation), our sampling was dependent on the weather and the contractors. This means that the time between the before, during, and after sampling is highly variable. Since upstream and downstream controls were sampled on the same day as the "at the site" samples, this did not cause a significant analytical problem.

We sampled three sites on each stream, including >100m upstream, at the site, and >100m downstream. We took two replicate Surber samples for macrobenthos, identified to species whenever keys permitted, including chironomids. Chironomids are essential because they often constitute >90% of the individuals sampled, especially in the impacted reaches. The number of samples is small since our objective was not to analyze any one stream in detail, but to treat streams as replicates. In the overall analyses, multiple samples per site are pseudoreplicates. The mean of the replicate Surber samples was used in the analyses. We electroshocked for fish along one 50m reach of riffles and pools. We collected basic water chemistry data. Water quality parameters included D.O., turbidity, conductivity, Total N, NH_4^+, NO_3^{-1}, Total PO_4^{-1}, SRP, pH, and temperature. We also studied leaf litter decomposition rates. Five g leafpacks of *Cornus florida* (dogwood) leaves were incubated for two weeks *in situ* at all three sites in the "during construction" period to assess the critical ecosystem process of litter decomposition.

Environmental Policy Analysis

Surveys and semi-structured interviews were used to investigate both the regulatory agencies and developers. The surveys focused on the *capacity* of the agency, the external *commitment* that the agency receives, as well as the internal commitment toward the environment, and the *control* measures that are used. The surveys and interviews achieved a 100% response and participation rate. Although it has been harder to get their cooperation, we have nearly completed data collection from developers. The survey data is being augmented with documentary data from the sediment and erosion control offices in each of the counties.

The evaluation of implementation focused on (1) the extent to which developers comply with sediment and erosion control regulations and (2) the way that regulatory and organizational factors interact to shape compliance behaviors. The examination of outcomes combines social science and biological data to examine associations among regulatory styles, agency activities, and stringency of policy enforcement. We further analyzed how variations in sediment and erosion control enforcement are related to the ecological outcomes (including biological, chemical, and physical factors) in the impacted streams.

Hypotheses

Hypothesis 1. Greatest degradation will be evidenced at the construction sites, compared to upstream controls, with moderate to complete recovery downstream.

Hypothesis 2. Tighter enforcement of erosion and sediment control laws will result in less damage to streams.

Hypothesis 3. Stronger erosion and sediment control regulations will result in less damage to streams.

Results

Nearly all biotic and environmental variables measured tell the same story. Figure 1 shows the changes in the EPT Index for the during construction sampling. That is the species richness of the Ephemeroptera (the mayflies), Plecoptera (the stoneflies), and Trichoptera (the caddisflies). The tally of EPT taxa (i.e., EPT Richness or the EPT Index) is a well-established and universally accepted measure of stream health. These groups of aquatic insects are particularly sensitive to (and highly intolerant of) high temperature, low oxygen, toxic substances, a wide range of pollutants, and burial by sedimentation. An abundance of EPT species and individuals and high EPT diversity are clear indicators of good stream health. Reductions in EPT values demonstrate degradation of stream conditions.

EPT richness follows a pattern. The differences between jurisdictions are clear. The greatest decline in EPT values from upstream to at-the-site occurs in District IV. The EPT Index in Orange County changes little at any site. Wake County actually shows some enhancement of the EPT richness as you go from upstream to at-the-site. We sampled many other variables but the results parallel the EPT richness.

A short summary of the enforcement activities and attitudes of the regulators in the various jurisdictions is found in Table 2. These data show that these agencies differ in these aspects. Orange County had the strictest enforcement, penalizing nearly 25% of all construction projects, while Wake penalized ~22% and District IV penalized only ~ 4.5% of the projects they inspected. Orange County is most likely to use stop-work orders to halt construction due to sedimentation violations, while District IV relies on fines. District IV is perceived as being so understaffed that it is unable to make sufficient inspections. Consequently, some contractors do not feel obliged to follow their approved plans. Some contractors agree to a plan and then cut costs by not following the sediment controls. This laxity is detectable from the stream data (see Figure 1).

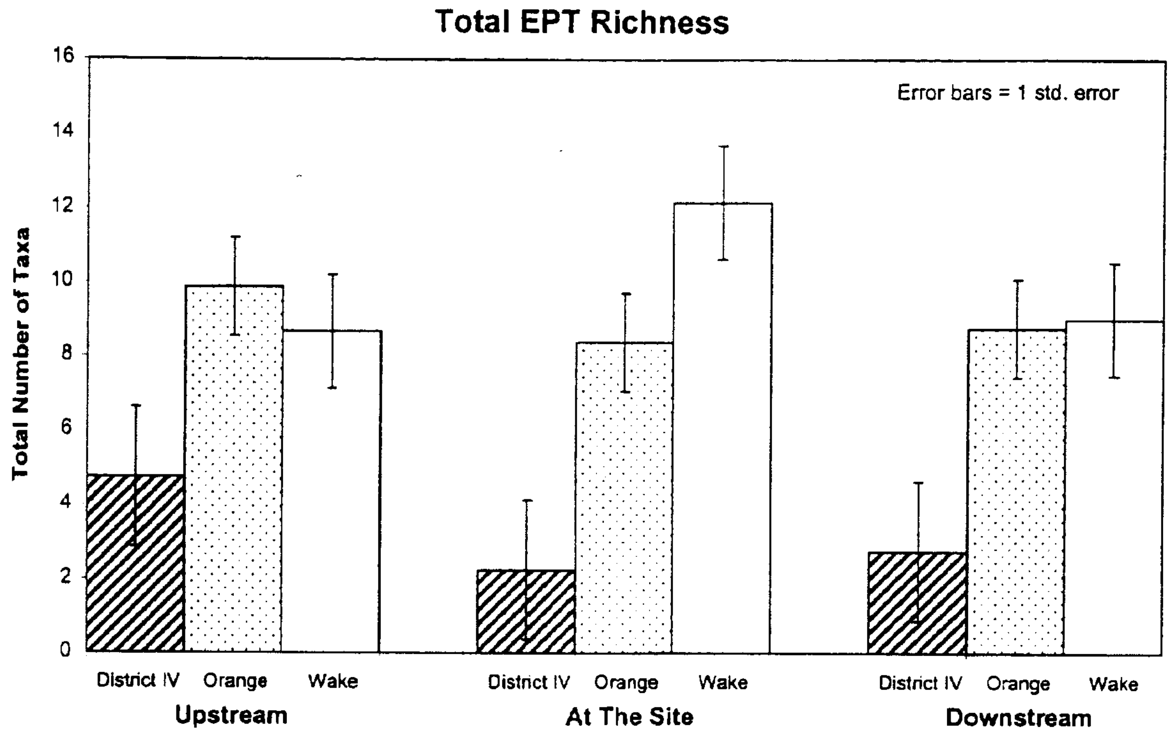

Figure 1. Total EPT Richness.

Table 2. Regulatory Environment

Agency/Variables	Orange County	NC District IV	Wake County
Enforcement Action	Very Strict	Average	Strict
Penalties enacted past year	24	44	88
Stringency of Penalties	High	Medium	Medium
Attitudes of Regulators			
Perception of official commitment	Supportive	Very Supportive	Indifferent
Percent of developers that regulators	8	40	10

Orange County and Wake County regulators generally think that developers will try to avoid complying with erosion and sediment control regulations. As the regulators' workload increases, their task becomes more difficult. This may result in regulators adopting a more forgiving attitude toward developers and less vigorous enforcement of the regulations. District IV regulators think that fully 40% of developers are trying to comply with the regulations.

Discussion

There is a clear link between the attitudes and enforcement activities of the regulators of erosion and sediment control ordinances and environmental outcomes in the streams near construction sites. If the regulations are completely effective, all sites should be similar to the upstream controls when the construction is completed and the site has been stabilized (i.e., revegetated). In our analysis, the degradation is clearly detectable in the benthic community data (see Figure 1). Benthic communities at the site are dramatically negatively impacted in District IV, unchanged in Orange County, and actually enhanced in Wake County. The effect is sometimes reduced downstream but the degradation persists downstream in District IV.

Wake County and District IV have identical regulations, while Orange County's regulations are more stringent. Comparison between the two jurisdictions with the same rules but different inspection and enforcement intensities will help us tease apart these factors. The stream data suggest that the laws, as written, are not particularly important. Wake County has the best environmental results while District IV has the worst stream degradation. Our analysis suggests that differences in laws and regulations have limited impact on the degree of degradation of stream biota.

The key factors seem to be the attitudes and enforcement behavior of the regulatory agencies. The frequency of on-site inspections is particularly important. In Orange County, every construction site is inspected every week. If it is a problem site, the inspectors may visit daily. In Wake County, the inspections are closer to every other week. In District IV, the goal is to visit every site once in the entire duration of the project. They also seek to respond to any citizen complaints within one week. In Orange County a complaint generates an inspection within one day. Another critical factor is topography. A very steep, erodible slope can undermine the best attempts at enforcement of erosion and sediment control regulations.

Our analysis suggests that differences in the nature and frequency of enforcement and inspections does matter. Developers tell us that a rigid, command and control approach to enforcement is less palatable to them than a flexible problem-solving cooperative approach. If the developers perceive that the regulators are really tying to help them keep sediment on site and out of the streams, they do a better job. Flexibility enters in as follows. If the sedimentation inspectors have enough time to analyze a sedimentation problem in detail, their suggestions will be better. Very often, the inspectors need the authority to implement solutions which are not exactly "by the book." When inspectors propose innovative solutions, which can really solve the problem, this encourages the developers to be more cooperative. More frequent inspections and a cooperative, flexible approach by regulators does ameliorate the stream damage among similar streams in different jurisdictions.

On the other hand, if the developers know that the regulators will in fact shut them down (with a stop-work order or a court injunction), it is easier for the regulators to get developers' attention. Fines are notoriously ineffective penalties in North Carolina. Presently the maximum fine is $500 per day. When developers are pouring millions of dollars into a project, this amount of fine is trivial. As one said, "It's just a cost of doing business." In essence, the effectiveness of erosion and sediment control depends more on enforcement than on how the regulations are written. Even with weak laws, the success of Wake County's Erosion and Sedimentation Control Program plainly depends on their on-site enforcement actions.

Recommendations

- Provide sufficient inspectors to visit each construction site at least weekly.
- Give inspectors the authority and knowledge to implement innovative solutions to erosion problems on a site-specific basis.
- Empower the inspectors to issue severe penalties (stop-work orders) in the case of sedimentation violations.
- Raise the maximum level of fines to a meaningful amount (we suggest $10,000 per day).
- Educate the development community to the damage that sedimentation does to stream communities.

Effectiveness in Erosion and Sediment Control: New Initiatives in Indianapolis

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Since the late 1960s, when the severity of pollution from sediment from construction sites was first documented, many states and municipalities have worked to develop effective programs for erosion and sediment control. These state and local programs were augmented in 1987, when Congress required in the *Clean Water Act* that operators of all construction sites over five acres prepare erosion and sediment control plans and obtain National Pollution Discharge Elimination Permits (NPDES). At that time, some states, such as Maryland and North Carolina, already had well-supported, comprehensive approaches that were developed largely in response to state law. Other states, including Indiana, have relatively new programs that were adopted only after the federal mandate. In general, these newer programs are not as comprehensive, and managers are still working to develop systematic and effective methods for implementation.

This paper describes a new initiative in Indianapolis, Indiana, to increase the effectiveness of erosion and sediment control programs. The paper describes a general framework for evaluating erosion and sediment control programs. Next, it describes an intergovernmental, "S.W.A.T." team approach to inspection that was used in Indianapolis in the summer of 1998. The paper summarizes the results of the inspections and concludes with a discussion of the implications for managers of erosion and sediment control programs.

Effectiveness in Erosion and Sediment Control Programs

Managers and analysts in Maryland and North Carolina have used a general framework for evaluating erosion and sediment control programs (Clevenger, n.d.; Departments of Civil Engineering and City and Regional Planning, 1990). The framework comprises five criteria, each of which must be satisfied for sediment pollution to be controlled effectively:

- Complete coverage
- Competent plans
- Careful installation
- Continual maintenance
- Consistent enforcement

Overall effectiveness requires that the coverage rate (the proportion of construction sites with controls) approach 100%. Operators of development sites must know of regulatory requirements and make efforts to comply. Second, erosion and sediment control plans must be competent. Best management practices (BMPs) incorporated into plans by engineers or technicians must be able, if constructed properly, to control erosion and sedimentation. Third, BMPs must be installed completely and correctly. Improper installation may result in failure and off-site sedimentation. Fourth, BMPs must be maintained for the duration of the construction process. Finally, consistently effective approaches to enforcement must be developed to ensure compliance with substantive criteria. If any one of these criteria is not met, the objectives of erosion and sediment control may not be achieved.

When new programs are developed, these criteria can be considered sequentially. That is, when building a new program, managers must first make sure that developers and builders are aware of regulatory requirements. Next, they must work to ensure that developer's engineers are preparing good plans. If developers are aware of requirements and are submitting good plans, attention can turn to installation and maintenance. Use of enforcement tools always is a last resort.

An Initiative in Indianapolis

Although the City of Indianapolis has a sediment control ordinance that predates federal requirements, erosion and sediment control programs in Indiana have largely been developed in response to a state regulation [Title 327-IAC 15-5 (Rule 5)], that was adopted in 1992 to comply with EPA regulations. Since the adoption of Rule 5, managers generally have seen improvements in efforts to comply. Most developers and builders are now aware of requirements, and coverage is approaching 100%. With respect to plan review, the Division of Permits in the Department of Capital Asset Management (DCAM) is responsible for plan review pursuant to the city's ordinance, while, under a memorandum of understanding with the Indiana Department of Environmental Management (IDEM) and the Department of Natural Resources (IDNR), the Marion County Soil and Water Conservation District (District) is responsible for plan review pursuant to Rule 5. MCSWCD reviewers estimate that the quality of plans is improving, but that as many as 60 to 70% of all plans still must be returned and revised before approval. Most plans are approved on the second iteration.

Although the review process now assures that competent plans are being prepared, installation often remains inadequate, BMPs often are not maintained, and resources for inspection and enforcement are limited. IDNR has only seven inspectors in the Division of Soil Conservation for all 92 counties and 550 municipalities. IDNR inspectors generally work individually within regions, inspecting sites sequentially and in response to complaints. District personnel lack enforcement authority and mainly visit sites in response to complaints. In Indianapolis, sediment control has been a low priority with DCAM, which has no inspectors trained in or assigned exclusively to enforcement of sediment control requirements.

Managers have struggled to find ways to overcome resource limitations and to increase the effectiveness of implementation. In 1998, IDNR and District staff conceived of a "S.W.A.T." team approach to inspection. In this approach, all IDNR inspectors and District staff together focused their efforts on all open construction sites in the county. The objective was to visit all sites in a brief time period, thereby increasing the visibility of the program. Managers believed that intensive scrutiny of the county, if only for a brief time, would result in greater efforts at compliance. One of the assumptions on which this approach was based was that there are both formal and informal networks among developers and builders and that this approach would stimulate discussion about compliance issues.

In Indianapolis, IDNR and District personnel completed a county-wide survey of construction sites on June 23 and 24, 1998 (Hayes and Matthieu 1998). DCAM staff was invited to participate. IDNR, District, and DCAM staff visited more than 300 construction sites. Of these sites, 177 were active and were evaluated for compliance with Rule 5. Construction had not yet begun at 23 of the sites, construction had been completed at 61 sites, and the remainder were not evaluated because they were inaccessible or because construction was just beginning. This summary is restricted to the sites under active construction. The results provide a good picture of the current status of implementation and the general level of effectiveness of erosion and sediment control requirements in Indianapolis.

Inspectors evaluated sites for compliance in nine categories using a standardized checklist developed by IDNR. Sites also were checked for obvious evidence of off-site sedimentation. The nine categories were: (1) proper installation of erosion and sediment control measures; (2) perimeter erosion control measures; (3) erosion and sediment control measures on individual building sites; (4) protection of storm-sewer inlets; (5) stabilization of disturbed areas, (6) proper stabilization of drainage channels; (7) stabilization of drainage outlets; (8) maintenance of existing erosion and sediment control measures; and (9) tracking or accumulation of sediment on roadways. These criteria generally can be grouped within the installation and maintenance stages of the evaluation framework outlined above, although most involve aspects of both installation and maintenance. The first seven criteria primarily concern installation of BMPs; only two, maintenance and tracking, primarily concern maintenance.

Inspectors rated each applicable criterion at each site on a scale of Satisfactory, Marginal, Unsatisfactory or not applicable (NA). Items in compliance with Rule 5 were rated S, items that were in danger of becoming out of compliance were rated M and items in violation of Rule 5 were rated U. Because all criteria were not applicable at all of the sites, the number of sites evaluated for with respect to each criterion varies.

Disturbing Results from Disturbed Sites

The results of the inspections are summarized in Figure 1 (Hayes and Matthieu 1998). Overall the results show that installation is inadequate and that maintenance is worse. Improvements in implementation clearly are needed. Discussion of each of the nine items reviewed follows.

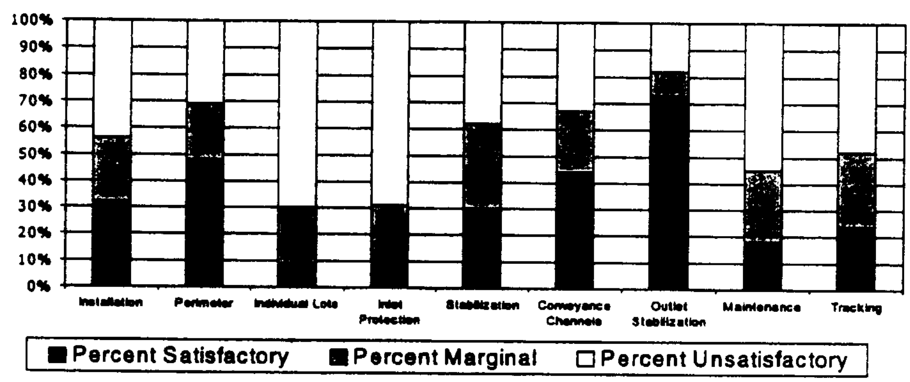

Figure 1. Rule 5 Compliance Summary-Percent of Applicable Sites.

Installation of Erosion Control Measures

Erosion control depends upon installation of appropriate control practices in given situations. Examples of these practices include silt-fence perimeter controls, sewer inlet and outlet protection devices, and the use of stone or mulch to stabilize slopes. Proper installation of these devices and practices helps reduce the risk of failure that may result in erosion and off-site sedimentation. Erosion and sediment control measures were installed correctly at only 32% of the active sites. Installation was marginal at 24% of the sites and had been done incorrectly at 44% of the sites. Proper installation was marked not applicable in cases where no erosion control practices were in use.

Perimeter Erosion Control Measures

Perimeter erosion control measures are designed to keep sediment from leaving a site directly at its perimeter through sheet or gully erosion. Perimeter erosion control devices/practices such as silt fence or buffer strips should be installed before land disturbance begins. The most effective and cost-efficient perimeter control practice is to leave existing vegetation in place, especially along waterways. Perimeter measures were installed and in compliance at 48% of the sites. Marginal conditions were found at 21% of the sites, and 31% of the sites were found to be out of compliance. Perimeter erosion control measures were not applicable at level or inward-sloping sites.

Individual Building Sites

Under Rule 5, erosion control is the responsibility of the site operator, either the developer or builder, throughout construction. At some sites, after the infrastructure has been installed and the lots have been sold to individual builders, the developer no longer has direct control over erosion and sediment control practices on those lots. Builders and contractors may or may not install and maintain erosion control practices. Erosion control on individual building sites is a serious problem in Marion County. Erosion and sediment control measures on individual building sites at developments were found to be adequate at only 9% of the active construction sites. Measures were in marginal condition at 21% of the sites, and 70% of the sites were found to be out of compliance. Most of these sites lacked proper construction entrances, storm-sewer protection, and perimeter protection. This category was not applicable for sites that had not yet begun construction of homes.

Storm-sewer Inlet Protection

Sediment entering storm-sewer inlets significantly reduces the capacity of retention/detention basins and drainage channels to store and convey stormwater away from flood prone areas effectively. If sediment is not removed prior to site closure, the specified volume and dimensions of retention/detention basins that were approved by the City can change. Inlet protection measures are especially important when sediment is tracked into or allowed to accumulate in roadways where it is conveyed directly to sewer inlets. Using measures such as seeding and silt fence adjacent to inlets will prevent sediment from clogging inlet protection devices and accumulating in the streets. Storm-sewer inlets were adequately protected from sediment at just 14% of the construction sites. Sewer inlets were marginally protected at 17% of the sites, and inlet protection measures were inadequate and not in compliance at 69% of the sites. Inlet protection was not applicable to sites that had not completed sewer installation.

Stabilization of Disturbed Areas

Stabilization of disturbed areas on construction sites may be the single most important practice for reducing erosion and off-site sedimentation. The best practice for achieving stabilization is to leave vegetation in place wherever possible. If soil must be disturbed, stabilization is relatively easily accomplished through temporary seeding or application of erosion control blanket. Rule 5 requires that disturbed areas that will be inactive be temporarily seeded. Stabilization by seeding results in higher perceived value by potential buyers, offering developers a financial incentive to vegetate land as soon as possible once the infrastructure is in place. Of active sites that were visited, 30% were in compliance with Rule 5 with respect to stabilization of disturbed areas, while 32% of the sites were marginal and 38% were not in compliance. This category of compliance was not applicable to sites that were being actively cleared or nearly completed at the time of the visit.

Drainage Channel Stabilization

Ditches and swales designed to convey storm water away from development to natural drainage ways or storm-sewers are subject to severe erosion and deterioration if not adequately protected. Erosion and damage to conveyance channels results in off-site sedimentation of waterways. This can be avoided by stabilizing the soil in conveyance channels immediately with permanent seeding of grasses, or with stone, mulch, or straw cover. Conveyance channel stabilization was satisfactory at 44% of the sites. Approximately 23% of the sites had marginally protected channels and 33% of the sites had channels in unsatisfactory conditions. Conveyance channel stabilization was not applicable at sites that did not have or require channels or at those that did not yet have them constructed.

Outlet Stabilization

Storm-sewer and drainage channel outlets from a site need to be properly stabilized to prevent erosion and sedimentation of the banks and waters they empty into. Outlet stabilization is best accomplished by protecting the soil around the outlet with stone riprap, geotextile fabric, or with well-established vegetation. Outlet stabilization was satisfactory at 73% of active sites. Outlets were in marginal conditions at 18% of the sites and unsatisfactory at 9%. This category was not applicable at sites that did not have outlets on the site or where infrastructure development was not yet completed.

Maintenance of Erosion Control Practices

Erosion control practices that have been installed properly must be maintained to be effective. In most cases, lack of maintenance results in the same effects as not employing erosion control practices at all. Examples of maintenance of erosion control practices include removing accumulated sediment from behind silt fence and reinforcing inlet protection after storms. Failure of erosion control practices allows sediment to leave construction sites via storm-sewers, drainage channels, roadways and sheet and gully erosion. An often-overlooked aspect of maintenance is removal of devices after work is completed. Maintenance of erosion control practices was satisfactory at only 18% of the sites. Maintenance was marginal at 27% of them, and there was little or no evidence of maintenance at 55% of the sites. Maintenance of erosion control measures was not applicable at sites that did not employ erosion or sediment control practices.

Sediment Tracking and Accumulation in Roadways

Soil and sediment in streets and roads are readily washed into sewers and drainage channels and can be a significant source of pollution. In addition, the sediment can be a traffic hazard with the potential for costly litigation against the local governments or developers. Sediment accumulated in roads is also unsightly and may discourage potential home buyers. Tracking and accumulation of soil in roads was kept to an acceptable level at 24% of the sites. Approximately 28% of the sites exhibited marginal compliance with the rule for keeping roads clear of sediment. Sites that were out of compliance with the rule made up 48% of this category. Large industrial sites where equipment was usually kept on site and residential sites that did not yet require extensive coming and going of vehicles were rated not applicable for sediment tracking.

Off-site Sedimentation

Sediment is the most abundant pollutant, by volume, in Indiana waters. Residential and commercial development sites are potential sources of high volume, sudden discharges of sediment that can cause problems for land owners down-stream of development. Besides the drainage and flooding problems caused by off-site sedimentation, sediment can obstruct and widen streams and erode stream banks. Sedimentation of the state's streams and rivers also causes habitat damage for many aquatic species. There were obvious signs of off-site sedimentation at 21% of the active sites. This figure is believed to be low, however, due to the large number of sites surveyed in a very short time. Only the most obvious cases were checked as displaying off-site sedimentation.

Observations and Implications: Priority-problem Solving

A number of observations that have important implications for managers of erosion and sediment control programs can be drawn from this inspection initiative. First, it is useful to consider the initiative in the more general framework for effectiveness in erosion control. Indiana regulations for erosion and sediment control first were adopted in 1992. Faced with implementation of a new regulation with few resources, IDEM, IDNR, and District staff first devoted efforts to education and ensuring complete coverage and competent planning. In late 1997 and early 1998, program managers determined that the plan review process was fairly well established and that additional effort needed to be devoted to installation and maintenance of BMPs. Because resource shortages preclude regular, periodic inspection, IDNR officials developed a S.W.A.T. team approach. Teams of state, district, and available municipal officials focused inspection efforts, visiting and inspecting as many sites as possible in a short time.

In Indianapolis, the results show that implementation generally is poor. Installation of erosion and sediment controls was unsatisfactory on 44% of all sites, and satisfactory on less than one-third. With the exception of outlet stabilization practices, which had been installed properly at nearly three-fourths of the sites, no practice was installed properly on more than half of the sites. Perimeter controls, a basic practice, were installed satisfactorily on fewer than half of the sites and they were unsatisfactory at almost one-third. Stabilization was satisfactory at less than one-third of the sites, inlet protection had been installed properly at less than 15% of the sites, and controls on individuals lots had been installed properly at just 9% of the sites where they were needed. It is clear that installation is deficient and that additional effort is needed to ensure that practices identified on plans are installed properly.

The inspections show that maintenance of erosion and sediment controls is even worse than installation. Inspectors determined that maintenance of controls was unsatisfactory on 55% of the sites and satisfactory on only 18%. Mud is being tracked on streets and washed into sewers and drainage channels on almost half the construction sites. Additional field work to ensure proper maintenance of BMPs is a critical need.

Although these results were disturbing, they were not unexpected. Program officials knew that implementation was inadequate and devised the S.W.A.T. team approach to provide a quick, comprehensive assessment of the status of implementation. Since the inspections, program managers have used the results as part of overall efforts to increase understanding of requirements for erosion and sediment control and to build commitment to the programs. City staff agreed to mail copies of inspection reports to all developers, and the district provided a summary of results to all city-county councilors.

The results provide information that program managers can use to establish priorities for problem solving and education. For example, installation of perimeter controls appears better than efforts to stabilize disturbed areas on site. Future inspections and educational efforts therefore can focus on the importance of stabilization. Similarly, since it appears that site operators are doing a fairly good job at stabilization of outlets, this requirement can be de-emphasized, and additional effort can be devoted to solving problems like installation of controls on individual lots that are not controlled by practices on the larger development site. More generally, as more people understand the different steps in the process of erosion and sediment control, implementation should become more effective.

The survey did not focus on discovering reasons behind compliance or non-compliance, but several inferences can be drawn from these data. First, the data and experience indicate that some developers are unaware of their obligation to control erosion and sedimentation and leave the permitting and erosion control planning to engineers and contractors. This can result in a lack of commitment to implementation. Second, some developers, engineers and contractors clearly do not yet understand the purpose and importance of implementing erosion and sediment control practices. Education is needed to increase their understanding and commitment. Third, some operators know the requirements of Rule 5, but do not take them seriously, ignoring the Erosion and Sediment Control Plan. For these individuals, enforcement action may be required. In addition, a general problem that was observed has to do with sequence of construction. All too often, land disturbance is beginning before erosion and sediment control measures are installed. More emphasis must be placed on installation of practices prior to earth disturbance, and site operators must learn to follow the sequence described on plans.

Given that resource shortages are likely to continue, problems in implementation are likely to continue and regulatory programs are likely to remain less effective than they could be. Steps that may be taken to increase effectiveness include making sure that the regulated community participates in on-site, pre-construction meetings that underscore the scope and importance of controls; increasing the visibility of IDNR and District staff and the frequency of their site visits; educating developers, engineers and contractors about erosion and sediment control practices and how to install and maintain them; and emphasizing the need for erosion and sediment control throughout the entire development process.

The S.W.A.T. team approach clearly does not solve the problems of a relatively new, understaffed erosion and sediment control program. But the approach is an effective way to obtain a significant amount of information in a short time, raise the visibility of erosion and sediment control programs, and help establish priorities for problem solving.

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Using Constructed Wetlands to Reduce Nonpoint Source Pollution in Urban Areas

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Abstract

Potential pollutants carried in stormwater runoff from urban surfaces are a major component of Nonpoint Source (NPS) pollution. NPS pollution is a leading cause of reduced water quality in US rivers and lakes, and there are major efforts underway to find innovative approaches to reducing NPS pollution from a wide range of sources. In urban areas, where much of the land has existing structures, a major challenge is to find ways to retrofit built sites to reduce NPS pollution associated with stormwater runoff. One component of this may be more widespread use of constructed wetlands that have value not only in terms of water quality improvement, but also in terms of urban ecology, aesthetics and education.

We have begun a long-term monitoring program of the performance of constructed wetlands in two settings: 1) On a commercial site where surface runoff is dominated by stormwater flow from parking lots and store roofs, and, 2) On a golf course that receives considerable surface flow from adjacent commercial, residential and highway areas. Monitoring includes both continuous measurements of flow, temperature, conductivity, pH and dissolved oxygen, and automated sample collection during storm events for more complete chemical analyses. Initial results suggest that the commercial site constructed wetland acts as an efficient trap during the spring and summer for suspended sediment and some dissolved matter. During the fall and winter dormant season trap efficiencies are much lower, and in some cases negative. The golf course site constructed wetlands also function as efficient traps during the summer, and plant growth in these wetlands has been helped considerably by the regular water supply provided by golf course irrigation. Both wetland systems also provide value in terms of improved aesthetics, their use by local educators, their diverse ecological assemblages, and the public relations benefits associated with visible efforts at improved environmental management.

Replacing portions of existing parking lots with carefully designed constructed wetlands, and adding constructed wetlands to urban recreational sites (such as golf courses and parks) should be viewed as one of several elements of an integrated approach for effective retrofitting urban areas to reduce NPS pollution from stormwater runoff.

Introduction

One of the major challenges facing urbanized areas is to find ways to improve environmental management in ways that do not involve major, costly impacts on existing infrastructure. Increasing recognition of the environmental impacts of built areas on parameters such as runoff amount and quality has increased regulatory and public pressure to develop and implement effective management practices. However, many of the best management approaches that can be integrated into the design of new developments cannot be implemented in existing built areas without prohibitive costs. Thus there is considerable interest in best management practices that can be used to retrofit urban areas for improved environmental performance.

Wetlands have the ability to store large amounts of water, reducing flooding of surrounding areas and in some cases recharging groundwater (Mitsch and Gosselink, 1993). In addition, wetlands are capable of improving runoff quality in many situations (Perry and Vanderklein, 1996) because they trap both solid and dissolved pollutants. Wetlands also can have considerable aesthetic benefits, and provide habitat for a wide range of plants and animals. Constructed wetlands are wetlands specifically designed and built for hydrologic and water quality management, as opposed to either natural wetlands or created wetlands. Created wetlands are designed and built to replace lost wetlands or to compensate for destruction of natural wetlands. Using constructed wetlands for water treatment attempts to take advantage of the benefits of wetlands without compromising natural wetland areas.

In urban areas there are unique challenges to be faced in proposing and designing constructed wetlands. Existing built areas rarely include extensive undeveloped space that can be converted to constructed wetlands. However, there are several opportunities that arise in many areas, including: 1) Making space by reducing the size of an existing parking lot; 2) Adding a constructed wetland to a redevelopment or urban renewal project; 3) Adding a constructed wetland to a park or green space; 4) Adding constructed wetlands to existing recreational facilities such as golf courses. A second major challenge in proposing constructed wetlands in built urban areas is to maintain adequate hydrology for long-term wetland survival. The extensive impervious surfaces of built areas generate large amounts of runoff during storm events, but this water is usually routed quickly away from the built area to prevent flooding. Because there is little opportunity for rainfall to infiltrate into the soil in urban areas (because most soil is covered by impervious surfaces), shallow groundwater flow is reduced. This means that wetlands in urban areas will receive far less between-storm water recharge from shallow groundwater than would be expected for a similar non-urban setting. In essence, wetlands in urban areas will experience a "flood and drought" hydrologic regime, which is poorly suited to an ecosystem that is based on extensive periods of wet conditions. One way around this problem is to look for locations where water is applied regularly to adjacent areas, in particular where extensive irrigation is used. Golf courses and lawns and gardens of major corporate complexes are potential sites where between storm irrigation might provide excess runoff and soil water drainage to adjacent constructed wetlands.

Given the potential use of constructed wetlands to improve water quality in built areas, it is important to evaluate how well wetlands function as pollutant traps in such settings. Such studies can be used to drive design improvements, and to evaluate the cost-effectiveness of using constructed wetland for NPS pollution control. Although there has been less work done in the area of stormwater constructed wetlands, in comparison to wetlands used as part of a wastewater treatment system (e.g. Hicks and Stober, 1989), limited results so far suggest that wetlands can be effective in treating stormwater for nonpoint source (NPS) pollution (Mitsch and Gosselink, 1993; Witthar, 1993; Livingston, 1989). Few data sets are available because of poor follow-up of constructed wetland performance through appropriate monitoring programs (Perry and Vanderklein, 1996). However, available studies to date and theoretical reasoning suggest that NPS pollution control is enhanced by maximizing the distance between the wetland's inlet and outlet, including deep and shallow sections in the wetland, selecting vegetation on the basis of climate and water quality and supply conditions, maximizing the ratio of treatment area to base flow, and minimizing the slope along which the water travels (Horner, *et al.*, 1994; Witthar, 1993). The idea in such a design is to model the constructed wetland after a natural wetland, which not only has the ability to slow down the flow of water (as does a detention or retention pond), but also can remove pollutants from the runoff water. The most important factor in the design and maintenance of constructed wetlands is hydrology (Mitsch and Gosselink, 1993). Without the proper water inflow and outflow, the newly created wetland will fail and be unable to accomplish its task of stormwater treatment.

Aims and Objectives

We are monitoring the performance of urban constructed wetlands in two settings, a constructed wetland incorporated into site development for a commercial facility and a series of constructed wetlands built into a recently renovated golf course that receives runoff from an adjacent urban area. Both sites are in West Lafayette, Indiana. The goal of long-term monitoring is to provide insight into seasonal and longer-term variations in trap efficiency, both as the basis for improved scientific understanding of constructed wetland processes and controls, and to form the basis for future improvements in design.

Study Areas

The commercial constructed wetland site occupies approximately 0.51 ha, with a water surface area of 0.26 ha and volume of 1300 m^3. This wetland is intended to treat the "first flush" of runoff, and so was designed to accommodate the volume of water corresponding to first half-inch of precipitation on the store's impervious surfaces (the parking lot and the rooftop). The mean depth of the constructed wetland is 0.5 m but this includes two deeper pools with a maximum depth of 1.8 m (Tatalovich, 1998). Conventional wisdom (which may not be correct) states that 90% of the annual pollutant load is transported in the runoff produced by the first 1.3 cm of precipitation (known as the first flush), and this has been shown to be true for the transport of most pollutants over impervious surfaces (Chang, 1994). At this commercial site, runoff that exceeds the first-flush equivalent is routed to a separate basin.

One motivating force behind use of a constructed wetland on this site was concern over potential impacts on a natural wetland (Celery Marsh) adjacent to the property. In addition to the constructed wetland, this site includes: elimination of a proposed auto care center, abstinence from chemical ice-clearing methods, and construction of additional ponds to treat stormwater runoff that could potentially include harmful pollutants. The constructed wetland receives runoff primarily from the 4.1 ha commercial parking lot, as well as minor additional input from an adjacent store, local access roads, and US Highway 52.

The golf course created wetlands are part of Purdue's new Kampen Golf Course and are positioned to intercept both runoff from much of the golf course and the adjacent urban area. The developed area includes two residential highways, a section of state highway, the parking lot of a motel, a gas station, and 200 residences. The water flowing through the Kampen Course eventually enters Celery Marsh, but prior to reconstruction this water flowed directly through drainage tiles and overland transport to the marsh, with no treatment. The golf course constructed wetlands serve several purposes: providing a water hazard and aesthetic component of the course, and enhancing environmental quality that can also be used in environmental education. Runoff from the urban area travels through three constructed wetlands prior to leaving the course. One particularly notable aspect of these constructed wetlands is that they have flourished even during long dry summer periods. Frequent watering of the greens and fairways, common on most courses, has the added advantage that it provides runoff and tile drainage to the wetlands throughout the summer.

Methodology

To determine the effectiveness of each constructed wetland in trapping potential pollutants, water samplers were installed at the inlet and outlet of the commercial constructed wetland (Figure 1), and at six locations in the golf course constructed wetland complex to track the progress of water as it enters the course, moves through the wetland system, and exits to the Celery Marsh. The samplers are equipped with ISCO® Submerged Probes that measure water levels, used in conjunction either with a weir or pipe of known geometry. The sampler uses these levels and the corresponding geometry of the sampling sites to calculate the flow into and out of the wetland. Each sampler also has a YSI® 600 Multi-Parameter Water Quality Monitor that measures dissolved oxygen, conductivity, temperature, and pH. The samplers record flow and water quality parameters every five minutes and are programmed to take water samples during storm events. Storm sampling is triggered in most cases by a change in water level, and at two locations, by rainfall intensity as measured with an automatic tipping bucket rain gauge. The trigger points were determined empirically, so that inlet and outlet samplers begin to sample at approximately the same time. The sampling programs for each sampler are split into two sections. The interval of time between samples in part A of each routine is closer together than those in the corresponding part B routines, so that sampling occurs more often during the "first flush." After that, the second stage

Figure 1. Sampling equipment at a constructed wetland. The laptop computer is downloading monitoring data from the sampler, and in the foreground is a set of 24 sample bottles for storm sampling.

of each routine samples at larger intervals to guarantee samples at times coinciding with the downward slope of the hydrograph.

Overall, the design of the experiment is to track flow and water quality into and out of the constructed wetlands continuously, both during storms and between storms, for a multi-year period. This allows for determinations of storm, seasonal and multi-year trends in constructed wetland trap efficiency. Trap efficiency can be defined in a number of ways, depending on the likely application of the results. In this work we are interested in concentration trap efficiency (percentage change in potential pollutant concentration between the inlet and outlet, both maximum and average values) and load trap efficiency (percentage change in potential pollutant load between the inlet and outlet for given points in a storm, for storm totals, and seasonally and annually). Selected samples from each precipitation event are analyzed by a Purdue University laboratory for total suspended solids (TSS), hardness, total Kjeldahl nitrogen (TKN), and total phosphorus (TP). These parameters are the same as those measured for seven other local sites as part of a larger analysis of water quality in rural and urban settings. In addition to the analyses performed at the Purdue laboratory, more complete chemical scans are performed once per season on selected samples by Heritage Environmental Services in Indianapolis, Indiana. The selection of tests is based on the pollutants that might reasonably occur at each site. The reason for this more complete scan is to determine whether any potential pollutants not routinely measured at the Purdue laboratory show up at unusually high levels. Any parameters that were not detected in the Heritage samples could potentially be excluded from future testing, but those parameters considered to be problems would need to be monitored on a consistent basis in the future.

Results and Discussion

To illustrate possible types of analyses and some major trends in the performance data, without reviewing the entire data sets available, this discussion includes three examples from the two sites. These include a complete storm record at the commercial site, between-storm sampling at the commercial site, and first-flush storm sampling at the golf course site.

Sample Storm at the Commercial Site

A 0.97 cm-storm occurred on 26 October 1997, with a double peak in intensity (Figure 2). As expected, the wetland acts to damp peak flows, so discharge values at the outlet slightly lag those at the inlet and are lesser in magnitude. Water temperature in the constructed wetland inlet is high and uniform (no diurnal variations) prior to the storm (Figure 3),

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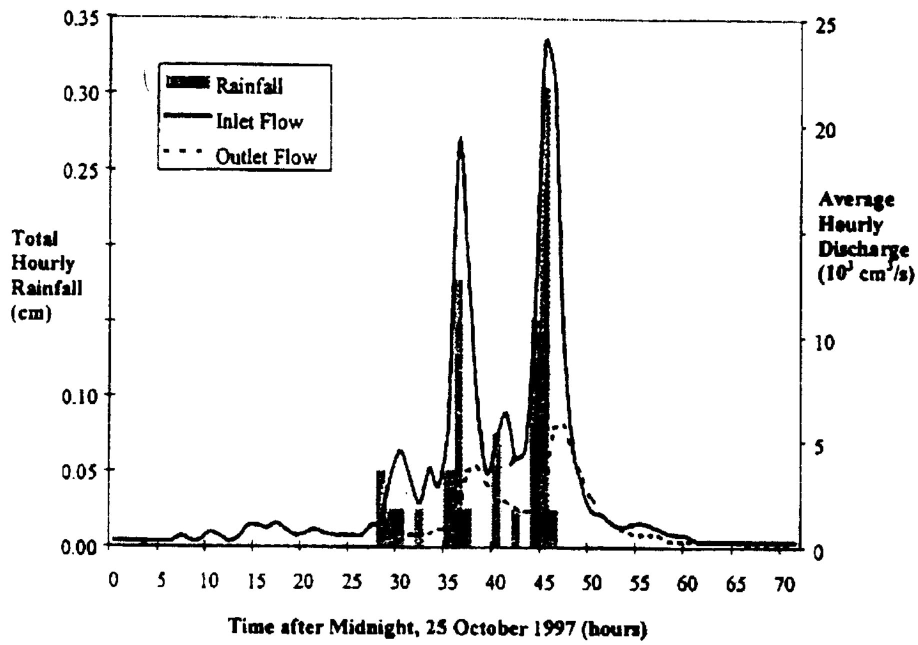


Figure 2. Rainfall and inlet and outlet runoff records for a storm event at the commercial site constructed wetland.

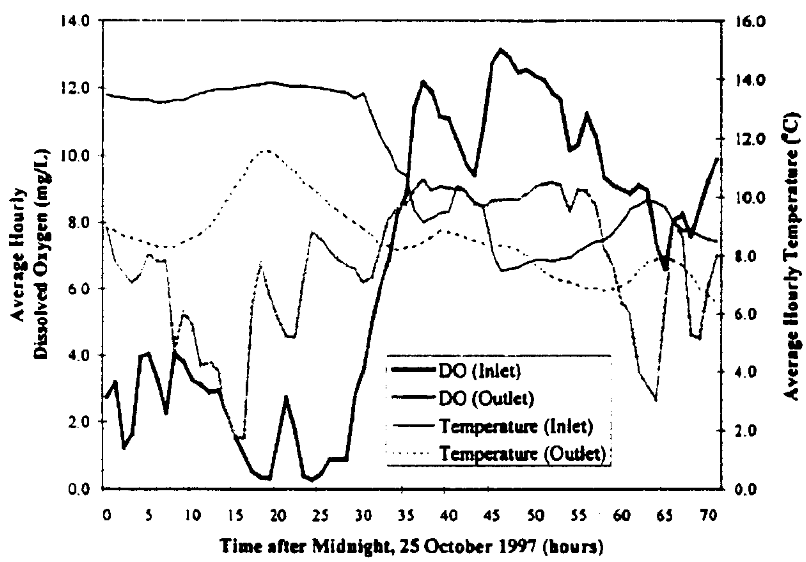
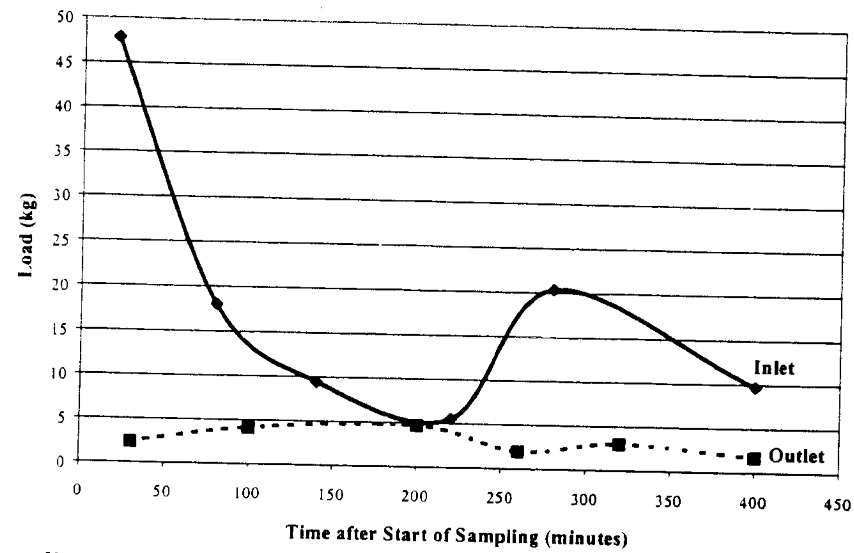


Figure 3. Dissolved oxygen and temperature records for the storm shown in Figure 1.

drops 6°C during the storm, and slowly climbs back 2°C in the 20 hours after precipitation stops. The outlet temperature shows a 4°C diurnal cycle prior to the storm, and a lower amplitude cycle after the storm. At the same time, the dissolved oxygen (DO) values climb during the storm (Figure 3). Inlet DO values vary within the 0 to 4 mg/L range before the storm, jump up to 9 to 13 mg/L during the storm, and fall during the 24 hours following the storm event. The outlet DO varies from 1 to 8 mg/L prior to the storm, is very stable between 8 and 9 mg/L during the storm, and has strong variations from 3 to 9 mg/L post-storm. High DO values during the storm are due to the increased mixing of the water, which causes oxygen to be introduced to the wetland, as well as the addition of "new" water that is higher in oxygen to the stagnant water.



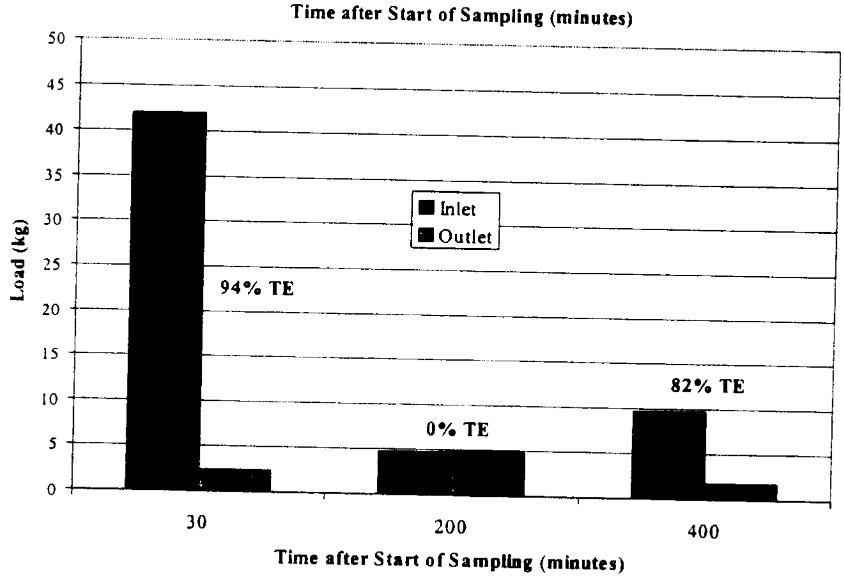


Figure 4. Total suspended sediment load for the storm shown in Figure 1 (upper), and calculated trap efficiency (TE) if only grab sampling had been used (lower). The actual load TE for the storm was 84%.

Initially, hardness data from the 26 October 1997 storm showed much higher values for the outlet than the inlet. This discrepancy relates to the movement of water through the wetland. Soon after the start of a storm, water begins to flow over the weir at the inlet and inlet sampling begins. This new runoff from the site has a low hardness, reflecting the naturally low hardness of rainwater. At the outlet, high hardness values show that the water initially being sampled is not new inlet water being displaced from the wetland; rather it is water that was stored in the concrete outlet box prior to the storm. Hardness values at the outlet fall throughout the storm, showing that hardness is lower in the wetland than in the concrete outlet box. Because hard water occurs when concentrations of Ca^{2+} and Mg^{2+} are high (Zumdahl, 1989), the concrete surroundings themselves can add to the hardness of the water. Ninety-five percent of all concrete used is made from Portland cement, which is prepared using finely ground limestone (Mindess and Young, 1981). The cement is made into concrete using admixtures such as calcium chloride. Also, the interaction of the surface water with groundwater, which in this geographic location is very hard due to infiltrating rainwater that dissolves the calcite-rich till from limestone in the region, can add to the hardness of the water in the wetland (Davis and Cornwell, 1991).

The hardness data suggest that the outlet record probably does not include water that enters and exits the wetland during the same storm. Other studies (e.g. Bhaduri, et al., 1997) have shown through chemical load distributions that the inflow and outflow from a basin are actually two different water masses, except in extreme storm events. The only way that the same water could appear at the inlet and outlet during the same storm would be if the inflow sheeted over the water in the basin, arriving at the outlet without significantly mixing with the water stored in the wetland prior to the storm; or if the storm produced enough water to completely displace the volume of water in the wetland.

Total suspended solids (TSS) concentration data and flow values for the storm are used to calculate TSS loading values, which depict the effect of the basin in reducing the overall sediment load. Total loads depict the actual physical amount of sediment entering the wetland and are important for planning activities such as dredging. TSS load values for the inlet are larger than the outlet (Figure 4). The inlet values start high, dip down, and then increase again. This indicates that the initial runoff has "first flush" (high load) characteristics, and then the load input rate decreases. A second, lower peak later in the storm could be the result of the later pulse of higher rainfall intensity (Figure 2). The values of TSS at the outlet remain fairly uniform throughout the storm. The initial value presumably represents between-storm ambient TSS loading in standing water in the wetland. During the storm, the increase in flow creates more turbulence, which can stir up some of the bed sediment, slightly increasing the TSS concentration and, therefore, the load. More importantly, though, the outlet values are lower than those for the inlet; thus there is a net decrease in TSS loading from the inlet to the outlet for this particular storm. In one sense, this traditional approach is a valid efficiency measure because the water going out is compared to that going into the wetland, but in another sense it is a skewed picture because the new inlet water is being compared with "old" outlet water that arrived in the basin during a previous storm (Bhaduri, *et al.,* 1997).

Multiple storm sequence sampling will provide a better view of overall trap efficiency (TE) than a single storm, just as a complete storm record is better than a grab sample. Standard grab samples do not always lead to accurate trap efficiency calculations (Figure 4). If one sample were taken each from the inlet and the outlet at exactly same time, the data could show a very high trap efficiency (30 minutes), no trap efficiency (200 minutes), or a fairly high trap efficiency (400 minutes). The overall load TE for this analysis was 84%. This is one of the reasons that this particular study samples several times after the start of a storm -- to bridge the gap between standard grab samples and actual events within the wetland. Continuous monitoring provides a more complete record of the constructed wetland's activity, more accurately depicting the trap efficiency of the wetland. From conductivity data, during the monitoring period, 137 kg of dissolved load entered the basin, and 59 kg left the basin, for a total dissolved solids (TDS) load TE over the storm of 57%. Further analysis of many storms can be used to determine an overall trap efficiency over longer periods of time. This type of analysis could be used to determine the effects of different storm intensities, seasonal variations, and increased urbanization in the area.

Detailed Chemical Scan at the Commercial Site: Between Storm Conditions

Samples for a detailed chemical scan were taken on 17 December 1997 using the sampler's grab sampling mechanism. At this time, there had not been a precipitation event in a couple of weeks, so these samples represent between-storm conditions in the wetland. Although these samples were tested for many possible pollutants, only a few were detected (Table 1).

Parameters which show reductions between the inlet and the outlet were chloride, sulfate, ammonia nitrogen, calcium, magnesium, sodium, silicon, strontium, and total dissolved solids (TDS). For instance, chloride levels fell from 210 to 160 mg/L, calcium levels fell from 95 to 54 mg/L, and strontium levels fell from 0.16 mg/L to below the detection level of 0.10

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Table 1. Detailed chemical scan of the commercial site constructed wetland. All values are mg/L.

Parameter	Inlet	Outlet	Detection Limit
Chloride	210	160	2.5
Sulfate	49	37	1.3
Nitrogen, Nitrate-Nitrite	0.12	0.11	0.01
Nitrogen, Ammonia	0.21	0.14	0.12
Chemical Oxygen Demand	*18*	*28*	*10*
Aluminum	*BDL*	*1.3*	*0.10*
Calcium	95	54	0.10
Iron	*0.33*	*1.7*	*0.10*
Potassium	*2.5*	*2.7*	*0.10*
Magnesium	28	15	0.10
Manganese	0.32	0.24	0.10
Sodium	110	85	0.10
Silicon	5.1	3.0	0.10
Strontium	0.16	BDL	0.10
Total Organic Carbon	*BDL*	*4.2*	*1.0*
Total Phosphorus	*BDL*	*0.10*	*0.03*
Dissolved Solids	720	490	10
Total Suspended Solids	*4*	*13*	*1*

Notes: Italicized parameters are those which have an outlet value > inlet value.
BDL = below detection limit

mg/L. Also, TDS levels fell from 720 to 490 mg/L. When compared to the values calculated using conductivity data from the sampler, these values are slightly higher than the values calculated for the 26 October 1997 storm event. The maximum TDS values calculated for the inlet and the outlet were, respectively, 568 and 365 mg/L, with average values around 337 and 263 mg/L. The higher between-storm values could be a result of the ability of sediments to dissolve in the wetland waters. Reductions in values between the inlet and the outlet indicate removal of certain pollutants within the wetland and also suggest that at the beginning of a storm, the outlet values will be lower than those of water near the inlet. Because of this, the best TE should be at the start of a storm, which is shown in the 26 October 1997 storm chemical data.

Not all of the detectable parameters were lower at the outlet than at the inlet. The ones that were actually larger at the outlet than at the inlet were: chemical oxygen demand (COD), aluminum, iron, potassium, total organic carbon (TOC), total phosphorus (TP), and total suspended solids (TSS). The increase in TSS is interesting, and may be the cause of increases in adsorbed pollutants. This could be attributable to the lack of growth of plants in the middle of December. Plants slow flow within the wetland, allowing sediments in the water to settle, and plants have the ability to take into their roots pollutants carried by the sediments (Pond, 1995). Because of this, as the plants die, they may release the sediments and pollutants trapped earlier in the year, as well as releasing products of the decay of the organic matter. Aluminum, iron, potassium, and phosphorus could have been attached to these sediments, especially the finer particles. Findings such as these agree with previous studies that noted a distinct reduction in the performance of stormwater wetlands in winter months (Oberts, 1994; Ferlow, 1993). Not only does plant death have an effect, but also the formation of ice on the water surface can scour the margins and resuspend the sediments and the pollutants that they carry (Oberts, 1994).

Detailed Chemical Scan at the Golf Course Site

First flush samples were collected for detailed chemical analysis during the first pulse of runoff from a storm in November 1998 and a second storm in June 1999 (Table 2). In November 1998, 14 water quality parameters declined in terms of a comparison between the urban input (Site 1) and the golf course output (Site 6). Four water quality parameters improved between the urban input and the water exiting the course during the same storm. This suggests that the constructed wetlands were not working well soon after initial construction, during the late fall. However, key parameters such as ammonia and nitrate-nitrite nitrogen and pesticide levels were either decreased as the water circulated through the golf course wetlands or were not detectable at either sampling site.

A distinctly different pattern of results is apparent in the June 1999 sampling (Table 2). Fifteen water quality parameters improved between the urban input and the water exiting the course, and only 4 parameters declined. This suggests that the golf course's created wetland system is functioning well to improve the water quality in the late spring when wetland plants have become established. Two parameters of particular interest for a golf course are nitrate-nitrite N and ammonia-N, which were undetectable in water exiting the course, but at 2.1 and 31 ppm, respectively, in water flowing onto the course.

Table 2. Detailed chemical scan of the golf course site constructed wetland, selected parameters. All values are mg/L.

		November 1998			June 1999		
Parameter	Detection limit	Site 1 Urban runoff	Site 6 Created wetland outlet	increase/ decrease	Site 1 Urban runoff	Site 6 Created wetland outlet	increase/ decrease
Simazine	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	0.10	BDL	BDL	BDL	0.1	BDL	-91%*
Oil and Grease	5	BDL	BDL	BDL	BDL	BDL	BDL
Chloride	2.5	8.6	22	+156%	32	20	-38%
Sulfate	2.5	11	55	+400%	18	31	+72%
Nitrogen nitrate-nitrite	0.01	1.1	0.06	-95%	2.1	BDL	-100%*
Ammonia nitrogen	0.12	0.23	BDL	-52%*	31	BDL	-100%*
Chem. O_2 Demand	10	40	37	-8%	480	25	-95%
Mercury	0.0002	BDL	BDL	BDL	BDL	BDL	BDL
Total Organic Carbon	1	8.2	10	+22%	240	1.6	-99%
Phosphorus	0.03	0.19	0.17	-11%	0.32	0.08	-75%
Dissolved Solids	10	91	270	+197%	240	220	-8%
Suspended Solids	1	17	290	+1606%	8	2	-75%
Silver	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Aluminum	0.10	0.31	5.8	+1771%	1.8	0.16	-91%
Arsenic	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Calcium	0.10	29	61	+110%	40	34	-15%
Cadmium	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Copper	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Iron	0.10	0.51	4.7	+822%	1.6	0.26	-84%
Potassium	0.10	2.3	7.8	+239%	2.2	0.37	-83%
Magnesium	0.10	7.1	24	+238%	9.9	28	+183%
Manganese	0.10	BDL	0.21	+133%	0.28	BDL	-64%
Molybdenum	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Sodium	0.10	4.5	6.8	+51%	6.5	8.7	+34%
Nickel	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Lead	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Selenium	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Silicon	0.10	2	14	+600%	2.0	4.8	+140%
Tin	0.10	BDL	BDL	BDL	BDL	BDL	BDL
Titanium	0.10	BDL	0.14	+56%*	BDL	BDL	BDL
Zinc	0.10	BDL	BDL	BDL	0.38	BDL	-74%*

BDL = Below Detection Limit
* where contaminant was BDL, the detection limit was used for % increase/decrease calculations

No unusually high levels of any of a wide array of potential pollutants, including pesticides and metals, were detected at the golf course sampling sites. However, atrazine was detected in water exiting the neighborhood and entering the golf course (Site 1). Surprisingly, even from the urban runoff there was no measurable oil and grease. It is reassuring to note that heavy metals of concern, such as mercury and lead, are below detection limits in all samples.

Conclusions

Constructed wetlands can potentially be used to improve NPS pollution management in urban areas. Although finding space for constructed wetlands can be a challenge in developed areas, these management tools can be incorporated into the design of new or renovated commercial and industrial facilities. In some cases, they can be added to recreational facilities such as parks and golf courses. In each of these cases, good initial design and attention to continued water supply for long-term wetland survival is critical.

The constructed wetland monitoring program in West Lafayette, Indiana, includes both commercial and golf course constructed wetlands. Selected results presented here illustrate the complexity of developing a program to evaluate performance of such wetland systems. Traditional grab sampling can provide misleading results compared to continuous sampling, and it is clear that apparent trap efficiency varies both within storms as well as between seasons. The type of complete picture of constructed wetland performance that is needed to improve design and enhance understanding of chemical and biological processes in constructed wetlands can be approached by continuous monitoring through several years. Initial data suggest that the constructed wetlands studied here are generally performing well to reduce loads and concentrations of a range of urban NPS pollutants, particularly during spring and summer storm events after wetland vegetation has become established. However there is also a strong indication that trap efficiencies are much lower, and in some cases negative, during winter months. The implications of this depend on the context provided by the receiving area.

Constructed wetlands also provide important benefits beyond water quality control. They provide aesthetic diversity in urban settings, they represent islands of habitat types that are generally absent or underrepresented in older developed areas, and they provide important local educational resources in urban areas. Overall, constructed wetlands should be considered as a potential element of urban retrofit projects, if there are situations where water supply is available to maintain wetland hydrology.

Acknowledgments

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Advanced Identification (ADID) Techniques Used to Protect Wetlands and Aquatic Resources in a Rapidly Growing County

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Abstract

McHenry County, Illinois, approximately 40 miles northwest of Chicago, is one of the fastest growing counties in the state. It also is home to many valued wetland and stream communities that are threatened by the impacts of new development. Because of this, county government officials, with funding from the U.S. Environmental Protection Agency, sought the assistance of resource experts from various local, regional, state, and federal agencies. Their task was to assess the quality of the aquatic resource and to develop strategies for improved wetland protection. The project initially involved the development of an up-to-date countywide inventory of wetlands, lakes, and streams. This inventory showed that over 11% of the county was covered with wetlands and waterbodies. These aquatic resources then were evaluated and rated based on the habitat, water quality, and stormwater storage functions that they provided. While only a small fraction of the total number of wetlands -- about 11% -- of the county's wetlands were designated high quality, these wetlands represented over 60% of the total wetland acreage. Inventory and assessment data were transferred to a customized CD-ROM mapping tool to provide ready access to project information by resource managers, planners, and local governments. The project team also developed a protection strategy for aquatic resources that was tied to the results of the Advanced Identification (ADID) study. In particular, it identified four critical protection components: improved education, regulations and best management practices, acquisition, and restoration. Though the ADID study is only recently completed, there are strong indications that this protection strategy is being taken seriously by officials in the county.

Background

McHenry County, Illinois lies approximately 40 miles northwest of Chicago along the Wisconsin border. Reflecting a history of glacial activity, McHenry County possesses an abundance of wetland types in a variety of physical settings. Predominant wetland types include palustrine, lacustrine, and riverine systems. Palustrine wetlands are found in a wide variety of geographic settings and terrains in the county and include marshes, bogs, fens, wet prairies, forested wetlands, and ponds. Lacustrine wetlands are less common. They are found mostly in eastern portions of the county and are exemplified by the wetlands of the Fox River - Chain O' Lakes. High quality rivers and streams, and associated riverine wetlands, are relatively common. In fact, McHenry County has some of the highest-quality stream ecosystems in Illinois, as exemplified by the Kishwaukee River and its tributaries.

While predominantly rural, McHenry County is one of the fastest urbanizing counties in the state. From 1990 to 1998, its population grew by 31.5% to 240,945. Population is forecast to grow to nearly 362,000 by 2020, an increase of an additional 50%. This rapid population growth has raised concerns over possible adverse impacts on the county's wetlands, lakes, and streams.

Historically, wetland and stream protection measures in McHenry County have included federal regulations, local government ordinances, and acquisitions by government agencies, primarily the McHenry County Conservation District and the Illinois Department of Natural Resources. However, with the recent rapid pace of urban development, unacceptable loss and/or degradation of wetlands and aquatic resources have been observed. Concerned over the possible environmental effects of rapid growth, the county board invited the U.S. Environmental Protection Agency Region 5 (EPA) to perform an "advanced identification" (ADID) study of its wetlands and aquatic resources.

An ADID project can have several objectives. One objective is to shorten permit processing, while providing increased predictability to the Corps of Engineers regulations under Section 404 of the Clean Water Act. ADID also provides information that can be used by state and local governments to aid in zoning, permitting, or land acquisition decisions. Another objective of ADID is to provide information to agencies, landowners, and private citizens interested in restoration or acquisition of aquatic sites.

Approach

The ADID study was initiated in 1995, under the coordination of the Northeastern Illinois Planning Commission (NIPC). The study was a cooperative effort among federal, state, and local agencies to inventory, evaluate, and map high-quality wetland and aquatic resources in the county. From the federal perspective, the primary purpose of this ADID study was to designate wetlands or other waters of the United States that are unsuitable for discharge of dredged or fill material. From the local perspective, the purposes of ADID were to improve the overall protection mechanism for wetlands via improved local regulation, improved predictability in the permitting process, identification of potential mitigation/restoration sites, and identification of potential sites for acquisition.

The scope of work for the ADID project included the following tasks:

- form a Technical Advisory Committee and a Planning and Policy Committee;
- develop ADID objectives for McHenry County and a strategy for protection and management;
- identify and map existing wetlands and aquatic resources;
- develop an evaluation methodology for identified functions of wetlands and aquatic resources;
- apply evaluation methodology utilizing Geographic Information System (GIS) technology and field inspection;
- map ADID sites for public review;
- develop a CD-ROM tool that contains both the project data and a customized GIS interface for display, query, and mapping; and
- produce a final report and brochure and conduct a workshop for local governments, landowners, and consultants.

The Technical Advisory Committee and the Planning and Policy Committee were formed soon after initiation of the project. There were two general purposes for these committees: 1) provide technical and policy assistance to NIPC and EPA, and 2) provide a forum for educating local interest groups regarding the value of wetlands and aquatic resources in the county.

The principal role of the Technical Advisory Committee was to advise project staff on scientific issues, particularly the development of evaluation methodologies for wetlands, lakes, and streams. Technical committee members provided expertise in wetland biology, soil science, hydrology, engineering, water quality, and computerized mapping. Technical committee members contributed substantial time evaluating wetlands, both in the office and the field. The technical committee consisted of the following invited agencies and organizations:

- U.S. Environmental Protection Agency, Region 5
- U.S. Army Corps of Engineers, Chicago District
- U.S. Department of the Interior, Fish and Wildlife Service, Chicago-Metro Wetlands Office
- USDA, Natural Resources Conservation Service
- Illinois Department of Natural Resources

- McHenry County Department of Planning and Development
- McHenry County Conservation District
- McHenry County Soil and Water Conservation District
- Fox Waterway Agency
- Northeastern Illinois Planning Commission

The principal role of the Planning and Policy Committee was to advise project staff on policy, particularly the determination of wetland functions important to McHenry County. The policy committee also provided advice on the development of a wetland protection and management strategy. The policy committee included all of the members of the technical committee as well as members of the following organizations:

- Homebuilders Association of Greater Chicago
- Illinois Audubon Society, McHenry County Chapter
- Illinois Environmental Protection Agency
- Land Foundation of McHenry County
- McHenry County Board
- McHenry County Defenders (a local environmental group)
- McHenry County Farm Bureau
- McHenry County Municipal Association
- McHenry County Realtors Association
- McHenry County Stormwater Committee
- Openlands Project (a regional open space advocate)

Developing an Aquatic Resource Inventory

Detailed inventories of wetlands, lakes, and streams were developed early in the project. Two principal existing inventories were considered for identifying and mapping wetlands: the National Wetland Inventory (NWI) developed by the U.S. Fish and Wildlife Service with the assistance of the Illinois Department of Conservation (1986) in the early 1980s, and an inventory by the Natural Resources Conservation Service (NRCS) that was being completed in McHenry County just as the ADID project began. While neither inventory was adequate alone (the NWI was becoming dated and the NRCS inventory, while more recent, and only a data set, focused principally on agricultural areas), in combination they served as a good starting point. In finalizing the inventory, numerous revisions and improvements were made based on reviews of aerials photos, field checks, and the knowledge of local experts.

The resultant inventory identified 2,535 wetlands, including lakes, covering 37,846 acres. The inventory identified an additional 1,250 *farmed* wetlands covering 3,839 acres. In total, there were 3,785 wetlands in all categories covering 41,685 acres, or nearly 11% of the county.

Lakes were identified as a subset of wetlands. Specifically, lakes were distinguished based on a criterion of 20 acres or more of open water. Fifteen such lakes were identified (excluding gravel pits).

Type	Number	Acreage	Percent of County Area
Wetland	2,518	33,003	8.4
Farmed Wetland	1,250	3,839	1.0
Lake	15	3,584	0.9
River	2	1,259	0.3
Total	3,785	41,685	10.6

Streams were identified and mapped based on an inventory developed by the EPA. EPA's Stream Reach File, Version 3 (1:100,000 scale), with minor revisions, provided an accurate and complete inventory of county streams. The inventory included over 570 miles of streams ranging in size from small, unnamed headwaters to large rivers like the Fox and Kishwaukee.

Evaluation of the Functions and Quality of Aquatic Resources

As the first step in developing a wetland evaluation methodology, members of the policy committee were asked to identify wetland and aquatic resource functions that were important to McHenry County. After considerable discussion, the committee recommended that the following functions be considered and evaluated: biological/habitat functions, water quality mitigation functions, stormwater storage functions, and groundwater functions. These functions then were evaluated and refined by the technical committee. Ultimately, it was concluded that groundwater functions of wetlands, while having important water supply implications, could not be evaluated because of insufficient data.

The project team and advisors then proceeded to develop evaluation criteria and methodologies for the following general categories: *biological/habitat functions* and *water quality/stormwater storage functions*. The development of a methodology for identifying high-functional-quality wetlands in McHenry County relied both on existing wetland evaluation methodologies and the technical expertise of members of the technical advisory committee. The resultant methodology builds on a methodology used in nearby Lake County, Illinois (Dreher, et al., 1992) as well as other documented methodologies, particularly the Wetland Evaluation Technique (WET) manual (Adamus et al., 1987), the Oregon Method (Roth et al., 1993), and the Minnesota manual (U.S. Army Corps of Engineers, 1988).

The methodology was designed to accomplish two objectives: 1) identify the functions that individual wetlands were performing, and 2) identify wetlands of such high quality that they merit special consideration for protection strategies. The evaluation of the identified functions for individual wetlands can be very complex and some of the referenced methodologies describe fairly elaborate approaches to perform thorough evaluations. However, because of the large number of wetlands to be considered in McHenry County, it was necessary to adopt a simpler evaluation procedure. The resultant methodology is fully documented in the final project report, "Advanced Identification (ADID) Study, McHenry County, Illinois" (NIPC et al., 1998). An overview of the evaluation criteria follows.

Biological functions include wildlife habitat, floristic diversity, stream aquatic habitat, and lake aquatic habitat. Wetlands were considered *high quality* for this function if they met one of several criteria. These criteria included:

- the presence of threatened or endangered plant or animal species;
- designation in the Illinois or McHenry County Natural Areas Inventory (NAI);
- field evaluation as a grade A, B, or C wetland community following NAI methods;

- streams with Index of Biotic Integrity (IBI) scores of 41 or greater;
- streams with high quality physical habitat; and
- healthy lake ecosystems with rich/diverse fish and plant communities.

Water quality/stormwater storage functions include shoreline and streambank stabilization, sediment and toxicant retention, nutrient removal and transformation, and stormwater storage and hydrologic stabilization. In order to be designated *high functional value* for water quality/stormwater functions, wetlands were required to meet three of the four following criteria:

- presence of stabilizing vegetation adjacent to an open waterbody or perennial stream;
- surface area larger than five acres and having characteristics indicating the propensity for sediment/toxicant retention;
- surface area larger than five acres, upstream of a lake or impoundment, and having characteristics indicating the likelihood of nutrient removal/transformation; or
- surface area larger than five acres, at least 50% outside the floodplain, and having characteristics indicating significant stormwater retention.

Alternatively, wetlands could be designated *high functional value* for water quality functions if they provided individual water quality functions adjacent to or upstream of wetlands, lakes, or streams that provide high quality habitat.

Individual wetlands and waterbodies were evaluated using a three-step procedure of GIS screening; aerial photo, map or desk-top evaluation; and field evaluation (as needed). Based on this evaluation, it was determined that 154 wetlands totaling 17,489 acres, or about 42% of the county's entire wetland area, met the criteria for high-quality habitats. Most of the high-quality wetlands tended to be large parcels, averaging 114 acres in size in comparison to the average wetland size of 11 acres countywide. An additional 274 wetlands totaling 8,292 acres (average size of 30 acres) met the criteria for high value for stormwater and water quality functions. Thus, while a relatively small number of wetlands (about 11%) were designated high quality or high functional value, these wetlands represent over 60% of the total wetland acreage.

Classification	Number	Percent of all Wetlands	Acreage	Percent of County Area	Percent of all Wetland Area
High Quality Habitat	154	4.0	17,489	4.5	42.0
High Functional Value	274	7.2	8,292	2.1	19.9
High Quality Lake	7	0.002	1,346	0.3	3.2

Of the 15 inventoried lakes, seven were determined to be high quality. A total of 572 miles of stream were evaluated and 170 miles (or nearly 30%) were designated high quality. Interestingly, high-quality stream segments were found on 18 different named streams and rivers scattered throughout the county.

Using ADID for Protection and Restoration

The ultimate measure of success for a project like the McHenry County ADID study is how it contributes to the protection and restoration of aquatic resources. With this in mind, the project scope included a work element to develop

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a strategy for protection and management of aquatic resources. With the assistance of the advisory committees, the project team developed a four-part strategy involving:

- improved education of local government officials, landowners, and the public;
- effective regulations and best management practices;
- expanded acquisition of aquatic sites and buffers; and
- restoration of degraded sites.

This strategy, which is described in detail in the project report (NIPC et al., 1998), is summarized below. Also described are some recent protection and management activities, although it is still too early to judge the long-term success of the project.

Improved Education: Educational initiatives are critical to improve awareness of wetlands and aquatic resources among local citizens, land owners, and elected officials. Improved awareness can enhance local support for protection, acquisition, and restoration programs.

- A 12-page brochure, *McHenry County's Wetlands, Lakes, and Streams*, was developed to educate the public and local officials about the value of wetlands and aquatic resources in their communities. The brochure also discussed the results of the ADID study and identified additional sources of information and agencies that can provide help. Over 1000 copies of brochure have been distributed by participating agencies, such as the county soil and water conservation district.
- Maps and information for all ADID sites were made available on a "user-friendly" CD-ROM. The CD-ROM includes simplified mapping software developed from a sophisticated GIS tool. The software enables querying and screening of various wetland characteristics at different geographic scales throughout the county. It also enables printing out detailed information on individual wetlands. Over 100 copies of the CD-ROM have been provided to local officials, consultants, and landowners in the county.
- The message of wetland, lake, and stream protection also is being carried to local officials and the public by county-based environmental groups and consortiums called "ecosystem partnerships" that have been established for the two main river watersheds in the county (the Fox and the Kishwaukee). ADID will be a useful tool in aiding the efforts of these organizations.

Effective Regulations: Effective regulations are needed to minimize the effects of new development on aquatic resources. Specifically, improved regulations are needed to fill in the gaps in existing federal, state, and local regulatory programs. It was the conclusion of both the ADID team and the *McHenry County Comprehensive Stormwater Management Plan* (McHenry County, 1996) that improved regulations are needed to address concerns such as buffers and setbacks, depressional storage volumes, pretreatment of stormwater runoff, and effective environmental mitigation for unavoidable disturbances.

- Current federal regulations authorized under Section 404 of the Clean Water Act require a permit for the discharge of dredged or fill material into wetlands or other waters of the United States. Federal guidelines also authorize the EPA and the Corps of Engineers to identify in advance of specific permit requests, aquatic sites that will be considered as areas generally unsuitable for disposal of dredged or fill material. The Chicago District of the Corps has indicated that it will apply this discretionary authority to high-quality habitat and high- functional value sites in McHenry County. The Corps also generally will require an individual permit (which allows public input) for proposed modifications of ADID sites.
- Stream and wetland regulations, based on a model ordinance developed by NIPC, also have been adopted by a number of local governments in the county. These regulations are intended to complement the federal regulations by discouraging development in buffers and setbacks adjacent to wetlands, lakes, and streams and requiring pre-

treatment of stormwater discharges. The City of Woodstock, the county seat, recently applied its wetland protection regulations in a residential development review that resulted in an innovative conservation design around a large wetland. Not only will the wetland be avoided, but the site design calls for clustering of homes and buffers adjacent to wetland areas. Also, drainage swales and natural landscaping will be incorporated on upland portions of the site to reduce hydrologic and water quality impacts of the development.

- ADID team members have worked closely with staff and consultants to the McHenry County Stormwater Committee in the development of a countywide ordinance for new development. It has been recommended that the countywide ordinance include provisions for stream and wetland protection that complement, but do not duplicate, federal regulations. While the ordinance adoption process has been challenged by financial constraints and political changes in the county, it appears likely that significant stream and wetland protections will be added to existing county and municipal regulations.

Acquisition: Acquisition of important wetlands and stream corridors is one of the best ways to assure their long-term protection. In fact, recent experience indicates that these areas are becoming high priorities for public land acquisition. Information developed in the ADID study, particularly the identification of high-quality habitats and high-functional-quality wetlands, will be valuable to land acquisition agencies, including park districts, the McHenry County Conservation District, the Illinois Department of Natural Resources, and local land trusts, in assessing acquisition priorities. In a recent example, the Plan Commission of Nunda Township in east-central McHenry County is developing a comprehensive land use plan that will utilize ADID maps to identify areas to be preserved as open space.

Restoration: Restoration of degraded wetlands, lakes, and stream corridors, and ongoing management of higher quality sites, are critical challenges for land management agencies. Management is needed to counteract the effects of disturbances such as site fragmentation, elimination of fire, invasive species, and hydrologic alterations. Notably, the McHenry County Conservation District has been a regional leader in restoring degraded streams and wetlands. The ADID data base will be very useful in identifying appropriate sites to continue this restoration. The availability of GIS data bases and mapping, particularly in conjunction with other digital data such as soils maps and data on seeps and springs, will greatly facilitate this objective.

Lessons Learned

ADID was a valuable experience in McHenry County that generally met its identified objectives. In considering ADID studies in other areas, there are several important lessons one can learn from the McHenry County experience.

1) *Engage local government sponsors and keep them informed throughout the project.* The McHenry County ADID began after the county board passed a resolution soliciting EPA's assistance. County staff and elected officials were invited to participate on advisory committees. When support appeared to waver at critical points in the process (e.g., staff changes and budget difficulties at the county), the project team reached out by convening special meetings reminding county officials of the benefits of the project with respect to adopted county objectives.

2) *Conduct an open study process involving both traditional supporters of stream and wetland protection efforts and potential adversaries.* Groups ranging from environmental organizations to developers and the agricultural community were invited to participate on advisory committees where issues and approaches were openly discussed. When a public meeting was held to present project results, over 200 individuals attended. The vast majority of those expressing opinions indicated support for ADID objectives and procedures, even though some had concerns over the ramifications of federal wetland regulations.

3) *Utilize the expertise and local knowledge of federal, state, and local resource agencies.* While EPA contracted with NIPC to coordinate the project, staff from numerous resource agencies contributed invaluable expertise in hydrology, soils, aquatic ecology, and botany. They also contributed countless hours in evaluating field sites. Scheduling such assistance from multiple agencies resulted in some time delays. However, without these voluntary contributions, the project could not have been completed.

4) *Define wetland and aquatic resource functions from a multi-objective perspective.* While there is a tendency sometimes to focus on just the habitat and recreational values of wetlands, lakes, and streams, it is important to consider a broader range of benefits to maximize local buy-in to the process. The McHenry County ADID specifically considered stormwater and water quality functions that were identified as being important in local plans, such as the *McHenry County Comprehensive Stormwater Management Plan.*

5) *Distribute end-products in user-friendly formats.* While ADID was a highly technical and complex project, efforts were made to provide products that were readily understandable by local governments, land owners, consultants, and the public. The product receiving the most interest was the CD-ROM containing ADID data, as well as a user-friendly GIS-based interface for querying and mapping. The CD-ROM promises to be much more useful than conventional paper maps.

6) *Engage the local press in covering the project.* Limited attempts were made to inform the local press during the course of the study. While there was some resultant news coverage in local newspapers, particularly around the time of the public meeting, this coverage was not particularly effective in informing the public about the benefits of wetlands and the importance of the ADID study. Focused efforts, such as targeted press releases, probably would have improved the frequency and quality of coverage.

Conclusions

The ADID study provides valuable information to advance the protection and restoration of wetlands and aquatic resources in McHenry County. It can aid residents and organizations desiring to protect high-quality resources or restore sites that have been degraded. It can inform landowners and developers about an appropriate course of action when they are considering disturbances in or adjacent to high-quality sites.

While the final ADID products have been available for only a short time, it is apparent that they will greatly facilitate ongoing efforts to educate county residents and officials, protect streams and wetlands from the effects of new development, preserve sensitive stream corridors and wetlands as public land, and restore degraded sites. While the ultimate success of county stream and wetland protection initiatives will depend on the will of landowners and local government officials, no one will be able to blame wetland loss on inadequate information.

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Local Government Involvement in Mitigation Banking

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Abstract

Mitigation banking is a valuable tool that can be used by local officials to achieve wetlands restoration and other local goals. Mitigation banks can be established by local governments to provide compensation for wetland losses that result from development projects. There are different strategies that local governments can use to establish a mitigation bank, depending upon their goals and objectives. The success of a mitigation bank is dependent upon several factors, ranging from bank location to the availability of funding. The Environmental Protection Agency conducted a survey of local jurisdictions to identify the different strategies that were utilized for effective development and implementation of mitigation banking. The findings of the survey are presented in case-studies that characterize the approaches that were used by local governments to achieve their mitigation banking goals and objectives.

Introduction

Mitigation banking is defined in the Federal Mitigation Banking Guidelines[1] as "wetland restoration, creation, or enhancement for the purpose of compensating for unavoidable wetland losses in advance of authorized impacts to similar resources." Under Section 404 of the Clean Water Act, applicants for permits must first avoid and minimize all impacts to wetlands and other waters of the United States. If there are still impacts, then applicants must provide compensatory mitigation through the restoration, creation, and the enhancement of similar type of aquatic resources. This "sequencing process" under the Section 404(b)(1) guidelines is a central premise of the Section 404 regulatory program, and mitigation banking can play a role in providing compensatory mitigation for unavoidable wetlands losses.

As a general matter, on-site and in-kind mitigation is preferred under the Section 404 Program. However, in those circumstances where it is determined, on a case-by-case basis, not to be practicable, then off-site, in-kind mitigation is acceptable.[2] Off-site mitigation can be accomplished using a federally-approved mitigation bank. Since the use of mitigation banking to offset permitted wetlands losses began in earnest in the early 1990's, local governments have been involved in developing banks to restore and replace lost wetlands functions and values within their jurisdictions. By simplifying the process for compensating for unavoidable wetlands losses, appropriate use of the banking concept can improve both permitting efficiency and environmental protection.

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[1] *Federal Guidance for the Establishment, Use and Operation of Mitigation Banks; Notice.* Federal Register, Volume 60, No. 228, pages 58605-58614, November 28, 1995.

[2] Memorandum of Agreement between the EPA and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines (February 6, 1990)

Mitigation Banking Objectives

- Local needs are best met when there are clear objectives and goals for establishing a mitigation bank. Examples of objectives for mitigation banking identified by local governments include:
- Use as part of a comprehensive watershed plan that addresses urban development and the need for preservation and restoration of wetlands
- Provide an incentive for economic growth by streamlining the process for providing compensation of unavoidable wetlands impacts
- Provide for restoration of degraded wetlands that otherwise might not be improved because of insufficient funding
- Use as part of a multi-objective strategy to manage stormwater, flooding, water quality, etc.
- Compensate for wetland losses from future local agency projects

Types of Mitigation Banks

Once the objectives for the proposed bank have been established by the local agency, the type of bank to meet the identified objectives must be determined. Local governments can establish a mitigation bank for their individual use or for credit sale as a commercial venture. The bank can be established solely by a public agency or as a joint venture with a private entity (e.g., entrepreneurial business). Mitigation bank types need not be mutually exclusive; for example a commercial mitigation bank may be established through public/private partnerships and still be part of a watershed management plan.

Commercial banks: A commercial mitigation bank is one in which the credits are sold to a party other than the bank sponsor (banker). The banker sells credits within the established service area to permittees who have approval from the U.S. Army Corps of Engineers (Corps); the agency responsible for issuing wetlands development permits; to compensate for wetland impacts through a mitigation bank.

Single-user: A single-user mitigation bank is established by a local agency to compensate only for wetland losses associated with activities conducted by the agency.

Factors Contributing to Mitigation Bank Success

Conditions for successful bank establishment

Local governments which have successfully established a mitigation bank have identified several conditions that need to be considered in order to successfully meet environmental and/or economic objectives.

- There must be a demand for compensatory mitigation within the local jurisdiction. Demand results from development pressure in a rapidly growing area where impacts to wetlands are expected to occur. The value of development in regions with rapid growth increases the willingness of the public agency or developer to pay for wetland mitigation. Potential bank sponsors should conduct a "needs" analysis to determine the demand for a mitigation bank in a given area. The analysis will show the extent of potential wetland impacts in the region and whether mitigation banking is a viable compensation option. Once demand for a bank is decided upon, the size of the bank can be determined.

- There must be a sufficient supply of available sites for restoration, creation, enhancement, or preservation.[3] The availability of appropriate sites will vary by geographic region. For example in Florida, large tracts of degraded wetlands have been impacted by previous land-use practices and by invasion of exotic plant species. Such large areas are conducive to restoration and enhancement. In some areas, there are mitigation banks where property is in high demand, resulting in high land acquisition costs. In other circumstances, finding an appropriate site may be difficult due to the lack of large wetland expanses. Land that is in public ownership can help lessen land acquisition cost, but may not have favorable physical attributes that would allow for a mitigation bank to be self-sustaining over time.

- Finally, regulatory coordination is important. The local agency needs to provide a prospectus to the Mitigation Banking Review Team (MBRT) established by the local Corps district.[4] The prospectus will serve as the mitigation banking instrument that identifies the objectives and administration of the proposed bank. As part of this coordination process, the local agency should identify the proposed bank site, the geographic service area, wetland types suitable for compensation at the site, the debiting and crediting system, performance standards, monitoring plan, contingency and remedial actions, and provisions for long-term management and maintenance.

♦ Proposing a mitigation bank in the context of a regional plan that integrates the bank into a comprehensive wetland or watershed management strategy may improve the likelihood of acceptance of the prospectus by the MBRT. A watershed management plan can provide greater certainty about the nature and extent of future wetland impacts and identify the most appropriate, environmentally beneficial options for offsetting the anticipated impacts. In this way, the MBRT has a level of assurance that the bank is a part of a broad goal to maintain or gain wetland functions in a given area or watershed.

Site selection criteria

Local agencies need to carefully consider the sites that are identified for potential mitigation banks. Site selection is one of the most important criteria affecting the successful establishment of a mitigation bank. The most significant site selection criteria is the potential that the site can be successfully restored or enhanced in a manner that will provide appropriate compensation for anticipated unavoidable wetlands losses. Selection of such ecologically important or desirable sites can further regulatory acceptance.

As identified in the federal guidance on mitigation banking, mitigation sites should be self-sustaining over time. Sites with naturally occurring hydrology are preferable to sites that require complex hydraulic engineering features that are costly to develop, operate, and maintain. Therefore, sites that can be restored without complex improvements should be the first option when establishing a mitigation bank.

Ideally, site selection would be undertaken in accordance with a watershed management plan under which existing wetlands have been surveyed to determine which sites are the highest priority for protection, the most suited for restoration or enhancement, and the most likely to be impacted by development. Through watershed planning, wetland functions that are lacking in a region can also be used to guide site selection. Additionally, planning at this level can help determine compensation requirements, because anticipated wetland impacts can also be identified. Two federal programs, the Special Area Management Plan (SAMP) and the Advance Identification (ADID) Program, can provide guidance and technical assistance to local sponsoring agencies that meet certain criteria and are interested in establishing a watershed scale planning effort.

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[3] The Federal Mitigation Banking Guidance states that the use of preservation in a mitigation bank may be authorized by the federal agencies when it is demonstrated that the preserved areas contribute to the functions of the restored, created or enhanced aquatic resource.

[4] The Mitigation Banking Review Team is established as consistent with the Federal Mitigation Banking Guidance.

Mitigation bank site selection can also be targeted to address specific environmental objectives. For example, wetlands in several counties in Florida were overrun by exotic vegetation. Mitigation banking provided the funds to improve the wetland habitat through exotic species eradication and revegetation with native plants.

Site selection may also be influenced by a regional demand for mitigation opportunities and the availability of suitable restoration sites. Land acquisition is often cost-prohibitive for local agencies; land ownership, zoning restrictions, and allowable uses also are important factors in determining a mitigation bank site. Important functional characteristics of a potential restoration site include the presence of hydrology, hydric vegetation, and/or hydric soils; size of the site; historic conditions; and the degraded condition of existing wetland (e.g., exotics, fill, compaction, trash). Experts in restoration should be consulted regarding specific wetland requirements and regional wetland attributes prior to site selection.

Funding

The most common funding option used by local governments is the advance-credit sale option addressed in the Federal Mitigation Banking Guidance.With this funding mechanism, advance sale of a percentage of the total credits is allowed after certain criteria have been met by the bank sponsor, such as conservation easement, land acquisition, and/or design plan approval. By selling a limited number of credits in advance, the banker can collect sufficient funds to begin conducting wetland improvements, then sell more credits as they are certified by the regulatory agency. The advance sale of credits, however, involves a degree of risk; for example, problems can arise prior to mitigation bank implementation or completion, leaving the bank sponsor liable for any credits sold.

Local governments have also identified various other strategies for funding the establishment of their mitigation banks. Some of the options include:

- Completing the project in phases so that initial credit sales will provide funding for the remainder of the project
- "Borrowing" money from other local agency funds, then paying it back using money from credit sales
- Using available federal or state grant money for wetland improvement as seed money to establish the banks;[5]
- Partnering with a private company to share the costs
- Using combinations of the above mechanisms

Bank Administration and Operation

Several issues related to bank administration and operation pose a challenge to local governments. The geographic service area, credit ratios, credit valuation, monitoring plans, and long-term maintenance provisions are all issues that must be addressed by the local sponsor and approved by the signatory agencies. Information on these issues can be found in the Federal Mitigation Banking Guidance mentioned earlier, as well as in any existing state guidance. A partnership with a private entity that has experience in mitigation banking is one alternative for addressing bank administration and operation challenges.

The geographic service area for the mitigation bank should be established and presented in the mitigation banking planning document. The service area is the area in which credits from a mitigation bank can be used to compensate for unavoidable wetland losses. This area can be a watershed or a political boundary, such as a county or municipality.

The number of credits produced by a mitigation bank are generally determined by two factors, (1) the number of acres restored, created, enhanced, or, in exceptional circumstances, preserved, and (2) a quantified evaluation of the

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[5] EPA has also identified the State Revolving Fund (SRF) as another potential source for funding the establishment of mitigation banks, subject to approval under each State's SRF regulations.

functional value of the wetlands in the bank. As a general matter, the greater the wetland improvement, the more credits generated. For example, more credits may be associated with restoration and fewer credits associated with enhancement. The second factor involves a functional assessment of the improved or created wetland, and a method for converting the functional units to credits.

To determine the appropriate compensation requirements for wetland losses, a mitigation ratio must be developed. This ratio can be based on lost wetland function and area, the rarity of the affected wetland, and the wetland replacement kind and function. The ratio will determine the number of credits required from the bank to replace the impacted aquatic resource. Generally, the mitigation ratio is greater than or equal to one; i.e., at least one credit (acre of restored, enhanced, or created wetlands) required to replace one acre of lost wetland resource.

As a general matter, the bank sponsor monitors the bank for a period of time (e.g., five years) to determine whether the bank is functioning at the level required by a previously determined set of performance standards established in the banking instrument. After the performance standards are met, the local agency may choose to transfer the mitigation bank to another entity (e.g., land trust) for the long-term maintenance and monitoring. An agency can also use volunteer labor to offset costs of monitoring and maintenance and to improve public awareness and citizen stewardship for the project. Among the local bank projects reviewed by EPA in the survey, local sponsors were usually responsible/liable for the performance of the mitigation site from the beginning, or after an established period of time if the project was a joint-venture.

Financial assurances for long-term maintenance and contingency plans for the bank most often take the form of additional fees added onto the cost of a credit, with a fixed amount from the sale of each credit put into an escrow account. The local agency then draws from the account for necessary maintenance expenditures. In some cases, completed banks become part of a park system or are turned over to a public agency for long-term management.

Mitigation Bank Approaches with Case-Study Examples

The following case-studies are examples of the different types of mitigation banks that can be established by a local agency, and highlight specific issues that are of concern to local governments. The banks discussed in the case-studies are not mutually exclusive, in that a given bank may fit into more than one "bank type" category.

Mitigation Banking in the Context of a Watershed or Wetland Management Plan

Local governments can use a watershed or wetland management plan as a means of addressing economic development and environmental concerns. An important aspect of such a plan involves compiling an inventory of existing wetlands in order to determine both coverage area and functions provided. This information can then be used to protect important resources, establish areas suitable for development, and determine the best sites for restoration. Mitigation banking is, therefore, a tool that can be integrated into a watershed plan to help meet resource management objectives.

Advantages of mitigation banking in the context of a watershed management plan are as follows:

- Sites to be restored and critical sites to be preserved are already identified in the plan
- Market demand for compensatory mitigation can be identified
- The extent and nature of potential impacts have been determined
- Likelihood of restoration project success is improved
- Uncertainty for regulatory agencies is lowered
- Multiple objectives can be attained

- Environmental benefits are maximize

West Eugene Mitigation Banking Program

Overview: The Eugene Wetland Mitigation Bank Program (Bank) was established in 1995. The program is operated by the City of Eugene, Oregon, under a separate fund within the City's financial structure. The goal of the Bank is to provide a mechanism to fund wetland mitigation projects, carry out the West Eugene Wetlands Plan (Plan) adopted in 1992, and meet other community needs. This program is being conducted in cooperation with the City's wetland partners (the U.S. Bureau of Land Management [BLM] and the Nature Conservancy [TNC]).[6] The objectives that the City seeks to accomplish with the mitigation banking program include:

- Creating credits in advance of wetland losses
- Meeting the mitigation needs of the community of Eugene
- Achieving community objectives, such as increased flood storage capacity, enhanced water quality, improved wildlife habitat, and establishment of education and recreation opportunities
- Targeting areas with high prospects for restoration success such as historic wetlands, disturbed agricultural wetlands, and areas adjacent to waterways
- Communicating the banking program's value to the community
- Operating the bank as part of a national model wetland program in cooperation with the wetland partners
- Establishing a permitting process familiar to businesses, environmental interests, and regulatory agencies

Funding for identifying wetland areas for the bank was provided through EPA's Advanced Identification (ADID) program. The West Eugene Wetlands Plan integrates wetlands protection and community development needs by identifying areas best suited for wetland preservation and areas with development potential. Thirteen hundred acres of wetlands were identified within the plan area, with more than 1,000 acres designated for protection or restoration and approximately 300 acres of lower value wetland designated as suitable for future fill and development. The Plan calls for the establishment of a mitigation banking program to compensate for unavoidable losses of wetlands through restoration and enhancement in conjunction with protection of important wetland resources.

All mitigation bank projects will be located within the Long Tom River watershed. Seven projects were initially constructed for a total of 56 acres. Three additional projects totaling 60 acres were in planning at the time of the EPA survey.

In this program, mitigation bank credits can be established in three ways

1. The City or its partners may undertake wetland mitigation work, then seek certification of credits by the Corps and Oregon Division of State Lands (DSL). The City provides documentation on a site prior to the mitigation work and after completing improvements to demonstrate an increase in wetland values.
2. The City may create more credits than are needed to compensate for permitted wetland losses as part of concurrent or advance mitigation work. If the Corps and DSL certify the excess credits, they will be added to the Mitigation Banking Program's ledger for sale.
3. Uncertified credits may be sold in order to fund initial mitigation work, which are later certified by the Corps and DSL when the initial hydrological and vegetative work is completed.

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[6] City of Eugene, Public Works Department. 1997. West Eugene Wetland Mitigation Bank, Annual Report 1996.

The City Stormwater Fund provided money for acquisition of site properties. Additional capital for the projects came from the sale of uncertified credits. No uncertified credit can be sold unless the Corps and DSL have approved a mitigation plan.

As the bank sponsor, the City is responsible for monitoring and maintaining the bank sites. Monitoring is required for a minimum of five years and the sites will be inspected by the Corps and DSL on an annual basis. Monitoring goals are determined on a site-by-site basis. Maintenance will be conducted to ensure that the wetland functions and values are fully established and functioning. If the site is not meeting the performance criteria, corrective measures will be taken. Funding for these tasks is included in the credit price. At least an additional 20% will be added to the estimated credit cost and set aside to be used to monitor, maintain and, where necessary, conduct remedial measures.

Single-user Mitigation Bank

Local governments can establish a single-user bank. In this case, the local government initiates the bank, creates the credits, and is the principal credit user. Local sponsors with long-range project plans that involve potential impacts to wetland areas may establish a mitigation bank or banking program in anticipation of the need for compensatory mitigation. For example, a public works department with road expansion plans may know in advance that there will be unavoidable impacts and provide the funds necessary to initiate a bank in anticipation of the project.

An advantage of a single-user bank is that long-term planning provides advance knowledge of potential wetland losses associated with future projects. This reduces the uncertainty surrounding the demand for the bank and eventual funding. Funding may be available to initiate the bank based on the predicted future use.

Snohomish County Airport Mitigation Banking Program

Overview: The Snohomish County Airport (SCA) needed to address the multiple objectives of their 20-year Master Plan, the aviation needs of the airport, the economic growth of the region, and environmental protection. The Master Plan identified three development/construction projects that will occur over five years, each with anticipated wetland impacts. The objectives that the SCA seeks to accomplish through the banking program include:

- Creating a mitigation alternative for projected airport development
- Replacing or augmenting wetland functions in the watershed
- Replacing habitats that will potentially be lost, including open-water habitat that cannot be created on-site
- Creating recreational and educational opportunities

The SCA analyzed the three watersheds containing the project areas to determine missing wetland functions and values. Potentially impacted wetlands were then characterized according to acreage, wetland category, and function. Based on these analyses, two mitigation banks were designed to replace the wetland functions that would be lost by the airport projects. The SCA banking program creates a "reserve" of mitigation that accommodates Master Plan impacts for approximately seven years.[7]

Mitigation banking was an effective alternative for the SCA since the Federal Aviation Administration (FAA) prohibits the creation of bird attracting habitat within 10,000 feet of a runway. In this circumstance, on-site mitigation was determined not to be a viable alternative as it would attract waterfowl and migratory birds. The SCA created or enhanced a total of 32 acres and preserved an additional 23 acres.

Following a format developed by the Washington State Department of Transportation, the SCA Memorandum of Agreement (MOA) was established. The MOA describes the procedures for selecting, managing, monitoring, and

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[7] Snohomish County Airport. 1997. Snohomish County Airport MOA/IM Executive Summary.

protecting mitigation banks. Additionally, an Implementation Manual was created by the SCA that presents agency recommendations for approval of the two specific bank sites. A technical oversight committee reviewed and advised changes to the MOA, and provides input for credit evaluation and ratio development.

Construction is nearly complete at both sites. One site has a nonprofit organization associated with it called the *Friends of Narbeck Wetland Sanctuary* that is working to promote citizen stewardship, protection of wildlife and wildlife habitat, native plant propagation, and environmental research.

Primary funding for the mitigation banks came from airport revenues. In addition, some funds were provided from the FAA, since the program will be used to mitigate for projects required by FAA safety regulations.

The SCA will be responsible for one of the sites in perpetuity. The other site will be donated to the City of Everett, Washington, Parks Department after all of the credits have been used. Monitoring will be conducted for five years in the emergent wetland and ten years in the forested wetland. Both sites have been placed in a conservation easement and a contingency plan will be executed if performance criteria are not met.

Public/Private Joint Venture

Public/private joint ventures can facilitate mitigation-bank establishment by providing investment capital and technical expertise. Mitigation banking is a complex process involving aspects of design, engineering, regulation, project management, biology, ecology, marketing, and long-term management. Because of this, a mitigation banking joint venture may be established to share the responsibilities and costs. A local agency role may be bank sponsor, bank creator, land owner, long-term manager, or all four. The private entity may conduct only the technical work, but can also assume any of the aforementioned roles. The EPA survey found that the local agencies partnered in joint ventures were most likely to provide the land for the mitigation bank and the private entity would provide funds and/or technical expertise.

City of Pembroke Pines and Florida Wetlandsbank, Inc.

Overview: In 1992, the City of Pembroke Pines in Broward County, Florida, entered into a partnership agreement with Florida Wetlandsbank, Incorporated to restore a heavily degraded site that was already overrun by exotic species and becoming further deteriorated by all-terrain vehicle use and illegal trash disposal. The City did not have the resources necessary to restore the site or to establish a mitigation bank. Concurrently, development pressures in the area were creating a demand for an effective mitigation alternative.[8] Florida Wetlandsbank agreed to design and construct a wetland system by eradicating the exotics and replacing them with a mixture of 10 typical Everglade habitats including cypress stands, emergent marshes, tree islands, and sawgrass prairie. Florida Wetlandsbank also provided the management for the bank, selling the first credits in 1994. In 1997, restoration was near completion, with 396 credits sold. The objectives for the Florida Wetlandsbank (the name of the mitigation bank) are to:

- Provide a mitigation alternative for the rapidly urbanizing City of Pembroke Pines
- Provide mitigation at a large site with high potential for ecological success
- Restore native wetland ecosystems in an area that was degraded and infested with exotic species

The mitigation bank provided a number of economic and environmental benefits, including the following.

[8] Paul Wattles, Assistant City Manager, City of Pembroke Pines, Florida. Personal communication, March 23, 1998.

- The project provided revenue for the City through the collection of franchise fees per acre (paid by Florida Wetlandsbank, Incorporated after credits were sold).

- Developers used the credits as quickly as they became available.

- The City plans to open part of the area as a park and offer public access and passive recreation opportunities.

- To date, the site is ecologically successful, with little reinfestation of exotic plants.

- Florida Wetlandsbank, Incorporated profited from the sale of credits.

The construction is completed and all credits sold for the original 350-acre site. An additional 100 acres has been added to the site with construction nearly completed and credit sales pending. The service area for the mitigation bank was kept at the county level rather than the basin level, which incorporates three counties. The County determined that mitigation for wetland losses should remain within the county.[9] The number of credits available in the mitigation bank were determined using a modified Wetland Rapid Assessment Procedure (WRAP).

Florida Wetlandsbank, Incorporated provided the capital for initiating the bank. Pre-project sale of credits allowed restoration work to begin. A trust fund was established to provide for the long-term maintenance of the site, with $1,000 per credit contributed to the fund.

Site monitoring will be conducted by Florida Wetlandsbank, Incorporated from the time that construction is completed for five years. Quarterly monitoring reports are required by the SFWMD. These reports contain information regarding the bank's performance criteria. A performance bond was placed with the SFWMD for each stage of construction. The bond will be used in the event that any of the performance criteria are not met. Once the performance criteria for the site are met, the money will be released to Florida Wetlandsbank.

Commercial Mitigation Banking

A local government can establish a commercial mitigation bank that sells credits to anyone who meets the requirements to use the bank for compensatory mitigation. The bank discussed here was established on public land, solely by public agencies, with credits for sale to the public. Optimally, a public commercial mitigation bank is part of a larger watershed plan.

A major advantage of public commercial banks is that they are in public ownership, which can better provide long-term management, and the funds generated from the bank can be used to further improve public resources. The disadvantage is that the up-front capital investment can be difficult for public agencies with limited availability of funds.

DuPage County, Illinois

Overview: DuPage County is a highly urbanized area located west of Chicago. Land development has negatively impacted the natural drainage system of the area by eliminating naturally occurring storage, reducing stormwater infiltration, and increasing the velocity and quantity of runoff. In response, the DuPage County Stormwater Management Plan (Management Plan) was developed in 1989, to reduce the potential for recurrent and increasing flood damage and to reduce further environmental degradation associated with development. The ecological assessment conducted during development of the Management Plan found that wetlands represented a significant portion of the natural watershed

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[9] Desmond Duke, Project Administrator, Florida Wetlandsbank. Personal communication, June 19, 1998.

storage in the county, and are essential for adequate stormwater retention, conveyance, sediment control, and water quality enhancement.[10]

Individual watershed plans, within the larger DuPage County management plan, were developed to identify wetlands for protection, enhancement, and restoration. The County attempts to establish mitigation banks in the four main watersheds within the County. The service area for each bank will be the watershed in which the bank is located. The County also established an ordinance for stormwater management that requires developers whose development proposals will affect the function and values of wetlands to consider mitigation banking as an alternative to compensatory on-site mitigation. The objectives of the DuPage County commercial mitigation banking program are to:

- Manage and mitigate the effects of urbanization on stormwater drainage
- Enhance the quality, quantity, and availability of surface and groundwater resources and prevent further degradation
- Preserve and enhance existing wetlands, aquatic, and riparian environments
- Encourage restoration of degraded areas

Any investment in a bank must be at least equal to the cost of planning, acquiring lands, constructing, and operating and maintaining mitigated wetlands of equivalent or greater functional value than those lost to development.

The land for the bank sites was in public ownership. Funding for establishing the bank and initial project work came from an advanced credit sale. One-third of the credits were allowed for sale prior to work beginning at the site. One site, Winfield Creek, was in the process of selling credits for project initiation when public opposition to the site halted the project. The County is now in the process of finding another site but, in the interim, is liable for the credits sold.

The County has five banks that have been approved by the agencies and are in various stages of implementation. The oldest project, Cricket Creek, is in year two and, to date, is exhibiting successful hydrologic and vegetation conditions.

Conclusion

The use of mitigation banking by local governments can be an effective tool to restore and protect their community's valuable wetlands resources. The case-studies presented provide local governments with different mitigation banking strategies that could be used to address the needs of their community. As demonstrated in the case-studies, the establishment of sound objectives and goals by the local agency will help determine the type of mitigation bank that will best meet the local needs. In addition, there are several conditions that local governments must evaluate and consider for successful bank implementation, including (1) a demand for compensatory mitigation, (2) a sufficient supply of suitable sites for the bank, and (3) opportunities for working in partnership with the federal and state regulatory and resource agencies.

Mitigation banks that are established by local governments can address more than just the need for compensatory mitigation. Wetlands mitigation banks can achieve additional community needs by increasing local flood storage capacity, improving wildlife habitat, and providing educational and recreational benefits while restoring and enhancing important wetland resources.

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[10] DuPage County Stormwater Management Committee. 1989. *DuPage County Stormwater Management Plan.* DuPage County, Illinois.

Massachusetts Stormwater Management Policy/Regulations: Development, Implementation, and Refinement

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Abstract

In March of 1996, the Massachusetts Department of Environmental Protection, in conjunction with the Massachusetts Office of Coastal Zone Management, released the Draft Version of the State's Stormwater Management Policy. The Policy includes nine specific Stormwater Performance Standards, which are to be met to achieve compliance. The Policy presented in two volumes: Volume One, the *Stormwater Policy Handbook,* which contains a description of the policy, its implementation, and descriptions of the nine individual stormwater management standards, and Volume Two, the *Stormwater Technical Handbook,* which contains more detailed information on Best Management Practices (BMPs), for stormwater management (i.e., detention basins, swales, etc.).

The policy is the result of three years of work by a Stormwater Advisory Committee that included representatives from regulatory offices (EPA, Department of Fisheries and Wildlife, Natural Resources Conservation Service, etc.), engineers and developers from the private sector, the highway department, and representatives of local conservation commissions. The Policy is to be implemented as an amendment to the existing Massachusetts Wetlands Protection Act, which is administered at the local level by local Conservation Commissions.

The nine performance standards are the key components of the policy. General descriptions of the standards include the following:

1. No new stormwater conveyances may discharge untreated stormwater directly to, or cause erosion in wetlands or waters of the Commonwealth.

2. Post-development peak discharge rates may not exceed pre-development rates.

3. Maximize recharge to groundwater: post-development must be similar to pre-development conditions.

4. Remove 80% of average annual load–post development of Total Suspended Solids (TSS).

5. Use specific BMPs for discharges from areas with higher potential pollutant loads; untreated infiltration prohibited.

6. Use specific BMPs for discharges to critical areas.

7. Redevelopment projects should not meet performance standards to the maximum extent practicable and at a minimum, improve existing conditions.

8. Erosion and sedimentation controls are required during construction.

9. Operation and Maintenance Plan for Stormwater Management required.

The Policy was introduced in March of 1996 for testing its effectiveness. Two Phases of training were provided over a two-year period across the state. The first phase focused on introducing the Policy and the second phase focused on detailed Engineering Companies, and local DPWs and planning departments.

Introduction

In March of 1997, the Massachusetts Department of Environmental Protection (MADEP), in conjunction with the Massachusetts Office of Coastal Zone Management (CZM), released a draft version of the state's Stormwater Management Policy (herein referred to as the "Policy"). Prior to the development of this policy, the control of peak stormwater discharges from development sites to prevent flooding and erosion problems was a fairly standard requirement across the country; and was well-implemented in Massachusetts. However, there were no state-level requirements for stormwater quality treatment, maintaining groundwater recharge processes, or maintaining stormwater treatment systems. The Policy was developed to provide standard minimum requirements for stormwater management that could be consistently implemented on development projects.

The Stormwater Management Policy is currently an amendment to the Wetlands Protection Act which is only applicable when a project proposes work within the boundary, or buffer zone, of a Wetland Resource Area. Hence, the Policy is not applicable to all developmental projects.

While the regulatory implementation of the Policy is through local Conservation Commissions, under the State's *Wetlands Protection Act,* the performance standards and design guidelines that define the Policy were developed for use by a larger audience. Development teams (typically the proponent and their engineers, architects, and planners) and the various reviewing agencies (Conservation Commissions, Planning Boards, DPWs, etc.) were expected to be users of the Policy. The goal was to provide guidance to ensure that negative impacts from stormwater runoff generated as a result of urban and suburban development would be minimized without placing an unjustifiable economic burden on developers for new projects, or preventing redevelopment of existing sites.

The Policy includes nine specific Stormwater Performance Standards for which compliance must be achieved on development projects. Included in these standards is a requirement to provide groundwater recharge, requirements for ensuring proper stormwater treatment prior to discharge to waters of the state, and provisions for waiving certain requirements if deemed infeasible for redevelopment projects. The Policy has been distributed as an Interim Draft to allow for refinements prior to its final promulgation as state regulations. In order to fully gage its effectiveness, however, the Interim Policy has been distributed and implemented as if the regulations were final.

The Policy is presented in two handbooks: Volumes One and Two. Volume One, the *Stormwater Policy Handbook.* contains a description of the policy, its implementation, and detailed definitions of the nine individual stormwater management standards. Volume Two, the *Stormwater Technical Handbook,* contains detailed information on Best Management Practices (BMPs), with guidelines for the design of standard stormwater management structures (such as detention basins and water quality swales).

Development

The Policy is a result of three years of work by a State Stormwater Advisory Committee. In addition to leaders from MADEP and CZM, this Committee included representatives from such regulatory offices as USEPA, Department of Fisheries and Wildlife, and the Natural Resources Conservation Service. Also on the committee were engineers and developers from the private sector (including the author) and representatives from the Massachusetts Highway Department and local Conservation Commissions.

The goal of the Committee was to provide a cohesive set of performance standards that addressed key issues associated with stormwater runoff control. The Policy was developed in such a manner that it provides adequate accompanying guidelines and recommendations, to allow for consistent implementation, while still allowing for flexibility in site-specific designs. Given the widely varying goals and perspectives of Committee members, the Policy published in 1997 was a result of group consensus and compromise.

The Committee was divided into two sub-committees, the Policy group, and the Technical sub-committee. The Policy group was tasked with developing the process for legal implementation and the Technical Committee was responsible for developing the specific technical requirements of the Stormwater Management Policy.

Some of the performance standards introduced completely new requirements for development projects and required detailed evaluation and discussion during the development stages. Some of the key issues that generated substantial debate include the following:

- ***Recharge:*** The loss of recharge to groundwater systems, which provide drinking water supplies and generate baseflow to streams and rivers, was a state-wide problem. A mechanism for requiring the maintenance of recharge after development was considered a high priority. The biggest issue relative to this requirement was: How much annual recharge should be required?

- ***Water Quality Treatment Volume:*** The quality and quantity of stormwater runoff from paved and unpaved areas can vary greatly. It was determined by the Committee that runoff from impervious areas was the highest concern and should require treatment. The largest decision relative to this concern was: What volume of stormwater runoff should be treated for water quality? Should it include runoff from both pervious and impervious areas?

- ***Critical Areas:*** The Committee felt that certain sensitive environmental areas should have the maximum practicable protection. Under the Massachusetts Stormwater Management Policy, "Critical areas" are defined as; shellfish growing areas, public swimming beaches, cold water fisheries, recharge areas for public water supplies and designated Outstanding Resource Waters (ORWs). ORWs are further defined to include surface drinking water supplies, certified vernal pools, and state designated Areas of Critical Environmental Concern (ACECs). The issue here was how to ensure that these areas are provided adequate protection and how to define what adequate protection is.

- ***Exemptions:*** Some Committee members expressed concern that stormwater management requirements may be too costly for small residential projects, or may be a deterrent for initiating redevelopment projects. The issue was what, if any, projects should be exempt from any or all of the standards?

- ***Operation/Maintenance:*** Maintenance of stormwater management practices is critical for their effectiveness. It is often difficult, if not impossible, to ensure that the operation and maintenance of BMPs will occur as necessary. The issue was: How can the necessary maintenance of BMPs implemented on the project be ensured?

A brief summary of the decisions on these key issues is as follows:

- ***Recharge:*** Annual recharge processes are permanently changed by the introduction of impervious areas to a site. In order to minimize this impact, it was agreed that the existing annual recharge should be determined and post-development annual recharge should maintain this to the maximum extent practicable. A preliminary methodology for determining existing recharge on the site was provided in the Draft Policy.

- Water Quality Treatment Volume:

  - For discharges to critical environmental areas (defined in the Policy), the volume of stormwater runoff to be treated for water quality control is defined as 1.0 inch of runoff times the total impervious area of the post-development project site.

  - For all other discharges, the volume to be treated is calculated as 0.5 inches of runoff times the total impervious area of the post-development project site.

  These volumes represent total runoff from the smaller, more frequent storms that occur annually, and the initial volumes of runoff from larger more infrequent storm events. The goal behind this decision was to fully treat the runoff from the majority of the storm events occurring annually, without approaching values where treatment system sizes would result in increasing costs with decreasing additional benefit.

  - ***Critical Areas:*** It was decided, as stated above, that 1.0 inch of runoff (as opposed to 0.5 inch) must be treated for water quality if the discharge is to a Critical Resource Area. Also, specific approved BMPs are recommended for use in particular critical areas. In addition, it was decided that spill prevention/containment methods must be included in the Stormwater Management System design.

- ***Exemptions***: Specific cases were provided exemption from the Policy, including: single family house projects, residential subdivisions with four or fewer lots that do not discharge to critical areas, and emergency repairs to highway/roadways or their drainage systems. However, none of these projects are exempt from the standard requiring sedimentation and erosion control requirements during construction activities.

  While redevelopment projects are not exempt, a redevelopment project may comply to the maximum extent possible if it can be proven that it is not practicable for the project to achieve full compliance.

- ***Operation/Maintenance***: All non-exempt projects require the development of a Stormwater Management System Operation and Maintenance Plan (O&M Plan). As defined in the Policy, the O&M Plan must contain the: names of the Stormwater Management System(s) owner and the person(s) responsible for implementing the O&M Plan, a schedule for inspection and maintenance, and a description of maintenance activities to be performed. Recommendations for specific maintenance practices and schedules are included in the Policy.

Stormwater Performance Standards

The nine Stormwater Performance Standards most accurately describe the key components of the policy that came out of the committee deliberations following resolution of the issues described above. The goal of the standards is to protect groundwater, surface water, and wetland resources from the impacts of stormwater runoff generated as a result of development and redevelopment projects. General descriptions of the standards are provided as follows:

1. No new stormwater conveyances may discharge untreated stormwater directly to, or cause erosion in wetlands or waters of the Commonwealth.

2. Post–development peak discharge rates must not exceed pre-development conditions for the 2-year and 10-year storm events under all conditions. The 100-year event must be analyzed to determine impacts and must be controlled if necessary.

3. Loss of annual recharge to groundwater should be minimized through the use of infiltration measures, to the maximum extent practicable. The recharge "requirement" which is to mimic existing annual recharge on sites to the maximum extent practical, has not been changed. However, a design methodology for estimating existing annual recharge at a site, and for designing recharge systems has been developed. The methodology uses soil classifications, soil gradation analyses and specific Massachusetts regional rainfall data as data inputs.

4. Stormwater management systems must be designed to remove 80% of the average annual (post development) load of total suspended solids (TSS). It is presumed that this standard is met when; (a) suitable nonstructural practices for source control and pollution prevention are implemented; (b) stormwater management BMPs are sized to capture the prescribed runoff volume; and (c) stormwater management BMPs are maintained and designed as specified in Volume Two. The Policy provides estimates of the percent TSS removal for individual BMPs when designed in accordance with the specified guidelines. Water quality treatment volume is 0.5 inches of runoff from impervious areas (1.0 inch if discharge is to critical environmental area).

5. Stormwater discharges from areas that are defined as having "higher potential pollutant loads" (as defined in the Policy) require specific stormwater BMPs. Infiltration of stormwater from these areas without pretreatment is prohibited.

6. Specific BMPs must be used for discharges to critical areas and the water quality treatment volume is 1.0 inch of runoff.

7. Redevelopment projects must meet the performance standards to the maximum extent practicable. It must be clearly stated why full compliance cannot be achieved and such projects must, at a minimum, improve existing conditions.

8. Erosion and sedimentation controls are required during construction.

9. An Operation and Maintenance Plan (O&M Plan) for Stormwater Management is required.

A detailed explanation of each of these Standards is available in Volume One, the Stormwater Policy Handbook.

Implementation

In order to test its effectiveness and identify potential problems, the Policy was introduced in March of 1997, prior to the promulgation of regulations. Copies of Volumes One and Two were distributed to each Conservation Commission office in the state, and to other relevant regulatory agencies. Two phases of training were provided across the state over a two-year period: first to introduce the Policy, and then to focus on detailed case studies and implementation issues. Training was made available to regulatory agencies, Conservation Commissions, local DPWs, planning departments, and engineering companies. During the training sessions, the largest turnout was from Conservation Commission representatives and engineering/consulting firms, with minimal attendance by the other groups invited.

At each of the training sessions, questions from the audience on the Policy were solicited and a list of most Frequently Asked Questions (FAQs) was developed. The FAQs provided an excellent basis for outlining where additional information and/or clarification was needed. Based on the number of recurring questions, the Committee decided to prepare a survey to solicit feedback from potential policy users. The survey was comprised of 23 questions for characterizing the respondent, determining the usefulness and ease of implementation of the Policy, identifying particular problems in understanding or implementing performance standards, and determining what type of BMPs were currently being implemented.

The survey was not designed to be a statistically valid data set, but rather to gain a practical working knowledge of what aspects of the Policy and/or its method of implementation needed to be refined. While this was generally evident from the FAQs, the survey further substantiated the specific areas where additional work was necessary. Some key findings from the 118 respondents to the survey were as follows:

- The overall sense of the Stormwater Performance Standards was that the Stormwater Policy implementation was good (63%) and that they consider the Stormwater Handbook to be a "useful resource for designing and reviewing systems (77%).
- In response to the standards, respondents were generally comfortable implementing peak discharge controls and sedimentation and erosion controls. This was not surprising since these were existing requirements in most municipalities that needed to be achieved for most development projects.
- Not surprisingly, new requirements for groundwater discharge, treatment of stormwater runoff water, and the preparation of stormwater Management O&M Plans were the standards for which additional clarification and technical support were most requested.

Feedback

The Draft Policy was issued prior to formal promulgation so that one to two years of interim implementation could be used for refinement. The FAQs, user survey, and ongoing feedback from the public defined those areas where refinements were especially necessary, including the following:

Standard No. 3 Recharge: The recharge requirement clearly created the most confusion, and required additional technical support. The original brief description included in Volume One was not sufficient for engineers or reviewers to prepare a comprehensive program for achieving the annual recharge requirement.

As a result, the technical sub-committee has focused on providing a more detailed definition of the recharge requirement and appointed a group to develop a design methodology for achieving compliance with this standard. The group has developed a methodology using soil groups and soils analysis and actual rainfall data to determine the existing annual recharge on project sites. Methodology for designing a recharge system to provide post-development recharge that best mimics pre-development conditions is being developed. This technical is currently in the final stages of development and is expected to be completed and distributed prior to December 1999.

Standard 4 - 80% TSS Removal: The Total Suspended Solids (TSS) removal requirement was not developed with the goal of removing only the TSS loads in stormwater runoff. Rather, it was considered an indicator parameter, whereby if 80% of the TSS is removed, a large portion of the additional pollutants carried in stormwater is also removed. This relationship does not hold true, however, if the proponent chooses to use only mechanical methods where settling of fines, assimilation of nutrients, or other biological processes that increase pollutant removal do not occur. For instance, a vegetated infiltrating swale, or wet pond, that is designed to provide substantial stormwater velocity reductions may greatly increase fine sediment removal and may also provide nutrient uptake in addition to gross TSS removal. A structure that removes solids only, and does not allow for detention or contact with plants or potential filtering areas does not comply with the goal/intent of the TSS removal standard.

In addition, users were having difficulty calculating TSS removals when numerous BMPs were to be used in a series. The specific percent removal rates provided in Volume One of the Policy are not additive and, as such, must be calculated as percents of the pollutant load that they receive.

In response to these issues, further definition of the goal of the TSS removal requirement and recommended practices for achieving the goal are being developed. A spreadsheet has been developed, which can be easily filled out by hand, to assist in calculating the percent TSS removal for a project based on the BMPs implemented.

Standard 9 - Operation and Maintenance: This standard has consistently raised the most concern relative to cost and implementation. Common questions were as follows:

- Who will pay for ongoing operation and maintenance of stormwater BMPs if it is not the town?
- How will the town fund the O&M requirements if they assume responsibility?
- What long-term mechanism is there to ensure that maintenance will be completed?
- What is the frequency of maintenance required for specific BMPs?

While these questions are difficult to answer, for a specific site or on a statewide basis, in terms of required maintenance, the Committee has responded by preparing operation and maintenance checklists, which may be used by the operator/owner. These checklists may be submitted to the local Conservation Commissions on an annual basis, if deemed necessary.

Specific maintenance practices and suggested frequencies have also been prepared and are currently being updated, as new information becomes available. It has also been noted that "one size does not fit all" in terms of required maintenance. For instance, an infrequently used residential guest parking area clearly does not warrant the same frequency of street sweeping as a commercial mall parking lot.

The question of financing stormwater management system operation and maintenance activities is also a site- and location-specific issue. The development of stormwater utilities and management districts is ever increasing and may be the option that some communities choose. The promulgation of the Policy as regulations will require the project proponent and/or towns and municipalities to develop a plan for ensuring O&M implementation. There are a variety of ways this may be achieved. Resolution may be somewhat facilitated in larger municipalities and/or USEPA-designated urban areas that must comply with the upcoming final USEPA NPDES Phase II Stormwater Regulations.

Summary

The development of the Massachusetts Stormwater Policy, which includes nine performance standards, was an integrated effort between state and local regulators, policy makers, engineers, developers, and the general public. The group effort and the implementation of the Policy as a Draft, to which refinements could and have been made, have contributed to the usefulness of the standards. While the development and implementation of the standards are still in the early stages, the Policy provides definitive goals for achieving stormwater water quality and quantity control, and addresses annual recharge on development sites. Until the development of these standards, there was no requirement to maximize groundwater recharge on sites or to mandate the development of the stormwater O&M Plan (unless required under other regulatory programs). These advances will provide an overall benefit to the natural resources of the Commonwealth of Massachusetts. The Stormwater Management Policy Volumes I and II may be obtained off the Internet or by request from:

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Implementation of Michigan's Voluntary Stormwater Permit—a Community Perspective

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Introduction

The Rouge River National Wet Weather Demonstration Project (Rouge Project) has made significant progress in restoring beneficial uses to a large, urban waterway using a holistic, "bottom up" watershed approach. This project was initiated in 1992, by the Wayne County (Michigan) Department of the Environment. The purpose of this document is to present a summary of the activities and progress of the Rouge Project; discuss the watershed approach being utilized in the Rouge Project, including the use of a general storm water permit; and summarize a community perspective on this entire effort.

Rouge Project Background and Summary of Progress to Date

The Rouge River National Wet Weather Demonstration Project is a watershed-based effort, substantially sponsored by the U.S. Environmental Protection Agency (USEPA), to manage wet weather pollution to the Rouge River, a tributary to the Detroit River in southeast Michigan (See Figure 1). The Rouge River Watershed is largely urbanized, spans approximately 438 square miles, and is home to over 1.5 million people in 48 communities in 3 counties. The Rouge River has been designated by the International Joint Commission as a significant source of pollution to the Great Lakes system.

The early focus of the Rouge Project was the control of CSOs in the older urban core portion of the downstream areas of the watershed. As a finite number of point source CSO discharges could be identified, and responsibility for each defined, the traditional regulatory approach of issuing National Pollutant Discharge Elimination System (NPDES) permits mandating corrective action worked relatively well. Additional monitoring of the river showed, however, that other sources of pollution needed to be controlled before full restoration of the river would be achieved throughout the watershed. These other sources of pollution include storm water runoff, interflow from abandoned dumps, discharges from illicit connections, discharges from failed on-site septic systems, and resuspension of contaminated sediment.

The Rouge Project is designed to identify the most efficient and cost-effective controls of wet weather pollution, while assuring maximum use of watershed resources. A great deal has been accomplished in these efforts. The following summarizes some of those accomplishments, focusing on CSO controls first. Approximately 50% of the watershed is served by separate sewer systems, with an additional 20% served by combined sewers (157 overflow points), and the

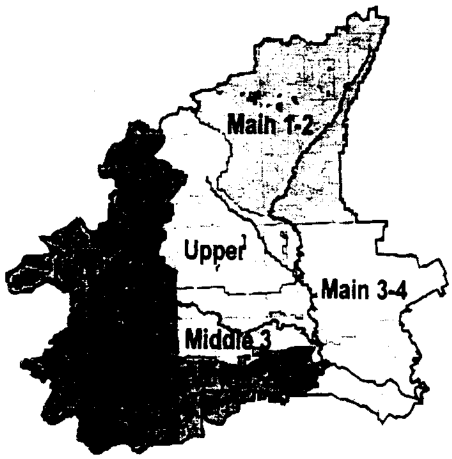

Figure 1. Rouge Subwatersheds & Location of Rouge Watershed in Michigan.

remaining area served by on-site sewage disposal systems. CSO controls are being implemented in phases. Under the first phase, six communities have separated their sewers and eight communities have constructed or are constructing 10 retention treatment basins. Each of these basins is sized for different design storms and several employ innovative technologies. A two-year evaluation study of the CSO control basins began on June 1, 1997. The results from the evaluation study, coupled with efforts to control storm water and other pollution sources in the watershed, will provide the basis for the second phase CSO control program for the remaining CSO sources in the watershed. The information gained from the evaluation of design storms and control technologies will be useful to others nationwide to determine cost-effective CSO controls to meet water quality standards.

The Rouge Project is also evaluating innovative stormwater control and watershed management technologies. Twenty-five different communities and agencies throughout the watershed are implementing over 100 pilot projects. Categories of pilot management projects currently underway include wetlands creation and restoration; structural storm water practices, such as grassed swales and detention ponds; erosion controls; stream bank stabilization; and habitat restoration, to name a few.

The Rouge Project also discovered that illicit connections and failing septic systems are major sources of pollution problems in the Detroit urban area. Creative ways to remediate these sources of pollution have been initiated.

A suite of computer models has been developed by the Rouge Project. These models simulate the water quality and quantity response of the Rouge River during wet weather events for existing and future conditions, and under various CSO and stormwater runoff management alternatives. This effort has resulted in a very useful public communication tool on water quality indices tied to actions needed to restore the Rouge River. A comprehensive geographic information system (GIS) and relational databases were designed and implemented to manage the wealth of data collected under the Project. In addition, a special data exploration tool, DataView, was developed to support routine analyses of large time-series data sets. DataView is user-friendly and readily transferable to other locations. Related to DataView is the Rouge Information Manager, also a user-friendly, readily transferable tool (an "electronic file cabinet") for accessing multi-media information about the Rouge River restoration effort.

Effective, readily transferable tools have been developed, employed by the Project, and are being shared with other cities and state agencies. Additional information on the Rouge Project can be obtained from the web site at *http:\www.rougeriver.com.*

Evolution of the Watershed Approach

The Rouge River watershed has seven subwatersheds that range in size between 19 and 89 square miles (See Figure 1). Older communities served by combined sewers dominate downstream portions of the Rouge River Watershed, while the headwater areas are typically open space, agricultural land, or low density residential developments that are undergoing rapid change due to growth pressures. Fully developed areas, typical of the middle portions of the Rouge Watershed, have separated storm sewers and limited opportunities to address stormwater problems with structural solutions.

Data gathered by the Rouge Project have shown numerous water quality and designated use problems, including high bacteria levels and low dissolved oxygen levels during wet weather events in all areas of the watershed. Fish consumption is prohibited in much of the watershed due to the threat to human health. Six of the seven subwatersheds have moderate to severe degradation of wildlife habitats, with fish populations suffering severe impairment in three of the subwatersheds. Aesthetic enjoyment is moderately to severely impaired throughout the watershed. Restrictions to small boat navigation resulting from logjams, garbage and sedimentation are a moderate to severe impairment in virtually all seven subwatersheds.

Based upon what was learned, the focus of the Rouge Project became more holistic to consider impacts from all sources of pollution and use impairments in receiving waters. The historic implementation of water quality management programs in the United States at the federal and state levels has been to focus on point sources, which are the most obvious sources of pollution to water bodies. This approach has worked well to control pollution from most point sources but has also left a patchwork of regulated and unregulated discharges of stormwater and nonpoint source pollution to surface waters. This patchwork is especially evident in most urbanized areas where multiple local jurisdictions are located in the same watershed. More subtle sources of pollution, such as stormwater, have emerged as the next priority for attention. The challenge for the Rouge Project became to develop innovative, coordinated solutions to achieve water quality objectives that may be: (1) be more cost-effective, (2) implemented in a more timely fashion, and (3) better able meet local needs.

It has become clear that water resources management must have the support of the general public in order to be effective and to become self-sustaining. A locally driven watershed approach to pollution management as a means to achieve management goals is an exciting concept discussed by many, but for which there is limited practical experience. This is particularly true in urban situations where there are multiple sources of impairment to a water body and stiff competition for limited local resources to address the pollution sources. The Rouge Project has provided a unique opportunity for a watershed-wide approach to restoring and protecting an urban river system by using a cooperative, locally based approach to pollution control.

The Michigan NPDES General Permit for Municipal Stormwater Discharges

As concern expanded to sources of pollution in the upper portion of the watershed above the CSO discharges, and water quality improvement focused more on watershed-wide approaches, the lack of a defined regulatory framework to address stormwater pollution and diffuse nonpoint source pollution became a major obstacle to further progress in improving water quality and restoring beneficial uses to the Rouge River. Beginning in 1995, the Michigan Department of Environmental Quality (MDEQ), the Rouge Project, and the communities in the Rouge Watershed jointly developed an innovative, watershed-based NPDES general permit ("General Permit") for municipal stormwater discharges. The permit was issued on July 31, 1997 (MDEQ, 1997). This collaborative process was outlined in a report entitiled "Adapting Regulatory Frameworks to Accommodating Watershed Approaches to Storm Water Management" (Fredericks, et al., 1997).

The MDEQ General Permit and USEPA's draft Phase II stormwater regulations (U.S. Environmental Protection Agency, 1998) due to be promulgated in September 1999, were developed during the same time frame. Wayne County, on behalf of the Rouge Project communities, was selected to serve on USEPA's Urban Wet Weather Flows Federal Advisory Committee, which (among other activities) assisted USEPA with the development of the Draft Phase II Stormwater Regulations. Participation on the federal advisory group on watershed approaches to stormwater management was invaluable to the development of the Michigan General Permit, and provides a high likelihood that the General Permit will be acceptable for implementing the forthcoming federal Phase II Stormwater Regulations in Michigan.

The General Permit incorporates the following elements:

General:

- Permit coverage is voluntary until the final EPA Phase II Stormwater Regulations are promulgated
- Public agencies who own, operate, or control stormwater systems are provided the opportunity for coverage
- Watershed size is established by the potential permitees during the application process
- Application and permit process have limited required actions; the focus is to establish desired outcomes.

Requires permittee to develop the following:

- *Illicit Discharge Elimination Plan* (IDEP) that has the goal of eliminating raw sewage discharges and includes addressing failing septic systems and improper connections of sanitary sewers to storm drains and open waterways.
- *Public Education Plan* (PEP) designed to inform residents and businesses about what actions they should take to protect the river.
- In cooperation with others, a *Watershed Management Plan* to resolve water quality concerns which includes: short and long-term goals for the watershed, delineation of actions needed to achieve the goals, estimated benefits and costs of management options, an opportunity for all stakeholders to participate in the process.
- *Storm Water Pollution Prevention Initiative*, which includes evaluation and implementation of pollution prevention and good housekeeping practices and the evaluation and implementation of BMPs to minimize impacts of new development and redevelopment.
- *Monitoring and Reporting Plan*, which includes a schedule for revisions to the Watershed Management Plan.

The IDEP and PEP are submitted to MDEQ at the time of application and the implementation of these plans begins when the MDEQ issues a certificate of coverage to a community/agency. Within six months after the issuance of a certificate of coverage to a community/agency, the General Permit requires the submission of a public involvement plan for approval by the state. This plan identifies the approaches that will be used within the hydrologic area to involve stakeholders in the development of a watershed plan that must be completed within 18 months after the certificate of coverage is issued. Once a consensus, long-term management plan has been completed, each agency and community within the watershed must prepare and submit for state approval its own pollution prevention initiative that identifies actions and schedules to address the pollution concerns identified in the consensus watershed plan. The watershed stormwater management plans developed by the communities and other public agencies do not require state approval; however, the individual pollution prevention initiatives emanating from the watershed planning process do require state approval, as the activities specified in the initiatives become permit requirements upon approval.

Rouge Community/Agencies Approach to Application and Permit Requirements

A total of 43 communities and agencies who own, operate, or control stormwater systems in the Rouge River Watershed have obtained coverage under Michigan's new watershed-based General Permit for municipal stormwater discharges. The result is that over 95% of the watershed is covered under this new program. The communities and agencies requested that, for purposes of the General Permit, the large Rouge watershed be subdivided into the seven subwatersheds shown in Figure 1. Long-term management plans will, therefore, be developed for each of these subwatersheds, with coordination of the plans provided by the MDEQ and the Rouge Project staff. The document "Implementing a Model Watershed Approach Through a State General Storm Water NPDES Permit" (Cave, et al., 1998) outlines key issues discussed and decisions reached by the communities as they developed their General Permit applications during 1998. The following section presents additional information regarding the application and permit requirements recently approved for the communities and agencies in the Rouge Watershed under the Michigan General Permit.

The Michigan General Permit for municipal stormwater discharges is quite flexible and allows those seeking coverage under the permit to use a wide variety of approaches to meet the public education, illicit connection/illegal discharge, and public involvement requirements. This flexible framework has allowed communities to experiment with various approaches that recognize local constraints and seize upon unique opportunities to meet the desired outcomes. While the basic requirements for what must be in the watershed plan are more detailed, the permitees within a watershed are allowed considerable freedom in deciding upon their own priorities, remedial actions, and schedules. Pollution prevention initiatives that are expected to be proposed by the communities will likely involve commitments to continue or expand current activities, like soil erosion and sedimentation control; implementation of new activities to address priority issues such as failing septic systems; and implementation of regional projects to reduce the frequency and velocity of storm flows in the river.

Table 1 and Table 2 outline the variety of public education and illicit discharge detection and elimination approaches identified by the communities and public agencies in the Rouge Lower 1 Subwatershed (Figure 1).

Across the watershed, communities actively sought ways to cooperatively address illicit connection/illegal discharge investigations and public education projects. In one subwatershed group, a community with experience in the production of videos agreed to make a river stewardship video that all other communities within the subwatershed could use on cable television, or through the distribution of cassette copies to local libraries and/or schools. In the same watershed, another community offered the use of a consultant to solicit bids for freestanding public information display boards and to develop stormwater information materials for the boards that could be used by all communities at public gatherings and inside public facilities. One community obtained the support of the local college to house and provide administrative support for a well-established non-profit organization, the Friends of the Rouge organization, whose public information activities were subsequently funded by several subwatershed groups to implement portions of their public education plans.

Advantages of Watershed Approach

The following section presents some of the lessons learned as the communities and agencies in the Rouge Watershed are beginning to implement the watershed-based, Michigan General Permit for municipal stormwater discharges.

Holistic Solutions/Local Ownership. There are distinct advantages in managing stormwater on a watershed basis. From the work already completed on the Rouge Project, it is clear that an integrated approach is needed to address all sources of water pollution and excessive flows in this urbanized watershed. By requiring those agencies and communities with responsibility for stormwater to work together at the subwatershed level to establish goals and objectives, local agencies and the state regulatory agency are forced to view solutions holistically. To achieve the desired level of river restoration, there must be integrated action plans that address not only stormwater but failing on-site sewage disposal systems (OSDS), CSOs, sanitary sewer overflows (SSOs), and significant nonpoint sources of pollution.

Ideally, a watershed-based regulatory framework should encompass all dischargers so that pollution sources can be addressed holistically. Practically, it must be recognized that prior NPDES permit programs at the state and federal level are already in place for municipal and industrial point source waste treatment discharges, and for many industrial and commercial stormwater discharges. While the Michigan watershed-based stormwater General Permit covers only public agencies that own, operate, or control stormwater conveyance systems not currently under a Phase I Stormwater Permit, the required watershed management plan does provide a framework for integrating activities under other permit programs. In addition, the General Permit gives communities and agencies the flexibility and encouragement to incorporate nonpoint source controls and pollution prevention activities as part of the required watershed management plan. For example, many

Table 1. Illicit Discharge Elimination Activities to be Implemented under Michigan Stormwater General Permit in Communities in Lower 1 Subwatershed, Rouge River Watershed

	Activity	Canton Township	Plymouth Township	Van Buren Township	Wayne County	Salem Township	Superior Township	Ypsilanti Township
Legal Basis	Existing ordinances for control of illicit connections and/or OSS have been determined sufficient or community/agency will evaluate existing ordinances	x	x	x		x	x	x
	Will adopt additional ordinances for control of illicit connections and/or OSDS if determined necessary	x	x	x		x		x
Locating Problem Areas	Review existing monitoring data to prioritize investigation areas	x	x	x		x		x
	Plan developed w/County to locate sources of suspicious discharges previously identified	x	x	x				x
	Develop, modify, implement and/or continue to use complaint system	x	x	x		x	x	x
	Procedure to coordinate complaint response/follow up	x		x		x	x	x
	Develop and/or use GIS for tracking complaints and/or activities	x				x		x
	Train field employees for identification & reporting of illicit discharges	x	x	x		x	x	x
	Mapping of storm system, jurisdictions and/or locations of outfalls	x	x	x				x
	Systematic dry weather screening of outfalls or manholes	x	x	x				
	Investigate possibility of systematic screening program					x		
	Screen drainage from facilities under jurisdiction						x	
Finding the Source	Dye testing when additions made to existing facilities	x						
	Establish priority of suspicious outfalls and/or initiate follow up visits for further analysis of flow	x	x	x				x
	Investigate to find sources of suspicious discharges using upstream manholes or dye testing or televising	x	x	x		x		x
Minimizing Seepage from Septic Fields and Sanitary Sewers	Identify and/or map areas served by OSDS			x				
	Determine feasibility of sewer extension/mitigation						x	
	Proposals for future sanitary sewer construction will consider existing OSDS			x				
	Develop agreement/cooperate with county for implementing an OSDS evaluation program	x	x	x				x
	OSDS evaluation prior to sale of property	x				x		x
	Continue sanitary sewer maintenance program	x	x	x			x	x
Reporting	Reporting to MDEQ on investigations, violations found & corrective actions taken	x	x	x		x	x	x
Other	Investigate Funding Mechanism for Stormwater Related Tasks			x				

Table 2. Public Education Activities to be Implemented Under Michigan Stormwater General Permit by Communities in Lower 1 Subwatershed, Rouge River Watershed

Activity	Canton Township	Plymouth Township	Van Buren Township	Salem Township	Superior Township	Ypsilanti Township
Cable TV ads	x		x		x	x
Clean Sweep program		x				
Coordinate with Master Composters Program						x
Co-sponsor annual River Day	x				x	
Co-sponsor educational workshops			x	x		
Co-Sponsor Healthy Lawn & Garden Workshop		x				x
Cosponsor informational outreach workshops						
Co-sponsor River Stewards program					x	
Co-sponsor River Watch program				x	x	
Co-sponsor Rouge River Day		x				
Co-sponsor Rouge Education Project	x	x		x	x	
Co-sponsor Rouge Friendly Neighborhood Program		x			x	
Co-sponsor Rouge Friendly Business Program		x				
Display maps of community, watersheds & boundaries				x		
Distribute miscellaneous brochures and/or fact sheets	x		x	x	x	x
Distribute Rouge Recreational Guide	x		x			
Distribute Rouge Repair Kit to homeowners				x		
Distribute septic system maintenance packet to homes with OSDS				x		
Distribute storm water general information package to new residents				x		
Heighten visibility & promote school water/resource monitoring				x		x
Periodically provide Rouge Information Kiosk system in public buildings					x	
Presentations	x		x		x	x
Provide articles, Information in community newsletter	x		x	x	x	x
Provide fliers/messages in water bills or tax notices					x	
Provide water quality educational information on Website					x	
Public service announcements					x	
Publicize garden hotline				x	x	x
Publicize illicit discharge hotline				x	x	x
Storm drain marking	x		x		x	x
Tributary signage					x	
Utilize "Our Actions" display at various community events	x		x		x	x

communities have initiated pilot projects to evaluate how stormwater best management practices (BMPs) will control stormwater flow and prevent pollution. In some cases, these pilot projects have permanently changed the way communities and/or government agencies manage stormwater. These management practices will be included, as part of a watershed management plan, and credit will be given to the entities that are performing those functions.

Many of the subwatershed units selected in the Rouge River Watershed involve communities that have combined sewers, separated sewers, and OSDS. Some individual communities have all three within their corporate limits. Once the communities began to work together at the subwatershed level to establish goals to achieve water quality standards necessary to restore the river, each found that they had a significant role in the process and that the control of flow in the rapidly developing headwater areas was as significant as CSO problems in the lower portion of the watershed. Evaluating the sources of water quality problems and/or the threats to existing uses of the river at the subwatershed level by local agencies is leading to a better understanding of local constraints, opportunities for innovative solutions, ownership of the long-term river restoration effort, and interagency cooperation.

Overcoming Institutional/Regulatory Barriers. Local agencies and communities in urbanized areas have a long history of cooperative efforts to address the delivery of common public services. Recent trends in Michigan, and elsewhere in the country, to reduce the size and cost of government and limit local taxing power have accelerated efforts at the local level to integrate or share the cost of a broad range of government services. Local agencies are increasingly seeking ways with their neighboring jurisdictions to reduce the cost of police and fire protection, solid waste disposal, libraries, recreational facilities, infrastructure maintenance and repairs, public transit, water supplies, and sewage disposal. Unfortunately, except in a few isolated instances where a single authority has been created to oversee all aspects of water management, the legal responsibility for stormwater is widely dispersed among local communities, county health and drain agencies, road agencies, private developers, and autonomous school districts and public colleges. The creation of a new level of government in the form of a water management authority with broad powers has been resoundingly rejected in the Rouge River watershed by local agencies and is likely to receive the same reception in many other urban areas of the country.

State and federal water quality regulatory programs have traditionally focused on large point sources where responsibility for obtaining and complying with specific permit limits is easy to establish. The regulatory framework to control water pollution has generally discouraged rather than encouraged cooperative solutions among communities and has relied upon command and control to achieve results. The complexities involved in addressing wet weather pollution problems in urban areas, and the widely dispersed accountability for managing stormwater, demands a new regulatory framework that will encourage cooperation among the locally responsible public agencies to design integrated, holistic solutions. The watershed approach to stormwater regulation developed in Michigan offers an opportunity to overcome the institutional and regulatory impediments that have discouraged cooperative local approaches to restoring urban watersheds.

Institutional arrangements and financing options necessary to implement the General Permit and subwatershed management plans are among the many elements the local communities in the Rouge Watershed are addressing in their working groups. As part of the subwatershed planning process, communities and agencies are also identifying issues which cross subwatershed boundaries. Rouge Project staff and the MDEQ currently provide coordination of individual subwatershed efforts and assist subwatersheds in developing a comprehensive strategy for addressing watershed-wide issues. The subwatershed communities are also identifying those activities, such as public education and water quality monitoring, that may be most cost-effectively performed throughout the entire watershed by a single entity.

Increased Local Accountability and Political Support. Building a watershed restoration project from the bottom-up by helping local communities and agencies identify problems, set their own priorities for restoration, select their own remedial measures and propose their own schedules requires a sharing of power among federal, state, and local agencies not usually found in water pollution control programs. The General Storm Water Permit program in Michigan is voluntary at this time and it has allowed state regulators the ability to provide flexibility that might not otherwise be available. It has also increased the accountability of local agencies who no longer have the freedom to blame federal and state officials for the impositions of requirements, but now are responsible for convincing local elected officials that the programs proposed are in the best long-term interest of the local residents.

Opportunities for Cost Efficiencies/Innovation. As discussed earlier, the Rouge River communities that have obtained coverage under Michigan's General Storm Water Permit and are working in subwatershed groups have already developed more cost effective and efficient methods to meet public education requirements through cooperatively developed projects. Similar joint programs are underway to train local community and agency staff in illicit discharge elimination activities and in sharing staff and equipment to conduct river and enclosed storm drain surveys. The three county health agencies are developing common approaches to permitting and inspecting OSDS. The county road agencies are working with the state highway agency to address the design, construction, and maintenance of transportation drainage systems.

The county agencies in the three counties responsible for designated storm drains are working together and with local communities toward implementing common standards for stormwater management at new developments. County and local officials have worked together to establish protocols for rapidly developing independent GIS to assure that databases can be integrated to assist in watershed-wide water quality/quantity management. The economic and political cost for each community or county agency to develop these approaches has been an impediment in the past. The watershed approach has enabled these cooperative programs to be established. It is anticipated that the pollution prevention initiatives required following completion of the watershed management plans would also involve joint projects.

Establishing a broad range of cooperative programs to address stormwater problems across jurisdictional boundaries is, in of itself, innovative. However, with the development of comprehensive watershed plans, new practical approaches to implementing total maximum daily load (TMDL) requirements of the Clean Water Act and effectively using water pollution trading options created at the state level become possible. The Rouge River National Wet Weather Demonstration Project is funding a pilot program to verify that the watershed management framework under the Michigan Stormwater General Permit can be used to meet the TMDL requirements, ahead of state schedules (and at potentially lower cost), and the objectives of the Clean Water Action Plan program. In addition, the pilot program will demonstrate how the General Permit watershed framework can be used as a basis for the proposed statewide water quality trading program currently under development.

The top-down, command-and-control approach often requires repeated threats or legal action by state and federal regulators to ensure compliance with requirements due to lack of political will at the local level. Locally generated watershed plans containing specific action schedules that have been adopted by elected boards, commissions, and councils are less likely to be abandoned or require enforcement actions to assure compliance. Peer pressure and citizen support at the local level should be sufficient incentive in most instances for each local agency to complete their responsibilities on schedule. Where legal enforcement action is required, the state and federal agencies are more likely to find support among other local agencies who have met their obligations as outlined in the joint subwatershed plan.

Conclusions and Recommendations from a Community Perspective

Local communities in southeast Michigan and the state regulatory agency are attempting, for the first time, a consensus, cooperative approach to stormwater management and regulation under the NPDES program. The Michigan General Permit is a watershed-based, general stormwater permit issued under the National Pollutant Discharge Elimination System. The permit requires permitees to immediately initiate activities, such as illicit discharge elimination, and to participate in watershed management planning for a self-determined hydrologic unit. The watershed management plan forms the basis for implementing watershed goals and objectives, including improved water quality and pollution control. This new regulatory program implements the watershed approach endorsed by USEPA and others and should facilitate watershed-based integration of control programs for different pollution sources, such as stormwater CSOs which may be present within a large, urban watershed. In addition, it is believed that the new watershed-based stormwater program in Michigan will achieve the objectives of the TMDL program, the Clean Water Action Plan Program, and water quality trading programs under development across the country. From the perspective of local communities and agencies, this approach provides optimum flexibility to solve the most pressing problems in their subwatersheds by empowering them to identify problems, choose from alternative solutions, establish priorities and schedules, and develop common strategies with neighbors. Communities and others involved in this new program are also addressing issues such as coordination of subwatershed efforts within larger watersheds.

The Rouge Project (and others) have shown that by holistically addressing all sources of pollution, a cost-effective action plan can be implemented to address impairments and restore river uses. Storm water issues cannot be corrected in a vacuum, but must be integrated into an overall solution that addresses the physical, chemical, and biological stressors in a waterway. Stormwater adversely affects all three and, therefore, must be woven into the fabric of the overall watershed management plan and watershed control program. Without this integration, stormwater control will become another "add on" program that misses an opportunity to encourage an integrated program that addresses all sources of ecosystem stress in a cost-effective, prioritized manner. The approach being followed in the Rouge River Watershed should prevent misplaced efforts and, most importantly, result in a restored Rouge River on a much faster timetable.

A key objective of the Rouge River National Wet Weather Demonstration Project has been to demonstrate alternative methods to a "command and control," top down regulatory approach for water quality protection and improvement. The alternative methods sought by the Rouge Project leverage "bottom-up" approaches that put place-based needs in the forefront and use local initiatives to make progress on water quality restoration. This approach has led to a number of institutional changes in the watershed that will help sustain the watershed management efforts into the future. From the perspective of the communities involved, the cooperative, iterative approach being followed appears to be working and is a welcome change from traditional "command and control" relationships with regulatory agencies.

The Rouge Project approach demonstrates that watersheds can be "managed." When water quality objectives can only be reached through control of CSO, stormwater, and nonpoint sources, watershed management must involve the active participation of local units of government. From a community perspective, this local involvement is critical to the overall success of the Project and to stream restoration. Also, from a community perspective, undertaking a watershed effort is not a simple matter. Watershed planning and implementation takes a large commitment of time and effort.

The communities involved in the Rouge Project have a sense of overwhelming success with the watershed restoration efforts to date. Water quality and ecosystem health are improving, and the demonstration techniques have resulted not only in concrete and steel structures, but in real institutional changes that integrate the work of stormwater and watershed improvement into the basic institutions of government. Most importantly, the public is able to utilize new canoeing areas and other river-based amenities, which are now possible due the noticeable improvement in water quality, aesthetics, and other attributes of the river. It is hoped that this effort, and the work of the Rouge River National Wet Weather Demonstration Project, will continue to identify and quantify the benefits of cooperative, watershed-based efforts to protect and restore our nations water resources.

Acknowledgments

This paper represents a summary of select elements from the ongoing efforts of many individuals and organizations involved in the restoration of the Rouge River in southeast Michigan. The authors also gratefully acknowledge the assistance of Ms. Sandra Kiser during the preparation of this manuscript.

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California's Model Urban Runoff Program (MURP): Urban Runoff Programs for Small Municipalities

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Background

Monterey Bay is a crown jewel of the California Coastline and has received special protection under the National Marine Sanctuaries Act since September 1992, and the California Coastal Act since 1976. The 5,300 square mile Monterey Bay National Marine Sanctuary includes a number of small coastal communities, and ranges from the City and County of San Francisco on the north to Cambria on the south. The cities of Monterey and Santa Cruz have long recognized that protection of the unique marine resources within the Sanctuary is critical to the economic vitality and quality of life of their communities. Monterey Bay, with its world renowned Monterey Bay Aquarium, rich bird and marine resources, recreational opportunities that include the Santa Cruz Boardwalk, and commanding vistas has become a major tourist attraction.

The Cities of Monterey and Santa Cruz developed and implemented a Model Urban Runoff Program (MURP) in a cooperative team effort with the Monterey Bay National Marine Sanctuary, the California Coastal Commission, California Regional Water Quality Control Board-Central Coast Region, and the Association of Monterey Bay Area Governments (AMBAG) funded by an EPA 319(h) grant. The MURP was developed to address and support a number of environmental regulations and initiatives that applied to the Sanctuary and adjacent coastal areas including: the Sanctuary's Water Quality Protection Program, requirements of the Coastal Zone Act Reauthorization Amendment (CZARA), Coastal Commission plans and policies, the Regional Board's watershed management initiative and basin plans, the State Water Resources Control Board's Ocean Plan and Nonpoint Source Pollution Control Program, and EPA's proposed draft Storm Water Phase II Rule (Storm Water Phase II).

The concept of the MURP originated in the Sanctuary's Water Quality Protection Program for Monterey Bay National Marine Sanctuary-Action Plan Implementing Solutions to Urban Runoff and a State's Urban Runoff Technical Advisory Committee Report, developed to address Section 6217 of CZARA.

One of the most important drivers in the development and implementation of the MURP was an initiative of municipal leaders to address the value that the community places on protecting the local creeks, streams, and wetlands and the Sanctuary's marine biological resources.

Development of Model Urban Runoff Program

A key objective of the MURP was to produce a document that would assist other communities in the development of their own urban runoff programs by providing an off-the-shelf "how-to" guidebook building on the experience gained through the development and implementation of Phase I Storm Water Management Programs. A second objective of the project was the development of Urban Runoff Management Programs for the cities of Monterey and Santa Cruz that would address the community's values and achieve early implementation of and compliance with the various regulatory programs and initiatives.

Representatives from Phase I municipalities who were responsible for the development of their programs and had gained experience in implementation were consulted throughout the project. They participated in workshops when the MURP was presented to Monterey Bay municipalities and provided extensive information and examples of material used in their communities, including what worked and what didn't. Woodward-Clyde Consultants, with its extensive experience in working with Phase I municipalities, was selected to assist the project team in developing and producing the MURP.

The cities used a conceptual framework for developing urban runoff programs appropriate for their individual needs following the guidance recommended by the MURP. It included four major steps:

- Assessment – Institutional assessment and assessment of environmental resources and sources of pollutants of concern
- Development – Program management, institutional arrangements and coordination, legal authority, and fiscal resources
- Implementation – BMPs and model programs for each of the six control measures proposed in Storm Water Phase II and for control of commercial and industrial activities
- Evaluation – Progress reporting and evaluation, water quality monitoring, and program update.

Periodic meetings were held during the two-year grant period to share, review, and comment on individual city work products, review progress, prepare and validate the MURP, and discuss early implementation actions. The Sanctuary was instrumental in the early implementation effort by providing public information and outreach support and developing public education materials. The Coastal Commission played an active role in formulating strategies for addressing Sanctuary-wide water quality and land use concerns and providing support in the development of GIS-based land use maps. Project status reports were presented to the Monterey Bay Regional Stormwater Management Task Force, AMBAG, city councils, and Monterey Bay area public works officers.

The Model Urban Runoff Program

The MURP contains these four major steps for the development and implementation of an urban runoff program, and a corresponding appendix containing additional information, examples, models, references, and contacts for further information.

The Assessment Phase of the MURP describes the importance of information gathering and research to provide an early survey of the municipalities, current policies, programs, legal authorities, and fiscal resources applied to control urban runoff. A similar institutional assessment of existing regional storm water, watershed, and other water quality control programs is recommended to avoid duplication and to identify potential conflicts, opportunities for coordination, and areas not previously addressed. This phase also provides guidance and methods for (1) describing a community's water resources and activities that can be impacted by polluted runoff, (2) mapping the storm drainage system, (3) developing a relationship of pollutant sources/activities to pollutants of concern, and (4) developing a working map to assist in targeting problem areas or pollutant sources. Coordination with and building upon existing efforts, including joining Phase I programs, is encouraged.

The Development Phase of the MURP describes the (1) selection of the program management structure, (2) identifies individual and departmental responsibilities for management of individual program elements (public education, control measures, or BMPs) and (3) coordination with other internal and external programs and agencies. The legal authority to ensure implementation of BMPs and achieve compliance with the MEP standard of the Clean Water Act was developed through use of a model ordinance. The appendices include examples of language for the amendment of Local Coastal and General Plans as required by the State of California. Revisions to the California Environmental Quality Act checklist were recommended to provide planners an additional tool to evaluate impacts of runoff from both new development and re-development. This Phase includes an estimate of staffing resources to implement each element of an urban runoff program. It also describes the use of assessment districts, storm water utility fees, and other sources of funding program implementation.

The Implementation Phase of the MURP describes eight program elements including six required by EPA's Phase II draft regulations as minimum requirements MURP program elements include (1) public involvement/participation, (2) a public education and outreach program, (3) an illicit connection and discharge detection and elimination program, (4) a municipal operations control program, (5) a construction site discharge control program, (6) a new development/redevelopment control program, (7) an optional control program for commercial facilities, and (8) an optional control program for industrial facilities. The MURP recommends objectives, BMPs, implementation activities, and methods for program evaluation and documentation. This includes measurable goals for each of the eight program elements. The appendices contain numerous examples of public participation and education; BMPs for residential areas, food service operations, municipal operations, construction sites, vehicle service facilities, and shopping centers; sample SWPPPs for corporation yards and construction sites; and reporting forms.

The Evaluation Phase describes methods for (1) determining whether water quality is improving and whether the efforts and resources are directed at the right source and pollutants of concern; (2) reporting progress using the BMP measurable goals, and (3) the developing and implementing of water quality monitoring programs and volunteer monitoring programs. This phase provides and stresses the need for procedures for modifying and updating the urban runoff program using the evaluation tools.

Each section of the MURP contains an extensive list of references to assist municipalities in obtaining additional detailed supporting information on how these programs were developed.

Implementation of the Model Urban Runoff Program

Municipalities in California's major metropolitan areas were encouraged, and in some cases required, to file for NPDES' permit coverage on an area-wide basis. Numerous smaller municipalities are already regulated by Phase I requirements. There are now approximately 260 municipalities, with a combined population of 29 million, regulated by Phase I NPDES permits in California.

In California, 76 incorporated places and counties are proposed to be automatically designated and 38 areas outside urbanized areas that could be potentially designated under Storm Water Phase II. The Monterey Bay Area has 13 incorporated places and counties that would be automatically designated. The MURP will be of significant benefit to a number of smaller California municipalities, and particularly in the area covered by this project.

Undertaken as part of a 319(h) Grant, this project was required to conduct an outreach effort to ensure early implementation of urban runoff programs. Two workshops were held in April of 1998 for planning, public works, building, parks, public information/education, and general municipal operations staff in the Monterey Bay Area. These workshops, attended by approximately 120 individuals, covered an introduction to urban runoff pollution, and regulatory requirements. They featured presentations from individuals experienced in the development and implementation of Phase I storm water management programs and included four break-out workshops covering MURP development and implementation.

The agencies participating in the development of the MURP have undertaken a number of actions, described in the following paragraphs, to implement the project recommendations.

City of Monterey

During the development of the MURP, the City of Monterey mapped watersheds, major storm drains, key streams, creeks and channels. They also identified and mapped automotive servicing facilities, restaurants, several industrial sites, and pest and weed management activities as potential sources of runoff pollution. Fifteen potential sources or activities that could contribute primary pollutants of concern were identified. The City has adopted a water quality ordinance and established a monthly storm water utility fee, currently $3.43, to implement its urban runoff management plan.

In cooperation with the Sanctuary and Coastal Watershed Council, the City has also initiated a citizens participation program to label storm drain inlets and perform volunteer monitoring (Urban Watch Stormdrain Monitoring Program). This volunteer effort led to the development of a Restaurant Outreach program to educate employees and eliminate pollution. The City has commenced implementation of BMPs for new and existing sources, conducted water quality monitoring, distributed public education material, and is currently working to implement its construction site pollution prevention program.

In cooperation with the Sanctuary, the City has obtained a grant to install and test storm water treatment devices at the Monterey Harbor and Fisherman's Wharf parking lots to determine the effectiveness of removing oil, sediment, and trash.

City of Santa Cruz

The City of Santa Cruz developed a computer-generated map of watersheds and land uses to identify potential pollutant sources. The City adopted a storm water ordinance in April 1998, regulating all water entering the storm drain system, prohibiting illicit discharges and connections, and requiring implementation of BMPs published by the City. The City has drafted BMPs for vehicle service facilities, retail shopping areas, residential areas, and food service facilities. The City Industrial Waste Inspectors will conduct initial inspections of 100 vehicle service facilities in 1999 to determine any actions which must be taken to comply with the ordinance, with second inspections scheduled to formally determine compliance. The City hosted an outreach presentation of the program and the proposed BMPs for the business community during its Pollution Prevention Week.

City of Watsonville

The City of Watsonville began implementing a storm water program in 1991, through its industrial facilities Source Control Program, and completed a bilingual storm drain stenciling program in 1992. Subsequent to the development of the MURP, the City has completed a review of existing programs and policies, developed a new storm water ordinance, started an illicit connection program that has sampled 50% of the City's storm drain outfalls, and established a public education program in cooperation with the Sanctuary. The City plans to implement a municipal, industrial, and commercial source control program, a targeted educational outreach program, and a construction and new development program.

Monterey Bay National Marine Sanctuary

The Sanctuary's Water Quality Protection Program addresses a number of water quality issues in addition to urban runoff and targets nonpoint sources of pollution. The Sanctuary's program supports the cities' urban runoff programs by developing and distributing educational materials on urban pollution and co-sponsoring teacher training workshops with the Monterey Bay Aquarium. It also collaborates with the City of Monterey on volunteer monitoring programs and public education. The Sanctuary has prepared a plan for addressing polluted runoff from agricultural lands and has received commitments from the California Farm Bureau and six regional Farm Bureaus to form a coalition to address this issue. The Coalition will focus on educating its members on polluted runoff, establishing landowner committees and pilot projects in several watersheds, and strengthening farm management practices by developing grower self monitoring and serving as a liaison with the Sanctuary and the Regional Board.

The Sanctuary and the City of Monterey have a cost-sharing agreement, which funds a Sanctuary employee at half time in return for the development of a City public education program. This agreement is going into its third year, and has resulted in the development of public education brochures, posters, exhibits, BMP pamphlets, and the Restaurant Outreach Program. Current work is focused on the development of a Public Service Announcement, a construction site education program for developers and inspectors, and signage for Monterey's Harbor.

State of California - Coastal Commission and Regional Water Quality Control Board

Implementation of the MURP has been identified as a priority in the California Nonpoint Source Pollution Control Program's first 5-Year Implementation Plan, which the State Water Resources Control Board and California Coastal Commission developed pursuant to the Clean Water Act and Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). Key actions that the State will undertake include the distribution of copies of the MURP Guidebook to California cities and the providing of technical support and training to cities developing Urban Runoff Management Plans using the MURP.

The Coastal Commission intends to review the experiences of Monterey Bay Area cities in implementing the MURP and coordinating with the Central Coast Regional Water Quality Control Board to revise the MURP Guidebook as needed. The document will be made available to other small coastal cities by printed copies, CD-ROM, or Internet web site.

Summary and Conclusions

The Model Urban Runoff Program project, which is funded through a 319(h) Grant has provided small communities in the Monterey Bay Area an excellent opportunity to develop their own urban runoff programs and to develop and validate an off-the-shelf " how-to" guidebook on development of urban runoff programs. The MURP will potentially benefit over 100 communities in California that will be required to develop urban runoff programs implementing the six minimum control measures contained in EPA's draft Storm Water Phase II Rule and the requirements of Section 6217 of the Coastal Zone Act Reauthorization Act.

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New Stormwater Treatment BMPs: Determining Acceptability to Local Implementing Agencies

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Over 200 local governments in the Puget Sound watershed of western Washington require new developments to install stormwater treatment systems. The retrofitting of existing developments is also often required. With the guidance of the State of Washington[1], each local jurisdiction developed a list of approved treatment technologies, mostly public domain technologies such as wet ponds and swales, in the mid-1990's. Having an approved list raises the issue of how to add new unapproved technologies, in particular the manufactured technologies such as swirl concentrators and drain inlet inserts. A protocol is needed by which local jurisdictions can determine acceptability of "unapproved" treatment technologies. This paper presents a protocol[2] recently developed to assist local jurisdictions in the Puget Sound watershed.

Protocol Structure

The protocol has four parts:

1. Performance criteria to compare currently unapproved treatment technologies with currently approved treatment technologies.

2. Types of data to be used in the evaluation and methods of sample collection.

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3. Factors that are to be considered in the evaluation other than performance.

4. Content of the report provided to the local jurisdiction by the proponent.

Method to Compare Performance

There are many problems inherent in the development of a protocol, not the least of which is that there is no agreed-upon definition as to what constitutes acceptable performance against which to judge equivalency. An informal "standard" that is much discussed and that has been adopted by some jurisdictions outside the Puget Sound region is 80% Total Suspended Solids (TSS) removal over all storms less than a specified event.

A one-number standard of 80% may be inconsistent with two complementary observations about the performance of stormwater treatment systems. The first observation[3] is that removal efficiency of sand filters is directly related to influent concentration: the higher the influent concentration the greater the efficiency. This relationship may hold for other treatment technologies. The second observation[4] in Schueler (1996) proposes that there is a lower limit to the effluent concentration.

Further, a reasonably strong and direct relationship exists between runoff rate and TSS concentration[5]. This is particularly germane to our region with its mild storm intensities. A comparison of data from our region to areas with higher average rainfall intensities indicates that we tend to have lower TSS concentrations in untreated stormwater. It is therefore possible that over an aggregate of storms, we cannot achieve 80% TSS removal in the Puget Sound region.

A more appropriate method to compare approved and unapproved technologies may be to relate efficiency to the influent concentration. This approach allows the pooling of data from sites with different pollutant concentrations.

The protocol presumes that if we are satisfied with the technologies that are currently approved, we should approve an unapproved technology with similar performance. Therefore, the starting point is to identify the performance of currently approved technologies: swales, wet vaults, wet ponds, constructed wetlands, and sand filters. The results are presented in Figures 1 through 3. The data points in the figures are of flow-weighted composite samples from individual storms. Only data from studies conducted in the maritime climate of the Pacific Northwest are used.

Although this is a large region, from northern California to southwest British Columbia, comprehensive studies have been conducted only in western Washington. Data considered acceptable are from two wet ponds, three grass swales, and two sand filters. The protocol[2] provides detail on the studies that were reviewed. The reasons for using only Pacific Northwest data differ with the technology. With wet ponds there is concern about the possible effect of differences in regional climates on effluent quality. For sand filters, possibly because of differing sand chemistry, filters used elsewhere may be able to remove dissolved phosphorus[6] and zinc[7], a capability our sands do not have. Swales studies conducted elsewhere do not provide the information needed to judge whether they were sized to criteria similar to that used in our region.

Figure 1 for TSS is used in all comparisons, and is the first performance requirement that must be met. If the receiving water is nutrient sensitive, Figure 2 is also used. If the water body is of regional significance because it supports salmon, a central issue in our region, Figure 3 is also used. Zinc was selected to represent all toxics primarily because it is the only toxic with influent concentrations that are commonly high enough to allow for the evaluation of efficiency.

Each figure has a "Line of Comparative Performance," the origins of which are discussed later. Each line is drawn so that most of the data points fall above and to the left. This is called the region of acceptable performance. The data points of the unapproved technology under consideration would be plotted using the same format. If most of the data points fall above and to the left of the "Line", it can be concluded that the candidate technology is reasonably equivalent. What constitutes "most" is up to the local jurisdiction. The protocol does not specify a hard rule but offers these suggestions as to the percentage of data points falling above the "Lines": TSS, 90%; phosphorus, 80%; and zinc, 90%. Note that low efficiencies generally occur at low influent concentrations.

FIGURE 1 TSS Evaluation

PNW data - Individual storms

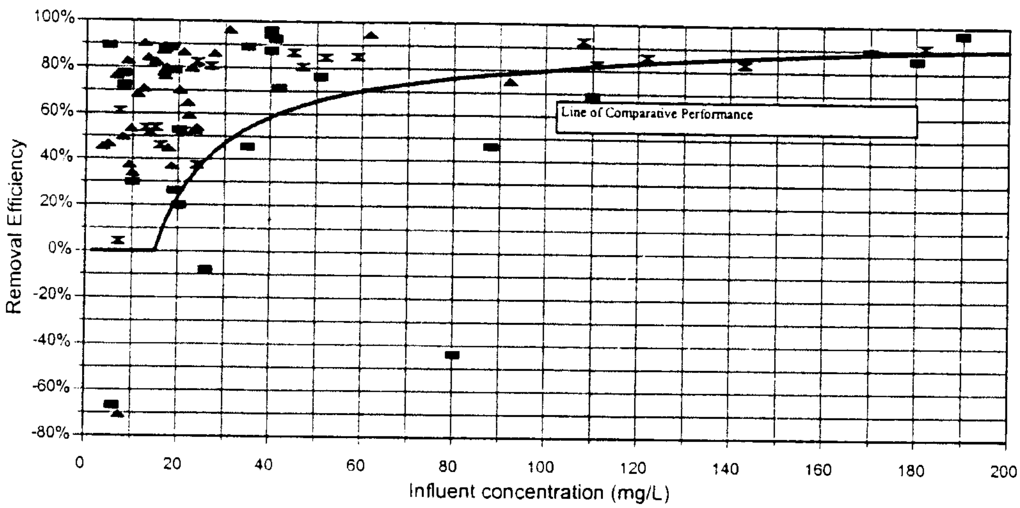
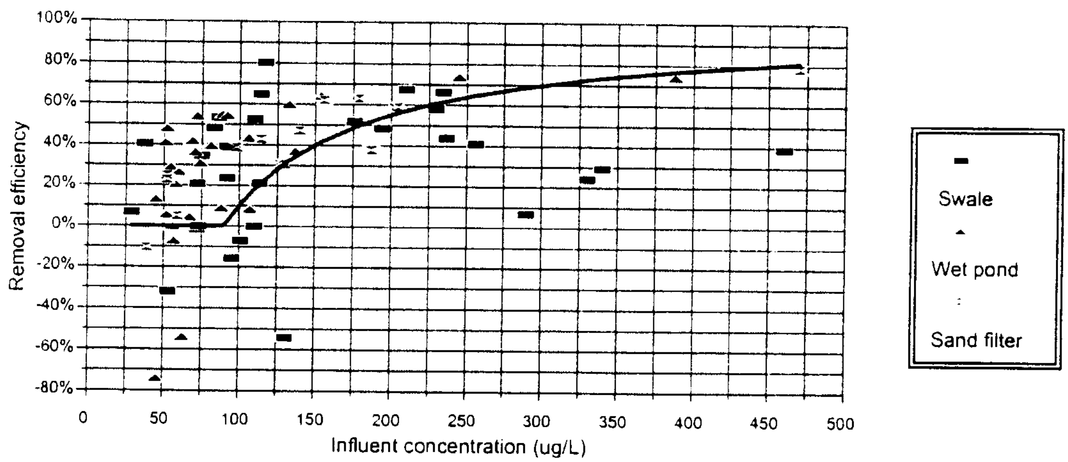


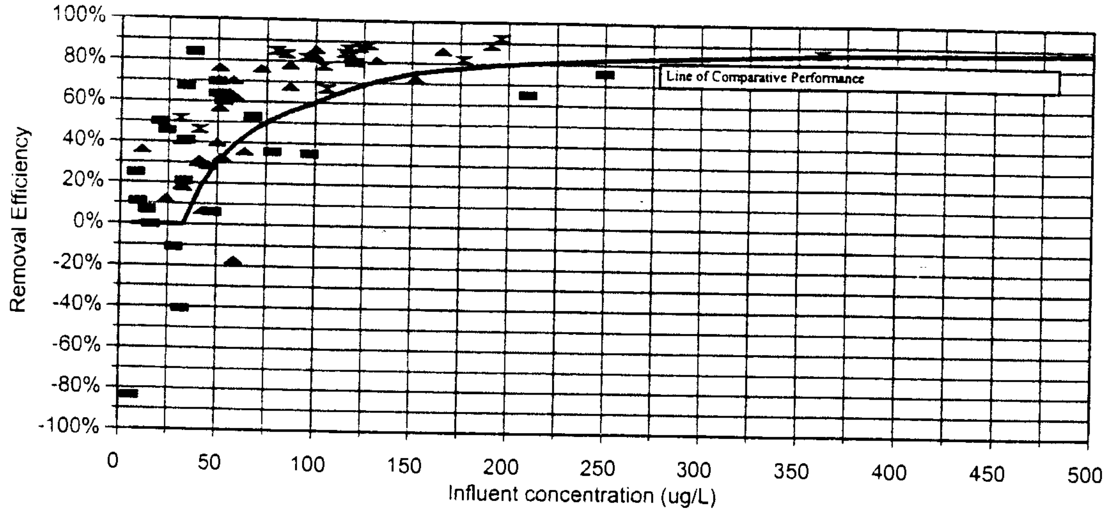
FIGURE 2 Phosphorus Evaluation

PNW data - Individual storms



How were the "lines" derived in Figures 1 through 3? Judgment was used to select a point of "irreducible" concentration, and to draw the line from this point to the upper right. Regarding "irreducible" concentrations: for TSS Tom Schueler has proposed[4] 20 to 40 mg/L, depending on the treatment BMP. A value of 15 mg/L was selected because the data in Figure 1 suggest that 15 mg/L is attainable. For TP (Figure 2), Schueler[4] proposed a concentration of 140 to 330 ug/L, depending on the treatment system. A lower value of 90 ug/L was selected for the same reasons as with TSS. Schueler[4] drew no conclusions with regard to zinc. However, his analysis[4] suggests "irreducible" concentrations of 36 ug/L for ponds and wetlands, so 35 ug/L was selected. It should be noted in Figures 1 through 3 that most of the incidents of low or negative efficiency occurred at low influent concentrations.

FIGURE 3 Zinc Evaluation
PNW data - Individual storms



Attempts were made to identify a line of best fit from which confidence limits could be derived under varying assumptions such as excluding all data below a particular influent concentration and/or removal efficiency. However, the relationships were so poor as to make confidence limits meaningless. It was concluded that basing the lines on some sort of statistical construct would give an air of rigor that is unwarranted at this time. Therefore, the lines were drawn using best professional judgment. It is expected that the Lines of Comparative Performance will change with time as additional data are collected.

Figures 1 through 3 can be used for inlet inserts if these pollutants are being considered. If, however, an insert is being considered for the removal of petroleum hydrocarbons, it must be compared to the effectiveness of oil/water separators. A graph comparable to Figures 1 through 3 is not provided for oil/water separators because of the lack of data. The criterion commonly used in the Pacific Northwest is that the concentration of individual samples shall not exceed 15 mg/L. This protocol could be used to generate data to compare to this criterion.

Data and Data Collection

It is the responsibility of the proponent of the unapproved technology, either the manufacturer or the development engineer, to obtain the required data. The protocol identifies the minimum requirements. Local jurisdictions are free to request more data. The protocol specifies the requirements for three sources of data: field studies with real storms, field studies with artificial storms, and laboratory tests. The protocol calls for discussion of advantages and disadvantages of each method. It is left to the local jurisdiction to decide the weight to place on each source of data. However, the protocol recommends that the local jurisdiction not rely solely on laboratory tests, particularly when considering the removal of dissolved pollutants or oil/grease and related products. It also recommends a size distribution of sediment for the laboratory tests.

The protocol is very specific with regard to the types and amounts of data that are to be collected. This aspect of the protocol is summarized in Table 1.

Table 1. Data Requirements

Item	Requirement
Number of test sites	One to three sites: medium density residential, retail commercial, and non-retail commercial.
Number of sampled storms	A minimum of 10 per site, total of 30 if one site
Storm depth	50% to the design storm depth (1.35" to 1.70")
Runoff duration	50% to 200% of the mean annual storm duration (7.5 to 30 hours)
Average rainfall intensity	50% to 200% of the mean annual intensity (0.02 to 0.08"/hour)
Type of samples	Flow-weight composite
Minimum aliquots per storm	10
Storm volume sampled	Samples are to be taken over not less than 75% of the total volume of each storm
Parameters	TSS, pH, total zinc, copper, and cadmium, TP, BAP, and TKN. Include dissolved metals and phosphorus if it is claimed that the technology can remove dissolved constituents. With catch basin inserts where the sole objective is the removal of petroleum hydrocarbons, measure oil/grease, TPH, TSS, and pH.
Additional	At the end of the test period, the sediment accumulated in the treatment system shall be removed, quantified, and anlyzed. The sediment shall be evaluated for total dry weight, moisture content, particle size distribution, organic content, and zinc. Use ASTM wet and dry sieve test procedures to analyze the particle size distribution. Also determine the amount of floatables, i.e. litter, and petroleum products.

The protocol states that for a data point to be used in the analysis of efficiency, the influent concentration of the parameter shall either be at least ten times its detection limit, or be greater than the "irreducible" concentration, whichever is greater.

Efficiency is to be calculated three ways.

Method 1: Removal in each sampled storm calculated as:

100 (average influent - average effluent)/average influent

Method #1 is required because it provides the data points to plot figures like Figures 1 through 3.

Method 2: Aggregate removal of the sampled storms as:

100(A-B)/A

Where: A = (influent conc. Storm 1)(flow Storm 1)+(influent conc. of Storm 2)(flow of Storm 2)

+ ... (influent conc. of Storm N)(flow of Storm N)

B = (effluent conc. of Storm 1)(flow of Storm 1)+(effluent conc. of Storm 2)(flow of Storm 2)

+ ... (effluent of Storm N)(flow of Storm N)

Method #2 is specified because it provides an overall efficiency of removal over the period of the research. If the amount of sediment that has accumulated in the bottom of the treatment facility has been determined from the separate lab test (See Section A.4), another calculation can be done to check the above estimate of efficiency. This second calculation is done as follows: subtract B from A, and then compare this difference to the amount of sediment determined from the separate laboratory test described in Section A.4. These calculations can also be done for zinc and phosphorus.

Method #3 Efficiency based on geometric mean:

100(A-B)/A

Where: A = geometric mean of all influent samples

B = geometric mean of all effluent samples

Method #3 is specified because it is the most correct method of calculating efficiency, although it has been used sparingly to-date. All influent and effluent data from multiple sites can be pooled.

Consideration of Factors Other than Performance

The protocol suggests that the local jurisdiction consider additional factors in making a decision should the technology pass the first requirement of acceptable performance. The protocol recommends the following factors, although the local jurisdiction is free to include other factors.

- Site characteristics
- Constructability
- Reliability
- Robustness
- Receiving water sensitivity
- Groundwater risk
- Operation and maintenance
- Habitat creation
- Thermal effect
- Aesthetics
- Recreational use
- Community acceptance

It is left to the reviewer to place a weight on the relative significance of each factor and to develop a scoring system. For example, the factors could be categorized and weighted as: "critical/ necessary," "important," and "desirable." A relative score, say 1 to 10, could be identified for each factor, and multiplied by the corresponding weight of each of the categories.

Content of the Applicant's Report

The proponent of the technology is responsible for producing a report for the local government conducting the evaluation. The protocol provides a very detailed list of items that are to be included in the report.

Explanation of the technology, such as:

- How it works, how it removes pollutants
- Where it is currently being used
- Available models
- Treatment and hydraulic capacities of each model
- Documentation of the treatment and hydraulic capacities
- Sediment storage capacities of each model up to the point of recommended maintenance
- Floatables storage capacities up to the point of recommended maintenance
- Sizing methodology

- Materials used in the construction of the product
- Recommended maintenance procedures and frequencies

Documentation of the field studies:

- A description of the test site including: total acreage, total impervious acreage, a description of landscaping if relevant, the acreage draining to the device if it differs from total acreage. A description of the drainage system including the size of the sumps, and whether the sumps were cleaned prior to or during the test period
- A description of the model used
- Complete drainage calculations showing the calculations to size the treatment device
- All raw data including laboratory reports. All data are to be reported including rejected data with an explanation for the rejection
- Statement from the analytical laboratory certifying that the appropriate procedures were followed in the preservation and analysis of the samples
- Calculation of efficiency of each storm by comparing influent and effluent concentrations
- Calculation of the efficiency for all storms by comparing the total aggregate inflow loading of all storms to the total aggregate outflow loading for all storms
- A graphic of data points showing influent concentration versus efficiency for each storm sampled for TSS, zinc, and phosphorus. Plot all data, including rejected data, with an explanation for the rejection
- Start and end times of the precipitation and runoff periods of each sampled storm.
- Start and end times of the sampling period of each sampled storm
- Antecedent conditions during the 72 hours prior to each sampled storm
- Total rainfall depth of each sampled storm
- Total runoff volume of each sampled storm
- Runoff volume that occurred during the period of sampling of each sampled storm
- Total rainfall during the period of all of the sampling, i.e. from the first storm sampled through the last storm sampled
- Total runoff that occurred during the period of all of the sampling, i.e. from the first storm sampled through the last storm sampled
- If artificial storms are used, identify the method and application rates of water and translate those rates into corresponding rainfall intensities
- Statement of certification signed by the proponent indicating that the protocol was followed

Additional considerations with inserts for drain inlets:

- Data showing the effect of accumulated litter and leaves on performance, flow capacities
- The point in the maintenance cycle that the field tests were run: i.e. were the units tested "fresh," without prior field exposure or were they in the field for some time

Documentation of laboratory studies:

- Description of the composition of the test water
- The size distribution of TSS in the influent and effluent
- The test flow rates
- The performance at each flow rate
- Mass balance of influent, effluent, and collected sediment

Conclusions

The protocol offers a reasonable and defensible approach that provides rationale for the consideration of technologies that are not currently approved for use in new developments as well as for public projects. The protocol is most suitable for the maritime climate of the Pacific Northwest. It is anticipated that the protocol will change over time, particularly as the data base for approved technologies becomes more extensive and as we learn from its use. More performance data are needed for public domain technologies located in our region, in particular wet vaults and constructed wetlands for which there are currently no data.

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By Any Measure...

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The introduction of a diverse array of stormwater quality management tools in the last few years has created problems for the growing number of individuals and organizations who would like to compare the performance of these tools. Comparison is complicated by differences in treatment capacities, targeted pollutants, and treatment approaches. Several methods of evaluation have emerged in response to the need for verification of theoretical performance predictions; yet none of these "yardsticks" are appropriate in all situations and results from each are often not readily comparable to results from other measures.

Complicating the matter further is the confusion regarding what is being compared. In some cases, a technology will be compared with another technology. In other cases, the technology is compared to a performance standard. (Analogy: My maple syrup may be better than your maple syrup, but does that make it Grade A maple syrup?)

The confusion stemming from this is greater than meets the eye. For example, many specifiying engineers and hydrologists want to meet a performance standard of 80% TSS removal on an annual average basis. They go to guidance manuals and product manufacturers seeking something that will meet the standard. As the selection process develops, they grapple with cost, maintenance, the availability of land needed, and many other issues under the heading of "cost-effectiveness" for their clients. But by the time the selection has been made, it has become more a question of who has the better maple syrup rather than whether or not the selected product meets the standard. That is partly because 80% TSS removal on an average annual basis is virtually an impossible standard to achieve.

It ***is not the purpose*** of this paper to propose the adoption of one standard over another.

It ***is the purpose*** of this paper to review the merits of various measures of performance and, more importantly, to stress that any monitoring program that attempts to measure performance of a stormwater quality management system should begin with a consideration of how the observations will be reported.

Any monitoring program will consist of:

- Sampling
- Testing
- Reporting

Often, researchers start with the selection of samplers and procede with questions of deployment and maintenance of the samplers. Only when samples have been collected are the questions of testing, and eventually reporting, given much thought. We propose that the reporting aspect, even though it is "last" chronologically, should dictate how the testing and sampling are done. For example, if the report is considered most informative when its focus is the mass of pollutants removed, as is often the case, there is no need for samplers. To get those results usually requires only the very simple task of periodically measuring accumulations of precipitated sediments or floatable petroleum products (or other pollutants) and doing simple arithmetic calculations to determine the mass removed. We know of projects that went to the extraordinary effort that it takes to procure, set up, operate, and maintain automatic samplers to obtain influent and effluent concentrations, only to "back into" an estimate of the mass of pollutants removed by a convoluted set of "volume-times-concentration" calculations. This is a classic case of doing something the hard way, not to mention the very expensive way. So the first rule of thumb for any monitoring project is to ***decide first how to report the results***. Then design the sampling and testing around the information that is to be reported.

In this paper, we will present the following four "measures" of performance from which to choose in making those decisions. We consider these measures to be the current "status quo of the art."

- Mass of pollutants removed
- Event mean concentration (EMC)
- Lines of Comparative Performance (Minton, et. al.)
- Plotting efficiency versus operating rate

First, we would like to discuss in some detail some of the broader issues involved in monitoring stormwater treatment systems and measuring and reporting on their performance.

Setting

The setting is nearly always in the field or in a laboratory. We feel that the many benefits of testing in a laboratory are generally underestimated by technical professionals and non-professionals alike. What we refer to as the setting tends to be pre-determined well before a study gets underway. Since the setting tends to influence the important decision of what performance measure is best, this cursory overview is provided for perspective.

Field testing

The drawback with field testing is that it cannot be replicated very well. Every site is different. Every storm is different. There are "wet years" and "dry years." There are seasonal variations that can produce easily treated heavy sediment loads in winter and spring; hard-to-treat loadings, such as pollen and grass clippings, in summer; and moderately treatable loadings (leaves etc.) in the fall. It is poor science to compare the results of a field test of any treatment system to the results of a test of the same system at a different time and place.

Still, field testing has tremendous appeal because the stormwater and the sediments are "real."

- Field testing of individual facilities is usually adopted to evaluate the facility's performance in comparison to a performance standard (such as 80% TSS removal) to see if it "measures up." This setting is the simplest and most common, and is adaptable to any of the measures. The treatment system can be set up to treat all runoff or it can bypass flows that exceed the treatment capacity.

- "Side-by-side" field testing of several different facilities is increasingly popular, at least in concept. But, to our knowledge, this approach has not yet been successfully implemented. A key element is the design of the "flow-splitter" that takes all of the runoff and "splits" it into an equivalent discharge to each treatment system. The easy part of the design of the flow-splitter is achieving equal flow rates of ***water*** to each of the facilities (and even this "easy part" is not always all that easy). The hard part is getting equal discharge of ***pollutants*** to each of the facilities.

Whether testing an individual system or multiple systems, researchers have the potential to learn something very basic and very important from field testing that has, to our knowledge, eluded researchers to date. That is the determination of an appropriate threshold for bypassing peak flows. Consider a site that is estimated by conventional runoff modeling to discharge stormwater runoff at a rate of 3 CFS in a 10-year storm. Consider further two proposals for treatment. One claims efficiency of 90% and a treatment capacity of 1 CFS. The other claims 80% and a treatment capacity of 3 CFS. Which treatment option should be selected? If the prevalent standard of 80% is in place, the "safe" choice would seem to be treating all runoff from a 10-year event with 80% efficiency. But what if price is a factor? Maybe the system with 1 CFS capacity costs less. Even at the same cost, would 90% efficient be preferable to 80%? And with that consideration comes the $64,000 question. Will the system that claims 90% efficiency with a capacity of just 1 CFS even meet the standard of 80% overall? How much of the pollutant load will bypass the system altogether?

Some proponents of small-flow/high-efficiency technologies have stated that 90% of all storms are less than 1 inch of total rainfall and, therefore, treating 90% of all rain at 90% efficiency will yield a net annual removal of 81%. This argument is fundamentally flawed. It assumes that the 90% of rain from small storms carries 90% of the pollutants. This is simply not the case. The rate of mobilization of virtually all pollutants depends on rainfall intensity, not depth of rain. Therefore, it is important to treat high-intensity flows resulting from the ***infrequent event***, which tend to carry a disproportionately high pollutant load.

If 1 inch of rain falls in 24 hours, virtually any system that is reasonably proportioned, designed and, of course, maintained for the treatment of stormwater will do a good job. Efficiencies of TSS removal should be in the 90% range if the runoff is fairly dirty with silty-to-fine sandy sediments.

It is questionable, however, as to whether or not all of the runoff would be dirty if the rain that produced the runoff totaled 1 inch and fell over a 24-hour period. Intuitively, the "last flush" of such a storm would be very clean. But even the first flush may be very clean in comparison to what it would be if 1 inch of rain fell in 1 hour. This highly variable "dirtiness" gives rise to another interesting question when trying to measure efficiency. That is the question of how to account for the inevitable reduction in treatment efficiency when the water to be treated is clean in the first place. No treatment system can remove what is not there. So it has been argued that some accounting should be made for the fact that there is some lower limit to the physical treatment that can be provided. Minton's "Lines Of Comparative Performance" (see figure 2.) take this important consideration into account and are discussed later.

The "Double Whammy" of the "2-Month Storm"

Infrequent, high-intensity storms are important to the effective treatment of stormwater for two reasons:

- Over time, the higher intensity of less-frequent rainfalls, and the resulting higher stormwater runoff velocity, is what transports most of the sediment off of streets.
- The treatment facility is overloaded by the high flow of water that is transporting the sediment at the same time that most of the sediment is being transported to it.

Schueler and Shepp (1993) performed monthly observations documenting a random pattern of accumulation and loss of sediment in a study of 17 different oil/grit separators in Maryland. Overall, the losses of sediment "outnumbered" the accumulations. In other words, the observed systems lost previously accumulated sediments ***once every two months.*** We have inferred from their work that the "2-month storm" is a reasonable benchmark for stormwater treatment. To be "measurably" better than the poorly reputed conventional oil/grit separator, a system or a facility should be able to demonstrate, at a minimum, that it can continue to function in the 2-month storm. If a system is found to lose sediment in a 2-month storm, it should not be considered any better than conventional technology. Similarly, if a system needs a bypass to protect it from washing out in 2-month storms, it should be considered only marginally better than conventional oil/grit separators. Bearing in mind that high flows transport much of the total sediment, treatment systems should be able to handle more than ***the 2-month storm without bypass.*** Otherwise, much of the total sediment load may be discharged to the receiving waters that the system is supposed to protect.

Clearly the statements of the preceeding paragraph are more of a hypothesis than a statement of fact. One way to validate or invalidate the hypothesis is described in the following section on side-by-side testing in the field.

Side-By-Side Testing

Testing stormwater facilities "side-by-side" has recently become a very popular idea. The premise is that a well-run comparison of systems treating "the same stormwater and the same pollutants at the same rates of flow" will go a long way to reduce the tremendous "scatter" in the data that has been obtained to-date by testing individual systems at different sites. If two systems are evaluated at different sites, even if the study is carried out by the same researchers using the same protocol, the results will probably not be comparable. Every site is different, and from the point of view of stormwater treatment, differences that appear slight can actually be significant. We have observed a dozen systems installed on a single site (a large shopping mall parking lot) which were specified by the same engineer and installed by the same contractor at more or less the same time and, of course, subjected to the same weather. They exhibited decidedly different results when we measured sediment accumulations in the systems. The sediment depths ranged from a light dusting to accumulations of over two feet in less than a year.

So it is important in "side-by-side" testing that there be just one flow stream to the two (or more) systems being tested and that the flows be split, so that each system gets exactly the same rate of flow and the same pollutant concentration at all times.

The main benefit of "side-by-side" testing is that it can provide an answer to the question, posed earlier, of whether it is preferable to have, the arrangement should be as shown in Figure 1.

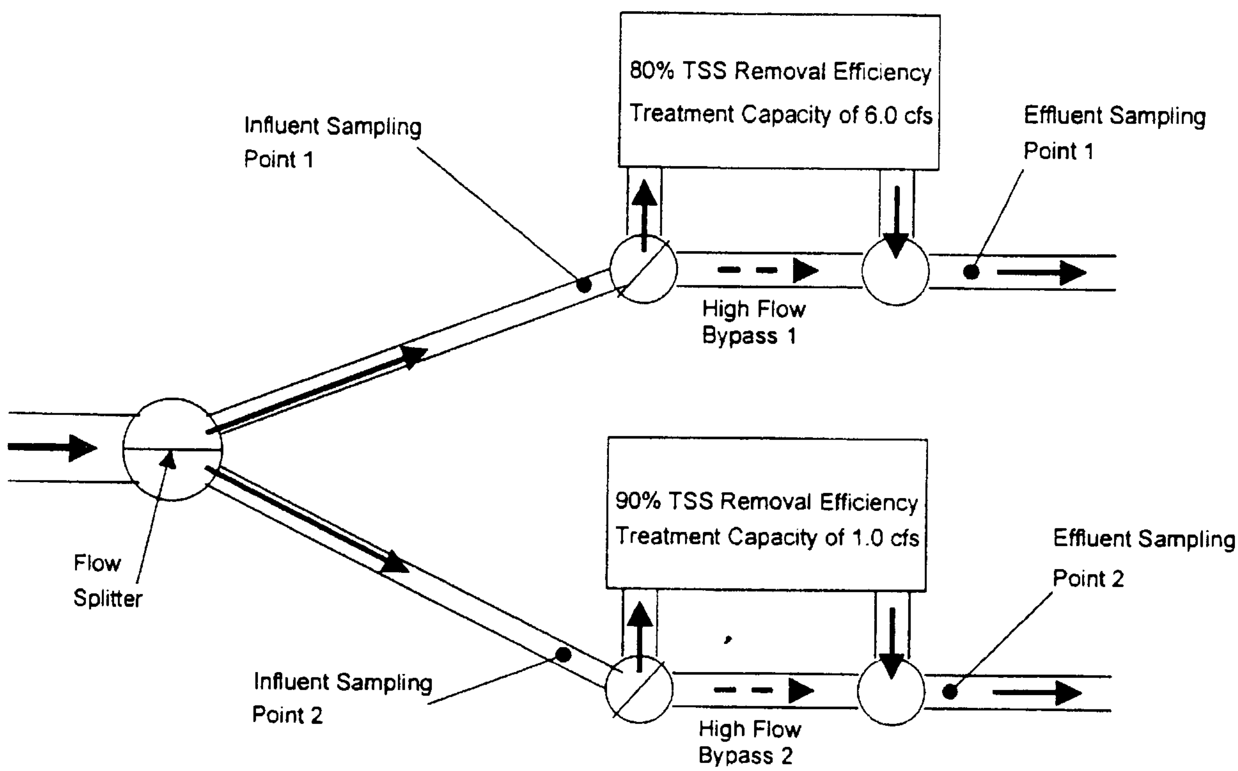

Figure 1. Recommended Arrangement For Side-by-Side Field Testing.

By sampling at points 1 and 2, the overall efficiency of the treatment system and bypass can be assessed objectively. Also, the question of "Which is the better system?" is answered. There are two shortcomings:

- Lack of repeatability. If one system gets 80% efficiency overall and the other gets 70% overall during one year of testing, there is no assurance whatsoever that either number will be repeated the next year. The test results should be regarded as indicative of performance. They are certainly not an assurance of performance over time. Such is the inconsistency, or "noisiness," of stormwater treatment data. A study like this should be conducted over a period of no less than two years. If the second year's results are reasonably close (in terms of statistical correlation) to the first, it can be considered complete. If not, it would be tempting to average all results. We feel that it would be poor science to do so, however. With the seasonal variability of stormwater pollutant loadings, one year's results will produce a single data point. A second year's results will produce a second data point. Many people seem to regard each storm result as a single data point, but as long as standards continue to be based on "average annual removal efficiencies," that is simply not the case.

- Variability with other sites. We have already mentioned the differences from one site to the next. The basic premise of side-by-side testing is to determine relative performance of two or more systems (i.e., which is best). As long as such a study is limited to this premise, the variability from one site to the next will not be a problem. But we know from experience that any "study," even the most cursory, tends to be overly generalized. We can only caution against doing so.

Laboratory Testing

Testing stormwater treatment systems in a laboratory setting offers some very significant advantages over field testing.

- It is repeatable and demonstrable.
- It is more productive in the sense that decades of rainfall can be simulated in a matter of days.
- It is more economical in terms of labor, sampling equipment, and flow-metering equipment costs.

Laboratory testing achieves these benefits by controlling operating rates, particle sizes, and pollutant loading. When influent concentrations are very low, removal efficiency will be low; but for concentrations that are generally recognized as representative for stormwater, all concentrations tend to produce comparable removal efficiencies.

In the lab, a set of tests can be run using one particle size (at representative concentrations) at operating rates from zero to the system's capacity. At the conclusion of these tests, a curve can be drawn plotting efficiency versus operating rate on the y-axis and x-axis, respectively. Such a curve typically slopes downward to the right, reflecting reduced efficiency and higher operating rates. Any point along a constructed curve should be reasonably reproducible when using the same influent sediment load.

Subsequently, a whole family of other curves can be constructed using different particles. Also, to more closely simulate "typical" sediment, a graded sediment sample can be developed and tested in the same way.

Laboratory testing should not be considered the "last word" in documentation of a system's performance, but can be considered a "benchmark" which is very useful in comparing systems operating at flow rates up to their capacity. Some field testing, where it is feasible, should supplement the work in the lab and, as previously discussed, side-by-side field testing is the only way to determine the impacts of bypasses on different systems.

The Four Most Common Measures of Performance

1. Mass of Pollutants Removed

This is easily the simplest approach to stormwater treatment measurements in the field. By measuring the depths of sediment accumulations in the facility on a periodic basis, it becomes a simple arithmetic exercise to calculate the volume and mass of sediments removed by the system.

Additional information is made available by this measurement. It may be recalled, from our earlier discussion of the 2-month storm, that Schueler and Shepp used measurements of sediment accumulations to document the poor performance of conventional oil/grit separators.

Researchers should consider using the same approach for the newer technologies that have come along since their important work was published. The approach can be made even more informative by correlating observations to such things as activities in the drainage area (e.g., winter sanding, sweeping, a spill, etc.) or meteorological events such as observed rainfall intensities or precipitation depths.

2. Event Mean Concentration (EMC)

These are sometimes referred to as "flow-weighted" or "flow-based composite" samples. They are nearly always obtained using automatic samplers, a flow-meter and a flow totalizer that arithmetically converts the flow rate measured by the flow-meter to flow volume over time and keeps track of the volume.

The sampler receives a signal that causes it to take a sub-sample when a programmed volume of flow is measured. For example, one sub-sample might be taken every 200 cubic feet of flow through the system. Over the course of the storm, all sub-samples would be combined into one large sample container from which the concentration will be obtained that represents the flow- weighted average for the entire storm.

Without a flow meter, the samplers could be set up to take a "time-based composite" sample; i.e., to sample every 30 minutes. Flow-weighted samples are much more representative, as a simple example will show. Consider a volume of 1,000 gallons with a uniform concentration of 300 mg/l flowing at a uniform rate past the sampling point in 15 minutes, followed by half as much volume (500 gallons) with a 100 mg/l concentration flowing by in the next 15 minutes. The correct representation of the concentration would be calculated as:

$$\frac{(1{,}000\,x\,300)+(500\,x\,100)}{1{,}000+500}=223$$

Flow-weighted sampling will more accurately reflect this. For example, if the sampler were programmed to pull a sample every 500 gallons, then 2 samples at the higher concentration would be taken and just one at the lower concentration. The average concentration would be calculated as:

$$\frac{300+300+100}{3}=223$$

Time-based sampling would, if the programmed time interval were 15 minutes, take one sample with a concentration of 300 and another with a concentration of 100, and the average would be calculated as:

$$\frac{300+100}{2}=200$$

Automatic samplers that can take flow-based composites have become a very valuable tool for sanitary engineers measuring concentrations of pollutants in wastewater. We believe that they have been too quickly applied to stormwater monitoring without regard for some of the inherent differences. Waste streams have "highs and lows" of both flow rate and concentration, but they are not nearly as wide as the variability of stormwater, which can change from flow rates of zero to a deluge in a matter of minutes and concentrations that can also exhibit a minimum of zero. These "spikes" can cause very brief periods of negative efficiency if a system is prone to washing out (as stormwater systems were shown by Schueler and Shepp to do regularly). If a wash-out occurs, it is an important phenomenon to note, but the briefly elevated concentration in the effluent will be "composited" with the rest of the (presumably lower) effluent samples. This will reduce the "event-mean-concentration," but will not reveal that a washout has occurred. Noting washouts, and the flow rate that caused them, is a very important aspect of a stormwater monitoring program; but they are not likely to ever be revealed by EMC data.

The second drawback of EMC data is that when influent concentrations drop to very low levels that cannot be further reduced by physical treatment, the efficiency, as measured by EMC's, will be reduced. This tends to obscure the fact that higher efficiencies can be achieved when they need to be achieved; i.e., when influent concentrations are higher.

3. Minton's "Lines of Comparative Performance"

It is widely acknowledged that there is a lower limit to the capabilities of physical treatment systems for stormwater. This means that it is very unlikely that effluent concentrations would ever be zero. It also means that very low concentrations would not be significantly reduced.

Minton et. al. has proposed the following mathematical expression to describe this lower limit:

$$\frac{Influent - LowerLimit}{Influent}$$

If the lower limit is 20 mg/l, then a plot of this expression is that shown in figure 2.

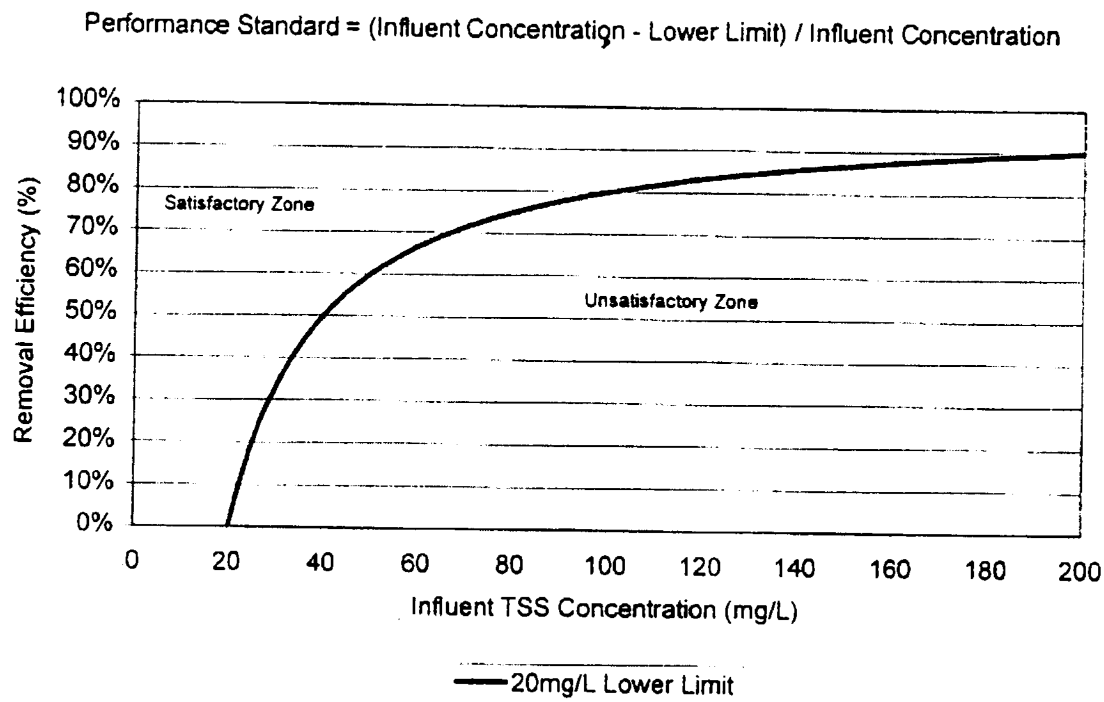

Figure 2. Line of Comparative Performance.

Plotting individual data points on such a graph can be very informative. Observed efficiencies above the line (designated a "line of comparative performance" by Minton) are considered satisfactory, while those below the line are unsatisfactory. Best of all, EMC's can be used without unfairly representing the efficiency. While the efficiency may be reduced by low influent concentrations, it may still be shown to be "satisfactory." More research will be needed to determine what is an appropriate lower-limit value to use in this approach.

4. Plotting efficiency vs. operating rate.

This approach was essentially described earlier under the heading of Laboratory Testing. By using discrete sediment particles in the laboratory, a family of curves such as those in Figure 3 can be developed.

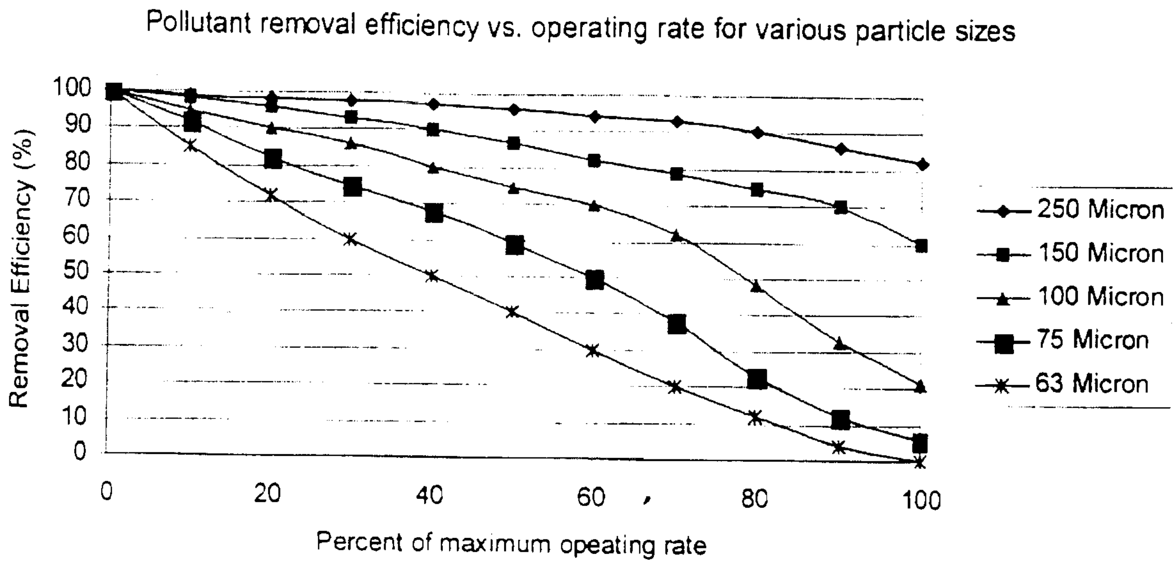

Figure 3. Removal Efficiency versus Operating Rate.

Field data is less likely to fit the relatively tight curves that can be generated in the lab. At the same operating rate, you may have vastly different influent concentrations, particle gradations, organic content, etc., depending on such factors as the time of the storm, antecedent dry period, and time of year. Removal efficiency is a function of all of these factors combined.

We feel that this performance measurement technique and presentation is the most informative. Its repeatability under controlled conditions makes it ideal for comparing one system to another. Certainly, if one system's performance curve on 100-micron particles, for example, is higher at all flow rates than another, it could reasonably be judged to be the higher efficiency system. If the curves are similar at low rates of operation, but either system drops down to zero efficiency at some higher flow rate, that flow rate should, of course, be considered the peak capacity for that system. This approach cannot show compliance with any standard for a stated percentage of TSS removal on an annual average basis.

Conclusion

To our knowledge, these four measures represent all of the techniques that have been used to measure the effectiveness of various stormwater treatment systems.

Measuring sediment accumulations in the field provides a good deal of useful information on mass removals and the ability to retain (or fail to retain) previously captured pollutants during periods of high flow. This approach costs very little to implement.

Event-mean-concentrations are the most widely accepted measure, but may not report all efficiencies and will almost certainly allow any failures to go undetected. This approach requires the use of automatic samplers at considerable cost, in terms of both time and money.

Minton's Lines of Comparative Efficiency are more fair to the treatment system because they account for the inability of any system to remove pollutants that are not present (or present in very low concentrations). If EMC data is collected to plot against the lines, then there are the same drawbacks of cost and automatic samplers allowing failures to go undetected. Both of those drawbacks can be overcome, but only with a very dedicated effort to take samples manually. Taking manual samples throughout the duration of all storms is very time-consuming and unpleasant work. For that reason, it is almost never done.

Plotting efficiency versus operating rate, whether in the field or in the laboratory, is arguably the most informative approach. In the field, automatic samplers are used (with individual samples in individual bottles and not composited), so there are those costs to consider. In the lab, samplers are needed but the construction of a model treatment facility, and the pumps and tanks to handle the required flow rates and volumes of water, will more than offset that cost saving.

Since none of these measures provides an ironclad confirmation that the widely prevalent standard of 80% TSS removal is being met, we submit that a different standard should be adopted by stormwater management jurisdictions.

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Stormceptor Hydrology and Non-point Source Pollution Removal Estimates

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Abstract

A model has been developed to estimate total suspended solids (TSS) removal using Stormceptor, an oil/sediment separator. The model was based on a commonly used, continuous simulation model United States Environmental Protection Agency Stormwater Management Model (USEPA SWMM) for hydrological processes. The suspended solids loading was estimated using build-up and wash-off equations. The solids were assumed to be distributed into five particle sizes for settling calculations. Simulations were conducted using various assumptions of loading and settling velocities to determine the sensitivity of the model to assumptions. Simulations were also conducted for a diverse range of geographic areas to determine the sensitivity of the TSS removal rates to regional hydrology. The model was sensitive to the selection of settling velocities and pollutant loading. The model was less sensitive to changes in hydrology, although significant changes in hydrology did impact TSS removal estimates.

Keywords: Stormwater; suspended solids; model; hydrology; Stormceptor, separator

Introduction

The Stormceptor is a mechanical water quality separator designed to remove oil and sediment from stormwater. A key feature of the design is an internal high flow by-pass to prevent scouring and re-suspension of previously trapped pollutants. Since the separator is based on treating "the everyday storm," the effectiveness of the separator is dependent on the distribution of pollution in stormwater and the frequency and magnitude of stormwater flows throughout the year.

In 1995, sizing guidelines were derived for the Stormceptor based on field monitoring of sludge accumulation over time in Toronto, Ontario, Canada. The accumulation data were used to derive estimates of annual total suspended solids (TSS) removal. Two key assumptions were made in the 1995 analysis to estimate TSS removal: (1) a TSS loading rate of 185 mg/l based on the USEPA's Nationwide Urban Runoff Program (NURP) median (U.S. Environmental Protection Agency, 1983), and (2) a sludge water content of 75% water. Actual Toronto rainfall data, combined with the NURP TSS concentration, provided estimates of annual TSS loading. Figure 1 shows the performance relationship derived from the Toronto monitoring, which forms the basis for the existing sizing guidelines.

Toronto rainfall time-series data (5 minute timestep) were input to a continuous hydrologic simulation model (SWMM Version 4.3) to determine the percentage of annual runoff treated based on the sizing criteria shown in Figure 1. The

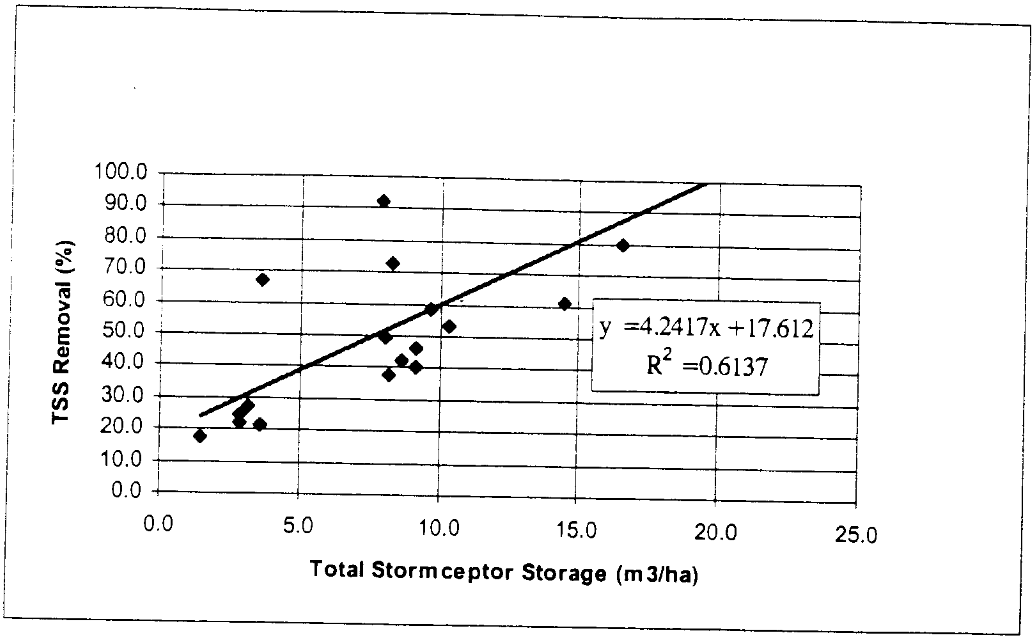

Figure 1. TSS Removal versus Stormceptor Total Storage (Toronto, 1995).

analysis of Toronto rainfall indicated that 80% - 90% of the annual runoff would be treated if the Stormceptor were sized according to these 1995 guidelines. This study was initiated to address concerns about the applicability of the Toronto-based sizing criteria to meteorological conditions in other regions.

Methodology

A computer simulation model was developed based on USEPA's SWMM Version 4.3. Solids build-up, wash-off, and settling calculations were added to the hydrology code to estimate suspended solids capture by the Stormceptor.

The model accommodates the use of either an EMC (event mean concentration) or build-up/wash-off calculations to estimate suspended solids loads. The build-up/wash-off model is more theoretically and physically correct. The EMC method has been shown to provide reasonable estimates of total solids loads (Charbeneau and Barrett, 1998) alone, if the distribution of the load is not important.

The distribution of pollutant load is important for measures that incorporate a high-flow by-pass (commonly known as "first flush" measures). Accordingly, preference is given to the build-up/wash-off calculations to correctly distribute the pollutant load with flow, recognizing the need to optimize the sizing of small-site stormwater quality measures.

In the model, solids build-up and wash-off are both approximated using an exponential distribution. The distribution of solids build-up is a function of antecedent dry days according to Equation 1 (Sartor and Boyd, 1972).

$$P_t = P_i + (PA-P_i)(1-e^{-kt}) \tag{1}$$

Where: P_t = solids accumulation up to day t (kg)
P = maximum solids build-up (2.4 kg/ha)
A = drainage area (ha)
P_i = initial solids load on the surface (not washed off from the previous storm) (kg)
k = exponential build-up factor (0.4) (days^{-1})
t = antecedent dry days

The maximum solids build-up (P) load was adjusted to provide similar long-term solids loading rates (124 mg/l) when compared to the EMC method. An exponential build-up factor (k) of 0.4 was used based on previous literature (SWMM 4.3 Users Manual). A k-value of 0.4 translates into 90% of the maximum solids build-up occurring after 5.66 days. Once the pollutant build-up reaches the 2.4 kg/ha limit, additional build-up is not allowed (assumed to be wind re-suspended/driven off the surface). Wash-off is estimated using Equation 2.

$$P_t = P_i e^{-kV} \tag{2}$$

Where: Pt = solids remaining on the surface at day t (kg)
Pi = initial solids load (from equation 1) (kg)
k = exponential decay factor (0.2) (mm^{-1})
V = volume of accumulated runoff from the surface (mm)

The exponential decay factor (k) of 0.2 was based on a review of previous literature that indicates k-values range from 0.03 to 0.55 (Alley, 1981; Charbeneau and Barrett, 1998).

Charbeneau and Barrett (1998) found that the simple wash-off model adequately described observed solids wash-off in Austin, Texas. Other researchers have cited that the wash-off Equation (2) is reasonable for fine material but may not be reasonable for larger solids that require a high rainfall intensity for mobilization (Metcalf and Eddy, 1991; Ball and Abustan, 1995). The SWMM model treats wash-off as a function of the runoff rate to account for mobilization. This correction is applied indiscriminately to the entire solids load and does not account for the variation in wash-off rate with particle size. If an "availability" factor is applied to all particle sizes uniformly, the model will underestimate the wash-off of solids with increasing runoff volume if the majority of particles are fine in size. The approach taken in this study was to use an availability factor for particles 400 μm in size or larger. Smaller particles follow the simple wash-off estimates given by Equation 2. The larger particles (≥ 400 μm) require greater runoff intensities to induce wash-off according to the availability factor provided in Equation 3.

$$A = 0.057 + 0.04(r)^{1.1} \tag{3}$$

Where: A = availability factor
r = runoff rate (mm/h)

Equation 3 is based on research by Novotny and Chesters (1997). The runoff rate is used instead of rainfall intensity, recognizing that the wash-off will lag the rainfall based on the time of concentration. The availability factor varies each timestep and is only applied to the runoff volume for that timestep, as dictated in Equation 4. The availabilty factor has an upper limit of 1.

$$V = V_i + A(V_t) \tag{4}$$

Where: V = accumulated runoff volume used in Equation 2 (mm)
V_i = accumulated runoff volume prior to current timestep (mm)
A = availability factor (equals 1 for particles smaller than 400 μm)
V_t = runoff volume for current timestep (mm)

The correction in Equation 4 effectively re-defines the accumulated runoff volume to be the runoff volume sufficient to mobilize the particles. This methodology requires more accounting in the model but provides a more physically correct wash-off model.

The separator was treated as a completely stirred tank reactor (CSTR). Alterations to the concentration of solids in the separator will vary according to Equation 5 (Tchobanoglous and Schroeder, 1987).

$$C'V = QC_i - QC_t - r_c V \tag{5}$$

Where C' = the change in concentration of solids in the tank with time (kg/m^3s)
Q = flow rate through the tank (m^3/s)
C_i = solids concentration in the influent to the tank (kg/m^3)
C_t = solids concentration in the tank (kg/m^3)
V = tank volume (m^3)
r_c = reduction in solids in the tank (kg/m^3s)

For gravity settling devices r_c can be estimated using Equation 6.

$$r_c = V_sC/D \tag{6}$$

Where r_c = reduction in solids in the tank (kg/m^3s)
Vs = settling velocity of solids (m/s)
D = depth of tank (m)
C = concentration of solids in the tank (kg/m^3)

Substituting Equation 6 into Equation 5, solving the first-order differential equation and integrating provides the general form of the non-steady state solution (Equation 7) for the concentration in the tank at time t.

$$C = QC_i/(V(V_s/D + Q/V))(1-e^{-(Vs/D + Q/V)t}) + C_te^{-(Vs/D + Q/V)t} \tag{7}$$

Where C = concentration in the tank at time t (kg/m^3)
C_i = concentration in the flow influent to the tank (kg/m^3)
C_t = concentration in the tank at the beginning of the timestep (kg/m^3)
Q = flow rate through the tank (m^3/s)
V = volume of water in the tank (m^3)
V_s = suspended solids settling velocity (m/s)
D = tank depth
t = time

Equation 7 was used to estimate the suspended solids concentration in the tank, and in the discharge from the tank each timestep. Equation 7 assumes the suspended solids are completely mixed within the tank volume.

During periods without flow (inter-event periods) the solids are not assumed completely mixed at the beginning of each timestep and the depth of suspended solids in the separator decreases each timestep until all of the solids are removed or there are subsequent flows into the separator. The concentration of solids in the tank during periods without flow was calculated using Equation 8.

$$C = C_t(1-V_st/ D) \tag{8}$$

Where: C = solids concentration in the tank (kg/m^3)
C_t = initial solids concentration in the tank at the beginning of the timestep (kg/m^3)
V_s = settling velocity (m/s)
t = timestep (s)
D = depth of solids in the separator (m)

The depth of solids (D) in the separator in Equation 8 decreases each timestep based on the settling velocity until all of the solids are removed or there are subsequent inflows to the tank.

The model can be used with either hourly or 15 minute rainfall data. Fifteen minute data are preferred, recognizing that the Stormceptor is only applicable for small drainage areas. Small drainage areas have short times of concentration and require data with a suitable timestep. Internally, the model performs calculations with a 5 minute timestep.

The choice of particle size distribution and settling velocities is a key part of the modeling exercise. Different settling velocities can be applied to the same particle size distribution, based on the specific gravity of the particles or to account for the effect of non-ideal settling or flocculation on settling. In this study, a typical stormwater particle size distribution (USEPA, 1983) was used for analysis (Table 1). The distribution given in Table 1 is commonly accepted by most regulatory agencies in North America.

The model allows the user to alter the percentages of each size based on site-specific conditions, if required. In most areas, it is anticipated that the particle size distribution will not vary significantly since it is primarily related to vehicle wear and atmospheric deposition. There may be certain instances, however, where the native soils contribute loading and the default distribution needs to be altered. The default percentages were used in our study.

Table 1. USEPA Default Particle Size Distribution

Particle Size (μm)	% by Mass
20	20
60	20
130	20
400	20
4000	20

Settling velocities were then assessed for each of the particle sizes provided in Table 1. Settling velocities were either calculated or based on empirical literature (USEPA, 1983). The calculation of settling velocities for small particles follows Stokes' law (Equation 9) since the Reynolds number (Equation 10) is less than 0.3.

$$Vs = g\,(p_s - p_w)d^2/18u \qquad (9)$$

Where
Vs = settling velocity for particle diameter d (m/s)
g = gravity (m/s^2)
p_s = density of particles (kg/m^3)
p_w = density of water (kg/m^3)
d = particle diameter (m)
u = viscosity of water (kg/ms)

$$N_R = V_s d p_w/u \qquad (10)$$

Where
N_R = Reynolds number
Vs = settling velocity for particle diameter d (m/s)
p_w = density of water (kg/m^3)
d = particle diameter (m)
u = viscosity of water (kg/ms)

If the Reynolds number is greater than 0.3, drag on the particles reduces the settling velocity. An iterative solution was used (solving for the Reynolds number, drag coefficient, and settling velocity until changes in the settling velocity were insignificant) for particle sizes with the Reynolds numbers. The drag coefficient is given by Equation 11, and the settling velocity is calculated by Equation 12.

$$C_D = 24/N_R + 3/(N_R 0.5) + 0.34 \qquad (11)$$

Where
C_D = drag coefficient
N_R = Reynolds number

$$Vs = (4g(p_s - p_w)d/(3C_D p_w))^{0.5} \qquad (12)$$

Where V_s = settling velocity for particle diameter d (m/s)
g = gravity (m/s^2)
ρ_s = density of particles (kg/m^3)
ρ_w = density of water (kg/m^3)
d = particle diameter (m)
C_D = drag coefficient

Table 2 provides a comparison of the settling velocities used in this study.

Table 2. Discrete Particle Size Settling Velocities (mm/s)

Particle Size (μm)	S.G. = 1.3 calculated	S.G. = 1.8 calculated	S.G. = 2.65 calculated	USEPA (1983) empirical
20	0.07	0.17	0.36	0.00254
60	0.59	1.57	3.23	0.02540
130	2.50	5.70	11.20	0.12700
400	16.00	37.00	65.00	0.59267
4000	180.00	300.00	450.00	5.50330

S.G. = Specific Gravity

The settling velocities that are based on the empirical USEPA data are 65 to 150 times smaller than the settling velocities based on a specific gravity of 2.65. A specific gravity of 2.65 is commonly associated with sand-size particles whereas the fines in stormwater are commonly associated with a lower specific gravity. The use of a higher specific gravity may be justified, however, if the values are considered representative of the settling velocities of fines in a flocculated or coagulated state. Research indicates that there is a high potential for coagulation amongst particles (Ball and Abustan, 1995) which will increase settling velocities and TSS removal rates. Furthermore, historical settling velocity calculations have been based on discrete particle methodologies (vertical settling column tests) that do not account for potential coagulation. Coagulation would effectively offset the settling velocity columns in Table 2 (i.e., discrete settling velocity for 60 μm represents coagulated 20 μm particle size).

Numerous field tests on the Stormceptor (Labatiuk, 1996; Henry et al., 1999; Bryant, 1995) have indicated a high percentage of fines in the Stormceptor. This empirical evidence lends credence to the coagulated settling theory, indicating that the USEPA discrete particle settling velocities may underestimate actual TSS removal rates. Settling velocities based on a specific gravity of 1.8 were chosen in this study as the default or benchmark selection. The solids loading was segmented into the particle size distribution and the concentration of solids in each particle size was tracked individually during the settling calculations.

Meteorological Data

Rainfall data from the City of Toronto (5 minute timestep, 0.25 mm resolution, 10 years record, 1987-1996) was agglomerated into 15 minute data for use with the model. Fifteen minute data were obtained for the entire U.S.A. from EarthInfo on CD ROM. Stations were selected based on location, period of record, data resolution and completeness within the period of record. Data were also obtained from CSR Humes for various stations throughout Australia. The rainfall data were converted into National Climatic Data Center (NCDC) format for input to SWMM.

Fifteen minute data were utilized, recognizing the small time of concentration that would typically be encountered in most Stormceptor applications. Simulations were also conducted using hourly data to determine the sensitivity of the results to the precipitation timestep. Numerous hourly stations were available on the EarthInfo CD for this purpose. The model uses a 5 minute timestep at all times regardless of the rainfall timestep.

Modeling Parameters

SWMM models catchments and conveyance systems based on input rain, temperature, wind speed, and evaporation data. Only rain data were used in these analyses. The default SWMM daily evaporation values (2.5 mm/day) were used. Evaporation data will not be important in this analysis since the catchment area is small (< 10 ha) and has minimal depression storage. The Horton equation was chosen for infiltration. The method of infiltration chosen is unimportant due to the small amount of pervious area (1%). Table 3 provides a list of the parameters used in the SWMM model.

Table 3. SWMM Area Parameters

Area - ha (ac)	variable
Imperviousness	99%
Width - m (ft)	variable
Slope	2%
Impervious Depression Storage - mm (in.)	4.7 (0.19)
Pervious Depression Storage - mm (in.)	0.5 (0.02)
Impervious Mannings n	0.015
Pervious Mannings n	0.25
Maximum Infiltration Rate - mm/h (in/hr)	62.5 (2.46)
Minimum Infiltration Rate - mm/h (in/hr)	10 (0.39)
Decay Rate of Infiltration (s^{-1})	0.00055

The width of catchment was assumed to be equal to twice the square root of the area.

Results

EMC versus Build-up/Wash-off

The suspended solids removal results based on the build-up/wash-off model were compared to those based on an EMC of 124 mg/l (USEPA, 1983) to demonstrate the sensitivity of the model to the different solids loading approaches. The use of an EMC assumes an equal concentration of suspended solids in all of the stormwater that is conveyed to the Stormceptor.

Figure 2 shows a comparison of results using an event mean concentration loading and build-up/wash-off loading, given the default particle size distribution and settling velocities based on a specific gravity of 1.8.

The results in Figure 2 show that the TSS removal rates using the EMC approach are lower by 14% when compared to the build-up/wash-off method even though the total loads are similar. This is expected due to the by-pass nature of the Stormceptor. The estimated TSS removals for the existing (1995) sizing guidelines, which are based on an early field study, are lower than both the EMC and build-up/wash-off estimates for low values (50% TSS removal) of separator storage/drainage area and are higher than the other estimates for larger values of separator storage/drainage area (80% TSS removal).

The range of TSS removal values based on computer modeling is smaller than the empirical TSS removal rates. Doubling the size of unit for the same area results in an increase of 30% for TSS removal, based on the current sizing guidelines, whereas the increase in performance based on the modeling is less dramatic (a 5% to 10% increase in TSS performance). This finding indicates that the modeling results will be less sensitive to changes in the model size for any given drainage area.

Selection of Settling Velocities

A comparison was made regarding the choice of settling velocities using Toronto rainfall data and the build-up/wash-off TSS generation methodology. Figure 3 provides the results of this analysis. The TSS removal estimates using the USEPA settling velocities are an average of 20% lower than the original TSS removal estimates, 29% lower than the estimates using the SG=1.3 velocities, and 39% lower than the estimates using the SG=2.65 velocities. These results indicate that the TSS removal performance results are very sensitive to the selection of settling velocities.

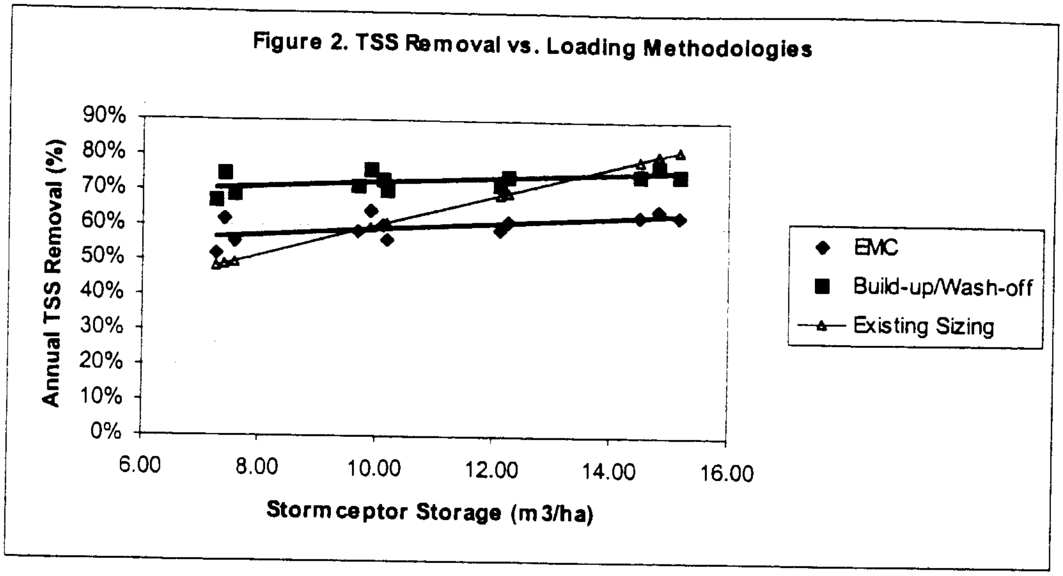

Figure 2. TSS Removal vs. Loading Methodologies.

Annual Flow Treatment

Numerous regulatory agencies design stormwater quality measures using a "design" event. The design event used generally ranges from the 25 mm storm, or annual storm, to the 25-year storm. The modified SWMM program was used to calculate the percentage of annual runoff that would be treated (not by-passed) with different by-pass flow rates. This analysis was conducted using the Toronto rainfall for a drainage area of 2.25 ha. Figure 4 shows that the volume of runoff that is treated prior to by-pass quickly becomes asymptotic with increasing treatment flow rate. A device that treats 30 L/s prior to by-pass would treat approximately 80% of the annual runoff. A device that treats 70 L/s (over 2x higher flow rate) only treats 10% more runoff (90%). Although the relationship between conveyance (% of annual runoff treated) and TSS removal is non-linear, Figure 4 shows that high-rate treatment devices are not required for small drainage areas.

The relationship provided in Figure 4 will vary with local meteorological conditions and is inherently accounted for in the TSS removal modeling.

Regional TSS Removal Performance Analysis

The model was used to compare results from different areas in North America and Australia to determine the effect of regional hydrology on TSS removal performance. All analyses were conducted using 15 minute rainfall data and based on the TSS build-up and washoff model and settling velocities for a specific gravity of 1.8.

Table 4 shows the results for various sized Stormceptors with a 2 ha drainage area. The locations of stations listed in Table 4 were selected to cover a wide geographic area, provide rainfall on a 15 minute timestep with a 0.25 mm resolution, and provide results representative of large nearby cities. Most data from city airports are recorded hourly, and therefore were not included in the comparison. The results in Table 4 are plotted in order of decreasing performance expectations in Figure 5.

Of the 16 stations analyzed, 12 stations provided TSS removal estimates within ±5% of the Toronto values.

Although the majority of stations provided similar TSS removal estimates, there were areas with significant differences. The performance estimates were lowest for the southeastern United States. This area is well know for its intense seasonal rainfall distribution. Figure 5 indicates that the TSS removal rates may vary up to 20% under different hydrological conditions on the same land use/site conditions. The use of local or regional rainfall data is therefore appropriate for design purposes.

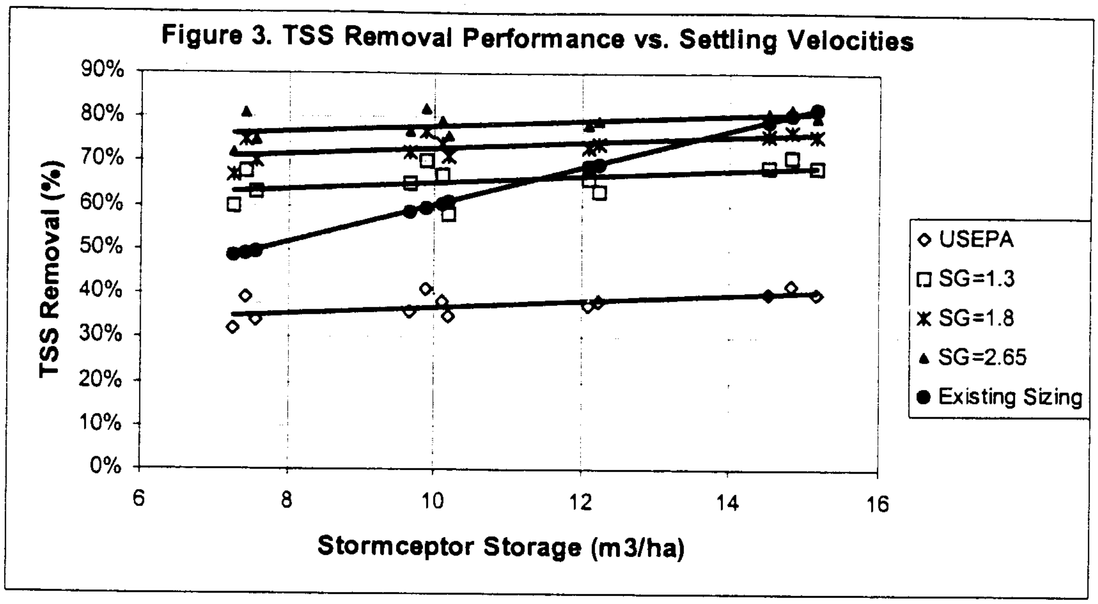

Figure 3. TSS Removal Performance vs. Settling Velocities.

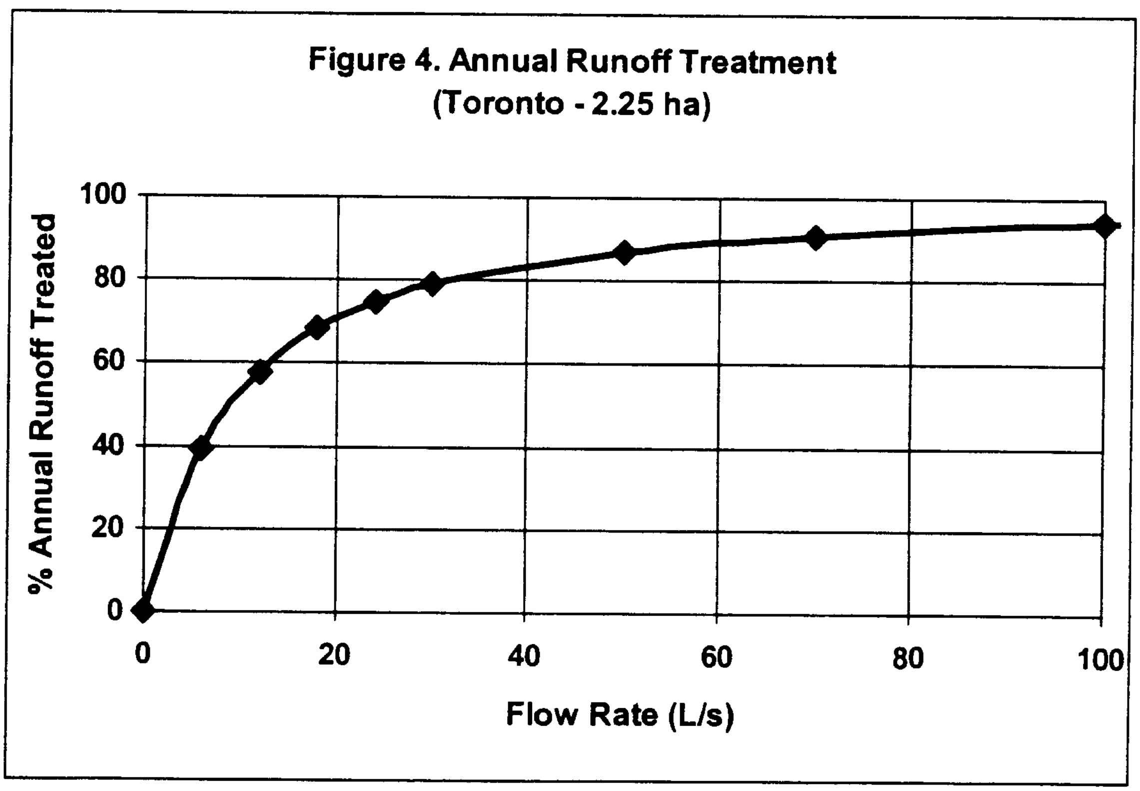

Figure 4. Annual Runoff Treatment.

Table 4. Regional Comparison of TSS Removal Performance (2ha)

State/ Province	Location	Stormceptor Model (CDN/USA) 300/ 450	750/ 900	1500/ 1800	3000/ 3600	5000/ 6000	6000/ 7200
Colorado	Fort Collins	49%	63%	65%	71%	76%	79%
Alberta	Calgary Forest	48%	63%	65%	71%	76%	79%
British Columbia	Vancouver	48%	65%	66%	71%	76%	78%
California	Davis	44%	61%	63%	69%	74%	77%
Massachusetts	East Brimfield Lake	43%	59%	61%	67%	73%	75%
Ontario	Toronto	43%	58%	60%	66%	72%	75%
New South Wales	Sydney	42%	57%	59%	66%	72%	76%
New York	Rhinebeck	41%	57%	59%	65%	71%	74%
North Carolina	Cataloochee	41%	56%	58%	64%	71%	74%
Queensland	Brisbane	41%	55%	57%	64%	71%	74%
Minnesota	Le Sueur	41%	56%	57%	64%	70%	74%
California	Orange County	39%	57%	59%	65%	71%	74%
Maryland	College Park	37%	53%	54%	61%	67%	70%
Missouri	Miller	34%	50%	51%	59%	65%	69%
Florida	St. Lucie New Lock	30%	43%	44%	52%	59%	64%
Texas	Houston Addicks	27%	41%	42%	49%	57%	61%

Figure 5. Regional Comparison of TSS Removal Performance (2ha)

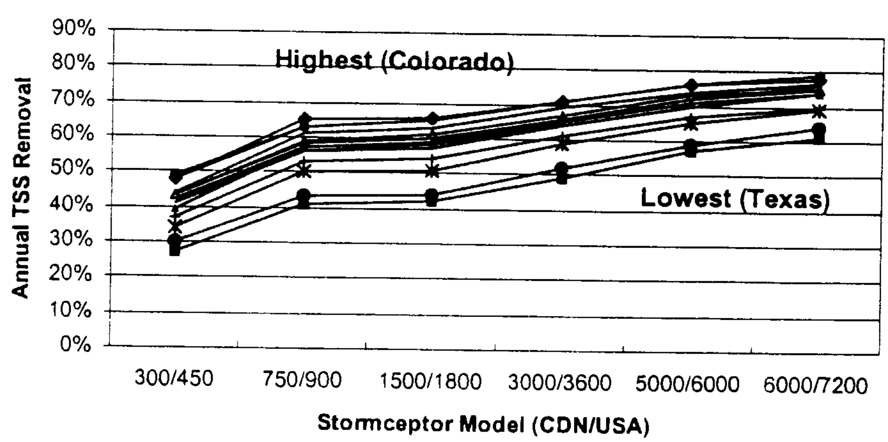

Figure 5. Regional Comparison of TSS Removal Performance

Rainfall Timestep

An analysis was conducted to determine the sensitivity of the model to changes in rainfall resolution. Results based on hourly rainfall data (0.25 mm resolution) were compared to those based on 15 minute rainfall data, to determine the impact of using the hourly data. Hourly data are more readily available than 15 minute data and most large cities have airports that collect rainfall on an hourly basis.

The model reads the hourly data as rainfall that falls during the first fifteen minute timestep of each hour. This will produce higher intensities since the rain is not distributed correctly over the entire hour. The greater intensity is compensated for, however, by the completeness of the hourly records which translates into a greater number of small rainfall values.

Four areas were analyzed (Rockville, Maryland; Boston, Massachusetts; Miami, Florida; and Houston, Texas). The results of this analysis (Figure 6) indicate that the use of hourly data does not significantly alter the TSS removal estimates for units that are designed to remove over 40% of the annual TSS load. Greater discrepancies can be expected at large ratios of drainage area to separator storage.

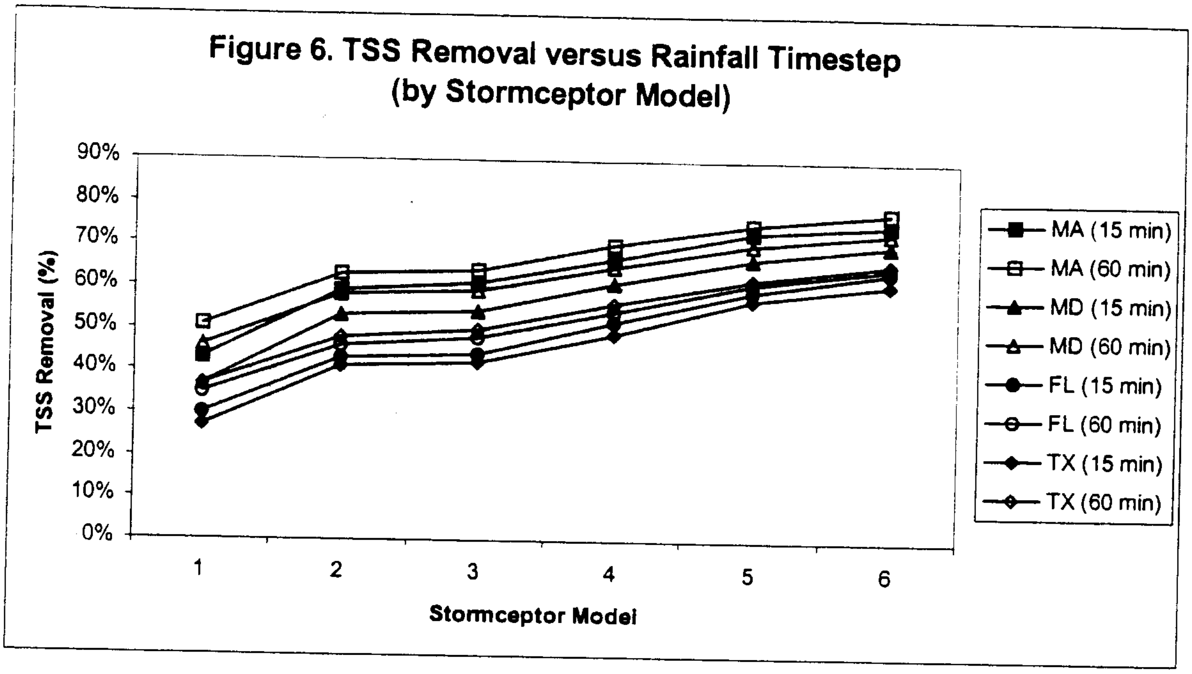

Figure 6. TSS Removal vs. Rainfall Timestep (by Stormceptor Model).

Conclusions

The TSS removal results were sensitive to the selection of settling velocities for the specified particle distribution. Differences in TSS removal of up to 40% were obtained, depending on the settling velocities that were evaluated.

Results were also affected by the TSS loading method. The use of an EMC underestimated TSS removal performance by approximately 15%, when compared to using the build-up and wash-off equations. This difference is expected since the EMC method increases the load that is by-passed and provides higher loads during higher treated flow rates when the detention time, and hence settling effectiveness of the unit, is reduced.

The model indicates that high percentages of the annual runoff can be treated with low-flow treatment devices such as the Stormceptor. The model also predicts that the TSS removal performance is less sensitive to the size of separator than observed from previous field studies.

Regional hydrology affected the TSS removal estimates provided by the model. Although differences of up to 20% were observed, significant hydrological differences between the sites were needed to obtain this variance. Most of the rainfall station locations tested provided TSS removal estimates similar to those of Toronto, where the original sizing guidelines were developed.

Testing the model with different rainfall timesteps (15 minute versus hourly) indicated that hourly rainfall records can provide an adequate estimation of performance if the rainfall is collected at adequate resolution (0.25 mm increments).

The modeling indicated that significant TSS removal rates can be achieved using small infrastructure control measures if the drainage area is limited. The results lend credence to the positive field monitoring results obtained to-date for the Stormceptor, and to the concept of small storm hydrology being the predominant parameter for urban stormwater quality design.

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NPDES Phase II Cost Estimates

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Introduction

The United States Environmental Protection Agency (EPA) has published final rules expanding the existing stormwater NPDES permitting program to smaller cities and other urban areas throughout the United States. Due both to external pressures and directives from the current and past administrations, EPA is conscious of attempting to make the current stormwater NPDES program "cost-effective." For example:

> "EPA believes this rule will cost significantly less than the existing 1995 rule that is currently in place, and will result in significant monetized financial, recreational and health benefits, as well as benefits that EPA has been unable to monetize, including reduced scouring and erosion of streambeds, improved aesthetic quality of waters, reduced eutrophication of aquatic systems, benefit to wildlife and endangered and threatened species, tourism benefits, biodiversity benefits and reduced siting costs of reservoirs." [1]

> "... the Agency recognizes the continuing imperative to assure that environmental regulations accomplish statutory objectives in the least burdensome and most cost-effective fashion. As explained further in this preamble, the form and substance of NPDES permits to address the sources designated in today's proposal would provide greater flexibility for the newly covered sources than the existing "standard" NPDES permit."[2]

While the "benefit" side of the proposed regulations exists in the realm of gross estimates, the "cost" side is also filled with unknowns. What will the mandated and negotiated stormwater program cost a local community? Are there ways to reduce costs? What should a local community be doing now to prepare for this regulatory program? This paper seeks to address these related questions.

The final regulations were published on December 8, 1999 and the changes from the draft regulations are only minor[3]. But it is still not possible to say what the regulations will cost everyone in toto. This is so because:

- there is great flexibility inherent in the regulations to create a stormwater quality program tailored to meet an individual community's needs and situation;
- each permit writer has preferences and "hot buttons" that will color what any particular program will look like; and
- each community setting is different in terms of climate, topography, pollutants of concern, and current condition of local waters.

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[1] Federal Register, January 9, 1998 p. 1536
[2] ibid. p. 1550
[3] Federal Register, December 8, 1999 pp. 68722-68851

Basic Approach to Permitting

Under proposed § 123.35(g), an NPDES permitting authority issues a general permit to authorize stormwater discharges from regulated small municipal separate storm sewer systems. The NPDES permitting authority will also provide a menu of regionally appropriate and field-tested Best Management Practices (BMPs) that the permitting authority determines to be "cost-effective." The regulated small municipal separate storm sewer systems could choose to select from this menu or select other BMPs that they feel are appropriate.

Under Phase II each regulated community will need to develop a set of BMPs under each of six specific program minimums. These BMPs can be any combination of programs, structures and other controls that, in the agreed opinion of the permit writer and the regulated community, meet the standard of reducing pollution discharge to waters of the state to the Maximum Extent Practicable (MEP). In this process, permittees and permit writers would evaluate the proposed stormwater management controls to determine whether reduction of pollutants to the MEP could be achieved with the identified BMPs. EPA envisions that this evaluative process would consider such factors as condition of receiving waters, specific local concerns, and other aspects included in a comprehensive watershed plan.

Under the proposed approach, implementation of BMPs consistent with stormwater management program requirements at § 122.34 and permit provisions at § 122.33 would constitute compliance with the standard of "reducing pollutants to the maximum extent practicable." That is, "if you do what you say you will do, you are by definition in compliance." It is important to note that states implementing their own NPDES programs may develop more stringent requirements than those proposed in the Federal Register. In fact, we anticipate that many states will require more specific and rigorous requirements under special circumstances relating to the condition of the receiving water within, and downstream from, the community. For example, if a certain stream is required to have a Total Maximum Daily Load (TMDL) or similar study performed on it (for example, a watershed assessment for the purposes of wastewater treatment plan permitting or expansion), the NPDES stormwater Phase II permit conditions may reflect the allocation of pollutants to that community.

The steps for a community are: (1) review the conditions of the general permit, (2) develop and submit a Notice of Intent (NOI) to comply with the general NPDES permit through description of a BMP-based program under each of the six minimum controls or program areas (see below), (3) negotiate this proposed program with the permit writer, (4) receive approval of the submittal, and (5) begin implementation of the conditions and programs described in the NOI including record keeping and submittal of appropriate reports describing attainment of "measurable goals" for each BMP as described in the NOI.

Current NPDES Phase II Program Cost Estimates

There is naturally much speculation on the actual program elements and costs for a particular stormwater program developed under Phase II. There have been several attempts at estimating Phase II program costs based on current costs of "similar" programs.

In the draft regulations, EPA had provided estimates of the probable cost implications of the NPDES Phase II Permit. These estimates were based on summary information from the permit applications from 21 Phase I cities. Very high and very low figures were thrown out by EPA in developing these estimates. Figure 1 shows the summary table developed by EPA.

The range depicted in Figure 1 is from $1.39 to $7.83 per person per year for the first permit five-year period, and $1.28 to $5.63 for other permit cycles. For a city of 50,000 that is a very wide range of $69,500 to $391,500 annually for the first permit cycle. This is clearly not helpful in attempting to estimate a specific community's costs.

There is question about the vagueness in the regulatory language, and the high degree of potential flexibility inherent in briefly described program elements. For example, for the first of the minimum controls the regulatory language states:

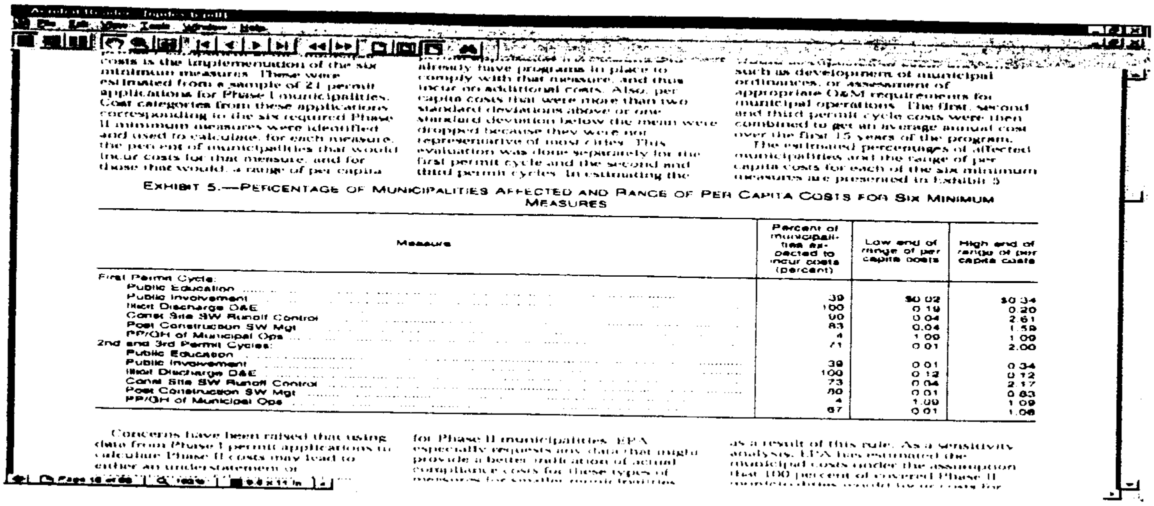

EXHIBIT 5.—PERCENTAGE OF MUNICIPALITIES AFFECTED AND RANGE OF PER CAPITA COSTS FOR SIX MINIMUM MEASURES

Measure	Percent of municipalities expected to incur costs (percent)	Low end of range of per capita costs	High end of range of per capita costs
First Permit Cycle:			
Public Education	39	$0.02	$0.34
Public Involvement	100	0.19	0.20
Illicit Discharge D&E	90	0.04	2.61
Const Site SW Runoff Control	83	0.04	1.59
Post Construction SW Mgt	4	1.00	1.00
PP/GH of Municipal Ops	71	0.01	2.00
2nd and 3rd Permit Cycles:			
Public Education	39	0.01	0.34
Public Involvement	100	0.12	0.12
Illicit Discharge D&E	73	0.04	2.17
Const Site SW Runoff Control	80	0.01	0.83
Post Construction SW Mgt	4	1.09	1.09
PP/GH of Municipal Ops	67	0.01	1.06

Figure 1. EPA Cost Estimates for Phase II NPDES Compliance.

1. Public education and outreach on storm water impacts[4].. You must implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of storm water discharges on water bodies and the steps that can be taken to reduce storm water pollution.

   (You may use stormwater educational materials provided by your State, Tribe, EPA, or, subject to the approval of the local government, environmental or other public interest or trade organizations. The materials or outreach programs should inform individuals and households about the steps they can take, such as ensuring proper septicsystem maintenance, limiting the use and runoff of garden chemicals, becoming involved in local stream restoration activities that are coordinated by youth service and conservation corps and other citizen groups, and participating in storm drain stenciling, to reduce storm water pollution. In addition, some of the materials or outreach programs should be directed toward targeted groups of commercial, industrial, and institutional entities likely to have significant storm water impacts. For example, information to restaurants on the impact of grease clogging storm drains and to garages on the impact of oil discharges. You are encouraged to tailor your outreach program to address the viewpoints and concerns of all communities, particularly minority and disadvantaged communities, as well as children.)

The "regulatory" wording in parentheses is not mandatory but suggested. There is wide room for interpretation of the intensity and detail necessary to accomplish this minimum control. The devil is always in the details, and there will always be great variability in what two different programs intend to do to accomplish the same general goals.

NAFSMA (1999a, 1999b) published a survey on potential Phase II program costs responded to by 121 cities and counties nationally. Ten communities responded with programs that had three or more suggested elements in the first minimum control: Public Education and Outreach. The annual per capita costs for these ten ranged from $0.04 to $1.17 – again a wide range.

Of those responding, only one community stated that it had program activity in each of the six minimum control measure areas and it spent $15.11 per capita annually, well above the EPA estimate (the city has a population of about 25,000). Of the 121 respondents only 26 had programs in at least three (most had only three) of the six mandatory minimum control areas, and these can be considered far from complete. Figure 2 shows the distribution of costs for these 26 programs. The vertical axis is the annual per capita cost for these elements. The median was $1.44 and the average was $4.07. The low value was $0.04 and the high was $26.00.

[4]Federal Register, January 9,1998, p. 1639.

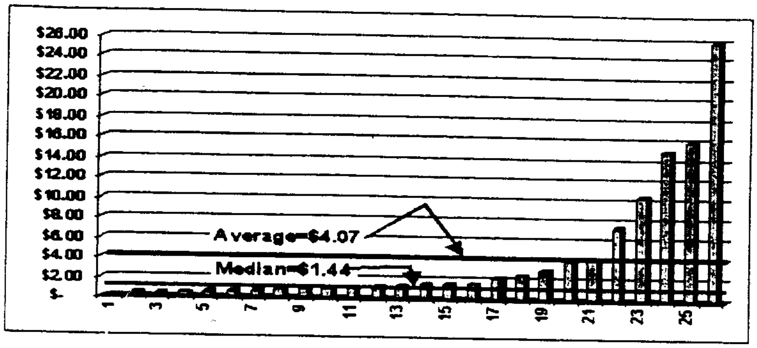

Figure 2. NAFSMA Study Program Costs.

We can speculate that if many of these communities had a fully developed Phase II program, the average costs could more than double, since each community would be adding both new program areas and upgrading their existing programs they had to make them comply with the details of the Phase II permit writers requirements.

In the final regulations, USEPA took a different approach to making estimates of the costs of compliance, using both the NAFSMA information and past experience with Phase I (EPA, 1999). EPA estimated annual costs for the municipal programs based on a fixed cost component and a variable cost component. The fixed cost component included costs for the municipal application, record keeping, and reporting activities. On average, EPA estimated annual costs of $1,525 per municipality. Variable costs include the costs associated with annual operations for the six minimum measures and are calculated at a rate of $8.93 annually per household (assuming 2.62 persons per household). The the cost estimating equation is:

Annual cost = $1,525 + population/2.62*$8.93

Finally, rule of thumb estimates based on the author's experience working in over 100 communities indicate that comprehensive stormwater programs that include advanced stormwater quality programs cost between $7.00 and $20.00 per capita per year – above the EPA estimates. The quality portion is normally between 20 and 30% of the total average program cost.

Estimating Costs from Anticipated Programs[5]

The methods used above do not provide details of the components of the stormwater programs resulting in the costs, and thus are not very helpful in assisting other communities in their thinking about the regulations. An effort was made to develop cost estimate ranges based on a direct interpretation of the stormwater regulations as applied to example communities at each end of the spectrum, in terms of size and intensity of water quality program. This has an advantage in that it deals directly with the stormwater regulatory requirements and illustrates specific program components so that we can control and define all details. The following sub-sections will develop two hypothetical permit applications for the six minimum controls.

The Two Permittees

Permittee one ("Smallville") is a community of 10,000 that is adjacent to a larger city that has obtained a Phase I permit or that can assist Smallville in many of its permit responsibilities. It is a small bedroom community interested in compliance with minimum disruption and cost. It does not really have an engineering or planning component of its city staff, but relies on a city administrator and hired consultants.

[5] Based on a presentation made by Andy Reese of Ogden Environmental at the APWA seminar, "Designing and Implementing an Effective Storm Water Management Program, Denver, 1998.

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Permittee two ("Midtown") is a larger and more self-contained community with a population of 50,000 located within an urbanizing county whose total population makes it a designated "urbanized area." It is aggressively annexing growth areas, and has a thriving economy. It has a City Engineer/Public Works director, road maintenance staff, and other municipal capabilities and resources. It also has a growing stormwater quantity program and wishes to bring quality together with quantity in a comprehensive and integrated approach. It wants to take advantage of its GIS database and capability.

The Programs

We can assume that contained within. or subsequent to obtaining the general permit, the permit writer will publish a list of regionally appropriate BMPs to be used in permit applications. The general permit will have narrative effluent limitations which describe goals or narrative standards for each of the minimum controls. Each permittee must then develop basic program objectives and measurable standards (not included here) under the goals provided by USEPA for each of the six minimum controls. These measurable standards can be stated in terms of actions taken or results achieved. It is best to state them in terms of things that can be controlled and which do not have uncontrollable and unpredictable results.

It is also smart to schedule the programs (the schedule is not demonstrated here) in terms of phases, pilot programs, demonstration projects, trials, etc., with an evaluation process at some point in the permit. It should then be written into the NOI that this program will be modified, expanded, curtailed or even abandoned if it is not effective.

Smallville sought to obey only the letter of the law, but did not see many ways to proceed. It had no real stormwater program, no known water quality problems, and few current responsibilities. This community sought to take advantage of "big brother" next door in joint programs or education, and to adopt more regionally uniform development regulations enforced locally. Smallville sought to fund any program needs through budget changes and through economies gained by taking advantage of regional programs, free information, and expanding duties of existing staff.

Midtown sought to meet the program minimums in a more proactive way focusing on perceived needs within the community. They took advantage of the strength of existing local programs, a strong economy, a strong environmental awareness, and outside assistance where available in the form of copied resources and shared efforts. Midtown expanded its current program using EPA suggestions to build a more comprehensive and meaningful program in several key areas[6]. Because they did not have the ability to try to work regionally (the adjacent county had no resources for developing a stormwater program, but would cooperate as necessary) it needed to build the program alone and to work extra-territorially as appropriate. Midtown looked at each program to insure the existence of: adequate legal authority, competent technical approach, dedicated financial resources and appropriate administrative procedures and staffing.

Because program funding became an issue, Midtown sought to establish a stormwater user fee system (often called a stormwater utility) to provide stable, adequate and equitable funds. The costs and steps of the utility development are not included here.

Program Objectives

Table 1 develops the basic objectives of each of the programs in each of the six minimum areas. In real life these objectives would be developed through a series of discussions with staff and, perhaps, a citizen's group, and through early coordination with the permit writer.

Table 2, which is attached as an Appendix, gives basic cost-estimate information for the two programs. The costs are approximate and would vary depending on how all costs are accounted for, availability of staff, etc. The intent is to give ballpark estimates and not to quibble over details. In these estimates all personnel time is costed at $50/hr regardless of

[6] NAFSMA has taken an earlier version of the Midtown values, refined them, and developed a minimal and advanced program concept out of this information. That information can be obtained from NAFSMA by calling 202-218-4122.

the source of the labor (in-house or contracted). This corresponds to a fully burdened salary rate plus allocated overhead costs for a mid-level technical person.

Table 1. Basic Program Objectives

Smallville	Midtown
Public Education and Outreach on Storm Water Impacts	
1. Acquire and mail existing public domain informational brochures 2. Encourage and facilitate newspaper articles 3. Educate the few industrial and commercial stakeholders individually	1. Acquire and mail existing and specifically pertinent public domain informational brochures to the general public 2. Develop a stratified database of stakeholder groups and develop and execute targeted education programs 3. Develop and implement elementary school education programs with preexisting curriculum 4. Develop and advertise complaint hotline as a pollution hotline 5. Develop press information and briefings with the objective of having a quarterly news article 6. Develop and make available a slide show and speakers bureau
Public Involvement/Participation	
1. Develop and implement a citizens advisory group appointed by the mayor 2. Encourage citizen participation in the neighboring city's programs for used oil, household hazardous waste, adopt-a-stream, etc. through news articles in local neighborhood newspaper	1. Develop and implement a stratified and diverse citizens advisory group/task force 2. Develop a citizen monitoring and/or adopt-a-stream program -- may be partially federally funded 3. Develop a student storm drain stenciling program and student dry weather screening program (see illicit connections program) 4. Encourage the development of watershed groups for each major watershed within the jurisdiction (see BMP control)
Illicit Discharge Detection and Elimination	
1. Develop a stormwater major outfall map on USGS base map 2. Modify slightly and adopt a generic ordinance available from the state or other organization.	1. Develop a major stormwater system map and inventory on existing GIS topo. Base mapping 2. Cross-reference map with existing databases on NPDES permit holders (available from the state) and SARA Title III database to identify likely source of dry weather pollution 3. Develop an illicit connections and illegal dumping ordinance including hotspot program 4. Perform initial dry weather screening in several key parts of the city by student volunteers 5. Develop inspection and enforcement capabilities and resources, and develop a detection program using city staff and a database of potential specific locations 6. Advertise hotline and write news articles (see public education) 7. Advertise existing private used oil disposal sites (see public education) 8. Educate all public employees to recognize and report problems (see pollution prevention) 9. Develop automotive industry sponsorship of spill prevention, materials management, and inspection and education programs (see public education for part of this)
Construction Site Storm Water Runoff Control	
1. Modify the adjacent city's sediment and erosion control ordinance to meet the regulatory minimums 2. Modify plans review and inspection procedures to include program minimums 3. Train city secretary to collect phone complaints and take appropriate action on erosion complaints 4. Advertise the complaint line as part of the public education program.	1. Modify existing sediment and erosion control ordinance to include all the requirements of the regulations 2. Add a BMP section and clear design steps to the drainage manual 3. Conduct training and familiarization program for developers, contractors and engineers, as well as in-house training for inspectors 4. Insure hotline has a formal and defined ability to receive and properly process erosion complaints 5. Upgrade the erosion control inspection and enforcement program

Post-Construction Storm Water Management in New Development and Redevelopment

1. Modify and adopt the adjacent city's stormwater ordinance regarding stormwater quantity and quality requirements to require similar controls and requirements. Add a maintenance requirement for BMPs and detention designs
2. Transform the inspection process to be able to inspect and enforce the new ordinance
3. Communicate the new requirements

1. Investigate and seek to institute zoning and policy changes to encourage density restrictions, transferable development rights, easier use of PUDs, limitation of impervious areas, conservation easements, mandatory floodplain dedication, etc.
2. Develop design guidance for the use of structural and non-structural BMPs
3. Develop and conduct an ongoing training program in the proper use of BMPs
4. Develop several BMP pilot projects to demonstrate and gain experience in BMP use
5. Overhaul and develop a comprehensive storm water ordinance for both water quantity and quality which includes mandatory use of BMPs and a maintenance requirement
6. Establish inspection program for private BMPs
7. Develop a monitoring program for local surface waters and to monitor their long term changes
8. Develop master plans for areas facing new development and establish and enact policy for regional BMP design and maintenance
9. Develop ways to improve extra-territorial planning and zoning input
10. Identify key environmentally sensitive areas and take steps to protect such areas through ordinance, overlay districts, etc.
11. Seek to establish local watershed organizations and neighborhood adopt-a-stream programs to assist in compliance and build public support

Pollution Prevention/Good Housekeeping for Municipal Operations

1. Review all current municipal procedures and document ways to reduce pollution
2. Make changes and document
3. Obtain and distribute materials on ways to reduce pollution as available and appropriate.

1. Conduct an outside review of all applicable procedures and criteria and make recommendations for change, implement changes
2. Obtain available information and conduct sensitivity and familiarization training for all applicable city employees
3. Seek to control floatables partially through adopt-a-stream program (see public participation)
4. Review existing flood control projects to insure advantage is taken of pollution reduction opportunities in design and operation

Hours are given in most cases. Italicized numbers are one-time costs that are experienced some time in the first permit period, assumed to fill the year in which they initiate. For ongoing programs, the program initiates beginning in the next year. The annual costs are the anticipated costs thereafter. I have assumed that all programs initiate in year one for the total five-year cost estimate. Obviously if a program initiates in a later year there will be savings in annual costs not incurred until the program initiates. The five-year total is four times the annual cost plus the initial cost -- making a total of five years. Some programs are five-year programs only, ending after the first cycle.

A schedule of tasks and of manpower requirements is not developed in this paper. The costs are given as initial costs and as ongoing costs (clear from the context of the table). Because not all program elements will be developed and in-place for the whole permit term, there will be a ramp-up process. Also, most of the program elements will continue to change and evolve over time, and program costs will also change (up or down) in subsequent permit periods. Extraordinary volunteer efforts have not been assumed (e.g. writing news articles, manning a hotline, etc.).

It is important to realize that some per capita costs go down for large cities because they have a large fixed component. For example, it may cost the same to develop a one-page brochure whether the city has 20,000 or 200,000 people in it. Expenses are based on medium levels of effort wherever appropriate. Detailed expenses (e.g. long distance phone costs) have not been estimated.

Measurable goals have also not been provided in this handout. But for each BMP measure or program it will be necessary to develop some measurable standard by which to judge success. The standard may be based on internal activities where it cannot easily be based on external results. For example, sending out brochures three times per year can be measured. But, the effectiveness of those brochures can only be measured through phone surveys of public knowledge before and after the brochure was sent, or based on statistics on increased public participation in whatever program the brochure was about. Neither measure is easy and reliable. And, should a certain percent "effectiveness increase" be stated as the measurable goal, if it is not achieved the city would, technically, be out of compliance. Better to make the goal controllable, especially in the first permit cycles when little is known on the effectiveness of certain (especially non-structural) BMP measures.

In no case have the costs of structural BMPs been estimated or included. Cost estimates are available in several references including the Center for Watershed Protection (1997) and Northern Virginia Planning District Commission (1994). The economic benefits of structural BMPs are discussed in EPA (1995).

Monitoring costs are developed for Midtown based on both receiving stream monitoring and some pilot BMP program monitoring; they are non-existent for Smallville. EPA estimates that about 50% of permittees may incur monitoring costs in subsequent permit cycles. It is also assumed that there are no TMDL or other types of watershed assessment actions going on in the watershed which may radically modify the permit conditions, and that there are no regional or state-wide programs which could simply be adopted by reference for portions of the NPDES minimum requirements.

Summary Results

The summary results of the analysis are presented in Table 3, in terms of cost per capita, for each of the programs in a manner comparable to the EPA estimates.

The range of results is similar to that experienced by EPA in making its original estimates of the cost of the Phase II program. The details of this program development can assist a local community in fashioning its own stormwater program in response to the regulations.

Table 3. Summary Results

Minimum Control	Annual Per-Capita Cost Small	 Midtown
First 5-year Permit Period		
1 - Public Ed.	0.39	1.24
2 - Public Inv.	0.21	0.62
3 - Illicit Connections	0.24	1.77
4 - Construction	0.20	0.96
5 - Post Const.	0.14	5.78
6 - Housekeeping	0.15	0.59
Totals	1.33	10.96
Subsequent 5-year Permit Periods		
1 - Public Ed.	0.36	1.40
2 - Public Inv.	0.24	0.51
3 - Illicit Connections	0.10	1.16
4 - Construction	0.18	1.10
5 - Post Const	0.13	1.26
6 - Housekeeping	0.10	0.20
Totals	1.11	5.63

The Phase II Action Plan

Given the great range in costs for the Phase II program it makes sense to get a jump start on planning for it. Many of the requirements or potential inter-local arrangements that could be developed take time to implement, more time than is available if the community waits until the general permit has been finalized and the NOI is due. There are steps that a local government should take now to prepare itself for the regulations and to position itself to meet compliance in the most cost-effective manner. These steps can be performed as part of a Phase II action plan:

1. Assess your status

Ask yourself if you are "in," "potentially in," or "out." Find out who else is in your category.

2. Get to know the permit writers

Find out what the permit writers are thinking about the permits, what the general permit will look like, when you will know more, how they will evaluate those potentially in, what other actions are going on in the state that may impact the permit, etc. Find out their ideas about what is important in the permit, what their special interests are, do they strongly support the permit, etc. Plan to establish an ongoing dialog.

3. Assess your surface waters

Find out if there are any ongoing actions which might designate surface waters in your jurisdiction as not meeting water quality standards. See if there are any planned watershed assessments or TMDL requirements coming in the future.

4. Assess your own program

How much of your own stormwater program looks like the regulations, even with some minor modifications. Can you get a jump on the requirements through transformation of your current programs?

5. Check out your neighbors

Are there some other programs nearby that might result in savings to you? Can you simply be covered under another program? Can parts of the requirements be waived because they are already being done by someone else? Can you plan to be part of a regional permit? Can you split the permit requirements with an adjacent entity and perform them together at savings to both of you?

6. Get a team together

Once you have answered some of these questions, it is time to pull the action team together. This may include only your own staff, a multi-disciplinary staff within your own jurisdiction, or a multi-jurisdictional or regional team. Get together to brainstorm and come up with a proposal to the permit writer which has mutual benefits. Remember, permit writers are being encouraged to think regionally and on a watershed basis.

7. Develop an action plan

Once you have a team, it is time to have a plan. Begin to formulate what you will need to do to apply for the permit and to carry it out. What might your program minimums look like? Are there some things you can do now, over several years, that you cannot afford to do in any one year, or that will take too long to get going if you wait until the permit is upon you? Can you begin the program transformation process now? What about data collection and mapping? Are there other uses for any data you will collect which will create synergy?

8. Get started

Some things are best started early. But do not jump the gun by committing resources in areas that are not yet anticipated to be firm. Ask the permit writer for his or her opinion.

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United States Environmental Protection Agency, 1999, Report to Congress on the Phase II Stormwater Regulations, EPA 833-R99-001, October.

Appendix

Table 2. Hypothetical Program Detail and Cost Summary

Smallville Program Element	Cost	Midtown Program Element	Cost
Public Education and Outreach on Stormwater Impacts			
Acquisition of available mailers and information from private institutions and other governmental entities - 20 hrs	$1,000	Acquisition of available mailers and information from private institutions and other governmental entities - 40 hrs	$2000
Keep up with available literature - 20 hrs/yr	$1000/yr	Keep up with available literature - 50 hrs/yr	$2500/yr
Coordination with neighborhood or shoppers newspaper to run articles on pollution sources - 4 hrs	$200	Stratified mailing database development for key stakeholder groups - commercial, automotive, minority, etc. - 100 hrs	$5,000
Develop 2 articles per year - 24 hrs/yr	$1,200/yr	Maintenance of database - 1 hr/wk	$2,600/yr
Coordination with the few individual potential sources of pollution about the program and their needs - 10 hrs	$500	Obtaining or developing educational materials for the specific outreach and stakeholders' programs, printing - 30 hr	$4,000
		Updating materials - 100 hrs/yr. Mailing 5,00 brochures per year	$7,500/yr
Series of three mailings - stuffers in utility bill	$3,600	Developing outreach and educational programs - 200 hrs	$10,000
One mailing per year afterward	$1,050/yr	Executing programs - updating, mailing, training, presentations - 200 hrs/yr	$12,000/yr
Responding to information requests - 1/2 hr/wk	$1,300/yr	Develop elementary and middle school education programs - preexisting Material/curriculum - free materials - 100 hrs	$5,000
		Ongoing program maintenance - refresher training, 5 schools - 100 hrs/yr	$5,000/yr
		Advertising of hotline - radio spots developed in-house and on public And other radio service spots and Newspaper ad, 3 times per year - 140 hrs - donated spots	$12,000/yr
		Develop white paper and press package - initial, brief - 32 hrs	$1,600
		Develop quarterly press package/briefing - brief press - 24 hrs per + expenses	$5,000/yr
		Development of a short, scripted stormwater pollution slide show, Presentation and speakers bureau & initial presentation - 60 hrs	$3,000
		Give presentations - 48 hrs/yr + expenses	$2,600/yr
		General informational brochure development and mailing - once/year - 60 hrs/yr - 25,000 inserts @ 0.50 per	$15,500/yr

Continued

Table 2. Cont.

Smallville Program Element	Smallville Cost	Midtown Program Element	Midtown Cost
		Responding to information requests - 2 hrs/wk	$5,200/yr
Initial Cost	$5,350	Initial Cost	$30,600
Annual Cost	$4,550	Annual Cost	$69,900
Total Cost (first 5 years)	$23,500	Total Cost (first 5 years)	$310,200
Total Cost (ongoing 5 -year period)	$22,750	Total Cost (ongoing 5-year periods)	$349,500
Public Involvement/Participation			
Development and implementation of a citizen advisory committee appointed by the mayor - 2 initial meetings - 14 hrs	$700	Development and implementation of a citizen advisory committee appointed by the council - 5 initial meetings - 70 hrs + expenses	$3,700
Quarterly meetings - 32 hrs/yr	$1,600/yr	Bimonthly meetings - 60 hrs/yr	$3,000/yr
Advertisement of the larger city's stream cleanup program in local shopper newspapers - news articles, and coordination with them in all such programs - 16 hrs/yr	$800/yr	Initial coordination of monitoring program and/or adopt-a-stream - 60 hrs - equipment purchase	*$40,000*
		Ongoing coordination and equipment, database maintenance - 100 hrs/yr + expenses	$15,500/yr
		Student storm drain stenciling program development and implementation - 80 hrs	*$6,500*
		Annual cost	$3,000
NOTE: *italics* are initial cost - for first year only		Watershed group encouragement - presentations, advertising - 50 hrs + expenses	*$2,800*
		Ongoing coordination, education - 4 groups - 20 hrs. per	$4,000/yr
Initial Cost	$700	Initial Cost	$53,000
Annual Cost	$2,400	Annual Cost	$25,500
Total Cost (first 5 years)	$10,300	Total Cost (first 5 years)	$155,000
Total Cost (ongoing 5 -year period)	$12,000	Total Cost (ongoing 5-year periods)	$127,500
Illicit Discharge Detection and Elimination			
Collect and plot field information on system locations and sizes - 5 hrs - contract	*$7,000*	Develop system map, perform inventory of major structures - 60 hrs + contract	*$150,000*
		Update map - 60 hrs	$3,000/yr
Adopt ordinance - 20 hrs	$1,000	Database development and GIS programming and mapping - 200 hrs + expenses of $3k	*$13,000*
Enforcement of ordinance - 20 hrs/yr	$1,000/yr	Database maintenance - 100 hrs	$5,000/yr

Continued

Table 2. Cont

Smallville Program Element	Cost	Midtown Program Element	Cost
		Ordinance development with public participation - contract	*$20,000*
		Initial dry-weather screen in parts of city - student volunteers - 240 hrs	*$12,000*
		One staff member 1 day/week for inspection and enforcement of Illicit connection program - + expenses	$28,000/yr
		Development of automotive or other specialty programs - 100 hrs + 1k exp.	*$6,000*
		Annual implementation of inspection and education - 1 day/wk	$22,000/yr
Initial Cost	*$8000*	Initial Cost	*$201,000*
Annual Cost	$1,000	Annual Cost	$58,000
Total Cost (first 5 years)	$12,000	Total Cost (first 5 years)	$433,000
Total Cost (ongoing 5 -year period)	$5,000	Total Cost (ongoing 5-year periods)	$290,000
Construction Site Stormwater Runoff Control			
Modify and pass new erosion control ordinance - 40 hrs	*$2,000*	Modify existing ordinance - public participation - 60 hrs	*$3,000*
Enforcement ordinance in inspection process - 50 hrs/yr	$2,500/yr		
Modify development procedures - 4 hrs	$200	Add BMP section to design manual - 140 hrs + printing cost	*$12,000*
Train secretary to handle calls - 8 hrs	$800	Conduct training sessions for staff and local development related persons - 80 hrs	*$4,000*
Handle erosion calls - 10 hrs/yr	$500/yr	Ongoing biannual training - 32 hrs/yr	$1,600/yr
		Develop hotline procedure for complaints reception - 10 hrs	$500
		Hotline @ 150 hrs/yr + expenses	$8,500/yr
		Upgrade erosion control program for more sites and more activities - one person two days/wk + expenses	$45,000/yr
Initial Cost	$2,600	Initial Cost	$19,500
Annual Cost	$3,000	Annual Cost	$55,100
Total Cost (first 5 years)	$14,600	Total Cost (first 5 years)	$239,900
Total Cost (ongoing 5 -year period)	$15,000	Total Cost (ongoing 5-year periods)	$275,500
Post-Construction Stormwater Management in New Development and Redevelopment			
Modify and get ordinance passed - 40 hrs	*$2,000*	Work on major policy changes in land use regulations - contract + 200 hours	*$100,000*
Enforce/explain new ordinance provisions - 1/2 hr/wk	$1,300/yr		
		Develop design guidance for BMPs - contract	*$25,000*
		Training program for BMP use - debvelopment - 24 hrs + contract	*$3,000*
		Annual training - 60 hrs/yr	$3,000/yr

Continued

Table 2. Cont.

Smallville Program Element	Smallville Cost	Midtown Program Element	Midtown Cost
		BMP Pilot projects - federal funding assistance - 5-year program - contract 5 yrs	$200,000
		Comprehensive stormwater ordinance with public participation - contract	*$40,000*
		BMP inspection and enforcement program - one person one day/wk + expenses	$25,800/yr
		Data collection program - SWAG	$30,000/yr
		Master planning for new areas for both quality and quantity - 2 mile Planning zone around city - 5-year program - 40 mi^2	$800,00 5 yrs
		Costs of administration of regional BMP program - SWAG	$4,000/yr
		Sensitive area identification program, ordinances and policy enactment- 5-year program - 100 hrs incl. Mapping 5 yrs	$25,000
Initial Cost	*$2,000*	Initial Cost	*$393,000*
Annual Cost	$1,300	Annual Cost	$62,800
Total Cost (first 5 years)	$7,200	Total Cost (first 5 years)	$644,200
Total Cost (ongoing 5 -year period)		Total Cost (ongoing 5-year periods)	$314,000
		Master planning	
Pollution Prevention/Good Housekeeping to Municipal Operations			
Review of all current procedures - modification of procedures - 40 hrs	*$2,000*	Review and modification of all applicable procedures and criteria contract	*$25,000*
Obtain and distribute educational materials - 10 hrs	*$500*	Site inspections and corrections - 5-year program - $5k/yr	$25,000 5 yrs
Annual cost of changed procedures - SWAG	$1,000/yr	Training for city employees on new procedures - 40 hrs + 10 hrs @ 75 persons + expenses	*$42,000*
		Review flood control projects for retrofit opportunities - contract	*$15,000*
		Annual cost of changed procedures - SWAG	$10,000/yr
TOTAL Initial Cost	*$2,500*	Initial Cost (without master planning)	*$107,000*
Annual Cost	$1,000	Annual Cost	$10,000
Total Cost (first 5 years)	$6,500	Total Cost (first 5 years without master planning)	$147,000
Total Cost (ongoing 5 -year period)	$5,000	Total Cost (ongoing 5-year periods)	$50,000
		Master planning	$800,000
TOTAL Initial Cost	*$21,500*	Initial Cost (without master planning)	*$804,100*
Annual Cost	$13,250	Annual Cost	$281,300
Total Cost (first 5 years)	$74,150	Total Cost (first 5 years without master planning)	$1,929,300
Total Cost (ongoing 5 -year period)	$66,250	Total Cost (ongoing 5-year periods)	$1,406,500
		Master planning	$800,000

The Stormwater Utility Concept in the Next Decade (Forget the Millenium)

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Abstract

In the mid-1970's, the first stormwater utilities were viewed as novel innovations in a few western states. Today, just 25 years later, more than four hundred cities, counties, and special districts throughout the United States have established such utilities. The pace is accelerating, and the stormwater utility concept has moved from a novelty to a well-accepted management and funding approach. What will we see in the next decade?

The stormwater utility has been adapted to fit diverse stormwater management problems and needs across the United States. Program content, priorities, institutional and organizational structures, and rate methodologies have been tailored to fit local needs and municipal authority and practices that vary widely. Courts in several states, and even federal courts, have been engaged in resolving key issues, including but not limited to the legality of utility service fees and the use of other funding mechanisms.

Major changes in the concept are still emerging today. Stormwater quality has become a concern equal to flood control in many communities. The National Pollutant Discharge Elimination System Phase II stormwater permits have spurred a new round of interest in the stormwater utility concept among smaller communities. This is creating a demand for basic utility concepts suitable for small cities and towns, which will need to be less costly and simpler to implement and maintain. Concurrently, more large cities, urban and urbanizing counties, regional service agencies such as metropolitan sewer districts, and consolidated governments are investigating the utility approach. They will require more complex institutional and funding solutions.

Stormwater management itself is also changing rapidly. Interest and involvement in stormwater management have broadened. As combined sewer overflow programs, total maximum daily load (TMDL) negotiations, stormwater quality mandates, coastal zone management measures, and safe drinking water supply issues converge, more wastewater and even water supply utilities are engaging in stormwater management. Regional resource management programs, watershed-based master planning, multi-purpose cooperative efforts involving urban forestry and riparian corridor protection, and use of state revolving loan funds for stormwater quality projects are becoming more common.

Local programs are quickly evolving as well. They have become more comprehensive in scope, more costly, and more demanding of technical and administrative skills while the pool of resources has grown relatively slowly. Local governments are accepting responsibility for more components of the stormwater drainage systems or, in some cases, being forced to take on such responsibilities. Open streams, historic remnants or agricultural ditches and levees, and detention facilities are being included among the system components actively improved, operated, and maintained by local stormwater management agencies. A preventive orientation that minimizes problems is replacing reactive measures. Technology, such as geographical information systems and hydrologic and hydraulic modeling, is more widely available and more productive in support of stormwater management, even in smaller communities. Public involvement in decisions, policies, and even the operation of systems is increasing.

This paper examines these and other emerging trends that characterize where stormwater utilities are heading in the next decade.

Pressures Moving us from Draining the Swamp to Stormwater Management

Historically, local drainage flooding, erosion, and water pollution due to stormwater runoff have not been high priorities for municipal governments. Unless homes, businesses, valuable agricultural land, or public properties have been devastated by flooding or other "drainage" problems, competing priorities have generally garnered more public concern and thus more support from elected officials. As a result, stormwater management operations, regulatory measures, and capital investment were historically ignored or, at best, received inadequate attention and erratic funding. Stormwater management has been a "stepchild" among municipal programs.

Symptoms of this past disregard are evident in many cities and counties.

- Improvements to stormwater systems in many communities have been limited to site-specific facilities installed by subdivision and commercial developers.
- Design practices have traditionally emphasized collecting and discharging runoff from each property as quickly as possible, without regard for downstream consequences.
- Public maintenance of stormwater systems has typically been reactive, and usually limited to road rights-of-way where uncontrolled stormwater might impact traffic safety, degrade the integrity of road surfaces, or threaten valuable adjacent properties.
- Maintenance of stormwater systems located outside of road corridors has commonly been left to private property owners, who are rarely capable of or willing to properly improve, clean, and repair such facilities.
- Municipal governments have usually improved and maintained individual structures or reaches instead of entire drainage systems, creating a patchwork of pieces having widely varying capacity and reliability.
- Failures of substandard components frequently impair the performance of otherwise adequate parts of the systems and damage properties near them.

As described by one municipal public works official, this stepchild is also the "sleeping giant" of unmet municipal infrastructure needs. Long-term stormwater remedial repair costs potentially exceed street and bridge repair needs in many older cities. Learning the high cost of correcting stormwater management deficiencies through master planning may have frightened as many local jurisdictions into inaction as it has spurred others. Perhaps the classic example is the stormwater master plan for Key West, Florida, which (in the early 1990's) identified $78 million in capital needs for that four square mile island community of less than 30,000 people.

Several factors are now changing local governments' traditional orientation to stormwater management.

- Citizens' service expectations are higher than in the past. In many cities and counties the number of citizen complaints about stormwater problems exceeds those about potholes in roads.
- Crumbling inlets and silt clogged ditches along roadsides spawn complaints even though they are on public property.
- Individual citizens or neighborhood associations no longer tolerate minor problems like localized flooding and channel erosion in backyards.

Environmental awareness in general is greater than in the past, and much more attention is being focused on stormwater impacts on receiving water quality in recent years.

- Stormwater management is now recognized as being part of an effective water resource protection strategy.
- Local concerns about acute threats of water pollution from spills and surreptitious dumping of toxic materials into stormwater systems are becoming more common.
- Phase II of the National Pollutant Discharge Elimination System (NPDES) stormwater permitting program is extending the program to smaller communities and those larger urban cities that escaped Phase I due to combined sewer service area exemptions.
- Programs proposed by local governments in NPDES Phase II permit applications will cost many thousands of dollars per year in cities, towns, and urban counties.

An encompassing, umbrella perspective of water resource management is emerging.

- Solutions to combined sewer overflow (CSO) problems will have to balance optimization of wastewater transport and treatment facilities against stormwater quantity and quality concerns.
- Several coastal states have instituted restrictive limitations on stormwater runoff to protect fragile estuaries and offshore waters from stormwater impacts.
- Drinking water supply watershed protection measures have imposed stormwater runoff regulations on developers independent of local stormwater management control practices.
- The point is becoming clear. Drinking water is water. Wastewater is water. Stormwater is water. Ground water is water. It is all WATER!

In the face of these pressures, the inadequacies of traditional stormwater management practices and funding are more widely recognized. More comprehensive and cohesive programs that address both stormwater quantity and quality are emerging. Clearly, however, the diversity of our communities and their problems and priorities means that no single solution is appropriate for every county, city, town, and village. Nor can a single funding method or stormwater utility rate structure fit every situation. Stormwater service fee methodologies can be designed to meet the specific needs of each community and provide equitable, adequate, and stable funding. The key is to tailor the funding to a clear program strategy.

"Stormwater Utility" can have Many Meanings

The fact that the simple term "stormwater utility" obscures the various meanings it may encompass, results in many misunderstandings. The term may imply a funding and accounting method, an organizational approach, a management concept, or a combination of all these. In reality a "utility" provides an umbrella under which the financial, organizational, and management approaches of each local stormwater program can be orchestrated to achieve practical and efficient solutions. Responsibilities may be consolidated and focused. Substantial new funding may be generated. New technology, different management concepts, and upgraded support systems may be adopted. A comprehensive, preventive program may be instituted.

Changes in the Approaching Decade

The spectrum of the stormwater utility concept will broaden more in the next 10 years than it has in the 25 years since the first utilities were established. The definition of "conventional" will change. Smaller towns and even villages will need to employ simpler variations of the concept. Larger cities, urban counties, consolidated governments, and coordinated regional approaches will demand more complex institutional, organizational, and funding solutions. The following are a few of the changes that may occur.

NPDES Phase II Will Impact the Stormwater Utility Concept

The findings of a survey of Phase II cities conducted by the National Association of Stormwater and Flood Management Agencies (NAFSMA) and published in July, 1999 indicate that 17% of all the respondent communities did not know how they would obtain funding to meet the stormwater regulations. Nearly half indicated they were not currently spending money on any of the stormwater program elements mandated by the regulations. Nearly three-quarters did not have a public information or education program as the regulations mandate. The 54% of respondents that currently fund programs or activities that fit the Phase II regulations on average spend upwards of $4,000 per square mile, or about $2.79 per capita. The implication seems clear that the NPDES Phase II program poses demands on local governments that may cause them to look to the stormwater utility concept to meet their stormwater quality program funding requirements.

The typical community that found the stormwater utility concept attractive in the past was a mid-size to larger city undergoing rapid development. Analyses of their stormwater management needs and programs typically revealed initial costs of service ranging from $25,000/sq. mile to $50,000/sq. mile annually. Costs per capita were typically $10 to $30 annually, with smaller cities trending toward the higher end of the range. In this context, the NAFSMA survey data is not alarming. It suggests that the Phase II program costs will likely be in the neighborhood of five (5) to fifteen (15) percent of the typical cost of stormwater management at the outset of utility-based programs.

Given its cost implications, NPDES Phase II makes the stormwater utility concept attractive to a broader variety of cities, counties, towns, and villages. Many communities that do not suffer flooding or other drainage problems will find the revenue potential and flexibility of a utility service fee attractive in the face of NPDES permit requirements. This will result in utility approaches that are outside the current spectrum of our experience. The needs in individual small communities may be less diverse than in large cities and urban counties, but the range will be cumulatively broader among the communities involved in NPDES Phase II than in those that have implemented utilities previously.

New institutional arrangements and relationships will have to be devised. The "utility" concept will take on new forms. Use of interlocal agreements among several local jurisdictions will increase, with responsibilities in some cases concentrated in one entity capable of providing the range of services required or, conversely, allocated among several participants.

The limits of existing authorizing legislation in some states will be tested. Many states will need to adopt new legislation and amendments, giving local governments greater flexibility in dealing with their water resource management responsibilities. Courts in the various states, and perhaps even federal courts, will be challenged to arrive at some sense of continuity among the institutional and financial solutions characterized as "stormwater utilities." Whether the court decisions will enable rather than hinder local governments' efforts to comply with NPDES mandates is a key question.

Organizationally and financially independent stormwater utilities have been common to date. In the next decade more stormwater utilities will be integrated with other water resource programs: organizationally, through formalized working relationships, or through financial arrangements. Other resource management agencies and programs, including but not limited to health departments and growth management authorities, will demand a seat at the stormwater table.

As NPDES permitting is applied to smaller urban areas of less than 100,000 people, more of the regional wastewater and water utilities already serving those communities will assume stormwater management responsibilities. In some cases their involvement will be limited to water quality aspects. In others they will address both quantity and quality. Funding of stormwater management costs will simply be assumed by some of these existing utility agencies without changes in their rate methodologies. Others will establish independent stormwater cost centers and rate components to track spending and allocate costs. Some will even modify existing wastewater and/or water rate methodologies to better reflect the impact of stormwater control on costs of service.

As more small cities and counties seek to establish utilities, stormwater funding strategies and rate methodologies will need to minimize implementation costs, yet be more flexible to accommodate stormwater quality management costs and unique local needs. The urge to use a "cookbook" solution will cause some to adopt approaches that are poorly suited to their circumstances. The desire for more precision in service fee rate algorithms will lead to methodologies that give an illusion of greater refinement without actually achieving it.

The mandated involvement of smaller jurisdictions and more rural communities in stormwater management will spawn "paper utilities" established solely to generate added revenue. Most of these will be initiated without the foundation of a solid program strategy. Accountability will become a key issue in some of these communities within a few years. Political challenges based on accountability issues will cause some of these storm water utilities to be melded into other local agencies or programs or even dissolved entirely before they have geared up to address their program priorities.

Despite NPDES storm water permit mandates, locally perceived needs will still predominate in setting priorities. Flooding will remain a more important local issue than storm water quality. NPDES mandates will influence actual spending priorities only slightly. Few communities will need to institute a utility service fee just to support their NPDES Phase II programs, but many will justify it (at least partially) on that basis because it is easy to blame unfunded federal mandates for new local taxes, assessments, and service fees.

The technological resources and expertise required will change from the traditional engineering emphasis to a multi-disciplinary mix. More natural science and social science skills will be needed. Operational practices will change as new technology and information management systems enable innovative approaches and result in greater efficiency. Greater use will be made of outsourcing because of limited personnel resources and the high cost of specialized equipment.

The Stormwater Utility Concept will Impact NPDES Phase II

Local approaches to stormwater management will influence the content of Phase II permits and attainment of NPDES objectives. Stormwater utilities offer both financial capability and flexibility. Except in rare instances, stormwater utilities will not be established strictly to address stormwater quality and NPDES permit requirements. Rather, they will have a broader stormwater management perspective. For many communities this will mean that water quality management activities to comply with their NPDES permit will be tacked onto other stormwater efforts. NPDES Phase II permitting will, within a few years, adjust to accommodate this reality in terms of permit mandates, technical and scientific standards, and reporting requirements.

Related issues ranging from combined sewer overflow strategies to drinking water protection will be melded with Phase II permit requirements because they have to be. Local stormwater quality management cannot independently meet the entire range of regulatory expectations operating strictly by reference to NPDES Phase II. Conflicts and primacy battles will identify inconsistencies and gaps between the issues and programs, and will ultimately filter down to changes in NPDES Phase II program priorities and the permit requirements imposed on local governments. The unknown is whether this result in responsibility shifting toward bigger agencies with more resources and a broader perspective or toward local entities that have the ability to identify and activate locally acceptable solutions.

Watershed-based regulatory programs will overtake jurisdictional-based regulatory programs like NPDES Phase II. The utility approach will broaden to encompass watersheds through agreements among counties and cities simply because utility funding has the proven capacity to generate sufficient funding in politically acceptable ways. The transition has already begun in some areas. Where TMDLs affecting discharges of all sorts into receiving waters are an issue, they will supercede the six minimum practices identified for NPDES Phase II, making them essentially meaningless. Scientifically based, public health driven measures to protect drinking water supplies, estuaries, lakes, fisheries, and recreational beaches will overwhelm the programmatic approach represented by NPDES Phase II.

You May Need a Program to Identify All the Players

Stormwater utilities were first established because no one wanted responsibility for stormwater management. Those involved were concerned only about the impact of stormwater on their "real" jobs. The utility approach provided a way to focus responsibility and obtain dedicated, if not always adequate, funding for stormwater management. If there had been another option that was working, the stormwater utility concept probably would never have emerged.

A key issue in the next decade will be whether stormwater utilities will be major protagonists or bit players among all those now crowding onto the stage. More established and better-funded water and wastewater utilities now recognize that stormwater influences their operations directly and, in some cases, dramatically. For example, TMDL-based wastewater discharge limitations may severely curtail development in some areas. Will local wastewater utility administrators (and local elected officials) allow independent stormwater management utilities to address stormwater quality when economic vitality is at risk?

Other interests are becoming involved in stormwater management. Water supply utilities face the requirements of federal and state legislation regulating sources of supply and treatment. Coastal zone management has recognized that many priority uses of the shorelines and near-shore areas are dependent on good water quality. Growth management is an emerging concept, and concurrency of infrastructure improvements with development approvals highlights the issue of deficient stormwater systems in many communities. Protection of endangered and threatened species, urban forestry, and riparian corridor protection all have a relationship with stormwater management.

The Walls Will ComeTumbling Down (or at least they better)

The proliferation of federal, state, and local water resource (and related) regulations in recent years has created an environment in which dispersed responsibility for water in various forms and for various purposes is rapidly becoming unworkable. The institutional barriers that have been created over the past hundred years or so to focus attention, energy, and responsibility no longer fit the public needs. As watershed-scale studies, planning efforts, and the concept of TMDLs clearly illustrate, water resources are inextricably bound together regardless of their temporary form, use, and character.

The next decade will see accelerating consolidation of water resource management responsibilities at the local level of government. This is contrary to the control interests of some individuals and entities, and will not happen silently or easily. Will cities, counties, and special districts relinquish a little (or a lot) of their control over water resources through interlocal agreements? Will they accept a regional entity for water supply, wastewater treatment, stormwater management, or even water quality? What will be the effect on stormwater utilities?

What are the organizational implications of the coming changes in storm water management? Realistically, local governments change slowly. Public Works and Street Departments have historically been the lead organizations of storm water programs, but they rarely have had much involvement in water quality issues. If storm water quality begins to influence local priorities, it is more likely that water and wastewater utilities will assume storn water management responsibilities from Public Works and Street Departments than the reverse. Public Works agencies will have to upgrade their engineering and scientific capability or risk losing their storm water management role to water and wastewater utilities that are typically well-established, well-funded, and well-understood by the public.

The Ability to Innovate Will Exceed the Need

Most of the early stormwater utilities programs were rather narrowly focused, and the funding mechanisms supporting them were relatively simple. In recent years, however, there has been a shift toward more sophisticated and complex approaches to all aspects of stormwater management--from master planning to rate methodology design. Much of the credit goes to the explosive growth in information processing capability associated with the computer revolution of the past 20 years. It is not clear, however, that much of the added capability to innovate is necessary to meet stormwater management needs. This is not to suggest that opportunities to improve should be ignored simply because they are based on increasing capability to do so. The following examples demonstrate how the ability to innovate in stormwater through technology can run amok, and suggest how it should be managed to the benefit of people and the environment.

There is no substitute for understanding what is really important. One Southeastern United States city invested over $1 million dollars assembling a highly detailed location inventory of its stormwater systems on a relatively sophisticated data processing platform. Unfortunately, the need for the inventory was not premised on a clear program strategy, nor was adequate funding available or established concurrently to support capital improvements or maintenance enhancements that could be facilitated by the inventory. The local elected officials finally tired of the seemingly mindless spending on the inventory and refused to discuss program improvements. Today, nearly 10 years later, the inventory has not been maintained and is out of date, and few improvements have been made in the stormwater management program.

What is technically possible does not always make common sense, and what makes sense is not always technically possible. A Northeastern city recognized that the stormwater component of its wastewater service fee rate methodology (one that was based on water meter size and internalized within its water/wastewater rates) was not reasonably allocating the cost of stormwater services and facilities across the community. Change to a more rational approach was desired, so a thorough assessment of the range of options was undertaken. A broadly representative advisory committee aided in the selection process. A relatively simple stormwater rate concept was selected that segregates stormwater funding from wastewater and water service. It will allocate a portion of the cost of stormwater service on the basis of gross area and a portion on the basis of impervious area. Once the impact of the change on certain rate payers was recognized, however, the advisory committee decided that phasing in the new rate over three years was a better idea than making the change in one step. While the technical support requirements of the phased approach are not especially demanding, the public information and education challenge is enormous. Not only must the new rate methodology explained to the public; it and the phase-in concept must be explained every year for three years.

Errors by a Few Will Make Life Miserable for Many

As the number of stormwater utilities grows, there is a natural tendency among municipal managers to assume that the process and results have become standardized, and the experiences of another community can simply be transferred. In an effort to save money, some cities and counties have established utilities without sufficient foundation and have even adopted service fee ordinances without the benefit of a cost of service analysis or a rate study. Such misjudgments have led to some monumental errors that have the potential to erode if not destroy the viability of the utility concept in a region, a state, or even nationally.

One city recently established a stormwater utility and adopted rates based on internal analyses that did not define a program, project the cost of service, or estimate the rate base available to generate revenue. As a result, the initial service fee billing was for nearly three times as much total revenue as the administration had indicated it hoped to raise for stormwater management. Furthermore, sufficient public information and education had not been conducted prior to the initial billing, so the public did not understand the purpose of the billing. A lawsuit was filed, and a same judgement on behalf of the plaintiff has resulted in the servie fees being rescinded and revenues returned with interest.

Expectations Will Advance Faster than Programs

One common experience of the cities and counties that have established stormwater utilities is that public expectations for the program have exceeded the utility's ability to perform. This means that creating accurate expectations before a utility is established must be a high priority. One cause for unfulfilled expectations is that stormwater utility revenue streams are usually insufficient to address all the accumulated problems in a relatively short time. Initial stormwater utility service fees have typically been less than $3 month for single-family residences.

Perhaps more significant, however, is the fact that most stormwater utilities inherit programs and systems that are not only deficient, but also do not offer an adequate foundation for a good, more comprehensive, program. Utilities often must invest one to three years creating the foundation for the program before real results begin to emerge in the form of capital improvements, remedial repairs, upgraded maintenance, and more effective regulations. Ratepayers tend to have little patience, however, when they are writing checks regularly to a stormwater utility.

In the context of NPDES Phase II permits, public expectations of improvements in water quality need to reflect the complexity of water quality issues and the limited ability of local government to quickly alter conditions in receiving waters through informational and regulatory programs. Attempting to sell a utility to a community as a response to federal water quality mandates has been unsuccessful in several communities. The public recognizes that stormwater quality, while important, is still a minor part of the total cost of stormwater management. Unless a comprehensive quantity and quality control program strategy is apparent, it is difficult to generate support for a stormwater utility.

Are Green Lots Worth More Than Brown Lots? An Economic Incentive for Erosion Control on Residential Developments[1]

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Abstract

Construction sites are major contributors to nonpoint source (NPS) pollution. However, a lack of personnel to enforce erosion control regulations and limited voluntary compliance means that few developers apply effective erosion control. New approaches are needed to increase erosion control on construction sites if this source of NPS pollution is to be significantly reduced. We have tested whether an economic advantage exists for developers who use vegetative cover for erosion control, independent of advantages gained in addressing environmental or regulatory concerns. Improving residential lot appearance from muddy brown to green grass may increase the appeal of the lot to buyers. A market survey shows that homebuyers and Realtors perceive vegetated lots to be worth more than unvegetated lots, and this increased value exceeds the cost of seeding. Thus, developers can now be encouraged to invest in vegetative cover because of the potentially high return on the investment.

Introduction

Sediment Pollution and Construction Sites

Nonpoint source (NPS) pollution, produced from diffuse sources such as runoff from agricultural land, construction sites, and urban surfaces, is now the leading cause of surface water quality degradation in the United States (Novotny and Chesters, 1989; Federal Register, 1990). In developing areas, construction sites are a major source of NPS pollution because soil erosion rates are increased dramatically when land is exposed and disturbed by excavation and vehicular movement (Harbor et al., 1995; Goudie, 1994; Goldman et al., 1986, Fennessey and Jarrett, 1994). In fact, some of the greatest soil erosion rates ever reported are associated with construction activities (Crawford and Lenat, 1989); erosion rates on construction sites are typically 2-40,000 times greater than rates under preconstruction conditions (Wolman and Schick, 1967; Harbor, in press). Sediment contributed to streams by construction sites can exceed that previously

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deposited over many decades under pre-development land uses, radically altering stream geomorphology and ecology (e.g., Wolman and Schick, 1967). The larger-than-normal sediment deposition in waterways frequently exceeds the natural capacity of the receiving water system to assimilate and equilibrate to the sediment influx (Paterson et al., 1993), causing rapid channel changes and increased probability of flooding, erosion, and sedimentation problems (Goldman et al., 1986).

In addition to sediment, construction sites generate other pollutants such as pesticides, nitrogen, and phosphorus from fertilizers, petroleum products such as oil and gas from machinery, soil stabilizers, construction chemicals, and washings from concrete or bituminous mixing and flushing operations (Koehn and Rispoli, 1982; Lemly, 1982). In some cases these pollutants are in particulate form or are adsorbed by soil particles and are transported with the suspended sediment in runoff from construction sites (Paterson et al., 1993; Bhaduri et al., 1997).

Although construction sites generate a wide range of potential pollutants, sediment overshadows all the other construction site pollutants in total ecological and economic impact on receiving waters (Lemly, 1982). It was estimated that 15 million tons of sediment were released from urban construction sites to surface waters in or near heavily populated areas in 1975 (Lemly, 1982). The North Carolina Department of Natural Resources and Community Development has stated, that "sediment and its effects on stream environments" is the "most widespread water quality problem in North Carolina" (Crawford and Lenat, 1989). Because construction activities predominantly occur near existing population centers, the waters that are most seriously degraded are generally those that are most frequently used (Lemly, 1982).

Economic Consequences of Sedimentation

In addition to environmental impacts, enhanced delivery of sediment to off-site areas from construction activities has significant economic effects (Table 1). These economic impacts result from lakes and streams becoming turbid and filling with silt, destruction of commercial aquatic species, the need for additional treatment of turbid water for industrial use, filling of harbors and navigation channels, loss of storage capacity of reservoirs, damage to drainage ditches, increased frequency of flooding, loss of aesthetic value in the environment, and loss of game habitat (Lemly, 1982; Wolman and Schick, 1967; Koehn and Rispoli, 1982). The economic burden of mitigating these environmental impacts is almost always placed upon the taxpayer, rather than on the operator of the construction site that is producing high sediment yields (Harbor, in press). By not paying to prevent the off-site transport of sediment through the use of erosion control measures, the developer allows sediment from the construction site to reach waterways where the economic and environmental costs of any impacts are paid by downstream landowners and the community as a whole, and not the developer.

Overall, annual expenditures for in-stream and off-stream impacts due to sedimentation in the United States exceeds $11.6 billion (Table 1). In-stream effects include impacts while sediment is in a waterway (stream, river, lake, or reservoir). Off-stream effects can occur before or after sediment reaches a waterway, either in floodwater or in water withdrawn from waterways to be used for industries, municipalities, or agriculture (Clark, 1985; Clark et al., 1985; Paterson et al., 1993). Although agricultural areas are far more extensive than construction sites, the mass of sediment per unit volume of runoff from urban and construction areas is 5 to 20 times greater than that of runoff from agricultural lands (Fennessey and Jarrett, 1994). In addition, construction sites are usually located in developing or developed areas, where potential impacts on infrastructure and other water uses are more severe than in rural areas. Estimates of agriculture's contribution to off-site effects range from 1/3 to 2/3 of the total (Clark, 1985; Clark et al., 1985; Colacicco et al., 1989, Pimentel, et al. 1995). Thus, urban off-site environmental impacts are probably on the order of $3.9 to $7.8 billion per year (1/3 to 2/3 of the total off-site effects), and are often borne by off-site landowners and communities. One of the main goals of erosion and sediment control regulations is to avoid these costs. The problem, however, is that developers have to pay to reduce erosion yet do not see any immediate return on this investment. Because there is little economic incentive for developers to control erosion, regulatory and educational approaches have been developed to improve construction site erosion control, and requests to impose impact fees on developers have increased (Trotti, 1997).

Table 1. Off-site damage costs from soil erosion by water in the United States

Type of Damage	Cost (millions in 1997 dollars*)
In-stream damage	
Recreational (fishing, boating, swimming)	3,886.0
Water storage facilities (dredging, excavation, construction of sediment pools)	1,340.7
Navigation (accidents, dredging)	1,088.1
Other in-stream uses (commercial fisheries)	1,748.7
Subtotal in-stream	8,063.5
Off-stream effects	
Flood damages (sediment damage to urban and agricultural areas)	1,496.1
Water conveyance facilities (sediment removal of drainage ditches and irrigation canals)	388.6
Water treatment facilities	194.3
Other-off stream uses (municipal and industrial, steam electric power plants, irrigation)	1,554.4
Subtotal off-stream	3,633.4
Total water erosion costs	11,696.9⁺

(Data based on: Clark et al., 1985)
*Conversion using Consumer Price Index from 1980-1997.
⁺ Assuming that effects are the same today as in 1980.

Vegetation and erosion control

The significant ecological and economic impacts of sedimentation provide strong motivation for erosion control. Soil erosion involves the detachment of soil particles by raindrop impact, wind-blown particle impact, wetting and drying cycles, freezing and thawing, and runoff, and the transport of detached soil particles by rain splash, wind and runoff (Ekwue, 1990; Goldman et al., 1986). Climate, topography, vegetative cover, and soil characteristics are the principal factors that control soil erosion potential. Climate and soil characteristics cannot be readily controlled on a site, and topography is constrained by pre-existing conditions and the grading plan, leaving surface cover as the most easily modified variable that controls oil erosion on a site. Increasing vegetative cover on barren areas such as construction sites is an excellent way to impede soil erosion and decrease sedimentation (Fig. 1).

"Vegetative cover is the most effective form of erosion control...a properly revegetated soil will be protected from erosion indefinitely without any need for human attention" (Goldman et al., 1986, p. 6.23). Vegetation (especially close to the ground surface) protects the surface from raindrop impact and reduces the velocity of water flowing over the surface by increasing surface roughness and disrupting overland flow (Clark et al., 1985; Rogers and Schumm, 1991; Satterlund, 1972). The reduction of water velocity flowing over the surface and the breaking up of soil by plant roots increases the amount of infiltration, thereby reducing the amount of surface water flow (Clark et al., 1985). Vegetation also depletes subsurface water between rainfall events, which reduces the amount of runoff during storm events. In fact, vegetative stabilization on construction sites has been shown to reduce soil loss by 80% (Harbor et al., 1995) to 99% as compared to bare soil (Koehn and Rispoli, 1982). The cost of reducing soil erosion using vegetative cover depends on the materials used, but typical temporary seeding on a one-third acre residential lot in the Midwestern US costs from $250 to $325.

Regulations requiring construction site erosion control

In the US, the biological and physical impacts of off-site sedimentation have prompted local, state, and federal regulations requiring erosion and sediment control for construction sites. The National Pollution Discharge Elimination System (NPDES) is a national program that issues, monitors and enforces permits for stormwater discharges associated

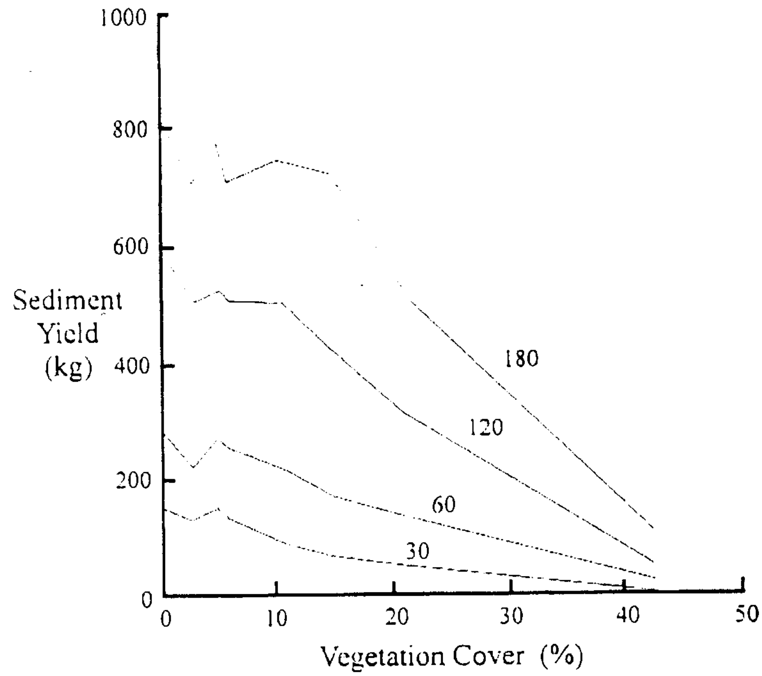

Figure 1. Sediment yields for different vegetative cover densities at 30, 60, 120, and 180 minutes of simulated rainfall on a 10% slope (Rogers and Schumm, 1991).

with industrial activity such as construction under the Clean Water Act (Federal Register, 1990). State and local regulators, under the NPDES program, require erosion and sediment control for construction sites with 5 acres or more of land disturbance (Federal Register, 1990). Because vegetative cover greatly reduces soil erosion, many federal and state regulations, such as Rule 5 in Indiana and the Model Regulations for Urban Soil Sediment Pollution Control in Ohio, encourage the use of surface cover as an important element of erosion control on construction sites.

In Indiana, for example, state regulations mandate that sediment should be contained on the construction site and not, for example, allowed to run onto public or private roadways. Rule 5 requires that if vegetative practices such as seeding and mulching are used, they must be implemented within seven days of the "last land-disturbing activity" at the site and that these actions are the responsibility of the person in charge of the construction activity, which usually is the developer (Indiana Department of Natural Resources, 1992). Similarly, in Ohio, Model Regulations for Urban Soil Sediment Pollution Control (1980) require that the responsible party for the development stabilize denuded areas with permanent or temporary soil stabilization within seven days for any denuded area that has reached its final grade or is to remain dormant for more than 45 days. The permanent vegetation is not "considered established until ground cover is achieved which...provides adequate cover and is mature enough to control soil erosion satisfactorily and to survive adverse weather conditions" (Ohio Department of Natural Resources, 1980).

Enforcement of erosion control regulations varies significantly among states. For example, in Indiana, the Indiana Department of Environmental Management (IDEM) controls permitting and enforcement, but local soil and water conservation districts (SWCD) review and evaluate erosion control plans. At typical staffing levels, SWCDs in developing areas find it very hard to keep up with the large number of developments they are responsible for. The local SWCDs inspect the construction sites to establish whether the developer is implementing the soil erosion control plan correctly and to observe whether the possibility of or the actual transport of sediment off-site exists. The SWCD will provide the developer with written recommendations describing which erosion control measures need to be improved, maintained, or installed. The developer then has two weeks to comply with the recommendations. If the developer is not found in compliance with the requirements after recommendations have been made, the SWCD reports the site to the Urban

Erosion Control Specialist from the Indiana Department of Natural Resources (IDNR), who has been receiving copies of all written warnings to the developer. The Urban Erosion Control Specialist will then visit the site and determine whether the site should be reported to the IDEM. Subsequently, the IDEM determines whether further action, such as levying a fine against the developer, is warranted. This process can lead to delays of many months between identification of a problem and regulatory enforcement.

In reality, it takes a great deal of coercion to get developers to promptly apply erosion control measures on their sites. Developers find applying erosion control measures inconvenient, costly, and time consuming, and are fully aware of the lack of regulatory personnel to enforce local, state, and federal mandated erosion control (Harbor et al., 1995). Therefore, developers often do not comply with the regulations and let their sites remain bare (Harbor, in press; Harbor et al., 1995). When inspected, sites are often either lacking erosion control measures or maintenance of existing control measures is long overdue. The effort (if any) on the developer's part to maintain or implement the erosion control measures is often inadequate and is done to appease the local SWCD, rather than with the goal of achieving 'best management' of the site. Aside from regulation, there is little incentive for a developer to use erosion and sediment control practices. In fact, a developer who uses erosion control may be at a cost disadvantage compared to other developers who do not, thereby making construction less profitable (Harbor, in press).

Origin of this study

In a study evaluating the use of rapid seeding and mulching to reduce NPS pollution from construction sites, one developer commented that he liked seeding because he thought that it made his developments more marketable (Harbor et al., 1995). The developer soon began to include extensive seeding on his other developments to achieve the same neat, green looking result. Even though the developer was interested in seeding because he thought it would give him a competitive edge over other developers, he was voluntarily using vegetative erosion control (Harbor et al., 1995; Harbor, in press). As similar anecdotal evidence accumulated, it seemed possible that a higher market value for a seeded site might provide an incentive for voluntary erosion control. If an economic advantage can be established, then it may be possible to persuade developers to use erosion control on the basis of a profit motive, where regulation and education have proved ineffective. If widespread voluntary application can be achieved by this means of increased profitability, it will make it easier to obtain compliance with erosion control programs and reduce the burden on regulators. Furthermore, and most importantly, the NPS pollution load from construction sites would be reduced.

Methodology

We hypothesize that green, grassed lots are more attractive to buyers and therefore may be valued more highly and sell faster than bare, dirt lots. There are several ways to test this hypothesis, with the most thorough being a detailed tracking of the sales prices and sales timing of a large number of randomly selected treated and untreated control lots on residential constructions sites throughout the US. In the absence of data to perform this type of highly detailed approach, we undertook a pilot study using photos of treated and untreated lots in a market survey questionnaire aimed at establishing whether lots with green vegetative cover are valued higher than barren ones by Realtors, developers, and homebuyers. In the work reported here, however, we do not evaluate whether green, grassed lots sell faster than bare, dirt lots.

Randomly selected lots in three residential housing developments in Ohio and Indiana were seeded and mulched. Photographs of these lots were taken prior to seeding and then when the grass was approximately one inch high (Fig. 2). Lots were photographed from three angles (front left, front center, and front right), and selected photos were used in a lot valuation survey. The market survey was designed as a broad tool to investigate a wide range of factors which homebuyers, Realtors, and developers find important when buying/selling a lot in a residential housing development. The survey included open- and closed-ended questions, and those surveyed were not told the actual purpose of the survey. The survey is reproduced in Herzog (1997). Included within the wide range of questions in the survey were specific questions on the importance of lot appearance, and a lot valuation question in which those surveyed were asked to place prices on lots shown in photographs. Those surveyed were told the lots were in the same neighborhood/subdivision, with the streets and curbs installed and had the samesewer/septic system, water system, and noise level. They were then

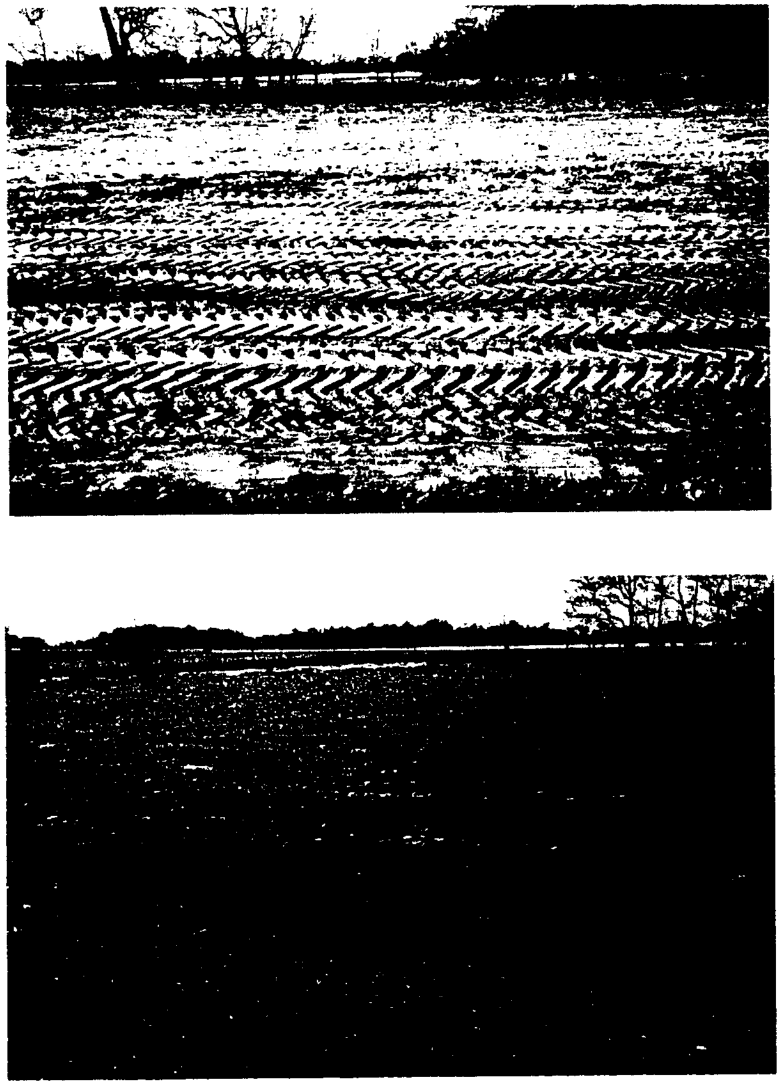

Figure 2. Examples of grassed and bare lot photographs used in the survey.

given 10 lot photos and asked to establish prices for each lot, having been told that the average lot value in the development was $20,000.

Most Realtors and developers were interviewed at their offices in St. Joseph County, Indiana and Geauga County, Ohio. Potential homebuyers were interviewed either at a neutral location or at their place of work, and included residents of St. Joseph County and West Lafayette, Indiana, as well as personnel at a chemical engineering facility in Buffalo, New York which was relocating to Philadelphia, Pennsylvania. The survey typically took 10-20 minutes depending on the responsiveness of the individual.

After completion of the surveys, comparative statistics were used on the lot valuation data to assess whether there was any significant difference between "brown" and "green" lot values for Realtors, developers, and homebuyers. Analysis of variance was initially used to be able to test for the existence of significant interaction between the fixed variables (respondent group and color), while taking into account variation that occurs in the random variables (eg., subjects). The assumptions needed to appropriately apply this method, such as normality of the error terms, were found to be satisfied (Montgomery, 1997).

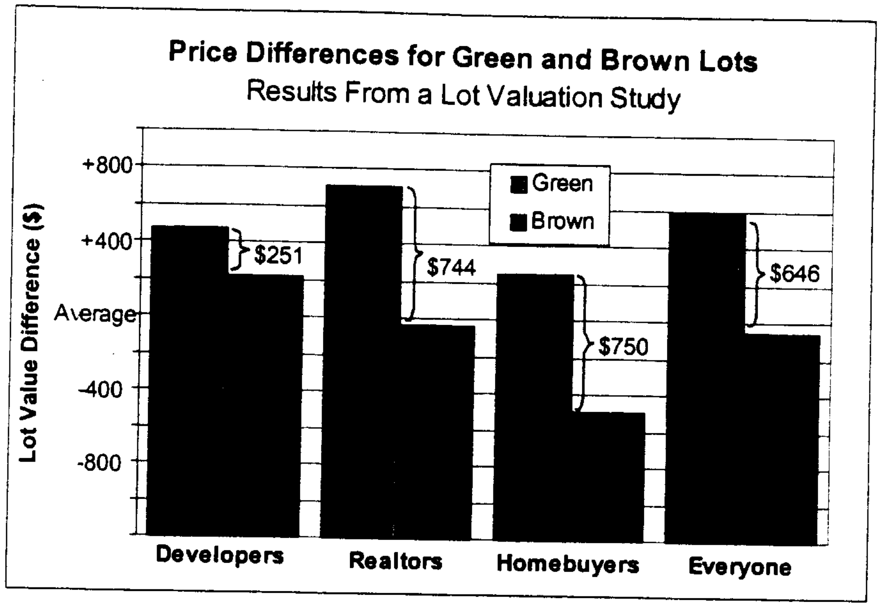

Figure 3. Differences in average prices for green and brown lots between survey groups.

Table 2. Effect of lot treatment on price for three different survey groups

Group	Green Lot Mean Price ($), sample size (n)	Brown Lot Mean Price ($), sample size (n)	Price Difference ($)	Test Statistic	Significance Level (p-value)
Realtors	20,711 (n=155)	19,967 (n=154)	744	t=4.0085	0.0001
Homebuyers	20,250 (n=36)	19,500 (n=36)	750	t= -1.7957	0.0788
Developers	20,469 (n=48)	20,218 (n=48)	251	t= -0.9200	0.3609

An important element of the economic analysis of lot greening is the actual cost involved in applying seed. This can vary widely depending on the method used to apply the seed, and the density of vegetation desired. In this work, we restrict the analysis to an amount and type of cover intended for erosion control, as opposed to grass species and density intended for final lawn cover. For this study we used independent contractors to apply seed, mulch, water and fertilizer by hydroseeding. Other common approaches include use of a hand seeder, and mulching with straw either by hand or using a blower. During dry seasons in some areas, watering may be necessary to produce successful germination and early growth. Thus there is a wide range of possible costs of lot greening. In this study we use the actual cost of hydroseeding for our study sites in Indiana and Ohio, $300 per lot, although we could have applied seed and mulch by hand for about $100 per lot. Readers may want to contact their local Soil and Water Conservation District to get estimates of typical costs for their areas.

Results

A total of 478 lot valuations (310 by Realtors, 96 by developers, and 72 by homebuyers) were made. However, during the survey process, it became apparent that two of the photographed lots were being ranked either highest or lowest based on their specific background (one with a fire hydrant and another with lush tree vegetation behind the lot giving an appearance of more privacy than the other lots). Lot valuations based on these two photos, one green lot and one brown were eliminated prior to the statistical analysis.

Initial statistical evaluation of the entire data set focused on determining if the data fit a model in which price was a function of the overall mean price, effects related to the group, the individual surveyed, the individual lot and the lot color plus interaction and random error terms. In this model we assume that the effect of the particular lot and the particular individual are random variables that are independently and normally distributed with a mean of zero, and also that the error terms are independently and identically distributed as normal random variables with mean of zero and variance σ^2. Analysis of variance followed by a normal probability plot of the residuals, and plotting of the residuals versus the predicted values, demonstrated that the error terms were normally distributed with constant variance (Montgomery, 1997). This analysis also demonstrated that there appeared to be significant differences in the variations of prices between groups, which complicates analysis of the data as a combined group. Thus it was necessary to analyze each group separately, using a t test to evaluate the overall effect of color within each group.

Realtors

The Realtors surveyed gave an average value of $20,711 on the green grassed lots and $19,969 on the brown dirt lots. The distributions of lot values for green and brown lots were statistically significantly different at a 99.99% confidence level (Fig. 3, Table 2). As a simple difference between means, the perceived added value for green lots was $742 per lot.

Narrative questions on the survey revealed additional qualitative insight into Realtors' perceptions of lot value, and reasons for preferring green lots. One Realtor commented: "I don't like these mud lots." Others said the grass was more appealing and "easier on the eye," and that the lots look better because they are green. Other Realtors did not see the importance of seeding and believed that grass should not enter into the decision because it will be destroyed in the house building process. "Grass makes it look better but means nothing for what's coming."

Overall Realtors perceived that homebuyers would prefer the grassed lots ("I think people like grass,") and the green lots would sell first because the green grass will remind homebuyers of a yard and allow them to visualize what a house and yard would look like on the lot. One Realtor stated that the grass/ground cover was more appealing than dirt, and that homebuyers "wouldn't like the bare ones very much." Another noted that buyers would be more willing to walk a grassed lot in inclement weather lot because the grass would absorb the moisture and that buyer would not walk a dirt lot because it would become muddy and puddle. One Realtor stated: the green lots look "lush and fertile;" some people cannot visualize dirt lots as possibly being lush and fertile. This Realtor also brought up the concern that a buyer may ask about the drainage if the lot is wet, and if the dirt lot is dry, caked, and cracked, the buyer will wonder if anything can grow on it.

Homebuyers

The homebuyers surveyed placed an average value of $20,250 for the green lots and $19,500 for the brown lots. The distributions of lot values for green and brown lots were statistically significantly different at a 92% confidence level (Fig. 3, Table 2). As a simple difference between means, the perceived added value for green lots was $750 per lot. The added value of $750 (the greatest added value among the groups surveyed) is particularly significant because homebuyers are the ones who actually pay for the lots.

Homebuyers stated that grass gives a realistic impression of the future appearance of the lot and it is more appealing; and that the final product is more difficult to visualize on dirt lots. In general, the homebuyers acknowledged that the grass looks good and has more appeal, while understanding that the lots would be disturbed during construction. One homebuyer said that the green look was nicer but that it "wouldn't effect my decision to buy," because grass was not a "big deal." Even though comments such as these were made, on average homebuyers valued green lots $750 more than brown lots.

Developers

The developers surveyed placed an average value of $20,469 on the green lots and $20,219 on the brown lots. The distributions of lot values for green and brown lots were statistically significantly different at only a 64% confidence level (Fig. 3, Table 2). Typically this would be viewed as indicating no statistically significant difference. As a simple difference between means, the perceived value of the green lots was $250 greater than the brown lots. Clearly, the small difference between the green and brown lots data sets and the comparatively low significance level indicate that developers perceive little or no difference based on lot color.

During the survey, developers addressed the difference between the grass and dirt lots and stated that it should not be a factor in lot price. They pointed out that the green lots will become brown lots during construction and that the homebuyer will put in a yard anyway. Other developers saw that ground cover was more attractive ("I like the green") and perceived that homebuyers would like the grass. Also, some perceived that the green look made a development more marketable compared to other developments; one developer said he "greens up" his developments to make them look more attractive. Another stated that grass makes a lot look like it has topsoil, and if there are soil concerns, the grass demonstrates that vegetation can be grown and is holding soil. One developer remarked how ground cover may be important to homebuyers for more than just appearance. He stated that grass cover is more significant when there is rolling ground because if there is unseeded soil on an adjacent lot, the soil may erode onto the grassed property to the dismay of the homeowner.

The Economic Incentive

Although green lots may be priced higher than brown lots, this gross value is only significant if the price differential exceeds the cost of seeding. The difference in value between grassed and bare lots compared to the cost of seeding provides a measure of potential net economic benefit to the developer. In terms of a simple net return on investment, seeding a lot provides potentially excellent return. Homebuyers valued grassed lots $750 more than brown lots, and as it cost $300 to seed a lot in this study, the developer stands to profit by $450 per lot, which is a 150% return on the initial investment. The ability to more than double an initial investment should be an attractive and sensible advantage for the developer, if the perceived value difference actually translates into a sale price difference.

Present Limitations and Future Work

This pilot study is an initial step in developing information that can be used to persuade more developers to make widespread use of vegetative cover, and other forms of environmental protection. The results of this pilot study are most relevant in areas where climate conditions allow for relatively easy establishment of temporary vegetative cover, and are not applicable to arid or semi arid areas. In addition, budget restrictions limited the scale of the study. Although we collected 478 lot valuations from 62 respondents, a much larger study with respondents from many areas of the United States would overcome a potential criticism that the current study only represents conditions in a small portion of the Midwest. Developers are also more likely to notice results based on data collected within their region, especially if these are coupled with regional demonstration projects. Thus, the next logical step is to initiate a network of coordinated studies in regions experiencing rapid residential development. This would provide for analysis on a national as well as a regional level, and for comparisons between regions.

An additional limitation of the results presented here is that they consider only <u>perceived</u> increase in lot values. In actual sales transactions, buyers may not actually behave in the way they say they would on a survey. As a linked project, it would be desirable to track actual sales histories (timing and pricing) to provide a more complete picture of the actual economic impact of lot greening. Future research should include analysis of a large number of real-world transactions for which lot condition is known. This could be based on a large-scale, long-term study in which researchers intervene to change lot conditions on selected lots or developments. Alternatively, if some landowners are convinced by the results of this study, the experiment might occur naturally in the marketplace as the findings of our work are disseminated.

Further extension of the basic concept of examining the direct profitability of environmental protection is also possible. We were recently contacted by a consultant who had heard of the lot valuation study, and wanted a similar study performed on the increased value of lots next to ponds on developments. Although ponds are often built for stormwater control, and also aid in reduction of nonpoint source pollution, they can also have considerable aesthetic appeal. Thus, it would be potentially very useful to know what the return on investment on a pond is for a new residential development, both in terms of the increased price of lots adjacent to the pond, as well as the increase in average price in lots for the development as a whole because of the improved appearance of the development.

Conclusions

Showing that erosion control may be profitable provides a new way to reach developers who have failed to act on the logic that erosion control provides environmental protection and is required to comply with local, state or federal erosion control regulations. Evaluating the cost of environmental damage is not only very difficult, but also of little direct relevance to a developer who does not directly pay the cost of the damage. Land development is a business, with profit as a leading motive, so appealing to increased profitability is one potentially effective way to change behavior.

The pilot study described here indicates that vegetated lots are perceived to be more valuable and more desirable by Realtors and homebuyers. Realtors perceived that vegetated lots are worth more than barren lots (by $742). They also perceived that vegetated lots are worth more to homebuyers and that homebuyers would be willing to pay more for grassed lots. Homebuyers also perceived grassed lots to be more valuable and put the largest premium ($750) on the lots for all those surveyed. The added lot value is only significant if the price differential exceeds the cost of seeding ($300), which was the case for Realtors and homebuyers by $417 and $450, respectively. Developers valued the vegetated lots higher than non-vegetated lots by an average of $250, but the difference was not statistically significant. Even if it were significant, this price differential is less than the cost of seeding and indicates that developers perceive that seeding costs are greater than the benefits of vegetation. This perception of a net cost associated with greening a lot is perhaps why the market has largely failed to recognize this simple way to increase a property's value. Some developers did recognize the visual appeal of the grass and believed that a greened development would attract homebuyers more rapidly than a development that appears unkempt. However, the valuation study indicates that developers have not aligned their perception of lot value with that of homebuyers.

An alternative way of interpreting the results is to consider the potential return on the investment in the vegetative cover. For a $300 investment the developer can receive a return of $750, i.e. a 150% return on investment. Such a rate of return is difficult to achieve in most conventional investments. Finally, price differential is not the only economic benefit of lot greening; if lots sell faster because of greening, profits will increase because of lower financing costs for capital invested in the development process. Further research is needed to clearly define the value of this potential economic impact associated with lot greening. However, at this stage it is possible to state that in addition to the environmental benefits, and regulatory requirements associated with using vegetation for erosion control, there may be significant marketing and thus economic returns associated with lot greening.

Education concerning the environmental benefits of erosion control, and enforcement of regulations have not produced widespread, effective use of vegetative cover for erosion control. Because developers generally do not perceive much incentive to vegetate their developments aside from complying with often-ineffective regulations, they typically do not. Typically a developer who is using erosion control practices believes s/he is at a cost disadvantage compared to other developers who are not, thereby making the developer following regulation believe s/he will be less profitable. Furthermore, the developer does not directly pay for the mitigation of the environmental impacts caused by the sediment leaving the site; it is the burden of the taxpayer instead. In this study, we have demonstrated that vegetating a development may be a profitable investment. Appealing to the profit motive will hopefully provide a way to generate widespread use of vegetative cover that also provides erosion prevention on construction sites.

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Federal Register

Monday,
October 30, 2000

Part II

Environmental Protection Agency

Final Reissuance of National Pollutant Discharge Elimination System (NPDES) Storm Water Multi-Sector General Permit for Industrial Activities; Notice

ENVIRONMENTAL PROTECTION AGENCY

[FRL–6880–5]

Final Reissuance of National Pollutant Discharge Elimination System (NPDES) Storm Water Multi-Sector General Permit for Industrial Activities

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of Final NPDES general permit.

SUMMARY: The Regional Administrators of EPA Regions 1, 2, 3, 4, 6, 8, 9 and 10 are today reissuing EPA's NPDES Storm Water Multi-Sector General Permit (MSGP). This general permit was first issued on September 29, 1995 (60 FR 50804), and amended on February 9, 1996 (61 FR 5248), February 20, 1996 (61 FR 6412), September 24, 1996 (61 FR 50020), August 7, 1998 (63 FR 42534) and September 30, 1998 (63 FR 52430). The reissuance of the MSGP was proposed by EPA on March 30, 2000 (65 FR 17010). Today's final MSGP will authorize the discharge of storm water from industrial facilities consistent with the terms of the permit.

DATES: This MSGP shall be effective on October 30, 2000. This effective date is necessary to provide dischargers with the immediate opportunity to comply with Clean Water Act requirements in light of the expiration of the existing MSGP on October 1, 2000. Deadlines for submittal of notices of intent are provided in Section VI.A.2 of this fact sheet and Part 2.1 of the MSGP. Today's MSGP also provides additional dates for compliance with the terms of the permit.

ADDRESSES: The index to the administrative record for the final MSGP is available at the appropriate Regional Office or from the EPA Water Docket Office in Washington, DC. The administrative record, including documents immediately referenced in this reissuance notice and applicable documents used to support the original issuance of the MSGP in 1995, are stored at the EPA Water Docket Office at the following address: Water Docket, MC–4101, U.S. EPA, 401 M Street SW, room EB57, Washington, DC 20460. The records are available for inspection from 9 a.m. to 4 p.m., Monday through Friday, excluding legal holidays. For appointments to examine any portion of the administrative record, please call the Water Docket Office at (202) 260–3027. A reasonable fee may be charged for copying. Specific record information can also be made available at the appropriate Regional Office upon request.

FOR FURTHER INFORMATION CONTACT: For further information on the final MSGP, contact the appropriate EPA Regional Office. The name, address and phone number of the EPA Regional Storm Water Coordinators are provided in Section VI.F of this fact sheet. Information is also available through the Internet on EPA's Office of Wastewater Management website at http://www.epa.gov/owm/sw.

SUPPLEMENTARY INFORMATION: The following fact sheet provides background information and explanation for today's notice of final MSGP reissuance, including a summary Response to Comments regarding the comments which were received on the proposed MSGP. The actual language of the final MSGP appears after this fact sheet.

Fact Sheet

Table of Contents

I. Background

The Regional Administrators of EPA Regions 1, 2, 3, 4, 6, 8, 9 and 10 are today reissuing EPA's NPDES Storm Water Multi-Sector General Permit (MSGP). The MSGP currently authorizes storm water discharges associated with industrial activity for most areas of the United States where the NPDES permit program has not been delegated. The MSGP was originally issued on September 29, 1995 (60 FR 50804), and amended on February 9, 1996 (61 FR 5248), February 20, 1996 (61 FR 6412), September 24, 1996 (61 FR 50020), August 7, 1998 (63 FR 42534) and September 30, 1998 (63 FR 52430). The proposed reissuance of the MSGP appeared in the **Federal Register** on March 30, 2000 (65 FR 17010).

The 1995 MSGP was the culmination of the group permit application process described at 40 CFR 122.26(c)(2). A group permit application was one of three options for obtaining an NPDES industrial storm water permit which were provided by the 1990 storm water permit application regulations (55 FR 48063). The 1990 regulations also provided that industrial facilities could apply for coverage under an existing general NPDES permit or apply for an individual permit. In 1992, EPA issued a baseline general permit (57 FR 41175 and 57 FR 44412) to cover industrial facilities which did not select the group application option or submit an application for an individual permit.

In response to the group application option, EPA received applications from approximately 1,200 groups representing nearly all of the categories of industrial facilities listed in the storm water regulations at 40 CFR 122.26(b)(14). To facilitate permit issuance for the group applications, EPA consolidated the groups into 29 industrial sectors, with subsectors also included in certain sectors as appropriate.

In developing the requirements for the 1995 MSGP, EPA utilized and built upon the storm water pollution control requirements of the 1992 baseline general permit. The baseline permit had required a storm water pollution prevention plan (SWPPP) with generic best management practice (BMP) requirements which applied to all facilities covered by the permit. In addition, certain categories of facilities were required to monitor storm water discharges based on EPA's best professional judgment concerning the risks posed by the facilities.

The group permit applications included information concerning the specific types of operations which are present at the different types of industrial facilities, potential sources of pollutants at the facilities, industry-specific BMPs which are available, and monitoring data from the different types of facilities. Using this information, EPA developed SWPPP requirements for the MSGP which consisted of the generic requirements of the baseline permit plus industry-specific requirements developed from the group application information. Also, the monitoring requirements of the 1995 MSGP were developed using the monitoring data submitted with the group applications rather than EPA's best professional judgment.

On September 30, 1998 (63 FR 52430), EPA terminated the baseline general permit and required facilities which were previously covered by the baseline permit to seek coverage under the MSGP (or submit an individual permit application). EPA believed that the MSGP, with its industry-specific requirements, would provide improved water quality benefits as compared to the baseline permit.

For today's reissuance of the MSGP, EPA has re-evaluated the industry-specific requirements of the MSGP. In a few instances, additional requirements have been included based on new information which has been obtained since the original MSGP issuance in 1995. These changes are discussed in more detail in Section VIII of this fact sheet, and in the Response to Comments. EPA also re-evaluated the monitoring requirements of the existing MSGP. However, after review of the comments received from the public, and the monitoring data received during the term of the 1995 MSGP, EPA has retained the same monitoring requirements for the reissued MSGP as were found in the 1995 MSGP.

A. Pollutants in Storm Water Discharges Associated With Industrial Activities in General

The volume and quality of storm water discharges associated with industrial activity will depend on a number of factors, including the industrial activities occurring at the facility, the nature of the precipitation, and the degree of surface imperviousness. A discussion of these factors was provided in the fact sheet for the original proposed MSGP (58 FR 61146 Nov. 19, 1993), and is not being repeated here.

B. Summary of Options for Controlling Pollutants

Pollutants in storm water discharges from industrial plants may be reduced using the following methods: Eliminating pollution sources, implementing BMPs to prevent pollution, using traditional storm water management practices, and providing end-of-pipe treatment. A general discussion of each of these was included in the original proposed MSGP (58 FR 61146, Nov. 19, 1993), and is not being repeated here.

C. The Federal/Municipal Partnership: The Role of Municipal Operators of Large and Medium Municipal Separate Storm Sewer Systems

A key issue in developing a workable regulatory program for controlling pollutants in storm water discharges associated with industrial activity is the proper use and coordination of limited regulatory resources. This is especially important when addressing the appropriate role of municipal operators of large and medium municipal separate storm sewer systems in the control of pollutants in storm water associated with industrial activity which discharge through municipal separate storm sewer systems. The original proposed MSGP discussed several key policy factors (see 58 FR 61146).

II. Organization of Final MSGP and Summary of Changes From the 1995 MSGP and the March 30, 2000 Proposed MSGP

The organization of today's final MSGP has been revised from the 1995 MSGP to reduce the overall size of the permit. In Part XI of the 1995 MSGP, many requirements such as SWPPP and monitoring requirements which were common to each sector were repeated in each sector, greatly adding to length of the permit. For today's reissuance, such requirements are found only once in expanded sections of the permit (Parts 4 and 5) which include requirements common to each sector. Requirements which are genuinely unique to a given sector or subsector are found in Part 6 in the permit. Similarly, Section VIII of the fact sheet for the 1995 MSGP repeated certain explanatory information in the discussions of sector-specific requirements, and also included considerable descriptive information about the various sectors. To reduce the length of today's notice, most of this information is not being repeated. Section VIII of today's fact sheet focuses on the changes (if any) in the various sectors. The reorganization and reduction of duplication have reduced the size of the permit by approximately 75%.

Also note that the section/paragraph identification scheme of today's final MSGP has been modified from the 1995 MSGP. The original scheme utilized a sometimes lengthy combination of numbers, letters and Roman numerals (in both upper and lower cases) which many permittees found confusing. Today's reissuance identifies sections/ paragraphs, and hence permit conditions, using numbers only, except in Part 6 (which also incorporates the sector letters from the 1995 MSGP for consistency). Under the original permit, only the last digit or letter of the section/paragraph identifier appeared with its accompanying section title/ paragraph, making it difficult to determine where you were in the permit. In today's reissuance, the entire string of identifying numbers is listed at each section/paragraph to facilitate recognizing where you are and in citing and navigating through the permit. For example, paragraph number 1.2.3.5 tells you immediately that you are in Part 1, section 2, paragraph 3, subparagraph 5; whereas under the 1995 MSGP you would only see an "e", thereby forcing you to hunt back through the permit to determine that you were in Part I.B.3.e. The exception to the numbering rule is in Part 6, where the Sector letters from the 1995 MSGP have been retained to correspond to the sectors of industry covered by the permit and make it easy to tell that you are in a section of the permit which has conditions which only apply to a specific industrial sector. For example, paragraph 6.F.3.4 immediately tells you that you are in Part 6 and looking at conditions that only apply to sector "F" facilities. In some cases, requirements which previously appeared in a single paragraph are now found listed out as separate individual items. The final MSGP is also written in EPA's "readable regulations" style using terms like "you" and "your" in referring to permittees, etc.

Following below is a list of the major changes included in the proposed MSGP of March 30, 2000 (as compared to the 1995 MSGP) and retained in today's final MSGP. These changes are discussed in more detail later in this fact sheet.

1. Requirements for co-located activities clarified (Part 1.2.1.1).

2. Incidental cooling tower mist discharges included as an authorized non-storm water discharge, subject to certain requirements (Parts 1.2.2.2.13 and 4.4.2.3).

3. Eligibility provided for coverage of inactive mining activities occurring on Federal Lands where an operator has not been identified (Part 1.2.3).

4. Clarified language for situations where a discharge previously covered by an individual permit can be covered under today's MSGP (Part 1.2.3.3).

5. Clarified/added language for compliance with water quality standards and requirements for follow-up actions if standards are exceeded (Parts 1.2.3.5 and 3.3).

6. ESA and NHPA eligibility requirements modified (Parts 1.2.3.6 and 1.2.3.7).

7. Eligibility requirements for discharges to water quality impaired/limited waterbodies added/clarified (Part 1.2.3.8).

8. Clarified that discharges which do not comply with anti-degradation requirements are not authorized by the permit (Part 1.2.3.9).

9. Deadline of 30 days for submission of an NOT added (Part 1.4.2).

10. Opportunity for termination of permit coverage based on the "no exposure exemption" from the Phase II storm water regulations (64 FR 68722, 12/8/99) added (Parts 1.5 and 11.4).

11. Notice of Intent requirements and modified form (Part 2.2 and Addendum D).

12. Permit will accommodate electronic filing of NOIs, NOTs, or DMRs, should these options become available during the term of the permit (Parts 2.3 and 7.1)

13. Prohibition on discharges of solid materials and floating debris and requirement to minimize off-site tracking of materials and generation of dust added (Part 4.2.7.2.3).

14. Requirement to include a copy of the permit with the storm water pollution prevention plan (SWPPP) was added (Part 4.7).

15. Special conditions for EPCRA 313 facilities were modified (Part 4.12).

16. Monitoring requirements reorganized and additional clarification/revisions on monitoring periods, waivers, default minimum monitoring for limitations added by State 401 certification, and reporting requirements added (Part 5).

17. Manufacturing of fertilizer from leather scraps (SIC 2873) moved from Sector Z—Leather Tanning and Finishing to Sector C—Chemical and Allied Products (Table 1-1 and Part 6.C).

18. New effluent limitations guidelines for landfills in Sectors K and L included; the final guidelines were published in the **Federal Register** on January 19, 2000 (65 FR 3007) (Parts 6.K.5 and 6.L.6).

19. Sector AD (Non-Classified Facilities) language clarified to say that facilities cannot choose coverage under Sector AD, but can only be so assigned by permitting authority (Part 6.AD).

20. Additional BMP requirements in Sectors S, T, and Y added (Parts 6.S, 6.T, and 6.Y).

21. NOI to continue coverage under the permit when it expires (without a replacement permit in place) is not required and the reapplication process has been clarified (Part 9.2).

22. Process for EPA to remove facilities from permit coverage clarified (Part 9.12).

Following below is another list which summarizes the provisions of today's final MSGP which differ from the proposed MSGP of March 30, 2000.

1. Reference to "drinking fountain water" removed from Part 1.2.2.2.3.

2. Part 1.2.3.3.2.1 of the proposed MSGP was deleted. This requirement had not allowed MSGP coverage for facilities previously covered by another permit, unless the other permit only covered storm water and MSGP authorized non-storm water discharges.

3. Part 2.2.3.6 revised to indicate that the NOI must include the name of the MS4 receiving the discharges only if it is different from the permittee.

4. Part 4.9.3 revised to clarify the time frame for implementation of revised SWPPP.

5. Part 4.11 revised to require permittees to provide a copy of their SWPPP to the public when requested in writing to do so.

6. Sector E coverage was modified for consistency with the September 30, 1998 MSGP modification.

7. In Sector G, language was added stating that non-storm water discharges must be tested or evaluated; this change ensures consistency with the 1995 MSGP. Also in Sector G, the definition of "reclamation" was revised.

8. The title for Sector I was changed to include "Refining."

9. Sector T revised for consistency with 40 CFR 122.26(b)(14)(ix) concerning size of POTWs covered.

10. Section V.C. deleted the requirement to consider species proposed for listing as endangered or threatened.

III. Geographic Coverage of Final MSGP

The geographic coverage of today's final MSGP includes the following areas:

EPA Region 1—for the States of Maine, Massachusetts and New Hampshire; for Indian Country lands located in Massachusetts, Connecticut, Rhode Island and Maine; and for Federal facilities in the State of Vermont.

EPA Region 2—for the Commonwealth of Puerto Rico.

EPA Region 3—for the District of Columbia and Federal facilities in the State of Delaware.

EPA Region 4—for Indian Country lands located in the State of Florida.

EPA Region 6—for the State of New Mexico; for Indian Country lands located in the States of Louisiana, New Mexico, Texas and Oklahoma (except Navajo lands and Ute Mountain Reservation lands); for oil and gas facilities under SIC codes 1311, 1381, 1382, and 1389 in the State of Oklahoma not on Indian Country lands; and oil and gas facilities under SIC codes 1311, 1321, 1381, 1382, and 1389 in the State of Texas not on Indian Country lands.

EPA Region 8—for Federal facilities in the State of Colorado; for Indian Country lands in Colorado, North Dakota, South Dakota, Wyoming and Utah (except Goshute and Navajo Reservation lands); for Ute Mountain Reservation lands in Colorado and New Mexico; and for Pine Ridge Reservation lands in South Dakota and Nebraska.

EPA Region 9—for the State of Arizona; for the Territories of Johnston Atoll, American Samoa, Guam, the

Commonwealth of Northern Mariana Islands, Midway and Wake Islands; for Indian Country lands located in Arizona, California, and Nevada; and for the Goshute Reservation in Utah and Nevada, the Navajo Reservation in Utah, New Mexico, and Arizona, the Duck Valley Reservation in Nevada and Idaho, and the Fort McDermitt Reservation in Oregon and Nevada.

EPA Region 10—for the State of Idaho; for Indian Country lands located in Alaska, Oregon (except Fort McDermitt Reservation lands), Idaho (except Duck Valley Reservation lands) and Washington; and for Federal facilities in Washington.

For several reasons, the geographic area of coverage described above differs from the area of coverage of the 1995 MSGP. Indian country in Vermont and New Hampshire has been removed since there are no Federally recognized tribes in these States. Also, state NPDES permit programs have since been authorized in the States of South Dakota, Louisiana, Oklahoma (except for certain oil and gas facilities in Oklahoma) and Texas (again except for oil and gas facilities). In Oklahoma, EPA maintains NPDES permitting authority over oil and gas exploration and production related industries, and pipeline operations regulated by the Oklahoma Corporation Commission (See 61 FR 65049). Oklahoma received NPDES program authorization only for those discharges covered by the authority of the Oklahoma Department of Environmental Quality (ODEQ). In Texas, EPA maintains NPDES permitting authority over oil and gas discharges regulated by the Texas Railroad Commission (See 63 FR 51164). Texas received NPDES program authorization only for those discharges covered by the authority of the Texas Natural Resource Conservation Commission (TNRCC).

Specific additional conditions required in Region 6 as a result of a State or Tribal CWA Section 401 certification have been added for New Mexico, Oklahoma, and the Pueblos of Isleta, Pojoaque, San Juan, and Sandia. Numeric limitations for discharges in Texas contained in the previous permit pursuant to 31 TAC 319.22 and 319.23 have been continued in accordance with 40 CFR 122.44(d) and (l).

Federal facilities in Colorado, and Indian country located in Colorado (including the portion of the Ute Mountain Reservation located in New Mexico), North Dakota, South Dakota (including the portion of the Pine Ridge Reservation located in Nebraska), Utah (except for the Goshute and Navajo Reservation lands) and Wyoming were not included in the 1995 MSGP, but are included in today's MSGP. Indian country lands in Montana are not included at this time due to a recent court order. Prior to today, industrial facilities in these areas were largely covered under an extension of EPA's 1992 baseline general permit for industries (57 FR 41175).

Also, subsequent to the issuance of the MSGP in 1995, coverage was extended to the Island of Guam on September 24, 1996 (61 FR 50020) and the Commonwealth of the Northern Mariana Islands on September 30, 1998 (63 FR 52430). Certification was not received from Arizona in time for that state to be included in this permit.

The 1995 MSGP was issued in the State of Alaska, except Indian Country, on February 9, 1996 (61 FR 5247). Industrial facilities in Alaska outside of Indian Country will continue to be covered under the 1995 MSGP through February 9, 2001. EPA will reissue the permit for Alaska at a later date, and will include any state-specific modifications or additions or additions applicable to parts 1 through 12 of this permit as part of the State's Clean Water Act Section 401 or Coastal Zone Management Act certification processes.

Lastly, today's MSGP reissuance differs from the March 30, 2000 MSGP proposal in that the State of Florida (except for Indian country) is not included. This is a result of the recent NPDES program delegation to the State of Florida.

There are some areas where the NPDES permit program has not been delegated (such as Indian country in states not listed above) where neither the MSGP nor an alternate general permit is available for authorization of storm water discharges associated with industrial activity. However, only a very small number of permittees exist in such areas and individual permits are issued as needed.

IV. Categories of Facilities Covered by the Final MSGP

Today's final MSGP authorizes storm water discharges associated with industrial activity from the categories of facilities shown in Table 1 below:

TABLE 1.—SECTOR/SUBSECTORS COVERED BY THE FINAL MSGP

Subsector	SIC code	Activity represented
		Sector A. Timber Products
1*	2421	General Sawmills and Planning Mills.
2	2491	Wood Preserving
3*	2411	Log Storage and Handling
4*	2426	Hardwood Dimension and Flooring Mills.
	2429	Special Product Sawmills, Not Elsewhere Classified.
	2431–2439 (except 2434)	Millwork, Veneer Plywood, and Structural Wood.
	2448, 2449	Wood Containers
	2451, 2452	Wood Buildings and Mobile Homes.
	2493	Reconstituted Wood Products.
	2499	Wood Products, Not Elsewhere Classified.
		Sector B. Paper and Allied Products Manufacturing
1	2611	Pulp Mills.
2	2621	Paper Mills.
3*	2631	Paperboard Mills.
4	2652–2657	Paperboard Containers and Boxes.
5	2671–2679	Converted Paper and Paperboard Products, Except Containers and Boxes.
		Sector C. Chemical and Allied Products Manufacturing
1*	2812–2819	Industrial Inorganic Chemicals.

TABLE 1.—SECTOR/SUBSECTORS COVERED BY THE FINAL MSGP—Continued

Subsector	SIC code	Activity represented
2*	2821–2824	Plastics Materials and Synthetic Resins, Synthetic Rubber, Cellulosic and Other Man-made Fibers Except Glass.
3	2833–2836	Medicinal chemicals and botanical products; pharmaceutical preparations,; invitro and invivo diagnostic substances; biological products, except diagnostic substances.
4*	2841–2844	Soaps, Detergents, and Cleaning Preparations; Perfumes, Cosmetics, and Other Toilet Preparations.
5	2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products.
6	2861–2869	Industrial Organic Chemicals.
7*	2873–2879	Agricultural Chemicals, including Facilities that Make Fertilizer Solely from Leather Scraps and Leather Dust.
8	2891–2899	Miscellaneous Chemical Products.
9	3952 (limited to list)	Inks and Paints, Including China Painting Enamels, India Ink, Drawing Ink, Platinum Paints for Burnt Wood or Leather Work, Paints for China Painting, Artist's Paints and Artist's Watercolors.
Sector D. Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers.		
1*	2951, 2952	Asphalt Paving and Roofing Materials.
2	2992, 2999	Miscellaneous Products of Petroleum and Coal.
Sector E. Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing		
1	3211	Flat Glass.
	3221, 3229	Glass and Glassware, Pressed or Blown.
	3231	Glass Products Made of Purchased Glass.
	3281	Cut Stone and Stone Products.
	3291–3292	Abrasive and Asbestos Products.
	3296	Mineral Wool.
	3299	Nonmetallic Mineral Products, Not Elsewhere Classified.
2	3241	Hydraulic Cement.
3*	3251–3259	Structural Clay Products.
	3261–3269	Pottery and Related Products.
	3297	Non-Clay Refractories.
4*	3271–3275	Concrete, Gypsum and Plaster Products.
	3295	Minerals and Earth's, Ground, or Otherwise Treated.
Sector F. Primary Metals		
1*	3312–3317	Steel Works, Blast Furnaces, and Rolling and Finishing Mills.
2*	3321–3325	Iron and Steel Foundries.
3	3331–3339	Primary Smelting and Refining of Nonferrous Metals.
4	3341	Secondary Smelting and Refining of Nonferrous Metals.
5*	3351–3357	Rolling, Drawing, and Extruding of Nonferrous Metals.
6*	3363–3369	Nonferrous Foundries (Castings).
7	3398, 3399	Miscellaneous Primary Metal Products.
Sector G. Metal Mining (Ore Mining and Dressing)		
1	1011	Iron Ores.
2*	1021	Copper Ores.
3	1031	Lead and Zinc Ores.
4	1041, 1044	Gold and Silver Ores.
5	1061	Ferroalloy Ores, Except Vanadium.
6	1081	Metal Mining Services.
7	1094, 1099	Miscellaneous Metal Ores.
Sector H. Coal Mines and Coal Mining-Related Facilities		
NA*	1221–1241	Coal Mines and Coal Mining-Related Facilities Sector.
Sector I. Oil and Gas Extraction and Refining		
1*	1311	Crude Petroleum and Natural Gas.
2	1321	Natural Gas Liquids.
3*	1381–1389	Oil and Gas Field Services.
4	2911	Petroleum refining.
Sector J. Mineral Mining and Dressing		
1*	1411	Dimension Stone.
	1422–1429	Crushed and Broken Stone, Including Rip Rap.

TABLE 1.—SECTOR/SUBSECTORS COVERED BY THE FINAL MSGP—Continued

Subsector	SIC code	Activity represented
	1481	Nonmetallic Minerals, Except Fuels.
2*	1442, 1446	Sand and Gravel.
3	1455, 1459	Clay, Ceramic, and Refractory Materials.
4	1474–1479	Chemical and Fertilizer Mineral Mining.
	1499	Miscellaneous Nonmetallic Minerals, Except Fuels.
Sector K. Hazardous Waste Treatment Storage or Disposal Facilities		
NA*	HZ	Hazardous Waste Treatment, Storage or Disposal.
Sector L. Landfills and Land Application Sites		
NA*	LF	Landfills, Land Application Sites and Open Dumps.
Sector M. Automobile Salvage Yards		
NA*	5015	Automobile Salvage Yards.
Sector N. Scrap Recycling Facilities		
NA*	5093	Scrap Recycling Facilities.
Sector O. Steam Electric Generating Facilities		
NA*	SE	Steam Electric Generating Facilities.
Sector P. Land Transportation		
1	4011, 4013	Railroad Transportation.
2	4111–4173	Local and Highway Passenger Transportation.
3	4212–4231	Motor Freight Transportation and Warehousing.
4	4311	United States Postal Service.
5	5171	Petroleum Bulk Stations and Terminals.
Sector Q. Water Transportation		
NA*	4412–4499	Water Transportation.
Sector R. Ship and Boat Building or Repairing Yards		
NA	3731, 3732	Ship and Boat Building or Repairing Yards.
Sector S. Air Transportation Facilities		
NA*	4512–4581	Air Transportation Facilities.
Sector T. Treatment Works		
NA*	TW	Treatment Works.
Sector U. Food and Kindred Products		
1	2011–2015	Meat Products.
2	2021–2026	Dairy Products.
3	2032	Canned, Frozen and Preserved Fruits, Vegetables and Food Specialties.
4*	2041–2048	Grain Mill Products.
5	2051–2053	Bakery Products.
6	2061–2068	Sugar and Confectionery Products.
7*	2074–2079	Fats and Oils.
8	2082–2087	Beverages.
9	2091–2099	Miscellaneous Food Preparations and Kindred Products.
	2111–2141	Tobacco Products.
Sector V. Textile Mills, Apparel, and Other Fabric Product Manufacturing		
1	2211–2299	Textile Mill Products.
2	2311–2399	Apparel and Other Finished Products Made From Fabrics and Similar Materials.
	3131–3199 (except 3111)	Leather Products.

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TABLE 1.—SECTOR/SUBSECTORS COVERED BY THE FINAL MSGP—Continued

Subsector	SIC code	Activity represented
		Sector W. Furniture and Fixtures
NA	2511–2599	Furniture and Fixtures.
	2434	Wood Kitchen Cabinets.
		Sector X. Printing and Publishing
NA	2711–2796	Printing, Publishing and Allied Industries.
		Sector Y. Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries
1*	3011	Tires and Inner Tubes.
	3021	Rubber and Plastics Footwear.
	3052, 3053	Gaskets, Packing, and Sealing Devices and Rubber and Plastics Hose and Belting.
	3061, 3069	Fabricated Rubber Products, Not Elsewhere Classified.
2	3081–3089	Miscellaneous Plastics Products.
	3931	Musical Instruments.
	3942–3949	Dolls, Toys, Games and Sporting and Athletic Goods.
	3951–3955 (except 3952 as specified in Sector C).	Pens, Pencils, and Other Artists' Materials.
	3961, 3965	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal.
	3991–3999	Miscellaneous Manufacturing Industries.
		Sector Z. Leather Tanning and Finishing
NA	3111	Leather Tanning and Finishing.
		Sector AA. Fabricated Metal Products
1*	3411–3499	Fabricated Metal Products, Except Machinery and Transportation Equipment and Cutting, Engraving and Allied Services.
	3911–3915	Jewelry, Silverware, and Plated Ware.
2*	3479	Coating, Engraving, and Allied Services.
		Sector AB. Transportation Equipment, Industrial or Commercial Machinery
NA	3511–3599 (except 3571–3579)	Industrial and Commercial Machinery (except Computer and Office Equipment—see Sector AC).
NA	3711–3799 (except 3731, 3732)	Transportation Equipment (except Ship and Boat Building and Repairing—see Sector R).
		Sector AC. Electronic, Electrical, Photographic and Optical Goods
NA	3612–3699	Electronic, Electrical Equipment and Components, Except Computer Equipment.
	3812–3873	Measuring, Analyzing and Controlling Instrument; Photographic and Optical Goods, Watches and Clocks.
	3571–3579	Computer and Office Equipment.
		Sector AD. Reserved for Facilities Not Covered Under Other Sectors and Designated by the Director

*Denotes subsector with analytical (chemical) monitoring requirements.
NA indicates those industry sectors in which subdivision into subsectors was determined to be not applicable.

The final MSGP modification of September 30, 1998 (63 FR 52430) expanded the coverage of the 1995 MSGP to include a small number of categories of facilities which had been covered by the 1992 baseline industrial general permit but excluded from the MSGP. In Table 1 above, these categories have been included in the appropriate sectors/subsectors of the MSGP as determined by the September 30, 1998 modification.

With the September 30, 1998 modification, EPA believes that the MSGP now covers all of the categories of industrial facilities which may discharge storm water associated with industrial activity as defined at 40 CFR 122.26(b)(14) (except construction activities disturbing five or more acres which are permitted separately). However, the September 30, 1998 modification also added another sector to the MSGP (Sector AD) to cover any inadvertent omissions. EPA has retained Sector AD in today's reissued MSGP.

Sector AD is further intended to provide a readily available means for covering many of the storm water facilities which are designated for permitting in accordance with NPDES regulations at 40 CFR 122.26(g)(1)(i). These regulations provide that permit applications may be required within 180 days of notice for any discharges which contribute to a violation of a water quality standard, or are determined to be significant sources of pollutants.

EPA also recognizes that a new North American Industry Classification System (NAICS) was recently adopted by the Office of Management and Budget (62 FR 17288, April 9, 1997). NAICS replaces the 1987 standard industrial classification (SIC) code

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system for the collection of statistical economic data. However, the use of the new system for nonstatistical purposes is optional. EPA considered the use of NAICS for the today's MSGP reissuance, but elected to retain the 1987 SIC code system since the storm water regulations (40 CFR 122.26(b)(14)) reference the previous system and this system has generally proven to be adequate for identifying the facilities covered by storm water regulations. EPA will consider transitioning to the new NAICS system in future rule making.

V. Limitations on Coverage

A. Storm Water Discharges Subject to Effluent Guideline Limitations, Including New Source Performance Standards

The general prohibition on coverage of storm water subject to an effluent guideline limitation in the 1995 MSGP has been retained in today's MSGP reissuance. Only those storm water discharges subject to the following effluent guidelines are eligible for coverage (provided they meet all other eligibility requirements):

TABLE 2.—EFFLUENT GUIDELINES APPLICABLE TO DISCHARGES THAT MAY BE ELIGIBLE FOR PERMIT COVERAGE

Effluent guideline	New Source performance standards included in effluent guidelines?	Sectors with affected facilities
Runoff from material storage piles at cement manufacturing facilities [40 CFR Part 411 Subpart C (established February 23, 1977)].	Yes	E
Contaminated runoff from phosphate fertilizer manufacturing facilities [40 CFR Part 418 Subpart A (established April 8, 1974)].	Yes	C
Coal pile runoff at steam electric generating facilities [40 CFR Part 423 (established November 19, 1982)]	Yes	O
Discharges resulting from spray down or intentional wetting of logs at wet deck storage areas [40 CFR Part 429, Subpart I (established January 26, 1981)].	Yes	A
Mine dewatering discharges at crushed stone mines [40 CFR part 436, Subpart B]	No	J
Mine dewatering discharges at construction sand and gravel mines [40 CFR part 436, Subpart C]	No	J
Mine dewatering discharges at industrial sand mines [40 CFR part 436, Subpart D]	No	J
Runoff from asphalt emulsion facilities [40 CFR Part 443 Subpart A (established July 24, 1975)].	Yes	D
Runoff from landfills, [40 CFR Part 445, Subpart A and B (established February 2, 2000.]	Yes	K & L

Section 306 of the Clean Water Act (CWA) requires EPA to develop performance standards for all new sources described in that section. These standards apply to all facilities which go into operation after the date the standards are promulgated. Section 511(c) of the CWA requires the Agency to comply with the National Environmental Policy Act (NEPA) prior to issuance of a permit under the authority of Section 402 of the CWA to facilities defined as a new source under Section 306.

The fact sheet for the 1995 MSGP described a process for ensuring compliance with NEPA for the MSGP (60 FR 50809). This process, which is repeated below, has been retained for the reissued MSGP. Additional guidance is found in a new Addendum C to the final MSGP.

Facilities which are subject to the performance standards for new sources as described in this section of the fact sheet must provide EPA with an Environmental Information Document pursuant to 40 CFR 6.101 prior to seeking coverage under this permit. This information shall be used by the Agency to evaluate the facility under the requirements of NEPA in an Environmental Review. The Agency will make a final decision regarding the direct or indirect impact of the discharge. The Agency will follow all administrative procedures required in this process. The permittee must obtain a copy of the Agency's final finding prior to the submission of a Notice of Intent to be covered by this general permit. In order to maintain eligibility, the permittee must implement any mitigation required of the facility as a result of the NEPA review process. Failure to implement mitigation measures upon which the Agency's NEPA finding is based is grounds for termination of permit coverage. In this way, EPA has established a procedure which allows for the appropriate review procedures to be completed by this Agency prior to the issuance of a permit under Section 402 of the CWA to an operator of a facility subject to the new source performance standards of Section 306 of the CWA. EPA believes that it has fulfilled its requirements under NEPA for this Federal action under Section 402 of the CWA.

B. Historic Preservation

The National Historic Preservation Act (NHPA) requires Federal agencies to take into account the effects of Federal undertakings, including undertakings on historic properties that are either listed on, or eligible for listing on, the National Register of Historic Places. The term "Federal undertaking" is defined in the existing NHPA regulations to include any project, activity, or program under the direct or indirect jurisdiction of a Federal agency that can result in changes in the character or use of historic properties, if any such historic properties are located in the area of potential effects for that project, activity, or program. See 36 CFR 802(o). Historic properties are defined in the NHPA regulations to include prehistoric or historic districts, sites, buildings, structures, or objects that are included in, or are eligible for inclusion in, the National Register of Historic Places. See 36 CFR 802(e).

Federal undertakings include EPA's issuance of general NPDES permits. In light of NHPA requirements, EPA included a provision in the eligibility requirements of the 1995 MSGP for the consideration of the effects to historic properties. That provision provided that an applicant is eligible for permit coverage only if: (1) the applicant's storm water discharges and BMPs to control storm water runoff do not affect a historic property, or (2) the applicant has obtained, and is in compliance with, a written agreement between the applicant and the State Historic Preservation Officer (SHPO) that outlines all measures to be taken by the applicant to mitigate or prevent adverse effects to the historic property. See Part I.B.6, 60 FR 51112 (September 29, 1995). When applying for permit coverage, applicants were required to certify in

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the NOI that they are in compliance with the Part I.B.6 eligibility requirements. Provided there are no other factors limiting permit eligibility, MSGP coverage was then granted 48 hours after the postmark on the envelope used to mail the NOI.

The September 30, 1998 modification included two revisions of the original MSGP with respect to historic properties. First, EPA amended the original Part I.B.6.(ii) to include a reference to Tribal Historic Preservation Officers (THPOs) because MSGP coverage extends to Tribal lands and in recognition of the central role Tribal governments play in the protection of historic resources. Second, EPA included NHPA guidance and a list of SHPO and THPO addresses in a new Addendum I to the MSGP to assist applicants with the certification process for permit eligibility under this condition.

For today's MSGP reissuance, EPA has modified slightly the requirements of the first option for obtaining permit coverage to enhance the protection of historic properties. Permit coverage is only available if storm water and allowable non-storm water discharges and "discharge-related activities" do not affect historic properties. "Discharge-related activities" are defined to include activities which cause, contribute to, or result in storm water and allowable non-storm water point source discharges, and measures such as the siting, construction and operation of BMPs to control, reduce or prevent pollution in the discharges. Discharge-related activities are included to ensure compliance with NHPA requirements to consider the effects of activities which are related to the activity which is permitted, *i.e.*, the storm water and non-storm water discharges. Because this change was minor, EPA is relying on its 1995 and 1998 consultations with the Advisory Council on Historic Preservation as its basis for reissuance of this permit.

Also, as discussed in Section VI.A.1 below, EPA intends to modify, contingent upon Office of Management and Budget review and approval, the Notice of Intent form to require that operators identify which of the above two options they are using to ensure eligibility for permit coverage under the MSGP. The NHPA guidance has also been modified to reflect the above pending changes, and appears in Addendum B in today's notice rather than Addendum I. Until the revised form is approved and issued, the current form (with minor clarifications) remains in effect.

Facilities seeking coverage under today's MSGP which cannot certify compliance with the NHPA requirements must submit individual permit applications to the permitting authority. For facilities already covered by the existing MSGP, the deadline for the individual applications is the same as that for NOIs requesting coverage under the reissued MSGP (December 29, 2000).

C. Endangered Species

The Endangered Species Act (ESA) of 1973 requires Federal Agencies such as EPA to ensure, in consultation with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) (also known collectively as the "Services"), that any actions authorized, funded, or carried out by the Agency (*e.g.*, EPA issued NPDES permits authorizing discharges to waters of the United States) are not likely to jeopardize the continued existence of any Federally-listed endangered or threatened species or adversely modify or destroy critical habitat of such species (see 16 U.S.C. 1536(a)(2), 50 CFR 402 and 40 CFR 122.49(c)).

For the 1995 MSGP, EPA conducted formal consultation with the Services which resulted in a joint Service biological opinion issued by the FWS on March 31, 1995, and by the NMFS on April 5, 1995, which concluded that the issuance and operation of the MSGP was not likely to jeopardize the existence of any listed endangered or threatened species, or result in the adverse modification or destruction of any critical habitat.

The 1995 MSGP contained a number of conditions to protect listed species and critical habitat. Permit coverage was provided only where:

• The storm water discharge(s), and the construction of BMPs to control storm water runoff, were not likely to jeopardize species identified in Addendum H of the permit, or

• The applicant's activity had received previous authorization under the Endangered Species Act and established an environmental baseline that was unchanged; or,

• The applicant was implementing appropriate measures as required by the Director to address jeopardy.

For today's MSGP reissuance, EPA has modified the ESA-related requirements for obtaining permit coverage to enhance the protection of listed species. First, permit coverage is only available if storm water and allowable non-storm water discharges and "discharge-related activities" result in no jeopardy to listed species. "Discharge-related activities" are defined to include activities which cause, contribute to or result in storm water and allowable non-storm water point source discharges, and measures such as the siting, construction and operation of BMPs to control, reduce or prevent pollution in the discharges. Discharge-related activities are included for compliance with ESA requirements to consider the effects of activities which are related to the activity which is permitted, *i.e.*, the storm water and non-storm water discharges.

In addition, operators seeking coverage under the reissued MSGP must certify that they are eligible for coverage under one of the following five options which are provided in Parts 1.2.3.6.3.1 through 5 of the permit:

1. No endangered or threatened species or critical habitat are in proximity to the facility or the point where authorized discharges reach the receiving water; or

2. In the course of a separate federal action involving the facility (*e.g.*, EPA processing request for an individual NPDES permit, issuance of a CWA Section 404 wetlands dredge and fill permit, etc.), formal or informal consultation with the Fish and Wildlife Service and/or the National Marine Fisheries Service under Section 7 of the ESA has been concluded and that consultation:

(a) addressed the effects of the storm water and allowable non-storm water discharges and discharge-related activities on listed species and critical habitat and

(b) the consultation resulted in either a no jeopardy opinion or a written concurrence by the Service(s) on a finding that the storm water and allowable non-storm water discharges and discharge-related activities are not likely to jeopardize listed species or critical habitat; or

3. The activities are authorized under Section 10 of the ESA and that authorization addresses the effects of the storm water and allowable non-storm water discharges and discharge-related activities on listed species and critical habitat; or

4. Using due diligence, the operator has evaluated the effects of the storm water discharges, allowable non-storm water discharges, and discharge-related activities on listed endangered or threatened species and critical habitat and does not have reason to believe listed species or critical habitat would be jeopardized; or

5. The storm water and allowable non-storm water discharges and discharge-related activities were already addressed in another operator's

certification of eligibility under Part 1.2.3.6.3.1 through 1.2.3.6.3.4 which included the facility's activities. By certifying eligibility under this Part, a permittee agrees to comply with any measures or controls upon which the other operator's certification was based.

The first four options listed above are similar to the eligibility provisions of the 1995 MSGP. Option 5 was added to account for situations such as an airport facility where one operator (*e.g.*, the airport authority) may have covered the entire airport through its certification. Option 5 allows other operators to take advantage of such a certification without repeating the reviews conducted by the first operator. Option 1 applies to operators who are not jeopardizing endangered species because listed species simply are not in proximity to their facility. Option 4 applies to operators who have endangered species nearby and must look more closely at potential jeopardy and may need to adopt measures to reduce the risk of jeopardy to listed species or critical habitat. The provision of the two options to determine that a facility is unlikely to jeopardize listed species, coupled with the pending new NOI requirement to indicate whether or not the Service was contacted in making the determination, will also allow for better oversight of the permit. Under the 1995 permit, there was no way to tell from the NOI information whether the decision on eligibility was due to no species in the county, a discussion with the Service, or a simple unilateral decision by the operator.

Addendum H of the 1995 MSGP provided instructions to assist permittees in determining whether they met the permit's ESA-related eligibility requirements. For today's reissued MSGP, this guidance has been updated to reflect the above requirements and appears as Addendum A. As noted in Section VI.A.1 below, EPA intends to modify the Notice of Intent form to conform with new ESA requirements discussed above.

Addendum H of the 1995 MSGP contained a list of proposed and listed endangered and threatened species that could be jeopardized by the discharges and measures to control pollutants in the discharges. EPA reinitiated and completed formal consultation with the Services for the September 30, 1998 modification of the MSGP. As a result of this consultation and in response to public comments on the modification, EPA updated the species list in Addendum H to include species that were listed or proposed for listing since the Addendum H list was originally compiled on March 31, 1995. EPA also decided to expand the list to include all of the terrestrial (*i.e.*, non-aquatic) listed and proposed species in recognition that those species may be impacted by permitted activities such as the construction and operation of the BMPs. The September 30, 1998 MSGP modification included the species list updated as of July 8, 1998 (63 FR 52494). The species list is also being updated on a regular basis and an electronic copy of the list is available at the Office of Wastewater Management website at "http://www.epa.gov/owm/esalst2.htm". The information may also be obtained by contacting the Services. The permittee is responsible for obtaining the updated information.

Based on comments received on the proposed MSGP on March 30, 2000 (65 FR 17010), the final permit requires facility operators to consider only listed endangered or threatened species, and not species proposed to be listed. Further explanation for the change can be found in Section IX of this notice.

On August 10, 2000, EPA initiated informal consultation with FWS and NMFS on EPA's finding of no likelihood of adverse effect on threatened and endangered species and critical habitat resulting from issuance of MSGP–2000. On September 22, 2000 FWS concurred with EPA's finding.

To be eligible for coverage under today's reissued MSGP, facilities must review the updated list of species and their locations in conjunction with the Addendum A instructions for completing the application requirements under this permit. If an applicant determines that none of the species identified in the updated species list is found in the county in which the facility is located, then there is a likelihood of no jeopardy and they are eligible for permit coverage. Applicants must then certify that their storm water and allowable non-storm water discharges, and their discharge-related activities, are not likely to jeopardize species and will be granted MSGP permit coverage 48 hours after the date of the postmark on the envelope used to mail the NOI form, provided there are no other factors limiting permit eligibility.

If listed species are located in the same county as the facility seeking MSGP coverage, then the applicant must determine whether the species are in proximity to the storm water or allowable non-storm water discharges or discharge-related activities at the facility. A species is in proximity to a storm water or allowable non-storm water discharge when the species is located in the path or down gradient area through which or over which the point source discharge flows from industrial activities to the point of discharge into the receiving water, and once discharged into the receiving water, in the immediate vicinity of, or nearby, the discharge point. A species is also in proximity if it is located in the area of a site where discharge-related activities occur. If an applicant determines there are no species in proximity to the storm water or allowable non-storm water discharges, or discharge-related activities, then there is no likelihood of jeopardizing the species and the applicant is eligible for permit coverage.

If species are in proximity to the storm water or allowable non-storm water discharges or discharge-related activities, as long as they have been considered as part of a previous ESA authorization of the applicant's activity, and the environmental baseline established in that authorization is unchanged, the applicant may be covered under the permit. The environmental baseline generally includes the past and present impacts of all Federal, state and private actions that were occurring at the time the initial NPDES authorization and current ESA section 7 action by EPA or any other federal agency was taken. Therefore, if a permit applicant has received previous authorization and nothing has changed or been added to the environmental baseline established in the previous authorization, then coverage under this permit will be provided.

In the absence of such previous authorization, if species identified in the updated species list are in proximity to the discharges or discharge-related activities, then the applicant must determine whether there is any likely jeopardy to the species. This is done by the applicant conducting a further examination or investigation, or an alternative procedure, as described in the instructions in Addendum A of the permit. If the applicant determines that there is no likely jeopardy to the species, then the applicant is eligible for permit coverage. If the applicant determines that there likely is, or will likely be any jeopardy, then the applicant is not eligible for MSGP coverage unless or until he or she can meet one of the other eligibility conditions.

All dischargers applying for coverage under the MSGP must provide in the application information on the Notice of Intent form: (1) A determination as to whether there are any listed species in proximity to the storm water or allowable non-storm water discharges or discharge related activity, and (2) (when

EPA receives approval from the Office of Management and Budget and issues the revised form) an indication of which option under Part 1.2.3.6.3 of the MSGP they claim eligibility for permit coverage, and (3) a certification that their storm water and allowable non-storm water discharges and discharge-related activities are not likely to jeopardize listed species, or are otherwise eligible for coverage due to a previous authorization under the ESA. Coverage is contingent upon the applicant's providing truthful information concerning certification and abiding by any conditions imposed by the permit.

Dischargers who cannot determine if they meet one of the endangered species eligibility criteria cannot sign the certification to gain coverage under the MSGP and must apply to EPA for an individual NPDES storm water permit. For facilities already covered by the 1995 MSGP, the deadline for the individual applications is the same as that for NOIs requesting coverage under the reissued MSGP (December 29, 2000). As appropriate, EPA will conduct ESA section 7 consultation when issuing such individual permits.

Regardless of the above conditions, EPA may require that a permittee apply for an individual NPDES permit on the basis of possible jeopardy to species or critical habitats. Where there are concerns that coverage for a particular discharger is not sufficiently protective of listed species, the Services (as well as any other interested parties) may petition EPA to require that the discharger obtain an individual NPDES permit and conduct an individual section 7 consultation as appropriate.

In addition, the Assistant Administrator for Fisheries for the National Oceanic and Atmospheric Administration, or his/her authorized representative, or the U.S. Fish and Wildlife Service (as well as any other interested parties) may petition EPA to require that a permittee obtain an individual NPDES permit. The permittee is also required to make the SWPPP, annual site compliance inspection report, or other information available upon request to the Assistant Administrator for Fisheries for the National Oceanic and Atmospheric Administration, or his/her authorized representative, or the U.S. Fish and Wildlife Service Regional Director, or his/her authorized representative.

These mechanisms allow for the broadest and most efficient coverage for the permittee while still providing for the most efficient protection of endangered species. They significantly reduce the number of dischargers that must be considered individually and therefore allow the Agency and the Services to focus their resources on those discharges that are indeed likely to jeopardize listed species. Straightforward mechanisms such as these allow applicants more immediate access to permit coverage, and eliminates "permit limbo" for the greatest number of permitted discharges. At the same time it is more protective of endangered species because it allows both agencies to focus on the real problems, and thus, provide endangered species protection in a more expeditious manner.

D. New Storm Water Discharges to Water Quality-Impaired or Water Quality-Limited Receiving Waters

Today's final MSGP includes a new provision (Part 1.2.3.8) which establishes eligibility conditions with regard to discharges to water quality-limited or water quality-impaired waters. For the purposes of this permit, "water quality-impaired" refers to a stream, lake, estuary, etc. that is not currently meeting its assigned water quality standards. These waters are also referred to as "303(d) waters" due to the requirement under that section of the CWA for States to periodically list all state waters that are not meeting their water quality standards. "Water quality-limited waters" refers to waterbodies for which a State had to develop individual Total Maximum Daily Loads (TMDLs), a tool which helps waterbodies meet their water quality standards. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. Water quality standards are set by States, Territories, and Tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. The CWA, section 303, establishes the water quality standards and TMDL programs.

Prior to submitting a Notice of Intent, any new discharger (see 40 CFR 122.2) to a 303(d) waterbody must be able to demonstrate compliance with 40 CFR 122.4(i). In essence, you are a new discharger if your facility started discharging after August 13, 1979 and your storm water was not previously permitted. Any discharger to a waterbody for which there is an approved TMDL must confirm that the TMDL allocated a portion of the load for storm water point source discharges. These provisions apply only to discharges containing the pollutant(s) for which the waterbody is impaired or the TMDL developed.

Part 1.2.3.8.1 (which applies to new storm water discharges and not to existing discharges) is designed to better ensure compliance with NPDES regulations at 40 CFR 122.4(i), which include certain special requirements for new discharges into impaired waterbodies. Lists of impaired waterbodies (sometimes referred to as 303(d) waterbodies) may be obtained from appropriate State environmental offices or their internet sites. NPDES regulations at 40 CFR 122.4(i) prohibit discharges unless it can be shown that:

1. There are sufficient remaining pollutant load allocations to allow for the discharge; and
2. The existing dischargers into that segment are subject to compliance schedules designed to bring the segments into compliance with applicable water quality standards.

Part 1.2.3.8.2 (which applies to both new and existing storm water discharges) is designed to better ensure compliance with NPDES regulations at 40 CFR 122.4(d), which requires compliance with State water quality standards. The eligibility condition prohibits coverage of new or existing discharges of a particular pollutant where there is a TMDL, unless the discharge is consistent with the TMDL. Lists of waterbodies with TMDLs may be obtained from appropriate State environmental offices or their internet sites and from EPA's TMDL internet site at *http://www.epa.gov/owow/tmdl/index.html.*

E. Storm Water Discharges Subject to Anti-Degradation Provisions of Water Quality Standards

Part 1.2.3.9 of today's final MSGP includes a new provision which clarifies that discharges which do not comply with applicable anti-degradation provisions of State water quality standards are not eligible for coverage under the MSGP. This eligibility condition is designed to better ensure compliance with NPDES regulations at 40 CFR 122.4(d), which requires compliance with State water quality standards. Anti-degradation provisions may be obtained from the appropriate State environmental office or their internet sites.

F. Storm Water Discharges Previously Covered by an Individual Permit

The 1995 MSGP contained general prohibitions on coverage where a discharge was covered by another NPDES permit (Part I.B.3.d) and where a permit had been terminated other than at the request of the permittee (Part

I.B.3.e.). It was therefore possible to obtain coverage by requesting termination of an individual permit and then submitting an NOI for coverage under the MSGP. This could be desirable from both the discharger's and EPA's perspective for a variety of reasons, for example, where a wastewater permit included storm water outfalls, but the wastewater outfalls had been eliminated. Being able to use the general permit would reduce the application cost to the permittee and the administrative burden of permit issuance to the Agency. Today's permit clarifies the conditions under which transfer from an individual permit to this general permit would be acceptable (Part 1.2.3.3.2).

In order to avoid conflict with the anti-backsliding provisions of the CWA, transfer from an individual permit to the MSGP will only be allowed where both of the following conditions are met:

- The individual permit did not contain numeric water quality-based effluent limitations developed for the storm water component of the discharge; and
- The permittee includes any specific BMPs for storm water required under the individual permit in their storm water pollution prevention plan.

Implementation of a comprehensive Storm Water Pollution Prevention Plan for the entire facility (as opposed to selected outfalls in an individual permit) and compliance with all other conditions of the MSGP is deemed to be at least as stringent a technology-based permit limit as the conditions of the individual permit. This assumption is only made where the previous permit did not contain any specific water quality-based effluent limitations on storm water discharges (e.g., storm water contained high levels of zinc and the individual permit contained a zinc limit developed to ensure compliance with the State water quality criteria).

G. Requiring Coverage Under an Individual Permit or an Alternate General Permit

Part 9.12 of today's final MSGP provides that EPA may require an individual permit or coverage under a separate general permit instead of today's MSGP. This is in accord with NPDES regulations at 40 CFR 122.28(b)(3). These regulations also provide that any interested party may petition EPA to take such an action. The issuance of the individual permit or alternate general permit would be in accordance with 40 CFR Part 124 and would provide for public comment and appeal of any final permit decision. The circumstances in which such an action would be taken are set forth at 40 CFR 122.28(b)(3).

VI. Summary of Common Permit Conditions

The following section describes the permit conditions common to discharges from all the industrial activities covered by today's final MSGP. These conditions are largely the same as the conditions of the 1995 MSGP.

A. Notification Requirements

General permits for storm water discharges associated with industrial activity must require the submission of a Notice of Intent (NOI) prior to the authorization of such discharges (see 40 CFR 122.28(b)(2)(i), April 2, 1992 (57 FR 11394)). Consistent with these regulatory requirements, today's final MSGP establishes NOI requirements. These requirements apply to facilities currently covered by the 1995 MSGP, as well as new facilities seeking coverage. EPA made minor modifications to the NOI form to allow the discharger, the Agency and the public to more easily determine sector-specific conditions that will apply to the facility. Further modifications proposed on March 30, 2000 (65 FR 17010) require review and approval by the Office of Management and Budget under the Paperwork Reduction Act. EPA will have all appropriate approvals in place prior to requiring the use of the expanded NOI form. In the interim the NOI form with the minor modifications, contained in this notice, is in effect.

The information requirements of the revised NOI form are described below:

1. Content of NOI

a. An indication of which permit the operator is filing the NOI for (e.g., a facility in New Hampshire would be filing for coverage under permit NHR05*###, a facility located on Navajo Reservation lands in New Mexico under the AZR05*##I permit, a private contractor operating a federal facility in Colorado that is not located on Indian Country lands under the COR05*##F permit, etc.);

b. The name, address, and telephone number of the operator filing the NOI for permit coverage;

c. An indication of whether the owner of the site is a Federal, State, Tribal, private, or other public entity;

d. The name (or other identifier), address, county, and latitude/longitude of the facility for which the NOI is submitted (latitude/longitude will be accepted in either degree-minute-second or decimal format);

e. An indication of whether the facility is located on Indian Country lands;

f. An indication of whether the facility is a federal facility operated by the federal government;

g. The name of the receiving water(s);

h. The name of the municipal operator if the discharge is through a municipal separate storm sewer system prior to discharge to a water of the U.S.;

i. Up to four 4-digit Standard Industrial Classification (SIC) codes that best represent the principal products produced or services rendered, including hazardous waste treatment, storage, or disposal activities, land disposal facilities that receive or have received any industrial waste, steam electric power generating facilities, or treatment works treating domestic sewage;

j. Identification of applicable sector(s) in this permit, as designated in Table 1, for facility discharges associated with industrial activity the operator wishes to have covered under this permit;

k. Certification that a storm water pollution prevention plan (SWPPP) meeting the requirements of Part 4 has been developed (with a copy of the permit language in the SWPPP);

l. Based on the instructions in Addendum A, whether any listed threatened or endangered species, or designated critical habitat, are in proximity to the storm water discharges or storm water discharge-related activities to be covered by this permit;

m. Whether any historic property listed or eligible for listing on the National Register of Historic Places is located on the facility or in proximity to the discharge;

n. A signed and dated certification, signed by a authorized representative of the facility as detailed in Part 9.7 and maintained with the SWPPP that certifies the following:

I certify under penalty of law that I have read and understand the Part 1.2 eligibility requirements for coverage under the multi-sector storm water general permit including those requirements relating to the protection of endangered or threatened species or critical habitat. To the best of my knowledge, the storm water and allowable non-storm discharges authorized by this permit (and discharged related activities), are not likely and will not likely, jeopardize endangered or threatened species or critical habitat, or are otherwise eligible for coverage under Part 1.2.3.6 of the permit. To the best of my knowledge, I further certify that such discharges and discharge related activities do not have an effect on properties listed or eligible for listing on the National Register of Historic Places under the National Historic Preservation Act, or are otherwise eligible for coverage under Part 1.2.3.7 of the permit. I understand that continued coverage under the multi-sector storm water general permit is contingent upon maintaining eligibility as provided for in Part 1.2.

Two additional components of the form pending approval by the Office of Management and Budget are:

a. under which Part(s) of Part 1.2.3.6 (Endangered Species) the applicant is certifying eligibility and whether the FWS or NMFS was involved in making the determination of eligibility;

b. under which Part(s) of Part 1.2.3.7 (Historic Properties) the applicant is certifying eligibility and whether the SHPO or THPO was involved in the determination of eligibility.

The NOI must be signed in accordance with the signatory requirements of 40 CFR 122.22. A complete description of these signatory requirements is provided in the instructions accompanying the NOI. Completed NOI forms must be submitted to the Storm Water Notice of Intent (4203), 1200 Pennsylvania Avenue NW., Washington, DC 20460.

In the future (but not at the present time), EPA may also allow alternate means of NOI submission (such as electronic submission). An alternate means of NOI submission may be used by operators provided EPA has informed the operator of the acceptability of the alternative.

2. Deadlines

For facilities currently covered by the 1995 MSGP, the deadline for submission of an NOI requesting coverage under the reissued MSGP is January 29, 2001 (90 days after expiration of the 1995 MSGP). For these facilities, the requirements of the 1995 MSGP are incorporated into today's MSGP and continue to apply during the interim period subsequent to the expiration of the 1995 MSGP, but prior to submission of the NOI requesting coverage under the reissued MSGP. In response to a question from some permittees, EPA wishes to clarify that there is no need to submit an NOT to rescind coverage under the 1995 MSGP.

Facilities currently covered by the 1995 MSGP who cannot immediately determine if they are eligible for coverage under today's reissued MSGP may nevertheless be covered for up to 270 days provided an application for an alternative permit is submitted within 90 days. This interim coverage allows permit coverage while the permittee assesses his eligibility for the reissued MSGP and, if necessary, still meet the 180 day lead time required for applications for individual permits.

For facilities commencing operations after reissuance of the MSGP, the NOI must be submitted at least two days prior to the commencement of the new industrial activity. New operators of existing facilities must also submit the NOI at least two days prior to assuming operational control at existing facilities.

Dischargers who submit a complete NOI in accordance with the MSGP requirements are authorized to discharge storm water associated with industrial activity two days after the date the NOI is postmarked, unless otherwise notified by EPA. EPA may deny coverage under the MSGP and require submission of an individual NPDES permit application based on a review of the completeness and/or content of the NOI or other information (e.g., Endangered Species Act compliance, National Historic Preservation Act Compliance, water quality information, compliance history, history of spills, etc.). Where EPA requires a discharger authorized under the MSGP to apply for an individual NPDES permit (or an alternative general permit), EPA will notify the discharger in writing that a permit application (or different NOI) is required by an established deadline. Coverage under the MSGP will automatically terminate if the discharger fails to submit the required permit application in a timely manner. Where the discharger does submit a requested permit application, coverage under the MSGP will automatically terminate on the effective date of the issuance or denial of the individual NPDES permit or the alternative general permit as it applies to the individual permittee.

A discharger is not precluded from submitting an NOI at a later date than described above. However, in such instances, EPA may bring appropriate enforcement actions.

3. Municipal Separate Storm Sewer System Operator Notification

Operators of storm water discharges associated with industrial activity that discharge through a large or medium municipal separate storm sewer system (MS4) or a municipal system designated by the Director,[1] must (upon request of the MS4 operator) submit a copy of the NOI to the municipal operator of the system receiving the discharge. This requirement of today's MSGP differs from the 1995 MSGP which had required that a copy of the NOI be sent to the MS4 operator. Today's MSGP has been modified in this regard to reduce paperwork requirements, and in consideration of the fact that most large and medium MS4 operators already have good information concerning the industrial facilities discharging into their MS4s.

EPA wishes to ensure a coordinated program between EPA and operators of MS4s for controlling pollutants in storm water discharges associated with industrial activity which enter an MS4. Such a coordinated program was intended by EPA's original storm water permit application regulations of November 16, 1990 (55 FR 48063). Additional discussion of this matter can be found in the original proposed MSGP (58 FR 61146).

4. Notice of Termination

Where a discharger is able to eliminate the storm water discharges associated with industrial activity from a facility, the discharger may submit a Notice of Termination (NOT) form (or photocopy thereof) provided by the Director. Today's final MSGP also differs from the 1995 MSGP by requiring that an NOT be submitted within 30 days after one or both of the following two conditions having been met:

a. a new owner/operator has assumed responsibility for the facility; or

b. the permittee has ceased operations at the facility and there no longer are discharges of storm water associated with industrial activity from the facility;

A copy of the NOT and instructions for completing the NOT are included in Addendum E. The NOT form requires the following information:

a. Name, mailing address, and location of the facility for which the notification is submitted. Where a street address for the site is not available, the location of the approximate center of the site must be described in terms of the latitude and longitude to the nearest 15 seconds, or the section, township and range to the nearest quarter;

b. The name, address and telephone number of the operator addressed by the Notice of Termination;

c. The NPDES permit number for the storm water discharge associated with industrial activity identified by the NOT;

d. An indication of whether the storm water discharges associated with industrial activity have been eliminated or the operator of the discharges has changed; and

e. The following certification:

I certify under penalty of law that all storm water discharges associated with industrial activity from the identified facility that are

[1] The terms large and medium municipal separate storm sewer systems (systems serving a population of 100,000 or more) are defined at 40 CFR 122.26(b)(4) and (7). Some of the cities and counties in which these systems are found are listed in Appendices F, G, H, and I to 40 CFR Part 122. Other municipal systems have been designated by EPA on a case-by-case basis or have brought into the program based upon the 1990 Census.

authorized by an NPDES general permit have been eliminated or that I am no longer the operator of the industrial activity. I understand that by submitting this Notice of Termination I am no longer authorized to discharge storm water associated with industrial activity under this general permit, and that discharging pollutants in storm water associated with industrial activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by an NPDES permit. I also understand that the submission of this notice of termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

NOTs are to be sent to the Storm Water Notice of Termination (4203), 1200 Pennsylvania Avenue NW., Washington, DC 20460.

The NOT must be signed in accordance with the signatory requirements of 40 CFR 122.22. A complete description of these signatory requirements is provided in the instructions accompanying the NOT.

5. Conditional Exclusion for No Exposure

Today's final MSGP includes a special provision (Part 1.5 of the permit) which provides that a facility may discontinue permit coverage if the facility determines that it is eligible for the "no exposure" permit exemption which was created by EPA as part of the promulgation of the Phase II storm water regulations (64 FR 68722). A notice of termination is not required to discontinue permit coverage under these circumstances. However, in accordance with the Phase II regulations, a no exposure certification must be filed with the permitting authority.

It should also be noted that facilities operating under the existing MSGP are eligible, as of the effective date of the Phase II regulations, to submit no exposure certifications immediately if they meet the criteria for no exposure. No exposure certification renewals must be submitted five years from the time they are first submitted (assuming the facility still qualifies for the exemption). If conditions change at a facility such that renewed MSGP coverage is needed, the facility may submit an NOI requesting renewed coverage.

In response to comments on this matter, EPA has included a copy of the "No Exposure" form and instructions as Addendum F to today's permit.

EPA has also prepared a new guidance document entitled "Guidance Manual for Conditional Exclusion from Storm Water Permitting Based on "No Exposure" of Industrial Activities to Storm Water" to assist permittees in determining eligibility for the exemption. This guidance document is available on EPA's storm water website. In addition, EPA recently conducted a mass mailing to permittees (as well as other stakeholder groups) alerting them to the no exposure exemption.

B. Special Conditions

The conditions of today's final MSGP have been designed to comply with the technology-based standards of the CWA (BAT/BCT). Based on a consideration of the appropriate factors for BAT and BCT requirements, and a consideration of the factors and options for controlling pollutants in storm water discharges associated with industrial activity, the final MSGP lists a set of tailored requirements for developing and implementing storm water pollution prevention plans (SWPPPs) and, for selected discharges, numeric effluent limitations.[2] This is the same approach as in the 1995 MSGP.

Section VIII of the fact sheet for the 1995 MSGP summarized the industry-specific BMP options for controlling pollutants in storm water discharges associated with industrial activity for the various industrial sectors covered by the MSGP. Section VIII of today's fact sheet does not repeat the information from the 1995 fact sheet; however, updates are provided as appropriate.

Section VI.B.4 of today's fact sheet discusses the storm water discharges which are subject to numeric effluent limitations. For other discharges covered by the final MSGP, the permit conditions reflect EPA's decision to identify a number of BMP and traditional storm water management practices which prevent pollution in storm water discharges as the BAT/BCT level of control for the majority of storm water discharges covered by this permit. The permit conditions applicable to these discharges are not numeric effluent limitations, but rather are flexible requirements for developing and implementing site specific plans to minimize and control pollutants in storm water discharges associated with industrial activity

EPA is authorized under 40 CFR 122.44(k)(2) to impose BMPs in lieu of numeric effluent limitations in NPDES permits when the Agency finds numeric effluent limitations to be infeasible. EPA may also impose BMPs which are "reasonably necessary * * * to carry out the purposes of the Act" under 40 CFR 122.44(k)(3). Both of these standards for imposing BMPs were recognized in *NRDC* v. *Costle*, 568 F.2d 1369, 1380 (D.C. Cir. 1977). The conditions in today's final MSGP are issued under the authority of both of these regulatory provisions. The pollution prevention or BMP requirements in today's final MSGP operate as limitations on effluent discharges that reflect the application of BAT/BCT. This is because the BMPs identified require the use of source control technologies which, in the context of the MSGP, are the best available of the technologies economically achievable (or the equivalent BCT finding). See *NRDC* v. *EPA*, 822 F.2d 104, 122–23 (D.C. Cir. 1987) (EPA has substantial discretion to impose nonquantitative permit requirements pursuant to Section 402(a)(1)). See also EPA's memorandum of August 1, 1996 entitled "Interim Permitting Approach for Water Quality-Based Effluent Limitations for Storm Water Discharges."

1. Prohibition of Non-storm Water Discharges

Today's final MSGP includes basically the same provisions pertaining to non-storm water discharges as the 1995 MSGP. Like the 1995 MSGP, today's MSGP does not authorize non-storm water discharges that are mixed with storm water except as provided below. Today's MSGP does authorize one additional non-storm water discharge: mist discharges which originate from cooling towers and which are deposited at an industrial facility and may be discharged. During the term of the 1995 MSGP, these discharges were brought to the attention of EPA with a request that the discharges be authorized under the reissued MSGP. The mist discharges are authorized under today's MSGP provided:

a. The permittee has evaluated the potential for the discharges to be contaminated by chemicals used in the cooling tower and determined that the levels of such chemicals in the discharges would not cause or contribute to a violation of an applicable water quality standard; and

b. The permittee has addressed this source of pollutants with appropriate BMPs in the SWPPP.

The other non-storm water discharges that are authorized under today's final MSGP are the same as those in the 1995 MSGP and include discharges from fire

[2] Section 9.12.2 of the final MSGP provides that facility operators with storm water discharges associated with industrial activity who, based on an evaluation of site specific conditions, believe that the appropriate conditions of this permit do not adequately represent BAT and BCT requirements for the facility may submit to the Director an individual application (Form 1 and Form 2F). A detailed explanation of the reasons why the conditions of the available general permits do not adequately represent BAT and BCT requirements for the facility as well as any supporting documentation must be included.

fighting activities; fire hydrant flushings; potable water sources, including waterline flushings; irrigation drainage; lawn watering; routine external building washdown without detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; compressor condensate; uncontaminated ground water or spring water; and foundation or footing drains where flows are not contaminated with process materials such as solvents that are combined with storm water discharges associated with industrial activity. In response to a comment, the final MSGP includes "potable water sources, including waterline flushings" on the list of authorized non-storm water discharges, but deletes the reference to "drinking fountain water," which a commenter felt could conflict with local ordinances.

To be authorized under today's MSGP, these other sources of non-storm water (except flows from fire fighting activities) must be identified in the SWPPP prepared for the facility. (SWPPP requirements are discussed in more detail below). Where such discharges occur, the SWPPP must also identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

Today's final MSGP does not require pollution prevention measures to be identified and implemented for non-storm water flows from fire-fighting activities because these flows will generally be unplanned emergency situations where it is necessary to take immediate action to protect the public.

The prohibition of unpermitted non-storm water discharges in today's MSGP ensures that non-storm water discharges (except for those classes of non-storm water discharges that are conditionally authorized in Part 1.2.2.2 of the MSGP) are not inadvertently authorized by the permit. Where a storm water discharge is mixed with non-storm water that is not authorized by today's MSGP or another NPDES permit, the discharger should submit the appropriate application forms (Forms 1, 2C, and/or 2E) to gain permit coverage of the non-storm water portion of the discharge.

2. Releases of Reportable Quantities of Hazardous Substances and Oil

As discussed below, today's final MSGP includes the same provisions pertaining to releases of reportable quantities of hazardous substances and oil as the 1995 MSGP.

a. Today's final MSGP provides that the discharge of hazardous substances or oil from a facility must be eliminated or minimized in accordance with the SWPPP developed for the facility. Where a permitted storm water discharge contains a hazardous substance or oil in an amount equal to or in excess of a reporting quantity established under 40 CFR Part 117, or 40 CFR Part 302 during a 24-hour period, the following actions must be taken:

(1) Any person in charge of the facility that discharges hazardous substances or oil is required to notify the National Response Center (NRC) (800–424–8802; in the Washington, DC, metropolitan area, 202–426–2675) in accordance with the requirements of 40 CFR Part 117, and 40 CFR Part 302 as soon as they have knowledge of the discharge.

(2) The SWPPP for the facility must be modified within 14 calendar days of knowledge of the release to provide a description of the release, an account of the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed to identify measures to prevent the reoccurrence of such releases and to respond to such releases, and it must be modified where appropriate.

(3) The permittee must also submit to EPA within 14 calendar days of knowledge of the release a written description of the release (including the type and estimate of the amount of material released), the date that such release occurred, the circumstances leading to the release, and steps to be taken to modify the SWPPP for the facility.

b. Anticipated discharges containing a hazardous substance in an amount equal to or in excess of reporting quantities are those caused by events occurring within the scope of the relevant operating system. Facilities that have more than one anticipated discharge per year containing a hazardous substance in an amount equal to or in excess of a reportable quantity are required to:

(1) Submit notifications of the first release that occurs during a calendar year (or for the first year of this permit, after submission of an NOI); and

(2) Provide a written description in the SWPPP of the dates on which such releases occurred, the type and estimate of the amount of material released, and the circumstances leading to the releases. In addition, the SWPPP must address measures to minimize such releases.

c. Where a discharge of a hazardous substance or oil in excess of reporting quantities is caused by a non-storm water discharge (e.g., a spill of oil into a separate storm sewer), that discharge is not authorized by the MSGP and the discharger must report the discharge as required under 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302. In the event of a spill, the requirements of Section 311 of the CWA and other applicable provisions of Sections 301 and 402 of the CWA continue to apply. This approach is consistent with the requirements for reporting releases of hazardous substances and oil that make a clear distinction between hazardous substances typically found in storm water discharges and those associated with spills that are not considered part of a normal storm water discharge (see 40 CFR 117.12(d)(2)(i)).

3. Co-located Industrial Facilities

Like the 1995 MSGP, today's MSGP includes requirements pertaining to co-located industrial facilities. However, these requirements have been modified from the requirements of the 1995 MSGP to clarify their applicability. Co-located industrial activities occur when activities being conducted onsite fall into more than one of the categories of the industrial facilities listed in Part 1.2.1 of today's MSGP (e.g., a landfill at a wood treatment facility). Facilities operating under the 1995 MSGP have sometimes been unclear whether certain limited activities (e.g., minor vehicle maintenance activities at an industrial plant) would trigger the MSGP's requirements regarding co-located activities.

If you have co-located industrial activities on-site that are described in a sector(s) other than your primary sector, you must comply with all other applicable sector-specific conditions found in Part 6 for the co-located industrial activities. The extra sector-specific requirements are applied only to those areas of your facility where the extra-sector activities occur. An activity at a facility is not considered co-located if the activity, when considered separately, does not meet the description of a category of industrial activity covered by the storm water regulations, and identified by today's MSGP SIC code list. For example, unless you are actually hauling substantial amounts of freight or materials with your own truck fleet or are providing a trucking service to outsiders, simple maintenance of vehicles used at your facility is unlikely to meet the SIC code group 42 description of a motor freight transportation facility. Even though Sector P may not apply, the runoff from your vehicle maintenance facility would likely still be considered storm water associated with industrial activity. As such, your SWPPP must still address the runoff from the vehicle maintenance facility—although not necessarily with the same degree of detail as required by Sector P—but you would not be required to monitor as per Sector P.

In the event there truly are co-located activities at your facility, today's MSGP authorizes, as does the 1995 MSGP, all storm water discharges provided that your facility complies with all SWPPP and monitoring requirements for each co-located activity. By monitoring the discharges from the different industrial activities, you can better determine the effectiveness of your SWPPP for controlling all major pollutants of concern in your storm water discharges. However, if monitoring for the same parameter is required for more than one sector (and the different industrial activities drain to the same outfall), then only one sample analysis is required for that parameter.

4. Numeric Effluent Limitations

Today's MSGP retains the numeric effluent limitations which were included in the 1995 MSGP, and also includes the effluent limitations guidelines which EPA recently finalized for certain storm water discharges from new and existing hazardous and non-hazardous landfills (65 FR 3007, January 19, 2000). The new effluent limitations guidelines for these landfills are discussed in more detail in the Sections VIII.K and L of this fact sheet (Special Requirements for Discharges Associated with Industry Activities).

Today's MSGP retains the numeric effluent limitations from the 1995 MSGP for the following discharges: coal pile runoff (including runoff from steam electric power plants subject to 40 CFR Part 423 requirements), discharges from phosphate fertilizer manufacturing (40 CFR Part 418), asphalt paving and roofing emulsions (40 CFR Part 443), cement manufacturing materials storage pile runoff (40 CFR Part 411), and discharges resulting from the spray down of lumber and wood products storage yards (wet decking) (40 CFR Part 429). In addition, the final MSGP authorizes mine dewatering discharges from construction sand and gravel, industrial sand, and crushed stone facilities (40 CFR Part 436) in EPA Regions 1, 2, 3, 6, 8, 9, 10. The actual numeric effluent limitations can be found in Part 6 of the final MSGP.

5. Compliance with Water Quality Standards

The 1995 MSGP does not specifically address compliance with water quality standards (WQS), other than to exclude from coverage discharges which may contribute to an exceedance of WQS. Today's final MSGP includes the same restriction on eligibility, and in Part 3.3 also includes certain requirements if exceedances occur for discharges covered by the MSGP. If a discharge authorized under the final MSGP is later discovered to cause, or have the reasonable potential to cause or contribute to, a violation of a WQS, the permitting authority will inform the permittee of the violation. The permittee must then take all necessary actions to ensure future discharges do not cause or contribute to the violation of WQS, and document these actions in the SWPPP. If violations remain or recur, coverage under the MSGP may be terminated by the permitting authority and an alternate permit issued. Today's final MSGP also clarifies that compliance with this requirement does not preclude enforcement actions as provided by the CWA for the underlying violation.

C. Common Storm Water Pollution Prevention Plan (SWPPP) Requirements

Like the 1995 MSGP, today's reissued MSGP requires that all facilities which intend to be covered by the MSGP for storm water discharges associated with industrial activity prepare and implement a SWPPP. The MSGP addresses pollution prevention plan requirements for a number of categories of industries. Following below is a discussion of the common permit requirements for all industries; special requirements for facilities subject to EPCRA Section 313 reporting requirements; and special requirements for facilities with outdoor salt storage piles. These are the permit requirements which apply to discharges associated with any of the industrial activities covered by today's final MSGP. These common requirements may be amended or further clarified in the industry-specific SWPPP requirements which are found in Part 6 of the final MSGP. These industry-specific requirements are additive for facilities where co-located industrial activities occur.

The Storm Water Pollution Prevention Plan (SWPPP) approach in today's final MSGP focuses on two major objectives: (1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from the facility; and (2) ensure implementation of measures to minimize and control pollutants in storm water discharges associated with industrial activity from the facility.

The SWPPP requirements in today's final MSGP are intended to facilitate a process whereby the operator of the industrial facility thoroughly evaluates potential pollution sources at the site and selects and implements appropriate measures designed to prevent or control the discharge of pollutants in storm water runoff. The process involves the following four steps: (1) formation of a team of qualified plant personnel who will be responsible for preparing the plan and assisting the plant manager in its implementation; (2) assessment of potential storm water pollution sources; (3) selection and implementation of appropriate management practices and controls; and (4) periodic evaluation of the effectiveness of the plan to prevent storm water contamination.

EPA believes the pollution prevention approach is the most environmentally sound and cost-effective way to control the discharge of pollutants in storm water runoff from industrial facilities. This position is supported by the results of a comprehensive technical survey EPA completed in 1979.[3] The survey found that two classes of management practices are generally employed at industries to control the nonroutine discharge of pollutants from sources such as storm water runoff, drainage from raw material storage and waste disposal areas, and discharges from places where spills or leaks have occurred. The first class of management practices includes those that are low in cost, applicable to a broad class of industries and substances, and widely considered essential to a good pollution control program. Some examples of practices in this class are good housekeeping, employee training, and spill response and prevention procedures. The second class includes management practices that provide a second line of defense against the release of pollutants. This class addresses containment, mitigation, and cleanup. Since publication of the 1979 survey, EPA has imposed management practices and controls in NPDES permits on a case-by-case basis. The Agency also has continued to review the appropriateness and effectiveness of such practices,[4] as well as the

[3] See "Storm Water Management for Industrial Activities," EPA, September 1992, EPA–832–R–92–006.

[4] For example, see "Best Management Practices: Useful Tools for Cleaning Up," Thron, H. Rogoshewski, P., 1982, Proceedings of the 1982 Hazardous Material Spills Conference; "The Chemical Industries" Approach to Spill Prevention," Thompson, C., Goodier, J. 1980. Proceedings of the 1980 National Conference of Control of Hazardous Materials Spills; a series of EPA memoranda entitled "Best Management Practices in NPDES Permits—Information Memorandum." 1983, 1985, 1986, 1987, 1988; Review of Emergency Systems: Report to Congress," EPA, 1988; and "Analysis of Implementing

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techniques used to prevent and contain oil spills.[5] Experience with these practices and controls has shown that they can be used in permits to reduce pollutants in storm water discharges in a cost-effective manner. In keeping with both the present and previous administration's objective to attain environmental goals through pollution prevention, pollution prevention has been and continues to be the cornerstone of the NPDES permitting program for storm water. EPA has developed guidance entitled "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," September 1992, to assist permittees in developing and implementing pollution prevention measures.

Note: The discussions of the SWPPP requirements are grouped in subject areas and do not follow the exact order of the permit conditions.

1. Pollution Prevention Team (Part 4.2.1)

As a first step in the process of developing and implementing a SWPPP, permittees are required to identify a qualified individual or team of individuals to be responsible for developing the plan and assisting the facility or plant manager in its implementation. When selecting members of the team, the plant manager should draw on the expertise of all relevant departments within the plant to ensure that all aspects of plant operations are considered when the plan is developed. The plan must clearly describe the responsibilities of each team member as they relate to specific components of the plan. In addition to enhancing the quality of communication between team members and other personnel, clear delineation of responsibilities will ensure that every aspect of the plan is addressed by a specified individual or group of individuals. Pollution Prevention Teams may consist of one individual where appropriate (*e.g.*, in certain small businesses with limited storm water pollution potential).

2. Description of the Facility and Potential Pollution Sources (Part 4.2.2)

Each SWPPP must describe activities, materials, and physical features of the facility that may contribute significant amounts of pollutants to storm water runoff or, during periods of dry weather, result in pollutant discharges through the separate storm sewers or storm water drainage systems that drain the facility. This assessment of storm water pollution risk will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. Some operators may find that significant amounts of pollutants are running onto the facility property. Such operators should identify and address the contaminated runon in the SWPPP. If the runon cannot be addressed or diverted by the permittee, the permitting authority should be notified. If necessary, the permitting authority may require the operator of the adjacent facility to obtain a permit.

Part 6 of the final MSGP includes industry-specific requirements for the various industry sectors covered by today's permit. All SWPPPs generally must describe the following elements:

a. *Description of the Facility Site and Receiving Waters/Wetlands (Parts 4.2.2 and 4.2.3):* The plan must contain a map of the site that shows the location of outfalls covered by the permit (or by other NPDES permits), the pattern of storm water drainage, an indication of the types of discharges contained in the drainage areas of the outfalls, structural features that control pollutants in runoff,[6] surface water bodies (including wetlands), places where significant materials[7] are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of an NOI to be covered under this permit. The map also must show areas where the following activities take place: fueling, vehicle and equipment maintenance and/or cleaning, loading and unloading, material storage (including tanks or other vessels used for liquid or waste storage), material processing, and waste disposal. For areas of the facility that generate storm water discharges with a reasonable potential to contain significant amounts of pollutants, the map must indicate the probable direction of storm water flow and the pollutants likely to be in the discharge. Flows with a significant potential to cause soil erosion also must be identified. In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

b. *Summary of Potential Pollutant Sources (Part 4.2.4):* The description of potential pollution sources culminates in a narrative assessment of the risk potential that sources of pollution pose to storm water quality. This assessment should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water. Any such activities, materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The assessment must list any significant pollution sources at the site and identify the pollutant parameter or parameters (*i.e.*, biochemical oxygen demand, suspended solids, etc.) associated with each source.

c. *Significant Spills and Leaks (Part 4.2.5):* The plan must include a list of any significant spills and leaks of toxic or hazardous pollutants that occurred in the three years prior to the date of the submission of an NOI to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of CWA (see 40 CFR 110.10 and 40 CFR 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements and releases of materials that are not classified as oil or a hazardous substance.

The listing should include a description of the causes of each spill or leak, the actions taken to respond to each release, and the actions taken to prevent similar such spills or leaks in the future. This effort will aid the facility operator as she or he examines existing spill prevention and response procedures and develops any additional

Permitting Activities for Storm Water Discharges Associated with Industrial Activity," EPA, 1991.

[5] See for example, "The Oil Spill Prevention, Control and Countermeasures Program Task Force Report," EPA, 1988; and "Guidance Manual for the Development of an Accidental Spill Prevention Program," prepared by SAIC for EPA, 1986.

[6] Nonstructural features such as grass swales and vegetative buffer strips also should be shown.

[7] Significant materials include, but are not limited to the following: raw materials; fuels; solvents, detergents, and plastic pellets; finished materials, such as metallic products; raw materials used in food processing or production; hazardous substances designated under Section 101(14) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); any chemical the facility is required to report pursuant to EPCRA Section 313; fertilizers; pesticides; and waste products, such as ashes, slag, and sludge that have the potential to be released with storm water discharges. (See 40 CFR 122.26(b)(8)).

procedures necessary to fulfill the requirements set forth in Parts 4 and 6 of the final permit.

d. *Allowable and Prohibited Non-storm Water Discharges (Part 4.4):* Each SWPPP must include a certification, signed by an authorized individual, that discharges from the site have been tested or evaluated for the presence of non-storm water discharges. The certification must describe possible significant sources of non-storm water, the results of any test and/or evaluation conducted to detect such discharges, the test method or evaluation criteria used, the dates on which tests or evaluations were performed, and the onsite drainage points directly observed during the test or evaluation. Acceptable test or evaluation techniques include dye tests, television surveillance, observation of outfalls or other appropriate locations during dry weather, water balance calculations, and analysis of piping and drainage schematics.[8]

Except for flows that originate from fire fighting activities, sources of non-storm water that are specifically identified in the permit as being eligible for authorization under the general permit must be identified in the plan. SWPPPs must identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water discharge.

EPA recognizes that certification may not be feasible where facility personnel do not have access to an outfall, manhole, or other point of access to the conduit that ultimately receives the discharge. In such cases, the plan must describe why certification was not feasible. Permittees who are not able to certify that discharges have been tested or evaluated must notify the Director in accordance with Part 4.4 of the final MSGP.

e. *Sampling Data (Part 4.2.6):* Any existing data on the quality or quantity of storm water discharges from the facility must be described in the plan, including data collected for Part 2 of the group application process. These data may be useful for locating areas that have contributed pollutants to storm water. The description should include a discussion of the methods used to collect and analyze the data. Sample collection points should be identified in the plan and shown on the site map.

[8] In general, smoke tests should not be used for evaluating the discharge of non-storm water to a separate storm sewer as many sources of non-storm water typically pass through a trap that would limit the effectiveness of the smoke test.

3. Selection and Implementation of Storm Water Controls (Part 4.2.7, et al.)

Following completion of the source identification and assessment phase, the permit requires the permittee to evaluate, select, and describe the pollution prevention measures, BMPs, and other controls that will be implemented at the facility. BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in storm water runoff.

EPA emphasizes the implementation of pollution prevention measures and BMPs that reduce possible pollutant discharges at the source. Source reduction measures include, among others, preventive maintenance, chemical substitution, spill prevention, good housekeeping, training, and proper materials management. Where such practices are not appropriate to a particular source or do not effectively reduce pollutant discharges, EPA supports the use of source control measures and BMPs such as material segregation or covering, water diversion, and dust control. Like source reduction measures, source control measures and BMPs are intended to keep pollutants out of storm water. The remaining classes of BMPs, which involve recycling or treatment of storm water, allow the reuse of storm water or attempt to lower pollutant concentrations prior to discharge.

The SWPPP must discuss the reasons each selected control or practice is appropriate for the facility and how each will address one or more of the potential pollution sources identified in the plan. The plan also must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential storm water contamination problems. The permit requirements included for the various industry sectors in Part 6 of today's final MSGP generally require that the portion of the plan that describes the measures and controls address the following minimum components.

When "minimize/reduce" is used relative to SWPPP measures, EPA means to consider and implement BMPs that will result in an improvement over the baseline conditions as it relates to the levels of pollutants identified in storm water discharges with due consideration to economic feasibility and effectiveness.

a. *Nonstructural Controls:*

• Good Housekeeping. Good housekeeping involves using practical, cost-effective methods to identify ways to maintain a clean and orderly facility and keep contaminants out of separate storm sewers. It includes establishing protocols to reduce the possibility of mishandling chemicals or equipment and training employees in good housekeeping techniques. These protocols must be described in the plan and communicated to appropriate plant personnel.

• Minimizing Exposure. Where practicable, protecting potential pollutant sources from exposure to storm water is an important control option. Pollutants that are never allowed to contaminate storm water do not require development of "treatment" type BMPs. Elimination of all exposure to storm water may also make the facility eligible for the "No Exposure Certification" exclusion from permitting at 40 CFR 122.26(g)

• Preventive Maintenance. Permittees must develop a preventive maintenance program that involves regular inspection and maintenance of storm water management devices and other equipment and systems. The program description should identify the devices, equipment, and systems that will be inspected; provide a schedule for inspections and tests; and address appropriate adjustment, cleaning, repair, or replacement of devices, equipment, and systems. For storm water management devices such as catch basins and oil/water separators, the preventive maintenance program should provide for periodic removal of debris to ensure that the devices are operating efficiently. For other equipment and systems, the program should reveal and enable the correction of conditions that could cause breakdowns or failures that may result in the release of pollutants.

• Spill Prevention and Response Procedures. Based on an assessment of possible spill scenarios, permittees must specify appropriate material handling procedures, storage requirements, containment or diversion equipment, and spill cleanup procedures that will minimize the potential for spills and, in the event of a spill, enable proper and timely response. Areas and activities that typically pose a high risk for spills include loading and unloading areas, storage areas, process activities, and waste disposal activities. These activities and areas, and their accompanying drainage points, must be described in the plan. For a spill prevention and response program to be effective, employees should clearly understand the proper procedures and requirements and have the equipment necessary to respond to spills.

• Routine Inspections. In addition to the comprehensive site evaluation, facilities are required to conduct periodic inspections of designated equipment and areas of the facility. Industry-specific requirements for such inspections, if any, are set forth in Part 6 of the final MSGP. When required, qualified personnel must be identified to conduct inspections at appropriate intervals specified in the plan. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections must be maintained. These periodic inspections are different from the comprehensive site evaluation, even though the former may be incorporated into the latter. Equipment, area, or other inspections are typically visual and are normally conducted on a regular basis, *e.g.*, daily inspections of loading areas. Requirements for such periodic inspections are specific to each industrial sector in today's permit, whereas the comprehensive site compliance evaluation is required of all industrial sectors. Area inspections help ensure that storm water pollution prevention measures (*e.g.*, BMPs) are operating and properly maintained on a regular basis. The comprehensive site evaluation is intended to provide an overview of the entire facility's pollution prevention activities. Refer to Part VI.C.3.h. below for more information on the comprehensive site evaluation.

• Employee Training. The SWPPP must describe a program for informing personnel at all levels of responsibility of the components and goals of the SWPPP. The training program should address topics such as good housekeeping, materials management, and spill response procedures. Where appropriate, contractor personnel also must be trained in relevant aspects of storm water pollution prevention. A schedule for conducting training must be provided in the plan. Several sections in Part 6 of today's final MSGP specify a minimum frequency for training of once per year. Others indicate that training is to be conducted at an appropriate interval. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

b. *Structural Controls:*

• Sediment and Erosion Control. The SWPPP must identify areas that, due to topography, activities, soils, cover materials, or other factors have a high potential for significant soil erosion. The plan must identify measures that will be implemented to limit erosion in these areas.

• Management of Runoff. The plan must contain a narrative evaluation of the appropriateness of traditional storm water management practices (*i.e.*, practices other than those that control pollutant sources) that divert, infiltrate, reuse, or otherwise manage storm water runoff so as to reduce the discharge of pollutants. Appropriate measures may include, among others, vegetative swales, collection and reuse of storm water, inlet controls, snow management, infiltration devices, and wet detention/retention basins.

c. *Example BMPs:* Part 4.2.7.2.2 includes a list of example BMPs that could be considered for use in a SWPPP, for example: detention structures (including wet ponds); storm water retention structures; flow attenuation by use of open vegetated swales and natural depressions; infiltration of runoff onsite; and sequential systems (which combine several practices). These examples are not intended to limit the creativity of facility operators in developing alternative BMPs or applications for BMPs that increase cost effectiveness.

d. *Selection of Controls:* Based on the results of the evaluation, the plan must identify practices that the permittee determines are reasonable and appropriate for the facility. The plan also should describe the particular pollutant source area or activity to be controlled by each storm water management practice. Reasonable and appropriate practices must be implemented and maintained according to the provisions prescribed in the plan.

In selecting storm water management measures, it is important to consider the potential effects of each method on other water resources, such as ground water. Although storm water pollution prevention plans primarily focus on storm water management, facilities must also consider potential ground water pollution problems and take appropriate steps to avoid adversely affecting ground water quality. For example, if the water table is unusually high in an area, an infiltration pond may contaminate a ground water source unless special preventive measures are taken. Under EPA's July 1991 Ground Water Protection Strategy, States are encouraged to develop Comprehensive State Ground Water Protection Programs (CSGWPP). Efforts to control storm water should be compatible with State ground water objectives as reflected in CSGWPPs.

e. *Other Controls:* Today's final MSGP includes a new requirement that no solid materials, including floating debris may be discharged to waters of the United States, except as authorized by a permit under Section 404 of the Clean Water Act. In addition, off-site tracking of raw, final, or waste materials or sediment, and the generation of dust must be minimized. Tracking or blowing of raw, final, or waste materials from areas of no exposure to exposed areas must be minimized. These requirements are similar to requirements included in EPA's construction general storm water permit (63 FR 7858, February 17, 1998) which EPA believes would be appropriate for industrial facilities as well.

f. *Maintenance (Part 4.3):* All BMPs identified in the SWPPP must be maintained in effective operating condition.

g. *Controls for Allowable Non-Storm Water (Part 4.4.2):* Where an allowable non-storm water has been identified, appropriate controls for that discharge must be included in the permit. In many cases, the same types of controls for contaminated storm water would suffice, but the nature and volume of potential pollutants in the non-storm water discharges must be taken into consideration in selection of controls.

h. *Comprehensive Site Compliance Evaluation (Part 4.9):* Today's final MSGP requires that the SWPPP describe the scope and content of the comprehensive site evaluations that qualified personnel will conduct to (1) confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of the permit. Note that the comprehensive site evaluations are not the same as periodic or other inspections described for certain industries in Section VI.C.3.d of this fact sheet. However, in the instances when frequencies of inspections and the comprehensive site compliance evaluation overlap, they may be combined allowing for efficiency as long as the requirements for both types of inspections are met. The plan must indicate the frequency of comprehensive evaluations which must be at least once a year, except where comprehensive site evaluations are shown in the plan to be impractical for inactive mining sites, due to remote location and inaccessibility.[9] The individual or individuals who will conduct the comprehensive site evaluation must be identified in the plan and should be members of the pollution prevention team. Material handling and storage areas and other potential sources of pollution must be visually inspected for evidence of actual or potential pollutant discharges to the drainage system. Inspectors also must observe erosion controls and structural storm water management devices to ensure that each is operating correctly. Equipment needed to implement the SWPPP, such as that used during spill response activities, must be inspected to confirm that it is in proper working order.

The results of each comprehensive site evaluation must be documented in a report signed by an authorized company official. The report must describe the scope of the comprehensive site evaluation, the personnel making the comprehensive site evaluation, the date(s) of the comprehensive site evaluation, and any major observations relating to implementation of the SWPPP. Comprehensive site evaluation reports must be retained for at least three years after the date of the evaluation. Based on the results of each comprehensive site evaluation, the description in the plan of potential pollution sources and measures and controls must be revised as appropriate within two weeks after each comprehensive site evaluation, unless indicated otherwise in Part 6 of the permit. If existing BMPs need to be modified or if additional BMPs are necessary, implementation must be completed before the next anticipated storm, or not more than 12 weeks after completion of the comprehensive site evaluation.

i. *Applicable State, Tribal, or Local Plans (Part 4.8):* The SWPPP must be consistent with any applicable requirements of State, Tribal, or Local storm water, waste disposal, sanitary sewer or septic system regulations to the extent these apply to a facility and are more stringent than the requirements of this permit.

j. *Documentation of Permit Eligibility with Regards to ESA and NHPA Requirements (Parts 4.5 and 4.6):* To better ensure compliance with the requirements of the ESA and NHPA, Parts 4.5 and 4.6 of today's final MSGP require that documentation be included with the SWPPP demonstrating permit eligibility with regards to the requirements of the ESA and NHPA. The following information is required for the ESA:

• Information on whether listed endangered or threatened species, or critical habitat, are found in proximity to the facility;
• Whether such species may be jeopardized by the storm water discharges or storm water discharge-related activities;
• Results of the Addendum A endangered species screening determinations; and
• A description of measures necessary to protect listed endangered or threatened species, or critical habitat, including any terms or conditions that are imposed under the eligibility requirements of Part 1.2.3.6. The final MSGP notes that discharges from facilities which fail to describe and implement such measures are ineligible for coverage under the permit.

The following information is required for the NHPA determination:

• Information on whether the storm water discharges or storm water discharge-related activities would have an effect on a property that is listed or eligible for listing on the National Register of Historic Places;
• Where effects may occur, any written agreements which have been made with the State Historic Preservation Officer, Tribal Historic Preservation Officer, or other Tribal leader to mitigate those effects;
• Results of the Addendum B historic places screening determinations; and
• A description of measures necessary to avoid or minimize adverse impacts on places listed, or eligible for listing, on the National Register of Historic Places, including any terms or conditions that are imposed under the eligibility requirements of Part 1.2.3.7 of this permit. The final MSGP notes that discharges from facilities which fail to describe and implement such measures are ineligible for coverage under the permit.

k. *Keeping a Copy of the Permit with the SWPPP (Part 4.7):* A new requirement to have a copy of the permit language in the SWPPP has been added to today's permit. The "confirmation" letter received from the NOI Processing Center is not the permit; it is essentially only the equivalent of a "receipt" for a facility's "registration" (NOI) to use the general permit. Since determining permit eligibility and preparing a SWPPP is required prior to obtaining permit coverage, a copy of the permit would be needed anyway. Requiring a copy of the permit in the SWPPP ensures that facility operators, and not just whoever prepared the SWPPP, will have ready access to all permit requirements.

l. *Recordkeeping and Keeping the SWPPP Current (Parts 4.9.4, 4.10, et al.):* Records must be kept with the SWPPP documenting the status and effectiveness of plan implementation. At a minimum, records must address results of the annual Comprehensive Site Compliance Evaluations, routine facility inspections, spills, monitoring, and maintenance activities. The plan also must describe a system that enables timely reporting of storm water management-related information to appropriate plant personnel. Inspectors or other enforcement officers will ask for records documenting permit compliance during inspections or facility compliance reviews.

The SWPPP must be updated whenever there is a change at the facility that would significantly affect the discharges authorized under the MSGP. The SWPPP must also be updated whenever monitoring results and/or an inspection by the permittee or by local, state, tribal, or federal officials indicate a portion of the SWPPP is proving to be ineffective in controlling storm water discharge quality.

m. *Signature, Plan Review, and Access to the SWPPP (Part 4.11):* The SWPPP must be signed and certified in accordance with Part 7 of the permit. A copy of the SWPPP must be kept on site at the facility or be locally available for the use of the Director, a State, Tribe, or local agency (*e.g.*, MS4 operator) at the time of an onsite inspection. The SWPPP must also be made available to the U.S. Fish and Wildlife Service or National Marine Fisheries Service upon request. Since SWPPPs are living documents that change over time, access to the current version of the SWPPP is critical in assessing permit compliance. Facilities are also required to provide a copy of the SWPPP to the public when requested in writing to do so.

The Director may notify you at any time that your SWPPP does not meet one or more of the minimum requirements of this permit. The notification will identify provisions of the permit which are not being met, as well as the required modifications. Required changes must be made within thirty (30) calendar days and a written certification submitted to the Director confirming that the changes were made.

EPA does not intend to require public comment on SWPPPs or hold public hearings. As noted above, EPA may require changes to a SWPPP when necessary and may consider concerns from the public in making such judgments. The MSGP also provides

[9] Where annual site inspections are shown in the plan to be impractical for inactive mining sites due to remote location and inaccessibility, site inspections must be conducted at least once every three years.

that individual permits may be required when the MSGP is inappropriate for a given facility. During the issuance of the individual permits, the public would have an opportunity to comment on the requirements of the permits.

4. Deadlines

Today's MSGP requires that permittees previously covered by the 1995 MSGP must update their SWPPPs to comply with any new requirements of today's MSGP by the date they submit their new NOIs. As noted earlier, the new NOIs are due January 29, 2001. However, a permittee may request an extension for the SWPPP update not to exceed 270 days from the expiration date of the 1995 MSGP.

D. Special Requirements

1. Special Requirements for Storm Water Discharges Associated With Industrial Activity From Facilities Subject to EPCRA Section 313 Requirements (Part 4.12)

Today's final MSGP replaces the special requirements of the 1995 MSGP for certain permittees subject to reporting requirements under Section 313 of the EPCRA (also known as Title III of the Superfund Amendments and Reauthorization Act (SARA)) with a requirement to identify areas with these pollutants. EPCRA Section 313 requires operators of certain facilities that manufacture (including import), process, or otherwise use listed toxic chemicals to report annually their releases of those chemicals to any environmental media. Listed toxic chemicals include more than 500 chemicals and chemical classes listed at 40 CFR Part 372 (including the recently added chemicals published November 30, 1994).

By requiring identification of EPCRA 313 chemicals in the summary of potential pollutant sources under the Storm Water Pollution Prevention Plan (Part 4.2.4), the facility operator is then required to develop appropriate storm water controls for such areas (Part 4.2.7). EPA expects that many controls for EPCRA chemicals will continue to be driven by other state and federal environmental regulations such as Spill Prevention Control and Countermeasure (SPCC) plans required under Section 311 of the CWA, etc. as long as such a requirement is incorporated into the SWPPP.

This reduction in permit complexity by eliminating redundant requirements was requested by members of the regulated community.

2. Special Requirements for Storm Water Discharges Associated With Industrial Activity From Salt Storage Facilities

Today's MSGP retains the same special requirements as the 1995 MSGP for storm water discharges associated with industrial activity from salt storage facilities. Storage piles of salt used for deicing or other commercial or industrial purposes must be enclosed or covered to prevent exposure to precipitation, except for exposure resulting from adding or removing materials from the pile. This requirement only applies to runoff from storage piles discharged to waters of the United States. Facilities that collect all the runoff from their salt piles and reuse it in their processes or discharge it subject to a separate NPDES permit do not need to enclose or cover their piles.

These special requirements have been included in today's permit based on human health and aquatic effects resulting from storm water runoff from salt storage piles compounded with the prevalence of salt storage piles across the United States.

3. Consistency With Other Plans

SWPPPs may reference the existence of other plans for Spill Prevention Control and Countermeasure (SPCC) developed for the facility under Section 311 of the CWA or BMP programs otherwise required by an NPDES permit for the facility as long as such requirement is incorporated into the SWPPP.

E. Monitoring and Reporting Requirements

Today's final MSGP retains the same monitoring requirements as the existing MSGP. Numerous comments were submitted on these monitoring requirements. A summary of EPA's responses to these comments and justification for retaining these requirements is contained in this section. A more detailed discussion is found in Section IX of this fact sheet (Summary of Responses to Comments). Responses to individual comments are contained in the Water Docket.

Like the 1995 MSGP, today's final MSGP includes three general types of monitoring: analytical monitoring or chemical monitoring; compliance monitoring for effluent guidelines compliance, and visual examinations of storm water discharges. A general description of each of these types of monitoring which was provided with the 1995 MSGP is repeated below.

1. Analytical Monitoring Requirements

Analytical monitoring requirements involve laboratory chemical analyses of samples collected by the permittee. The results of the analytical monitoring are quantitative concentration values for different pollutants, which can be easily compared to the results from other sampling events, other facilities, or to national benchmarks.

The categories of facilities subject to analytical monitoring in today's final MSGP are noted in Table 1 of this fact sheet. The MSGP requires analytical monitoring for the industry sectors or subsectors that demonstrated in the group application data a potential to discharge pollutants at concentrations of concern or, in certain State-specific cases, to satisfy those States' requirements. The data submitted with the group permit applications were reviewed by EPA to determine the industry sectors and subsectors listed in Table 1 of this fact sheet that are to be subject to analytical monitoring requirements. First, EPA divided the Part 1 and Part 2 application data by the industry sectors listed in Table 1. Where a sector was found to contain a wide range of industrial activities or potential pollutant sources, it was further subdivided into the industry subsectors listed in Table 1. Next, EPA reviewed the information submitted in Part 1 of the group applications regarding the industrial activities, significant materials exposed to storm water, and the material management measures employed. This information helped identify potential pollutants that may be present in the storm water discharges. Then EPA entered into a database the sampling data submitted in Part 2 of the group applications. Those data were arrayed according to industrial sector and subsector for the purposes of determining when analytical monitoring would be appropriate.

To conduct a comparison of the results of the statistical analyses to determine when analytical monitoring would be required, EPA established "benchmark" concentrations for the pollutant parameters on which monitoring results had been received. The "benchmarks" are the pollutant concentrations above which EPA determined represent a level of concern. The level of concern is a concentration at which a storm water discharge could potentially impair, or contribute to impairing, water quality or affect human health from ingestion of water or fish. The benchmarks are also viewed by EPA as a level that, if below, a facility presents little potential for water quality concern. As such, the benchmarks also

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provide an appropriate level to determine whether a facility's storm water pollution prevention measures are successfully implemented. The benchmark concentrations are not effluent limitations and should not be interpreted or adopted as such. These values are merely levels which EPA has used to determine if a storm water discharge from any given facility merits further monitoring to ensure that the facility has been successful in implementing a SWPPP. As such, these levels represent a target concentration for a facility to achieve through implementation of pollution prevention measures at the facility. Table 3 lists the parameter benchmark values and the sources used for the benchmarks. Two changes from the 1995 MSGP are the addition of benchmark values for total Cyanide and Total Magnesium. Benchmark values for the two parameters were included in the Fact Sheet of the 1995 MSGP at Table K–3, but were inadvertently not included in the general listing of parameter benchmark values (Table 5 of the Fact Sheet for the 1995 MSGP). Additional information explaining the derivation of the benchmarks can be found in the fact sheet for the 1995 MSGP (60 FR 50825).

TABLE 3.—PARAMETER BENCHMARK VALUES

Parameter name	Benchmark level	Source
Biochemical Oxygen Demand (5 day)	30 mg/L	4
Chemical Oxygen Demand	120 mg/L	5
Total Suspended Solids	100 mg/L	7
Oil and Grease	15 mg/L	8
Nitrate + Nitrite Nitrogen	0.68 mg/L	7
Total Phosphorus	2.0 mg/L	6
pH	6.0–9.0 s.u.	4
Acrylonitrile (c)	7.55 mg/L	2
Aluminum, Total (pH 6.5–9)	0.75 mg/L	1
Ammonia	19 mg/L	1
Antimony, Total	0.636 mg/L	9
Arsenic, Total (c)	0.16854 mg/L	9
Benzene	0.01 mg/L	10
Beryllium, Total (c)	0.13 mg/L	2
Butylbenzyl Phthalate	3 mg/L	3
Cadmium, Total (H)	0.0159 mg/L	9
Chloride	860 mg/L	1
Copper, Total (H)	0.0636 mg/L	9
Cyanide, Total	0.0636 mg/l	9
Dimethyl Phthalate	1.0 mg/L	11
Ethylbenzene	3.1 mg/L	3
Fluoranthene	0.042 mg/L	3
Fluoride	1.8 mg/L	6
Iron, Total	1.0 mg/L	12
Lead, Total (H)	0.0816 mg/L	1
Magnesium, Total	0.0636 mg/l	9
Manganese	1.0 mg/L	13
Mercury, Total	0.0024 mg/L	1
Nickel, Total (H)	1.417 mg/L	1
PCB–1016 (c)	0.000127 mg/L	9
PCB–1221 (c)	0.10 mg/L	10
PCB–1232 (c)	0.000318 mg/L	9
PCB–1242 (c)	0.00020 mg/L	10
PCB–1248 (c)	0.002544 mg/L	9
PCB–1254 (c)	0.10 mg/L	10
PCB–1260 (c)	0.000477 mg/L	9
Phenols, Total	1.0 mg/L	11
Pyrene (PAH,c)	0.01 mg/L	10
Selenium, Total (*)	0.2385 mg/L	9
Silver, Total (H)	0.0318 mg/L	9
Toluene	10.0 mg/L	3
Trichloroethylene (c)	0.0027 mg/L	3
Zinc, Total (H)	0.117 mg/L	1

Sources:
1. "EPA Recommended Ambient Water Quality Criteria." Acute Aquatic Life Freshwater.
2. "EPA Recommended Ambient Water Quality Criteria." LOEL Acute Freshwater.
3. "EPA Recommended Ambient Water Quality Criteria." Human Health Criteria for Consumption of Water and Organisms.
4. Secondary Treatment Regulations (40 CFR 133).
5. Factor of 4 times BOD5 concentration—North Carolina benchmark.
6. North Carolina storm water benchmark derived from NC Water Quality Standards.
7. National Urban Runoff Program (NURP) median concentration.
8. Median concentration of Storm Water Effluent Limitation Guideline (40 CFR Part 419).
9. Minimum Level (ML) based upon highest Method Detection Limit (MDL) times a factor of 3.18.
10. Laboratory derived Minimum Level (ML).
11. Discharge limitations and compliance data.
12. "EPA Recommended Ambient Water Quality Criteria." Chronic Aquatic Life Freshwater.
13. Colorado—Chronic Aquatic Life Freshwater—Water Quality Criteria.

Notes:
(*) Limit established for oil and gas exploration and production facilities only.
(c) carcinogen.

(H) hardness dependent.
(PAH) Polynuclear Aromatic Hydrocarbon.
Assumptions:
Receiving water temperature - 20 C.
Receiving water pH - 7.8.
Receiving water hardness CaCO3 100 mg/L.
Receiving water salinity 20 g/kg
Acute to Chronic Ratio (ACR) - 10.

EPA prepared a statistical analysis of the sampling data for each pollutant parameter reported within each sector or subsector. (Only where EPA did not subdivide an industry sector into subsectors was an analysis of the entire sector's data performed.) The statistical analysis was performed assuming a delta log normal distribution of the sampling data within each sector/subsector. The analyses calculated median, mean, maximum, minimum, 95th, and 99th percentile concentrations for each parameter. The results of the analyses can be found in the appropriate section of Section VIII of the fact sheet accompanying the 1995 MSGP. From this analysis, EPA was able to identify pollutants for further evaluation within each sector or subsector.

EPA next compared the median concentration of each pollutant for each sector or subsector to the benchmark concentrations listed in Table 3. EPA also compared the other statistical results to the benchmarks to better ascertain the magnitude and range of the discharge concentrations to help identify the pollutants of concern. EPA did not conduct this analysis if a sector had data for a pollutant from less than three individual facilities. Under these circumstances, the sector or subsector would not have this pollutant identified as a pollutant of concern. This was done to ensure that a reasonable number of facilities represented the industry sector or subsector as a whole and that the analysis did not rely on data from only one facility.

For each industry sector or subsector, parameters with a median concentration higher than the benchmark level were considered pollutants of concern for the industry and identified as potential pollutants for analytical monitoring under today's permit. EPA then analyzed the list of potential pollutants to be monitored against the lists of significant materials exposed and industrial activities which occur within each industry sector or subsector as described in the Part I application information. Where EPA could identify a source of a potential pollutant which is directly related to industrial activities of the industry sector or subsector, the permit identifies that parameter for analytical monitoring. If EPA could not identify a source of a potential pollutant which was associated with the sector/subsector's industrial activity, the permit does not require monitoring for the pollutant in that sector/subsector. Industries with no pollutants for which the median concentrations are higher than the benchmark levels are not required to perform analytical monitoring under this permit, with the exceptions explained below.

In addition to the sectors and subsectors identified for analytical monitoring using the methods described above, EPA determined, based upon a review of the degree of exposure, types of materials exposed, special studies and in some cases inadequate sampling data in the group applications, that the following industries also warrant analytical monitoring notwithstanding the absence of data on the presence or absence of certain pollutants in the group applications: Sector K (hazardous waste treatment storage and disposal facilities), and Sector S (airports which use more than 100,000 gallons per year of glycol-based fluids or 100 tons of urea for deicing). Today's final MSGP retains the monitoring requirements of the 1995 MSGP due to the high potential for contamination of storm water discharge which EPA believes was not adequately characterized by group applicants in the information they provided in the group application process. Like the 1995 MSGP, exemptions for today's MSGP would be on a pollutant-by-pollutant and outfall-by-outfall basis.

As part of the reissuance process for today's MSGP, EPA evaluated Discharge Monitoring Reports (DMRs) submitted by facilities for analytical monitoring conducted during the second and fourth year of the 1995 MSGP. The purpose of the evaluation was to evaluate any trends in the monitoring results. One factor common to almost all industrial sectors, however, was that the number of DMRs submitted for the year-four monitoring period far exceeded the number of DMRs submitted for the year-two monitoring period. For the second-year monitoring period, EPA received 380 DMRs, whereas 1377 DMRs were received for the fourth-year monitoring period. For example, the number of Sector M (Auto Salvage Yards) facilities that submitted monitoring results for total suspended solids from the second year monitoring period was roughly 26; the number of DMRs submitted for the fourth year monitoring for the same industrial sector and parameter was 240. As a result, EPA could not conduct the trends analysis it intended to perform.

While the exact reason for the significant increase in the number of DMRs received in year 4 of the permit (as compared to year 2) is unknown, EPA suspects it is related to the administrative extension of EPA's 1992 baseline general permit. Although the 1992 general permit expired in September 1997, the permit was administratively extended. It was not until December 28, 1998 that facilities previously covered under EPA's baseline industrial permit were required to obtain coverage under the MSGP. As a result, facilities previously covered under the baseline industrial permit were not required to conduct analytical monitoring (as required in the second year of the 1995 MSGP). In essence, the fourth-year monitoring data set EPA received represents the baseline of pollutant discharge information under the sector-specific industrial general storm water permit.

Based on the information received during the public comment period and the DMRs received, EPA believes it is premature to make any final conclusions regarding the value of the Agency's acquisition of the monitoring data or to consider dropping the monitoring. EPA is retaining quarterly analytic monitoring requirements for storm water discharges as per the 1995 MSGP for all sectors previously identified. Comparison of pollutant levels against benchmark levels is still regarded as one of the important tools operators must use to evaluate their facilities' storm water pollution prevention plans (SWPPPs) and best management practices (BMPs). Facilities' discharge monitoring reports (DMRs) are also vital to the Agency for use in characterizing an industrial sector's discharges. EPA has not, and does not, intend for pollutant levels above the benchmark values to mean a facility is out of compliance with the MSGP–2000.

While today's permit retains the analytical monitoring requirements of the 1995 MSGP, the Agency continues to support the position that any analytical monitoring program required under the MSGP needs to be structured so that it provides useful information to facility operators, EPA and the general public on the effectiveness of Storm Water Pollution Prevention Plans. EPA commits to using data from the 1995 and 2000 permits to evaluate the effectiveness of management practices on an industry sector basis and to evaluate the need for changes in monitoring protocols for the next permit. The Agency will work with program stakeholders in conducting the evaluation and may seek to implement certain changes possibly on a pilot basis.

Like the 1995 MSGP, today's MSGP requires that all facilities, save for Sector G, within an industry sector or subsector identified for analytical monitoring must, at a minimum, monitor their storm water discharges quarterly during the second year of permit coverage, unless the facility exercises the Alternative Certification described in Section VI.E.3 of this fact sheet. At the end of the second year of coverage under the current permit, a facility is required to calculate the average concentration for each parameter for which the facility is required to monitor. If the average concentration for a pollutant parameter is less than or equal to the benchmark value, then the permittee is not required to conduct analytical monitoring for that pollutant during the fourth year of the permit. If, however, the average concentration for a pollutant is greater than the benchmark value, then the permittee is required to conduct quarterly monitoring for that pollutant during the fourth year of permit coverage. Analytical monitoring is not required during the first, third, and fifth year of the permit. When average concentrations exceed benchmark levels, facilities are encouraged to conduct more monitoring if appropriate to identify additional management practices which may be necessary to include in their SWPPP. The exclusion from analytical monitoring in the fourth year of the permit was conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. For purposes of the above monitoring, year 2 runs from October 1, 2001 to September 30, 2002; year 4 runs from October 1, 2003 to September 30, 2004.

EPA acknowledges that, considering the small number of samples required per monitoring year (four), and the vagaries of storm water discharges, it may be difficult to determine or confirm the existence of a discharge problem as a commenter claimed. When viewed as an indicator, analytic levels considerably above benchmark values can serve as a flag to the operator that his SWPPP needs to be reevaluated and that pollutant loads may need to be reduced. Conversely, analytic levels below or near benchmarks can confirm to the operator that his SWPPP is doing its intended job. EPA believes there is presently no alternative that provides stakeholders with an equivalent indicator of program effectiveness.

Commenters also had concerns that only four samples and variability in conditions severely reduce the utility of monitoring results for judging BMP effectiveness. While not practicable for EPA to require an increase in monitoring, operators are encouraged to sample more frequently to improve the statistical validity of their results. Unless the proper data acquisition protocol for making a valid BMP effectiveness determination is rigorously followed, any other method used to assess BMP effectiveness would be qualitative, and therefore less reliable. The least subjective approach, and most beneficial to operators and stakeholders, EPA believes, remains a combination of visual and analytic monitoring, using analyte benchmark levels to target potential problems. Statistical uncertainties inherent in the monitoring results will necessitate both operators and EPA exercising best professional judgement in interpreting the results. As stated above, when viewed as an indicator, analytic levels considerably above benchmark values can serve as a flag to the operator that his SWPPP needs to be reevaluated and that pollutant loads may need to be reduced. Conversely, analytic levels below or near benchmarks can confirm to the operator that his SWPPP is doing its intended job.

Commenters had additional concerns regarding impacts of storm water on water quality standards and that monitoring has marginal value in assessing and protecting water quality. In the absence of establishing discharge pollutant levels that correlate directly to water quality standards, as would be done for an individual permit, EPA settled on benchmark levels which would, under nearly all scenarios, be protective of water quality standards. Recognizing the shortcomings of these generic pollutant levels, EPA only intends for them to be used as indicators of possible problems and as a flag to reevaluate the SWPPP and possibly the operation of the facility—not as a trigger to begin mandatory SWPPP or operational revisions (unless, after employing BPJ, the operator deems such revisions are necessary).

Monitoring results also serve as an oversight tool for EPA to prioritize sites which may benefit from a site inspection. A requirement to submit test results serves as an incentive for the facility operator to perform the monitoring and take any necessary action based on the results.

Some commenters felt the validity of benchmark values need to be reevaluated. Universal WQ-based discharge levels for storm water cannot be established; the next best thing would be to determine water segment-specific total maximum daily loads (TMDLs) for these discharges. But when benchmarks are employed merely as indicators, without requiring specific corrective actions beyond using best professional judgement to reassess present conditions and make any changes deemed necessary, the present benchmarks are adequate. In many cases operators can, upon receipt of analytic monitoring results above benchmarks, still conclude their present SWPPPs/BMPs are adequately protective of water quality, or that other situations such as discharging to low-quality, ephemeral streams may obviate the need for SWPPP/BMP revisions.

The fact that storm water discharge pollutant levels could be affected by atmospheric/dry deposition, run on and fate in transport, as well as structural sources, was a concern of a few commenters. EPA acknowledges the potential for adding pollutants to a facility's discharges from external or structural sources. Permittees are, nonetheless, still legally responsible for the quality of all discharges from their sites (or any runoff that comes into contact with their structures, industrial activities or materials, regardless of where these are located)—but not from pollutants that may be introduced into their discharges outside the boundaries of their properties. Pollutant levels, whether elevated from air deposition, run-on from nearby sites, or leachate from on-site structures, remain the responsibility of permittees. This was affirmed in the ruling by the Environmental Appeals Board against the General Motors Corporation CPC-Pontiac Fiero Plant in December 1997.

a. *Other Monitoring Options:* There were various comments for and against various alternatives to quarterly analytic monitoring submitted. The other non-analytic monitoring options are summarized in the following paragraphs, along with EPA responses.

b. *Visual Monitoring:* Numerous commenters supported dropping analytic monitoring from the MSGP–

2000 in favor of just requiring quarterly visual monitoring. Commenters claimed visual monitoring is adequate to ensure compliance and environmental protection (especially coupled with training), and is least burdensome.

Quarterly visual monitoring of storm water discharges has always been a permit requirement, for many of the same reasons why commenters favor it, and will continue to be so. EPA will also be retaining analytic monitoring because we believe the best way to ensure SWPPP effectiveness and protection of water quality is through a combination of visual and analytic monitoring. The reasons for not adopting visual monitoring only are explained further in the rationale for justifying quarterly analytic monitoring.

c. *Annual Reporting:* One option suggested by commenters was for an annual report, possibly using a standardized form, to be submitted to EPA detailing the permittee's SWPPP highlights and revisions/additions, inspections, compliance evaluations, visual monitoring results, etc. This information is already required to be documented in a facility's SWPPP, which, if deemed necessary, must be provided to EPA on demand. One comment against this option stated that the volume of data submitted would be too great for the Agency to evaluate. Other opponents to this option indicated that the reports would not contain enough information to evaluate SWPPP effectiveness, ensure water quality protection, or provide the information necessary to make long-term management plans. Commenters in support of the annual report concept held that it would provide a record of the permittee's commitment to storm water control, was better for evaluating SWPPP effectiveness, and would provide information to EPA to determine if sampling or a site inspection is needed.

If no monitoring data were available, an annual report could be used to ensure that a facility is implementing its SWPPP. The reports could also be used to prioritize sites for inspection. However, EPA agrees that it would be very burdensome to review all the reports and very difficult to assess the effectiveness of a facility's SWPPP based on that review alone. The subjectivity inherent in annual reporting makes it a undesirable substitute for analytic monitoring. Documenting the kind of information in the annual report is already a SWPPP requirement, and is therefore available to operators for assessing and improving their storm water programs. For these reasons, EPA will not require reports containing essentially the same information required in SWPPPs to be submitted in lieu of analytic monitoring.

d. *Group Monitoring:* Commenters also suggested group monitoring. In this option a consortium of like permittees would do sampling at one facility, possibly on a rotating basis. The sample results would represent all the facilities in the consortium. A variation of group monitoring is for the consortium to retain a consultant to do representative sampling and provide storm water program guidance and evaluations. Supporters of this concept said it may allow for comparisons of effectiveness of different SWPPP practices (e.g., sweeping vs. catchment basin for solids control). One commenter pointed out that the feasibility of the group concept is suspect due to the fact that individual facilities may have different topography, soil and other natural conditions. EPA believes that technically valid BMP comparisons could be done under this type of program. However, it would be difficult and very resource-intensive for EPA to establish criteria for group eligibility and then monitor to ensure that groups met these criteria.

e. *Watershed Monitoring:* This option involves replacing the monitoring of discrete storm water discharges with ambient receiving water monitoring on a watershed basis. Watershed monitoring is invaluable to making real conclusions regarding storm water impacts of water quality, and will be employed in making total maximum daily load (TMDL). However, watershed monitoring cannot replace facility-specific storm water discharge monitoring to determine the loads contributed by the facilities and to evaluate the effectiveness of the SWPPP.

f. *Monitoring Only in Impaired Waters:* Several commenters supported requiring monitoring only in impaired water bodies and for pollutants that cause the impairment. Although this option would focus attention on the problem water bodies and possible pollutant sources. EPA and a commenter point out that not all impaired water bodies and their impairments have been determined. The goal of EPA's storm water program is also to protect and maintain water quality, not just remediate impaired waters, so focusing on impaired waters only does not fulfill all the program's responsibilities.

2. Compliance Monitoring

Today's final MSGP retains the same compliance monitoring requirements as the 1995 MSGP, and also includes compliance monitoring requirements for certain storm water discharges from new and existing hazardous and non-hazardous landfills. As noted earlier, EPA has recently finalized effluent limitations guidelines for these landfills (65 FR 3007, January 19, 2000) and the compliance monitoring is required to ensure compliance with the guidelines. These discharges must generally be sampled annually (in some cases quarterly) and tested for the parameters which are limited by the permit. Discharges subject to compliance monitoring include (in addition to the landfills discharges): coal pile runoff, contaminated runoff from phosphate fertilizer manufacturing facilities, runoff from asphalt paving and roofing emulsion production areas, material storage pile runoff from cement manufacturing facilities, and mine dewatering discharges from crushed stone, construction sand and gravel, and industrial sand mines located in EPA Regions 1, 2, 3, 6, 8, 9, 10. All samples are to be grabs taken within the first 30 minutes of discharge where practicable, but in no case later than the first hour of discharge. Where practicable, the samples shall be taken from the discharges subject to the numeric effluent limitations prior to mixing with other discharges.

Monitoring for these discharges is required to determine compliance with numeric effluent limitations. Discharges covered under today's final MSGP which are subject to numeric effluent limitations are not eligible for the alternative certification described in Section VI.E.3 of this fact sheet.

Where a State or Tribe has imposed a numeric effluent limitation as a condition for certification under CWA § 401, a default minimum monitoring frequency of once per year has been included in the final permit. This default monitoring frequency would only apply if a State failed to provided a monitoring frequency along with their conditional § 401 certification.

3. Alternate Certification

Today's final MSGP retains the provision in the 1995 MSGP for an alternative certification in lieu of analytical monitoring. The MSGP includes monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative certification described below is included in the permit to ensure that monitoring requirements are only imposed on those facilities which do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if there are no sources of a pollutant exposed to storm water at the site then the potential for that pollutant to contaminate storm water discharges does not warrant monitoring.

A discharger is not subject to the analytical monitoring requirements provided the discharger makes a certification for a given outfall, on a pollutant-by-pollutant basis, that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the SWPPP, and submitted to EPA in lieu of monitoring reports required under Part 7 of the permit. The permittee is required to complete any and all sampling until the exposure is eliminated. If the facility is reporting for a partial year, the permittee must specify the date exposure was eliminated. If the permittee is certifying that a pollutant was present for part of the reporting period, nothing relieves the permittee from the responsibility to sample that parameter up until the exposure was eliminated and it was determined that no significant materials remained. This certification is not to be confused with the low concentration sampling waiver. The test for the application of this certification is whether the pollutant is exposed, or can be expected to be present in the storm water discharge. If the facility does not and has not used a parameter, or if exposure is eliminated and no significant materials remain, then the facility can exercise this certification.

As noted above, the MSGP does not allow facilities with discharges subject to numeric effluent limitations guidelines to submit alternative certification in lieu of compliance monitoring requirements. The permit also does not allow air transportation facilities or hard rock mines subject to the analytical monitoring requirements in Part 6 of the final MSGP to exercise an alternative certification.

A facility is not precluded from exercising the alternative certification in lieu of analytical monitoring requirements in the second or fourth year of the reissued MSGP, even if that facility has failed to qualify for a low concentration waiver thus far. EPA encourages facilities to eliminate exposure of industrial activities and significant materials where practicable.

4. Reporting and Retention Requirements

Like the 1995 MSGP, today's final MSGP requires that permittees submit all analytical monitoring results obtained during the second and fourth year of permit coverage. As noted earlier, year 2 runs from October 1, 2001 to September 30, 2002; year 4 runs from October 1, 2003 to September 30, 2004. Monitoring results must be submitted by January 28, 2003 for year 2 monitoring and January 28, 2005 for year 4 monitoring.

For each outfall, one Discharge Monitoring Report (DMR) form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum requirements, an additional DMR form must be filed for each analysis. The permittee must include a measurement or estimate of the total precipitation, volume of runoff, and peak flow rate of runoff for each storm event sampled. Permittees subject to compliance monitoring requirements are required to submit all compliance monitoring results annually by October 28 following each annual sampling period (which run from October 1 of each year to September 30 of the following year). Compliance monitoring results must be submitted on signed DMR forms. For each outfall, one DMR form must be submitted for each storm event sampled.

Permittees are not required to submit records of the visual examinations of storm water discharges unless specifically asked to do so by the Director. Records of the visual examinations must be maintained at the facility. Records of visual examination of storm water discharge need not be lengthy. Permittees may prepare typed or hand written reports using forms or tables which they may develop for their facility. The report need only document: the date and time of the examination; the name of the individual making the examination; and any observations of color, odor, clarity, floating solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution.

The address for submission of DMR forms for today's final MSGP is as follows: MSGP DMR (4203), U.S. EPA, 1200 Pennsylvania Avenue, NW., Washington, DC 20460.

Under the 1995 MSGP, DMRs had been sent to the EPA Regional Offices. However, to facilitate review of all DMRs from facilities operating under the MSGP, the final MSGP requires that they be sent to the one location specified above.

Today's final MSGP also retains the requirement in the 1995 MSGP that permittees submit signed copies of DMRs to the operator of a large or medium MS4 (those which serve a population of 100,000 or more), if there are discharges of storm water associated with industrial activity through the MS4.

The location for submission of all reports (other than DMRs) for today's final MSGP remains the EPA Regional Offices as found in Part 8.3 of the final permit. Consistent with Office of Management and Budget Circular A-105, facilities located on the following Federal Indian Reservations, which cross EPA Regional boundaries, should note that permitting authority for such lands is consolidated in one single EPA Region.

a. Duck Valley Reservations lands, located in Regions 9 and 10, are handled by Region 9.

b. Fort McDermitt Reservation lands, located in Regions 9 and 10, are handled by Region 9.

c. Goshute Reservation lands, located in Regions 8 and 9, are handled by Region 9.

d. Navajo Reservation lands, located in Regions 6, 8, and 9, are handled by Region 9.

e. Ute Mountain Reservation lands, located in Regions 6 and 8, are handled Region 8.

Pursuant to the requirements of 40 CFR 122.41(j), today's MSGP (like the 1995 MSGP) requires permittees to retain all records for a minimum of three years from the date of the sampling, examination, or other activity that generated the data.

5. Sample Type

Today's final MSGP retains the same requirements regarding the type of sampling as the 1995 MSGP. A general description is provided below. Certain industries have different requirements. Permittees should check the industry-specific requirements in Part 6 of the final permit to confirm these requirements. Grab samples may be used for all monitoring unless otherwise stated. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval may be waived by the permittee where the preceding measurable storm event did not result in a measurable discharge from the facility. The 72-hour requirement may also be waived by the permittee where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample must be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger must submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. A minimum of one grab is required. Where the discharge to be sampled contains both storm water and non-storm water, the facility shall sample the storm water component of the discharge at a point upstream of the location where the non-storm water mixes with the storm water, if practicable.

6. Representative Discharge

Today's MSGP retains the same provision as the 1995 MSGP regarding substantially identical outfalls which allows a facility to reduce its overall monitoring burden. This representative discharge provision provides facilities with multiple storm water outfalls, a means for reducing the number of outfalls that must be sampled and analyzed. This may result in a substantial reduction of the resources required for a facility to comply with analytical monitoring requirements. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one such outfall and report that the quantitative data also apply to the substantially identical outfalls provided that the permittee includes in the SWPPP a description of the location of the outfalls and detailed explanation why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (*e.g.*, low (under 40 percent), medium (40 to 65 percent) or high (above 65 percent)) shall be provided in the plan. Facilities that select and sample a representative discharge are prohibited from changing the selected discharge in future monitoring periods unless the selected discharge ceases to be representative or is eliminated. Permittees do not need EPA approval to claim discharges are representative, provided they have documented their rationale within the SWPPP. However, the Director may determine the discharges are not representative and require sampling of all non-identical outfalls.

The representative discharge provision in the permit is available to almost all facilities subject to the analytical monitoring requirements (not including compliance monitoring for effluent guideline limit compliance purposes) and to facilities subject to visual examination requirements.

The representative discharge provisions described above are consistent with Section 5.2 of NPDES Storm Water Sampling Guidance Document (EPA 833–B–92–001, July 1992).

7. Sampling Waiver

Today's final MSGP retains the same provisions for sampling waivers (as discussed below) which are found in the 1995 MSGP:

a. Adverse Weather Conditions. Today's final MSGP allows for temporary waivers from sampling based on adverse climatic conditions. This temporary sampling waiver is only intended to apply to insurmountable weather conditions such as drought or dangerous conditions such as lightning, flash flooding, or hurricanes. These events tend to be isolated incidents and should not be used as an excuse for not conducting sampling under more favorable conditions associated with other storm events. The sampling waiver is not intended to apply to difficult logistical conditions, such as remote facilities with few employees or discharge locations which are difficult to access. When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next sampling period as well as a sample for the routine monitoring required in that period. Both samples should be analyzed separately and the results of that analysis submitted to EPA. Permittees are not required to obtain advance approval for sampling waivers.

b. *Unstaffed and Inactive Sites—Chemical Sampling Waiver.* Today's final MSGP allows for a waiver from sampling for facilities that are both inactive and unstaffed. This waiver is only intended to apply to these facilities where lack of personnel and locational impediments hinder the ability to conduct sampling (i.e., the ability to meet the time and representative rainfall sampling specifications). This waiver is not intended to apply to remote facilities that are active and staffed, or to facilities with just difficult logistical conditions. When a discharger is unable to collect samples as specified in this permit, the discharger shall certify to the Director in the DMR that the facility is unstaffed and inactive and the ability to conduct samples within the specifications is not possible. Permittees are not required to obtain advance approval for this waiver.

c. *Unstaffed and Inactive Sites—Visual Monitoring Waiver.* Today's final MSGP allows for a waiver from sampling for facilities that are both inactive and unstaffed. This waiver is only intended to apply to these facilities where lack of personnel and locational impediments hinder the ability to conduct visual examinations (i.e., the ability to meet the time and representative rainfall sampling specifications). This monitoring waiver is not intended to apply to remote facilities that are active and staffed, or to facilities with just difficult logistical conditions. When a discharger is unable to perform visual examinations as specified in this permit, the discharger shall maintain on site with the pollution prevention plan a certification stating that the facility is unstaffed and inactive and the ability to perform visual examinations within the specifications is not possible. Permittees are not required to obtain advance approval for visual examination waivers.

8. Quarterly Visual Examination of Storm Water Quality

Today's final MSGP retains the requirements of the 1995 MSGP for quarterly visual examinations of storm water discharges which EPA continues to believe provide a useful and inexpensive means for permittees to evaluate the effectiveness of their SWPPPs (with immediate feedback) and make any necessary modifications to address the results of the visual examinations. All sectors of today's final MSGP are required to conduct these examinations. In the 1995 MSGP all sectors except Sector S (which covers air transportation) were required to conduct the examinations.

Basically, the MSGP requires that grab samples of storm water discharges be taken and examined visually for the presence of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen or other obvious indicators of storm water pollution. The grab samples must be taken within the first 30 minutes after storm water discharges begin, or as soon as practicable, but not longer than 1 hour after discharges begin. The sampling must be conducted quarterly during the following time periods: January–March, April–June, July–September and October–December of each year. The reports summarizing these quarterly visual storm water examinations must be maintained on-site with the SWPPP.

The examination of the sample must be made in well lit areas. The visual examination is not required if there is insufficient rainfall or snow-melt to run off or if hazardous conditions prevent sampling. Whenever practicable the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible in recording observations.

When conducting a storm water visual examination, the pollution prevention team, or team member, should attempt to relate the results of the examination to potential sources of storm water contamination on the site. For example, if the visual examination reveals an oil sheen, the facility personnel (preferably members of the pollution prevention team) should conduct an inspection of the area of the site draining to the examined discharge to look for obvious sources of spilled oil, leaks, etc. If a source can be located, then this information allows the facility operator to immediately conduct a clean-up of the pollutant source, and/or to design a change to the SWPPP to eliminate or minimize the contaminant source from occurring in the future.

Other examples include: if the visual examination results in an observation of floating solids, the personnel should carefully examine the solids to see if they are raw materials, waste materials or other known products stored or used at the site. If an unusual color or odor is sensed, the personnel should attempt to compare the color or odor to the colors or odors of known chemicals and other materials used at the facility. If the examination reveals a large amount of settled solids, the personnel may check for unpaved, unstabilized areas or areas of erosion. If the examination results in a cloudy sample that is very slow to settle out, the personnel should evaluate the site draining to the discharge point for fine particulate material, such as dust, ash, or other pulverized, ground, or powdered chemicals.

To be most effective, the personnel conducting the visual examination should be fully knowledgeable about the SWPPP, the sources of contaminants on the site, the industrial activities conducted exposed to storm water and the day to day operations that may cause unexpected pollutant releases.

If the visual examination results in a clean and clear sample of the storm water discharge, this may indicate that no pollutants are present. This would be an indication of a high quality result. However, the visual examination will not provide information about dissolved contamination. If the facility is in a sector or subsector required to conduct analytical (chemical) monitoring, the results of the chemical monitoring, if conducted on the same sample, would help to identify the presence of any dissolved pollutants and the ultimate effectiveness of the Storm Water Pollution Prevention Plan. If the facility is not required to conduct analytical monitoring, it may do so if it chooses to confirm the cleanliness of the sample.

While conducting the visual examinations, personnel should constantly be attempting to relate any contamination that is observed in the samples to the sources of pollutants on site. When contamination is observed, the personnel should be evaluating whether or not additional BMPs should be implemented in the SWPPP to address the observed contaminant and, if BMPs have already been implemented, evaluating whether or not these are working correctly or need maintenance. Permittees may also conduct more frequent visual examinations than the minimum quarterly requirement, if they so choose. By doing so, they may improve their ability to ascertain the effectiveness of their plan. Using this guidance, and employing a strong knowledge of the facility operations, EPA believes that permittees should be able to maximize the effectiveness of their storm water pollution prevention efforts through conducting visual examinations which give direct, frequent feedback to the facility operator or pollution prevention team on the quality of the storm water discharge.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. EPA recommends that the visual examination be conducted at different times than the chemical monitoring, but is not requiring this. In addition, more frequent visual examinations can be conducted if the permittee so chooses. In this way, better assessments of the effectiveness of the Storm Water Pollution Prevention Plan can be achieved. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or followup procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the site's storm water problems and the effects of the management practices that are included in the plan.

F. Regional Offices

1. Notice of Intent Address

Notices of Intent to be authorized to discharge under the MSGP should be sent to: Storm Water Notice of Intent (4203), USEPA, 401 M Street, SW., Washington, DC 20460.

2. EPA Regional Office Addresses and Contacts

For further information, please call the appropriate EPA Regional storm water contacts listed below:

• ME, MA, NH, Indian country in CT, MA, ME, RI, and Federal Facilities in VT

EPA Region 1, Office of Ecosystem Protection, JFK Federal Building (CMU), Boston, MA 02203, Contact: Thelma Murphy (617) 918–1615.

• PR

U.S. EPA, Region 2, Caribbean Environmental Protection Division, Centro Europa Building, 1492 Ponce de Leon Avenue, Suite 417, San Juan, Puerto Rico 00907–4127, Contact: Sergio Bosques (787) 729–6951.

• DC and Federal Facilities in DE

EPA Region 3, Water Protection Division, (3WP13), Storm Water Staff, 841 Chestnut Building, Philadelphia, PA 19107, Contact: Cheryl Atkinson (215) 814–3392.

• Indian country in FL

EPA Region 4, Water Management Division, Surface Water Permits Section (SWPFB), 61 Forsyth Street, SW, Atlanta, GA 30303–3104, Contact: Floyd Wellborn (404) 562–9296.

• NM; Indian country in LA, OK, TX and NM (Except Navajo and Ute Mountain Reservation Lands); oil and gas exploration and production related industries, and pipeline operations in OK (which under State law are regulated by the Oklahoma Corporation Commission and not the Oklahoma Department of Environmental Quality); and oil and gas sites in TX.

EPA Region 6, NPDES Permits Section (6WQ-PP), 1445 Ross Avenue, Dallas, TX 75202–2733, Contact: Brent Larsen (214) 665–7523.

• Federal facilities in the State of Colorado; Indian country in CO, ND, SD, WY and UT (except Goshute and Navajo Reservation lands); Ute Mountain Reservation lands in CO and NM ; and Pine Ridge Reservation lands in SD and NE.

EPA Region 8, Ecosystems Pr.otection Program (8EPR–EP), 999 18th Street, Suite 300, Denver, CO 80202–2466 Contact: Vern Berry (303) 312–6234.

• AZ, American Samoa, Commonwealth of Northern Mariana Islands, Johnston Atoll, Guam, Midway Island and Wake Island; all Indian country in AZ, CA, and NV; those portions of the Duck Valley, Fort McDermitt and Goshute Reservations that are outside NV; those portions of the Navajo Reservation that are outside AZ.

EPA Region 9, Water Management Division, (WTR–5), Storm Water Staff, 75 Hawthorne Street, San Francisco, CA 94105, Contact: Eugene Bromley (415) 744–1906.

• ID; Indian country in AK, ID (except the Duck Valley Reservation), OR (except the Fort McDermitt Reservation), and WA; and Federal facilities in WA

EPA Region 10, Office of Water (OW–130), Storm Water Staff, 1200 Sixth Avenue, Seattle, WA 98101, Contact: Misha Vakoc (206) 553–6650 (toll-free in Region 10 states: 800–424–4372, extension 6650).

VII. Cost Estimates for Common Permit Requirements

Cost estimates for the MSGP were included with the final fact sheet accompanying the issuance of the MSGP on September 29, 1995 and are not being repeated here. However, additional costs for facilities seeking coverage under the reissued MSGP should be minor since the new MSGP includes few changes from the 1995 MSGP.

VIII. Special Requirements for Discharges Associated With Specific Industrial Activities

Section VIII of the fact sheet accompanying the 1995 MSGP included a detailed description of the industrial sectors covered by the permit, sources of pollutants from the different types of industries, available industry-specific BMPs, and a description of the industrial-specific permit requirements. As noted previously, EPA is not repeating all this information due to its considerable length. Table 1 in Section IV of this fact sheet listed the industrial sectors and subsectors covered by today's final MSGP. For today's MSGP, EPA reviewed the various sectors and subsectors to determine whether additional BMP opportunities have been identified subsequent to the issuance of the 1995 MSGP which would be appropriate to include in the reissued MSGP.

To update the various sectors and subsectors, EPA reviewed a variety of sources of information. As noted in Section VI.C of this fact sheet, pollution prevention is the cornerstone of the NPDES storm water permit program and, as such, EPA focused on new pollution prevention opportunities in updating the sectors. EPA has several ongoing programs directed toward identifying additional pollution prevention opportunities for different industrial sectors. One example is the "sector notebooks" which EPA's Office of Compliance has published covering 28 different industries, including many of those covered by the MSGP. EPA's Design for the Environment Program and Common Sense Initiative are additional examples. States, municipalities, industry trade associations and individual companies have also been active in recent years in trying to identify additional pollution prevention opportunities for different types of industries.

In reviewing the new information, however, EPA has identified only a few sectors where there appear to be additional storm water BMPs which would be appropriate for the reissued MSGP. For many industries, while considerable work has been conducted to reduce the environmental effects of these industries, little of the work has focused specifically on storm water. Rather, the efforts have focused more in areas such as manufacturing process changes to reduce hazardous waste generation or to reduce pollutant discharges in process wastewater. Where additional storm water BMPs have been identified and incorporated into the reissued MSGP, these new requirements are discussed below by sector. In some sectors, additional language clarifying the permit requirements has been added and these changes are also discussed below.

A. Sectors C—Chemical and Allied Products Facilities

Industry-specific requirements for the manufacture of fertilizer from leather scraps (SIC 2873) was moved from Sector Z (Leather Tanning and Finishing) to Sector C. This change places the requirements for SIC 2873 in the same sector as other manufacturers of fertilizers.

B. Sector G—Metal Mining (Ore Dressing and Mining)

To clarify the applicability of the MSGP regarding construction activity at metal mining sites and to make metal mining requirements consistent with mineral mining provisions (Sector J), Sector G has been modified to indicate that earth-disturbing activities occurring in the "exploration and construction phase" of a mining operation must be covered under EPA's Construction General Permit (63 FR 7858, February 17, 1998) if the area disturbed is one acre or more. All mining exploration/construction operations of less than one acre must be covered under the MSGP–2000.

Today's MSGP also incorporates the MSGP modifications of August 7, 1998 (63 FR 42534) regarding storm water discharges from waste rock and overburden piles. On October 10, 1995, the National Mining Association challenged the interpretation set forth in Table G–4 of the 1995 MSGP that runoff from waste rock and overburden piles would categorically be considered mine drainage subject to effluent limitations guidelines (ELGs) at 40 CFR Part 440. The litigation was settled on August 7, 1998 with a revised interpretation by EPA of the applicability of the ELGs which is incorporated into today's MSGP. Under the revised interpretation, runoff from waste rock and overburden piles is not subject to ELGs unless it naturally drains (or is intentionally diverted) to a point source and combines with "mine drainage" that is otherwise subject to the ELGs.

The August 7, 1998 modification of the MSGP provided permit coverage for storm water discharges from waste rock and overburden piles which are not subject to ELGs. However, due to concerns regarding potential pollutants in the discharges, additional monitoring requirements were included in the permit to determine the pollutant concentrations in the discharges. These monitoring requirements are also included in today's MSGP. The monitoring results which have been submitted to EPA pursuant to these requirements were also considered in determining the monitoring requirements for today's permit for this sector.

Concerns were expressed by some commenters over the use of the term "Numeric limitation" in the headings in the tables in Sector G in the proposed MSGP. However, since there are no actual numeric limitations in the tables, EPA believes this concern is not justified and the final MSGP has not been modified in response to these comments. In response to other comments, the revised Table G–4 from the August 7, 1998 MSGP modification has been added to the permit in Part 6.G.

In response to comments received on the proposed MSGP, the language in Part 6.G.1.6.6 of the final MSGP was modified to indicate that a permittee may test "or evaluate" mining-related discharges for non-storm water discharges to make today's MSGP consistent with the 1995 MSGP.

Also in response to comments, the permit language in the final MSGP which defines the reclamation phase was modified to reflect post-mining land uses other than "pre-mining state" which had been in the proposed MSGP. In addition, the final MSGP has been clarified to indicate that sampling waivers in Part 5.3.1 of the MSGP do apply to Sector G.

C. Sector I—Oil and Gas Extraction and Refining

In response to a comment, the title for Sector I was changed to include "Refining" to clarify that runoff from refineries (except runoff subject to effluent limitations guidelines) is eligible for coverage under today's MSGP.

D. Sector J—Mineral Mining and Processing

EPA has re-evaluated the provisions of the 1995 MSGP for industrial facilities in Sector J to determine whether these provisions need to be updated for the reissued MSGP. To clarify the applicability of the MSGP regarding construction activity at mineral mining sites and to make mineral mining requirements consistent with metal mining provisions (Sector G), Sector J has been modified to indicate that earth-disturbing activities occurring in the "exploration and construction phase" of a mining operation must be covered under EPA's Construction General Permit (63 FR 7858, February 17, 1998) if the area disturbed is one acre or more. All mining exploration/construction operations of less than one acre must be covered under the MSGP–2000.

E. Sector K—Hazardous Waste Treatment, Storage or Disposal Facilities

EPA has re-evaluated the provisions of the 1995 MSGP for industrial facilities in Sector K to determine whether these provisions need to be updated for the reissued MSGP. On January 19, 2000 (65 FR 3008), EPA promulgated final effluent limitations guidelines (ELGs) for "contaminated storm water discharges" from new and existing hazardous landfill facilities regulated under RCRA Subtitle C at 40 CFR Parts 264 (Subpart N) and 265 (Subpart N), except for the following "captive" landfills:

(a) Landfills operated in conjunction with other industrial or commercial operations when the landfill only receives wastes generated by the industrial or commercial operation directly associated with the landfill;

(b) Landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes generated by the industrial or commercial operation directly associated with the landfill and also receives other wastes provided the other wastes received for disposal are generated by a facility that is subject to the same provisions in 40 CFR Subchapter N as the industrial or commercial operation or the other wastes received are of similar nature to the wastes generated by the industrial or commercial operation;

(c) Landfills operated in conjunction with Centralized Waste Treatment (CWT) facilities subject to 40 CFR Part 437 so long as the CWT facility commingles the landfill wastewater with other non-landfill wastewater for discharge. A landfill directly associated with a CWT facility is subject to this part if the CWT facility discharges landfill wastewater separately from other CWT wastewater or commingles the wastewater from its landfill only with wastewater from other landfills; or

(d) Landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes from public service activities so long as the company owning the landfill does not receive a fee or other remuneration for the disposal service.

For Sector K of the new MSGP, EPA has included the new ELGs (40 CFR Part 445 Subpart A) for hazardous landfill facilities.

The term "contaminated storm water" is defined in the ELGs as "storm water which comes in direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater." [40 CFR 445.2]. Contaminated storm water may originate from areas at a landfill including (but not limited to): "the open face of an active landfill with exposed waste (no cover added); the areas around wastewater treatment operations; trucks, equipment or machinery that has been in direct contact with the waste; and waste dumping areas." [40 CFR 445.2].

The term "non-contaminated storm water" is defined in the ELGs as "storm water which does not come in direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater." [40 CFR 445.2]. Non-contaminated storm water includes storm water which "flows off the cap, cover, intermediate cover, daily cover, and/or final cover of the landfill." [40 CFR 445.2].

The term "landfill wastewater" is defined in the ELGs as "all wastewater associated with, or produced by, landfilling activities except for sanitary wastewater, non-contaminated storm water, contaminated groundwater, and wastewater from recovery pumping wells. Landfill wastewater includes, but is not limited to, leachate, gas collection condensate, drained free liquids, laboratory derived wastewater, contaminated storm water and contact washwater from washing truck, equipment, and railcar exteriors and surface areas which have come in direct contact with solid waste at the landfill facility."

The 1995 MSGP authorized discharges of storm water associated with industrial activity which includes contaminated storm water discharges (as defined above) as well as other non-contaminated storm water discharges (also defined above). Today's final MSGP continues to authorize storm water associated with industrial activity; however, for contaminated storm water discharges as defined above, the reissued MSGP requires compliance with the promulgated ELGs for such discharges (with monitoring once/year during each year of the term of the final MSGP). The ELGs for the new and existing hazardous landfills are found in Table K–1 below:

TABLE K–1—EFFLUENT LIMITATIONS GUIDELINES FOR CONTAMINATED STORM WATER DISCHARGES (MG/L)

Pollutant	Maximum for 1 day	Monthly average maximum
BOD5	220	56

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TABLE K–1—EFFLUENT LIMITATIONS GUIDELINES FOR CONTAMINATED STORM WATER DISCHARGES (MG/L)—Continued

Pollutant	Maximum for 1 day	Monthly average maximum
TSS	88	27
Ammonia	10	4.9
Alpha Terpineol	0.042	0.019
Aniline	0.024	0.015
Benzoic Acid	0.119	0.073
Naphthalene	0.059	0.022
p-Cresol	0.024	0.015
Phenol	0.048	0.029
Pyridine	0.072	0.025
Arsenic (Total)	1.1	0.54
Chromium (Total)	1.1	0.46
Zinc (Total)	0.535	0.296
pH	Within the range of 6–9 pH units.	

Today's final MSGP (like the 1995 MSGP) does not authorize non-storm water discharges such as leachate and vehicle and equipment washwater. These and other landfill-generated wastewaters are subject to the ELGs. Today's final MSGP does, however, continue to authorize certain minor non-storm water discharges (listed in Part 1.2.2.2) which are very similar to the 1995 MSGP.

F. Sector L—Landfills, Land Application Sites and Open Dumps

EPA has re-evaluated the provisions of the 1995 MSGP for industrial facilities in Sector L to determine whether these provisions need to be updated for the reissued MSGP. The SWPPP requirements of the 1995 MSGP already include several special BMPs for this industry in addition to the MSGP's basic BMP requirements.

On January 19, 2000 (65 FR 3008), EPA promulgated final effluent limitations guidelines (ELGs) for "contaminated storm water discharges" from new and existing non-hazardous landfill facilities regulated under RCRA Subtitle D (40 CFR Part 445 Subpart B). For Sector L of today's MSGP, EPA has included the ELGs as they apply to facilities covered by this sector. For Sector L facilities, the ELGs apply to:

Municipal solid waste landfills regulated under RCRA Subtitle D at 40 CFR Part 258 and those landfills which are subject to the provisions of 40 CFR Part 257, except for any of the following "captive" landfills:

(a) Landfills operated in conjunction with other industrial or commercial operations when the landfill only receives wastes generated by the industrial or commercial operation directly associated with the landfill;

(b) Landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes generated by the industrial or commercial operation directly associated with the landfill and also receives other wastes provided the other wastes received for disposal are generated by a facility that is subject to the same provisions in 40 CFR Subchapter N as the industrial or commercial operation or the other wastes received are of similar nature to the wastes generated by the industrial or commercial operation;

(c) Landfills operated in conjunction with Centralized Waste Treatment (CWT) facilities subject to 40 CFR Part 437 so long as the CWT facility commingles the landfill wastewater with other non-landfill wastewater for discharge. A landfill directly associated with a CWT facility is subject to this part if the CWT facility discharges landfill wastewater separately from other CWT wastewater or commingles the wastewater from its landfill only with wastewater from other landfills; or

(d) Landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes from public service activities so long as the company owning the landfill does not receive a fee or other remuneration for the disposal service.

EPA has not modified Sector L for the discharges which are not subject to the ELGs. In addition, EPA would like to call attention to a new EPA publication entitled "Guide for Industrial Waste Management" (EPA 530–R–99–001, June, 1999) which provides a useful information resource for permittees in complying with the MSGP, and in minimizing the impact of landfills to the environment overall.

The term "contaminated storm water" is defined in the ELGs as "storm water which comes in direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater." [40 CFR 445.2]. Contaminated storm water may originate from areas at a landfill including (but not limited to): "the open face of an active landfill with exposed waste (no cover added); the areas around wastewater treatment operations; trucks, equipment or machinery that has been in direct contact with the waste; and waste dumping areas." [40 CFR 445.2].

The term "non-contaminated storm water" is defined in the ELGs as "storm water which does not come in direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater." [40 CFR 445.2]. Non-contaminated storm water includes storm water which "flows off the cap, cover, intermediate cover, daily cover, and/or final cover of the landfill." [40 CFR 445.2].

The term "landfill wastewater" is defined in the ELGs as "all wastewater associated with, or produced by, landfilling activities except for sanitary wastewater, non-contaminated storm water, contaminated groundwater, and wastewater from recovery pumping wells. Landfill wastewater includes, but is not limited to, leachate, gas collection condensate, drained free liquids, laboratory derived wastewater, contaminated storm water and contact washwater from washing truck, equipment, and railcar exteriors and surface areas which have come in direct contact with solid waste at the landfill facility." [40 CFR 445.2].

The 1995 MSGP authorized discharges of storm water associated with industrial activity from landfills including contaminated storm water discharges as defined in the ELGs as well as non-contaminated storm water. Today's final MSGP continues to authorize storm water associated with industrial activity; however, for contaminated storm water discharges as defined above, today's MSGP requires compliance with the promulgated ELGs for such discharges (with monitoring once/year during each year of the term of the final MSGP). The ELGs are found in Table L–1 below:

TABLE L–1—EFFLUENT LIMITATIONS GUIDELINES FOR CONTAMINATED STORM WATER DISCHARGES (MG/L)

Pollutant	Maximum for 1 Day	Monthly average maximum
BOD5	140	37
TSS	88	27
Ammonia	10	4.9
Alpha Terpineol	0.033	0.016
Benzoic Acid	0.12	0.071
p-Cresol	0.025	0.014
Phenol	0.026	0.015
Zinc (Total)	0.20	0.11
pH	within the range of 6–9 pH units.	

Today's final MSGP (like the 1995 MSGP) does not authorize non-storm water discharges such as leachate and vehicle and equipment washwater. These and other landfill-generated wastewaters are subject to the ELGs. Today's MSGP does, however, continue to authorize the same minor non-storm water discharges (listed in Part 1.2.2.2) as the 1995 MSGP.

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G. Sector S—Air Transportation Facilities

EPA has re-evaluated the provisions of the 1995 MSGP for industrial facilities in Sector S to determine whether these provisions need to be updated for the reissued MSGP. The SWPPP requirements of the 1995 MSGP included several special BMP requirements for airports in addition to the MSGP's basic BMP requirements. Additional technologies have been developed since the original MSGP issuance for deicing operations which have been included in today's MSGP. A lengthy (but not comprehensive) list of new deicing chemical and BMP options is provided in Parts 6.S.5.3.6.2 and 6.S.5.3.7. More information on these options is found in the EPA publication "Preliminary Data Summary, Airport Deicing Operations" *(http://www.epa.gov/ost/guide/airport/index.html).*

The MSGP-2000 has been clarified such that compliance evaluations (Part 6.S.5.5) shall be conducted during a period when deicing activities are likely to occur (vs. a month when deicing activities would be atypical or during an extended heat wave), not necessarily during an actual storm or when intense deicing activities are occurring. This requirement is not seen as onerous, as EPA believes that most weather conditions can be reasonably anticipated and the evaluation can be planned for.

In addition, EPA has revised Part 6.S.5.4 to reflect that monthly inspections of deicing areas during the deicing season (e.g., October through April) are now allowed at airports with highly effective, rigorously implemented SWPPPs. This requirement is a reduction from the previous MSGP's weekly requirement. However, if unusually large amounts of deicing fluids are being applied, spilled or discharged, weekly inspections should be conducted and the Director may specifically require such weekly inspections. In addition, personnel who participate in deicing activities or work in these areas should, as the need arises, inform the monthly inspectors of any conditions or incidents constituting an environmental threat, especially those needing immediate attention.

H. Sector T—Treatment Works

EPA has re-evaluated the provisions of the 1995 MSGP for industrial facilities in Sector T to determine whether these provisions need to be updated for the reissued MSGP. The SWPPP requirements of the 1995 MSGP already include a few special BMP requirements for this industry in addition to the MSGP's basic BMP requirements. In reviewing the information which EPA has available on this industry, EPA has identified several additional areas at treatment works facilities which we believe should be considered more closely for potential storm water controls. As a result, EPA has included additional or modified permit requirements which we believe are appropriate to include in Sector T.

Today's MSGP requires that operators of Sector T treatment works include the following additional areas or activities, where they are exposed to precipitation, in their SWPPP site map, summary of potential pollutant sources, and inspections: grit, screenings and other solids handling, storage or disposal areas; sludge drying beds; dried sludge piles; compost piles; septage and/or hauled waste receiving stations. An additional BMP that permittees must consider is routing storm water into the treatment works, or covering exposed materials from these additional areas or activities.

I. Sector Y—Rubber, Miscellaneous Plastic Products and Miscellaneous Manufacturing Industries

EPA has re-evaluated the provisions of the 1995 MSGP for industrial facilities in Sector Y. The 1995 MSGP included several special BMP requirements for rubber manufacturers to control zinc in storm water discharges. However, no special BMPs beyond the MSGP's basic SWPPP requirements were included in the 1995 MSGP for manufacturers of miscellaneous plastic products or miscellaneous manufacturing industries.

EPA has several ongoing programs directed toward identifying additional pollution prevention opportunities for different industrial sectors. For example, EPA's Office of Compliance has published "sector notebooks" for a number of industries, including the rubber and miscellaneous plastics industry (EPA 310-R-95-016). The sector notebooks are intended to facilitate a multi-media analysis of environmental issues associated with different industries and include a review of pollution prevention opportunities for the industries. As discussed below, EPA's sector notebook for the rubber and plastic products industry identifies a number of additional BMPs (beyond those in the 1995 MSGP) which could further reduce pollutants in storm water discharges from these facilities, and which have been included in the reissued MSGP.

1. Rubber Manufacturing Facilities

Today's MSGP requires that rubber manufacturing facility permittees consider the following additional BMPs (which were selected from those in the sector notebook) for the rubber product compounding and mixing area:

(1) consider the use of chemicals which are purchased in pre-weighed, sealed polyethylene bags. The sector notebook points out that some facilities place such bags directly into the banbury mixer, thereby eliminating a formerly dusty operation which could result in pollutants in storm water discharges.

(2) consider the use of containers which can be sealed for materials which are in use; also consider ensuring an airspace between the container and the cover to minimize "puffing" losses when the container is opened.

(3) consider the use of automatic dispensing and weighing equipment. The sector notebook observes that such equipment minimizes the chances for chemical losses due to spills.

2. Plastic Products Manufacturing Facilities

For plastic products manufacturing facilities, today's final MSGP requires that permittees consider and include (as appropriate) specific measures in the SWPPP to minimize loss of plastic resin pellets to the environment. These measures include (at a minimum) spill minimization, prompt and thorough cleanup of spills, employee education, thorough sweeping, pellet capture and disposal precautions. Additional specific guidance on minimizing loss can be found in the EPA publication entitled "Plastic Pellets in the Aquatic Environment: Sources and Recommendations" (EPA 842-B-92-010, December, 1992) and at the website of the Society of the Plastics Industry (www.socplas.org).

3. Industry-Sponsored Efforts

Both the rubber manufacturing and plastic products industries are also active in sponsoring studies designed to reduce the environmental impacts associated with the production, use and ultimate disposal of their products. However, in reviewing recent work in this regard, EPA has not identified any additional BMPs for storm water discharges which would be appropriate for the reissued MSGP. Therefore, only the additional BMPs noted above are included in the reissued MSGP for these industries.

IX. Summary of Responses to Comments on the Proposed MSGP

EPA received comments from 45 individuals in response to the proposed permit. A summary of the Agency's responses to those comments appears below. Responses to each comment is available from the Water Docket, whose address and hours of operation are listed in the introduction to this notice.

Section 1.2 Eligibility

Comment a: One commenter requested clarification on the responsibilities military bases, which resemble small municipalities, have with regard to non-industrial areas of the base. The commenter expressed concern that examples of co-located industrial activities in Section VI.B.3 of the fact sheet and Part 1.2.1.1 of the proposed permit could be interpreted to require coverage for all vehicle maintenance activities at a base, even those unrelated to an industrial activity. The commenter further noted that bases in urbanized areas would require base-wide storm water management programs anyway as Small Municipal Separate Storm Sewer Systems under Phase II of the Storm Water Program.

Response a: EPA agrees that municipalities and military or other governmental installations are only responsible for obtaining permits for storm water associated with industrial activity for those portions of their municipality or installations where they have a storm water discharge that is covered under the definition of "storm water associated with industrial activity." Under this interpretation, even though a military base may choose to submit a single NOI for all industrial activities on the base, the SWPPP would only need to identify facilities/areas associated or not associated with industrial activities and that have a SWPPP covering the industrial activity areas. The SWPPP required under the MSGP would not need to address storm water controls for the non-industrial areas of the base. A note has been added to Part 4.1 (Storm Water Pollution Prevention Plans) of the permit to clarify the scope of the SWPPP.

Comment b: The proposed limitations on transfer of storm water discharges from a previous permit to the MSGP could result in undue restrictions. The commenter felt that there could be reasons, e.g., for consistent management of storm water across a site, etc. that either the permittee or the permitting authority would want to address all storm water at a facility under a general permit.

Response b: EPA has reconsidered the Part 1.2.3.3.2 restrictions and Part 1.2.3.3.2.1 of the proposed permit has been eliminated. Part 1.2.3.3.2.1 would only have allowed permittees to seek MSGP coverage for storm water discharges previously covered by another permit if that previous permit contained only storm water and eligible non-storm water (i.e., an individual permit for wastewater, etc. would no longer be required if coverage under the MSGP was allowed). EPA's review did identify some unintended consequences and unresolved issues that could result from this restriction.

A facility (including new facilities) that never had storm water discharges covered by an individual permit, or which was located where access to a municipal wastewater treatment plant for wastewater discharges was available, would have an opportunity for burden reduction that would not be available to a facility with even cleaner storm water that happened to have storm water discharges covered in a previous permit and could not eliminate their wastewater discharges. There could be cases were a smaller and "cleaner" facility would not be able to take advantage of the savings (e.g., individual permit application sampling is not required) the MSGP offered their competitors simply because they had a minor wastewater discharge that could not be eliminated.

While the main purpose of the proposed Part 1.2.3.3.2.1 restriction was to discourage dual permits at a facility, there are already many facilities that have permit coverage split between an individual permit and the MSGP and dual permit coverage would still be available in many cases anyway. Currently, some of these "dual permit" facilities have only wastewater under an individual permit and all their storm water discharges under the MSGP, while at others, the individual wastewater permit includes some of the storm water discharges, with the remaining storm water discharges covered by the MSGP. This ability to have split coverage in at least some situations is necessary to address situations where at least interim coverage under a general permit for a new storm water discharge is necessary or desirable from either the permittee's or the permitting authority's standpoint.

EPA has determined that the proposed restrictions in Part 1.2.3.3.2 relating to discharges for which a water quality-based limit had been developed and discharges at a facility for which a permit had been (or was in the process of being) either denied or revoked by the permitting authority were necessary to address the anti-backsliding requirements of the Clean Water Act or to ensure that discharges from a facility requiring the additional scrutiny of an individual permit application were not inadvertently allowed under the general permit. In any event, only those storm water discharges under the previous permit that met all other eligibility conditions of the MSGP could even be considered for transfer.

EPA periodically promulgates new effluent limitation guidelines, some of which, such as the those for landfills published February 2, 2000, contain storm water effluent limitation guidelines. Under Part 1.2.2.1.3 of the MSGP, a storm water discharge subject to a promulgated effluent limitation guideline is only eligible for coverage if that guideline is listed in Table 1–2. A new guideline promulgated during the term of the permit would thus alter the eligibility for the permit not only for new dischargers, but also for discharges already covered by the permit. In order to avoid the situation where a discharge would suddenly become ineligible upon promulgation of a new guideline, Part 1.2.2.1.3 has been modified to allow interim coverage under the permit where a storm water effluent guideline has been promulgated after the effective date of the permit, but the permit has not yet been modified to include the new guideline. This will allow continued coverage until the new storm water guideline could be added to the permit. Where the new guideline includes new source performance standards, "new sources" would need to comply with Part 1.2.4 prior to seeking permit coverage.

Section 1.4 Terminating Coverage

Comment: (Comment also addresses Section 11.1 Transfer of Permit Coverage) Several commenters viewed the submittal of an NOT by the old operator and the submittal of an NOI by the new operator in order to transfer permit coverage after a change in ownership as a new and overly burdensome requirement (Parts 1.4 and 11.1). An alternative suggested was a simple notice to the permit file of the ownership change.

Response: EPA has determined that the most effective method for accommodating and tracking a change in the owner/operator at a facility covered by the general permit is to have the old operator submit a Notice of Termination certifying that they are no longer the operator of the facility, and for the new operator to submit a Notice of Intent certifying their desire and eligibility to be covered by the general permit. In fact, this is not a new

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requirement since the same process was required under the 1995 MSGP (see Part II.A.4 and Part XI.A at 60 FR 51113 and 51122, respectively). The only "new" aspect of the process is the 30 day timeframe for submittal of the NOT by the old operator and a clarification that simple name changes in a particular company (e.g., Jones Industrial Manufacturing, Co. changing to JIMCO) can be made with a simple update to the company's NOI and a NOT would not be required. Submittal of the NOT by the old operator documents that the old operator believes he no longer needs coverage under the MSGP for any storm water discharges. In addition, EPA is more able to maintain a cleaner database of facilities actually covered by the permit both currently and in the past. The NOI/NOT process for transfers under the general permit is thus essentially a streamlined parallel process to what would otherwise be required under 40 CFR 122.61.

The permit transfer procedures at 40 CFR 122.61 are designed to avoid the time delays and resource burdens associated with issuance of a new permit for a facility just because there is a new owner/operator. Under this process, transfer of the permit to the new owner/operator cannot be made without an actual permit modification (a lengthy process especially for general permits), unless the old operator submits a thirty day advance notice and a written agreement between the parties containing a specific date for transfer of permit responsibility, coverage, and liability between them.

The nature of a general permit is such that there is no actual permit issued to any individual facility, but rather that multiple dischargers are in effect "registering" their intent to use the discharge authority offered by the general permit to anyone who is eligible. This "registration" is accomplished by an operator's submittal of the Notice of Intent to be covered by the general permit as little as two days before they need permit coverage. In fact, regulations at 40 CFR 122.28(b)(2) specifically require submittal of an NOI in order for an operator to be authorized under a general permit for discharges of storm water associated with industrial activity. EPA thus views the requirements for the new operator to file an NOI as little as two days prior to the transfer and for the old operator to file an NOT within thirty days after the transfer to be less burdensome than the thirty day advance notice and written agreements that would otherwise be required under the permit transfer requirements of 40 CFR 122.61.

Section 1.5 Conditional Exclusion for No Exposure

Comment: EPA should insert the No Exposure Certification form and guidance within the permit since many facility operators are unaware of its existence.

Response: EPA has generated a document, "Guidance Manual for Conditional Exclusion from Storm Water Permitting Based on "No Exposure" of Industrial Activities to Storm Water," and a separate no exposure announcement to help operators understand and apply for the conditional permitting exclusion. The guidance is available in hard copy from EPA's Water Resource Center. In addition, EPA also sent a mass mailing alerting all EPA permittees as well as stakeholder groups to the MSGP–2000 and the no exposure exclusion. To provide the No Exposure Certification in as many possible places, EPA is publishing the form and instructions as an addendum to the MSGP–2000.

Section 2.1 Notice of Intent (NOI) Deadlines

Comment: Commenters requested an extension of the 90 day timeframe for submission of their NOI to 270 days. Commenters said they needed the additional time to complete their Storm Water Pollution Prevention Plan (SWPPP), application for an alternate permit, or their endangered species consultation or adverse impact investigation. A commenter also requested clarification of coverage during the 90 days between this publication and their submission of their NOI.

Response: The fact sheet clarifies that SWPPPs are to be prepared at the time the NOI is submitted. Since most permittees are already covered under the current MSGP and have a requirement to update their SWPPP as the need arises, there is no basis for an automatic extension to 270 days. However, facilities may seek an extension up to 270 days to develop their SWPPP, or to obtain an alternate permit, on a case-by-case basis. Similarly, facilities can request an extension up to 270 days if they need to conduct an endangered species consultation or adverse impact investigation. Permittees covered under the current MSGP will continue to be covered during the next 90 days as long as they meet the conditions set forth in the 1995 MSGP.

Section 2.2 Contents of Notice of Intent (NOI)

Comment a: Clarify how to complete the NOI form in situations where an MS4 has industrial activities and is conveying the pollutants to its own storm drainage system.

Response a: The intent of Section 2.2.2.5 was to identify the municipal separate storm sewer system under the assumption that it would be under different ownership. If there is not a separate owner, this requirement is unnecessary. This section has been revised to clarify "the name of the municipal operator if the discharge is through a municipal separate storm sewer system under separate ownership."

Comment b: A commenter questioned whether EPA was requiring or encouraging permittees to consult FWS and NMFS in making its endangered species finding.

Response b: The facility is responsible for obtaining the threatened or endangered species list to make sure that listed specie or critical habitat is not located in or around the vicinity of your facility. That list may be obtained by phoning or mailing the FWS or NMFS, visiting EPA's website, or by some other means. Thus, the permittee is not required to contact the two agencies if he can meet his obligation in another manner.

Comment c: Do not include latitude/longitude information on the NOI.

Response c: EPA requires all regulated facilities to submit latitude and longitude information. The information is critical in overseeing compliance with endangered species assessments and coordinating compliance assistance and enforcement activities across media programs.

Section 2.3 Use of NOI Form

Comment a: Do not add check boxes related to NHPA and ESA compliance.

Response a: EPA believes the additional information improves the Agency's ability to oversee implementation of the permit and compliance with ESA and NHPA requirements. Because the permittee is already responsible for conducting the analysis, there is minimal additional burden associated with indicating on the NOI form how the analysis was conducted. Therefore, EPA intends to retain this requirement. The NOI form requires review by the Office of Management and Budget. Until the new form is approved, permittees should use the current form. EPA's ability to issue today's permit is contingent upon its compliance with ESA and NHPA; thus, provisions related to those statutes is part and parcel of today's permitting action.

Comment b: Commenters supported EPA's proposal to allow facilities to

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submit NOIs, notices of termination, and discharge monitoring reports electronically. However, they cautioned that EPA continue to allow hard copy filing since not all permittees have internet access.

Response b: The final permit retains the requirement of paper filing for NOIs, NOTs, and DMRs. While EPA believes that electronic filing will be incorporated as an option in the future, it is currently not available.

Section 3.3 Compliance with Water Quality Standards

NPDES regulations at 40 CFR 122.44(d)(1)(i) require that the MSGP ensure compliance with State water quality standards for all discharges which "will cause, have the reasonable potential to cause, or contribute" to an exceedance of a State standard. With the wide variety of facilities to be permitted under the MSGP, EPA believes that reasonable potential to cause or contribute to exceedances of water quality standards is likely to exist at least for some facilities. Therefore the MSGP must include appropriate provisions to ensure compliance with State standards. For general permits, EPA's guidance document entitled "General Permit Program Guidance" (February, 1988) suggests an overall narrative statement requiring compliance with State standards to address the fact that the permit will cover a wide variety of facilities subject to different standards depending on their location. Part 3.3 of the proposed MSGP included a narrative statement in accordance with this guidance to ensure compliance with 40 CFR 122.44(d)(1)(i). Part 1.2.3.5 of the proposed MSGP also included an exclusion from permit coverage for facilities which EPA has determined may cause or contribute to violations of State standards. Commenters raised a number of concerns regarding the provisions of the proposed MSGP related to compliance with State standards. However, after review of the comments, EPA believes that the provisions of the proposed MSGP were appropriate and these provisions have been retained in the final MSGP. Following below are EPA responses to the specific issues raised by the commenters:

Lack of Coverage for Facilities With Reasonable Potential

Comment a: A commenter was puzzled by the exclusion from coverage in Part 1.2.3.5 of the proposed MSGP and requested additional explanation.

Response a: EPA believes that facilities which are shown to cause, or have the reasonable potential to cause or contribute to exceedances of State standards may be more appropriately permitted under individual permits or a separate general permit with alternate permit requirements designed to ensure compliance with State standards. This is the basis for the exclusion. Part 1.2.3.5 also provides, however, that MSGP coverage may be available if the control measures in the storm water pollution prevention plan (SWPPP) are sufficient to ensure compliance with State standards.

Comment b: Part 1.2.3.5 of the proposed MSGP could prove burdensome and could lead to permit backlogs depending on the extent of its use.

Response b: Given the large number of facilities covered by the MSGP, it is not practical for EPA to individually review the status of all facilities covered by the MSGP prior to submittal of the NOI. EPA has developed eligibility criteria for coverage under the MSGP–2000 which should, if applied appropriately by the facility operator, screen out facilities which have "reasonable potential" to exceed a state standard. In addition, where EPA determines there is a "reasonable potential," the Director will require the facility to submit an individual permit or take other appropriate action.

Comment c: MSGP coverage should not be allowed until the absence of reasonable potential had been demonstrated by the discharger.

Response c: As noted above, EPA does not believe this is practical for all facilities given the large number of dischargers covered by the permit. Moreover, as discussed in EPA's "Interim Permitting Policy for Water Quality-Based Effluent Limitations in Storm Water Permits" (61 FR 43761, November 26, 1996), there will likely be circumstances where inadequate information is available to perform the reasonable potential analysis.

Are Discharges with Reasonable Potential a Permit Violation?

Comment d: Several commenters objected to Part 3.3 of the proposed MSGP which indicated that discharges which have occurred would be violations of the MSGP if they are later shown to have the reasonable potential to cause or contribute to exceedances of State standards.

Response d: EPA believes that such discharges are appropriately characterized by the MSGP as violations. The narrative statement in the MSGP requiring compliance with water quality standards in effect incorporates into the permit all numeric effluent limitations which are necessary to ensure compliance with State standards. When a discharge is shown to have reasonable potential, this implies that discharges are occurring which would exceed the permit limits needed to ensure compliance with State standards. Since the narrative statement incorporates all limits needed to ensure compliance with State standards, the discharges are appropriately characterized as violations of the permit.

Process for Terminating Coverage Under the MSGP

Comment e: Several commenters expressed concern regarding the process for terminating coverage under the MSGP and ensuring due process for dischargers to contest such actions by EPA.

Response e: EPA believes that the MSGP does ensure due process for dischargers. Part 9.12 of the MSGP provides that EPA may require an individual permit application from a discharger, or require the discharger to seek coverage under an alternate general permit. If an individual permit application were required, a draft permit would be prepared and a full opportunity would be provided to the discharger in accordance with 40 CFR Part 124 to comment on the draft permit and contest any final determination. Further, any alternate general permit would provide (in accordance with 40 CFR 122.28(b)(3)(iii)) that the discharger could seek coverage under an individual permit rather than the alternate general permit. Such a request would also be processed in accordance with the procedures at 40 CFR Part 124.

Comment f: A number of commenters also asked whether a notice of violation of Part 3.3 of the MSGP for violations of State water quality standards would be in writing.

Response f: Dischargers would be notified in writing by EPA of any violation of Part 3.3.

Permit as a Shield Concerns

Comment g: Section 402(k) of the Clean Water Act shields permittees from the requirements of Part 3.3 of the MSGP to comply with water quality standards.

Response g: EPA disagrees with the commenters on this matter. Section 402(k) provides that compliance with an NPDES permit is considered to be compliance, for purposes of section 309 and 505 enforcement, with sections 301, 302, 306, 307 and 403 of the Clean Water Act. However, the violations which are envisioned by Part 3.3 of the MSGP would be violations of an NPDES permit itself, *i.e.*, the water quality-based effluent limitations which are incorporated into the MSGP by virtue of the narrative statement. Section 402(k) does not provide a shield for such violations.

Concerns about Applying State Water Quality Standards to Storm Water

Comment h: Water quality standards cannot apply to storm water discharges since special wet weather standards have not been developed to address episodic events.

Response h: EPA disagrees that State water quality standards cannot apply in the absence of special wet weather standards. Section 402(p)(3)(A) of the Clean Water Act specifically requires that industrial storm water dischargers comply with State water quality standards. EPA has recognized, however, the difficulties in developing appropriate water quality-based effluent limitations for storm water discharges. In response to concerns such as those raised by the commenter, EPA has developed an "Interim Permitting Policy for Water Quality-Based Effluent Limitations in Storm Water Permits' (61 FR 43761, November 26, 1996). Where numeric water quality-based effluent limitations are infeasible (due for example to inadequate information on which to base the limitations), best management practices (BMPs) such as those in the SWPPP would serve as the water quality-based effluent limitations.

Comment i: Clarify whether mixing zones would apply to the storm water discharges.

Response i: Mixing zones would apply to the extent that State water quality standards provide for their use.

Required Actions if Violations of Standards Occur

Comment j: A commenter was unclear concerning the modifications of the SWPPP that would be required by Part 3.3 of the MSGP if violations of State water quality standards occur.

Response j: The SWPPP must be modified to include additional BMPs to the extent necessary to prevent future violations.

Comment k: Clarify who would determine the additional control measures that would be required by Part 3.3 of the MSGP.

Response k: The discharger would at least initially be responsible for determining the additional control measures. However, Part 4.10 of the MSGP also provides that EPA may require modifications of the SWPPP if it proves to be inadequate.

Can a Reasonable Potential Analysis Occur at Any Time During the Permit Term?

Comment l: Part 3.3 of the MSGP should not require a reasonable potential analysis at any time during the term of the permit.

Response l: The information to support a reasonable potential determination would be based on additional information that becomes available concerning a particular discharge (from monitoring results, for example). As such, the permit appropriately provides that a reasonable potential analysis (possibly leading to an individual permit or separate general permit) may be required at such a time.

Comment m: Discharges of a pollutant which increase during the term of the permit should not be considered a permit violation.

Response m: EPA disagrees with the commenter on this issue. The narrative statement in Part 3.3 of the MSGP requires that dischargers comply with all State water quality standards throughout the term of the permit. Dischargers must ensure that, if there are increases in the discharges of a particular pollutant, the increases are not sufficient to cause or contribute to exceedances of water quality standards.

Questions Regarding the Benchmark Concentrations

Comment n: Part 3.3 of the proposed MSGP would undermine EPA's use of the benchmark values in the MSGP.

Response n: EPA disagrees with the commenters in this regard. The benchmark values are concentrations which are used to evaluate whether a generally effective SWPPP is being implemented. The SWPPP is required to ensure compliance with the technology-based discharge requirements of the Clean Water Act. Exceedance of a benchmark value is not a permit violation. However, if a permittee complies with the benchmarks, the permittee is eligible for the monitoring waiver in year 4 of the term of the permit and this provides an incentive to implement an effective SWPPP. Part 3.3 of the MSGP is required to ensure compliance with the water quality-based requirements of the Clean Water Act, which are in addition to the technology-based requirements. Part 3.3 of the MSGP does not undermine the benchmarks. Part 3.3 is simply a separate requirement of the Clean Water Act which must be included in the permit in addition to the technology-based requirements.

General Comment on Water Quality Standards Requirements

Comment o: One commenter lodged a general objection to Part 3.3 of the proposed MSGP, but did not elaborate on specific concerns.

Response o: As discussed above, EPA believes that Part 3.3 is appropriate and necessary to ensure compliance with State water quality standards. As such, Part 3.3 was retained in the final MSGP.

Section 4.1 Storm Water Pollution Prevention Plan (SWPPP) Requirements

Comment a: EPA should not measure progress solely on the number of BMPs applied.

Response a: As stated, EPA's intention in requiring the comprehensive site compliance evaluation is to determine the effectiveness of BMPs in use at the site, and to assess compliance with the terms and conditions of the permit. Additional new BMPs are not prescribed as part of this requirement; the options to include BMPs to replace those which are not working appropriately, or to augment existing BMPs to ensure better performance, rests solely with the facility operator, based on the findings of the compliance evaluation.

Comment b: Clarify the frequency of training required.

Response b: Some industrial sectors covered by this permit are required to provide training at least once per year. In other sectors, it is left to the discretion of the operator. EPA's fact sheet recommends that facilities conduct employee training annually at a minimum, and acknowledges that, for some facilities, a more frequent training schedule may be appropriate to ensure that personnel at all levels of responsibility are informed of the components and goals of the site's SWPPP.

Comment c: Clarify the term "locally available."

Response c: EPA intends the term "locally available" to mean a facility office which need not actually be located on-site, but co-located with other facility operations. It is not necessary for a permittee to maintain a local presence near an unstaffed site for the purposes of maintaining availability of the SWPPP.

Comment d: Fourteen days is an unrealistic timeframe for modifying a SWPPP in response to a discharge of a reportable quantity of oil.

Response d: EPA does not consider the requirement to revise the SWPPP within 14 days after a discharge of a reportable quantity of oil to be unrealistic. Changes to accommodate a description of the release, date and circumstances of the release, as well as a description of the actions taken to address the problem and any necessary changes to the BMPs to prevent future releases are inherently necessary to prevent water quality degradation.

Comment e: It is standard practice to keep a copy of their SWPPPs with their permit and, therefore, there is no objection to this requirement.

Response e: EPA acknowledges that many industrial facilities already keep a copy of the storm water permit with their SWPPP, and the Agency is formalizing that practice as a requirement of the permit for all facilities.

Section 4.2 Contents of Plan

Comment a: A commenter believed EPA was requiring velocity dissipation devices to minimize erosion due to flow velocity.

Response a: EPA's intention is to require facilities to evaluate the need for velocity dissipation devices where it is necessary to minimize erosion due to flow velocity. Facilities should use their best judgment when considering if velocity dissipation devices are needed. The language in the permit has been clarified.

Comment b: Specify a set of minimum management practices for coverage under the permit.

Response b: Due to the variety of industries covered by the Multi-Sector General Permit, there is no "minimum" list of best management practices that would suitably address the multiple situations found at different industrial sites. EPA considers it sufficient to outline minimum criteria that each facility operator must consider to minimize discharges from their property, and allow facility operators to identify and implement BMPs that are appropriate for their site.

Comment c: Do not require the SWPPP to identify oil spills or leaks below reportable quantities. Only those sites that have not been cleaned up to appropriate levels should be included in the site description and shown on the site map.

Comment d: EPA has not changed the basic intent of this permit requirement: a facility must keep a record of significant spills or leaks of both hazardous substances or oil and, for releases in excess of reportable quantities under 40 CFR Parts 117 or 302, revise its pollution prevention plan as necessary to prevent the reoccurrence of such releases. A spill or leak may not meet the threshold of a "reportable quantity" but may still be sufficiently significant to cause water quality impairment, and therefore should be acknowledged and mitigated by the permittee. EPA does not intend that "reportable quantity" defines the minimum amount of a substance which should be appropriately managed. In regards to including previous spill and/or leak areas in the site map and associated descriptions, the Agency views the inclusion of all areas where spills have occurred over the last three years from the date of NOI submittal as important information which may be useful in assessing future risks.

Comment d: The provision prohibiting discharge of "solid materials" is too broad and should be eliminated.

Response d: EPA intends the reference to "solid materials, including floating debris" and "Off-site tracking of raw, final, or waste materials or sediment, and the generation of dust" as having the generally accepted plain language meanings, and that facility operators should use their best professional judgment in applying this requirement to their discharge. The reference is not necessarily meant to apply in particular to suspended soil. EPA has purposefully allowed for reasonable flexibility in allowing each facility to determine whether "solid materials," "floating debris" and/or "dust" are a component of their storm water discharge. The Agency acknowledges that many areas have state or local ordinances prohibiting the off-site tracking and generation of dust; therefore, this requirement does not pose a hardship on facility operators. While not prohibiting the discharge of waters containing soils, the permit still requires that discharges must comply with state/local water quality standards.

Comment e: The requirement for "routine inspections" and "records of inspections" are too broad.

Response e: EPA acknowledges that most industrial facilities conduct regular inspections of plant conditions. As discussed in Part 4.2.7.1.5 of the permit, facility operators must explicitly outline in the SWPPP the frequency of regular inspections at their facility which will incorporate inspections of industrial activities or materials that are exposed to storm water. Records of these specific storm water inspections, along with records of any followup actions taken as a result of these inspections, must be kept with the SWPPP. This facility-specific schedule of periodic inspections is what EPA is referring to as "routine facility inspections."

Comment f: An evaluation of groundwater impacts or concerns is beyond the scope of a stormwater pollution prevention plan.

Response f: In some cases, groundwater beneath a facility may be hydrologically connected to surface waters. EPA's intent for including an evaluation of impacts to groundwater when considering appropriate BMPs is to ensure that facility operators are fully cognizant of the hydrology of their area, and have evaluated any appropriate BMPs in the event that such a situation exists for their property. If there are no possible impacts to groundwater, this fact should be acknowledged in the SWPPP.

Section 4.4 Non-Storm Water Discharges

Comment a: Include swimming pool discharges as an allowable storm water discharge.

Response a: EPA does not include swimming pool discharge as an allowable non-storm water discharge in the Multi-Sector General Permit, as this is a general permit to cover storm water discharges from industrial activity. The Agency is unclear as to how many industrial facilities have swimming pools that would necessitate this specific exemption. The inclusion of nonchlorinated swimming pool discharges as an allowable non-storm water discharge will be better suited to the upcoming EPA Small Multiple Separate Storm Sewer General Permit, which will be available by December 2002.

Comment b: The permit should allow for case-by-case determinations for inclusion of de minimus non stormwater sources.

Response b: By its very nature, a general permit is meant to cover many similar discharges from a variety of similar sources. Case-by-case determinations for de minimus non-stormwater discharges would be extremely time-intensive, and it is not possible to provide for such individual determinations in the context of a general permit. Specific examples of de minimus discharges were not provided by the commenter; therefore, the Agency is not inclined to include such a provision at this time.

Comment c: Delete "drinking fountain water:" from Section 1.2.2.2.3 and cite only "potable water including water line flushings."

Response c: EPA agrees with the issues presented by the commenter, and that the term "drinking fountain water," in itself, is imprecise. Both the draft MSGP fact sheet and permit specifically authorize potable water as an allowable non-storm water discharge. The "drinking fountain water" language has been deleted.

Section 4.7 Copy of Permit Requirements

Comment: Recommend electronic website access in lieu of paper copy of permit.

Response: The new requirement that a hard copy of the Multi-Sector General Permit be kept with a facility's Storm Water Pollution Prevention Plan is intended to ensure that the permit requirements are easily and readily available to all facility staff who are or may be responsible for implementing the provisions of the permit. Internet access may not be available to staff in all situations; therefore, for ease of reference, EPA is requiring that at least one copy of the permit be retained along with the SWPPP. The sections referring to EPA's acceptance of the electronic medium is contingent, in both cases cited by the commenter, upon the future viability of electronic submittal of NOIs and DMRs to the Agency.

Section 4.9 Timeline

Comment a: The fact sheet and permit need to provide consistent timeframes for SWPPP revisions.

Response a: The fact sheet and permit language were consistent on revising the SWPPP within 14 days of the site evaluation, but were somewhat confusing on how long the permittee had to implement the revisions. To clarify this time period, EPA has revised Part 4.9.3 of the permit to state: "If existing BMPs need to be modified or if additional BMPs are necessary, implementation must be completed before the next anticipated storm event, or not more than 12 weeks after completion of the comprehensive site evaluation."

Comment b: Thirty days to correct deficiencies in the SWPPP following notification by the Director is insufficient.

Response b: EPA intends for corrections to the Storm Water Pollution Prevention Plan to be accomplished in a timely manner, particularly when deficiencies are identified formally by the Director. The Agency feels that thirty days, as outlined in the existing permit language, is a reasonable amount of time for such changes to be made; if revisions are significant, the permittee may request, and the Director can provide, additional time for revisions to be accomplished.

Comment c: Fourteen days to modify a SWPPP is insufficient.

Response c: The Agency feels that revising the Storm Water Pollution Prevention Plan appropriately to address deficiencies within 14 days is a reasonable timeframe in which to address changes administratively; additional time is provided to actually put those revisions into place.

Comment d: The SWPPP must be completed and in place prior to issuance of the permit.

Response d: Part 4.1 of the permit states that a SWPPP must be prepared for the facility before submitting a Notice of Intent for permit coverage. EPA's issuance of the MSGP–2000 does not automatically confer coverage to permittees; therefore, EPA feels the requirement that a site-specific SWPPP be in place for the facility operations prior to seeking coverage by way of the submittal of a NOI is sufficient to prevent environmental degradation.

Section 4.12 Additional Requirement: EPCRA Section 313 Reporting

Comment: Many commenters supported removal of EPCRA Section 313 reporting requirements from the permit. Two commenters objected to identifying areas with pollutants that must be reported under EPCRA Section 313 and to develop appropriate storm water controls for these areas.

Response: EPA acknowledges the general support for revisions to this section. The intent of these modifications is to eliminate the redundant requirements of the existing MSGP for permittees subject to reporting requirements under Section 313 of EPCRA, which includes the 20+ categories of Toxic Release Inventory chemicals. The Agency believes that the MSGP–2000 places no additional burden on facility operators with TRI chemicals. Identification of EPCRA 313 chemicals in the SWPPP acknowledges that these chemicals are pollutants of concern. Facilities with any of these pollutants need to develop appropriate storm water controls to contain them. As noted in the fact sheet, EPA believes these concerns have been addressed through existing state and federal requirements which can be referenced in the SWPPP.

Section 4.13 Public Availability for Review

Comment a: The public should be able to obtain access to and comment upon a SWPPP and "no exposure" claim before they are finalized.

Response a: EPA has, in response to this comment, included a provision in the final permit requiring facility operators to make a hard copy of their SWPPP available to the public when requested in writing. EPA believes this requirement is an acceptable compromise between the facility operator's concerns about having members of the public at their site and the need of the public to understand potential impacts on their environment. EPA does not receive SWPPPs routinely, and, therefore, cannot make them available at its offices or provide them to local government offices. As with the previous MSGP, members of the public have the option of contacting the NOI Center or the Regional EPA Storm Water Coordinators directly to inquire about a facility's permit status.

EPA does not intend to require public comment on SWPPPs, nor require public hearings, because SWPPPs are intended to be modified as necessary to address changes at the facility or when periodic inspections indicate that a portion of the SWPPP is proving to be ineffective. Requirements for public comment and public hearings would delay needed modifications to, not to mention development of, the SWPPP, be burdensome and serve as disincentives to plan updates.

At any time the Agency can conclude that a facility is no longer eligible for coverage under a general permit and require the facility to apply for a general permit. In that event, there would be significant opportunity for public input in the decision-making process.

Comment b: The following should be available in paper copy and on the web: NOI, SWPPP, and "no exposure" certification.

Response b: EPA has found that having a central location for processing NOIs is an efficient and effective way of managing the tremendous amount of data which the Storm Water program generates. Very shortly, members of the public will be able to access information from the NOI database online. The NOI database contains facility information, including the type of industrial activity taking place, facility contact information, and receiving water body information. Also available online will be information on facilities that have submitted "no exposure certifications." Regarding SWPPPs, EPA does not receive them routinely and, therefore, cannot make them available on-line. EPA has, in response to this comment, included a provision in the final permit requiring facility operators to make a hard copy of their SWPPP available to the public when requested in writing. EPA believes this requirement is an acceptable compromise between the facility operator's concerns about having members of the public at their site and the need of the public to understand potential impacts on their environment.

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Section 5.1 Types of Monitoring Requirements and Limitations

Comment a: A commenter requested language clarification for the first paragraph under Part 5.1, Quarterly Visual Monitoring.

Response a: Quarterly visual monitoring is required for all permittees covered under the MSGP. The visual inspection must cover all outfalls at the facility from which there are storm water discharges associated with industrial activity.

Comment b: A commenter indicated that Part 5.1.1.4 was clear regarding the visual monitoring waiver for inactive and unstaffed sites. However, it was unclear if a similar waiver for benchmark monitoring applies to inactive and unstaffed sites.

Response b: EPA has clarified in Part 5 that a permittee may exercise a waiver for benchmark monitoring at unstaffed and inactive sites.

Section 5.3 General Monitoring Waivers

Comment a: Commenters supported the adverse sampling condition waiver, as long as the permittee doubles sampling during the next event or eliminates the substitute sampling requirement for areas with extended frozen conditions.

Response a: EPA has decided to keep this temporary waiver, since the main purpose of this specific waiver is to allow the permittees the opportunity to take samples under no adverse nor threatening weather conditions.

Comment b: Allow permittees to waive benchmark monitoring in years 2 and 4 of the MSGP–2000 with the result of the 1995–MSGP; waive difficult logistical conditions or location access similar to those for unstaffed/inactive facilities; and impractical sample collection at large facilities.

Response b: Under Section 402 of the CWA, EPA is required to issue permits which apply and ensure compliance with any applicable requirements of sections 301, 302, 306, 307, and 403. Since these permits are issued with fixed terms not exceeding five (5) years, EPA needs to ensure that permittees continue to comply with applicable requirements. EPA believes that benchmark monitoring is not overly burdensome and provides useful information to the permittee and the Agency. Therefore, EPA will require permittees covered under the reissued MSGP to ensure continued compliance with permit conditions and requirements. In addition, EPA has determined that the general monitoring waivers provided in the previous permit are adequate, and that additional waivers are not needed. With regard to problems facilities encounter when monitoring their storm water discharges, such as difficult logistical conditions, access to discharge locations or impractical sample collection at large facilities, EPA recommends permittees review the "NPDES Storm Water Sampling Guidance Document" which suggest solutions to these sampling problems.

Section 6.E Sector E—Glass, Clay, Cement, Concrete and Gypsum Products

Comment a: Separate the concrete pipe manufacturing from the cement, ready mixed and concrete block manufacturing sector.

Response a: Based on the characterization of the concrete pipe manufacturing industry and the cement, ready mixed and concrete block manufacturing industry, EPA has determined that the two industries are similar and, thus, has retained the industrial sectors as described in the 1995 permit.

Comment b: Section 6.E.3.1 of the draft permit was not reflective of the September 30, 1998 modification.

Response b: The commenter is correct. The final permit has been changed to reflect the September 30, 1998 modification which removed the limitations of coverage for various industries. Paragraph 6.E.3 has been removed and the remaining paragraphs have been renumbered accordingly.

Section 6.F Sector F—Primary Metals

Comment a: Do not propose any new BMPs for the steel industry in the MSGP–2000.

Response a: Similarly to the 1995 MSGP, the MSGP–2000 prefers the implementation of structural and non-structural BMPs for stormwater management from Primary Metals facilities. It is up to the individual operators to decide which BMPs most effectively meet their needs. This does not preclude the use of additional or new technologies should they be found to be more effective in any given application.

Comment b: The BMPs provided at Parts 6.F.3.2 and 6.F.3.3 omit the most obvious qualifier, which is that inventories of exposed material and housekeeping should be mandated by the MSGP only where the exposed materials have a potential to contact storm water that is discharged from a point source to a water of the United States. In many cases, the types of materials and activities discussed in the above referenced parts occur in areas where precipitation is collected and contained, and is not discharged. Thus, site inventories and BAT practices discussed in these parts are not relevant except in areas where they affect storm water discharges authorized by the MSGP. Parts 6.F.3.2 and 6.F.3.3 should be clarified (similarly to Part 6.F.3.1) with a statement that these activities are required only in areas where such activities could result in a discharge of pollutants to waters of the United States.

Response b: One of the underlying premises of the MSGP is that if there is a potential for contact between storm water and environmental contaminants, then the facility should apply for coverage under the MSGP. If there is no potential for contact, the facility may be able to submit a "no exposure" certification form, and not be required to obtain permit coverage. Where there is a potential for contact between storm water and industrial activities and/or materials, then the operator needs to obtain permit coverage and take appropriate measures to mitigate the discharge of pollutants.

Comment c: Part 6.F.3.4 includes a requirement for inspections performed under the 2000–MSGP to, among other things, evaluate air pollution control equipment. This activity does not belong under the MSGP. It is a Clean Air Act requirement and an activity performed under each facility's Clean Air Act permit. Such inspections under the MSGP are redundant, inappropriate and extend EPA's CWA authority into the CAA. Inspections of air pollution control equipment should not be a component of any SWPPP or compliance certification under the CWA.

Response c: EPA understands why inspection requirements which routinely fall under the purview of one environmental program (in this case the Air Program) would appear inappropriate under another environmental program (in this case the Water Program). However, if one looks at the potential sources of pollution at primary metals facilities, one will soon discover that one of the principal sources of contamination is from the air pollution control devices. The purpose of the storm water regulations is to keep storm water from coming into contact with any contaminants, regardless of the environmental media from which it arose. If inspections are routinely conducted at a facility pursuant to one environmental statute, that same inspection will generally be accepted by another program. For example, if the facility routinely inspects its air pollution control devices as a requirement of its CAA permit, that

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same inspection, with the possibility of a few additional observations, *e.g.*, to see if there is any evidence of run off, should also be accepted as part of the SWPPP. The SWPPP can cross reference inspection protocols for the CAA permit. Thus, EPA does not agree with the commenter that these requirements are either redundant, inappropriate or extend EPA authority.

Section 6.G. Sector G —Metal Mining (Ore Mining and Dressing)

Comment a: Include Table G–4, published in the August 7, 1998 modifications, in MSGP–2000. Also, table titles in this section are confusing since they appear to imply that effluent guideline limitations apply to waste rock and overburden piles.

Response a: We have included the revised table G–4 from the August 7, 1998 modification in the fact sheet for today's permit. The titles of tables G–1 and G–2 are consistent with the titles in the other sectors of the final permit. All monitoring tables in Part 6 of the permit are titled "SECTOR–SPECIFIC NUMERIC LIMITATIONS AND BENCHMARK MONITORING." The Agency doesn't not believe that this title is misleading because each table contains a column labeled "Numeric Limitation" which either contains a numerical value or is blank. For those Sectors where there are no values listed in the numeric limitation column it is clear that numeric limitations do not apply. EPA recognizes that benchmark concentrations are not effluent limitations and is provided specific language in the permit to that effect.

Comment b: The commenter opposes EPA's disallowance of sampling waivers from monitoring requirements for waste rock and overburden piles. Another commenter argued that another waiver based on "not present or no exposure" had also been deleted. A third commenter noted that monitoring requirements were also inconsistent with the 1998 permit modifications.

Response b: The restriction on sampling waivers was not intended to exclude the "Adverse Climatic Conditions Waiver" in Part 5.3.1 of the permit. The final permit has been revised to correct this error. Also, Part 6.G.7.2 has been modified to reflect that the monitoring requirements only apply to discharges from active ore mining and dressing facilities and that these requirements remain unchanged from the 1998 permit modification. The second waiver in Part 5.3 which is based on "not present or no exposure" was not part of the August 1998 notice, and was not intended for sector G facilities.

Comment c: The limitation on coverage for adit drainage and contaminated springs or seeps should be modified to exclude only those that do not result from precipitation events. The proposed Certification of Discharge language is confusing since it implies an obligation for testing or evaluation of mining-related discharges that are composed entirely of non-storm water covered by an NPDES permit.

Response c: Adit drainage and contaminated springs and seeps are discharges that originate below the surface of the ground. Often they discharge during dry periods and, while in some instances these flows may increase in response to a storm event, they may continue to flow well after the precipitation has ended. Therefore, EPA has determined that the restriction (*i.e.*, prohibition) for MSGP coverage of discharges from adit drainage, contaminated springs and seeps should remain as proposed.

The "Certification of Discharge Testing" language has been modified to clarify that certification must be provided to show that any mining-related discharge has been "tested or evaluated for the presence of non-storm water discharges." Additional wording has been added to Part 6.G.6.1.6.6 to make it consistent with the language in the 1995 MSGP.

Comment d: Provide guidance in Section 6.G.6.1.6.6 on what type of test should be performed.

Response d: The language has been modified to allow for a certification based on "tested or evaluated" information. Additional wording has been added to Part 6.G.6.1.6.6 to make it consistent with the language in the 1995 MSGP.

Comment e: The definition of "reclamation phase" is inconsistent with most state programs.

Response e: The definition of the three general phases of mining was taken from the fact sheet to the 1995 MSGP. The intent was to recognize that "mining" is comprised of several distinct activities, not to set a standard for each phase. EPA acknowledges that reclamation requirements are typically set by state programs, and therefore the permit language defining the reclamation phase has been modified to reflect other post-mining land uses.

Comment f: In reformatting the permit language, EPA introduced new requirements which are inconsistent with the settlement EPA reached with NMA in 1998.

Response f: The draft MSGP–2000 intended to incorporate all the requirements from the 1998 notice resulting from the settlement with NMA. However, in making the changes and converting to a more "readable" format some unintended errors occurred. The revisions to the monitoring requirements have been made so the final permit language is consistent with the 1998 **Federal Register** publication (63 FR 42534, Aug 7, 1998).

Comment g: Delete the phrase "directly or indirectly" from coverage of "storm water discharges that have come into contact (directly or indirectly) with any overburden, raw material, intermediate product* * *" since it is inconsistent with prior versions of the permit.

Response g: The storm water regulations (Section 122.25(b)(14)(iii)) require permit coverage for "facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products* * *" When revisions were made to the draft MSGP 2000 language to make the permit more "readable," some of the words were changed. In order to be consistent with the storm water regulations, the permit language has been revised. The words "come into contact (directly or indirectly)" have been deleted and replaced with "contaminated by contact or that has come into contact."

Comment h: EPA was incorrect in stating that all facilities permitted in this sector are "no discharge" facilities.

Response h: The monitoring discussion in the Fact Sheet to the permit is a summary of the data available at the time the draft permit was published for public comment. The main focus of the summary was on data from the second year of permit coverage. Of those sector G facilities that submitted information in year 2 of the permit none of them reported a discharge. The 1998 MSGP modification which reflected the settlement with NMA and added monitoring requirements for sector G was much later in the permit term. The final fact sheet language has been changed to recognize the later data and discharge status of sector G facilities covered by the permit.

Comment i: Water technically qualifying as mine drainage but which meets all applicable surface water quality standards should be approved for use in lieu of fresh water for dust control on roads at mine sites.

Response i: The quality of the mine drainage can change from source to source and over time within the same mine. The MSGP would need to specify a process (*e.g.*, monitoring frequency) to ensure that the quality of the mine drainage is protective of water quality. This type of facility specific considerations and potential monitoring requirements would be better addressed under an individual permit issued to the facility.

Sections 6.G and 6.J Construction Requirements for Sector G—Metal Mining and Sector J—Mineral Mining

Comment a: Commenters questioned why EPA was requiring coverage under a construction general permit for earth disturbing activities during the "exploration and construction phase" of a mining operation.

Response a: This requirement was originally contained in the 1995 MSGP Fact Sheet for Sector J (it was inadvertently not duplicated in the metal and coal mining [Sector G] sectors). It therefore represents a clarification or technical correction to the original MSGP. To clarify the applicability of the MSGP regarding construction activity at metal mining sites and to make metal mining requirements consistent with mineral mining provisions (Sector J), Sector G has been modified to indicate that earth-disturbing activities occurring in the "exploration and construction phase" of a mining operation must be covered under EPA's Construction General Permit (63 FR 7858, February 17, 1998) or under an individual permit if the area disturbed is one acre or more. Earth-disturbing activities during exploration/construction affecting less than one acre must be covered under the MSGP–2000. If permittees then opt to actively mine the site they are required to transition to the MSGP–2000 (they should terminate their coverage under the CGP, but there is no requirement to do so). This procedure removes commenters' "dual-permit requirement" fear. Once in the active phase, any subsequent mine enlargement would be covered under the MSGP–2000. All phases of a mining operation must be covered which includes the "reclamation phase." EPA believes the appropriate level of environmental protection for initial land-disturbing mining activities is a construction permit. SWPPP requirements under a construction permit are more effective for the often temporary conditions found during the initial phase versus that which would be appropriate for a more permanent mining operation. Many of the BMPs and other SWPPP requirements of the Construction General Permit could be incorporated in the MSGP–2000 SWPPP, thereby minimizing any duplicative efforts.

Comment b: For Sector J for Region 9, the proposed MSGP only authorized mine dewatering discharges from crushed stone, construction sand and gravel, and industrial sand mines in Arizona. For Regions 1, 2, 6, and 10, coverage was proposed throughout the areas of these regions covered by the MSGP. Expressions of interest in MSGP coverage for these discharges have been received for other areas, such as Indian country in Nevada and California.

Response b: For consistency with the other regions, coverage for the discharges has been extended throughout the areas of Regions 3, 8 and 9 covered by the permit, provided the dischargers meet all other permit eligibility requirements.

Section 6.I Sector I—Oil and Gas Extraction

Comment: One commenter expressed concern that while refineries were covered under Sector I—Oil and Gas Extraction, refining was not usually considered "oil and gas extraction" and the title of Sector I could thus cause refinery operators to overlook permit conditions that could apply to them.

Response: EPA welcomes this suggestion to make the permit easier to use and the title for Sector I has been changed to "Oil and Gas Extraction and Refining" in Table 1–1 and in Part 6.I. Note however, that any storm water at a refinery that is subject to storm water effluent limitation guidelines at 40 CFR 419 is not eligible for permit coverage.

Section 6.R Sector R—Ship and Boat Building or Repair Yards

Comment: One commenter requested that the provisions of part 6.R.4.3.1. be clarified to note that pressure washing to remove paint would require a separate NPDES permit.

Response: EPA agrees that if pressure washing occurs to remove paint, the discharge of that wash water would require separate NPDES permit coverage. EPA also intends for the discharge of wash waters removing marine growth to be permitted separately. The source of the discharge is not storm water and, as a general rule, the MSGP only authorizes the discharge of storm water. The non-storm water discharges that are authorized by the MSGP are a specific list found in Part 1.2.2.2. of the permit and the list does not include pressure wash waters.

Section 6.S Sector S—Air Transportation

Comment: Commenters had concerns regarding the execution of site compliance evaluations and inspections of deicing areas. They also requested EPA to limit the inspection obligation to once per month during periods of deicing operations.

Response: The MSGP–2000 has been clarified to state that compliance evaluations shall be conducted during a period when deicing activities are likely to occur (vs. a month when deicing activities would be atypical or during an extended heat wave), not necessarily during an actual storm or when intense deicing activities are occurring. This requirement is not seen as onerous, as EPA believes that most weather conditions can be reasonably anticipated and the evaluation can be planned for. EPA generally agrees that regularly scheduled, monthly inspections of deicing areas during the deicing season (*e.g.*, October through April) are sufficient at airports with highly effective, rigorously implemented SWPPPs. However, if unusually large amounts of deicing fluids are being applied, spilled or discharged, weekly inspections should be conducted and the Director may specifically require such weekly inspections. In addition, personnel who participate in deicing activities or work in these areas should, as the need arises, inform the monthly inspectors of any conditions or incidents constituting an environmental threat, especially those needing immediate attention. EPA requires permittees to record, to the best of their ability, the quantity of all deicing chemicals applied on a monthly basis (not just glycols and urea, *e.g.*, potassium acetate), as discharges of large quantities of these chemicals can have an adverse impact on receiving waters. The capability to record usage of chemicals should not depend on the type of chemical used. EPA never intended to provide a comprehensive list of technologies and BMP options for airport operators to consider, nor to provide a discussion of the relative merits of each. EPA's discussion was simply an introduction of the many options available and was intended to stimulate thought on the variety of BMPs available. EPA intends that storm water personnel use their best professional judgment to select site-appropriate measures for inclusion in their SWPPPs. For a more thorough source of information on deicing fluid control and airport deicing operations in general, stakeholders can check the EPA publication "Preliminary Data Summary, Airport Deicing Operations" at http://www.epa.gov/ost/guide/airport/index.html.

Section 6.T Sector T—Treatment Works

Comment: Clarify that treatment works smaller than 1.0 MGD are not

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defined as industrial activities and, therefore, are not subject to the permit.

Response: The final permit language has been modified to be consistent with the industrial definition of § 122.26(b)(14)(ix). The requirements of Sector T are intended to apply only to those treatment works with a design flow of 1.0 MGD or more, or required to have an approved pretreatment program.

Section 8 Retention of Records

Comment: Clarify the Retention of Records language.

Response: EPA has clarified the Retention of Records language used in this permit. Part 8.1 states that the permittee will retain, for three (3) years after the permit expires or is terminated, the SWPPP and all documents/reports needed to complete their Notice of Intent form. In addition, Part 9.16.2.1 addresses the retention of records for the permit monitoring requirements for three (3) years from the date of sample, measurement, evaluation or inspection, or report. Permittees are required to submit Discharge Monitoring Reports for compliance and/or analytical monitoring.

Section 9 Standard Permit Conditions

Comment a: Several comments were received on Part 9.12.1 for requiring coverage under an individual permit or an alternative general permit. Commenters suggest that the permittee be allowed to appeal a Director's decision; provide for determination of non eligibility and semblance of surety available by a permittee who demonstrates eligibility and compliance with the MSGP; and authorize automatic transfer provided all storm water permitting conditions and obligations are met.

Response a: EPA may modify, revoke and reissue, or terminate a permit during its term. Causes for modification, revocation and reissuance, and termination are set forth in 40 CFR § 122.62 and 122.64. Specific causes may include: noncompliance by the permittee with any condition of the permit; failure in the application or during the permit issuance process to disclose fully all relevant facts; determination that the permitted discharge endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination; or there is a change in any condition that requires either a temporary or a permanent reduction or elimination of any discharges controlled by the permit. In addition, EPA recently published a final rule which revises certain regulations pertaining to the NPDES program, including the procedures for appealing an EPA determination on NPDES permits. See *Amendments to Streamline the National Pollutant Discharge Elimination System Program Regulations; Round II,* 65 Fed. Reg. 30886 (May 15, 2000). Included in the rule are revisions to the permit appeals process that replace evidentiary hearing procedures with direct appeal to the Environmental Appeals Board (EAB). The website for the EAB is "http://www.epa.gov/eab/". The webpage has a frequently asked question section, "http://www.epa.gov/eab/eabfaq.htm". Questions 1 through 9 deal with filing issues, which the commenter can refer to for instructions on how to proceed in filing an appeal with EAB. EPA does not allow automatic transfer from individual permits into other individual or general permits since EPA needs to maintain adequate records of permittees and make periodic evaluations of the adequacy of their measures to comply with permit requirements.

Comment b: EPA should extend coverage to facilities wishing to apply after the expiration date of the MSGP until the permit is reissued.

Response b: Where EPA fails to reissue a permit prior to the expiration of a previous permit, EPA has the authority to administratively extend the permit for facilities already covered. However, EPA does not have the authority to provide coverage to "new" facilities seeking coverage under an expired permit. This concern is not applicable in this instance to the MSGP since the MSGP–2000 was issued before the MSGP–1995 expired.

Section 13 Permit Conditions Applicable to Specific States, Indian Country Lands

Comment: The Agency should not require compliance with provisions of state rules that it cannot specifically identify. For example, EPA requires compliance with state anti-degradation provisions. The Agency provides no assistance with regard to how a small business might somehow ascertain what those provisions are, who has them, and how they might apply to the facility's discharge. See 65 Fed. Reg. at 17021. The Agency must specify precisely how a company would obtain appropriate data and how it should apply that data to its operations. Without this necessary guidance, this new provision should be removed from the final permit.

Response: The permit states that discharges are not covered if they violate, or contribute to the violation of, a state water quality standard. An anti-degradation policy is one component of a state's water quality standards program. The permittee is responsible for checking to ensure compliance with these provisions. Facility operators can check with the EPA official listed in this permit to obtain the name of the appropriate state contact.

Section I.A General Opposition to Proposed Changes

Comment: A commenter objected to several of the proposed modifications to the "Limitations on Coverage" provisions in the Proposed MSGP–2000, including the proposed revisions to the Endangered Species Act requirements (Section 1.2.3.6), the addition of the antidegradation provision (Section 1.2.3.9), the addition of the impaired waters and TMDL provisions (Section 1.2.3.8), and the addition of the compliance with water quality standards provisions in Section 3.3.

Response: The Agency acknowledges the comment. Justifications for each of the positions cited by the commenter are provided in the fact sheet accompanying the permit. Specific objections to these provisions are addressed elsewhere in the comment response document.

Section I.B General Support to Proposed Changes

Comment a: Several commenters supported EPA's continued use of a general NPDES permit for regulating storm water discharges associated with industrial activity. The commenters indicated that this was an efficient and effective means for achieving the goals of the Clean Water Act.

Response a: EPA agrees with the commenters regarding the appropriateness of general permits for the majority of industrial storm water discharges. The issuance of the final MSGP is consistent with these comments.

Comment b: A commenter supported the proposal to authorize incidental windblown mist discharges from cooling towers as an authorized non-storm water discharge under the MSGP.

Response b: These discharges are included in the final MSGP consistent with the recommendation of the commenter.

Comment c: A commenter supported the provision in the proposed MSGP to allow termination of permit coverage based on the "no exposure exemption" (40 CFR 122.26(g)) provided under EPA's Phase II storm water regulations of December 8, 1999 (64 *Fed. Reg.* 68722).

Response c: Although the no exposure exemption would be available whether or not it is specifically included in the

MSGP, EPA has retained the provision in the final MSGP to highlight its availability for those facilities which qualify.

Section I.C Fact Sheet

Comment a: It is imperative that EPA conduct an environmental justice analysis for the MSGP to ensure that the permit is consistent with the goals of EPA's Environmental Justice Strategy of April 3, 1995, the President's 1994 Executive Order on Environmental Justice and Title VI of the Civil Rights Act. The notice of intent (NOI) must include demographic information. EPA must seek comments of minority and low-income communities regarding the MSGP.

Response a: EPA disagrees with the commenter that an environmental justice analysis is necessary prior to the reissuance of the MSGP. Regarding Title VI requirements, EPA has recently proposed guidance (65 *Fed. Reg.* 39649, June 27, 2000) for assisting recipients of Federal funding which administer environmental programs (such as state environmental agencies), as well as guidance for investigating alleged disparate environmental impacts stemming from permitting programs administered by these agencies. The guidance is also appropriate for EPA permits, such as the MSGP.

The Title VI guidance encourages permitting authorities to integrate environmental justice into their permitting programs. However, an environmental justice analysis is not required for every permit issued by a state permitting authority or by EPA. No information was provided by the commenter that a disparate impact on minorities would exist as a result of the MSGP. The MSGP includes numerous effluent limitations and other conditions which should be protective of water quality for all neighborhoods in which permitted facilities are present. EPA does intend to integrate environmental justice considerations explicitly into its permitting programs as outlined in the Title VI guidance. However, this will likely be a longer term process (extending beyond the time frame for reissuance of the MSGP) given the many complexities of the issue.

EPA's Environmental Justice Strategy of April 3, 1995 (developed pursuant to the President's 1994 Executive Order) has similar goals as Title VI of the Civil Rights Act. Again, however, an environmental justice analysis is not required for every permit issuance. The integration of the goals of the Environmental Justice Strategy into the NPDES permit program will also take time given the many complexities of the environmental justice issue.

EPA is committed to implementing the Executive Order on Environmental Justice. As a practical matter, environmental justice concerns are community specific. EPA will work with a specific community that may express concerns related to a specific source or other environmental burdens. If and when a community raises such issues, EPA can then consider a proper course of action. In the case of the MSGP which will largely permit existing facilities, EPA will engage the community that has raised the issue and, if appropriate, work with the State and local agencies to address their concerns. If violations of any applicable standards are identified, EPA can pursue possible enforcement actions. The MSGP also provides that an alternate general permit could be issued for any geographic area which may be identified in the future as subject to disparate environmental impacts.

EPA has public noticed its intent to reissue the MSGP and has requested comments throughout the areas potentially affected by the permit, including areas where minority and low-income communities are present. EPA believes that its outreach activities have been sufficient for the permitting action which was proposed. However, EPA's Environmental Justice Strategy also provides for additional outreach activities in the future which may include outreach to minority and low-income communities specifically regarding the MSGP.

EPA disagrees that demographic information should be required with the NOI. The NOI does include location information for industrial facilities seeking coverage under the permit. Using this information it is possible to locate facilities covered by the permit relative to the locations of different demographic groups. As such, it is not necessary for the NOI to include demographic information.

Comment b: A commenter expressed concern that some non-storm water discharges may be improperly characterized as storm water by certain facilities. The commenter recommended that EPA carefully review permit applications and conduct inspections to ensure that such discharges are treated as point source discharges and not covered by the MSGP.

Response b: Point source discharges would violate the Clean Water Act unless they are authorized by a separate NPDES permit. The MSGP also requires that operators review their facilities for the presence of unpermitted non-storm water discharges which are not authorized by the MSGP. When such discharges are located, the MSGP requires that the discharges be permitted or terminated. This requirement should minimize the possibility that inappropriate non-storm water discharges are discharged under the MSGP. As recommended by the commenter, EPA does conduct periodic inspections of facilities permitted under the NPDES permit program to evaluate the compliance status of a facility with the requirements of the Clean Water Act, including the presence of any unpermitted discharges. Although the permit application for the MSGP (the notice of intent) does not specifically address the issue of non-storm water discharges, EPA believes that the other requirements of the MSGP, along with EPA's inspection program, adequately address the commenter's concern.

Section II.A Organization and Clarity

Comment a: Virtually all commenters supported EPA's effort to make the MSGP smaller and easier to understand. Several comments did express concern that the reorganization and clarification of the permit may have resulted in some substantial changes in permit requirements that may not have been identified and explained in the preamble to the proposed permit. The issue of whether or not explanation and guidance contained in the 1995 MSGP preamble could still be relied upon was also raised.

Response a: EPA went to great lengths to make the permit shorter and easier to understand and believes all substantive changes were identified and discussed in the preamble to the proposed permit. Responses to specific comments on areas where a commenter felt that adequate explanation for changes was not included in the proposal are provided in responses to that comment. With regard to the more specific explanation of sector-specific activities, etc. in the preamble to the 1995 MSGP, this information was incorporated by reference into the proposal of today's permit and may still be relied upon to the extent it does not conflict with the MSGP–2000 documents or is superceded by later guidance. Commenters noted several instances where EPA unintentionally changed requirements through the reformatting. EPA has corrected the permit and identified these instances throughout the comment response document.

Comment b: Based on EPA's use of incorporation by reference in the proposed permit's preamble to avoid reprinting material from the 1995 MSGP's preamble, one commenter expressed concern that the requirement in Part 4.7 to have a copy of the final permit with the Storm Water Pollution Prevention Plan would be difficult if the entire permit was not in a single package. This commenter also was concerned that references to multiple Internet sites for more information would further compound this problem. The commenter further suggested that a copy of the permit and relevant guidance be included with the NOI "confirmation" letter sent by EPA in response to a complete NOI. Another commenter supported making all relevant information available in a single document.

Response b: The entire permit, appropriate addendums, the preamble "fact sheet," and comment response summary are being published today in the **Federal Register** and will, therefore, be easily available from several Internet sites and from Federal Depository Libraries. The information not repeated in the proposed permit notice was primarily background and fact sheet information from the preamble to the 1995 MSGP. While the preamble and response to comments sections of the final permit notice will undoubtedly be valuable to many permittees, the Part 4.7 requirement to have a copy of the permit language with the Storm Water Pollution Prevention Plan refers only to the permit language itself, including addendums. Based on experience with the previous permit, EPA believes the benefits of keeping the size and complexity of the permit to manageable (*i.e.*, less intimidating, easier to use) level far outweigh the benefit of making all supporting and guidance information, much of which will apply to only a small portion of potential permittees, available in a single document. EPA does expect that for convenience, many permittees will simply attach a copy of the entire **Federal Register** notice of the final permit to comply with Part 4.7.

EPA believes the references throughout the permit and preamble to various Internet sites is a sensible alternative to publishing information, only a small part of which may apply to any one facility or which will be changing over time and quickly become outdated. For example, due to periodic updates that must be made to the endangered species list based on new species being listed or old ones delisted, the county-species list was not published with the final permit. This omission saves tax dollars on publication, keeps the size of the permit package down (the current list would double the size of the permit while any one facility only needs to look at a page or so of information), and avoids the inadvertent use of an outdated species list that could result not only in failure to consider potential adverse effects on an endangered species, but also negate a discharger's permit coverage. EPA relies heavily on electronic distribution of documents and guidance, but will be able to provide hard copy or telephone-based information to those who have no access to the Internet or Federal Depository Libraries.

As noted above, the complete permit has been printed and EPA intends to make guidance available, primarily through the Internet. The suggestion to include a copy of the permit and guidance with the NOI "confirmation" letter is impractical since most of this information would have been necessary to develop the Storm Water Pollution Prevention Plan that must be developed before the NOI can be submitted.

Section III Geographic Coverage of Proposed MSGP

Comment: Several commenters and attendees of meetings on the proposed permit identified an inconsistency between Part 6.J.3 of the permit, where mine dewatering discharges from construction sand and gravel, industrial sand, and crushed stone mines were apparently eligible only in Arizona and both the previous permit and the preamble to the proposed MSGP–2000 where such discharges were also eligible in all of the permits for Region 1, 2, 6, and 10. One commenter referred to pages 17025 and 17034 of the preamble to the proposed permit in support of their belief that the proposed permit had been intended to provide coverage in Regions 1, 2, 6, and 10 and in Arizona.

Response: The typographical error in Part 6.J.3 has been corrected. As supported by item 4 on page 17025 and item 2 on page 17034 of the **Federal Register** notice of the proposed permit (65 FR 17025 and 17034), coverage for mine dewatering discharges from construction sand and gravel, industrial sand, and crushed stone mines in not only Arizona, but also Regions 1, 2, 6, and 10 was intended.

Section V.A Historic Preservation

Comment a: It would be more in keeping with balancing the agency's CWA mandate and NHPA obligation to not preclude general permit coverage for those discharges that may affect historic properties. Instead, require the general permittee to notify the agency of the existence of a listed historic property that will be affected along with any preventive or mitigation measures, if necessary, that it plans to implement. EPA could then decide if any further consideration or action is warranted, including any comment by the Council. The obligations established under § 106 are placed upon the agency, not on the permittee.

Response a: EPA agrees and acknowledges that NHPA Section 106 imposes obligations only on federal agencies and not on third parties. EPA's action in issuing permits, however, triggers NHPA Section 106. In order to issue a general permit, EPA included historic preservation-related application and eligibility provisions in order to ensure that it could "filter" out permitting activities that might otherwise trigger advanced procedures under NHPA Section 106. Section 110(k) of the Act prohibits a Federal agency from granting a loan, loan guarantee, permit, license or other assistance to an applicant who intends to avoid requirements of section 106 (64 FR 95 May 18, 1999). To meet this responsibility, EPA requires the applicant to do one of the following: (1) Determine that historic properties are not in the path of permit activities, (2) determine that permit activities have no impact on historic properties, or (3) the permittee reaches agreement with appropriate authorities on measures to mitigate or prevent adverse effects. Thus, it is quite possible for facilities having an impact on historic properties to be covered by the MSGP. Authorization to discharge under the MSGP is a privilege, not a right, which carries with it certain procedural and timing advantages for the permittee. Therefore, it is incumbent upon the permittee, not EPA, to conduct whatever investigations and consultations are necessary consistent with EPA's obligation to satisfy NHPA provisions.

Comment b: The notice states that the provisions in Part 1.2.3.7, are "likely to change as a result of consultations" under the NHPA. The procedures set forth in Addendum B are described as being "models" of what the NHPA guidance "may look like." These provisions are critical for permittees to determine their eligibility for coverage under MSGP–2000, and any substantive changes in these areas should be subject to review and comment by the regulated community before they are adopted.

Response b: There are no changes to these provisions as a result of NHPA consultations.

Comment c: Part 2.1.2.2, which deals with discharges that are authorized under the 1995 MSGP, but not clearly eligible for coverage under this permit, does not allow adequate transition time for those permittees who do not have up-to-date determinations pursuant to the NHPA.

Response c: Within 90 days the permittee must apply for MSGP coverage and certify his compliance with other permit provisions. He then has up to 180 additional days of interim coverage under the MSGP while he conducts the consultation and determines whether he meets the criteria for coverage under the MSGP. EPA believes that 270 days is a sufficient period to conduct and conclude this consultation and take whatever action is necessary to ensure continued permit coverage.

Comment d: EPA states that, "For existing dischargers * * * a simple visual inspection may be sufficient * * * " (emphasis added). This statement is somewhat disingenuous because a "simple visual inspection" is rarely sufficient to determine historic eligibility of an area because many historic resources are often located underground. EPA should provide reasonable guidance worded specifically to shield permittees from liability.

Response d: EPA believes that, for existing dischargers who do not need to construct BMPs for permit coverage, a simple visual inspection may be sufficient to determine whether historic properties are affected. However, for facilities which are new industrial storm water dischargers and for existing facilities which are planning to construct BMPs for permit eligibility, applicants should conduct further inquiry to determine whether historic properties may be affected by the storm water discharge or BMPs to control the discharge. In such instances, applicants should first determine whether there are any historic properties or places listed on the National Register or if any are eligible for listing on the register (*e.g.*, they are "eligible for listing"). Thus, the Agency does not imply that a visual inspection is always sufficient. In instances of uncertainty, the permittee is encouraged to consult with authorities who can advise on the likelihood of historic properties above or below ground.

Given the Agency's obligation to comply with the NHPA and its efforts to coordinate that obligation with the implementation of general permits, the historic preservation-related eligibility restrictions cannot provide an ironclad shield from liability. The permit guidance provides a common sense approach to an historic property assessment. Facility operators are encouraged to consult with local authorities who can advise on the likelihood of historic properties at the facility.

Comment e: Portions of the text are reproduced and other portions not reproduced in columns 1 and 2 of page 17018 of the notice. See 65 F.R. at 17018. Due to this problem, the commenter is unable to provide any comments on EPA's proposed new changes to the MSGP since he is uncertain what EPA intends or proposes. The commenter suggests that EPA fix the language related to the proposed MSGP and re-issue that correction for public review and comment.

Response e: EPA apologizes for the typing error which resulted in a number of sentences being listed twice on p. 1018. Despite this confusion, EPA believes the intent of the section is clear and does not require reproposal.

Section V.B Endangered Species

Comment a: The term "unacceptable effects" is used almost interchangeably with "likely to adversely affect" (See 65 Fed. Reg. 17051), which is similarly undefined in the permit and in pertinent regulation. The correct term for purposes of ESA compliance is the "no jeopardy" standard set forth in Section 7 of the ESA (17 U.S.C § 1536(a)(2)).

Response a: EPA agrees with the commenter regarding the term "avoid unacceptable effects." Therefore, EPA has deleted the term and uses the "no jeopardy" language as stated in part 1.2.3.6.6.

Comment b: The definition of "discharge-related activities" is so all-encompassing that it could include virtually all activities at a mine, from drilling and blasting to loading, hauling and dumping and equipment maintenance, in addition to any activities that are part of a Storm Water Pollution Prevention Plan (SWPPP). There is no justification for a requirement to certify ESA compliance for all of these activities in order to obtain coverage under the MSGP. This requirement clearly exceeds EPA's authority under the Clean Water Act.

Response b: The endangered species provision covers only those activities that are associated with storm water industrial activity. The phrase "discharge-related activities" is intended to clarify that EPA considers a broad range of activities related to storm water discharges to be covered by the permit and, therefore, subject to ESA and NHPA provisions. This broader list of activities could result in environmental impairment if not addressed through a SWPPP. Since the permit covers this broad range, and EPA's permit authority is subject to ESA provisions, then this broader range of activities is subject to the "no jeopardy" finding. BMPs, whether already in place or added, which serve to satisfy the criteria for coverage under the MSGP, are thus subject to the endangered species provisions.

Comment c: While transitional discharge authorization is available for up to 270 days from the date of publication of the permit in the **Federal Register**, that transitional coverage is only available if the permittee submits an application for an alternative permit (most likely an individual permit) within 90 days after publication. Since formal Section 7 consultation is nominally a 135-day process (as stated in the Construction General Permit, see 63 Fed. Reg. 7872), permittees, in order to ensure continuous coverage, would be required to prepare and submit an application for an individual permit before they knew whether they were eligible for coverage under MSGP–2000. This is an unnecessary burden, on both the permittee and the agency. EPA should extend these time limits—for submission of an application for an alternative permit to 180 days, and for transitional coverage to one year.

Response c: EPA will retain the requirement that all applicants must submit their Notice of Intent (NOI) in 90 days. Those applicants who are entering into endangered species consultations or adverse impact investigations could apply for extensions up to 180 days and be covered by an interim permit until their application is completed. EPA believes that 270 days is a sufficient period to conduct and conclude this consultation and take whatever action is necessary to ensure continued permit coverage. The County Species list is available on EPA's web site or by contacting a local official. EPA will update its web site list every 90 days.

Comment d: EPA indicates that the proposed species-related requirements could change, before final issuance, based on consultation with the Fish and Wildlife Service. The public will not have an opportunity to participate in that process, including through commenting on any additional requirements suggested by the Service. If the Service does suggest any substantial changes in MSGP–2000, the public should have an opportunity to review and comment on those changes before EPA makes a decision as to whether to incorporate them into the final permit.

Response d: There are no changes to these provisions as a result of NHPA and ESA consultations, except that, based on comments to the proposed permit, EPA has deleted the inclusion of proposed species on the endangered species list.

Comment e: The duty triggered by the section of the Endangered Species Act (ESA) upon which EPA relies falls not upon the discharger but upon EPA. Thus under EPA's proposal, it would be EPA's duty to assess the impact of each discharger applying for coverage, and if this provision is not removed, EPA loses the benefit of the general permit. The action of adopting the general permit itself triggers EPA's duty, and so EPA, not the discharger, must assess ESA impacts now, not after the fact of the permit.

Response e: EPA is bound by the ESA and attempted to coordinate general permit implementation with its ESA obligations. Authorization to discharge under the MSGP is a privilege which carries with it certain procedural and timing advantages for the permittee. Therefore, it is incumbent upon the permittee, not EPA, to conduct whatever investigations and consultations are necessary to satisfy the ESA-related eligibility provisions. Since EPA cannot predetermine which facilities will apply for coverage under the MSGP, it is impossible for EPA to conduct the site-specific assessments required under the ESA at the time of general permit issuance.

Comment f: Despite previous consultation on the problems of earlier MSGP drafts, certain problems persist, including the gray area language that has fueled citizen suits against permittees. Not only has the agency failed to adequately address this issue, it has increased the liability potential by increasing the requirements for permittees to comply with other agency rules. EPA should clarify language to eliminate the potential for liability for permittees and should reduce the cost and paperwork burdens for compliance with ESA and NHPA.

Response f: Given the operation of the regulatory innovation, the "general permit," EPA cannot provide an ironclad shield from liability in the way the commenter proposes. The permit guidance provides a common sense approach to endangered species and historic property assessments. Facility operators are encouraged to consult with local authorities who can advise on the likelihood of endangered or threatened species, critical habitat, or historic properties at the facility. EPA believes the additional burden associated with the expanded NOI form is minimal because permittees are required to make the findings which are reflected on the form. The additional information provides greater assurance that the assessment has been conducted, but does not in itself constitute the requirement for the assessment. EPA acknowledges that, until such time as the revised form has been cleared by OMB, permittees will continue to use the current NOI form (as modified slightly to conform to changes made elsewhere to the permit).

Comment g: The endangered species section of the permit relating to endangered species is cumbersome and appears to go beyond the intent of the Clean Water Act and beyond the EPA's authority set in the CWA.

Response g: EPA acknowledges the comment, but disagrees. EPA believes these provisions are essential to carry out its responsibility not to issue a permit which could jeopardize an endangered or threatened species, or critical habitat. EPA has consulted with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to ensure compliance with the Endangered Species Act. The "discharge-related activities" restriction on eligibility also implements the Agency's obligations under NHPA Section 106.

Comment h: The permit should clarify that coverage of the MSGP, and certification by the permittee, need address only new impacts resulting from new changes in operations for which discharges are covered and authorized by the MSGP. In other words, the "baseline" for assessment of effects or impacts should be the date of reissuance of the MSGP or, if later, initiation of new activities to be covered by the MSGP.

Response h: All activities covered by the permit, whether new or existing, are subject to the provisions. It is inappropriate to interpret that these provisions apply only to new activities.

Comment i: The endangered species section suggests that a potential permittee utilize "due diligence" in determining whether or not a potential impact to an endangered or threatened species may exist. This language is too vague and subjective—differing interpretations what constitutes due diligence exist. This is particularly true when dealing with an issue as complex as impact to endangered species or their habitats, where the expertise necessary to make this determination is usually beyond the reach of most industrial operators. It is likely that this could become the focal point of efforts to block permit issuance by those with differing agendas. Further clarification of what is required under "due diligence" is required.

Response i: EPA believes that the language must provide flexibility to reflect the case-by-case decisions which must be made. In response to the commenter's concern, EPA has replaced the "due diligence" phrase with "best judgment." Consultations with local endangered species officials is advised if the permittee is uncertain how to apply these provisions to his facility.

Comment j: Only those species that have been listed should be identified on this list and used in the determination of permit coverage; not those that have not gone through the entire listing process.

Response j: EPA acknowledges the comment and has revised the language to exclude proposed listing requirements.

Comment k: In this section, an applicant is expected to determine whether endangered species are "in proximity" to the stormwater discharges or discharge-related activities at the facility. In proximity is described as being "in the path or down gradient" or in the "immediate vicinity of or nearby," the facility. These definitions are far too vague, and could refer to the presence of species located a considerable distance from a facility, not merely those located close enough to a facility to be affected by that facility's stormwater discharge. This section requires clanfication.

Response k: EPA has retained this language from the 1995 MSGP. EPA believes that the language must provide flexibility to reflect the case-by-case decisions which must be made. Consultations with local endangered species officials is advised if the permittee is uncertain how to apply these provisions to his facility.

Comment l: This section provides that "where there are concerns that coverage for a particular discharger is not sufficiently protective of listed species (and presumably those proposed for listing as well) the Services (as well as any other interested parties) may petition EPA to require that the discharger obtain an individual NPDES permit and conduct an individual section 7 consultation as appropriate." It is clear that this will provide ample opportunity to those who would seek to delay or deny permit issuance, even in those circumstances where an actual impact to species or habitat does not exist. This procedure should be a formal one in which the permit remains in force until EPA, after careful and rigorous scientific evaluation of the potential impact, determines whether or not an impact exists and, if so, whether or not an alternative permit is warranted.

Response l: Opportunity for public input is an essential component of any government regulatory program. As the commenter suggests, the permit would remain in effect until such time as EPA concludes that the activity is no longer eligible for coverage under the permit.

Section V.C 303(d)

Comment a: Several commenters challenged Parts 1.2.3.8. of the permit because they believe it inaccurately applies 40 CFR 122.4(i) regarding compliance with water quality standards to discharges covered by a general permit. Several commenters believe that one doesn't have to consider 40 CFR 122.4(i) if they only add an outfall and similarly one commenter believes that new dischargers under Phase 2 do not have to consider 40 CFR 122.4(i). Commenters stated that any provisions added to the reissued MSGP regarding impaired waters or TMDLs are premature until the new TMDL rule is final. It seems that the major concern is that previously unpermitted discharges would be disallowed coverage under this Part.

Response a: EPA, in Sections 1.2.3.8.1 and 1.2.3.8.2, was merely conditioning a discharger's eligibility for coverage under the MSGP upon meeting certain existing conditions and requirements in EPA's NPDES regulations which apply in all applicable circumstances involving both individual and general permits. In doing so, EPA intended to merely restate those existing conditions and requirements as eligibility requirements under the MSGP. Specifically, EPA's intention in section 1.2.3.8.1 was to condition a new discharger's eligibility for coverage under the MSGP upon meeting the existing regulatory conditions under 40 CFR 122.4(i). A new discharger, therefore would not be eligible for coverage under the MSGP if its discharge would "cause or contribute to a violation of a water quality standard." As mentioned, this regulation is applicable to all new dischargers irrespective of the type of permit they are seeking coverage under; there is no language in this regulation that exempts new dischargers seeking coverage under a general permit. EPA, in section 1.2.3.8.1 of the MSGP, did not intend to create any confusion or change any existing interpretation of the current regulatory language referred to in that section. To avoid confusion EPA is therefore amending the language in section 1.2.3.8.1 to state that "you are not authorized to discharge if your discharge is prohibited under 40 CFR 122.4(i)."

EPA's intention in section 1.2.3.8.2 was to condition a discharger's eligibility for coverage under the MSGP upon meeting the existing regulatory requirements under existing 40 CFR 122.44(d)(1)(vii)(B). This section of EPA's regulations requires permitting authorities to develop effluent limits in permits that are "consistent with the assumptions and requirements of any available wasteload allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7" (EPA's existing TMDL regulations). This requirement applies to all NPDES permits both individual and general permits.

Comment b: One commenter expressed confusion about what is meant by "new discharges" as this term is not defined in 40 CFR 122.2.

Response b: The final permit will omit the term "new discharge" since it is not necessary for the requirement and it has caused confusion. Today's permit will change the term "new discharge" to simply "discharge" in the first sentence of Part 1.2.3.8.1.

Comment c: Eligibility restrictions of the permit should be limited to those discharges of pollutants actually listed in a TMDL.

Response c: Section 1.2.3.8.2 of the MSGP contains the eligibility requirement that discharges be consistent with an EPA established or approved TMDL. EPA agrees with the commenter's suggestion that Section 1.2.3.8.2 should clearly state that such requirement is only applicable to facilities discharging the pollutant for which the TMDL is established. EPA is therefore, adding this language to Section 1.2.3.8.2.

Comment d: Discharges to 303(d) listed or 303(e) listed waters should be monitored for contaminants that impair or threaten water quality; however, monitoring requirements should be relaxed for other contaminants that do not impair or threaten receiving water quality. Several commenters wanted either exclusive or additional monitoring of discharges to impaired waters for pollutants of concern in lieu of the eligibility requirements based on whether or not a facility causes or contributes to the impairment.

Response d: EPA acknowledges that the MSGP may not contain monitoring requirements for a pollutant for which a waterbody is listed as impaired. This does not eliminate the burden of the discharger in determining that its effluent does not cause or contribute to a violation of water quality standards. Section 1.2.3.8.1 in the MSGP is an eligibility provision which restates existing regulatory requirements, it does not create new restrictions on any dischargers. If a discharger cannot meet the eligibility requirements, then that discharger is not authorized to discharge under the MSGP. Under existing regulations, EPA has the discretion to establish whatever eligibility requirements that it believes are appropriate. Section 1.2.3.8.1 is an eligibility provision that does no more than restate existing regulatory requirements as a condition of being authorized to discharge under the permit. It does not dictate, establish or restrict the use of any particular framework, effluent limits or permit conditions within the permit itself or describe or restate any new interpretation of the underlying regulations which it refers to.

Comment e: Several commenters were not clear how to determine or implement loadings imposed by TMDLs. Further they requested that loadings based on the TMDL be excluded from the MSGP and addressed separately so that the regulated community could have an opportunity to comment on them. One commenter stated that the eligibility requirement of Part 1.2.3.8. is not appropriate because there was no opportunity to comment on the TMDL.

Response e: It is not necessary that all dischargers receive individual wasteload allocations. EPA's regulations at 40 CFR 130.2 define a wasteload allocation as the portion of the receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. EPA has interpreted this regulation to mean that each point source must be given an individual wasteload allocation when it is feasible to calculate such a wasteload allocation. EPA believes that states may find it infeasible to calculate individual wasteload allocations for all point sources covered by a specific general permit. In that case, the TMDL would establish individual wasteload allocations for dischargers subject to individual permits whereas dischargers subject to a general permit would be accounted for in the aggregate under a single wasteload allocation specific to the general permit under which they are authorized to discharge.

In addition, wasteload allocations can be expressed in different ways, including, percent loading reductions. See 40 CFR 130.2(i) "* * * TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures. * * *" Effluent limitations must be consistent with (but not identical to) the wasteload allocations in TMDLs. See 40 CFR 122.44(d)(1)(vii)(B). Effluent limitations for point source discharges of storm water may be narrative limitations that are expressed in terms of best management practices (BMPs). This policy is consistent with EPA's approach in its Interim Permitting

Approach For Water Quality-Based Effluent Limitations in Storm Water Permits (September 1996, EPA 833–D–96–001). This interim approach allows limits to be expressed in the form of BMPs as a means of satisfying the requirement that limits derive from and comply with water quality standards and are consistent with an EPA approved or established TMDL.

All dischargers who discharge the pollutant for which the waterbody is impaired must be accounted for in the TMDL. Every point source discharger located on the impaired waterbody and discharging the pollutant for which the waterbody is impaired must be accounted for under a wasteload allocation. The State may choose, however, to give a discharger a wasteload allocation that would not require any reduction in loading. In other words, all facilities discharging the pollutant for which the waterbody is impaired must be subject to a wasteload allocation but all facilities subject to a wasteload allocation may not be required to reduce their loads.

Comment f: Several commenters requested guidance on how to adequately evaluate a discharge's eligibility under Part 1.2.3.8 and 1.2.3.9 of the permit.

Response f: EPA intends the analysis to be similar to what a permittee under the previous MSGP had to do in accordance with Part I.B.3.f. of that permit. The applicant must avail himself of all discharge characterization data or estimation of discharge character and determine compliance. If the permittee is able to evaluate eligibility on his own because he has access to State Water Quality Standards, 303(d) lists, TMDLs etc. (all of which are available either from the permit issuing authority or in some cases, online) then he can make his determination, document the determination process in his pollution prevention plan, and sign the NOI. In other cases, the Director may notify him that he is not eligible for coverage if such a determination is made independently, and may require an application for an individual permit.

Comment g: One commenter requested confirmation that Part 1.2.3.8.1 applies to facilities constructed after August 13, 1979 that have not yet been issued an NPDES permit.

Response g: Part 1.2.3.8.1 applies to discharges, not facilities, that have begun after August 13, 1979 that have not yet been authorized by an NPDES permit.

Section V.D—Antidegradation

Comment a: The proposed requirements do not accurately reflect States' anti-degradation policy. Commenters stated that anti-degradation does not hold a permittee accountable until a State's policy is interpreted into a permit. The State's review of the general permit under the CWA 401 is the extent of applicable anti-degradation review. Therefore, delete Part 1.2.3.9. since an individual discharger applying for general permit coverage cannot determine how the State's anti-degradation policy, especially regarding the Tier 2 "high quality water" provisions, will be implemented at a particular facility.

Response a: EPA, in Sections 1.2.3.8.1 and 1.2.3.8.2, was merely conditioning a discharger's eligibility for coverage under the MSGP upon meeting certain existing conditions and requirements in EPA's NPDES regulations which apply in all applicable circumstances involving both individual and general permits. In doing so, EPA intended to merely restate those existing conditions and requirements as eligibility requirements under the MSGP. Specifically, EPA's intention in section 1.2.3.8.1 was to condition a new discharger's eligibility for coverage under the MSGP upon meeting the existing regulatory conditions under 40 CFR 122.4(i). A new discharger, therefore would not be eligible for coverage under the MSGP if its discharge would "cause or contribute to a violation of a water quality standard." As mentioned, this regulation is applicable to all new dischargers irrespective of the type of permit they are seeking coverage under; there is no language in this regulation that exempts new dischargers seeking coverage under a general permit. EPA, in section 1.2.3.8.1 of the MSGP, did not intend to create any confusion or change any existing interpretation of the current regulatory language referred to in that section. To avoid confusion EPA is therefore amending the language in section 1.2.3.8.1 to state that "you are not authorized to discharge if your discharge is prohibited under 40 CFR 122.4(i)."

EPA acknowledges that the MSGP may not contain monitoring requirements for a pollutant for which a waterbody is listed as impaired. This does not eliminate the burden of the discharger in determining that its effluent does not cause or contribute to a violation of water quality standards. Section 1.2.3.8.1 in the MSGP is an eligibility provision which restates existing regulatory requirements, it does not create new restrictions on any dischargers. If a discharger cannot meet the eligibility requirements, then that discharger is not authorized to discharge under the MSGP. Under existing regulations, EPA has the discretion to establish whatever eligibility requirements that it believes are appropriate. Again, section 1.2.3.8.1 is an eligibility provision that does no more than restate existing regulatory requirements as a condition of being authorized to discharge under the permit. It does not dictate, establish or restrict the use of any particular framework, effluent limits or permit conditions within the permit itself or describe or restate any new interpretation of the underlying regulations which it refers to.

EPA's intention in section 1.2.3.8.2 was to condition a discharger's eligibility for coverage under the MSGP upon meeting the existing regulatory requirements under existing 40 CFR 122.44(d)(1)(vii)(B). This section of EPA's regulations requires permitting authorities to develop effluent limits in permits that are "consistent with the assumptions and requirements of any available wasteload allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7" (EPA's existing TMDL regulations). This requirement applies to all NPDES permits both individual and general permits.

Wasteload allocations can be expressed in different ways, including, percent loading reductions. See 40 CFR 130.2(i) "* * *TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measures * * *." Effluent limitations must be consistent with (but not identical to) the wasteload allocations in TMDLs. See 40 CFR 122.44(d)(1)(vii)(B). Effluent limitations for point source discharges of storm water may be narrative limitations that are expressed in terms of best management practices (BMPs). This policy is consistent with EPA's approach in its Interim Permitting Approach For Water Quality-Based Effluent Limitations in Storm Water Permits (September 1996, EPA 833–D–96–001). This interim approach allows limits to be expressed in the form of BMPs as a means of satisfying the requirement that limits derive from and comply with water quality standards and are consistent with an EPA approved or established TMDL.

The commenter correctly recognizes the difficulty in determining what defines "necessary to accommodate important economic or social development" in accordance with 40 CFR Section 131.12(a)(2). By statute, this determination involves public participation, the assurance that water quality will be protected, and several other factors. EPA would have to modify the permit for each discharge in question in order to comply with 40 CFR Section 131.12(a)(2). Individual considerations such as these are contrary to the concept of a general permit. In addition, public participation would be impossible since the permit issuing authority would not know about the particular discharge to tier 2 waters before a NOI was submitted. Therefore, a facility operator must seek coverage under an individual permit to discharge to tier 2 waters under 40 CFR Section 131.12(a)(2)'s allowable degradation provisions to satisfy the requirements for public participation and protection of water quality. The only discharges allowed coverage under today's permit are those which do not degrade the use of a tier 2 water below its existing levels, even though those existing levels exceed levels necessary to support propagation of fish, shellfish and wildlife and recreation in and on the water.

Comment b: While the eligibility requirements disallow the discharge to cause and contribute to the impaired water, the permit doesn't require monitoring for the pollutant of concern. This presents the potential for the permit issuing authority to determine that a discharge causes or contributes at a later date than the submittal of the NOI, effectively creating a violation of the permit without the permittee being able to know of it or prevent it.

Response b: There will be situations where an NOI is accepted by the permit issuing authority and coverage provided to a facility that did not meet the eligibility requirements. Other situations include changes, such as the approval of a TMDL, which may cause a discharge to no longer be eligible. Upon learning of these types of situations, the Director may either require the permittee to submit an application for an individual NPDES permit, take an enforcement action, allow the facility to eliminate the concern, or any combination of these actions.

Comment c: The eligibility requirements require the permittees to predict the final requirements of the TMDL rule and the final loadings of TMDLs approved in the future. Part 1.2.3.8.1 shouldn't be included in the permit because it inaccurately applies 122.4(i) to general permittees.

Response c: EPA, in Sections 1.2.3.8.1 and 1.2.3.8.2, was merely conditioning a discharger's eligibility for coverage under the MSGP upon meeting certain existing conditions and requirements in EPA's NPDES regulations which apply in all applicable circumstances involving both individual and general permits. In doing so, EPA intended to merely restate those existing conditions and requirements as eligibility requirements under the MSGP. Specifically, EPA's intention in section 1.2.3.8.1 was to condition a new discharger's eligibility for coverage under the MSGP upon meeting the existing regulatory conditions under 40 CFR 122.4(i). A new discharger, therefore would not be eligible for coverage under the MSGP if its discharge would "cause or contribute to a violation of a water quality standard." As mentioned, this regulation is applicable to all new dischargers irrespective of the type of permit they are seeking coverage under; there is no language in this regulation that exempts new dischargers seeking coverage under a general permit. EPA, in section 1.2.3.8.1 of the MSGP, did not intend to create any confusion or change any existing interpretation of the current regulatory language referred to in that section. To avoid confusion EPA is therefore amending the language in section 1.2.3.8.1 to state that "you are not authorized to discharge if your discharge is prohibited under 40 CFR 122.4(i)."

EPA's intention in section 1.2.3.8.2 was to condition a discharger's eligibility for coverage under the MSGP upon meeting the existing regulatory requirements under existing 40 CFR 122.44(d)(1)(vii)(B). This section of EPA's regulations requires permitting authorities to develop effluent limits in permits that are "consistent with the assumptions and requirements of any available wasteload allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7" (EPA's existing TMDL regulations). This requirement applies to all NPDES permits both individual and general permits.

Comment d: The final permit needs to be clear that the requirements of Part 1.2.3.8.2 only apply to the pollutant of concern in the TMDL actually being discharged by the facility. This idea is in Part 1.2.3.8.1. and should be included in 1.2.3.8.2 as well. Similarly, EPA should lift the new source and new discharger restrictions if there is not a storm water component of the approved TMDL. The final permit should clarify that a facility may not have a specific allocation in an approved TMDL and as such may still be eligible for the general permit.

Response d: Section 1.2.3.8.2 of the MSGP contains the eligibility requirement that discharges be consistent with an EPA established or approved TMDL. EPA agrees with the commenter's suggestion that Section 1.2.3.8.2 should clearly state that such requirement is only applicable to facilities discharging the pollutant for which the TMDL is established. EPA is therefore, adding this language to Section 1.2.3.8.2.

Comment e: The eligibility requirements in Part 1.2.3.9 defeat the concept of efficiency of a general permit and should be removed. EPA does not have the authority to require the applicant to assess if they support the use classification of the receiving water because it increases the cost of applying for general permit coverage which has not been evaluated by EPA under the Unfunded Mandates Reform Act. Furthermore, the duty to determine whether or not a discharge supports the use classification of a receiving water is the permit issuing authority's responsibility.

Response e: The concept of the general permit is to reduce the administrative burden on EPA and the regulated community by issuing one permit for many facilities that would otherwise all have exactly the same conditions in their individual permits. If a facility is not like other ones where it would have different permit conditions it should not apply for the general permit in question. This general permit only applies to facilities that support the use classification of the receiving waters. If they do not, EPA is not obligated to change the general permit to include them. The applicant must seek alternate permit coverage. It is the permit issuing authority's responsibility to ensure that the conditions of the general permit support use classifications. It is not their responsibility to ensure that each individual discharge authorized by the permit supports the use. The eligibility requirements are there to indicate the type of facility that can be covered under the permit. The efficiency intended by a general permit is to reduce the number of individual permits and to make application for NPDES permit easier for those who qualify for the coverage under the general permit.

Comment f: The final permit needs to be clear that a facility may not have a specific allocation in an approved TMDL and as such may still be eligible for the general permit.

Response f: EPA agrees in part with the commenter that there may be circumstances under which it is not necessary that all dischargers receive individual wasteload allocations. EPA's regulations at 40 CFR 130.2 define a wasteload allocation as the portion of the receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. EPA has interpreted this regulation to mean that each point source must be given an individual wasteload allocation when it is feasible to calculate such a wasteload allocation. EPA believes that states may find it infeasible to calculate individual wasteload allocations for all point sources covered by a specific general permit. In that case, the TMDL would establish individual wasteload allocations for dischargers subject to individual permits, whereas dischargers subject to a general permits would be accounted for in the aggregate under a single wasteload allocation specific to the general permit under which they are authorized to discharge.

Comment g: Lift the new source/new discharger restriction if there is not a storm water component of the approved TMDL.

Response g: EPA, in Sections 1.2.3.8.1 and 1.2.3.8.2, was merely conditioning a discharger's eligibility for coverage under the MSGP upon meeting certain existing conditions and requirements in EPA's NPDES regulations which apply in all applicable circumstances involving both individual and general permits. In doing so, EPA intended to merely restate those existing conditions and requirements as eligibility requirements under the MSGP. Specifically, EPA's intention in section 1.2.3.8.1 was to condition a new discharger's eligibility for coverage under the MSGP upon meeting the existing regulatory conditions under 40 CFR 122.4(i). A new discharger, therefore would not be eligible for coverage under the MSGP if its discharge would "cause or contribute to a violation of a water quality standard." As mentioned, this regulation is applicable to all new dischargers irrespective of the type of permit they are seeking coverage under; there is no language in this regulation that exempts new dischargers seeking coverage under a general permit. EPA, in section 1.2.3.8.1 of the MSGP, did not intend to create any confusion or change any existing interpretation of the current regulatory language referred to in that section. To avoid confusion EPA is therefore amending the language in section 1.2.3.8.1 to state that "you are not authorized to discharge if your discharge is prohibited under 40 CFR 122.4(i)."

Section V.E Discharges Not Previously Covered by an Individual Permit

Comment: One commenter requested clarification of the permit requirement at Part 1.2.3.3.2.3 to include any specific storm water BMPs from the old individual permit in the Storm Water Pollution Prevention Plan when transferring from an individual permit to the MSGP. The commenter interpreted this condition to mean that only those specific storm water BMPs from the old individual permit (and areas associated with outfalls from the old permit) needed to be included in the Plan, and noted an apparent inconsistency on page 17021, Item F, of the preamble which states that the Plan must address the entire facility.

Response: When transferring from an individual permit to the MSGP, the requirement at Part 1.2.3.3.2.3 to include any specific storm water BMPs from the old individual permit in the Storm Water Pollution Prevention Plan is in addition to and not in lieu of the basic requirements in Part 4. However, the BMPs brought over from the old individual permit may satisfy one or more of the "basic" Storm Water Pollution Prevention Plan requirements under Part 4 and/or the sector-specific requirements under Part 6. There could be areas at a facility (*e.g.*, employee parking lots) that do not need to be addressed under the permit (and SWPPP) unless the runoff from such areas commingles with storm water associated with industrial activity (or was previously permitted).

Section VI.A Notification Requirements

Comment a: The commenter supported the use of electronic filing of NOIs, but expressed concern that facilities without Internet access would be at a disadvantage.

Response a: It is not the intention of EPA to only accept electronic submittals. Electronic submittal is another alternative which, hopefully, will be available to the regulated community in the near future.

Comment b: The commenter does not support any changes to the NOI form, and expects any changes to comply with the Paperwork Reduction Act.

Response b: Any changes to the NOI form that result in an increase in burden for the applicant must first be reviewed and approved by the Office of Management and Budget. Part of this review includes compliance with the requirements of the Paperwork Reduction Act. Changes to the NOI form published in today's permit were limited to those that provide clarification in information, as well as those changes that reflect changes in the storm water permits issued by EPA. EPA has determined that these changes do not represent an increase in burden for completing the NOI form. As noted in Section 2.2, the more extensive changes listed in the March 30, 2000 proposal need to complete their OMB review before they can be included in the NOI form.

Comment c: A commenter supported inclusion of the no exposure certification form as an addendum to the MSGP–2000.

Response c: EPA agrees that providing the form with the permit is a convenience for facilities qualifying for the no exposure exemption. The certification form is an addendum to the permit.

Section VI.B Special Conditions

Comment a: The Agency is shifting its responsibility regarding meeting minimum technology standards in NPDES permits to the discharger.

Response a: EPA expects that when a facility submits an NOI they are familiar with both the permit and their facility. They should be able to determine their eligibility. The permitting authority may concur with the facility's assessment, or not. EPA does not believe that it has shifted its responsibility on this matter.

Comment b: There was a request to clarify the requirements in the MSGP–2000 regarding co-located facilities.

Response b: A facility is considered co-located if there is a second industrial activity occurring which meets the definition of storm water discharge associated with industrial activity. For example, a facility operates an auto salvage yard and also has an area onsite for scrap recycling. The facility as a whole would meet the requirements for Sector M—Auto salvage. The area where scrap recycling occurs would meet the requirements for Sector N—Scrap Recycling. Any storm water discharges from the scrap recycling area needs to meet the requirements for both sectors. The second activity may or may not be related to the primary industrial activity. The determination as to whether something is co-located rests in the definition of storm water discharges associated with industrial activity. If a second activity exists at a facility which meets one of the categories in the definition, then the facility has co-located industrial activities.

Section VI.C Common Pollution Prevention Plan Requirements

Comment a: A commenter expressed concern about various interpretations and implementation of the storm water program, including incorporation of effluent limits, and stressed "* * * It is imperative that the Agency maintains that SWPPP requirements be interpreted and implemented in a practicable and economically feasible manner."

Response a: EPA believes that proper implementation of storm water BMPS will achieve compliance with water quality standards. EPA is responsible for implementation of the storm water program in eight states, various territories, including Puerto Rico and District of Columbia; and various Indian Country lands throughout the country. For the remaining 42 states, the state agency is responsible for program implementation. They have the authority to interpret and implement the program as appropriate for their state. It continues to be EPA's policy not to include effluent limitations in storm water permits. However, a state may choose to follow a different policy than EPA's.

Comment b: There is not a specific mention of catch basin inserts or fillers on the listing of BMPs.

Response b: In discussions concerning BMPs, EPA attempted to provide some examples of various types of BMPs. By no means is the listing intended to be all inclusive. EPA acknowledges that there are other BMPs, such as catch basin inserts or fillers, that were not mentioned in discussions but may be appropriate in various circumstances.

Section VI.E Monitoring and Reporting Requirements

Comment a: Monitoring results are an unreliable indicator of a discharge problem and they do not provide confirmation of a problem. Permittees cannot use results to support facility management.

Response a: EPA believes that since analytic monitoring has been performed by substantial numbers of permittees only during the fourth year of the 1995 MSGP (many facilities complying with monitoring requirements in the fourth year were covered under the earlier baseline general permit during the second monitoring year and, consequently, had no equivalent monitoring requirement), it is premature to make any final conclusions regarding the value of the Agency's acquisition of the monitoring data or to consider dropping the monitoring. In essence, the fourth-year monitoring data set EPA received represents the baseline of pollutant discharge information under the sector-specific industrial general storm water permit. Several rounds of monitoring significantly enhances the utility of the results for evaluating the effectiveness of management practices at the site as well as for the industry sector as a whole. EPA commits to using data from the 1995 and 2000 permits to evaluate the effectiveness of management practices on an industry sector basis and to evaluate the need for changes in monitoring protocols for the next permit.

EPA acknowledges that, considering the small number of samples required per monitoring year (four), and the vagaries of storm water discharges, it may be difficult to determine or confirm the existence of a discharge problem as a commenter claimed. When viewed as an indicator, analytic levels considerably above benchmark values can serve as a flag to the operator that his SWPPP needs to be reevaluated and that pollutant loads may need to be reduced. Conversely, analytic levels below or near benchmarks can confirm to the operator that his SWPPP is doing its intended job. EPA believes there is presently no alternative that provides stakeholders with an equivalent indicator of program effectiveness.

Comment b: Monitoring results are not necessarily an indicator of BMP effectiveness and EPA never justified that they are.

Response b: While not practicable for EPA to require an increase in monitoring, operators are encouraged to sample more frequently to improve the statistical validity of their results. Unless the proper data acquisition protocol for making a valid BMP effectiveness determination is rigorously followed, any other method used to assess BMP effectiveness would be qualitative, and therefore less reliable. The least subjective approach, and most beneficial to operators and stakeholders, EPA believes, remains a combination of visual and analytic monitoring, using analyte benchmark levels to target potential problems. Statistical uncertainties inherent in the monitoring results will necessitate both operators and EPA exercising best professional judgment in interpreting the results. When viewed as an indicator, analytic levels considerably above benchmark values can serve as a flag to the operator that his SWPPP needs to be reevaluated and that pollutant loads may need to be reduced. Conversely, analytic levels below or near benchmarks can confirm to the operator that his SWPPP is doing its intended job.

Comment c: Alternate test methods can be used for determining effectiveness of BMPs at a facility, and benchmarks will need modifying to account for variability in test methods.

Response c: A technically valid, deterministic investigation of BMP effectiveness would necessarily involve collecting discharge pollutant load data before and after the BMP. The constraints inherent in monitoring preclude requiring this kind of investigation. All other methods used to make an assessment of SWPPP/BMP effectiveness are qualitative. The least subjective approach, and most beneficial to operators and stakeholders, EPA believes, is a combination of visual and analytic monitoring, using analyte benchmark levels (or "targets") as an indicator of potential problems. Vagaries of storm discharges and statistical concerns will necessitate operators and EPA exercising best professional judgment in interpreting the results of any monitoring. When viewed as an indicator, analytic levels considerably above benchmark values can serve as a flag to the operator that his SWPPP needs to be reevaluated and that pollutant loads may need to be reduced. Conversely, analytic levels below or near benchmarks can confirm to the operator that his SWPPP is doing its intended job.

Comment d: (a) The presumption of an impact on water quality standards by storm water is inappropriate given the episodic nature of storms. (b) EPA recognizes that during a storm, water quality standards will not always be met, so EPA shouldn't rely on water quality standards at a discharge point to determine if a facility is in compliance. (c) Monitoring has marginal value in assessing and protecting water quality.

Response d: (a) It is true that many impacts of storm water are short-term and that many pollutants are not really toxic or bioaccumulative. A short term water quality standard violation is not necessarily going to persist long enough to be toxic. (b) In the absence of establishing discharge pollutant loads that correlate directly to a receiving water, as would be done for an individual permit, EPA settled on benchmark levels which would, under nearly all scenarios, be protective of water quality standards. Recognizing the shortcomings of these generic pollutant levels, EPA only intends for them to be used as indicators of possible problems and as a flag to reevaluate the SWPPP—not as a trigger to begin mandatory SWPPP or operational revisions unless, after employing BPJ, the operator deems such revisions are necessary. (c) While end-of-pipe/end-of-property analytic monitoring for storm water may not reflect potential impacts to water quality, EPA does not intend to use the data for that purpose.

Comment e: EPA needs to reevaluate the validity of benchmark values.

Response e: Universal benchmark levels cannot be established; the next best thing would be storm water pollutant loadings vis-a-vis water segment-specific TMDLs. But when used as a target or indicator, without requiring specific corrective actions beyond using BPJ to reassess present conditions and make any changes deemed necessary, the present benchmarks are adequate. In specific situations operators may reasonably conclude, after analyzing monitoring results above benchmarks, their present SWPPPs/BMPs are adequately protective of water quality, or that other conditions such as discharging to low-quality, ephemeral streams may obviate the need for SWPPP/BMP revisions.

Comment f: Monitoring diverts resources from more effective implementation of SWPPPs. EPA should focus on pollution prevention, instead.

Response f: In developing the monitoring requirements, *i.e.*, pollutants of concern, monitoring waivers, etc., along with providing sampling and monitoring guidances, EPA endeavored to make the financial burden as minimal as possible. Four quarterly samples is a minimal data set for evaluating the effectiveness of SWPPPs. Those least able to afford expansive monitoring programs, *i.e.*, small businesses, likely have few outfalls to begin with. EPA believes that if monitoring is required at a facility, it should be planned for and budgeted as a cost of doing business.

Comment g: Permittees fear benchmark limits would be viewed as effluent limitations.

Response g: EPA agrees that benchmark limits are not effluent limitations and should not be used, in and of themselves, as the basis for issuing an enforcement violation.

Comment h: Storm water discharge variability can be caused by atmospheric/dry deposition, run on and fate in transport; facilities with structural leachate are at a disadvantage vis-a-vis those without the problem.

Response h: EPA acknowledges the potential for adding pollutants to a facility's discharges from external or structural sources. A permittee is, nonetheless, still legally responsible for the quality of all discharges from his/her site—but not from pollutants that may be introduced outside the boundaries of his/her property or the areas where his/hers structures, industrial activities or materials are located. Anything that increases the pollutant load in the runoff prior to leaving the site, whether originating from air deposition, run-on from nearby sites, or leachate from on-site structures, remains the responsibility of the permittee. This was affirmed in the ruling by the Environmental Appeals Board against the General Motors Corp. CPC-Pontiac Fiero Plant in December 1997.

Comment i: Allow pollutant credits for background sources of pollution.

Response i: Pollutant credits for background sources of pollution is unfeasible for storm water. Either EPA or the permittee would have to determine the pollutant loads of both the run-on and runoff to calculate pollutant credits. Resources are insufficient to implement this practice.

Comment j: Differences in monitoring results may result from changes in business conditions; changes in personnel doing monitoring can make observations/discharge examinations unreliable.

Response j: EPA published guidance on both monitoring and sampling procedures (available from EPA's Office of Water Resource Center) to standardize data collection practices.

Comment k: The same person cannot always do monitoring. Having to rely on different people is bad for consistency in recording observations and making discharge examinations.

Response k: EPA requires that personnel implementing the SWPPP be provided training as an element of the SWPPP. This training must cover program elements to ensure the quality and validity of all information collected.

Comment l: Sampling can be dangerous.

Response l: EPA provides waivers and options such that extreme weather or perilous conditions are accounted for.

Comment m: Determining whether a storm qualifies to be monitored is difficult.

Response m: EPA has always defined what constitutes a storm event worthy of monitoring. Modern weather forecasting is making it easier to anticipate and plan for qualifying storms.

Comment n: Monitoring in remote west or arid/semi-arid areas is difficult and burdensome.

Response n: EPA has always had accommodations and waivers for lack of qualifying storm events. See EPA Response o below.

Comment o: EPA should reduce analytic monitoring and visual monitoring based on average rainfall (similar to Phase II regulations).

Response o: EPA already allows permittees to skip monitoring in any quarter in which no qualifying storm events occur.

Comment p: Some discharges (in the west) occur only infrequently and sometimes only to isolated, ephemeral streams (which may have no indigenous biota).

Response p: Ephemeral streams may still eventually flow into permanent waters of the U.S.; hence, protective measures may still be needed to protect water quality. If there are truly no water quality standards established for an ephemeral stream and the outflow does not feed another water body, then it's likely there would not be a "point source discharge" and no permit would be required. Only those point source discharges to waters of the U.S. need to be included in a SWPPP.

Comment q: Continuation of monitoring is not justified, especially for mining sectors.

Response q: EPA believes that since analytic monitoring has been performed by substantial numbers of permittees only during the fourth year of the 1995 MSGP (many facilities complying with monitoring requirements in the fourth year were covered under the earlier baseline general permit during the second monitoring year and, consequently, had no equivalent monitoring requirement), it is premature to make any final conclusions regarding the value of the Agency's acquisition of the monitoring data or to consider dropping the monitoring. In essence, the fourth-year monitoring data set EPA received represents the baseline of pollutant discharge information under the sector-specific industrial general storm water permit. Several rounds of monitoring significantly enhance the utility of the results for evaluating the effectiveness of management practices at the site as well as for the industry sector as a whole. EPA commits to using data from the 1995 and 2000 permits to evaluate the effectiveness of management practices on an industry sector basis and to evaluate the need for changes in monitoring protocols for the next permit.

EPA acknowledges that, considering the small number of samples required per monitoring year (four), and the vagaries of storm water discharges, it may be difficult to determine or confirm the existence of a discharge problem as a commenter claimed. When viewed as an indicator, analytic levels considerably above benchmark values can serve as a flag to the operator that his SWPPP needs to be reevaluated and that pollutant loads may need to be reduced. Conversely, analytic levels below or near benchmarks can confirm to the operator that his SWPPP is doing its intended job. EPA believes there is presently no alternative that provides stakeholders with an equivalent indicator of program effectiveness.

Comment r: EPA has not provided guidance on monitoring snow melt events.

Response r: EPA does not have any specific guidance on this matter at the present time. Guidance may be developed in the future. In the interim, however, EPA believes that facilities should be able to obtain reasonably representative samples using their best judgment. Two important points must be considered to ensure the snow melt

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sample is representative: (1) The melted runoff must come in contact with any pollutants of concern present and not be overly "contaminated" with concentrated surficial deposits of hydrocarbons, dirt, salt, etc., and (2) the melted runoff must have characteristics that approximate those of a monitor-qualifying rain storm (0.1 inch runoff volume, sampled within the first ½ up to 1 hour).

Comment s: (a) In addition to monitoring results, EPA should also require submission of a description of storm water controls being implemented. (b) EPA should require facilities to monitor for pollutants similar to what would be done under an individual permit (to ensure BMPs are being implemented). (c) Monitoring will aid the permittee, permitting authority and the public in understanding the sources and toxicity of storm water at a site.

Response s: (a) EPA already requires that all BMPs and other controls be described in the SWPPP, including inspections, maintenance, etc. Any BMP changes or additions must be added to an updated SWPPP, so EPA will not require this information be formally submitted. If EPA needs to inspect a facility or determine an enforcement issue, the facility's SWPPP will be reviewed for BMP information. (b) Customizing a facility's monitoring requirements is tantamount to writing an individual permit for the facility, which would require the same application package as for an individual permit. This is an option for those facilities where discharges or receiving waters are a concern but, otherwise, EPA believes the requirements of the present general permit with the identified pollutants of concern is sufficient for a large majority of facilities. (c) EPA agrees that monitoring can be used as an indicator of potential problems or toxicity concerns.

Comment t: Submit Discharge Monitoring Reports (DMRs) along with NOIs to prove compliance. If no DMRs were submitted under the current MSGP, require quarterly monitoring for all five years of MSGP–2000.

Response t: DMR and NOI submission deadlines have not coincided in the past and, from a regulatory perspective, it is not feasible to link them. Past instances of non-compliance are an enforcement issue with established penalties in the CFRs, but these instances do not automatically preclude future permit coverage nor can EPA include separate "penalties" such as 5-year monitoring in the permit for them.

Comment u: Analytic monitoring may be good for general info, which may be of use to the facility and regulatory agency, but it should not be required under the permit. Only visual monitoring should be required. One commenter indicated that analytic monitoring may be good for watershed-wide indications of general trends.

Response u: EPA believes that since analytic monitoring has been performed by substantial numbers of permittees only during the fourth year of the 1995 MSGP (many facilities complying with monitoring requirements in the fourth year were covered under the earlier baseline general permit during the second monitoring year and, consequently, had no equivalent monitoring requirement), it is premature to make any final conclusions regarding the value of the Agency's acquisition of the monitoring data or to consider dropping the monitoring. In essence, the fourth-year monitoring data set EPA received represents the baseline of pollutant discharge information under the sector-specific industrial general storm water permit. Several rounds of monitoring significantly enhance the utility of the results for evaluating the effectiveness of management practices at the site as well as for the industry sector as a whole. EPA commits to using data from the 1995 and 2000 permits to evaluate the effectiveness of management practices on an industry sector basis and to evaluate the need for changes in monitoring protocols for the next permit.

EPA acknowledges that, considering the small number of samples required per monitoring year (four), and the vagaries of storm water discharges, it may be difficult to determine or confirm the existence of a discharge problem. When viewed as an indicator, analytic levels considerably above benchmark values can serve as a flag to the operator that his SWPPP needs to be reevaluated and that pollutant loads may need to be reduced. Conversely, analytic levels below or near benchmarks can confirm to the operator that his SWPPP is doing its intended job. EPA believes there is presently no alternative that provides stakeholders with an equivalent indicator of program effectiveness. A technically valid, deterministic investigation of BMP effectiveness would necessarily involve collecting discharge pollutant load data before and after the BMP. The constraints inherent in monitoring preclude requiring this kind of investigation. All other methods used to make an assessment of SWPPP/BMP effectiveness are qualitative. Quarterly visual monitoring of storm water discharges has always been a permit requirement, for many of the same reasons why commenters favor it, and will continue to be so. The least subjective approach, and most beneficial to operators and stakeholders, EPA believes, is a combination of visual and analytic monitoring, using analyte benchmark levels (or "targets") as an indicator of potential problems. Variability of storm discharges and statistical concerns will necessitate operators and EPA exercising best professional judgement in interpreting the results of any monitoring.

Monitoring in impaired water bodies would focus attention on the problem water bodies and possible pollutant sources. However, not all impaired water bodies and their impairments have been determined. The goal of EPA's storm water program is also to protect and maintain water quality, not just remediate impaired waters, so focusing on impaired waters only does not fulfill all the program's responsibilities.

Comment v: If monitoring results are below the benchmark, facilities should not be required to monitor unless there are major changes to the facility.

Response v: Several rounds of monitoring significantly enhances the utility of the results for evaluating the effectiveness of management practices at the site as well as for the industry sector as a whole. EPA is keeping the monitoring requirement for all specified sectors at least one more time to provide stakeholders with continued assurance that SWPPPs are being implemented, concerted efforts to protect water quality are ongoing, and a mechanism is in place to indicate potential problems. The previous second year monitoring waiver for facilities with pollutant levels below the benchmark level is being retained.

Comment w: Substantially identical outfalls reduces burden and is beneficial to SWPPP implementation.

Response w: Noted.

Visual Monitoring

Comment x: Numerous commenters supported dropping analytic monitoring from the MSGP–2000 in favor of just requiring quarterly visual monitoring. Commenters claimed visual monitoring is adequate to ensure compliance and environmental protection (especially coupled with training), and is least burdensome.

Response x: Quarterly visual monitoring of storm water discharges has always been a permit requirement, for many of the same reasons why commenters favor it, and will continue to be so. EPA will also be retaining analytic monitoring because we believe the best way to ensure SWPPP effectiveness and protection of water quality is through a combination of visual and analytic monitoring. The reasons for not adopting visual monitoring only are explained further in the rationale for justifying quarterly analytic monitoring.

Comment y: Operators need flexibility to collect representative samples for visual monitoring.

Response y: EPA believes the same representative sample reduction provided for analytic monitoring is inappropriate for the quarterly visual monitoring. A visual examination of all discharges is the least that operators can do to ensure all discharges are clean and would provide greater confirmation to themselves and other stakeholders that the representative discharge sample reduction claimed for analytic monitoring is, in fact, justified.

Comment z: Support visual monitoring with use of field test kits, which are cheaper and easier than 40 CFR 136.

Response z: Field test kits have not yet been confirmed as being as reliable as currently required analytical methods. Therefore, EPA is not allowing the use of kits in place of currently required analytical methods at this time.

Comment aa: Make visual evaluations standard.

Response aa: EPA has standard protocols for storm water sampling (the storm water sampling guidance can be obtained from EPA's Office of Water Resource Center at 202–260–7786) and the permit describes the examination procedures, parameters to be examined, meaning of results, etc.

Comment bb: Visual monitoring should be reduced commensurately in arid climates.

Response bb: EPA already allows permittees to document in their monitoring records that no discharge occurred during a monitoring quarter.

Annual Reporting

Comment cc: One option suggested by commenters was for an annual report, possibly using a standardized form, to be submitted to EPA detailing the permittee's SWPPP highlights and revisions/additions, inspections, compliance evaluations, visual monitoring results, etc. One comment against this option stated that the volume of data submitted would be too great for the Agency to evaluate. Other opponents to this option indicated that the reports would not contain enough information to evaluate SWPPP effectiveness, ensure water quality protection, or provide the information necessary to make long-term management plans. Commenters in support of the annual report concept held that it would provide a record of the permittee's commitment to storm water control, was better for evaluating SWPPP effectiveness, and would provide information to EPA to determine if sampling or a site inspection is needed.

Response cc: Information on SWPPP highlights and revisions/additions, inspections, compliance evaluations, visual monitoring results, etc. is already required to be documented in a facility's SWPPP, which, if deemed necessary, must be provided to EPA on demand. If no monitoring data were available, an annual report could be used to ensure that a facility is implementing its SWPPP. The reports could also be used to prioritize sites for inspection. However, EPA agrees that it would be very burdensome to review all the reports and very difficult to assess the effectiveness of a facility's SWPPP based on that review alone. The subjectivity inherent in annual reporting makes it an undesirable substitute for analytic monitoring. Documenting the kind of information in the annual report is already a SWPPP requirement and is, therefore, available to operators for assessing and improving their storm water programs. For these reasons, EPA will not require reports containing essentially the same information required in SWPPPs to be submitted in lieu of analytic monitoring.

Group Monitoring

Comment dd: Commenters also suggested group monitoring. In this option a consortium of like permittees would do sampling at one facility, possibly on a rotating basis. The sample results would represent all the facilities in the consortium. A variation of group monitoring is for the consortium to retain a consultant to do representative sampling and provide storm water program guidance and evaluations. Supporters of this concept said it may allow for comparisons of effectiveness of different SWPPP practices (*e.g.*, sweeping vs. catchment basin for solids control). One commenter pointed out that the feasibility of the group concept is suspect due to the fact that individual facilities may have different topography, soil and other natural conditions.

Response dd: EPA believes that technically valid BMP comparisons could be done under this type of program. However, it would be difficult and very resource-intensive for EPA to establish criteria for group eligibility and then monitor to ensure that groups met these criteria.

Watershed Monitoring

Comment ee: Commenters suggested conducting watershed monitoring rather than monitoring at the facility. This option involves replacing the monitoring of discrete storm water discharges with ambient receiving water monitoring on a watershed basis.

Response ee: Watershed monitoring is invaluable to making real conclusions regarding storm water impacts of water quality, and will be employed in making total maximum daily load (TMDL) determinations. However, watershed monitoring cannot replace facility-specific storm water discharge monitoring to determine the loads contributed by the facilities and to evaluate the effectiveness of the SWPPP.

Monitoring Only in Impaired Waters

Comment ff: Several commenters supported requiring monitoring only in impaired water bodies and for pollutants that cause the impairment.

Response ff: Although this option would focus attention on the problem water bodies and possible pollutant sources, EPA and a commenter point out that not all impaired water bodies and their impairments have been determined. The goal of EPA's storm water program is also to protect and maintain water quality, not just remediate impaired waters, so focusing on impaired waters only does not fulfill all the program's responsibilities.

Section VII Cost Estimates for Common Permit Requirements

Comment: EPA incorrectly estimated costs associated with the original MSGP. The new permit imposes even more costs. EPA must better estimate these costs, especially for small businesses. EPA should conduct a Regulatory Flexibility Analysis as well as perform a Small Business Regulatory Enforcement Fairness Act (SBREFA) consultation.

Response: The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) generally requires an agency to prepare a regulatory flexibility analysis for any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute. Under section 605(b) of the RFA, however, if the head of an agency certifies that a rule will not have a significant economic impact on a substantial number of small entities, the statute does not require the agency to prepare a regulatory flexibility analysis.

The MSGP–2000 provides facilities the option of obtaining a general permit rather than applying for individual permits; it does not extend coverage of the existing NPDES regulations. Therefore, the costs associated with obtaining a permit were already addressed when the NPDES regulations were issued. Furthermore, the MSGP–2000 is intended to reduce costs by providing a streamlined procedure for obtaining permit coverage. For these reasons, there was no requirement on EPA to conduct a separate analysis to support the MSGP–2000.

X. Economic Impact (Executive Order 12866)

Under Executive Order 12866 [58 FR 51735 (October 4, 1993)], the Agency must determine whether the regulatory action is "significant" and therefore subject to OMB review and the requirements of the Executive Order. The Order defines "significant regulatory action" as one that is likely to result in a rule that may have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities; create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

EPA has determined that the reissued MSGP is not a "significant regulatory action" under the terms of Executive Order 12866 and is therefore not subject to formal OMB review prior to proposal.

XI. Unfunded Mandates Reform Act

Section 201 of the Unfunded Mandates Reform Act (UMRA), Public Law 104–4, generally requires Federal agencies to assess the effects of their "regulatory actions" on State, local, and tribal governments and the private sector. UMRA uses the term "regulatory actions" to refer to regulations. (See, *e.g.*, UMRA section 201, "Each agency shall * * * assess the effects of Federal regulatory actions * * * (other than to the extent that such regulations incorporate requirements specifically set forth in law)" (emphasis added)). UMRA section 102 defines "regulation" by reference to 2 U.S.C. 658 which in turn defines "regulation" and "rule" by reference to section 601(2) of the Regulatory Flexibility Act (RFA). That section of the RFA defines "rule" as "any rule for which the agency publishes a notice of proposed rulemaking pursuant to section 553(b) of [the Administrative Procedure Act (APA)], or any other law * * *"

As discussed in the RFA section of this notice, NPDES general permits are not "rules" under the APA and thus not subject to the APA requirement to publish a notice of proposed rulemaking. NPDES general permits are also not subject to such a requirement under the CWA. While EPA publishes a notice to solicit public comment on draft general permits, it does so pursuant to the CWA section 402(a) requirement to provide "an opportunity for a hearing." Thus, NPDES general permits are not "rules" for RFA or UMRA purposes.

EPA has determined that today's MSGP reissuance does not result in expenditures of $100 million or more for State, local and Tribal governments, in the aggregate, or the private sector in any one year.

The Agency also believes that the final MSGP will not significantly nor uniquely affect small governments. For UMRA purposes, "small governments" is defined by reference to the definition of "small governmental jurisdiction" under the RFA. (See UMRA section 102(1), referencing 2 U.S.C. 658, which references section 601(5) of the RFA.) "Small governmental jurisdiction" means governments of cities, counties, towns, etc., with a population of less than 50,000, unless the agency establishes an alternative definition.

Today's final MSGP also will not uniquely affect small governments because compliance with the final permit conditions affects small governments in the same manner as any other entities seeking coverage under the final permit.

XII. Paperwork Reduction Act

EPA has reviewed the requirements imposed on regulated facilities resulting from the final MSGP under the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 *et seq.* The information collection requirements of the MSGP have already been approved in previous submissions made for the NPDES permit program under the provisions of the CWA.

XIII. Regulatory Flexibility Act

The Agency has determined that the final MSGP being published today is not subject to the Regulatory Flexibility Act ("RFA"), which generally requires an agency to conduct a regulatory flexibility analysis of any significant impact the rule will have on a substantial number of small entities. By its terms, the RFA only applies to rules subject to notice-and-comment rulemaking requirements under the Administrative Procedure Act ("APA") or any other statute. Today's final MSGP is not subject to notice and comment requirements under the APA or any other statute because the APA defines "rules" in a manner that excludes permits. See APA section 551(4), (6), and (8).

APA section 553 does not require public notice and opportunity for comment for interpretative rules or general statements of policy. In addition to finalizing the new MSGP, today's notice repeats for the convenience of the reader an interpretation of existing regulations promulgated almost twenty years ago. The action would impose no new or additional requirements.

Authorization to Discharge Under the National Pollutant Discharge Elimination System

In compliance with the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 *et seq.*), operators of discharges associated with industrial activities that submit a complete Notice of Intent in accordance with Part 2.2 for a discharge that is located in an area specified in Part 1.1 and eligible for permit coverage under Part 1.2 are authorized to discharge pollutants to waters of the United States in accordance with the conditions and requirements set forth herein.

This permit becomes effective on October 30, 2000.

This permit and the authorization to discharge expire at midnight, October 30, 2005.

Signed and issued this 15th day of September, 2000.

Linda M. Murphy,

Director, Office of Ecosystem Protection, Region 1.

Signed and issued this 15th day of September, 2000.

Kathleen C. Callahan,

Director, Division of Environmental Planning and Protection, Region 2.

Signed and issued this 15th day of September, 2000.

Joseph T. Piotrowski,

Acting Director, Water Protection Division, Region 3.

Signed and issued this 12th day of September, 2000.

Douglas Mundrick,

Acting Deputy Division Director, Water Management Division, Region 4.

Signed and issued this 27th day of September, 2000.

Sam Becker,

Acting Director, Water Quality Protection Division, Region 6.

Signed and issued this 2d day of October, 2000.

Stephen S. Tuber,

Acting Assistant Regional Administrator, Office of Partnerships and Regulatory Assistance, Region 8.

Signed and issued this 28th day of September, 2000.

Alexis Strauss,

Director, Water Division, Region 9.

Signed and issued this 14th day of September, 2000.

Michael A. Bussell,

Deputy Director, Office of Water, Region 10.

NPDES Multi-Sector General Permits for Storm Water Discharges Associated With Industrial Activities

Table of Contents

Note: In the Spirit of the Agency's "Readable Regulations" policy, this permit was written as much as practicable in a more reader-friendly, plain language format that should make it easier for people less familiar with traditional EPA permits and regulations to read and understand the permit requirements. Terms like "you" and "your" are used to refer to the party(ies) that are operators of a discharge, applicants, permittees, etc. Terms like "must" are used instead of "shall." Phrasing such as "If you. * * * " is used to identify conditions that may not apply to all permittees.

1. Coverage Under This Permit

1.1 Permit Area

The permit language is structured as if it were a single permit, with State, Indian country land or other area-specific conditions contained in Part 13. Permit coverage is actually provided by legally separate and distinctly numbered permits, all of which are contained herein, and which cover each of the areas listed in Parts 1.1.1 through 1.1.10.

Note: EPA can only provide permit coverage for areas and classes of discharges not within the scope of a State's NPDES authorization. For discharges not described in an area of coverage below, please contact the appropriate State NPDES permitting authority to obtain a permit.

1.1.1 EPA Region 1: CT, MA, ME, NH, RI, VT

The states of Connecticut, Rhode Island, and Vermont are the NPDES Permitting Authority for the majority of discharges within their respective states.

Permit No.	Areas of coverage/where EPA is permitting authority
CTR05*##I	Indian country lands within the State of Connecticut.
MAR05*###	Commonwealth of Massachusetts, except Indian country lands.
MAR05*##I	Indian country lands within the Commonwealth of Massachusetts.
MER05*###	State of Maine, except Indian country lands.
MER05*##I	Indian country lands within the State of Maine.
NHR05*###	State of New Hampshire.
RIR05*##I	Indian country lands within the State of Rhode Island.
VTR05*##F	Federal Facilities in the State of Vermont.

1.1.2 EPA Region 2: NJ, NY, PR, VI

The state of New York is the NPDES Permitting Authority for the majority of discharges within that state. New Jersey and the Virgin Islands are the NPDES Permitting Authority for all discharges within their respective states.

Permit No.	Areas of coverage/where EPA is permitting authority
PRR05*###	The Commonwealth of Puerto Rico.

1.1.3 EPA REGION 3: DE, DC, MD, PA, VA, WV

The state of Delaware is the NPDES Permitting Authority for the majority of discharges within that state. Maryland, Pennsylvania, and Virginia, West Virginia are the NPDES Permitting Authority for all discharges within these states.

Permit No.	Areas of coverage/where EPA is permitting authority
DCR05*###	The District of Columbia.
DER05*##F	Federal Facilities in the State of Delaware.

1.1.4 EPA Region 4: AL, FL, GA, KY, MS, NC, SC, TN

The states of Alabama, Florida, Mississippi, and North Carolina are the NPDES Permitting Authority for the majority of discharges within their respective states. Georgia, Kentucky, South Carolina and Tennessee are the NPDES Permitting Authority for all discharges within their respective states.

Permit No.	Areas of coverage/where EPA is permitting authority
ALR05*##I	Indian country lands within the State of Alabama.
FLR05*##I	Indian country lands within the State of Florida.
MSR05*##I	Indian country lands within the State of Mississippi.
NCR05*##I	Indian country lands within the State of North Carolina.

1.1.5 EPA Region 5: IL, IN, MI, MN, OH, WI

Coverage Not Available.

1.1.6 EPA Region 6: AR, LA, OK, TX, NM (Except See Region 9 for Navajo Lands, and See Region 8 for Ute Mountain Reservation Lands)

The states of Louisiana, Oklahoma, and Texas are the NPDES Permitting Authority for the majority of discharges within their respective states. Arkansas is the NPDES Permitting Authority for all discharges within that state.

Permit No.	Areas of coverage/where EPA is permitting authority
LAR05*##I	Indian country lands within the State of Louisiana.
NMR05*###	The State of New Mexico, except Indian country lands.
NMR05*##I	Indian country lands within the State of New Mexico, except Navajo Reservation Lands that are covered under Arizona permit AZR05*##I listed in Part 1.1.9 and Ute Mountain Reservation Lands that are covered under Colorado permit COR05*##I listed in Part 1.1.8.
OKR05*##I	Indian country lands within the State of Oklahoma.
OKR05*##F	Facilities in the State of Oklahoma not under the jurisdiction of the Oklahoma Department of Environmental Quality, except those on Indian country lands. EPA-jurisdiction facilities include SIC codes 1311, 1381, 1382, 1389 and 5171 and point source (but not non-point source) discharges associated with agricultural production, services, and silviculture.

Permit No.	Areas of coverage/where EPA is permitting authority
TXR05*##F	Facilities in the State of Texas not under the jurisdiction of the Texas Natural Resource Conservation Commission, except those on Indian country lands. EPA-jurisdiction facilities include SIC codes 1311, 1321, 1381, 1382, and 1389 (other than oil field service company "home base" facilities).
TXR05*##I	Indian country lands within the State of Texas.

1.1.7 EPA Region 7: IA, KS, MO, NE

Coverage Not Available.

1.1.8 EPA Region 8: CO, MT, ND, SD, WY, UT (Except See Region 9 for Goshute Reservation and Navajo Reservation Lands), the Ute Mountain Reservation in NM, and the Pine Ridge Reservation in NE

The states of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming are the NPDES Permitting Authority for the majority of discharges within their respective states.

Permit No.	Areas of coverage/where EPA is permitting authority
COR05*##F	Federal Facilities in the State of Colorado, except those located on Indian country lands which are covered under Colorado permit CORO5*##I below.
COR05*##I	Indian country lands within the State of Colorado, including the portion of the Ute Mountain Reservation located in New Mexico.
MTR05*##I	Reserved.
NDR05*##I	Indian country lands within the State of North Dakota, including that portion of the Standing Rock Reservation located in South Dakota except Indian country within the former boundaries of the Lake Traverse Reservation that is covered under South Dakota permit SDR05*##I listed below.
SDR05*##I	Indian country lands within the State of South Dakota, including the portion of the Pine Ridge Reservation located in Nebraska and the portion of Indian country within the former boundaries of the Lake Traverse Reservation located in North Dakota except for the Standing Rock Reservation that is covered under North Dakota permit NDR05*##I listed above.
UTR05*##I	Indian country lands within the State of Utah, except Goshute and Navajo Reservation lands that are covered under Arizona permit AZR05*##I (Goshute) listed in Part 1.1.9 and Nevada permit NVR05*##I (Navajo) listed in Part 1.1.9.
WYR05*##I	Indian country lands within the State of Wyoming.

1.1.9 EPA Region 9: CA, HI, NV, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, the Goshute Reservation in UT and NV, the Navajo Reservation in UT, NM, and AZ, the Duck Valley Reservation in ID, and the Fort McDermitt Reservation in OR

The states of California and Nevada are the NPDES Permitting Authority for the majority of discharges within their respective states. Hawaii is the NPDES Permitting Authority for all discharges within that state.

Permit No.	Areas of coverage/where EPA is permitting authority
ASR05*###	The Island of American Samoa.
AZR05*###	The State of Arizona, except Indian country lands.
AZR05*##I	Indian country lands within the State of Arizona, including Navajo Reservation lands in New Mexico and Utah.
CAR05*##I	Indian country lands within the State of California.
GUR05*###	The Island of Guam.
JAR05*###	Johnston Atoll.
MWR05*###	Midway Island and Wake Island.
NIR05*###	Commonwealth of the Northern Mariana Islands.
NVR05*##I	Indian country lands within the State of Nevada, including the Duck Valley Reservation in Idaho, the Fort McDermitt Reservation in Oregon and the Goshute Reservation in Utah.

1.1.10 Region 10: AK, ID (Except See Region 9 for Duck Valley Reservation Lands), OR (Except See Region 9 for Fort McDermitt Reservation), WA

The states of Oregon and Washington are the NPDES Permitting Authority for the majority of discharges within their respective states. The 1995 Multi-Sector General Permit was issued in the State of Alaska on February 9, 1996 (61 FR 5247) and the terms and conditions of the 1995 permit are effective for facilities in Alaska through February 9, 2001. EPA will reissue this permit for the State of Alaska at a future date.

Permit No.	Areas of coverage/where EPA is permitting authority
AKR05*##I	Indian country lands within Alaska.
IDR05*###	The State of Idaho, except Indian country lands.
IDR05*##I	Indian country lands within the State of Idaho, except Duck Valley Reservation lands which are covered under Nevada permit NVR05*##I listed in Part 1.1.9.
ORR05*##I	Indian country lands within the State of Oregon except Fort McDermitt Reservation lands that are covered under Nevada permit NVR05*##I listed in Part 1.1.9.
WAR05*##I	Indian country lands within the State of Washington.
WAR05*##F	Federal Facilities in the State of Washington, except those located on Indian country lands.

1.2 Eligibility

You must maintain permit eligibility to discharge under this permit. Any discharges that are not compliant with the eligibility conditions of this permit are not authorized by the permit and you must either apply for a separate permit to cover those ineligible discharges or take necessary steps to make the discharges eligible for coverage.

1.2.1 Facilities Covered

Your permit eligibility is limited to discharges from facilities in the "sectors" of industrial activity based on Standard Industrial Classification (SIC) codes and Industrial Activity Codes summarized in Table 1–1. References to "sectors" in this permit (*e.g.*, sector-specific monitoring requirements, *etc.*) refer to these sectors.

TABLE 1–1.—SECTORS OF INDUSTRIAL ACTIVITY COVERED BY THIS PERMIT

SIC code or activity code [1]	Activity represented
	Sector A: Timber Products
2411	Log Storage and Handling (Wet deck storage areas only authorized if no chemical additives are used in the spray water or applied to the logs).
2421	General Sawmills and Planning Mills.
2426	Hardwood Dimension and Flooring Mills.
2429	Special Product Sawmills, Not Elsewhere Classified.
2431–2439 (except 2434)	Millwork, Veneer, Plywood, and Structural Wood (see Sector W).
2448, 2449	Wood Containers.
2451, 2452	Wood Buildings and Mobile Homes.
2491	Wood Preserving.
2493	Reconstituted Wood Products.
2499	Wood Products, Not Elsewhere Classified.
	Sector B: Paper and Allied Products
2611	Pulp Mills.
2621	Paper Mills.
2631	Paperboard Mills.
2652–2657	Paperboard Containers and Boxes.
2671–2679	Converted Paper and Paperboard Products, Except Containers and Boxes.
	Sector C: Chemical and Allied Products
2812–2819	Industrial Inorganic Chemicals.
2821–2824	Plastics Materials and Synthetic Resins, Synthetic Rubber, Cellulosic and Other Manmade Fibers Except Glass.
2833–2836	Medicinal chemicals and botanical products; pharmaceutical preparations; in vitro and in vivo diagnostic substances; biological products, except diagnostic substances.
2841–2844	Soaps, Detergents, and Cleaning Preparations; Perfumes, Cosmetics, and Other Toilet Preparations.
2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products.
2861–2869	Industrial Organic Chemicals.
2873–2879	Agricultural Chemicals.
2873	Facilities that Make Fertilizer Solely from Leather Scraps and Leather Dust.
2891–2899	Miscellaneous Chemical Products.
3952 (limited to list)	Inks and Paints, Including China Painting Enamels, India Ink, Drawing Ink, Platinum Paints for Burnt Wood or Leather Work, Paints for China Painting, Artist's Paints and Artist's Watercolors.
	Sector D: Asphalt Paving and Roofing Materials and Lubricants
2951, 2952	Asphalt Paving and Roofing Materials.
2992, 2999	Miscellaneous Products of Petroleum and Coal.
	Sector E: Glass Clay, Cement, Concrete, and Gypsum Products
3211	Flat Glass.
3221, 3229	Glass and Glassware, Pressed or Blown.
3231	Glass Products Made of Purchased Glass.
3241	Hydraulic Cement.
3251–3259	Structural Clay Products.
3261–3269	Pottery and Related Products.
3271–3275	Concrete, Gypsum and Plaster Products.
3291–3299	Abrasive, Asbestos, and Miscellaneous Nonmetallic Mineral Products.
	Sector F: Primary Metals
3312–3317	Steel Works, Blast Furnaces, and Rolling and Finishing Mills.
3321–3325	Iron and Steel Foundries.
3331–3339	Primary Smelting and Refining of Nonferrous Metals.
3341	Secondary Smelting and Refining of Nonferrous Metals.
3351–3357	Rolling, Drawing, and Extruding of Nonferrous Metals.

TABLE 1–1.—SECTORS OF INDUSTRIAL ACTIVITY COVERED BY THIS PERMIT—Continued

SIC code or activity code [1]	Activity represented
3363–3369	Nonferrous Foundries (Castings).
3398, 3399	Miscellaneous Primary Metal Products.
Sector G: Metal Mining (Ore Mining and Dressing)	
1011	Iron Ores.
1021	Copper Ores.
1031	Lead and Zinc Ores.
1041, 1044	Gold and Silver Ores.
1061	Ferroalloy Ores, Except Vanadium.
1081	Metal Mining Services.
1094, 1099	Miscellaneous Metal Ores.
Sector H: Coal Mines and Coal Mining Related Facilities	
1221–1241	Coal Mines and Coal Mining-Related Facilities.
Sector I: Oil and Gas Extraction and Refining	
1311	Crude Petroleum and Natural Gas.
1321	Natural Gas Liquids.
1381–1389	Oil and Gas Field Services.
2911	Petroleum Refineries.
Sector J: Mineral Mining and Dressing	
1411	Dimension Stone.
1422–1429	Crushed and Broken Stone, Including Rip Rap.
1442, 1446	Sand and Gravel
1455, 1459	Clay, Ceramic, and Refractory Materials.
1474–1479	Chemical and Fertilizer Mineral Mining.
1481	Nonmetallic Minerals Services, Except Fuels.
1499	Miscellaneous Nonmetallic Minerals, Except Fuels.
Sector K: Hazardous Waste Treatment, Storage, or Disposal Facilities	
HZ	Hazardous Waste Treatment Storage or Disposal.
Sector L: Landfills and Land Application Sites	
LF	Landfills, Land Application Sites, and Open Dumps.
Sector M: Automobile Salvage Yards	
5015	Automobile Salvage Yards.
Sector N: Scrap Recycling Facilities	
5093	Scrap Recycling Facilities.
Sector O: Steam Electric Generating Facilities	
SE	Steam Electric Generating Facilities.
Sector P: Land Transportation and Warehousing	
4011, 4013	Railroad Transportation.
4111–4173	Local and Highway Passenger Transportation.
4212–4231	Motor Freight Transportation and Warehousing.
4311	United States Postal Service.
5171	Petroleum Bulk Stations and Terminals.
Sector Q: Water Transportation	
4412–4499	Water Transportation.
Sector R: Ship and Boat Building or Repairing Yards	
3731,3732	Ship and Boat Building or Repairing Yards.
Sector S: Air Transportation	
4512–4581	Air Transportation Facilities.

R0019845

TABLE 1–1.—SECTORS OF INDUSTRIAL ACTIVITY COVERED BY THIS PERMIT—Continued

SIC code or activity code [1]	Activity represented
Sector T: Treatment Works	
TW	Treatment Works.
Sector U: Food and Kindred Products	
2011–2015	Meat Products.
2021–2026	Dairy Products.
2032	Canned, Frozen and Preserved Fruits, Vegetables and Food Specialties.
2041–2048	Grain Mill Products.
2051–2053	Bakery Products.
2061–2068	Sugar and Confectionery Products.
2074–2079	Fats and Oils.
2082–2087	Beverages.
2091–2099	Miscellaneous Food Preparations and Kindred Products.
2111–2141	Tobacco Products.
Sector V: Textile Mills, Apparel, and Other Fabric Product Manufacturing, Leather and Leather Products	
2211–2299	Textile Mill Products.
2311–2399	Apparel and Other Finished Products Made From Fabrics and Similar Materials.
3131–3199 (except 3111)	Leather and Leather Products, except Leather Tanning and Finishing (see Sector Z).
Sector W: Furniture and Fixtures	
2434	Wood Kitchen Cabinets.
2511–2599	Furniture and Fixtures.
Sector X: Printing and Publishing	
2711–2796	Printing, Publishing, and Allied Industries.
Sector Y: Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries.	
3011	Tires and Inner Tubes.
3021	Rubber and Plastics Footwear.
3052, 3053	Gaskets, Packing, and Sealing Devices and Rubber and Plastics Hose and Belting.
3061, 3069	Fabricated Rubber Products, Not Elsewhere Classified.
3081–3089	Miscellaneous Plastics Products.
3931	Musical Instruments.
3942–3949	Dolls, Toys, Games and Sporting and Athletic Goods.
3951–3955 (except 3952 facilities as specified in Sector C).	Pens, Pencils,and Other Artists' Materials.
3961, 3965	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal.
3991–3999	Miscellaneous Manufacturing Industries.
3411–3499	Fabricated Metal Products, Except Machinery and Transportation Equipment.
3911–3915	Jewelry, Silverware, and Plated Ware.
Sector AB: Transportation Equipment, Industrial or Commercial Machinery	
3511–3599 (except 3571–3579)	Industrial and Commercial Machinery (except Computer and Office Equipment) (see Sector AC).
3711–3799 (except 3731, 3732)	Transportation Equipment (except Ship and Boat Building and Repairing) (see Sector R).
Sector AC: Electronic, Electrical, Photographic, and Optical Goods	
3571–3579	Computer and Office Equipment.
3612–3699	Electronic, Electrical Equipment and Components, except Computer Equipment.
3812	Measuring, Analyzing and Controlling Instrument; Photographic and Optical Goods.
Sector AD: Non-Classified Facilities	
N/A	Other storm water discharges designated by the Director as needing a permit (see 40 CFR 122.26(g)(1)(I)) or any facility discharging storm water associated with industrial activity not described by any of Sectors A–AC. **Note:** Facilities may not elect to be covered under Sector AD. Only the Director may assign a facility to Sector AD.

[1] A complete list of SIC codes (and conversions from the newer North American Industry Classification System (NAICS)) can be obtained from the Internet at *http://www.census.gov/epcd/www/naics.html* or in paper form from various locations in the document entitled "Handbook of Standard Industrial Classifications," Office of Management and Budget, 1987. Industrial activity codes are provided on the Multi-Sector General Permit Notice of Intent (NOI) application form (EPA Form Number 3510–6).

R0019846

1.2.1.1 *Co-located Activities.* If you have co-located industrial activities on-site that are described in a sector(s) other than your primary sector, you must comply with all other applicable sector-specific conditions found in Part 6 for the co-located industrial activities. The extra sector-specific requirements are applied only to those areas of your facility where the extra-sector activities occur. An activity at a facility is not considered co-located if the activity, when considered separately, does not meet the description of a category of industrial activity covered by the storm water regulations, and identified by the MSGP–2000 SIC code list. For example, unless you are actually hauling substantial amounts of freight or materials with your own truck fleet or are providing a trucking service to outsiders, simple maintenance of vehicles used at your facility is unlikely to meet the SIC code group 42 description of a motor freight transportation facility. Even though Sector P may not apply, the runoff from your vehicle maintenance facility would likely still be considered storm water associated with industrial activity. As such, your SWPPP must still address the runoff from the vehicle maintenance facility—although not necessarily with the same degree of detail as required by Sector P—but you would not be required to monitor as per Sector P.

If runoff from co-located activities commingles, you must monitor the discharge as per the requirements of all applicable sectors (regardless of the actual location of the discharge). If you comply with all applicable requirements from all applicable sections of Part 6 for the co-located industrial activities, the discharges from these co-located activities are authorized by this permit.

1.2.2 Discharges Covered

1.2.2.1 *Allowable Storm Water Discharges.* Subject to compliance with the terms and conditions of this permit, you are authorized to discharge pollutants in:

1.2.2.1.1 Discharges of storm water runoff associated with industrial activities as defined in 40 CFR 122.26 (b)(14)(i–ix and xi) from the sectors of industry described in Table 1–1, and that are specifically identified by outfall or discharge location in the Storm Water Pollution Prevention Plan (see Part 4.2.2.3.7);

1.2.2.1.2 Non-storm water discharges as noted in Part 1.2.2.2 or otherwise specifically allowed by the permit;

1.2.2.1.3 Discharges subject to an effluent guideline listed in Table 1–2 that also meet all other eligibility requirements of the permit. Interim coverage is also available for discharges subject to a new storm water effluent limitation guideline promulgated after the effective date of this permit. Discharges subject to a New Source Performance Standard (NSPS) effluent guideline must also meet the requirements of Part 1.2.4.;

1.2.2.1.4 Discharges designated by the Director as needing a storm water permit under 40 CFR 122.26(a)(1)(v) or under 122.26(a)(9) and 122.26(g)(1)(i); and

1.2.2.1.5 Discharges comprised of a discharge listed in Parts 1.2.2.1.1 to 1.2.2.1.4 above commingled with a discharge authorized by a different NPDES permit and/or a discharge that does not require NPDES permit authorization.

TABLE 1–2.—EFFLUENT GUIDELINES APPLICABLE TO DISCHARGES THAT MAY BE ELIGIBLE FOR PERMIT COVERAGE

Effluent guideline	New source performance standards included in effluent guidelines?	Sectors with affected facilities
Runoff from material storage piles at cement manufacturing facilities [40 CFR Part 411 Subpart C (established February 23, 1977)].	Yes	E
Contaminated runoff from phosphate fertilizer manufacturing facilities [40 CFR Part 418 Subpart A (established April 8, 1974)].	Yes	C
Coal pile runoff at steam electric generating facilities [40 CFR Part 423 (established November 19, 1982)]	Yes	O
Discharges resulting from spray down or intentional wetting of logs at wet deck storage areas [40 CFR Part 429, Subpart I (established January 26, 1981)].	Yes	A
Mine dewatering discharges at crushed stone mines [40 CFR part 436, Subpart B]	No	J
Mine dewatering discharges at construction sand and gravel mines [40 CFR part 436, Subpart C]	No	J
Mine dewatering discharges at industrial sand mines [40 CFR part 436, Subpart D]	No	J
Runoff from asphalt emulsion facilities [40 CFR Part 443 Subpart A (established July 24, 1975)]	Yes	D
Runoff from landfills, [40 CFR Part 445, Subpart A and B (established February 2, 2000]	Yes	K & L

1.2.2.2 *Allowable Non-Storm Water Discharges.* You are also authorized for the following non-storm water discharges, provided the non-storm water component of your discharge is in compliance with Part 4.4.2 (non-storm water discharges):

1.2.2.2.1 Discharges from fire fighting activities;

1.2.2.2.2 Fire hydrant flushings;

1.2.2.2.3 Potable water including water line flushings;

1.2.2.2.4 Uncontaminated air conditioning or compressor condensate;

1.2.2.2.5 Irrigation drainage;

1.2.2.2.6 Landscape watering provided all pesticides, herbicides, and fertilizer have been applied in accordance with manufacturer's instructions;

1.2.2.2.7 Pavement wash waters where no detergents are used and no spills or leaks of toxic or hazardous materials have occurred (unless all spilled material has been removed);

1.2.2.2.8 Routine external building wash down which does not use detergents;

1.2.2.2.9 Uncontaminated ground water or spring water;

1.2.2.2.10 Foundation or footing drains where flows are not contaminated with process materials such as solvents;

1.2.2.2.11 Incidental windblown mist from cooling towers that collects on rooftops or adjacent portions of your facility, but NOT intentional discharges from the cooling tower (*e.g.*, "piped" cooling tower blowdown or drains).

1.2.3 Limitations on Coverage

1.2.3.1 *Prohibition on Discharges Mixed with Non-Storm Water.* You are not authorized for discharges that are mixed with sources of non-storm water. This exclusion does not apply to discharges identified in Part 1.2.2.2, provided the discharges are in compliance with Part 4.4.2 (Storm

Water Pollution Prevention Plan requirements for authorized non-storm water discharges), and to any discharge explicitly authorized by the permit.

1.2.3.2 *Storm Water Discharges Associated with Construction Activity.* You are not authorized for storm water discharges associated with construction activity as defined in 40 CFR 122.26(b)(14)(x) or 40 CFR 122.26(b)(15).

1.2.3.3 *Discharges Currently or Previously Covered by Another Permit.* You are not authorized for the following:

1.2.3.3.1 Storm water discharges associated with industrial activity that are currently covered under an individual permit or an alternative general permit.

1.2.3.3.2 Discharges previously covered by an individual permit or alternative general permit (except the 1992 "Baseline" or the 1995 Multi-Sector NPDES General Permits for Storm Water Discharges Associated With Industrial Activity) that has expired, or been terminated at the request of the permittee unless:

1.2.3.3.2.1 The individual permit did not contain numeric water quality-based limitations developed for the storm water component of the discharge; and

1.2.3.3.2.2 The permittee includes any specific BMPs for storm water required under the individual permit in the SWPPP required under Part 4 of this permit.

1.2.3.3.3 Storm water discharges associated with industrial activity from facilities where any NPDES permit has been or is in the process of being denied, terminated, or revoked by the Director (other than in a replacement permit issuance process). Upon request, the Director may waive this exclusion if operator of the facility has since passed to a different owner/operator and new circumstances at the facility justify a waiver.

1.2.3.4 *Discharges Subject to Effluent Limitations Guidelines.* You are not authorized for discharges subject to any effluent limitation guideline that is not included in Table 1–2. For discharges subject to a New Source Performance Standard (NSPS) effluent guideline identified in Table 1–2, you must comply with Part 1.2.4 prior to being eligible for permit coverage.

1.2.3.5 *Discharge Compliance with Water Quality Standards.* You are not authorized for storm water discharges that the Director determines will cause, or have reasonable potential to cause or contribute to, violations of water quality standards. Where such determinations have been made, the Director may notify you that an individual permit application is necessary in accordance with Part 9.12. However, the Director may authorize your coverage under this permit after you have included appropriate controls and implementation procedures designed to bring your discharges into compliance with water quality standards in your Storm Water Pollution Prevention Plan.

1.2.3.6 *Endangered and Threatened Species or Critical Habitat Protection.* You are not authorized for discharges that do not avoid unacceptable effects on Federally listed endangered and threatened ("listed") species or designated critical habitat ("critical habitat").

Caution: Additional endangered and threatened species have been listed and critical habit designated since the 1995 MSGP was issued. Even if you were previously covered by the 1995 MSGP, you must determine eligibility for this permit through the processes described below and in Addendum A. Where applicable, you may incorporate information from your previous endangered species analysis in your documentation of eligibility for this permit.

1.2.3.6.1 Coverage under this permit is available only if your storm water discharges, allowable non-storm water discharges, and discharge-related activities are not likely to jeopardize the continued existence of any species that are listed as endangered or threatened ("listed") under the ESA or result in the adverse modification or destruction of habitat that is designated or proposed to be designated as critical under the ESA ("critical habitat"). Submission of a signed NOI will be deemed to also constitute your certification of eligibility.

1.2.3.6.2 "Discharge-related activities" include: activities which cause, contribute to, or result in storm water point source pollutant discharges; and measures to control storm water discharges including the siting, construction and operation of best management practices (BMPs) to control, reduce or prevent storm water pollution.

1.2.3.6.3 *Determining Eligibility:* You must use the most recent Endangered and Threatened Species County-Species List available from EPA and the process in Addendum A (ESA Screening Process) to determine your eligibility *PRIOR* to submittal of your NOI. As of the effective date of this permit, the most current version of the List is located on the EPA Office of Water Web site at *http://www.epa.gov/owm/esalst2.htm.* You must meet one or more of the criteria in 1.2.3.6.3.1 through 1.2.3.6.3.5 below for the entire term of coverage under the permit. You must include a certification of eligibility and supporting documentation on the eligibility determination in your Storm Water Pollution Prevention Plan.

1.2.3.6.3.1 *Criteria A:* No endangered or threatened species or critical habitat are in proximity to your facility or the point where authorized discharges reach the receiving water; or

1.2.3.6.3.2 *Criteria B:* In the course of a separate federal action involving your facility (*e.g.*, EPA processing request for an individual NPDES permit, issuance of a CWA § 404 wetlands dredge and fill permit, *etc.*), formal or informal consultation with the Fish and Wildlife Service and/or the National Marine Fisheries Service (the "Services") under section 7 of the Endangered Species Act (ESA) has been concluded and that consultation:

(a) Addressed the effects of your storm water discharges, allowable non-storm water discharges, and discharge-related activities on listed species and critical habitat and

(b) The consultation resulted in either a no jeopardy opinion or a written concurrence by the Service on a finding that your storm water discharges, allowable non-storm water discharges, and discharge-related activities are not likely to adversely affect listed species or critical habitat; or

1.2.3.6.3.3 *Criteria C:* Your activities are authorized under section 10 of the ESA and that authorization addresses the effects of your storm water discharges, allowable non-storm water discharges, and discharge-related activities on listed species and critical habitat; or

1.2.3.6.3.4 *Criteria D:* Using best judgement, you have evaluated the effects of your storm water discharges, allowable non-storm water discharges, and discharge-related activities on listed endangered or threatened species and critical habitat and do not have reason to believe listed species or critical habitat would be adversely affected.

1.2.3.6.3.5 *Criteria E:* Your storm water discharges, allowable non-storm water discharges, and discharge-related activities were already addressed in another operator's certification of eligibility under Part 1.2.3.6.3.1 through 1.2.3.6.3.4 which included your facility's activities. By certifying eligibility under this Part, you agree to comply with any measures or controls upon which the other operator's certification was based;

1.2.3.6.4 The Director may require any permittee or applicant to provide documentation of the permittee or applicant's determination of eligibility for this permit using the procedures in Addendum A where EPA or the Fish and Wildlife and/or National Marine Fisheries Services determine that there is a potential impact on endangered or threatened species or a critical habitat.

1.2.3.6.5 You are not authorized to discharge if the discharges or discharge-related activities cause a prohibited "take" of endangered or threatened species (as defined under section 3 of the Endangered Species Act and 50 CFR 17.3), unless such takes are authorized under sections 7 or 10 of the Endangered Species Act.

1.2.3.6.6 You are not authorized for any discharges where the discharges or discharge-related activities are likely to jeopardize the continued existence of any species that are listed as endangered or threatened under the ESA or result in the adverse modification or destruction of habitat that is designated or proposed to be designated as critical under the ESA.

1.2.3.6.7 The Endangered Species Act (ESA) provisions upon which part 1.2.3.6 is based do not apply to state-issued permits. Should administration of all or a portion of this permit be transfer to a State as a result of that State assuming the NPDES program pursuant to Clean Water Act § 402(b), Part 1.2.3.6 will not apply to any new NOIs submitted to the State after the State assumes administration of the permit (unless otherwise provided in the state program authorization agreement). Likewise, any other permit conditions based on Part 1.2.3.6 will no longer apply to new NOIs accepted by the NPDES-authorized state.

1.2.3.7 *Storm water Discharges and Storm Water Discharge-Related Activities with Unconsidered Adverse Effects on Historic Properties.*

1.2.3.7.1 *Determining Eligibility:* In order to be eligible for coverage under this permit, you must be in compliance with the National Historic Preservation Act. Your discharges may be authorized under this permit only if:

1.2.3.7.1.1 *Criteria A:* Your storm water discharges, allowable non-storm water discharges, and discharge-related activities do not affect a property that is listed or is eligible for listing on the National Register of Historic Places as maintained by the Secretary of the Interior; or

1.2.3.7.1.2 *Criteria B:* You have obtained and are in compliance with a written agreement with the State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Officer (THPO) that outlines all measures you will undertake to mitigate or prevent adverse effect to the historic property.

1.2.3.7.2 Addendum B of this permit provides guidance and references to assist you with determining your permit eligibility concerning this provision.

1.2.3.8 *Discharges to Water Quality-Impaired or Water Quality-Limited Receiving Waters.*

1.2.3.8.1 You are not authorized to discharge if your discharge is prohibited under 40 CFR 122.4(i).

1.2.3.8.2 You are not authorized to discharge any pollutant into any water for which a Total Maximum Daily Load (TMDL) has been either established or approved by the EPA unless your discharge is consistent with that TMDL.

1.2.3.9 *Storm Water Discharges Subject to Anti-degradation Water Quality Standards.* You are not authorized for discharges that do not comply with your State or Tribe's anti-degradation policy for water quality standards. State and Tribal anti-degradation policies can be obtained from the appropriate State or Tribal environmental office or their Internet sites.

1.2.4 Discharges Subject to New Source Performance Standards (NSPS)[1] [2]

1.2.4.1 *Documentation of New Source Review.* If you have a discharge(s) subject to a NSPS effluent guideline, you must obtain and retain the following on site prior to the submittal of your Notice of Intent:

1.2.4.1.1 Documentation from EPA of "No Significant Impact" or

1.2.4.1.2 A completed Environmental Impact Statement in accordance with an environmental review conducted by EPA pursuant to 40 CFR 6.102(a)(6).

1.2.4.2 *Initiating a New Source Review.* If the Agency's decision has not been obtained, you may use the format and procedures specified in Addendum C to submit information to EPA to initiate the process of the environmental review.

To maintain eligibility, you must implement any mitigation required of the facility as a result of the National Environmental Policy Act (NEPA) review process. Failure to implement mitigation measures upon which the Agency's NEPA finding is based is grounds for termination of permit coverage.

1.2.4.3 *NEPA Requirements after State Assumption of this Permit.* The National Environmental Policy Act (NEPA) provisions upon which part 1.2.4 is based do not apply to state-issued permits. Should administration of all or a portion of this permit be transfer to a State as a result of that State assuming the NPDES program pursuant to Clean Water Act § 402(b), Part 1.2.4 will not apply to any new NOIs submitted to the State after the State assumes administration of the permit. Likewise, any other permit conditions based on Part 1.2.4 will no longer apply to new NOIs accepted by the NPDES-authorized state.

1.3 How To Obtain Authorization Under This Permit

1.3.1 Basic Eligibility

You may be authorized under this permit only if you have a discharge of storm water associated with industrial activity from your facility. In order to obtain authorization under this permit, you must:

1.3.1.1 Meet the Part 1.2 eligibility requirements; and

1.3.1.2 Develop and implement a Storm Water Pollution Prevention Plan (SWPPP) (see definition in Part 12) according to the requirements in Part 4 of this permit.

1.3.1.3 Submit a complete Notice of Intent (NOI) in accordance with the requirements of Part 2 of this permit. Any new operator at a facility, including those who replace an operator who has previously obtained permit coverage, must submit an NOI to be covered for discharges for which they are the operator.

1.3.2 Effective Date of Permit Coverage

Unless notified by the Director to the contrary, if you submit a correctly completed NOI in accordance with the requirements of this permit, you are authorized to discharge under the terms and conditions of this permit two (2) days after the date the NOI is postmarked (but in no event, earlier than the effective date of the permit). The Director may deny coverage under this permit and require submission of an application for an individual NPDES permit based on a review of your NOI or other information (see Part 9.12). Authorization to discharge is not automatically granted two days after the NOI is mailed if your NOI is materially incomplete (*e.g.*, critical information left off, NOI unsigned, *etc.*) or if your discharge(s) is not eligible for coverage by the permit.

[1] NSPS apply only to discharges from those facilities or installations that were constructed after the promulgation of NSPS. For example, storm water discharges from areas where the production of asphalt paving and roofing emulsions occurs are subject to NSPS only if the asphalt emulsion facility was constructed after July 24, 1975.

[2] The provisions specified in Part 1.2.2.3 and Part 1.2.4 related to documenting New Source reviews are requirements of Federal programs under the National Environmental Policy Act of 1969 and will not apply to such facilities in the event that authority for the NPDES program has been assumed by the State/Tribe agency and administration of this permit has been transferred to the State/Tribe.

1.4 Terminating Coverage

1.4.1 Submitting a Notice of Termination

If you wish to terminate coverage under this permit, you must submit a Notice of Termination (NOT) in accordance with Part 11 of this permit. You must continue to comply with this permit until you submit an NOT. Your authorization to discharge under the permit terminates at midnight of the day the NOT is signed.

1.4.2 When to Submit an NOT

You must submit an NOT within thirty (30) days after one or more of the following conditions have been met:

1.4.2.1 A new owner/operator has assumed responsibility for the facility

1.4.2.2 You have ceased operations at the facility and there no longer are discharges of storm water associated with industrial activity from the facility and you have already implemented necessary sediment and erosion controls as required by Part 4.2.7.2.2.1

1.4.3 Discharges After the NOT Is Submitted

Enforcement actions may be taken if you submit an NOT without meeting one or more of these conditions, unless you have obtained coverage under an alternate permit or have satisfied the requirements of Part 1.5.

1.5 Conditional Exclusion for No Exposure

If you are covered by this permit, but later are able to file a "no exposure" certification to be excluded from permitting under 40 CFR 122.26(g), you are no longer authorized by nor required to comply with this permit. If you are no longer required to have permit coverage due to a "no exposure" exclusion, you are not required to submit a Notice of Termination.

2. Notice of Intent Requirements

2.1 Notice of Intent (NOI) Deadlines

Your NOI must be submitted in accordance with the deadlines in Table 2–1. You must meet all applicable eligibility conditions of Part 1.2 before you submit your NOI.

TABLE 2.–1—DEADLINES FOR NOI SUBMITTAL

Category	Deadline
1. Existing discharges covered under the 1995 MSGP (see also Part 2.1.2—Interim Coverage).	December 29, 2000.
2. New discharges	Two (2) days prior to commencing operation of the facility with discharges of storm water associated with industrial activity.
3. New owner/operator of existing discharges.	Two (2) days prior to taking operational control of the facility.
4. Continued coverage when the permit expires in 2005.	See Part 9.2

Only one NOI need be submitted to cover all of your activities at the facility (*e.g.*, you do not need to submit a separate NOI for each separate type of industrial activity located at a facility or industrial complex, provided your SWPPP covers each area for which you are an operator).

2.1.1 Submitting a Late NOI

You are not prohibited from submitting an NOI after the dates provided in Table 2–1. If a late NOI is submitted, your authorization is only for discharges that occur after permit coverage is granted. The Agency reserves the right to take appropriate enforcement actions for any unpermitted discharges.

2.1.2 Interim Permit Coverage for 1995 MSGP Permittees

If you had coverage for your facility under the 1995 MSGP, you may be eligible for continued coverage under this permit on an interim basis.

2.1.2.1 *Discharges Authorized Under the 1995 MSGP.* If permit coverage for your facility under the 1995 MSGP was effective as of the date the 1995 MSGP expired (or the date this permit replaced the 1995 MSGP if earlier), your authorization is automatically continued into this replacement permit on an interim basis for up to ninety (90) days from the effective date of the permit. Interim coverage will terminate earlier than the 90 days when an NOI has been submitted and coverage either granted or denied; or after submittal of an NOT.

2.1.2.2 *Discharges Authorized Under the 1995 MSGP, But Not Clearly Eligible for Coverage Under This Permit.* If you were previously covered by the 1995 MSGP, but cannot meet (or cannot immediately determine if you meet) the eligibility requirements of this permit, you may nonetheless be authorized under this permit for a period not to exceed 270 days from the date this permit is published in the **Federal Register**, provided you submit an application for an alternative permit within 90 days from the permit publication date.

2.1.2.3 *Interim Coverage Permit Requirements.* While you are operating under interim coverage status, you must:

2.1.2.3.1 Submit a complete NOI (see Part 2.2) by the deadlines listed in Table 2–1 or Part 2.1.2.2 above.

2.1.2.3.2 Comply with the terms and conditions of the 1995 MSGP.

2.1.2.3.3 Update your Storm Water Pollution Prevention Plan to comply with the requirements of this permit within 90 days after the effective date of this permit.

2.2 Contents of Notice of Intent (NOI)

Your NOI for coverage under this permit must include the following information:

2.2.1 Permit Selection

2.2.1.1 If you were covered under the previous MSGP, provide the permit number assigned to your facility.

2.2.2 Owner/Operator Information

2.2.2.1 The name, address, and telephone number of the operator (*e.g.*, your company, etc.) filing the NOI for permit coverage;

2.2.3 Facility Information

2.2.3.1 The name (or other identifier), address, county, and latitude/longitude of the facility for which the NOI is submitted;

2.2.3.2 An indication of whether you are a Federal, State, Tribal, private, or other public entity;

2.2.3.3 An indication of whether the facility is located on Indian country lands;

2.2.3.4 Certification that a Storm Water Pollution Prevention Plan (SWPPP) meeting the requirements of Part 4 has been developed (including attaching a copy of this permit to the plan;

2.2.3.5 The name of the receiving water(s);

2.2.3.6 The name of the municipal operator if the discharge is through a municipal separate storm sewer system, unless you are the owner/operator of that municipal separate storm sewer system;

2.2.3.7 Identification of applicable sector(s) in this permit, as designated in Table 1–1, that cover the discharges associated with industrial activity you wish to cover under this permit;

2.2.3.8 Up to four 4-digit Standard Industrial Classification (SIC) codes or the 2-letter Activity Codes for hazardous waste treatment, storage, or disposal activities (HZ); land/disposal facilities that receive or have received any industrial waste (LF); steam electric power generating facilities (SE); or treatment works treating domestic sewage (TW) that best represent the principal products produced or services rendered by your facility and major co-located activities;

2.2.4 Eligibility Screening

2.2.4.1 Based on the instructions in Addendum A, whether any listed or proposed threatened or endangered species, or designated critical habitat, are in proximity to the storm water discharges or storm water discharge-related activities to be covered by this permit;

2.2.4.2 Whether any historic property listed or eligible for listing on the National Register of Historic Places is located on the facility or in proximity to the discharge;

2.2.4.3 A signed and dated certification, signed by a authorized representative of your facility and maintained with your SWPPP, as detailed in Part 9.7 that certifies the following:

"I certify under penalty of law that I have read and understand the Part 1.2 eligibility requirements for coverage under the multi-sector storm water general permit including those requirements relating to the protection of endangered or threatened species or critical habitat. To the best of my knowledge, the storm water and allowable non-storm discharges authorized by this permit (and discharged related activities), pose no jeopardy to endangered or threatened species or critical habitat, or are otherwise eligible for coverage under Part 1.2.3.6 of the permit. To the best of my knowledge, I further certify that such discharges and discharge related activities do not have an effect on properties listed or eligible for listing on the National Register or Historic Places under the National Historic Preservation Act, or are otherwise eligible for coverage under Part 1.2.3.7 of the permit. I understand that continued coverage under the multi-sector storm water general permit is contingent upon maintaining eligibility as provided for in Part 1.2"

2.3 Use of NOI Form

You must submit the information required under Part 2.2 on the latest version of the NOI form (or photocopy thereof) contained in Addendum D. Your NOI must be signed and dated in accordance with Part 9.7 of this permit.

Note: If EPA notifies dischargers (either directly, by public notice, or by making information available on the Internet) of other NOI form options that become available at a later date (*e.g.*, electronic submission of forms), you may take advantage of those options to satisfy the NOI use and submittal requirements of Part 2.

2.4 Where To Submit

Your NOI must be signed in accordance with Part 9.7 of this permit and submitted to the Director of the NPDES Permitting Program at the following address: Storm Water Notice of Intent (4203), US EPA, 1200 Pennsylvania Avenue NW, Washington, DC 20460.

2.5 Additional Notification

If your facility discharges through a large or medium municipal separate storm sewer system (MS4), or into a MS4 that has been designated by the permitting authority, you must also submit a signed copy of the NOI to the operator of that MS4 upon request by the MS4 operator.

3. Special Conditions

3.1 Hazardous Substances or Oil

You must prevent or minimize the discharge of hazardous substances or oil in your discharge(s) in accordance with the Storm Water Pollution Prevention Plan for your facility. This permit does not relieve you of the reporting requirements of 40 CFR 110, 40 CFR 117 and 40 CFR 302 relating to spills or other releases of oils or hazardous substances.

3.1.1 Single Releases and Spills

Where a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR 110, 40 CFR 117 or 40 CFR 302, occurs during a 24 hour period:

3.1.1.1 You must notify the National Response Center (NRC) (800–424–8802; in the Washington, DC, metropolitan area call 202–426–2675) in accordance with the requirements of 40 CFR 110, 40 CFR 117 and 40 CFR 302 as soon as he or she has knowledge of the discharge;

3.1.1.2 You must modify your Storm Water Pollution Prevention Plan required under Part 4 within 14 calendar days of knowledge of the release to: provide a description of the release, the circumstances leading to the release, and the date of the release. In addition, you must review your plan to identify measures to prevent the reoccurrence of such releases and to respond to such releases, and you must modify your plan where appropriate.

3.1.2 Anticipated Discharges

Anticipated discharges containing a hazardous substance in an amount equal to or in excess of reporting quantities are those caused by events occurring within the scope of the relevant operating system. If your facilities has (or will have) more than one anticipated discharge per year containing a hazardous substance in an amount equal to or in excess of a reportable quantity, you must:

3.1.2.1 Submit notifications of the first release that occurs during a calendar year (or for the first year of this permit, after submittal of an NOI); and

3.1.2.2 Provide a written description in the SWPPP of the dates on which such releases occurred, the type and estimate of the amount of material released, and the circumstances leading to the releases. In addition, your SWPPP must address measures to minimize such releases.

3.1.2.3 Where a discharge of a hazardous substance or oil in excess of reporting quantities is caused by a non-storm water discharge (*e.g.*, a spill of oil into a separate storm sewer), that discharge is not authorized by the MSGP and you must report the discharge as required under 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302 (see Part 3.1.1. above). In the event of a spill, the requirements of Section 311 of the CWA and other applicable provisions of Sections 301 and 402 of the CWA continue to apply.

3.2 Additional Requirements for Salt Storage

If you have storage piles of salt used for deicing or other commercial or industrial purposes, they must be enclosed or covered to prevent exposure to precipitation (except for exposure resulting from adding or removing materials from the pile). Piles do not need to be enclosed or covered where storm water from the pile is not discharged to waters of the United States or the discharges from the piles are authorized under another permit.

3.3 Discharge Compliance With Water Quality Standards

Your discharges must not be causing or have the reasonable potential to cause or contribute to a violation of a water quality standard. Where a discharge is already authorized under this permit and is later determined to cause or have the reasonable potential to cause or contribute to the violation of an applicable water quality standard, the Director will notify you of such violation(s). You must take all necessary actions to ensure future discharges do not cause or contribute to the violation of a water quality standard and document these actions in the Storm Water Pollution Prevention Plan. If violations remain or re-occur, then coverage under this permit may be terminated by the Director, and an alternative general permit or individual permit may be issued. Compliance with this requirement does not preclude any enforcement activity as provided by the Clean Water Act for the underlying violation.

4. Storm Water Pollution Prevention Plans

4.1 Storm Water Pollution Prevention Plan Requirements

You must prepare a Storm Water Pollution Prevention Plan (SWPPP) for your facility before submitting your Notice of Intent for permit coverage. Your SWPPP must be prepared in accordance with good engineering practices. Use of a registered professional engineer for SWPPP preparation is not required by the permit, but may be independently required under state law and/or local ordinance. Your SWPPP must:

4.1.1 Identify potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges from your facility;

4.1.2 Describe and ensure implementation of practices which you will use to reduce the pollutants in storm water discharges from the facility; and

4.1.3 assure compliance with the terms and conditions of this permit.

Note: At larger installations such as military bases where there are well-defined industrial versus non-industrial areas, the SWPPP required under this Part need only address those areas with discharges of storm water associated with industrial activity. (*e.g.*, under this permit, a U.S. Air Force Base would need to address the vehicle maintenance areas associated with the "airport" portion of the base in the SWPPP, but would not need to address a car wash that served only the on-base housing areas.)

4.2 Contents of Plan

4.24.2.1 Pollution Prevention Team

You must identify the staff individual(s) (by name or title) that comprise the facility's storm water Pollution Prevention Team. Your Pollution Prevention Team is responsible for assisting the facility/plant manager in developing, implementing, maintaining and revising the facility's SWPPP. Responsibilities of each staff individual on the team must be listed.

4.2.2 Site Description

Your SWPPP must include the following:

4.2.2.1 *Activities at Facility.* description of the nature of the industrial activity(ies) at your facility;

4.2.2.2 *General Location Map.* a general location map (*e.g.*, U.S.G.S. quadrangle, or other map) with enough detail to identify the location of your facility and the receiving waters within one mile of the facility;

4.2.2.3 *A legible site map identifying the following:*

4.2.2.3.1 Directions of storm water flow (*e.g*, use arrows to show which ways storm water will flow);

4.2.2.3.2 Locations of all existing structural BMPs;

4.2.2.3.3 Locations of all surface water bodies;

4.2.2.3.4 Locations of potential pollutant sources identified under 4.2.4 and where significant materials are exposed to precipitation;

4.2.2.3.5 Locations where major spills or leaks identified under 4.2.5 have occurred;

4.2.2.3.6 Locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, and liquid storage tanks;

4.2.2.3.7 Locations of storm water outfalls and an approximate outline of the area draining to each outfall;

4.2.2.3.8 Location and description of non-storm water discharges;

4.2.2.3.9 Locations of the following activities where such activities are exposed to precipitation: processing and storage areas; access roads, rail cars and tracks; the location of transfer of substance in bulk; and machinery;

4.2.2.3.10 Location and source of runoff from adjacent property containing significant quantities of pollutants of concern to the facility (an evaluation of how the quality of the storm water running onto your facility impacts your storm water discharges may be included).

4.2.3 Receiving Waters and Wetlands

You must provide the name of the nearest receiving water(s), including intermittent streams, dry sloughs, arroyos and the areal extent and description of wetland or other "special aquatic sites " (see Part 12 for definition) that may receive discharges from your facility.

4.2.4 Summary of Potential Pollutant Sources

You must identify each separate area at your facility where industrial materials or activities are exposed to storm water. Industrial materials or activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product or waste product. For each, separate area identified, the description must include:

4.2.4.1 *Activities in Area.* A list of the activities (*e.g.*, material storage, equipment fueling and cleaning, cutting steel beams); and

4.2.4.2 *Pollutants.* A list of the associated pollutant(s) or pollutant parameter(s) (*e.g.*, crankcase oil, iron, biochemical oxygen demand, pH, *etc.*) for each activity. The pollutant list must include all significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of three (3) years before being covered under this permit and the present.

4.2.5 Spills and Leaks

You must clearly identify areas where potential spills and leaks, which can contribute pollutants to storm water discharges, can occur, and their accompanying drainage points. For areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility to be covered under this permit, you must provide a list of significant spills and leaks of toxic or hazardous pollutants that occurred during the three (3) year period prior to the date of the submission of a Notice of Intent (NOI) . Your list must be updated if significant spills or leaks occur in exposed areas of your facility during the time you are covered by the permit.

Significant spills and leaks include, but are not limited to releases of oil or hazardous substances in excess of quantities that are reportable under CWA § 311 (see 40 CFR 110.10 and 40 CFR 117.21) or section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements.

4.2.6 Sampling Data

You must provide a summary of existing storm water discharge sampling data taken at your facility. All storm water sampling data collected during the term of this permit must also be summarized and included in this part of the SWPPP.

4.2.7 Storm Water Controls

4.2.7.1 *Description of Existing and Planned BMPs.* Describe the type and location of existing non-structural and structural best management practices (BMPs) selected for each of the areas where industrial materials or activities are exposed to storm water. All the areas identified in Part 4.2.4 should have a BMP(s) identified for the area's discharges. For areas where BMPs are not currently in place, describe appropriate BMPs that you will use to control pollutants in storm water discharges. Selection of BMPs should take into consideration:

4.2.7.1.1 The quantity and nature of the pollutants, and their potential to impact the water quality of receiving waters;

4.2.7.1.2 Opportunities to combine the dual purposes of water quality protection and local flood control benefits (including physical impacts of high flows on streams—*e.g.*, bank erosion, impairment of aquatic habitat, etc.);

4.2.7.1.3 Opportunities to offset the impact of impervious areas of the facility on ground water recharge and base flows in local streams (taking into account the potential for ground water contamination—See "User's Guide to the MSGP–2000" section on groundwater considerations).

4.2.7.2 *BMP Types to be Considered.* The following types of structural, non-structural and other BMPs must be considered for implementation at your facility. Describe how each is, or will be, implemented. This requirement may have been fulfilled with the area-specific BMPs identified under Part 4.2.7.2, in which case the previous description is sufficient. However, many of the following BMPs may be more generalized or non site-specific and therefore not previously considered. If you determine that any of these BMPs are not appropriate for your facility, you must include an explanation of why they are not appropriate. The BMP examples listed below are not intended to be an exclusive list of BMPs that you may use. You are encouraged to keep abreast of new BMPs or new applications of existing BMPs to find the most cost effective means of permit compliance for your facility. If BMPs are being used or planned at the facility which are not listed here (*e.g.*, replacing a chemical with a less toxic alternative, adopting a new or innovative BMP, etc.), include descriptions of them in this section of the SWPPP.

4.2.7.2.1 *Non-Structural BMPs.*

4.2.7.2.1.1 *Good Housekeeping:* You must keep all exposed areas of the facility in a clean, orderly manner where such exposed areas could contribute pollutants to storm water discharges. Common problem areas include: around trash containers, storage areas and loading docks. Measures must also include: a schedule for regular pickup and disposal of garbage and waste materials; routine inspections for leaks and conditions of drums, tanks and containers.

4.2.7.2.1.2 *Minimizing Exposure:* Where practicable, industrial materials and activities should be protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, or runoff.

Note: Eliminating exposure at all industrial areas may make the facility eligible for the 40 CFR 122.26(g) "No Exposure" exclusion from needing to have a permit.

4.2.7.2.1.3 *Preventive Maintenance:* You must have a preventive maintenance program which includes timely inspection and maintenance of storm water management devices, (*e.g.*, cleaning oil/water separators, catch basins) as well as inspecting, testing, maintaining and repairing facility equipment and systems to avoid breakdowns or failures that may result in discharges of pollutants to surface waters.

4.2.7.2.1.4 *Spill Prevention and Response Procedures:* You must describe the procedures which will be followed for cleaning up spills or leaks. Those procedures, and necessary spill response equipment, must be made available to those employees that may cause or detect a spill or leak. Where appropriate, you must explain existing or planned material handling procedures, storage requirements, secondary containment, and equipment (*e.g.*, diversion valves), which are intended to minimize spills or leaks at the facility. Measures for cleaning up hazardous material spills or leaks must be consistent with applicable RCRA regulations at 40 CFR Part 264 and 40 CFR Part 265.

4.2.7.2.1.5 *Routine Facility Inspections:* In addition to or as part of the comprehensive site evaluation required under Part 4.9, you must have qualified facility personnel inspect all areas of the facility where industrial materials or activities are exposed to storm water. The inspections must include an evaluation of existing storm water BMPs. Your SWPPP must identify how often these inspections will be conducted. You must correct any deficiencies in implementation of your SWP3 you find as soon as practicable, but not later than within 14 days of the inspection. You must document in your SWPPP the results of your inspections and the corrective actions you took in response to any deficiencies or opportunities for improvement that you identify.

4.2.7.2.1.6 *Employee Training:* You must describe the storm water employee training program for the facility. The description should include the topics to be covered, such as spill response, good housekeeping and material management practices, and must identify periodic dates (*e.g.*, every 6 months during the months of July and January) for such training. You must provide employee training for all employees that work in areas where industrial materials or activities are exposed to storm water, and for employees that are responsible for implementing activities identified in the SWPPP (*e.g.*, inspectors, maintenance people). The employee training should inform them of the components and goals of your SWPPP.

4.2.7.2.2 *Structural BMPs.*

4.2.7.2.2.1 *Sediment and Erosion Control:* You must identify the areas at your facility which, due to topography, land disturbance (*e.g.*, construction), or other factors, have a potential for significant soil erosion. You must describe the structural, vegetative, and/or stabilization BMPs that you will be implementing to limit erosion.

4.2.7.2.2.2 *Management of Runoff:* You must describe the traditional storm water management practices (permanent structural BMPs other than those which control the generation or source(s) of pollutants) that currently exist or that are planned for your facility. These types of BMPs typically are used to divert, infiltrate, reuse, or otherwise reduce pollutants in storm water discharges from the site. All BMPs that you determine are reasonable and appropriate, or are required by a State or local authority; or are necessary to maintain eligibility for the permit (see Part 1.2.3—Limitations on Coverage) must be implemented and maintained. Factors to consider when you are selecting appropriate BMPs should include: (1) The industrial materials and activities that are exposed to storm water, and the associated pollutant potential of those materials and activities; and (2) the beneficial and potential detrimental effects on surface water quality, ground water quality, receiving water base flow (dry weather stream flow), and physical integrity of receiving waters. (See "User's Guide to the MSGP–2000" for Considerations in Selection of BMPs) Structural measures should be placed on upland soils, avoiding wetlands and floodplains, if possible. Structural BMPs may require a separate permit under section 404 of the CWA before installation begins.

4.2.7.2.2.3 *Example BMPs:* BMPs you could use include but are not limited to: storm water detention structures (including wet ponds); storm water retention structures; flow attenuation by use of open vegetated swales and natural depressions;

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infiltration of runoff onsite; and sequential systems (which combine several practices).

4.2.7.2.3 *Other Controls.* No solid materials, including floatable debris, may be discharged to waters of the United States, except as authorized by a permit issued under section 404 of the CWA. Off-site vehicle tracking of raw, final, or waste materials or sediments, and the generation of dust must be minimized. Tracking or blowing of raw, final, or waste materials from areas of no exposure to exposed areas must be minimized. Velocity dissipation devices must be placed at discharge locations and along the length of any outfall channel if they are necessary to provide a non-erosive flow velocity from the structure to a water course.

4.3 Maintenance

All BMPs you identify in your SWPPP must be maintained in effective operating condition. If site inspections required by Part 4.9 identify BMPs that are not operating effectively, maintenance must be performed before the next anticipated storm event, or as necessary to maintain the continued effectiveness of storm water controls. If maintenance prior to the next anticipated storm event is impracticable, maintenance must be scheduled and accomplished as soon as practicable. In the case of non-structural BMPs, the effectiveness of the BMP must be maintained by appropriate means (*e.g.*, spill response supplies available and personnel trained, *etc.*).

4.4 Non-Storm Water Discharges

4.4.1 Certification of Non-Storm Water Discharges

4.4.1.1 Your SWPPP must include a certification that all discharges (*i.e.*, outfalls) have been tested or evaluated for the presence of non-storm water. The certification must be signed in accordance with Part 9.7 of this permit, and include:

4.4.1.1.1 The date of any testing and/or evaluation;

4.4.1.1.2 Identification of potential significant sources of non-storm water at the site;

4.4.1.1.3 A description of the results of any test and/or evaluation for the presence of non-storm water discharges;

4.4.1.1.4 A description of the evaluation criteria or testing method used; and

4.4.1.1.5 A list of the outfalls or onsite drainage points that were directly observed during the test.

4.4.1.2 You do not need to sign a new certification if one was already completed for either the 1992 baseline Industrial General Permit or the 1995 Multi-sector General Permit and you have no reason to believe conditions at the facility have changed.

4.4.1.3 If you are unable to provide the certification required (testing for non-storm water discharges), you must notify the Director 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification must describe:

4.4.1.3.1 Reason(s) why certification was not possible;

4.4.1.3.2 The procedure of any test attempted;

4.4.1.3.3 The results of such test or other relevant observations; and

4.4.1.3.4 Potential sources of non-storm water discharges to the storm sewer.

4.4.1.4 A Copy of the notification must be included in the SWPPP at the facility. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

4.4.2 Allowable Non-Storm Water Discharges

4.4.2.1 Certain sources of non-storm water are allowable under this permit (see 1.2.2.2—Allowable Non-Storm Water Discharges). In order for these discharges to be allowed, your SWPPP must include:

4.4.2.1.1 Identification of each allowable non-storm water source;

4.4.2.1.2 The location where it is likely to be discharged; and

4.4.2.1.3 Descriptions of appropriate BMPs for each source.

4.4.2.2 Except for flows from fire fighting activities, you must identify in your SWPPP all sources of allowable non-storm water that are discharged under the authority of this permit.

4.4.2.3 If you include mist blown from cooling towers amongst your allowable non-storm water discharges, you must specifically evaluate the potential for the discharges to be contaminated by chemicals used in the cooling tower and determined that the levels of such chemicals in the discharges would not cause or contribute to a violation of an applicable water quality standard after implementation of the BMPs you have selected to control such discharges.

4.5 Documentation of Permit Eligibility Related to Endangered Species

Your SWPPP must include documentation supporting your determination of permit eligibility with regard to Part 1.2.3.6 (Endangered Species), including:

4.5.1 Information on whether listed endangered or threatened species, or critical habitat, are found in proximity to your facility;

4.5.2 Whether such species may be affected by your storm water discharges or storm water discharge-related activities;

4.5.3 Results of your Addendum A endangered species screening determinations; and

4.5.4 A description of measures necessary to protect listed endangered or threatened species, or critical habitat, including any terms or conditions that are imposed under the eligibility requirements of Part 1.2.3.6. If you fail to describe and implement such measures, your discharges are ineligible for coverage under this permit.

4.6 Documentation of Permit Eligibility Related to Historic Places

Your SWPPP must include documentation supporting your determination of permit eligibility with regard to Part 1.2.3.7 (Historic Places), including:

4.6.1 Information on whether your storm water discharges or storm water discharge-related activities would have an effect on a property that is listed or eligible for listing on the National Register of Historic Places;

4.6.2 Where effects may occur, any written agreements you have made with the State Historic Preservation Officer, Tribal Historic Preservation Officer, or other Tribal leader to mitigate those effects;

4.6.3 Results of your Addendum B historic places screening determinations; and

4.6.4 Description of measures necessary to avoid or minimize adverse impacts on places listed, or eligible for listing, on the National Register of Historic Places, including any terms or conditions that are imposed under the eligibility requirements of Part 1.2.3.7 of this permit. If you fail to describe and implement such measures, your discharges are ineligible for coverage under this permit.

4.7 Copy of Permit Requirements

You must include a copy of this permit in your SWPPP.

Note: The confirmation of coverage letter you receive from the NOI Processing Center assigning your permit number IS NOT your permit—it merely acknowledges that your NOI has been accepted and you have been authorized to discharge subject to the terms and conditions of today's permit.

4.8 Applicable State, Tribal or Local Plans

Your SWPPP must be consistent (and updated as necessary to remain consistent) with applicable State, Tribal and/or local storm water, waste disposal, sanitary sewer or septic system regulations to the extent these apply to your facility and are more stringent than the requirements of this permit.

4.9 Comprehensive Site Compliance Evaluation

4.9.1 Frequency and Inspectors

You must conduct facility inspections at least once a year. The inspections must be done by qualified personnel provided by you. The qualified personnel you use may be either your own employees or outside consultants that you have hired, provided they are knowledgeable and possess the skills to assess conditions at your facility that could impact storm water quality and assess the effectiveness of the BMPs you have chosen to use to control the quality of your storm water discharges. If you decide to conduct more frequent inspections, your SWPPP must specify the frequency of inspections.

4.9.2 Scope of the Compliance Evaluation

Your inspections must include all areas where industrial materials or activities are exposed to storm water, as identified in 4.2.4, and areas where spills and leaks have occurred within the past 3 years. Inspectors should look for: (a) Industrial materials, residue or trash on the ground that could contaminate or be washed away in storm water; (b) leaks or spills from industrial equipment, drums, barrels, tanks or similar containers; (c) offsite tracking of industrial materials or sediment where vehicles enter or exit the site; (d) tracking or blowing of raw, final, or waste materials from areas of no exposure to exposed areas and (e) for evidence of, or the potential for, pollutants entering the drainage system. Results of both visual and any analytical monitoring done during the year must be taken into consideration during the evaluation. Storm water BMPs identified in your SWPPP must be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they must be inspected to see whether BMPs are effective in preventing significant impacts to receiving waters. Where discharge locations are inaccessible, nearby downstream locations must be inspected if possible.

4.9.3 Follow-Up Actions

Based on the results of the inspection, you must modify your SWPPP as necessary (*e.g.*, show additional controls on map required by Part 4.2.2.3; revise description of controls required by Part 4.2.7 to include additional or modified BMPs designed to correct problems identified. You must complete revisions to the SWPPP within 14 calendar days following the inspection. If existing BMPs need to be modified or if additional BMPs are necessary, implementation must be completed before the next anticipated storm event, if practicable, but not more than twelve (12) weeks after completion of the comprehensive site evaluation.

4.9.4 Compliance Evaluation Report

You must insure a report summarizing the scope of the inspection, name(s) of personnel making the inspection, the date(s) of the inspection, and major observations relating to the implementation of the SWPPP is completed and retained as part of the SWPPP for at least three years from the date permit coverage expires or is terminated. Major observations should include: the location(s) of discharges of pollutants from the site; location(s) of BMPs that need to be maintained; location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location; and location(s) where additional BMPs are needed that did not exist at the time of inspection. You must retain a record of actions taken in accordance with Part 4.9 of this permit as part of the Storm Water Pollution Prevention Plan for at least three years from the date that permit coverage expires or is terminated. The inspection reports must identify any incidents of non-compliance. Where an inspection report does not identify any incidents of non-compliance, the report must contain a certification that the facility is in compliance with the Storm Water Pollution Prevention Plan and this permit. Both the inspection report and any reports of follow-up actions must be signed in accordance with Part 9.7 (reporting) of this permit.

4.9.5 Credit As a Routine Facility Inspection

Where compliance evaluation schedules overlap with inspections required under Part 4.2.7.2.1.5, your annual compliance evaluation may also be used as one of the Part 4.2.7.5 routine inspections.

4.10 Maintaining Updated SWPPP

You must amend the Storm Water Pollution Prevention Plan whenever:

4.10.1 there is a change in design, construction, operation, or maintenance at your facility which has a significant effect on the discharge, or potential for discharge, of pollutants from your facility;

4.10.2 During inspections, monitoring, or investigations by you or by local, State, Tribal or Federal officials it is determined the SWPPP is ineffective in eliminating or significantly minimizing pollutants from sources identified under 4.2.4, or is otherwise not achieving the general objectives of controlling pollutants in discharges from your facility.

4.11 Signature, Plan Review and Making Plans Available

4.11.1 You must sign your SWPPP in accordance with Part 9.7, and retain the plan on-site at the facility covered by this permit (see Part 8 for records retention requirements).

4.11.2 You must keep a copy of the SWPPP on-site or locally available to the Director for review at the time of an on-site inspection. You must make your SWPPP available upon request to the Director, a State, Tribal or local agency approving storm water management plans, or the operator of a municipal separate storm sewer receiving discharge from the site. Also, in the interest of the public's right to know, you must provide a copy of your SWPPP to the public if requested in writing to do so.

4.11.3 The Director may notify you at any time that your SWPPP does not meet one or more of the minimum requirements of this permit. The notification will identify provisions of this permit which are not being met, as well as the required modifications. Within thirty (30) calendar days of receipt of such notification, you must make the required changes to the SWPPP and submit to the Director a written certification that the requested changes have been made.

4.11.4 You must make the SWPPP available to the USFWS or NMFS upon request.

4.12 Additional Requirements for Storm Water Discharges Associated With Industrial Activity From Facilities Subject to EPCRA Section 313 Reporting Requirements

Potential pollutant sources for which you have reporting requirements under EPCRA 313 must be identified in your summary of potential pollutant sources as per Part 4.2.4. Note this additional requirement only applies to you if you are subject to reporting requirements under EPCRA 313.

5. Monitoring Requirements and Numeric Limitations

There are five individual and separate categories of monitoring requirements and numeric limitations that your facility may be subject to under this permit. The monitoring requirements and numeric limitations applicable to your facility depend on a number of factors, including: (1) The types of industrial activities generating storm water runoff from your facility, and (2) the state or tribe where your facility is located. Part 6 identifies monitoring requirements applicable to specific sectors of industrial activity. Part 13 contains additional requirements that apply only to facilities located in a particular State or Indian country land. You must review Parts 5, 6 and 13 of the permit to determine which monitoring requirements and numeric limitations apply to your facility. Unless otherwise specified, limitations and monitoring requirements under Parts 5, 6, and 13 are additive.

Sector-specific monitoring requirements and limitations are applied discharge by discharge at facilities with co-located activities. Where storm water from the co-located activities are co-mingled, the monitoring requirements and limitations are additive. Where more than one numeric limitation for a specific parameter applies to a discharge, compliance with the more restrictive limitation is required. Where monitoring requirements for a monitoring quarter overlap (*e.g.*, need to monitor TSS 1/year for a limit and also 1/quarter for benchmark monitoring), you may use a single sample to satisfy both monitoring requirements.

5.1 Types of Monitoring Requirements and Limitations

5.1.1 Quarterly Visual Monitoring

The requirements and procedures for quarterly visual monitoring are applicable to all facilities covered under this permit, regardless of your facility's sector of industrial activity.

5.1.1.1 You must perform and document a quarterly visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The visual examination must be made during daylight hours (*e.g.*, normal working hours). If no storm event resulted in runoff from the facility during a monitoring quarter, you are excused from visual monitoring for that quarter provided you document in your monitoring records that no runoff occurred. You must sign and certify the documentation in accordance with Part 9.7.

5.1.1.2 Your visual examinations must be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging from your facility. The examination must document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples must be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The 72-hour storm interval is waived when the preceding measurable storm did not yield a measurable discharge, or if you are able to document that less than a 72-hour interval is representative for local storm events during the sampling period. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term. If no qualifying storm event resulted in runoff from the facility during a monitoring quarter, you are excused from visual monitoring for that quarter provided you document in your monitoring records that no qualifying storm event occurred that resulted in storm water runoff during that quarter. You must sign and certify the documentation in accordance with Part 9.7.

5.1.1.3 You must maintain your visual examination reports onsite with the Storm Water Pollution Prevention Plan. The report must include the examination date and time, examination personnel, the nature of the discharge (*i.e.*, runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

5.1.1.4 Inactive and Unstaffed Sites: When you are unable to conduct visual storm water examinations at an inactive and unstaffed site, you may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. If you exercise this waiver, you must maintain a certification with the Storm Water Pollution Prevention Plan stating that the site is inactive and unstaffed and that performing visual examinations during a qualifying event is not feasible. You must sign and certify the waiver in accordance with Part 9.7.

5.1.2 Benchmark Monitoring of Discharges Associated With Specific Industrial Activities

Table 5–1 identifies the specific industrial sectors subject to the Benchmark Monitoring requirements of this permit and the industry-specific pollutants of concern. You must refer to the tables found in the individual Sectors in Part 6 for Benchmark Monitoring Cut-Off Concentrations. If your facility has co-located activities (see Part 1.2.1.1) described in more than one sector in Part 6, you must comply with all applicable benchmark monitoring requirements from each sector.

The results of benchmark monitoring are primarily for your use to determine the overall effectiveness of your SWPPP in controlling the discharge of pollutants to receiving waters. Benchmark values, included in Part 6 of this permit, are not viewed as effluent limitations. An exceedance of a benchmark value does not, in and of itself, constitute a violation of this permit. While exceedance of a benchmark value does not automatically indicate that violation of a water quality standard has occurred, it does signal that modifications to the SWPPP may be necessary. In addition, exceedance of benchmark values may identify facilities that would be more appropriately covered under an individual, or alternative general permit where more specific pollution prevention controls could be required.

TABLE 5–1.—INDUSTRY SECTORS/SUB-SECTORS SUBJECT TO BENCHMARK MONITORING

MSGP sector [1]	Industry sub-sector	Required parameters for benchmark monitoring
A	General Sawmills and Planing Mills	COD, TSS, Zinc.
	Wood Preserving Facilities	Arsenic, Copper.
	Log Storage and Handling	TSS.
	Hardwood Dimension and Flooring Mills	COD, TSS.
B	Paperboard Mills	COD.

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TABLE 5–1.—INDUSTRY SECTORS/SUB-SECTORS SUBJECT TO BENCHMARK MONITORING—Continued

MSGP sector [1]	Industry sub-sector	Required parameters for benchmark monitoring
C	Industrial Inorganic Chemicals	Aluminum, Iron, Nitrate + Nitrite N.
	Plastics, Synthetic Resins, etc.	Zinc.
	Soaps, Detergents, Cosmetics, Perfumes	Nitrate + Nitrite N, Zinc.
	Agricultural Chemicals	Nitrate + Nitrite N, Lead, Iron, Zinc, Phosphorus.
D	Asphalt Paving and Roofing Materials	TSS.
E	Clay Products	Aluminum.
	Concrete Products	TSS, Iron.
F	Steel Works, Blast Furnaces, and Rolling and Finishing Mills.	Aluminum, Zinc.
	Iron and Steel Foundries	Aluminum, TSS, Copper, Iron, Zinc.
	Non-Ferrous Rolling and Drawing	Copper, Zinc.
	Non-Ferrous Foundries (Castings)	Copper, Zinc.
G [2]	Copper Ore Mining and Dressing	COD, TSS, Nitrate + Nitrite N
H	Coal Mines and Coal-Mining Related Facilities	TSS, Aluminum, Iron
J	Dimension Stone, Crushed Stone, and Nonmetallic Minerals (except fuels).	TSS.
	Sand and Gravel Mining	Nitrate + Nitrite N, TSS.
K	Hazardous Waste Treatment Storage or Disposal	Ammonia, Magnesium, COD, Arsenic, Cadmium, Cyanide, Lead, Mercury, Selenium, Silver.
L	Landfills, Land Application Sites, and Open Dumps	Iron, TSS.
M	Automobile Salvage Yards	TSS, Aluminum, Iron, Lead.
N	Scrap Recycling	Copper, Aluminum, Iron, Lead, Zinc, TSS, COD.
O	Steam Electric Generating Facilities	Iron.
Q	Water Transportation Facilities	Aluminum, Iron, Lead, Zinc.
S	Airports with deicing activities [3]	BOD, COD, Ammonia, pH.
U	Grain Mill Products	TSS.
	Fats and Oils	BOD, COD, Nitrate + Nitrite N, TSS.
Y	Rubber Products	Zinc.
AA	Fabricated Metal Products Except Coating	Iron, Aluminum, Zinc, Nitrate + Nitrite N.
	Fabricated Metal Coating and Engraving	Zinc, Nitrate + Nitrite N.

[1] Table does not include parameters for compliance monitoring under effluent limitations guidelines.
[2] See Sector G (Part 6.G) for additional monitoring discharges from waste rock and overburden piles from active ore mining or dressing facilities.
[3] Monitoring requirement is for airports with deicing activities that utilize more than 100 tons of urea or more than 100,000 gallons of ethylene glycol per year.

5.1.2.1 *Monitoring Periods for Benchmark Monitoring.* Unless otherwise specified in Part 6, benchmark monitoring periods are October 1, 2001 to September 30, 2002 (year two of the permit) and October 1, 2003 to September 30, 2004 (year four of the permit). If your facility falls within a Sector(s) required to conduct benchmark monitoring, you must monitor quarterly (4 times a year) during at least one, and potentially both, monitoring periods; unless otherwise specified in the sector-specific requirements of Part 6. Depending on the results of the 2001–2002 monitoring year, you may not be required to conduct benchmark monitoring in the 2003–2004 monitoring year (see Part 5.1.2.2).

5.1.2.2 *Benchmark Monitoring Year 2003–2004 Waivers for Facilities Testing Below Benchmark Values.* All of the provisions of Part 5.1.2.2 are available to permittees except as noted in Part 6. Waivers from benchmark monitoring are available to facilities whose discharges are below benchmark values, thus there is an incentive for facilities to improve the effectiveness of their SWPPPs in eliminating discharges of pollutants and avoid the cost of monitoring.

On both a parameter by parameter and outfall by outfall basis, you are not required to conduct sector-specific benchmark monitoring in the 2003–2004 monitoring year provided:

• You collected samples for all four quarters of the 2001–2002 monitoring year and the average concentration was below the benchmark value in Part 6; and

• You are not subject to a numeric limitation or State/Tribal-specific monitoring requirement for that parameter established in Part 5.2 or Part 13; and

• You include a certification in the SWPPP that based on current potential pollutant sources and BMPs used, discharges from the facility are reasonably expected to be essentially the same (or cleaner) compared to when the benchmark monitoring for the 2001–2002 monitoring year was done.

5.1.2.3 *Inactive and Unstaffed Sites.* If you are unable to conduct benchmark monitoring at an inactive and unstaffed site, you may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. If you exercise this waiver, you must maintain a certification with your Storm Water Pollution Prevention Plan stating that the site is inactive and unstaffed and that performing benchmark monitoring during a qualifying storm event is not feasible. You must sign and certify the waiver in accordance with Part 9.7.

5.1.3 Coal Pile Runoff

5.1.3.1 If your facility has discharges of storm water from coal storage piles, you must comply with the limitations and monitoring requirements of Table 5–2 for all discharges containing the coal pile runoff, regardless of your facility's sector of industrial activity.

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TABLE 5–2.—NUMERIC LIMITATIONS FOR COAL PILE RUNOFF

Parameter	Limit	Monitoring frequency	Sample type
Total Suspended Solids (TSS)	50 mg/L, max	1/year	Grab.
pH	6.0–9.0 min. and max	1/year	Grab.

5.1.3.2 You must not dilute coal pile runoff with storm water or other flows in order to meet this limitation.

5.1.3.3 If your facility is designed, constructed and operated to treat the volume of coal pile runoff that is associated with a 10-year, 24-hour rainfall event, any untreated overflow of coal pile runoff from the treatment unit is not subject to the 50 mg/L limitation for total suspended solids.

5.1.3.4 You must collect and analyze your samples in accordance with Part 5.2.2. Results of the testing must be retained and reported in accordance with Part 8 and 9.16.

5.1.4 Compliance Monitoring for Discharges Subject to Numerical Effluent Limitation Guidelines

Table 1–2 of Part 1.2.2.1.3 of the permit identifies storm water discharges subject to effluent limitation guidelines that are authorized for coverage under the permit. Facilities subject to storm water effluent limitation guidelines are required to monitor such discharges to evaluate compliance with numerical effluent limitations. Industry-specific numerical limitations and compliance monitoring requirements are described in Part 6 of the permit.

5.1.5 Monitoring for Limitations Required by a State or Tribe

Unless otherwise specified in Part 13 (state/tribal-specific permit conditions), you must sample once per year for any permit limit established as a result of a state or tribe's conditions for certification of this permit under CWA § 401.

5.2 Monitoring Instructions

5.2.1 Monitoring Periods

If you are required to conduct monitoring on an annual or quarterly basis, you must collect your samples within the following time periods (unless otherwise specified in Part 6):

• The monitoring year is from October 1 to September 30

• If your permit coverage was effective less than one month from the end of a quarterly or yearly monitoring period, your first monitoring period starts with the next respective monitoring period. (*e.g.*, if permit coverage begins June 5th, you would not need to start quarterly sampling until the July—September quarter, but you would only have from June 5th to September 30th to complete that year's annual monitoring)

5.2.2 Collection and Analysis of Samples

You must assess your sampling requirements on an outfall by outfall basis. You must collect and analyze your samples in accordance with the requirements of Part 9.16.

5.2.2.1 *When and How to Sample.* Take a minimum of one grab sample from the discharge associated with industrial activity resulting from a storm event with at least 0.1 inch of precipitation (defined as a "measurable" event), providing the interval from the preceding measurable storm is at least 72 hours. The 72-hour storm interval is waived when the preceding measurable storm did not yield a measurable discharge, or if you are able to document that less than a 72-hour interval is representative for local storm events during the sampling period.

Take the grab sample during the first 30 minutes of the discharge. If it is not practicable to take the sample during the first 30 minutes, sample during the first hour of discharge and describe why a grab sample during the first 30 minutes was impracticable. Submit this information on or with the discharge monitoring report (see Part 7.1). If the sampled discharge commingles with process or non-process water, attempt to sample the storm water discharge before it mixes with the non-storm water.

To get help with monitoring, consult the *Guidance Manual for the Monitoring and Reporting Requirements of the NPDES Storm Water Multi-Sector General Permit* which can be down loaded from the EPA Web Site at *www.epa.gov/OWM/sw/industry/index.htm.* It can also be ordered from the Office of Water Resource Center by calling 202–260–7786.

5.2.3 Storm Event Data

Along with the results of your monitoring, you must provide the date and duration (in hours) of the storm event(s) samples; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event samples and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge samples.

5.2.4 Representative Outfalls—Essential Identical Discharges

If your facility has two (2) or more outfalls that you believe discharge substantially identical effluents, based on similarities of the industrial activities, significant materials or storm water management practices occurring within the outfalls' drainage areas, you may test the effluent of just one of the outfalls and report that the quantitative data also applies to the substantially identical outfall(s). For this to be permissible, you must describe in the Storm Water Pollution Prevention Plan and include in the Discharge Monitoring Report the following: locations of the outfalls; why the outfalls are expected to discharge substantially identical effluents; estimates of the size of the drainage area (in square feet) for each of the outfalls; and an estimate of the runoff coefficient of the drainage areas (low: under 40 percent; medium: 40 to 65 percent; high: above 65 percent). Note: Page 107 of the *NPDES Storm Water Sampling Guidance Document* (EPA 800/B–92–001) lists criteria for substantially identical outfalls (available on EPA's web site at *http://www.epa.gov/owm/sw/industry/).*

5.3 General Monitoring Waivers

Unless specifically stated otherwise, the following waivers may be applied to any monitoring required under this permit.

5.3.1 Adverse Climatic Conditions Waiver

When adverse weather conditions prevent the collection of samples, take a substitute sample during a qualifying storm event in the next monitoring period, or four samples per monitoring year when weather conditions do not allow for samples to be spaced evenly during the year. Adverse conditions (*i.e.*, those which are dangerous or create inaccessibility for personnel) may include such things as local flooding, high winds, electrical storms, or situations which otherwise make sampling impracticable such as drought or extended frozen conditions.

5.3.2 Alternative Certification of "Not Present or No Exposure"

You are not subject to the analytical monitoring requirements of Part 5.1.2 provided:

5.3.2.1 You make a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring required under Part 5.1.2, that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period; and

5.3.2.2 Your certification is signed in accordance with Part 9.7, retained in the Storm Water Pollution Prevention Plan, and submitted to EPA in accordance with Part 7. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required Part 7; and

5.3.2.3 If you cannot certify for an entire period, you must submit the date exposure was eliminated and any monitoring required up until that date; and

5.3.2.4 No numeric limitation or State-specific monitoring requirement for that parameter is established in Part 5 or Part 13.

5.4 Monitoring Required by the Director

The Director may provide written notice to any facility, including those otherwise exempt from the sampling requirements of Parts 5, 6 and 12, requiring discharge sampling for a specific monitoring frequency for specific parameters. Any such notice will briefly state the reasons for the monitoring, parameters to be monitored, frequency and period of monitoring, sample types, and reporting requirements.

5.5 Reporting Monitoring Results

Deadlines and procedures for submitting monitoring reports are contained in Part 7.

6. Sector-Specific Requirements for Industrial Activity

You only need to comply with the additional requirements of Part 6 that apply to the sector(s) of industrial activity at your facility. These sector-specific requirements are in addition to the "basic" requirements specified in Parts 1–5 and 7–13 of this permit.

6.A Sector A—Timber Products

6.A.1 Covered Storm Water Discharges

The requirements in Part 6.A apply to storm water discharges associated with industrial activity from Timber Products facilities as identified by the SIC Codes specified under Sector A in Table 1–1 of Part 1.2.1.

6.A.2 Industrial Activities Covered by Sector A

The types of activities that permittees under Sector A are primarily engaged in are:

6.A.2.1 Cutting timber and pulpwood (those that have log storage or handling areas);

6.A.2.2 Mills, including merchant, lath, shingle, cooperage stock, planing, plywood and veneer;

6.A.2.3 Producing lumber and wood basic materials;

6.A.2.4 Wood preserving;

6.A.2.5 Manufacturing finished articles made entirely of wood or related materials except wood kitchen cabinet manufacturers (covered under Part 6.23);

6.A.2.6 Manufacturing wood buildings or mobile homes.

6.A.3 Special Coverage Conditions

6.A.3.1 *Prohibition of Discharges.* (See also Part 1.2.3.1) Not covered by this permit: storm water discharges from areas where there may be contact with the chemical formulations sprayed to provide surface protection. These discharges must be covered by a separate NPDES permit.

6.A.3.2 *Authorized Non-Storm Water Discharges.* (See also Part 1.2.3.1) Also authorized by this permit, provided the non-storm water component of the discharge is in compliance with SWPPP requirements in Part 4.2.7 (Controls): discharges from the spray down of lumber and wood product storage yards where no chemical additives are used in the spray down waters and no chemicals are applied to the wood during storage.

6.A.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.A.4.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Also identify where any of the following may be exposed to precipitation/surface runoff: processing areas; treatment chemical storage areas; treated wood and residue storage areas; wet decking areas; dry decking areas; untreated wood and residue storage areas; and treatment equipment storage areas.

6.A.4.2 *Inventory of Exposed Materials.* (See also Part 4.2.4) Where such information exists, if your facility has used chlorophenolic, creosote or chromium-copper-arsenic formulations for wood surface protection or preserving, identify the following: areas where contaminated soils, treatment equipment and stored materials still remain, and the management practices employed to minimize the contact of these materials with storm water runoff.

6.A.4.3 *Description of Storm Water Management Controls.* (See also Part 4.2.7). Describe and implement measures to address the following activities/sources: log, lumber and wood product storage areas; residue storage areas; loading and unloading areas; material handling areas; chemical storage areas; and equipment/vehicle maintenance, storage and repair areas. If your facility performs wood surface protection/preservation activities, address the specific BMPs for these activities.

6.A.4.4 *Good Housekeeping.* (See also Part 4.2.7.2.1.1). In areas where storage, loading/unloading and material handling occur, perform good housekeeping to limit the discharge of wood debris; minimize the leachate generated from decaying wood materials; and minimize the generation of dust.

6.A.4.5 *Inspections.* (See also Part 4.2.7.2.1.5). If your facility performs wood surface protection/preservation activities, inspect processing areas, transport areas and treated wood storage areas monthly to assess the usefulness of practices to minimize the deposit of treatment chemicals on unprotected soils and in areas that will come in contact with storm water discharges.

6.A.5 Monitoring and Reporting Requirements (See also Part 5)

TABLE A–1.—SECTOR-SPECIFIC NUMERIC LIMITATIONS AND BENCHMARK MONITORING

[Sector of permit affected/supplemental requirements]

Subsector (Discharge may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric limitation [2]
General Sawmills and Planning Mills (SIC 2421)	Chemical Oxygen Demand (COD).	120.0 mg/L.	
	Total Suspended Solids (TSS).	100 mg/L.	
	Total Zinc	0.117 mg/L.	
Wood Preserving (SIC 2491)	Total Arsenic	0.16854 mg/L.	
	Total Copper	0.0636 mg/L.	
Log Storage and Handling (SIC 2411)	Total Suspended Solids (TSS).	100 mg/L.	
Wet Decking Discharges at Log Storage and Handling Areas (SIC 2411).	pH		6.0–9.0 s.u.
	Debris (woody material such as bark, twigs, branches, heartwood, or sapwood).		No Discharge of debris that will not pass through a 2.54 cm (1″) diameter round opening.
Hardwood Dimension and Flooring Mills; Special Products Sawmills, not elsewhere classified; Millwork, Veneer, Plywood and Structural Wood; Wood Containers; Wood Buildings and Mobile Homes; Reconstituted Wood Products; and Wood Products Facilities not elsewhere classified (SIC Codes 2426, 2429, 2431–2439 (except 2434), 2448, 2449, 2451, 2452, 2593, and 2499).	Chemical Oxygen Demand (COD).	120.0 mg/L.	
	Total Suspended Solids (TSS).	100.0 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 monitoring years.
[2] Monitor once per year for each monitoring year.

6.B Sector B—Paper and Allied Products Manufacturing

6.B.1 Covered Storm Water Discharges

The requirements in Part 6.B apply to storm water discharges associated with industrial activity from Paper and Allied Products Manufacturing facilities as identified by the SIC Codes specified under Sector B in Table 1–1 of Part 1.2.1.

6.B.2 Industrial Activities Covered by Sector B

The types of activities that permittees under Sector B are primarily engaged in are:

6.B.2.1 Manufacture of pulps from wood and other cellulose fibers and from rags;

6.B.2.2 Manufacture of paper and paperboard into converted products, *i.e.* paper coated off the paper machine, paper bags, paper boxes and envelopes;

6.B.2.3 Manufacture of bags of plastic film and sheet.

6.B.3 Monitoring and Reporting Requirements (See also Part 5)

TABLE B–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring and cutoff concentration [1]	Numeric limitation
Part of Permit Affected/Supplemental Requirements			
Paperboard Mills (SIC Code 2631)	COD	120.0 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 monitoring years

6.C Sector C—Chemical and Allied Products Manufacturing

6.C.1 Covered Storm Water Discharges

The requirements in Part 6.C apply to storm water discharges associated with industrial activity from Chemical and Allied Products Manufacturing facilities as identified by the SIC Codes specified under Sector C in Table 1–1 of Part 1.2.1.

6.C.2 Industrial Activities Covered by Sector C

The requirements listed under this Part apply to storm water discharges associated with industrial activity from a facility engaged in manufacturing the following products:

6.C.2.1 basic industrial inorganic chemicals;

6.C.2.2 plastic materials and synthetic resins, synthetic rubbers, and cellulosic and other human made fibers, except glass;

6.C.2.3 soap and other detergents, including facilities producing glycerin from vegetable and animal fats and oils; speciality cleaning, polishing and sanitation preparations; surface active preparations used as emulsifiers, wetting agents and finishing agents, including sulfonated oils; and perfumes, cosmetics and other toilet preparations;

6.C.2.4 paints (in paste and ready mixed form); varnishes; lacquers; enamels and shellac; putties, wood fillers, and sealers; paint and varnish removers; paint brush cleaners; and allied paint producers;

6.C.2.5 industrial organic chemicals;

6.C.2.6 industrial and household adhesives, glues, caulking compounds, sealants, and linoleum, tile and rubber cements from vegetable, animal or synthetic plastic materials; explosives; printing ink, including gravure, screen process and lithographic inks; miscellaneous chemical preparations such as fatty acids, essential oils, gelatin (except vegetable), sizes, bluing, laundry sours, writing and stamp pad ink, industrial compounds such as boiler and heat insulating compounds, and chemical supplies for foundries;

6.C.2.7 ink and paints, including china painting enamels, indian ink, drawing ink, platinum paints for burnt wood or leather work, paints for china painting, artists' paints and artists' water colors;

6.C.2.8 nitrogenous and phosphatic basic fertilizers, mixed fertilizers, pesticides and other agricultural chemicals.

6.C.3 Limitations on Coverage

6.C.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.3.3) Not covered by this permit: non-storm water discharges containing inks, paints or substances (hazardous, nonhazardous, *etc.*) resulting from an onsite spill, including materials collected in drip pans; washwater from material handling and processing areas; and washwater from drum, tank or container rinsing and cleaning.

6.C.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.C.4.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Also identify where any of the following may be exposed to precipitation/surface runoff: processing and storage areas; access roads, rail cars and tracks; areas where substances are transferred in bulk; and operating machinery.

6.C.4.2 *Potential Pollutant Sources.* (See also Part 4.2.4) Describe the following sources and activities that have potential pollutants associated with them: loading, unloading and transfer of chemicals; outdoor storage of salt, pallets, coal, drums, containers, fuels, fueling stations; vehicle and equipment maintenance/cleaning areas; areas where the treatment, storage or disposal (on- or off-site) of waste/wastewater occur; storage tanks and other containers; processing and storage areas; access roads, rail cars and tracks; areas where the transfer of substances in bulk occurs; and areas where machinery operates.

6.C.4.3 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1) As part of your good housekeeping program, include a schedule for regular pickup and disposal of garbage and waste materials, or adopt other appropriate measures to reduce the potential for discharging storm water that has contacted garbage or waste materials. Routinely inspect the condition of drums, tanks and containers for potential leaks.

6.C.5 Monitoring and Reporting Requirements (See also Part 5)

TABLE C–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration[1]	Numeric limitation[2]
Part of Permit Affected/Supplemental Requirements			
Phosphate Subcategory of the Fertilizer Manufacturing Point Source Category (40 CFR § 418.10)—applies to precipitation runoff, that during manufacturing or processing, comes into contact with any raw materials, intermediate product, finished product, by-products or waste product (SIC 2874).	Total Phosphorus (as P)		105.0 mg/L, daily max. 35 mg/L, 30-day avg.
	Fluoride		75.0 mg/L, daily max. 25.0 mg/L, 30-day avg.
Agricultural Chemicals (2873–2879)	Nitrate plus Nitrite Nitrogen	0.68 mg/L.	
	Total Recoverable Lead	0.0816 mg/L.	
	Total Recoverable Iron	1.0 mg/L.	
	Total Recoverable Zinc	0.117 mg/L.	
	Phosphorus	2.0 mg/L.	
Industrial Inorganic Chemicals (2812–2819)	Total Recoverable Aluminum	0.75 mg/L	Nitrate plus Nitrite Nitrogen
		1.0 mg/L	
	Total Recoverable Iron	0.68 mg/L	
Soaps, Detergents, Cosmetics, and Perfumes (SIC 2841–2844).	Nitrate plus Nitrite Nitrogen	0.68 mg/L.	
	Total Recoverable Zinc	0.117 mg/L..	
Plastics, Synthetics, and Resins (SIC 2821–2824)	Total Recoverable Zinc	0.117 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.
[2] Monitor once/year for each Monitoring Year.

6.D Sector D—Asphalt Paving and Roofing Materials and Lubricant Manufacturers

6.D.1 Covered Storm Water Discharges

The requirements in Part 6.D apply to storm water discharges associated with industrial activity from Asphalt Paving and Roofing Materials and Lubricant Manufacturers facilities as identified by the SIC Codes specified under Sector D in Table 1–1 of Part 1.2.1.

6.D.2 Industrial Activities Covered by Sector D

The types of activities that permittees under Sector D are primarily engaged in are:

6.D.2.1 manufacturing asphalt paving and roofing materials;

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6.D.2.2 portable asphalt plant facilities;
6.D.2.3 manufacturing lubricating oils and greases.

6.D.3 Limitations on Coverage

The following storm water discharges associated with industrial activity are not authorized by this permit:
6.D.3.1 discharges from petroleum refining facilities, including those that manufacture asphalt or asphalt products that are classified as SIC code 2911;
6.D.3.2 discharges from oil recycling facilities;
6.D.3.3 discharges associated with fats and oils rendering.

6.D.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.
6.D.4.1 *Inspections.* (See also Part 4.2.7.2.1.5) Inspect at least once per month, as part of the maintenance program, the following areas: Material storage and handling areas, liquid storage tanks, hoppers/silos, vehicle and equipment maintenance, cleaning and fueling areas, material handling vehicles, equipment and processing areas. Ensure appropriate action is taken in response to the inspection by implementing tracking or follow up procedures.

6.D.5 Monitoring and Reporting Requirements. (See also part 5)

TABLE D–1.—SECTOR-SPECIFIC NUMERIC LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric Limitation [2]
Sector of Permit Affected/Supplemental Requirements			
Asphalt Paving and Roofing Materials (SIC 2951, 2952)	Total Suspended Solids (TSS).	100mg/L.	
Discharges from areas where production of asphalt paving and roofing emulsions occurs (SIC 2951, 2952).	TSS		23.0 mg/L, daily max 15.0 mg/L 30-day avg.
	Oil and Grease		15.0 mg/L daily max. 10mg/L, 30-day avg.
	pH		6.0–9.0

[1] Monitor once/quarter for the year 2 and year 4 monitoring years.
[2] Monitor once per year for each monitoring year.

6.E Sector E—Glass, Clay, Cement, Concrete, and Gypsum Products

6.E.1 Covered Storm Water Discharges

The requirements in Part 6.E apply to storm water discharges associated with industrial activity from Glass, Clay, Cement, Concrete, and Gypsum Products facilities as identified by the SIC Codes specified under Sector E in Table 1–1 of part 1.2.1.

6.E.2 Industrial Activities Covered by Sector E

The requirements listed under this permit apply to storm water discharges associated with industrial activity from a facility engaged in either manufacturing the following products or performing the following activities:
6.E.2.1 flat, pressed, or blown glass or glass containers;
6.E.2.2 hydraulic cement;
6.E.2.3 clay products including tile and brick;
6.E.2.4 pottery and porcelain electrical supplies;
6.E.2.5 concrete products;
6.E.2.6 gypsum products;
6.E.2.7 minerals and earths, ground or otherwise treated;
6.E.2.8 non-clay refractories:
6.E.2.9. lime manufacturing
6.E.2.10 cut stone and stone products
6.E.2.11 asbestos products
6.E.2.12 mineral wool and mineral wool insulation products.

6.E.3 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.
6.E.3.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify the locations of the following, as applicable: bag house or other dust control device; recycle/sedimentation pond, clarifier or other device used for the treatment of process wastewater, and the areas that drain to the treatment device.
6.E.3.2 *Good Housekeeping Measures.* (See also Part 4.2.2.3) With good housekeeping prevent or minimize the discharge of: spilled cement; aggregate (including sand or gravel); kiln dust; fly ash; settled dust; or other significant material in storm water from paved portions of the site that are exposed to storm water. Consider using regular sweeping or other equivalent measures to minimize the presence of these materials. Indicate in your SWPPP the frequency of sweeping or equivalent measures. Determine the frequency from the amount of industrial activity occurring in the area and the frequency of precipitation, but it must be performed at least once a week if cement, aggregate, kiln dust, fly ash or settled dust are being handled/processed. You must also prevent the exposure of fine granular solids (cement, fly ash, kiln dust, *etc.*) to storm water where practicable, by storing these materials in enclosed silos/hoppers, buildings or under other covering.
6.E.3.3 *Inspections.* (See also Part 4.2.7.2.1.5) Perform inspections while the facility is in operation and include all of the following areas exposed to storm water: material handling areas, above ground storage tanks, hoppers or silos, dust collection/containment systems, truck wash down/equipment cleaning areas.
6.E.3.4 *Certification.* (See also Part 4.4.1) For facilities producing ready-mix concrete, concrete block, brick or similar products, include in the non-storm water discharge certification a description of measures that insure that process waste water resulting from truck washing, mixers, transport buckets, forms or other equipment are discharged in accordance with NPDES requirements or are recycled.

6.E.4 Monitoring and Reporting Requirements. (See also Part 5)

TABLE E-1.—SECTOR-SPECIFIC NUMERIC LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric limitaiton [2]
Sector of Permit Affected/Supplemental Requirements			
Clay Product Manufacturers (SIC 3245–3259,3261–3269) Concrete and Gypsum Product Manufacturers (SIC 3271–3275).	Total Recoverable Aluminum.	0.75 mg/L	
	TSS	100 mg/L	
	Total Recoverable Iron	1.0 mg/L	
Cement Manufacturing Facility, Material Storage Runoff: Any discharge composed of runoff that derives from the storage of materials including raw materials, intermediate products, finished products, and waste materials that are used in or derived from the manufacture of cement.	Total Suspended Solids (TTS≤.	50 mg/L daily max..	
	pH		6.0–9.0 S.U.

[1] Monitor once/quarter for the year 2 and year 4 monitoring years.
[2] Monitor once per year for each monitoring year.

6.F Sector F—Primary Metals

6.F.1 Covered Storm Water Discharges

The requirements in Part 6.F apply to storm water discharges associated with industrial activity from Primary Metals facilities as identified by the SIC Codes specified under Sector F in Table 1–1 of Part 1.2.1.

6.F.2 Industrial Activities Covered by Sector F

The types of activities under this Part are facilities primarily engaged in are:

6.F.2.1 Steel works, blast furnaces, and rolling and finishing mills including: steel wire drawing and steel nails and spikes; cold-rolled steel sheet, strip, and bars; and steel pipes and tubes;

6.F.2.2 Iron and steel foundries, including: gray and ductile iron, malleable iron, steel investment, and steel foundries not elsewhere classified;

6.F.2.3 Primary smelting and refining of nonferrous metals, including: primary smelting and refining of copper, and primary production of aluminum;

6.F.2.4 Secondary smelting and refining of nonferrous metals;

6.F.2.5 Rolling, drawing, and extruding of nonferrous metals, including: rolling, drawing, and extruding of copper; rolling, drawing and extruding of nonferrous metals except copper and aluminum; and drawing and insulating of nonferrous wire;

6.F.2.6 Nonferrous foundries (castings), including: aluminum die-casting, nonferrous die-casting, except aluminum, aluminum foundries, copper foundries, and nonferrous foundries, except copper and aluminum;

6.F.2.7 Miscellaneous primary metal products, not elsewhere classified, including: metal heat treating, and primary metal products not elsewhere classified;

Activities covered include but are not limited to storm water discharges associated with cooking operations, sintering plants, blast furnaces, smelting operations, rolling mills, casting operations, heat treating, extruding, drawing, or forging all types of ferrous and nonferrous metals, scrap and ore.

6.F.3 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.F.3.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Also identify where any of the following activities may be exposed to precipitation/surface runoff: storage or disposal of wastes such as spent solvents/baths, sand, slag/dross; liquid storage tanks/drums; processing areas including pollution control equipment (*e.g.*, baghouses); and storage areas of raw material such as coal, coke, scrap, sand, fluxes, refractories or metal in any form. In addition, indicate where an accumulation of significant amounts of particulate matter could occur from such sources as furnace or oven emissions, losses from coal/coke handling operations, etc., and which could result in a discharge of pollutants to waters of the United States.

6.F.3.2 *Inventory of Exposed Material.* (See also Part 4.2.4) Include in the inventory of materials handled at the site that potentially may be exposed to precipitation/runoff, areas where deposition of particulate matter from process air emissions or losses during material handling activities are possible.

6.F.3.3 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1) As part of your good housekeeping program, include: a cleaning/maintenance program for all impervious areas of the facility where particulate matter, dust or debris may accumulate, especially areas where material loading/unloading, storage, handling and processing occur; the paving of areas where vehicle traffic or material storage occur but where vegetative or other stabilization methods are not practicable (institute a sweeping program in these areas too). For unstabilized areas where sweeping is not practicable, consider using storm water management devices such as sediment traps, vegetative buffer strips, filter fabric fence, sediment filtering boom, gravel outlet protection or other equivalent measures that effectively trap or remove sediment.

6.F.3.4 *Inspections.* (See also Part 4.2.7.2.1.5) Conduct inspections routinely, or at least on a quarterly basis, and address all potential sources of pollutants, including (if applicable): air pollution control equipment (*e.g.*, baghouses, electrostatic precipitators, scrubbers and cyclones) for any signs of degradation (*e.g.*, leaks, corrosion or improper operation) that could limit their efficiency and lead to excessive emissions. Consider monitoring air flow at inlets/outlets (or use equivalent measures) to check for leaks (*e.g.*, particulate deposition) or blockage in ducts. Also inspect all process and material handling equipment (*e.g.*, conveyors, cranes and vehicles) for leaks, drips or the potential loss of material; and material storage areas (*e.g.*, piles, bins or hoppers for storing coke, coal, scrap or slag, as well as chemicals stored in tanks/drums) for signs of material losses due to wind or storm water runoff.

6.F.4 Monitoring and Reporting Requirements. (See also Part 5)

TABLE F-1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Sector of permit affected/supplemental requirements—

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cutoff concentration [1]	Numeric limitation
Steel Works, Blast Furnaces, and Rolling and Finishing Mills (SIC 3312–3317).	Total Recoverable Aluminum	0.75 mg/L	
	Total Recoverable Zinc	0.117 mg/L.	
Iron and Steel Foundries (SIC 3321–3325)	Total Recoverable Aluminum	0.75 mg/L.	
	Total Suspended Solids	100 mg/L	
	Total Recoverable Copper	0.0636 mg/L	
	Total Recoverable Iron	1.0 mg/L	
	Total Recoverable Zinc	0.117 mg/L.	
Rolling, Drawing, and Extruding of Non-Ferrous Metals (SIC 3351–3357).	Total Recoverable Copper	0.0636 mg/L	
	Total Recoverable Zinc	0.117 mg/L.	
Non-Ferrous Foundries (SIC 3363–3369)	Total Recoverable Copper	0.636 mg/L.	
	Total Recoverable Zinc	0.117 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.

6.G Sector G—Metal Mining (Ore Mining and Dressing)

6.G.1 Covered Storm Water Discharges

The requirements in Part 6.G apply to storm water discharges associated with industrial activity from active, temporarily inactive and inactive metal mining and ore dressing facilities, including mines abandoned on Federal Lands, as identified by the SIC Codes specified under Sector G in Table 1–1 of Part 1.2.1. Coverage is required for facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate product, finished product, byproduct, or waste product located on the site of the operation.

6.G.1.1 *Covered Discharges from Inactive Facilities:* All storm water discharges.

6.G.1.2 *Covered Discharges from Active and Temporarily Inactive Facilities:* Only the storm water discharges from the following areas are covered: waste rock/overburden piles if composed entirely of storm water and not combining with mine drainage; topsoil piles; offsite haul/access roads; onsite haul/access roads constructed of waste rock/overburden/spent ore if composed entirely of storm water and not combining with mine drainage; onsite haul/access roads not constructed of waste rock/overburden/spent ore except if mine drainage is used for dust control; runoff from tailings dams/dikes when not constructed of waste rock/tailings and no process fluids are present; runoff from tailings dams/dikes when constructed of waste rock/tailings if and no process fluids are present if composed entirely of storm water and not combining with mine drainage; concentration building if no contact with material piles; mill site if no contact with material piles; office/administrative building and housing if mixed with storm water from industrial area; chemical storage area; docking facility if no excessive contact with waste product that would otherwise constitute mine drainage; explosive storage; fuel storage; vehicle/equipment maintenance area/building; parking areas (if necessary); power plant; truck wash areas if no excessive contact with waste product that would otherwise constitute mine drainage; unreclaimed, disturbed areas outside of active mining area; reclaimed areas released from reclamation bonds prior to December 17, 1990; and partially/inadequately reclaimed areas or areas not released from reclamation bonds.

6.G.2 Industrial Activities Covered by Sector G

Note: "metal mining" will connote any of the separate activities listed in Part 6.G.2. The types of activities that permittees under Sector G are primarily engaged in are:

6.G.2.1 exploring for metallic minerals (ores), developing mines and the mining of ores;

6.G.2.2 ore dressing and beneficiating, whether performed at co-located, dedicated mills or separate (*i.e.*, custom) mills.

6.G.3 Limitations on Coverage

6.G.3.1 *Prohibition of Storm Water Discharges.*

Storm water discharges not authorized by this permit: discharges from active metal mining facilities which are subject to effluent limitation guidelines for the Ore Mining and Dressing Point Source Category (40 CFR Part 440).

Note: discharges that come in contact with overburden/waste rock are subject to 40 CFR Part 440, providing: the discharges drain to a point source (either naturally or as a result of intentional diversion) and they combine with "mine drainage" that is otherwise regulated under the Part 440 regulations. Discharges from overburden/waste rock can be covered under this permit if they are composed entirely of storm water, do not combine with sources of mine drainage that are subject to 40 CFR Part 440, and meet other eligibility criteria contained in Part 1.2.2.1.

6.G.3.2 *Prohibition of Non-Storm Water Discharges.*

Not authorized by this permit: adit drainage and contaminated springs or seeps (see also the standard Limitations on Coverage in Part 1.2.3).

6.G.4 Definitions

6.G.4.1 *Mining Operation*—typically consists of three phases, any one of which individually qualifies as a "mining activity." The phases are the exploration and construction phase, the active phase, and the reclamation phase.

6.G.4.2 *Exploration and Construction Phase*—entails exploration and land disturbance activities to determine the financial viability of a site. Construction includes the building of site access roads and removal of overburden and waste rock to expose mineable minerals.

6.G.4.3 *Active Phase*—activities including each step from extraction through production of a salable product.

6.G.4.4 *Reclamation Phase*—activities intended to return the land to its pre-mining use

The following definitions are not intended to supercede the definitions of active and inactive mining facilities established by 40 CFR 122.26(b)(14)(iii).

6.G.4.5 *Active Metal Mining Facility*—a place where work or other activity related to the extraction, removal or recovery of metal ore is being conducted. For surface mines, this definition does not include any land where grading has returned the earth to a desired contour and reclamation has begun.

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6.G.4.6 *Inactive Metal Mining Facility*—a site or portion of a site where metal mining and/or milling occurred in the past but is not an active facility as defined above, and where the inactive portion is not covered by an active mining permit issued by the applicable State or Federal government agency.

6.G.4.7 *Temporarily Inactive Metal Mining Facility*—a site or portion of a site where metal mining and/or milling occurred in the past but currently are not being actively undertaken, and the facility is covered by an active mining permit issued by the applicable State or Federal government agency.

6.G.5 Clearing, Grading and Excavation Activities

Clearing, grading and excavation activities being conducted as part of the exploration and construction phase of a mining operation cannot be covered under this permit if these activities will disturb one or more acre of land. Instead, coverage for these activities must be under the latest version of EPA's General Permit for Storm Water Discharges from Construction Activities (the "Construction General Permit;" **Federal Register**, Vol. 63, p. 7858 and for Region 6, **Federal Register**, Vol. 63, p. 36490), or an individual construction permit. If the area of disturbance during the initial phase is less than one acre, you must continue to comply with the requirements of the MSGP–2000.

6.G.5.1 *Requirements for Activities Disturbing 5 or More Acres of Earth.* If the one-acre limit as defined in Part 6.G.5 is attained, coverage for these activities must be under the latest version of EPA's Construction General Permit (or individual permit). You must first obtain and comply with the Construction General Permit's requirements before submitting the separate Construction General Permit Notice of Intent (NOI) form (EPA Form 3510–9). The February 17, 1998 version of the permit can be downloaded from the EPA's Web Site at *www.epa.gov/owm/sw/construction/cgp/cgp-nat.pdf* and Region 6's July 6, 1998 version of the permit at *www.epa.gov/owm/sw/construction/cgp/cgp-reg6.pdf* or obtained from the Office of Water Resource Center at (202) 260–7786. The NOI form is also available from the Web Site at *www.epa.gov/owm/sw/construction/connoi.pdf* or from your EPA Regional office at the address listed under Part 8.3. Discharges in compliance with the provisions of the Construction General Permit are also authorized under the MSGP.

6.G.5.2 *Cessation of Earth Disturbing Activities.* If exploration phase clearing, grading and excavation activities are completed and no further mining activities will occur at the site, you must comply with the requirements for terminating the Construction General Permit, *i.e.*, stabilize and revegetate the disturbed land, submit a Notice of Termination, etc. If active mining activities will ensue, you must apply for coverage under the MSGP–2000 for your storm water discharges and be prepared to implement any new requirements prior to beginning the active phase. It is recommended you terminate your coverage under the Construction General Permit, but it is not mandatory that you do so. If you choose not to terminate your construction General Permit, you will be responsible for complying with all permit conditions of the construction permit in addition to those of the MSGP–2000. The Notice of Termination form is Addendum E to this permit and is available at http://www.epa.gov/owm/sw/industry/msgp/notform.pdf.

6.G.6 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.G.6.1 *SWPPP Requirements for Active and Temporarily Inactive Metal Mining Facilities.*

6.G.6.1.1 *Nature of Industrial Activities.* (See also Part 4.2.2.1) Briefly describe the mining and associated activities that can potentially affect the storm water discharges covered by this permit, including: the total acreage within the mine site; the estimated acreage of disturbed land; the estimated acreage of land proposed to be disturbed throughout the life of the mine; and a general description of the location of the site relative to major transportation routes and communities.

6.G.6.1.2 *Site Map.* (See also Part 4.2.2.3) Also identify the locations of the following (as appropriate): mining/milling site boundaries; access and haul roads; outline of the drainage areas of each storm water outfall within the facility and indicate the types of discharges from the drainage areas; equipment storage, fueling and maintenance areas; materials handling areas; outdoor manufacturing, storage or material disposal areas; chemicals and explosives storage areas; overburden, materials, soils or waste storage areas; location of mine drainage (where water leaves mine) or other process water; tailings piles/ponds (including proposed ones); heap leach pads; off-site points of discharge for mine drainage/process water; surface waters; and boundary of tributary areas that are subject to effluent limitations guidelines.

6.G.6.1.3 *Potential Pollutant Sources.* (See also Part 4.2.4) For each area of the mine/mill site where storm water discharges associated with industrial activities occur, identify the types of pollutants (e.g., heavy metals, sediment) likely to be present in significant amounts. Consider these factors: the mineralogy of the ore and waste rock (*e.g.*, acid forming); toxicity and quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; vegetation of site (if any); history of significant leaks/spills of toxic or hazardous pollutants. Also include a summary of any existing ore or waste rock/overburden characterization data and test results for potential generation of acid rock. If any new data is acquired due to changes in ore type being mined, update your SWPPP with this information.

6.G.6.1.4 *Site Inspections.* (See also Part 4.2.7.2.1.5) Inspect active mining sites at least monthly. Inspect temporarily inactive sites at least quarterly unless adverse weather conditions make the site inaccessible.

6.G.6.1.5 *Employee Training.* (See also Part 4.2.7.2.1.6) Conduct employee training at least annually at active mining and temporarily inactive sites.

6.G.6.1.6 *Controls.* (See also Part 4.2.7) Consider each of the following BMPs. The potential pollutants identified in Part 6.G.6.1.3 shall determine the priority and appropriateness of the BMPs selected. If you determine that one or more of these BMPs are not appropriate for your facility, explain why it is not appropriate. If BMPs are implemented or planned but are not listed here (*e.g.*, substituting a less toxic chemical for a more toxic one), include descriptions of them in your SWPPP.

6.G.6.1.6.1 *Storm Water Diversions.* Consider diverting storm water away from potential pollutant sources. BMP options: interceptor/diversion controls (*e.g.*, dikes, swales, curbs or berms); pipe slope drains; subsurface drains; conveyance systems (*e.g.*, channels or gutters, open top box culverts and waterbars; rolling dips and road sloping; roadway surface water deflector, and culverts); or their equivalents.

6.G.6.1.6.2 *Sediment and Erosion Control.* (See also Part 4.2.7.2.2.1) At active and temporarily inactive sites consider a range of erosion controls within the broad categories of: flow diversion (*e.g.*, swales); stabilization (*e.g.*, temporary or permanent seeding); and structural controls (*e.g.*, sediment traps, dikes, silt fences).

6.G.6.1.6.3 *Management of Runoff.* (See also Part 4.2.7.2.2.2) Consider the potential pollutant sources given in Part 6.G.6.1.3 when determining reasonable and appropriate measures for managing runoff.

6.G.6.1.6.4 *Capping.* When capping is necessary to minimize pollutant discharges in storm water, identify the source being capped and the material used to construct the cap.

6.G.6.1.6.5 *Treatment.* If treatment of storm water (*e.g.*, chemical or physical systems, oil/water separators, artificial wetlands, etc.) from active and temporarily inactive sites is necessary to protect water quality, describe the type and location of treatment used.

6.G.6.1.6.6 *Certification of Discharge Testing.* (See also Part 4.4.1) Test or evaluate for the presence of specific mining-related non-storm water discharges such as seeps or adit discharges or discharges subject to effluent limitations guidelines (*e.g.*, 40 CFR Part 440), such as mine drainage or process water. Alternatively (if applicable), you may certify in your SWPPP that a particular discharge comprised of commingled storm water and non-storm water is covered under a separate NPDES permit; and that permit subjects the non-storm water portion to effluent limitations prior to any commingling. This certification shall identify the non-storm water discharges, the applicable NPDES permit(s), the effluent limitations placed on the non-storm water discharge by the permit(s), and the points at which the limitations are applied.

6.G.6.2 *SWPPP Requirements for Inactive Metal Mining Facilities.*

6.G.6.2.1 *Nature of Industrial Activities.* (See also Part 4.2.2.1) Briefly describe the mining and associated activities that took place at the site that can potentially affect the storm water discharges covered by this permit. Include: approximate dates of operation; total acreage within the mine and/or processing site; estimate of acres of disturbed earth; activities currently occurring onsite (*e.g.*, reclamation); a general description of site location with respect to transportation routes and communities.

6.G.6.2.2 *Site Map.* (See also Part 4.2.2.3) See Part 6.G.6.1.2 for requirements.

6.G.6.2.3 *Potential Pollutant Sources.* (See also Part 4.2.4) See Part 6.G.6.1.3 for requirements.

6.G.6.2.4 *Controls.* (See also Part 4.2.7) Consider each of the following BMPs. The potential pollutants identified in Part 6.G.6.2.3 shall determine the priority and appropriateness of the BMPs selected. If you determine that one or more of these BMPs are not appropriate for your facility, explain why it is not appropriate. If BMPs are implemented or planned but are not listed here (*e.g.*, substituting a less toxic chemical for a more toxic one), include descriptions of them in your SWPPP. The non-structural controls in the general requirements at Part 4.2.7.2.1 are not required for inactive facilities.

6.G.6.2.4.1 *Storm Water Diversions.* See Part 6.G.6.1.6.2 for requirements.

6.G.6.2.4.2 *Sediment and Erosion Control.* (See also Part 4.2.7.2.2.1) See Part 6.G.6.1.6 for requirements.

6.G.6.2.4.3 *Management of Runoff.* (See also Part 4.2.7.2.2.2)

Also consider the potential pollutant sources as described in Part 6.G.6.2.3 (Summary of Potential Pollutant Sources) when determining reasonable and appropriate measures for managing runoff.

6.G.6.2.4.4 *Capping.* See Part 6.G.6.1.7 for requirements.

6.G.6.2.4.5 *Treatment.* See Part 6.G.6.1.8 for requirements.

6.G.6.2.5 *Comprehensive Site Compliance Evaluation.* (See also Part 4.9)

Annual site compliance evaluations may be impractical for inactive mining sites due to remote location/ inaccessibility of the site; in which case conduct the evaluation at least once every 3 years. Document in the SWPPP why annual compliance evaluations are not possible. If the evaluations will be conducted more often than every 3 years, specify the frequency of evaluations.

6.G.7 Monitoring and Reporting Requirements. (See also Part 5)

6.G.7.1 *Analytic Monitoring for Copper Ore Mining and Dressing Facilities.* Active copper ore mining and dressing facilities must sample and analyze storm water discharges for the pollutants listed in Table G–1.

TABLE G–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING FOR COPPER ORE MINING AND DRESSING FACILITIES

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric limitation
Part of Permit Affected/Supplemental Requirements			
Copper Ore Mining and Dressing Facilities (SIC 1021)	Total Suspended Solids (TSS).	100 mg/L.	
	Nitrate plus Nitrite Nitrogen	0.68 mg/L.	
	Chemical Oxygen Demand (COD).	120 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.

6.G.7.2 *Analytic Monitoring Requirements for Discharges From Waste Rock and Overburden Piles at Active Ore Mining and Dressing Facilities.* For discharges from waste rock and overburden piles, perform analytic monitoring at least once within the first year of permit coverage for the parameters listed in Table G–2, and twice annually thereafter for any parameters measured above the benchmark value (based on the initial sampling event) listed in Table G–2. Permittees must also conduct analytic monitoring twice annually for the parameters listed in Table G–3. The twice annual samples must be collected once between January 1 and June 30 and once between July 1 and December 31, with at least 3 months separating the storm events. The director may, however, notify you that you must perform additional monitoring to accurately characterize the quality and quantity of pollutants discharged from your waste rock/overburden piles. Monitoring requirements for discharges from waste rock and overburden piles are not eligible for the waivers in Part 5.3.2.

TABLE G–2.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING FOR DISCHARGES FROM WASTE ROCK AND OVERBURDEN PILES FROM ACTIVE ORE MINING OR DRESSING FACILITIES

Part of permit affected/supplemental requirements—			
Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cutoff concentration [1]	Numeric limitation
Iron Ores; Copper Ores; Lead and Zinc Ores; Gold and Silver Ores; Ferroalloy Ores Except Vanadium; Miscellaneous Metal Ores (SIC Codes 1011, 1021, 1031, 1041, 1044, 1061, 1081, 1094, 1099).	Total Suspended Solids (TSS)	100 mg/L.	
	Turbidity (NTUs)	5 NTUs above background.	
	pH	6.0–9.0 standard units.	
	Hardness (as $CaCO_3$)	no benchmark value.	
See above, as applicable	Antimony, Total	0.636 mg/L.	
	Arsenic, Total	0.16854 mg/L.	
	Beryllium, Total	0.13 mg/L.	
	Cadmium, Total (hardness dependent)	0.0159 mg/L.	
	Copper, Total (hardness dependent)	0.0636 mg/L.	
	Iron, Total	1.0 mg/L.	
	Lead, Total (hardness dependent)	0.0816 mg/L.	
	Manganese, Total	1.0 mg/L.	
	Mercury, Total	0.0024 mg/L.	
	Nickel, Total (hardness dependent)	1.417 mg/L.	
	Selenium, Total	0.2385 mg/L.	
	Silver, Total (hardness dependent)	0.318 mg/L.	
	Zinc, Total (hardness dependent)	0.117 mg/L.	

[1] Monitor at least once during the first year of permit coverage, and twice annually thereafter for any parameter that exceeds the benchmark value. Facilities that monitored for the full list of Table G–2 parameters during the previous permit need not sample the entire list again, however they must continue twice annual monitoring for parameters that exceeded the benchmark values in the initial sampling event.

6.G.7.2.1 Additional Analytic Monitoring Requirements for Discharges From Waste Rock and Overburden Piles. Table G–3 contains additional monitoring requirements for specific ore mine categories. Perform the monitoring twice annually using the schedule established in Part 6.G.7.2. The initial sampling event for a pollutant parameter required in Table G–2 satisfies the requirement for the first sample of any pollutant measurement in Table G–3.

TABLE G–3.—ADDITIONAL MONOTORING REQUIREMENTS FOR DISCHARGES FROM WASTE ROCK AND OVERBURDEN PILES FROM ACTIVE ORE MINING OR DRESSING FACILITIES

Supplemental requirements—			
Type of Ore mined	Pollutants of concern		
	Total suspended solids (TSS)	pH	Metals, total
Tungsten Ore	X	X	Arsenic, Cadmium (H), Copper (H), Lead (H), Zinc (H).
Nickel Ore	X	X	Arsenic, Cadmium (H), Copper (H), Lead (H), Zinc (H).
Aluminum Ore	X	X	Iron.
Mercury Ore	X	X	Nickel (H).
Iron Ore	X	X	Iron (Dissolved).
Platinum Ore			Cadmium (H), Copper (H), Mercury, Lead (H), Zinc (H).
Titanium Ore	X	X	Iron, Nickel (H), Zinc (H).
Vanadium Ore	X	X	Arsenic, Cadmium (H), Copper (H), Zinc (H).
Copper, Lead, Zinc, Gold, Silver and Molybdenum	X	X	Arsenic, Cadmium (H), Copper (H), Lead, Mercury, Zinc (H).
Uranium, Radium and Vanadium	X	X	Chemical Oxygen Demand, Arsenic, Radium (Dissolved and Total), Uranium, Zinc (H).

Note: (H) indicates that hardness must also be measured when this pollutant is measured.

6.G.7.2.2 *Reporting Requirements Storm Water Discharges From Waste Rock And Overburden Piles From Active Ore Mining or Dressing Facilities.* From active ore mining and dressing facilities, submit monitoring results for each outfall discharging storm water from waste rock and overburden piles, or certifications in accordance with Part 7. Submit monitoring reports on discharge monitoring report (DMR) forms postmarked no later than January 28 of the next year after the samples were collected.

TABLE G–4.—APPLICABILITY OF THE MULTI-SECTOR GENERAL PERMIT TO STORM WATER RUNOFF FROM ACTIVE ORE (METAL) MINING AND DRESSING SITES

Discharge/source of discharge	Note/comment
Piles	
Waste rock/overburden	If composed entirely of storm water and not combining with mine drainage. See Note below.
Topsoil	
Roads constructed of waste rock or spent ore	
Onsite haul roads	If composed entirely of storm water and not combining with mine drainage. See Note below.
Offsite haul/access roads	
Roads not constructed of waste rock or spent ore	
Onsite haul roads	Except if "mine drainage" is used for dust control.
Offsite haul/access roads	
Milling/concentrating	
Runoff from tailings dams/dikes when constructed of waste rock/tailings	Except if process fluids are present and only if composed entirely of storm water and not combining with mine drainage. See Note below.
Runoff from tailings dams/dikes when not constructed of waste rock/tailings	Except if process fluids are present.
Concentration building	If storm water only and no contact with piles.
Mill site	If storm water only and no contact with piles.
Ancillary areas	
Office/administrative building and housing	If mixed with storm water from the industrial area.
Chemical storage area	
Docking facility	Except if excessive contact with waste product that would otherwise constitute "mine drainage".
Explosive storage	
Fuel storage (oil tanks/coal piles)	
Vehicle/equipment maintenance area/building	
Parking areas	But coverage unnecessary if only employee and visitor-type parking.
Power plant	
Truck wash area	Except when excessive contact with waste product that would otherwise constitute "mine drainage".
Reclamation-related areas	
Any disturbed area (unreclaimed)	Only if not in active mining area.
Reclaimed areas released from reclamation bonds prior to Dec. 17 1990.	
Partially/inadequately reclaimed areas or areas not released from reclamation bond.	

Note: Storm water runoff from these sources are subject to the NPDES program for storm water unless mixed with discharges subject to the 40 CFR Part 440 that are not regulated by another permit prior to mixing. Non-storm water discharges from these sources are subject to NPDES permitting and may be subject to the effluent limitation guidelines under 40 CFR Part 440.

Discharges from overburden/waste rock and overburden/waste rock-related areas are not subject to 40 CFR Part 440 unless: (1) it drains naturally (or is intentionally diverted) to a point source; and (2) combines with "mine drainage" that is otherwise regulated under the Part 440 regulations. For such sources, coverage under this permit would be available if the discharge composed entirely of storm water does not combine with other sources of mine drainage that are not subject to 40 CFR Part 440, as well as meeting other eligibility criteria contained in Part I.B. of the permit. Permit applicants bear the initial responsibility for determining the applicable technology-based standard for such discharges. EPA recommends that permit applicants contact the relevant NPDES permit issuance authority for assistance to determine the nature and scope of the "active mining area" on a mine-by-mine basis, as well as to determine the appropriate permitting mechanism for authorizing such discharges.

6.H Sector H—Coal Mines and Coal Mining Related Facilities

6.H.1 Covered Storm Water Discharges

The requirements in Part 6.H apply to storm water discharges associated with industrial activity from Coal Mines and Coal Mining Related facilities as identified by the SIC Codes specified under Sector H in Table 1-1 of Part 1.2.1.

6.H.2 Industrial Activities Covered by Sector H

Storm water discharges from the following portions of coal mines may be eligible for this permit:

6.H.2.1 Haul roads (nonpublic roads on which coal or coal refuse is conveyed);

6.H.2.2 Access roads (nonpublic roads providing light vehicular traffic within the facility property and to public roadways);

6.H.2.3 Railroad spurs, siding and internal haulage lines (rail lines used for hauling coal within the facility property and to offsite commercial railroad lines or loading areas);

6.H.2.4 Conveyor belts, chutes and aerial tramway haulage areas (areas under and around coal or refuse conveyer areas, including transfer stations); and

6.H.2.5 Equipment storage and maintenance yards, coal handling buildings and structures, and inactive coal mines and related areas (abandoned and other inactive mines, refuse disposal sites and other mining-related areas).

6.H.3 Limitation on Coverage

6.H.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.2.2) Not covered by this permit: discharges from pollutant seeps or underground drainage from inactive coal mines and refuse disposal areas that do not result from precipitation events; and discharges from floor drains in maintenance buildings and other similar drains in mining and preparation plant areas.

6.H.3.2 *Discharges Subject to Storm Water Effluent Guidelines.* (See also Part 1.2.3.4) Not authorized by this permit: storm water discharges subject to an existing effluent limitation guideline at 40 CFR Part 434.

6.H.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4 of the MSGP.

6.H.4.1 *Other Applicable Regulations.* Most active coal mining-related areas (SIC Codes 1221–1241) are subject to sediment and erosion control regulations of the U.S. Office of Surface Mining (OSM) that enforces the Surface Mining Control and Reclamation Act (SMCRA). OSM has granted authority to most coal producing states to implement SMCRA through State SMCRA regulations. All SMCRA requirements regarding control of storm water-related pollutant discharges must be addressed in the SWPPP (directly or by reference).

6.H.4.2 *Drainage Area Site Map.* (See also Part 4.2.2.3) Also identify where any of the following may be exposed to precipitation/surface runoff: all applicable mining related areas described in Part 6.H.2; acidic spoil, refuse or unreclaimed disturbed areas, and liquid storage tanks containing pollutants such as caustics, hydraulic fluids and lubricants.

6.H.4.3 *Potential Pollutant Sources.* (See also Part 4.2.4) Describe the following sources and activities that have potential pollutants associated with them: truck traffic on haul roads and resulting generation of sediment subject to runoff and dust generation; fuel or other liquid storage; pressure lines containing slurry, hydraulic fluid or other potential harmful liquids; and loading or temporary storage of acidic refuse/spoil.

6.H.4.4 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1) As part of your good housekeeping program, consider: using sweepers; covered storage; watering haul roads to minimize dust generation; and conserving vegetation (where possible) to minimize erosion.

6.H.4.5 *Preventive Maintenance.* (See also Part 4.2.7.2.1.3) Also perform inspections of storage tanks and pressure lines of fuels, lubricants, hydraulic fluid or slurry to prevent leaks due to deterioration or faulty connections; or other equivalent measures.

6.H.4.6 *Inspections of Active Mining-Related Areas and Inactive Areas Under SMCRA Bond Authority.* (See also Part 4.2.7.2.1.5) Perform quarterly inspections of areas covered by this permit, corresponding with the inspections, as performed by SMCRA inspectors, of all mining-related areas required by SMCRA. Also maintain the records of the SMCRA authority representative.

6.H.4.7 *Sediment and Erosion Control.* (See also Part 4.2.7.2.2.1) As indicated in Part 6.H.4.1 above, SMCRA requirements regarding sediment and erosion control measures are primary requirements of the SWPPP for mining-related areas subject to SMCRA authority.

6.H.4.8 *Comprehensive Site Compliance Evaluation.* (See also Part 4.9.2) Include in your evaluation program, inspections for pollutants entering the drainage system from activities located on or near coal mining-related areas. Among the areas to be inspected: haul and access roads; railroad spurs, sliding and internal hauling lines; conveyor belts, chutes and aerial tramways; equipment storage and maintenance yards; coal handling buildings/structures; and inactive mines and related areas.

6.H.6 Monitoring and Reporting Requirements. (See also Part 5)

TABLE H-1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cutoff concentration [1]	Numeric limitation
Part of Permit Affected/Supplemental Requirements			
Coal Mines and Related Areas (SIC 1221–1241)	Total Recoverable Aluminum	0.75 mg/L.	
	Total Recoverable Iron	1.0 mg/L.	
	Total Suspended Solids	100 mg/L..	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.

6.I Sector I—Oil and Gas Extraction and Refining

6.I.1 Covered Storm Water Discharges

The requirements in Part 6.I apply to storm water discharges associated with industrial activity from Oil and Gas Extraction and Refining facilities as identified by the SIC Codes specified under Sector I in Table 1–1 of Part 1.2.1.

6.I.2 Industrial Activities Covered By Sector I

The types of activities that permittees under Sector I are primarily engaged in are:

6.I.2.1 Oil and gas exploration, production, processing or treatment operations, or transmission facilities;

6.I.2.2 Extraction and production of crude oil, natural gas, oil sands and shale; the production of hydrocarbon liquids and natural gas from coal; and associated oil field service, supply and repair industries.

6.I.3 Limitations On Coverage

6.I.3.1 *Prohibition of Storm Water Discharges.* This permit does not authorize contaminated storm water discharges from petroleum refining or drilling operations that are subject to nationally established BAT or BPT guidelines found at 40 CFR Parts 419 and 435, respectively. Note: most contaminated discharges at petroleum refining and drilling facilities are subject to these effluent guidelines and are not eligible for coverage by this permit.

6.I.3.2 *Prohibition of Non-Storm Water Discharges.* Not authorized by this permit: discharges of vehicle and equipment washwater, including tank cleaning operations.

Alternatively, washwater discharges must be authorized under a separate NPDES permit, or be discharged to a sanitary sewer in accordance with applicable industrial pretreatment requirements.

6.I.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.I.4.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: Reportable Quantity (RQ) releases; locations used for the treatment, storage or disposal of wastes; processing areas and storage areas; chemical mixing areas; construction and drilling areas; all areas subject to the effluent guidelines requirements for "No Discharge" in accordance with 40 CFR 435.32; and the structural controls to achieve compliance with the "No Discharge" requirements.

6.I.4.2 *Potential Pollutant Sources.* (See also Part 4.2.4)

Also describe the following sources and activities that have potential pollutants associated with them: chemical, cement, mud or gel mixing activities; drilling or mining activities; and equipment cleaning and rehabilitation activities. In addition, include information about the RQ release that triggered the permit application requirements; the nature of release (*e.g.*, spill of oil from a drum storage area); the amount of oil or hazardous substance released; amount of substance recovered; date of the release; cause of the release (*e.g.*, poor handling techniques and lack of containment in the area); areas affected by the release (i.e., land and water); procedure to clean up release; actions or procedures implemented to prevent or improve response to a release; and remaining potential contamination of storm water from release (taking into account human health risks, the control of drinking water intakes and the designated uses of the receiving water).

6.I.4.3 *Inspections.* (See also Part 4.2.7.2.1.5)

6.I.4.3.1 *Inspection Frequency.* Inspect all equipment and areas addressed in the SWPPP at a minimum of 6-month intervals. Routinely (but not less than quarterly) inspect equipment and vehicles which store, mix (including all on and offsite mixing tanks) or transport chemicals/hazardous materials (including those transporting supplies to oil field activities).

6.I.4.3.2 *Temporarily or Permanently Inactive Oil and Gas Extraction Facilities.* For these facilities that are remotely located and unstaffed, perform the inspections at least annually.

6.I.4.4 *Sediment and Erosion Control.* (See also Part 4.2.7.2.2.1) Unless covered by the General Permit for Construction Activity, the additional sediment and erosion control requirements for well drillings, and sand/shale mining areas include the following:

6.I.4.4.1 *Site Description:* Also include: a description of the nature of the exploration activity; estimates of the total area of site and area disturbed due to exploration activity; an estimate of runoff coefficient of the site; site drainage map, including approximate slopes; and the name of all receiving waters. All sediment and erosion control measures must be inspected once every seven days.

6.I.4.4.2 *Vegetative Controls:* Describe and implement vegetative practices designed to preserve existing vegetation where attainable and re-vegetate open areas as soon as practicable after grade drilling. Consider the following (or equivalent measures): temporary or permanent seeding, mulching, sod stabilization, vegetative buffer strips, tree protection practices. Begin implementing appropriate vegetative practices on all disturbed areas within 14 days following the last activity in that area.

6.I.4.5 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.I.4.5.1 *Vehicle and Equipment Storage Areas.* Confine vehicles/equipment awaiting or having undergone maintenance to designated areas (as marked on site map). Describe and implement measures to minimize contaminants from these areas (*e.g.*, drip pans under equipment, indoor storage, use of berms or dikes, or other equivalent measures).

6.I.4.5.2 *Material and Chemical Storage Areas.* Maintain these areas in good conditions to prevent contamination of storm water. Plainly label all hazardous materials.

6.I.4.5.3 *Chemical Mixing Areas.* (See also Part 4.4)

Describe and implement measures that prevent or minimize contamination of storm water runoff from chemical mixing areas.

6.J Sector J—Mineral Mining and Dressing

6.J.1 Covered Storm Water Discharges

The requirements in Part 6.J apply to storm water discharges associated with industrial activity from active and inactive mineral mining and dressing facilities as identified by the SIC Codes specified under Sector J in Table 1–1 of Part 1.2.1.

6.J.2 Industrial Activities Covered by Sector J

The types of activities that permittees under Sector J are primarily engaged in are:

6.J.2.1 exploring for minerals (*e.g.*, stone, sand, clay, chemical and fertilizer minerals, non-metallic minerals, etc.), developing mines and the mining of minerals; and

6.J.2.2 mineral dressing, and non-metallic mineral services.

6.J.3 Limitations on Coverage

Not authorized by this permit: most storm water discharges subject to an existing effluent limitation guideline at 40 CFR part 436. The exceptions to this limitation and which are therefore covered by the MSGP–2000 are mine dewatering discharges composed entirely of storm water or ground water seepage from: construction sand and gravel, industrial sand, and crushed stone mining facilities in Regions 1, 2, 3, 6, 8, 9, and 10.

6.J.4 Definitions

6.J.4.1 *Mining Operation*—typically consists of three-phases, any one of which individually qualifies as a "mining activity." The phases are the exploration and construction phase, the active phase and the reclamation phase.

6.J.4.2 *Exploration and Construction Phase*—entails exploration and land disturbance activities to determine the financial viability of a site. Construction includes the building of site access roads and removal of overburden and waste rock to expose mineable minerals.

6.J.4.3 *Active Phase*—activities including each step from extraction through production of a salable product.

6.J.4.4 *Reclamation phase*—activities intended to return the land to its pre-mining state.

Note: The following definitions are not intended to supercede the definitions of active and inactive mining facilities established by 40 CFR 122.26(b)(14)(iii).

6.J.4.5 *Active Mineral Mining Facility*—a place where work or other activity related to the extraction, removal or recovery of minerals is being conducted. This definition does not include any land where grading has returned the earth to a desired contour and reclamation has begun.

6.J.4.6 *Inactive Mineral Mining Facility*—a site or portion of a site where mineral mining and/or dressing occurred in the past but is not an active facility as defined above, and where the inactive portion is not covered by an active permit issued by the applicable State or Federal government agency.

6.J.4.7 *Temporarily Inactive Mineral Mining Facility*—a site or portion of a site where mineral mining and/or dressing occurred in the past but currently are not being actively undertaken, and the facility is covered by an active mining permit issued by the applicable State or Federal government agency.

6.J.5 Clearing, Grading and Excavation Activities

Clearing, grading and excavation activities being conducted as part of the exploration and construction phase of a mineral mining operation cannot be covered under this permit if these activities will disturb one or more acre of land. Instead, coverage for these activities must be under the latest version of EPA's General Permit for Storm Water Discharges from Construction Activities (the "Construction General Permit;" **Federal Register**, Vol. 63, p. 7858) and, for Region 6, **Federal Register**, Vol. 63, p. 36490), or an individual construction permit. If the area of disturbance during the initial phase is less than one acre, you must continue to comply with the requirements of the MSGP–2000.

6.J.5.1 *Obtaining Coverage Under the Construction General Permit.* If the one-acre limit as described in Part 6.J.5 is attained, coverage for these activities must be under the latest version of EPA's Construction General Permit (or individual permit). You must first obtain and comply with the Construction General Permit's requirements before submitting the separate Construction General Permit Notice of Intent (NOI) form (EPA Form 3510–9). The February 17, 1998 version of the permit can be downloaded from the EPA's Web Site at *http://www.epa.gov/owm/sw/construction/cgp/cgp-nat.pdf* or obtained from the Office of Water Resource Center at (202) 260–7786. The NOI form is also available from the Web Site at *http://www.epa.gov/owm/sw/construction/connoi.pdf* or from your EPA Regional office at the address listed under Part 8.3. Discharges in compliance with the provisions of the Construction General Permit are also authorized under the MSGP.

6.J.5.2 *Cessation of Exploration and Construction Activities.* If exploration phase clearing, grading and excavation activities are completed and no further mining activities will occur at the site, you must comply with the requirements for terminating the Construction General Permit, *i.e.*, stabilize and revegetate the disturbed land, submit a Notice of Termination, etc. If active mining operations will ensue, you must apply for coverage under the MSGP–2000 for your storm water discharges and be prepared to implement any new requirements prior to beginning the active phase. It is recommended you terminate your coverage under the construction general permit, but you are not required to do so. If you choose to not terminate, you will be responsible for complying with all permit conditions of the construction permit in addition to those of the MSGP–2000. The Notice of Termination form is available in Addendum F to this permit and at *http://www.epa.gov/owm/sw/industry/msgp/notform.pdf.*

6.J.6 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4 of the MSGP.

6.J.6.1 *Inspections.* (See also Part 4.2.7.2.1.5) Conduct quarterly visual inspections of all BMPs at active mining facilities. At temporarily or permanently inactive facilities, perform annual inspections. Include in your inspection program: assessment of the integrity of storm water discharge diversions, conveyance systems, sediment control and collection systems and containment structures; inspections to determine if soil erosion has occurred at, or as a result of vegetative BMPs, serrated slopes and benched slopes; inspections of material handling and storage areas and other potential sources of pollution for evidence of actual or potential discharges of contaminated storm water.

6.J.7 Monitoring and Reporting Requirements. (See also Part 5)

TABLE J–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric limitation [2]
Part of Permit Affected/Supplemental Requirements			
Mine Dewatering Activities at Construction Sand and Gravel; Industrial Sand; and Crushed Stone Mining Facilities (SIC 1422–1429, 1442, 1446).	Total Suspended Solids		25 mg/L, monthly avg. 45 mg/L, daily max
	pH		6.0–9.0
Sand and Gravel Mining (SIC 1442, 1446)	Nitrate plus Nitrogen	0.68 mg/L.	
	Total Suspended Solids	100 mg/L.	

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TABLE J–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING—Continued

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric limitation [2]
Dimension and Crushed Stone and Nonmetallic Minerals (except fuels) (SIC 1411, 1422–1429, 1481, 1499).	Total Suspended Solids	100 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.
[2] Monitor once/year for Each Monitoring Year.

6.K Sector K—Hazardous Waste Treatment, Storage or Disposal Facilities

6.K.1 Covered Storm Water Discharges

The requirements in Part 6.K apply to storm water discharges associated with industrial activity from Hazardous Waste Treatment, Storage or Disposal facilities as identified by the Activity Code specified under Sector K in Table 1–1 of Part 1.2.1.

6.K.2 Industrial Activities Covered by Sector K

This permit authorizes storm water discharges associated with industrial activity from facilities that treat, store or dispose of hazardous wastes, including those that are operating under interim status or a permit under subtitle C of RCRA.

6.K.3 Limitations on Coverage

For facilities located in Region 6, coverage is limited to Hazardous Waste Treatment Storage or Disposal Facilities (TSDF's) that are self-generating or handle residential wastes only and to those facilities that only store hazardous wastes and do not treat or dispose. Those permits are issued by EPA Region 6 for Louisiana (LAR05*###), New Mexico (NMR05*###), Oklahoma (OKR05*###), and Federal Indian Reservations in these States (LAR05*##F, NMR05*##F, OKR05*##F, or TXR05*##F). Coverage under this permit is not available to commercial hazardous waste disposal/treatment facilities located in Region 6 that dispose and treat on a commercial basis any produced hazardous wastes (not their own) as a service to generators.

6.K.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.3.1) Not authorized by this permit: leachate, gas collection condensate, drained free liquids, contaminated ground water, laboratory-derived wastewater and contact washwater from washing truck and railcar exteriors and surface areas which have come in direct contact with solid waste at the landfill facility.

6.K.4 Definitions

6.K.4.1 *Contaminated storm water*—storm water which comes in direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater as defined in Part 6.K.4.5. Some specific areas of a landfill that may produce contaminated storm water include (but are not limited to): the open face of an active landfill with exposed waste (no cover added); the areas around wastewater treatment operations; trucks, equipment or machinery that has been in direct contact with the waste; and waste dumping areas.

6.K.4.2 *Drained free liquids*—aqueous wastes drained from waste containers (*e.g.*, drums, etc.) prior to landfilling.

6.K.4.3 *Land treatment facility*—a facility or part of a facility at which hazardous waste is applied onto or incorporated into the soil surface; such facilities are disposal facilities if the waste will remain after closure.

6.K.4.4 *Landfill*—an area of land or an excavation in which wastes are placed for permanent disposal, that is not a land application or land treatment unit, surface impoundment, underground injection well, waste pile, salt dome formation, a salt bed formation, an underground mine or a cave as these terms are defined in 40 CFR 257.2, 258.2 and 260.10.

6.K.4.5 *Landfill wastewater*—as defined in 40 CFR Part 445 (Landfills Point Source Category) all wastewater associated with, or produced by, landfilling activities except for sanitary wastewater, non-contaminated storm water, contaminated groundwater, and wastewater from recovery pumping wells. Landfill wastewater includes, but is not limited to, leachate, gas collection condensate, drained free liquids, laboratory derived wastewater, contaminated storm water and contact washwater from washing truck, equipment, and railcar exteriors and surface areas which have come in direct contact with solid waste at the landfill facility.

6.K.4.6 *Leachate*—liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste.

6.K.4.7 *Non-contaminated storm water*—storm water which does not come into direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater as defined in Part 6.K.4.5. Non-contaminated storm water includes storm water which flows off the cap, cover, intermediate cover, daily cover, and/or final cover of the landfill.

6.K.4.8 *Pile*—any non-containerized accumulation of solid, nonflowing hazardous waste that is used for treatment or storage and that is not a containment building.

6.K.4.9 *Surface impoundment*—a facility or part of a facility which is a natural topographic depression, man-made excavation or diked area formed primarily of earthen materials (although it may be lined with man-made materials), which is designed to hold an accumulation of liquid wastes or wastes containing free liquids, and which is not an injection well. Examples of surface impoundments are holding, storage, settling, and aeration pits, ponds and lagoons.

6.K.5 Numeric Limitations, Monitoring and Reporting Requirements. (See also Part 5)

TABLE K–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK AND COMPLIANCE MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric limitation [2]
Part of Permit Affected/Supplemental Requirements			
ALL—Industrial Activity Code "HZ" (Note: permit coverage limited in some States)	Ammonia	19.0 mg/L	
	Total Recoverable Magnesium.	0.0636 mg/L	
	Chemical Oxygen Demand (COD).	120.0 mg/L	
	Total Recoverable Arsenic	0.16854 mg/L	
	Total Recoverable Cadmium.	0.0159 mg/L	
	Total Cyanide	0.0636 mg/L	
	Total Recoverable Lead	0.0816 mg/L	
	Total Recoverable Mercury	0.0024 mg/L	
	Total Recoverable Selenium.	0.2385 mg/L	
	Total Recoverable Silver	0.0318 mg/L	
ALL—Industrial Activity Code "HZ" Subject to the Provisions of 40 CFR Part 445 Subpart A.	BOD5		220 mg/l, daily max. 56 mg/l, monthly avg. maximum.
	TSS		88 mg/l, daily max. 27 mg/l, monthly avg. maximum.
	Ammonia		10 mg/l, daily maximum. 4.9 mg/l, monthly avg. maximum.
	Alpha Terpineol		0.042 mg/l, daily max. 0.019 mg/l, monthly avg. maximum.
	Aniline		0.024 mg/l, daily max. 0.015 mg/l, monthly avg. maximum.
	Benzoic Acid		0.119 mg/l, daily max. 0.073 mg/l, monthly avg. maximum.
	Naphthalene		0.059 mg/l, daily max. 0.022 mg/l, monthly avg. maximum.
	p-Cresol		0.024 mg/l, daily max. 0.015 mg/l, monthly avg. maximum.
	Phenol		0.048 mg/l, daily max. 0.029 mg/l, monthly avg. maximum.
	Pyridine		0.072 mg/l, daily max. 0.025 mg/l, monthly avg. maximum.
	Arsenic (Total)		1.1 mg/l, daily maximum. 0.54 mg/l, monthly avg. maximum.
	Chromium (Total)		1.1 mg/l, daily maximum. 0.46 mg/l, monthly avg. maximum.
	Zinc (Total)		0.535 mg/l, daily max. 0.296 mg/l, monthly avg. maximum.
	pH		Within the range of 6–9 pH units.

[1] These benchmark monitoring cutoff concentrations apply to storm water discharges associated with industrial activity other than contaminated storm water discharges from landfills subject to the numeric effluent limitations set forth in Table K–1. Monitor once/quarter for the year 2 and year 4 monitoring years.

[2] As set forth at 40 CFR Part 445 Subpart A, these numeric limitations apply to contaminated storm water discharges from hazardous waste landfills subject to the provisions of RCRA Subtitle C at 40 CFR Parts 264 (Subpart N) and 265 (Subpart N) except for any of the facilities described below:

(a) Landfills operated in conjunction with other industrial or commercial operations when the landfill only receives wastes generated by the industrial or commercial operation directly associated with the landfill;

(b) Landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes generated by the industrial or commercial operation directly associated with the landfill and also receives other wastes provided the other wastes received for disposal are generated by a facility that is subject to the same provisions in 40 CFR Subchapter N as the industrial or commercial operation or the other wastes received are of similar nature to the wastes generated by the industrial or commercial operation;

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(c) Landfills operated in conjunction with Centralized Waste Treatment (CWT) facilities subject to 40 CFR Part 437 so long as the CWT facility commingles the landfill wastewater with other non-landfill wastewater for discharge. A landfill directly associated with a CWT facility is subject to this part if the CWT facility discharges landfill wastewater separately from other CWT wastewater or commingles the wastewater from its landfill only with wastewater from other landfills; or

(d) Landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes from public service activities so long as the company owning the landfill does not receive a fee or other remuneration for the disposal service.

For the discharges subject to the numeric effluent limitations, monitoring for the specified parameters is required once/year during each year of the term of the permit.

6.L Sector L—Landfills, Land Application Sites and Open Dumps

6.L.1 Covered Storm Water Discharges

The requirements in Part 6.L apply to storm water discharges associated with industrial activity from Landfills and Land Application Sites and Open Dumps as identified by the Activity Codes specified under Sector L in Table 1–1 of Part 1.2.1.

6.L.2 Industrial Activities Covered by Sector L

This permit may authorize storm water discharges for Sector L facilities associated with waste disposal at landfills, land application sites and open dumps that receive or have received industrial waste, including sites subject to regulation under Subtitle D of RCRA.

6.L.3 Limitations on Coverage

6.L.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.3.1)

Not authorized by this permit: leachate, gas collection condensate, drained free liquids, contaminated ground water, laboratory wastewater, and contact washwater from washing truck and railcar exteriors and surface areas which have come in direct contact with solid waste at the landfill facility.

6.L.4 Definitions

6.L.4.1 *Contaminated storm water*—storm water which comes in direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater. Some specific areas of a landfill that may produce contaminated storm water include (but are not limited to): the open face of an active landfill with exposed waste (no cover added); the areas around wastewater treatment operations; trucks, equipment or machinery that has been in direct contact with the waste; and waste dumping areas.

6.L.4.2 *Drained free liquids*—aqueous wastes drained from waste containers (*e.g.*, drums, etc.) prior to landfilling.

6.L.4.3 *Landfill wastewater*—as defined in 40 CFR Part 445 (Landfills Point Source Category) all wastewater associated with, or produced by, landfilling activities except for sanitary wastewater, non-contaminated storm water, contaminated groundwater, and wastewater from recovery pumping wells. Landfill process wastewater includes, but is not limited to, leachate, gas collection condensate, drained free liquids, laboratory derived wastewater, contaminated storm water and contact washwater from washing truck, equipment and railcar exteriors and surface areas which have come in direct contact with solid waste at the landfill facility.

6.L.4.4 *Leachate*—liquid that has passed through or emerged from solid waste and contains soluble, suspended or miscible materials removed from such waste.

6.L.4.5 *Non-contaminated storm water*—storm water which does not come in direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater. Non-contaminated storm water includes storm water which flows off the cap, cover, intermediate cover, daily cover, and/or final cover of the landfill.

6.L.5 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.L.5.1 *Drainage Area Site Map.* (See also Part 4.2.2.3)

Identify where any of the following may be exposed to precipitation/surface runoff: Active and closed landfill cells or trenches, active and closed land application areas, locations where open dumping is occurring or has occurred, locations of any known leachate springs or other areas where uncontrolled leachate may commingle with runoff, leachate collection and handling systems.

6.L.5.2 *Summary of Potential Pollutant Sources.* (See also Part 4.2.4)

Describe the following sources and activities that have potential pollutants associated with them: fertilizer, herbicide and pesticide application; earth/soil moving; waste hauling and loading/unloading; outdoor storage of significant materials including daily, interim and final cover material stockpiles as well as temporary waste storage areas; exposure of active and inactive landfill and land application areas; uncontrolled leachate flows; failure or leaks from leachate collection and treatment systems.

6.L.5.3 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

As part of your good housekeeping program, consider providing protected storage areas for pesticides, herbicides, fertilizer and other significant materials.

6.L.5.4 *Preventative Maintenance Program.* (See also Part 4.2.7.1)

As part of your preventive maintenance program, maintain: all containers used for outdoor chemical/significant materials storage to prevent leaking; all elements of leachate collection and treatment systems to prevent commingling of leachate with storm water; the integrity and effectiveness of any intermediate or final cover (including repairing the cover as necessary to minimize the effects of settlement, sinking and erosion).

6.L.5.5 *Inspections.*

6.L.5.5.1 *Inspections of Active Sites.* (See also Part 4.2.7.2.1.5) Inspect operating landfills, open dumps and land application sites at least once every 7 days. Focus on areas of landfills that have not yet been finally stabilized, active land application areas, areas used for storage of material/wastes that are exposed to precipitation, stabilization and structural control measures, leachate collection and treatment systems, and locations where equipment and waste trucks enter/exit the site. Ensure that sediment and erosion control measures are operating properly. For stabilized sites and areas where land application has been completed, or where the climate is seasonally arid (annual rainfall averages from 0 to 10 inches) or semi-arid (annual rainfall averages from 10 to 20 inches), conduct inspections at least once every month.

6.L.5.5.2 *Inspections of Inactive Sites.* (See also Part 4.2.7.2.1.5) Inspect inactive landfills, open dumps and land application sites at least quarterly. Qualified personnel must inspect landfill (or open dump) stabilization and structural erosion control measures and leachate collection and treatment systems, and all closed land application areas.

6.L.5.6 *Recordkeeping and Internal Reporting.* Implement a tracking system for the types of wastes disposed of in each cell or trench of a landfill or open dump. For land application sites, track the types and quantities of wastes applied in specific areas.

6.L.5.7 *Non-Storm Water Discharge Test Certification.* (See also Part 4.) The discharge test and certification must also be conducted for the presence of leachate and vehicle washwater.

6.L.5.8 *Sediment and Erosion Control Plan.* (See also Part 4.2.7.2.2.1) Provide temporary stabilization (e.g., consider temporary seeding, mulching and placing geotextiles on the inactive portions of stockpiles): for materials stockpiled for daily, intermediate and final cover; for inactive areas of the landfill or open dump; for any landfill or open dump area that have gotten final covers but where vegetation has yet to established itself; and where waste application has been completed at land application sites but final vegetation has not yet been established.

6.L.5.9 *Comprehensive Site Compliance Evaluation.* (See also Part 4.9.2) Evaluate areas contributing to a storm water discharge associated with industrial activities at landfills, open dumps and land application sites for evidence of, or the potential for, pollutants entering the drainage system.

6.L.6 Numeric Limitations, Monitoring and Reporting Requirements. (See also Part 5)

TABLE L–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK AND COMPLIANCE MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric limitation [2]
Section of Permit Affected/Supplemental Requirements			
All Landfill, Land Application Sites and Open Dumps (Industrial Activity Code "LF").	Total Suspended Solids (TSS).	100 mg/L.	
All Landfill, Land Application Sites and Open Dumps, Except Municipal Solid Waste Landfill (MSWLF) Areas Closed in Accordance with 40 CFR 258.60 (Industrial Activity Code "LF").	Total Recoverable Iron	1.0mg/L.	
All Landfills Which are Subject to the Requirements of 40 CFR Part 445 Subpart B (Industrial Activity Code "LF").	BOD5		140 mg/1, daily max. 37 mg/1, monthly ave maximum
	TSS		88 mg/l, daily max. 27 mg/1, monthly ave maximum.
	Ammonia		10 mg/1, daily max. 4.9 mg/1, monthly ave maximum.
	Alpha Terpineol		0.033 mg/1, daily max. 0.016 mg/1, monthly ave maximum.
	Benzoic Acid		0.12 mg/1, daily max. 0.071 mg/1, monthly ave maximum.
	p-Cresol		0.025 mg/1, daily max. 0.014 mg/1, monthly ave maximum.
	Phenol		0.026 mg/1, daily max. 0.015 mg/1, monthly ave maximum.
	Zinc (Total)		0.20 mg/1, daily max. 0.11 mg/1, monthly ave maximum.
	pH		Within the range of 6–9 pH units.

[1] These benchmark monitoring cutoff concentrations apply to storm water discharges associated with industrial activity other than contaminated storm water discharges from landfills subject to the numeric effluent limitations set forth in Table L–1. Monitor once/quarter for the year 2 and year 4 monitoring years.

[2] As set forth at 40 CFR Part 445 Subpart B, these numeric limitations apply to contaminated storm water discharges from MSWLFs which have not been closed in accordance with 40 CFR 258.60, and contaminated storm water discharges from those landfills which are subject to the provisions of 40 CFR Part 257 except for discharges from any of facilities described in (a) through (d) below:

(a) landfills operated in conjunction with other industrial or commercial operations when the landfill only receives wastes generated by the industrial or commercial operation directly associated with the landfill;

(b) landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes generated by the industrial or commercial operation directly associated with the landfill and also receives other wastes provided the other wastes received for disposal are generated by a facility that is subject to the same provisions in 40 CFR Subchapter N as the industrial or commercial operation or the other wastes received are of similar nature to the wastes generated by the industrial or commercial operation;

(c) landfills operated in conjunction with Centralized Waste Treatment (CWT) facilities subject to 40 CFR Part 437 so long as the CWT facility commingles the landfill wastewater with other non-landfill wastewater for discharge. A landfill directly associated with a CWT facility is subject to this part if the CWT facility discharges landfill wastewater separately from other CWT wastewater or commingles the wastewater from its landfill only with wastewater from other landfills; or

(d) landfills operated in conjunction with other industrial or commercial operations when the landfill receives wastes from public service activities so long as the company owning the landfill does not receive a fee or other remuneration for the disposal service.

For the discharges subject to the numeric effluent limitations, monitoring for the specified parameters is required once/year during each year of the term of the permit.

6.M Sector M—Automobile Salvage Yards

6.M.1 Covered Storm Water Discharges

The requirements in Part 6.M apply to storm water discharges associated with industrial activity from Automobile Salvage Yards as identified by the Activity Code specified under Sector M in Table 1-1 of Part 1.2.1.

6.M.2 Industrial Activities Covered by Sector M

The types of activities that permittees under Sector M are primarily engaged in are dismantling or wrecking used motor vehicles for parts recycling/resale and for scrap.

6.M.3 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.M.3.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Indicate the location of each monitoring point, and estimate the total acreage used for industrial activity including, but not limited to, dismantling, storage and maintenance of used motor vehicle parts. Also identify where any of the following may be exposed to precipitation/surface runoff: Dismantling areas; parts (*e.g.*, engine blocks, tires, hub caps, batteries, hoods, mufflers) storage areas; liquid storage tanks and drums for fuel and other fluids.

6.M.3.2 *Potential Pollutant Sources.* (See also Part 4.2.4) Assess the potential for the following to contribute pollutants to storm water discharges: Vehicle storage areas; dismantling areas; parts storage area (*e.g.*, engine blocks, tires, hub caps, batteries, hoods, mufflers); fueling stations.

6.M.3.3 *Spill and Leak Prevention Procedures.* (See also Part 4.2.7.2.1.4) Drain vehicles intended to be dismantled of all fluids upon arrival at the site (or as soon thereafter as feasible); or employ some other equivalent means to prevent spills/ leaks.

6.M.3.4 *Inspections.* (See also Part 4.2.7.2.1.5) Immediately (or as soon thereafter as feasible) inspect vehicles arriving at the site for leaks. Inspect quarterly for signs of leakage, all equipment containing oily parts, hydraulic fluids or any other types of fluids. Also inspect quarterly for signs of leakage, all vessels and areas where fluids are stored, including, but not limited to, brake fluid, transmission fluid, radiator water and antifreeze.

6.M.3.5 *Employee Training.* (See also Part 4.2.7.2.1.6) If applicable to your facility, address the following areas (at a minimum) in your employee training program: Proper handling (collection, storage, and disposal) of oil, used mineral spirits, anti-freeze and solvents.

6.M.3.6 *Management of Runoff.* (See also Part 4.2.7.2.2.2) Consider the following management practices: Berms or drainage ditches on the property line (to help prevent run-on from neighboring properties); berms for uncovered outdoor storage of oily parts, engine blocks and above-ground liquid storage; installation of detention ponds; and the installation of filtering devices and oil/water separators.

6.M.4 Monitoring and Reporting Requirements. (See also Part 5)

TABLE M-1.—SECTOR-SPECIFIC NUMERIC LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration[1]	Numeric limitation
Sector of Permit Affected/Supplemental Requirements			
Automobile Salvage Yards (SIC 5015)	Total Suspended Solids (TSS).	100.0 mg/L.	
	Total Recoverable Aluminum.	0.75 mg/L.	
	Total Recoverable Iron	1.0 mg/L.	
	Total Recoverable Lead	0.0816 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 monitoring years.

6.N Sector N—Scrap Recycling and Waste Recycling Facilities

6.N.1 Covered Storm Water Discharges

The requirements in Part N apply to storm water discharges associated with industrial activity from Scrap Recycling and Waste Recycling facilities as identified by the SIC Codes specified under Sector N in Table 1-1 of Part 1.2.1.

6.N.2 Industrial Activities Covered by Sector N

The types of activities that permittees under Sector N are primarily engaged in are:

6.N.2.1 processing, reclaiming and wholesale distribution of scrap and waste materials such as ferrous and nonferrous metals, paper, plastic, cardboard, glass, animal hides;

6.N.2.2 reclaiming and recycling liquid wastes such as used oil, antifreeze, mineral spirits and industrial solvents.

6.N.3 Coverage Under This Permit

Separate permit requirements have been established for recycling facilities that only receive source-separated recyclable materials primarily from non-industrial and residential sources (*i.e.*, common consumer products including paper, newspaper, glass, cardboard, plastic containers, aluminum and tin cans). This includes recycling facilities commonly referred to as material recovery facilities (MRF).

6.N.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.2.2) Not covered by this permit: non-storm water discharges from turnings containment areas (see also Part 6.N.5.1.3). Discharges from containment areas in the absence of a storm event are prohibited unless covered by a separate NPDES permit.

6.N.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4 of the MSGP. Part 6.N.4.1 contains a requirement that applies to all recycling facilities and is followed by Parts 6.N.4.2 to 6.N.4.4.4, which have requirements for specific types of recycling facilities. Implement and describe in your SWPPP a program to address those items that apply. Included are lists of BMP options which, along with any functional equivalents, should be considered for implementation. Selection or deselection of a particular BMP or approach is up to the best professional judgement of the operator, as long as the objective of the requirement is met.

6.N.4.1 *Drainage Area Site Map.* (See also Part 4.2.2.3)

Identify the locations of any of the following activities or sources which may be exposed to precipitation/surface runoff: scrap and waste material storage, outdoor scrap and waste processing equipment, and containment areas for turnings exposed to cutting fluids.

6.N.4.2 *Scrap and Waste Recycling Facilities (Non-Source Separated, Non-Liquid Recyclable Materials).* Requirements for facilities that receive, process and do wholesale distribution of non-liquid recyclable wastes (*e.g.*, ferrous and nonferrous metals, plastics, glass, cardboard and paper). These facilities may receive both non recyclable and recyclable materials. This section is not intended for those facilities that only accept recyclables from primarily non-industrial and residential sources.

6.N.4.2.1 *Inbound Recyclable and Waste Material Control Program.* Minimize the chance of accepting materials that could be significant sources of pollutants by conducting inspections of inbound recyclables and waste materials. BMP options: (a) Provide information/education to suppliers of scrap and recyclable waste materials on draining and properly disposing of residual fluids (*e.g.*, from vehicles and equipment engines, radiators and transmissions, oil filled transformers and individual containers or drums), prior to delivery to your facility; (b) procedures to minimize the potential of any residual fluids from coming into contact with precipitation/runoff; (c) procedures for accepting scrap lead-acid batteries (additional requirements for the handling, storage and disposal or recycling of batteries are contained in the scrap lead-acid battery program provisions in N.5.1.6); (d) training targeted for those personnel engaged in the inspection and acceptance of inbound recyclable materials. In addition, (e) liquid wastes, including used oil, must be stored in materially compatible and non-leaking containers and disposed or recycled in accordance with RCRA.

6.N.4.2.2 *Scrap and Waste Material Stockpiles/Storage (Outdoor).* Minimize contact of storm water runoff with stockpiled materials, processed materials and non-recyclable wastes. BMP options: (a) Permanent or semi-permanent covers; (b) to facilitate settling or filtering of pollutants: sediment traps, vegetated swales and strips, catch basin filters and sand filters; (c) divert runoff away from storage areas via dikes, berms, containment trenches, culverts and surface grading; (d) silt fencing; (e) oil/water separators, sumps and dry absorbents for areas where potential sources of residual fluids are stockpiled (*e.g.*, automobile engine storage areas).

6.N.4.2.3 *Stockpiling of Turnings Exposed to Cutting Fluids (Outdoor).* Minimize contact of surface runoff with residual cutting fluids. BMP options (use singularly or in combination): (a) Store all turnings exposed to cutting fluids under some form of permanent or semi-permanent cover. Storm water discharges from these areas are permitted provided the runoff is first treated by an oil/water separator or its equivalent. Identify procedures to collect, handle and dispose/recycle residual fluids which may be present; (b) establish dedicated containment areas for all turnings that have been exposed to cutting fluids. Storm water runoff from these areas can be discharged provided: The containment areas are constructed of either concrete, asphalt or other equivalent types of impermeable material; there is a barrier around the perimeter of the containment areas (*e.g.*, berms, curbing, elevated pads, etc.) to prevent contact with storm water run-on; there is a drainage collection system for runoff generated from containment areas; you have a schedule to maintain the oil/water separator (or its equivalent); and you identify procedures for properly disposing or recycling collected residual fluids.

6.N.4.2.4 *Scrap and Waste Material Stockpiles/Storage (Covered or Indoor Storage).* Minimize contact of residual liquids and particulate matter from materials stored indoors or under cover with surface runoff. BMP options: (a) Good housekeeping measures including the use of dry absorbent or wet vacuuming to contain or dispose/recycle residual liquids originating from recyclable containers; (b) not allowing washwater from tipping floors or other processing areas to discharge to the storm sewer system; (c) disconnect or seal off all floor drains connected to the storm sewer system.

6.N.4.2.5 *Scrap and Recyclable Waste Processing Areas.* Minimize surface runoff from coming in contact with scrap processing equipment. Pay attention to operations that generate visible amounts of particulate residue (*e.g.*, shredding) to minimize the contact of accumulated particulate matter and residual fluids with runoff (*i.e.*, through good housekeeping, preventive maintenance, etc.). BMP options: (a) Regularly inspect equipment for spills/leaks, and malfunctioning/worn/corroded parts or equipment; (b) a preventive maintenance program for processing equipment; (c) use of dry-absorbents or other cleanup practices to collect and dispose/recycle spilled/leaking fluids; (e) on unattended hydraulic reservoirs over 150 gallons in capacity, install such protection devices as low-level alarms or other equivalent devices, or, alternatively, secondary containment that can hold the entire volume of the reservoir; (f) containment or diversion structures such as dikes, berms, culverts, trenches, elevated concrete pads, grading to minimize contact of storm water runoff with outdoor processing equipment or stored materials; (g) oil/water separators or sumps; (h) permanent or semi-permanent covers in processing areas where there are residual fluids and grease; (i) retention/detention ponds or basins; sediment traps, vegetated swales or strips (for pollutant settling/filtration); (j) catch basin filters or sand filters.

6.N.4.2.6 *Scrap Lead-Acid Battery Program.* Properly handle, store and dispose of scrap lead-acid batteries. BMP options: (a) Segregate scrap lead-acid batteries from other scrap materials; (b) proper handling, storage and disposal of cracked or broken batteries; (c) collect and dispose leaking lead-acid battery fluid; (d) minimize/eliminate (if possible) exposure of scrap lead-acid batteries to precipitation or runoff; (e) employee training for the management of scrap batteries.

6.N.4.2.7 *Spill Prevention and Response Procedures.* (See also Part 4.2.7.2.1.4) Minimize storm water contamination at loading/unloading areas, and from equipment or container failures. BMP options: (a) Prevention and response measures for areas that are potential sources of fluid leaks/spills; (b) immediate containment and clean up of spills/leaks. If malfunctioning equipment is responsible for the spill/leak, repairs should also be conducted as soon as possible; (c) cleanup measures including the use of dry absorbents. If this method is employed, there should be an adequate supply of dry absorbent materials kept onsite and used absorbent must be properly disposed of; (d) store drums containing liquids—especially oil and lubricants—either: Indoors, in a bermed area, in overpack containers or spill pallets, or in other containment devices; (e) install overfill prevention devices on fuel pumps or tanks; (f) place drip pans or equivalent measures under leaking stationary equipment until the leak is repaired. The drip pans should be inspected for leaks and potential overflow and all liquids must be properly disposed of (as per RCRA); (g) install alarms and/or pump shut off systems on outdoor equipment with hydraulic reservoirs exceeding 150 gallons in the event of a line break. Alternatively, a secondary containment system capable of holding the entire contents of the reservoir plus room for precipitation can be used.

6.N.4.2.8 *Quarterly Inspection Program*. (See also Part 4.2.7.2.1.5) Inspect all designated areas of the facility and equipment identified in the plan quarterly.

6.N.4.2.9 *Supplier Notification Program*. As appropriate, notify major suppliers which scrap materials will not be accepted at the facility or are only accepted under certain conditions.

6.N.4.3 *Waste Recycling Facilities (Liquid Recyclable Materials)*.

6.N.4.3.1 *Waste Material Storage (Indoor)*. Minimize/eliminate contact between residual liquids from waste materials stored indoors and surface runoff. The plan may refer to applicable portions of other existing plans such as SPCC plans required under 40 CFR Part 112. BMP options: (a) procedures for material handling (including labeling and marking); (b) clean up spills/leaks with dry-absorbent materials or a wet vacuum system; (c) appropriate containment structures (trenching, curbing, gutters, etc.); (d) a drainage system, including appurtenances (*e.g.*, pumps or ejectors, manually operated valves), to handle discharges from diked or bermed areas. Drainage should be discharged to an appropriate treatment facility, sanitary sewer system, or otherwise disposed of properly. These discharges may require coverage under a separate NPDES wastewater permit or industrial user permit under the pretreatment program.

6.N.4.3.2 *Waste Material Storage (Outdoor)*. Minimize contact between stored residual liquids and precipitation or runoff. The plan may refer to applicable portions of other existing plans such as SPCC plans required under 40 CFR Part 112. Discharges of precipitation from containment areas containing used oil must also be in accordance with applicable sections of 40 CFR Part 112. BMP options: (a) appropriate containment structures (*e.g.*, dikes, berms, curbing, pits) to store the volume of the largest tank with sufficient extra capacity for precipitation; (b) drainage control and other diversionary structures; (c) for storage tanks, provide corrosion protection and/or leak detection systems; (d) use dry-absorbent materials or a wet vacuum system to collect spills.

6.N.4.3.3 *Trucks and Rail Car Waste Transfer Areas*. Minimize pollutants in discharges from truck and rail car loading/unloading areas. Include measures to clean up minor spills/leaks resulting from the transfer of liquid wastes. BMP options: (a) containment and diversionary structures to minimize contact with precipitation or runoff; (b) use dry-clean up methods, wet vacuuming, roof coverings, or runoff controls.

6.N.4.3.4 *Quarterly Inspections*. (See also Part 4.2.7.2.1.5) At a minimum, the inspections must also include all areas where waste is generated, received, stored, treated or disposed and that are exposed to either precipitation or storm water runoff.

6.N.4.4 *Recycling Facilities (Source Separated Materials)*. The following identifies considerations for facilities that receive only source-separated recyclables, primarily from non-industrial and residential sources.

6.N.4.4.1 *Inbound Recyclable Material Control*. Minimize the chance of accepting non-recyclables (*e.g.*, hazardous materials) which could be a significant source of pollutants by conducting inspections of inbound materials. BMP options: (a) information/education measures to inform suppliers of recyclables which materials are acceptable and which are not; (b) training drivers responsible for pickup of recycled material; (c) clearly marking public drop-off containers regarding which materials can be accepted; (d) reject non-recyclable wastes or household hazardous wastes at the source; (e) procedures for handling and disposal of non-recyclable material.

6.N.4.4.2 *Outdoor Storage*. Minimize exposure of recyclables to precipitation and runoff. Use good housekeeping measures to prevent accumulation of particulate matter and fluids, particularly in high traffic areas. Other BMP options: (a) provide totally-enclosed drop-off containers for the public; (b) install a sump/pump with each container pit and treat or discharge collected fluids to a sanitary sewer system; (c) provide dikes and curbs for secondary containment (*e.g.*, around bales of recyclable waste paper); (d) divert surface water runoff away from outside material storage areas; (e) provide covers over containment bins, dumpsters, roll-off boxes; (f) store the equivalent one days's volume of recyclable material indoors.

6.N.4.4.3 *Indoor Storage and Material Processing*. Minimize the release of pollutants from indoor storage and processing areas. BMP options: (a) schedule routine good housekeeping measures for all storage and processing areas; (b) prohibit tipping floor washwater from draining to the storm sewer system; (c) provide employee training on pollution prevention practices.

6.N.4.4.4 *Vehicle and Equipment Maintenance*. BMP options for those areas where vehicle and equipment maintenance are occurring outdoors: (a) prohibit vehicle and equipment washwater from discharging to the storm sewer system; (b) minimize or eliminate outdoor maintenance areas whenever possible; (c) establish spill prevention and clean-up procedures in fueling areas; (d) avoid topping off fuel tanks; (e) divert runoff from fueling areas; (f) store lubricants and hydraulic fluids indoors; (g) provide employee training on proper handling, storage of hydraulic fluids and lubricants.

6.N.5 Monitoring and Reporting Requirements. (See also Part 5)

TABLE N-1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration[1]	Numeric limitation
Part of Permit Affected/Supplemental Requirements			
Scrap Recycling Facility (SIC 5093)	Chemical Oxygen Demand (COD).	120 mg/L.	
	Total Suspended Solids (TSS).	100 mg/L.	
	Total Recoverable Aluminum.	0.75 mg/L.	
	Total Recoverable Copper	0.0636 mg/L.	
	Total Recoverable Iron	1.0 mg/L.	
	Total Recoverable Lead	0.0816 mg/L.	
	Total Recoverable Zinc	0.117 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.

6.O Sector O—Steam Electric Generating Facilities

6.O.1 Covered Storm Water Discharges

The requirements in Part 6.O apply to storm water discharges associated with industrial activity from Steam Electric Power Generating Facilities as identified by the Activity Code specified under Sector O in Table 1–1 of Part 1.2.1.

6.O.2 Industrial Activities Covered by Sector O

This permit authorizes storm water discharges from the following industrial activities at Sector O facilities:

6.O.2.1 Steam electric power generation using coal, natural gas, oil, nuclear energy, etc. to produce a steam source, including coal handling areas;

6.O.2.2 Coal pile runoff, including effluent limitations established by 40 CFR Part 423;

6.O.2.3 Dual fuel co-generation facilities.

6.O.3 Limitations on Coverage

6.O.3.1 *Prohibition of Non-Storm Water Discharges.* Not covered by this permit: non-storm water discharges subject to effluent limitations guidelines.

6.O.3.2 *Prohibition of Storm Water Discharges.* Not covered by this permit: storm water discharges from ancillary facilities (*e.g.*, fleet centers, gas turbine stations and substations) that are not contiguous to a stream electric power generating facility; and heat capture co-generation facilities.

6.O.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.O.4.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify the locations of any of the following activities or sources which may be exposed to precipitation / surface runoff: storage tanks, scrap yards, general refuse areas; short and long term storage of general materials (including but not limited to: supplies, construction materials, paint equipment, oils, fuels, used and unused solvents, cleaning materials, paint, water treatment chemicals, fertilizer and pesticides); landfills, construction sites; stock piles areas (*e.g.*, coal or limestone piles).

6.O.4.2 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.O.4.2.1 *Fugitive Dust Emissions.* Describe and implement measures that prevent or minimize fugitive dust emissions from coal handling areas. Consider such procedures to minimize the tracking of coal dust offsite as installing specially designed tires, or washing vehicles in a designated area before they leave the site and controlling the wash water.

6.O.4.2.2 *Delivery Vehicles.* Describe and implement measures that prevent or minimize contamination of storm water runoff from delivery vehicles arriving at the plant site. Consider the following: procedures to inspect delivery vehicles arriving at the plant site and ensure overall integrity of the body or container; and procedures to deal with leakage / spillage from vehicles or containers.

6.O.4.2.3 *Fuel Oil Unloading Areas.* Describe and implement measures that prevent or minimize contamination of precipitation / surface runoff from fuel oil unloading areas. Consider, at a minimum (or their equivalents): using containment curbs in unloading areas; having personnel familiar with spill prevention and response procedures present during deliveries to ensure that any leaks / spills are immediately contained and cleaned up; using spill and overflow protection (*e.g.*, drip pans, drip diapers or other containment devices placed beneath fuel oil connectors to contain potential spillage during deliveries or from leaks at the connectors).

6.O.4.2.4 *Chemical Loading / Unloading.* Describe and implement measures that prevent or minimize contamination of precipitation / surface runoff from chemical loading / unloading areas. Consider, at a minimum (or their equivalents): using containment curbs at chemical loading / unloading areas to contain spill; having personnel familiar with spill prevention and response procedures present during deliveries to ensure that any leaks / spills are immediately contained and cleaned up; and load / unload in covered areas and store chemicals indoors.

6.O.4.2.5 *Miscellaneous Loading / Unloading Areas.* Describe and implement measures that prevent or minimize contamination of precipitation / surface runoff from loading / unloading areas. Consider, at a minimum (or their equivalents): covering the loading area; grading, berming, or curbing around the loading area to divert run-on; or locating the loading / unloading equipment and vehicles so leaks are contained in existing containment and flow diversion systems.

6.O.4.2.6 *Liquid Storage Tanks.* Describe and implement measures that prevent or minimize contamination of surface runoff from above ground liquid storage tanks. Consider using, at a minimum (or their equivalents): protective guards around tank; containment curbs; spill and overflow protection; and dry cleanup methods.

6.O.4.2.7 *Large Bulk Fuel Storage Tanks.* Describe and implement measures that prevent or minimize contamination of surface runoff from large bulk fuel storage tanks. Consider, at a minimum, using containment berms (or its equivalent). You must also comply with applicable State and Federal laws, including Spill Prevention Control and Countermeasures (SPCC).

6.O.4.2.8 *Spill Reduction Measures.* Describe and implement measures to reduce the potential for an oil / chemical spill or reference the appropriate Part of your SPCC plan. At a minimum, visually inspect on a weekly basis, the structural integrity of all above ground tanks, pipelines, pumps and other related equipment, and effect any necessary repairs immediately.

6.O.4.2.9 *Oil Bearing Equipment in Switchyards.* Describe and implement measures that prevent or minimize contamination of surface runoff from oil bearing equipment in switchyard areas. Consider using level grades and gravel surfaces to retard flows and limit the spread of spills or collecting runoff in perimeter ditches.

6.O.4.2.10 *Residue Hauling Vehicles.* Inspect all residue hauling vehicles for proper covering over the load, adequate gate sealing and overall integrity of the container body. Repair as soon as practicable, vehicles without load covering or adequate gate sealing, or with leaking containers or beds.

6.O.4.2.11 *Ash Loading Areas.* Describe and implement procedures to reduce or control the tracking of ash/residue from ash loading areas. Where practicable, clear the ash building floor and immediately adjacent roadways of spillage, debris and excess water before departure of each loaded vehicle.

6.O.4.2.12 *Areas Adjacent to Disposal Ponds or Landfills.* Describe and implement measures that prevent or minimize contamination of surface runoff from areas adjacent to disposal ponds or landfills. Develop procedures to reduce ash residue that may be tracked on to access roads traveled by residue handling vehicles, and reduce ash residue on exit roads leading into and out of residue handling areas.

6.O.4.2.13 *Landfills, Scrap Yards, Surface Impoundments, Open Dumps, General Refuse Sites.*

Address these areas in your SWPPP and include appropriate BMPs as referred to in Part 4.

6.O.4.2.14 *Vehicle Maintenance Activities.* For vehicle maintenance activities performed on the plant site, use the applicable BMPs outlined in Part 6.P.

6.O.4.2.15 *Material Storage Areas.* Describe and implement measures that prevent or minimize contamination of storm water runoff from material storage areas (including areas used for temporary storage of miscellaneous products and construction materials stored in lay-down areas). Consider using (or their equivalents): Flat yard grades; collecting runoff in graded swales or ditches; erosion protection measures at steep outfall sites (*e.g.*, concrete chutes, riprap, stilling basins); covering lay-down areas; storing materials indoors; and covering materials temporarily with polyethylene, polyurethane, polypropylene or hypalon. Storm water run-on may be minimized by constructing an enclosure or building a berm around the area.

6.O.4.3 *Comprehensive Site Compliance Evaluation.* (See also Part 4.9.3) As part of your evaluation, inspect the following areas on a monthly basis: Coal handling areas, loading/unloading areas, switchyards, fueling areas, bulk storage areas, ash handling areas, areas adjacent to disposal ponds and landfills, maintenance areas, liquid storage tanks, and long term and short term material storage areas.

6.O.5 Monitoring and Reporting Requirements. (See also Part 5)

TABLE O–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric Limitation [2]
Part of Permit Affected/Supplemental Requirements			
Steam Electric Generating Facilities (Industrial Activity Code "SE").	Total Recoverable Iron	1.0 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.
[2] Note that the numeric effluent limitation guidelines for coal pile runoff at steam electric generating facilities have been adopted as a standard numeric limits for all coal pile runoff. See Part 5.1.3.

6.P Sector P—Land Transportation and Warehousing

6.P.1 Covered Storm Water Discharges

The requirements in Part 6.P apply to storm water discharges associated with industrial activity from Land Transportation and Warehousing facilities as identified by the Activity Code specified under Sector P in Table 1–1 of Part 1.2.1.

6.P.2 Industrial Activities Covered by Sector P

The types of activities that permittees under Sector P are primarily engaged in are:

6.P.2.1 vehicle and equipment maintenance (vehicle and equipment rehabilitation, mechanical repairs, painting, fueling and lubrication);

6.P.2.2 equipment cleaning.

6.P.3 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.P.3.1 *Drainage Site Map.* (See also Part 4.2.2.3) Identify the locations of any of the following activities or sources: Fueling stations; vehicle/equipment maintenance or cleaning areas; storage areas for vehicle/equipment with actual or potential fluid leaks; loading/unloading areas; areas where treatment, storage or disposal of wastes occur; liquid storage tanks; processing areas; storage areas; and all monitoring areas.

6.P.3.2 *Potential Pollutant Sources.* (See also Part 4.2.4) Describe and assess the potential for the following to contribute pollutants to storm water discharges: Onsite waste storage or disposal; dirt/gravel parking areas for vehicles awaiting maintenance; and fueling areas.

6.P.3.3 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.P.3.3.1 *Vehicle and Equipment Storage Areas.* Confine the storage of leaky or leak-prone vehicles/equipment awaiting maintenance to designated areas. Consider the following (or other equivalent measures): The use of drip pans under vehicles/equipment, indoor storage of vehicles and equipment, installation of berms or dikes, use of absorbents, roofing or covering storage areas, and cleaning pavement surfaces to remove oil and grease.

6.P.3.3.2 *Fueling Areas.* Implement and describe measures that prevent or minimize contamination of storm water runoff from fueling areas. Consider the following (or other equivalent measures): Covering the fueling area; using spill/overflow protection and cleanup equipment; minimizing storm water runon/runoff to the fueling area; using dry cleanup methods; and treating and/or recycling collected storm water runoff.

6.P.3.3.3 *Material Storage Areas.* Maintain all material storage vessels (*e.g.*, for used oil/oil filters, spent solvents, paint wastes, hydraulic fluids) to prevent contamination of storm water and plainly label them (*e.g.*, "Used Oil," "Spent Solvents," etc.). Consider the following (or other equivalent measures): storing the materials indoors; installing berms/dikes around the areas; minimizing runoff of storm water to the areas; using dry cleanup methods; and treating and/or recycling collected storm water runoff.

6.P.3.3.4 *Vehicle and Equipment Cleaning Areas.* Implement and describe measures that prevent or minimize contamination of storm water runoff from all areas used for vehicle/equipment cleaning. Consider the following (or other equivalent measures): performing all cleaning operations indoors; covering the cleaning operation, ensuring that all washwater drains to a proper collection system (*i.e.*, not the storm water drainage system unless NPDES permitted); treating and/or recycling collected storm water runoff, or other equivalent measures. Note: the discharge of vehicle/equipment washwater, including tank cleaning operations, are not authorized by this permit and must be covered under a separate NPDES permit or discharged to a sanitary sewer in accordance with applicable industrial pretreatment requirements.

6.P.3.3.5 *Vehicle and Equipment Maintenance Areas.* Implement and describe measures that prevent or minimize contamination of storm water runoff from all areas used for vehicle/equipment maintenance. Consider the following (or other equivalent measures): performing maintenance activities indoors; using drip pans; keeping an organized inventory of materials used in the shop; draining all parts of fluid prior to disposal; prohibiting wet clean up practices if these practices would result in the discharge of pollutants to storm water drainage systems; using dry cleanup methods; treating and/or recycling collected storm water runoff, minimizing run on/runoff of storm water to maintenance areas.

6.P.3.3.6 *Locomotive Sanding (Loading Sand for Traction) Areas.* Consider the following (or other equivalent measures): covering sanding areas; minimizing storm water run on/runoff; or appropriate sediment removal practices to minimize the offsite transport of sanding material by storm water.

6.P.3.4 *Inspections.* (See also Part 4.2.7.2.1.5) Inspect all the following areas/activities: storage areas for vehicles/equipment awaiting maintenance, fueling areas, indoor and outdoor vehicle/equipment maintenance areas, material storage areas, vehicle/equipment cleaning areas and loading/unloading areas.

6.P.3.5 *Employee Training.* (See also Part 4.2.7.2.1.6) Train personnel at least once a year and address the following, as applicable: used oil and spent solvent management; fueling procedures; general good housekeeping practices; proper painting procedures; and used battery management.

6.P.3.6 *Vehicle and Equipment Washwater Requirements.* (See also Part 4.4) Attach to or reference in your SWPPP, a copy of the NPDES permit issued for vehicle/equipment washwater or, if an NPDES permit has not been issued, a copy of the pending application. If an industrial user permit is issued under a pretreatment program, attach a copy to your SWPPP. In any case, address all non-storm water permit conditions or pretreatment conditions in your SWPPP. If washwater is handled in another manner (*e.g.*, hauled offsite), describe the disposal method and attach all pertinent documentation/information (*e.g.*, frequency, volume, destination, etc.) in the plan.

6.Q Sector Q—Water Transportation

6.Q.1 Covered Storm Water Discharges

The requirements in Part 6.Q apply to storm water discharges associated with industrial activity from Water Transportation facilities as identified by the Activity Code specified under Sector Q in Table 1–1 of Part 1.2.1.

6.Q.2 Industrial Activities Covered by Sector Q

The requirements listed under this Part apply to storm water discharges associated with the following activities:

6.Q.2.1 Water transportation facilities classified in SIC Code major group 44 that have vehicle (vessel) maintenance shops and/or equipment cleaning operations including:

6.Q.2.1.1 Water transportation industry includes facilities engaged in foreign or domestic transport of freight or passengers in deep sea or inland waters;

6.Q.2.1.2 Marine cargo handling operations;

6.Q.2.1.3 Ferry operations;

6.Q.2.1.4 Towing and tugboat services;

6.Q.2.1.5 Marinas.

6.Q.3 Limitations on Coverage

6.Q.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.3.1) Not covered by this permit: bilge and ballast water, sanitary wastes, pressure wash water and cooling water originating from vessels.

6.Q.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.Q.4.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: fueling; engine maintenance/repair; vessel maintenance/repair; pressure washing; painting; sanding; blasting; welding; metal fabrication; loading/unloading areas; locations used for the treatment, storage or disposal of wastes; liquid storage tanks; liquid storage areas (*e.g.*, paint, solvents, resins); and material storage areas (*e.g.*, blasting media, aluminum, steel, scrap iron).

6.Q.4.2 *Summary of Potential Pollutant Sources.* (See also Part 4.2.4) Describe the following additional sources and activities that have potential pollutants associated with them: outdoor manufacturing or processing activities (*i.e.*, welding, metal fabricating); and significant dust or particulate generating processes (*e.g.*, abrasive blasting, sanding, painting).

6.Q.4.3 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.Q.4.3.1 *Pressure Washing Area.* If pressure washing is used to remove marine growth from vessels, the discharge water must be permitted by a separate NPDES permit. Describe in the SWPPP: the measures to collect or contain the discharges from the pressures washing area; the method for the removal of the visible solids; the methods of disposal of the collected solids; and where the discharge will be released.

6.Q.4.3.2 *Blasting and Painting Area.* Implement and describe measures to prevent spent abrasives, paint chips and over spray from discharging into the receiving water or the storm sewer systems. Consider containing all blasting/painting activities or use other measures to prevent or minimize the discharge the contaminants (*e.g.*, hanging plastic barriers or tarpaulins during blasting or painting operations to contain debris). Where necessary, regularly clean storm water conveyances of deposits of abrasive blasting debris and paint chips. Detail in the SWPPP any standard operating practices relating to blasting/painting (*e.g.*, prohibiting uncontained blasting/ painting over open water, or prohibiting blasting/painting during windy conditions which can render containment ineffective).

6.Q.4.3.3 *Material Storage Areas.* Store and plainly label all containerized materials (*e.g.*, fuels, paints, solvents, waste oil, antifreeze, batteries) in a protected, secure location away from drains. Implement and describe measures to prevent or minimize the contamination of precipitation/surface runoff from the storage areas. Specify which materials are stored indoors and consider containment or enclosure for those stored outdoors. If abrasive blasting is performed, discus the storage and disposal of spent abrasive materials generated at the facility. Consider implementing an inventory control plan to limit the presence of potentially hazardous materials onsite.

6.Q.4.3.4 *Engine Maintenance and Repair Areas.* Implement and describe measures to prevent or minimize the contamination of precipitation/surface runoff from all areas used for engine maintenance and repair. Consider the following (or their equivalents): performing all maintenance activities indoors; maintaining an organized inventory of materials used in the shop; draining all parts of fluid prior to disposal; prohibiting the practice of hosing down the shop floor; using dry cleanup methods; and treating and/or recycling storm water runoff collected from the maintenance area.

6.Q.4.3.5 *Material Handling Area.* Implement and describe measures to prevent or minimize the contamination of precipitation/surface runoff from material handling operations and areas (*e.g.*, fueling, paint and solvent mixing, disposal of process wastewater streams from vessels). Consider the following (or their equivalents): covering fueling areas; using spill/overflow protection; mixing paints and solvents in a designated area (preferably indoors or under a shed); and minimize runoff of storm water to material handling areas.

6.Q.4.3.6 *Drydock Activities.* Describe your procedures for routinely maintaining/cleaning the drydock to prevent or minimize pollutants in storm water runoff. Address the cleaning of accessible areas of the drydock prior to flooding, and final cleanup following removal of the vessel and raising the dock. Include procedures for cleaning up oil, grease or fuel spills occurring on the drydock. Consider the following (or their equivalents): sweeping rather than hosing off debris/spent blasting material from accessible areas of the drydock prior to flooding, and having absorbent materials and oil containment booms readily available to contain/cleanup any spills.

6.Q.4.3.7 *General Yard Area.* Implement and describe a schedule for routine yard maintenance and cleanup. Regularly remove from the general yard area: scrap metal, wood, plastic, miscellaneous trash, paper, glass, industrial scrap, insulation, welding rods, packaging, etc.

6.Q.4.4 *Preventative Maintenance.* (See also Part 4.2.7.2.1.4) As part of your preventive maintenance program, perform timely inspection and maintenance of storm water management devices (*e.g.*, cleaning oil/ water separators and sediment traps to ensure that spent abrasives, paint chips and solids will be intercepted and retained prior to entering the storm drainage system) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters.

6.Q.4.5 *Inspections.* (See also Part 4.2.7.2.1.5) Include the following areas in all monthly inspections: pressure washing area; blasting, sanding and painting areas; material storage areas; engine maintenance/repair areas; material handling areas; drydock area; and general yard area.

6.Q.4.6 *Employee Training.* (See also Part 4.2.7.2.1.6) As part of your employee training program, address, at a minimum, the following activities (as applicable): used oil management; spent solvent management; disposal of spent abrasives; disposal of vessel wastewaters; spill prevention and control; fueling procedures; general good housekeeping practices; painting and blasting procedures; and used battery management.

6.Q.4.7 *Comprehensive Site Compliance Evaluation.* (See also Part 4.9) Conduct regularly scheduled evaluations at least once a year and address those areas contributing to a storm water discharge associated with industrial activity (*e.g.*, pressure washing area, blasting/sanding areas, painting areas, material storage areas, engine maintenance/repair areas, material handling areas, and drydock area). Inspect these sources for evidence of, or the potential for, pollutants entering the drainage system.

6.Q.5 Monitoring and Reporting Requirements. (See also Part 5)

TABLE Q–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration [1]	Numeric limitation
Part of Permit Affected/Supplemental Requirements			
Water Transportation Facilities (SIC 4412–4499)	Total Recoverable Aluminum..	0.75 mg/L	
	Total Recoverable Iron.	1.0 mg/L	
	Total Recoverable Lead.	0.0816 mg/L	
	Total Recoverable Zinc.	0.117 mg/L	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.

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6.R Sector R—Ship and Boat Building or Repair Yards

6.R.1 Covered Storm Water Discharges

The requirements in Part 6.R apply to storm water discharges associated with industrial activity from Ship and Boat Building or Repair Yards as identified by the Activity Codes specified under Sector R in Table 1–1 of Part 1.2.1.

6.R.2 Industrial Activities Covered by Sector R

The types of activities that permittees under Sector R are primarily engaged in are:

6.R.2.1 Ship building and repairing and boat building and repairing [3]

6.R.3 Limitations on Coverage

6.R.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.3.1) Not covered by this permit: discharges containing bilge and ballast water, sanitary wastes, pressure wash water and cooling water originating from vessels.

6.R.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.R.4.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: fueling; engine maintenance/repair; vessel maintenance/repair; pressure washing; painting; sanding; blasting; welding; metal fabrication; loading/unloading areas; locations used for the treatment, storage or disposal of wastes; liquid storage tanks; liquid storage areas (*e.g.*, paint, solvents, resins); and material storage areas (*e.g.*, blasting media, aluminum, steel, scrap iron).

6.R.4.2 *Potential Pollutant Sources.* (See also Part 4.2.4) Describe the following additional sources and activities that have potential pollutants associated with them (if applicable): outdoor manufacturing/processing activities (*e.g.*, welding, metal fabricating); and significant dust/particulate generating processes (*e.g.*, abrasive blasting, sanding, painting).

6.R.4.3 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.R.4.3.1 *Pressure Washing Area.* If pressure washing is used to remove marine growth from vessels, the discharge water must be permitted as a process wastewater by a separate NPDES permit.

6.R.4.3.2 *Blasting and Painting Area.* Implement and describe measures to prevent spent abrasives, paint chips and over spray from discharging into the receiving water or the storm sewer systems. Consider containing all blasting/painting activities or use other measures to prevent the discharge of the contaminants (*e.g.*, hanging plastic barriers or tarpaulins during blasting or painting operations to contain debris). Where necessary, regularly clean storm water conveyances of deposits of abrasive blasting debris and paint chips. Detail in the SWPPP any standard operating practices relating to blasting/painting (*e.g.*, prohibiting uncontained blasting/painting over open water, or prohibiting blasting/painting during windy conditions which can render containment ineffective).

6.R.4.3.3 *Material Storage Areas.* Store and plainly label all containerized materials (*e.g.*, fuels, paints, solvents, waste oil, antifreeze, batteries) in a protected, secure location away from drains. Implement and describe measures to prevent or minimize the contamination of precipitation/surface runoff from the storage areas. Specify which materials are stored indoors and consider containment or enclosure for those stored outdoors. If abrasive blasting is performed, discuss the storage and disposal of spent abrasive materials generated at the facility. Consider implementing an inventory control plan to limit the presence of potentially hazardous materials onsite.

6.R.4.3.4 *Engine Maintenance and Repair Areas.* Implement and describe measures to prevent or minimize the contamination of precipitation/surface runoff from all areas used for engine maintenance and repair. Consider the following (or their equivalents): performing all maintenance activities indoors; maintaining an organized inventory of materials used in the shop; draining all parts of fluid prior to disposal; prohibiting the practice of hosing down the shop floor; using dry cleanup methods; and treating and/or recycling storm water runoff collected from the maintenance area.

6.R.4.3.5 *Material Handling Area.* Implement and describe measures to prevent or minimize the contamination of precipitation/surface runoff from material handling operations and areas (*e.g.*, fueling, paint and solvent mixing, disposal of process wastewater streams from vessels). Consider the following (or their equivalents): covering fueling areas; using spill/overflow protection; mixing paints and solvents in a designated area (preferably indoors or under a shed); and minimize runon of storm water to material handling areas.

6.R.4.3.6 *Drydock Activities.* Describe your procedures for routinely maintaining/cleaning the drydock to prevent or minimize pollutants in storm water runoff. Address the cleaning of accessible areas of the drydock prior to flooding, and final cleanup following removal of the vessel and raising the dock. Include procedures for cleaning up oil, grease or fuel spills occurring on the drydock. Consider the following (or their equivalents): sweeping rather than hosing off debris/spent blasting material from accessible areas of the drydock prior to flooding, and having absorbent materials and oil containment booms readily available to contain/cleanup any spills.

6.R.4.3.7 *General Yard Area.* Implement and describe a schedule for routine yard maintenance and cleanup. Regularly remove from the general yard area: scrap metal, wood, plastic, miscellaneous trash, paper, glass, industrial scrap, insulation, welding rods, packaging, etc.

6.R.4.4 *Preventative Maintenance.* (See also Part 4.2.7.2.1.4) As part of your preventive maintenance program, perform timely inspection and maintenance of storm water management devices (*e.g.*, cleaning oil/water separators and sediment traps to ensure that spent abrasives, paint chips and solids will be intercepted and retained prior to entering the storm drainage system) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters.

6.R.4.5 *Inspections.* (See also Part 4.2.7.2.1.5) Include the following areas in all monthly inspections: pressure washing area; blasting, sanding and painting areas; material storage areas; engine maintenance/repair areas; material handling areas; drydock area; and general yard area.

6.R.4.6 *Employee Training.* (See also Part 4.2.7.2.1.6) As part of your employee training program, address, at a minimum, the following activities (as applicable): used oil management; spent solvent management; disposal of spent abrasives; disposal of vessel wastewaters; spill prevention and control; fueling procedures; general good housekeeping practices; painting and blasting procedures; and used battery management.

6.R.4.7 *Comprehensive Site Compliance Evaluation.* (See also Part 4.9) Conduct regularly scheduled evaluations at least once a year and address those areas contributing to a storm water discharge associated with industrial activity (*e.g.*, pressure

[3] According to the U.S. Coast Guard, a vessel 65 feet or greater in length is referred to as a ship, and a vessel smaller than 65 feet is a boat.

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washing area, blasting/sanding areas, painting areas, material storage areas, engine maintenance/repair areas, material handling areas, and drydock area). They must be visually inspected for evidence of, or the potential for, pollutants entering the drainage system.

6.S Sector S—Air Transportation

6.S.1 Covered Storm Water Discharges

The requirements in Part 6.S apply to storm water discharges associated with industrial activity from Air Transportation facilities as identified by the SIC Codes specified under Sector S in Table 1–1 of Part 1.2.1.

6.S.2 Industrial Activities Covered by Sector S

The types of activities that permittees under Sector S are primarily engaged in are:

6.S.2.1 Air transportation, scheduled, and air courier;

6.S.2.2 Air transportation, non scheduled;

6.S.2.3 Airports; flying fields, except those maintained by aviation clubs; and airport terminal services including: air traffic control, except government; aircraft storage at airports; aircraft upholstery repair; airfreight handling at airports; airport hangar rental; airport leasing, if operating airport; airport terminal services; and hangar operations.

6.S.2.4 Airport and aircraft service and maintenance including: aircraft cleaning and janitorial service; aircraft servicing/repairing, except on a factory basis; vehicle maintenance shops; material handling facilities; equipment clearing operations; and airport and aircraft deicing/anti-icing.

Note: "deicing" will generally be used to imply both deicing (removing frost, snow or ice) and anti-icing (preventing accumulation of frost, snow or ice) activities, unless specific mention is made regarding anti-icing and/or deicing activities.

6.S.3 Limitations on Coverage

Only those portions of the facility that are involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling and lubrication), equipment cleaning operations or deicing operations are addressed in Part 6.S.

6.S.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.3.1) Not covered by this permit: aircraft, ground vehicle, runway and equipment washwaters; and dry weather discharges of deicing chemicals. These discharges must be covered by a separate NPDES permit.

6.S.4 Special Conditions

6.S.4.1 *Hazardous Substances or Oil.* (See also Part 3.1) Each individual permittee is required to report spills equal to or exceeding the reportable quantity (RQ) levels specified at 40 CFR 110, 117 and 302 as described at Part 3.2. If an airport authority is the sole permittee, then the sum total of all spills at the airport must be assessed against the RQ. If the airport authority is a co-permittee with other deicing operators at the airport, such as numerous different airlines, the assessed amount must be the summation of spills by each co-permittee. If separate, distinct individual permittees exist at the airport, then the amount spilled by each separate permittee must be the assessed amount for the RQ determination.

6.S.5 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4 of the MSGP.

(See also Part 4.1) If an airport's tenant has a SWPPP for discharges from their own areas of the airport, that SWPPP must be integrated with the plan for the entire airport. Tenants of the airport facility include air passenger or cargo companies, fixed based operators and other parties who have contracts with the airport authority to conduct business operations on airport property and whose operations result in storm water discharges associated with industrial activity.

6.S.5.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: aircraft and runway deicing operations; fueling stations; aircraft, ground vehicle and equipment maintenance/cleaning areas; storage areas for aircraft, ground vehicles and equipment awaiting maintenance.

6.S.5.2 *Potential Pollutant Sources.* (See also Part 4.2.4) Include in your inventory of exposed materials a description of the potential pollutant sources from the following activities: aircraft, runway, ground vehicle and equipment maintenance and cleaning; aircraft and runway deicing operations (including apron and centralized aircraft deicing stations, runways, taxiways and ramps). If you use deicing chemicals, you must maintain a record of the types (including the Material Safety Data Sheets [MSDS]) used and the monthly quantities, either as measured or, in the absence of metering, as estimated to the best of your knowledge. This includes all deicing chemicals, not just glycols and urea (*e.g.*, potassium acetate), because large quantities of these other chemicals can still have an adverse impact on receiving waters. Tenants or other fixed-based operations that conduct deicing operations must provide the above information to the airport authority for inclusion in any comprehensive airport SWPPPs.

6.S.5.3 *Good Housekeeping Measures.* (See also 4.2.7)

6.S.5.3.1 *Aircraft, Ground Vehicle and Equipment Maintenance Areas.* Describe and implement measures that prevent or minimize the contamination of storm water runoff from all areas used for aircraft, ground vehicle and equipment maintenance (including the maintenance conducted on the terminal apron and in dedicated hangers). Consider the following practices (or their equivalents): performing maintenance activities indoors; maintaining an organized inventory of material used in the maintenance areas; draining all parts of fluids prior to disposal; preventing the practice of hosing down the apron or hanger floor; using dry cleanup methods; and collecting the storm water runoff from the maintenance area and providing treatment or recycling.

6.S.5.3.2 *Aircraft, Ground Vehicle and Equipment Cleaning Areas.* Clean equipment only in the areas identified in the SWPPP and site map and clearly demarcate these areas on the ground. Describe and implement measures that prevent or minimize the contamination of storm water runoff from cleaning areas.

6.S.5.3.3 *Aircraft, Ground Vehicle and Equipment Storage Areas.* Store all aircraft, ground vehicles and equipment awaiting maintenance in designated areas only. Consider the following BMPs (or their equivalents): storing aircraft and ground vehicles indoors; using drip pans for the collection of fluid leaks; and perimeter drains, dikes or berms surrounding the storage areas.

6.S.5.3.4 *Material Storage Areas.* Maintain the vessels of stored materials (*e.g.*, used oils, hydraulic fluids, spent solvents, and waste aircraft fuel) in good condition, to prevent or minimize contamination of storm water. Also plainly label the vessels (e.g., "used oil," "Contaminated Jet A," etc.). Describe and implement measures that prevent or minimize contamination of precipitation/runoff from these areas. Consider the following BMPs (or their equivalents): storing materials indoors; storing waste materials in a centralized location; and installing berms/dikes around storage areas.

6.S.5.3.5 *Airport Fuel System and Fueling Areas.* Describe and implement measures that prevent or minimize the discharge of fuel to the storm sewer/ surface waters resulting from fuel servicing activities or other operations conducted in support of the airport fuel system. Consider the following BMPs (or their equivalents): implementing spill and overflow practices (*e.g.*, placing absorptive materials beneath aircraft during fueling operations); using dry cleanup methods; and collecting storm water runoff.

6.S.5.3.6 *Source Reduction.* Consider alternatives to the use of urea and glycol-based deicing chemicals to reduce the aggregate amount of deicing chemicals used and/or lessen the environmental impact. Chemical options to replace ethylene glycol, propylene glycol and urea include: potassium acetate; magnesium acetate; calcium acetate; anhydrous sodium acetate.

6.S.5.3.6.1 *Runway Deicing Operation:* Evaluate, at a minimum, whether over-application of deicing chemicals occurs by analyzing application rates and adjusting as necessary, consistent with considerations of flight safety. Also consider these BMP options (or their equivalents): metered application of chemicals; pre-wetting dry chemical constituents prior to application; installing a runway ice detection system; implementing anti-icing operations as a preventive measure against ice buildup.

6.S.5.3.6.2 *Aircraft Deicing Operations:* As in Part 6.S.5.3.6.1, determine whether excessive application of deicing chemicals occurs and adjust as necessary, consistent with considerations of flight safety. EPA intends for this evaluation to be carried out by the personnel most familiar with the particular aircraft and flight operations in question (vice an outside entity such as the airport authority). Consider using alternative deicing/anti-icing agents as well as containment measures for all applied chemicals. Also consider these BMP options (or their equivalents) for reducing deicing fluid use: forced-air deicing systems, computer-controlled fixed-gantry systems, infrared technology, hot water, varying glycol content to air temperature, enclosed-basket deicing trucks, mechanical methods, solar radiation, hangar storage, aircraft covers, thermal blankets for MD–80s and DC–9s. Also consider using ice-detection systems and airport traffic flow strategies and departure slot allocation systems.

6.S.5.3.7 Management of Runoff. Where deicing operations occur, describe and implement a program to control or manage contaminated runoff to reduce the amount of pollutants being discharged from the site. Consider these BMP options (or their equivalents): a dedicated deicing facility with a runoff collection/recovery system; using vacuum/collection trucks; storing contaminated storm water/deicing fluids in tanks and releasing controlled amounts to a publicly owned treatment works; collecting contaminated runoff in a wet pond for biochemical decomposition (be aware of attracting wildlife that may prove hazardous to flight operations); and directing runoff into vegetative swales or other infiltration measures. Also consider recovering deicing materials when these materials are applied during non-precipitation events (*e.g.*, covering storm sewer inlets, using booms, installing absorptive interceptors in the drains, etc.) to prevent these materials from later becoming a source of storm water contamination. Used deicing fluid should be recycled whenever possible.

6.S.5.4 *Inspections.* (See also Part 4.2.7.2.1.5) Specify the frequency of inspections in your SWPPP. At a minimum they must be conducted monthly during the deicing season (*e.g.*, October through April for most mid-latitude airports). If your facility needs to deice before or after this period, expand the monthly inspections to include all months during which deicing chemicals may be used. Also, if significantly or deleteriously large quantities of deicing chemicals are being spilled or discharged, or if water quality impacts have been reported, increase the frequency of your inspections to weekly until such time as the chemical spills/discharges or impacts are reduced to acceptable levels. The Director may specifically require you to increase inspections and SWPPP reevaluations as necessary.

6.S.5.5 *Comprehensive Site Compliance Evaluation.* (See also 4.9) (See also Part 4.9)

Using only qualified personnel, conduct your annual site compliance evaluations during periods of actual deicing operations, if possible. If not practicable during active deicing or the weather is too inclement, conduct the evaluations when deicing operations are likely to occur and the materials and equipment for deicing are in place.

6.S.6 Monitoring and Reporting Requirements. (See also Part 5)

TABLE S–1.—SECTOR-SPECIFIC NUMBERIC LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark monitoring cut-off concentration[1]	Numeric limitation
Sector of Permit Affected/Supplemental Requirements			
Facilities at airports that use more than 100,000 gallons of glycol-based deicing/anti-icing chemicals and/or 100 tons or more of urea on an average annual basis: monitor ONLY those outfalls from the airport facility that collect runoff from areas where deicing/ anti-icing activities occur (SIC 45XX).	Biochemical Oxygen Demand (BOD_5).	30 mg/L .... Chemical Oxygen Demand COD).	120.0mg/L. Ammonia 19 mg/L. pH 6/0 to 9 s.u

[1] Monitor once/quarter for the year 2 and year 4 monitoring years.

6.T Sector T—Treatment Works

6.T.1 Covered Storm Water Discharges

The requirements in Part 6.T apply to storm water discharges associated with industrial activity from Treatment Works as identified by the Activity Code specified under Sector T in Table 1–1 of Part 1.2.1.

6.T.2 Industrial Activities Covered by Sector T

The requirements listed under this Part apply to all existing point source storm water discharges associated with the following activities:

6.T.2.1 treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system used in the storage, treatment, recycling and reclamation of municipal or domestic sewage; including land dedicated to the disposal of sewage sludge; that are located within the confines of the facility with a design flow of 1.0 MGD or more; or required to have an approved pretreatment program under 40 CFR Part 403.

6.T.2.2 Not required to have permit coverage: farm lands; domestic gardens or lands used for sludge management where sludge is beneficially reused and which are not physically located within the facility; or areas that are in compliance with Section 405 of the CWA.

6.T.3 Limitations on Coverage

6.T.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.3.1) Not authorized by this permit: sanitary and industrial wastewater; and equipment/vehicle washwater.

6.T.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.T.4.1 *Site Map.* (See also Part 4.2.2.3.6) Identify where any of the following may be exposed to precipitation/surface runoff: grit, screenings and other solids handling, storage or disposal areas; sludge drying beds; dried sludge piles; compost piles; septage or hauled waste receiving station; and storage areas for process chemicals, petroleum products, solvents, fertilizers, herbicides and pesticides.

6.T.4.2 *Potential Pollutant Sources.* (See also Part 4.2.4) Describe the following additional sources and activities that have potential pollutants associated with them, as applicable: grit, screenings and other solids handling, storage or disposal areas; sludge drying beds; dried sludge piles; compost piles; septage or hauled waste receiving station; and access roads/rail lines.

6.T.4.3 *Best Management Practices (BMPs).* (See also Part 4.2.7.2) In addition to the other BMPs considered, consider the following: routing storm water to the treatment works; or covering exposed materials (*i.e.*, from the following areas: grit, screenings and other solids handling, storage or disposal areas; sludge drying beds; dried sludge piles; compost piles; septage or hauled waste receiving station).

6.T.4.4 *Inspections.* (See also Part 4.2.7.2.1.5) Include the following areas in all inspections: access roads/rail lines; grit, screenings and other solids handling, storage or disposal areas; sludge drying beds; dried sludge piles; compost piles; septage or hauled waste receiving station areas.

6.T.4.5 *Employee Training.* (See also Part 4.2.7.2.1.6) At a minimum, must address the following areas when applicable to a facility: petroleum product management; process chemical management; spill prevention and controls; fueling procedures; general good housekeeping practices; proper procedures for using fertilizer, herbicides and pesticides.

6.T.4.6 *Wastewater and Washwater Requirements.* (See also Part 4.4) Attach to your SWPPP a copy of all your current NPDES permits issued for wastewater, industrial, vehicle and equipment washwater discharges or, if an NPDES permit has not yet been issued, a copy of the pending applications. Address any requirements/conditions from the other permits, as appropriate, in the SWPPP. If the washwater is handled in another manner, the disposal method must be described and all pertinent documentation must be attached to the plan.

6.U Sector U—Food and Kindred Products

6.U.1 Covered Storm Water Discharges

The requirements in Part 6.U apply to storm water discharges associated with industrial activity from Food and Kindred Products facilities as identified by the SIC Codes specified in Table 1-1 of Part 1.2.1.

6.U.2 Industrial Activities Covered by Sector U

The types of activities that permittees under Sector U are primarily engaged in are:

6.U.2.1 meat products;
6.U.2.2 dairy products;
6.U.2.3 canned, frozen and preserved fruits, vegetables, and food specialties;
6.U.2.4 grain mill products;
6.U.2.5 bakery products;
6.U.2.6 sugar and confectionery products;
6.U.2.7 fats and oils;
6.U.2.8 beverages;
6.U.2.9 miscellaneous food preparations and kindred products and tobacco products manufacturing.

6.U.3 Limitations on Coverage

Not covered by this permit: storm water discharges identified under Part 1.2.3 from industrial plant yards, material handling sites; refuse sites; sites used for application or disposal of process wastewaters; sites used for storage and maintenance of material handling equipment; sites used for residential wastewater treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; and storage areas for raw material and intermediate and finished products. This includes areas where industrial activity has taken place in the past and significant materials remain. "Material handling activities" include the storage, loading/unloading, transportation or conveyance of any raw material, intermediate product, finished product, by-product or waste product.

6.U.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.2.2) Not authorized by this permit: discharges subject to Part 1.2.2.2 include discharges containing: boiler blowdown, cooling tower overflow and blowdown, ammonia refrigeration purging and vehicle washing/clean-out operations.

6.U.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.U.4.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify the locations of the following activities if they are exposed to precipitation/runoff: vents/stacks from cooking, drying and similar operations; dry product vacuum transfer lines; animal holding pens; spoiled product; and broken product container storage areas.

6.U.4.2 *Potential Pollutant Sources.*(See also Part 4.2.4) Describe, in addition to food and kindred products processing-related industrial activities, application and storage of pest control chemicals (*e.g.*, rodenticides, insecticides, fungicides, etc.) used on plant grounds.

6.U.4.3 *Inspections.*(See also Part 4.2.7.2.1.5) Inspect on a regular basis, at a minimum, the following areas where the potential for exposure to storm water exists: loading and unloading areas for all significant materials; storage areas including associated containment areas; waste management units; vents and stacks emanating from industrial activities; spoiled product and broken product container holding areas; animal holding pens; staging areas; and air pollution control equipment.

6.U.4.4 *Employee Training.*(See also Part 4.2.7.2.1.6) Address pest control in the training program.

6.U.5 Monitoring and Reporting Requirements. (See also Part 5)

TABLE U–1. SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one Sector/Subsector)	Parameter	Benchmark monitoring cut-off concentration[1]	Numeric limitation
Part or Permit Affected/Supplemental Requirements			
Grain Mill Products (SIC 2041–2048)	Total Suspended Solids (TSS).	100 mg/L.	
Fats and Oils Products (SIC 2074–2079)	Biochemical Oxygen Demand (BOD_5).	30 mg/L.	
	Chemical Oxygen Demand (COD).	120 mg/L.	
	Nitrate plus Nitrate Nitrogen.	0.68 mg/L.	
	Total Suspended Solids (TSS).	100 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.

6.V Sector V—Textile Mills, Apparel and Other Fabric Products

6.V.1 Covered Storm Water Discharges

The requirements in Part 6.V apply to storm water discharges associated with industrial activity from Textile Mills, Apparel, and Other Fabric Product Manufacturing as identified by the Activity Code specified under Sector V in Table 1–1 of Part 1.2.1.

6.V.2 Industrial Activities Covered by Sector V

The types of activities that permittees under Sector V are primarily engaged in are:

6.V.2.1 textile mill products, of and regarding facilities and establishments engaged in the preparation of fiber and subsequent manufacturing of yarn, thread, braids, twine, and cordage, the manufacturing of broadwoven fabrics, narrow woven fabrics, knit fabrics, and carpets and rugs from yarn;

6.V.2.2 processes involved in the dyeing and finishing of fibers, yarn fabrics, and knit apparel;

6.V.2.3 the integrated manufacturing of knit apparel and other finished articles of yarn;

6.V.2.4 the manufacturing of felt goods (wool), lace goods, non-woven fabrics, miscellaneous textiles, and other apparel products.

6.V.3 Limitations on Coverage

6.V.3.1 *Prohibition of Non-Storm Water Discharges.* (See also Part 1.2.3.1) Not authorized by this permit: discharges of wastewater (*e.g.*, wastewater resulting from wet processing or from any processes relating to the production process); reused/recycled water; and waters used in cooling towers. If you have these types of discharges from your facility, you must cover them under a separate NPDES permit.

6.V.4 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.V.4.1 *Potential Pollutant Sources.* (See also Part 4.2.4) Describe the following additional sources and activities that have potential pollutants associated with them: industrial-specific significant materials and industrial activities (*e.g.*, backwinding, beaming, bleaching, backing bonding, carbonizing, carding, cut and sew operations, desizing , drawing, dyeing locking, fulling, knitting, mercerizing, opening, packing, plying, scouring, slashing, spinning, synthetic-felt processing, textile waste processing, tufting, turning, weaving, web forming, winging, yarn spinning, and yarn texturing).

6.V.4.2 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.V.4.2.1 *Material Storage Area.* Plainly label and store all containerized materials (*e.g.*, fuels, petroleum products, solvents, dyes, etc.) in a protected area, away from drains. Describe and implement measures that prevent or minimize contamination of the storm water runoff from such storage areas, including a description of the containment area or enclosure for those materials stored outdoors. Also consider an inventory control plan to prevent excessive purchasing of potentially hazardous substances. For storing empty chemical drums/containers, ensure the drums/containers are clean (consider triple-rinsing) and there is no contact of residuals with precipitation/runoff. Collect and dispose of washwater from these cleanings properly.

6.V.4.2.2 *Material Handling Area.* Describe and implement measures that prevent or minimize contamination of storm water runoff from material handling operations and areas. Consider the following (or their equivalents): use of spill/overflow protection; covering fueling areas; and covering/enclosing areas where the transfer of material may occur. Where applicable address the replacement or repair of leaking connections, valves, transfer lines and pipes that may carry chemicals, dyes or wastewater.

6.V.4.2.3 *Fueling Areas.* Describe and implement measures that prevent or minimize contamination of storm water runoff from fueling areas. Consider the following (or their equivalents): covering the fueling area, using spill and overflow protection, minimizing runon of storm water to the fueling areas, using dry cleanup methods, and treating and/or recycling storm water runoff collected from the fueling area.

6.V.4.2.4 *Above Ground Storage Tank Area.* Describe and implement measures that prevent or minimize contamination of the storm water runoff from above ground storage tank areas, including the associated piping and valves. Consider the following (or their equivalents): regular cleanup of these areas; preparation of the spill prevention control and countermeasure program, provide spill and overflow protection; minimizing runoff of storm water from adjacent areas; restricting access to the area; insertion of filters in adjacent catch basins; providing absorbent booms in unbermed fueling areas; using dry cleanup methods; and permanently sealing drains within critical areas that may discharge to a storm drain.

6.V.4.3 *Inspections.* (See also Part 4.2.7.2.1.5) Inspect, at least on a monthly basis, the following activities and areas (at a minimum): transfer and transmission lines; spill prevention; good housekeeping practices; management of process waste products; all structural and non structural management practices.

6.V.4.4 *Employee Training.* (See also Part 4.2.7.2.1.6) As part of your employee training program, address, at a minimum, the following activities (as applicable): use of reused/recycling waters; solvents management; proper disposal of dyes; proper disposal of petroleum products and spent lubricants; spill prevention and control; fueling procedures; and general good housekeeping practices.

6.V.4.5 *Comprehensive Site Compliance Evaluation.* (See also Part 4.9) Conduct regularly scheduled evaluations at least once a year and address those areas contributing to a storm water discharge associated with industrial activity for evidence of, or the potential for, pollutants entering the drainage system. Inspect, at a minimum, as appropriate: storage tank areas; waste disposal and storage areas; dumpsters and open containers stored outside; materials storage areas; engine maintenance and repair areas; material handing areas and loading dock areas.

6.W Sector W—Furniture and Fixtures

6.W.1 Covered Storm Water Discharges

The requirements in Part 6.W apply to storm water discharges associated with industrial activity from Furniture and Fixtures facilities as identified by the Activity Code specified under Sector W in Table 1–1 of Part 1.2.1.

6.W.2 Industrial Activities Covered by Sector W

The types of activities that permittees under Sector W are primarily engaged in the manufacturing of:

6.W.2.1 wood kitchen cabinets;
6.W.2.2 household furniture;
6.W.2.3 office furniture;
6.W.2.4 public buildings and related furniture;
6.W.2.5 partitions, shelving, lockers, and office and store fixtures;
6.W.2.6 miscellaneous furniture and fixtures.

6.W.3 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.W.3.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: material storage (including tanks or other vessels used for liquid or waste storage) areas; outdoor material processing areas; areas where wastes are treated, stored or disposed; access roads; and rail spurs.

6.X Sector X—Printing and Publishing

6.X.1 Covered Storm Water Discharges

The requirements in Part 6.X apply to storm water discharges associated with industrial activity from Printing and Publishing facilities as identified by the Activity Code specified under Sector X in Table 1.1 of Part 1.2.1.

6.X.2 Industrial Activities Covered by Sector X

The types of activities that permittees under Sector X are primarily engaged in are:

6.X.2.1 book printing;
6.X.2.2 commercial printing and lithographics;
6.X.2.3 plate making and related services;
6.X.2.4 commercial printing, gravure;
6.X.2.5 commercial printing not elsewhere classified.

6.X.3 Storm Water Pollution Prevention Plan Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.X.3.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: above ground storage tanks, drums and barrel permanently stored outside.

6.X.3.2 *Potential Pollutant Sources.* (See also Part 4.2.4) Describe the following additional sources and activities that have potential pollutants associated with them, as applicable: loading and unloading operations; outdoor storage activities; significant dust or particulate generating processes; and onsite waste disposal practices (*e.g.*, blanket wash). Also identify the pollutant or pollutant parameter (*e.g.*, oil and grease, scrap metal, etc.) associated with each pollutant source.

6.X.3.3 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.X.3.3.1 *Material Storage Areas.* Plainly label and store all containerized materials (*e.g.*, skids, pallets, solvents, bulk inks, and hazardous waste, empty drums, portable/mobile containers of plant debris, wood crates, steel racks, fuel oil, etc.) in a protected area, away from drains. Describe and implement measures that prevent or minimize contamination of the storm water runoff from such storage areas, including a description of the containment area or enclosure for those materials stored outdoors. Also consider an inventory control plan to prevent excessive purchasing of potentially hazardous substances.

6.X.3.3.2 *Material Handling Area.* Describe and implement measures that prevent or minimize contamination of storm water runoff from material handling operations and areas (*e.g.*, blanket wash, mixing solvents, loading/unloading materials). Consider the following (or their equivalents): use of spill/overflow protection; covering fueling areas; and covering/enclosing areas where the transfer of materials may occur. Where applicable address the replacement or repair of leaking connections, valves, transfer lines and pipes that may carry chemicals or wastewater.

6.X.3.3.3 *Fueling Areas.* Describe and implement measures that prevent or minimize contamination of storm water runoff from fueling areas. Consider the following (or their equivalents): covering the fueling area, using spill and overflow protection, minimizing runoff of storm water to the fueling areas, using dry cleanup methods, and treating and/or recycling storm water runoff collected from the fueling area.

6.X.3.3.4 *Above Ground Storage Tank Area.* Describe and implement measures that prevent or minimize contamination of the storm water runoff from above ground storage tank areas, including the associated piping and valves. Consider the following (or their equivalents): regular cleanup of these areas; preparation of the spill prevention control and countermeasure program, provide spill and overflow protection; minimizing runoff of storm water from adjacent areas; restricting access to the area; insertion of filters in adjacent catch basins; providing absorbent booms in unbermed fueling areas; using dry cleanup methods; and permanently sealing drains within critical areas that may discharge to a storm drain.

6.X.3.4 *Employee Training.* (See also Part 4.2.7.2.1.6) As part of your employee training program, address, at a minimum, the following activities (as applicable): spent solvent management; spill prevention and control; used oil management; fueling procedures; and general good housekeeping practices.

6.Y Sector Y—Rubber, Miscellaneous Plastic Products and Miscellaneous Manufacturing Industries

6.Y.1 Covered Storm Water Discharges

The requirements in Part 6.Y apply to storm water discharges associated with industrial activity from Rubber, Miscellaneous Plastic Products and Miscellaneous Manufacturing Industries facilities as identified by the Activity

Code specified under Sector Y in Table 1–1 of Part 1.2.1.

6.Y.2 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.Y.2.1 *Potential Pollutant Sources.* (See also Part 4.2.4) Review the use of zinc at your facility and the possible pathways through which zinc may be discharged in storm water runoff.

6.Y.2.2 *Controls for Rubber Manufacturers.* (See also Part 4.2.7) Describe and implement specific controls to minimize the discharge of zinc in your storm water discharges. Parts 6.Y.2.2.1 to 6.Y.2.2.5 give possible sources of zinc to be reviewed and list some specific BMPs to be considered for implementation (or their equivalents). Some general BMP options to consider: using chemicals which are purchased in pre-weighed, sealed polyethylene bags; storing materials which are in use in sealable containers; ensuring an airspace between the container and the cover to minimize "puffing" losses when the container is opened; and using automatic dispensing and weighing equipment.

6.Y.2.2.1 Inadequate Housekeeping. Review the handling and storage of zinc bags at your facility. BMP options: employee training on the handling/storage of zinc bags; indoor storage of zinc bags; cleanup zinc spills without washing the zinc into the storm drain, and the use of 2,500-pound sacks of zinc rather than 50- to 100-pound sacks;

6.Y.2.2.2 Dumpsters. Reduce discharges of zinc from dumpsters. BMP options: covering the dumpster; moving the dumpster indoors; or provide a lining for the dumpster.

6.Y.2.2.3 Malfunctioning Dust Collectors or Baghouses: Review dust collectors/baghouses as possible sources in zinc in storm water runoff. Replace or repair, as appropriate, improperly operating dust collectors/baghouses.

6.Y.2.2.4 *Grinding Operations.*

Review dust generation from rubber grinding operations and, as appropriate, install a dust collection system.

6.Y.2.2.5 Zinc Stearate Coating Operations. Detail appropriate measures to prevent or clean up drips/spills of zinc stearate slurry that may be released to the storm drain. BMP option: using alternate compounds to zinc stearate.

6.Y.2.3 *Controls for Plastic Products Manufacturers.* Describe and implement specific controls to minimize the discharge of plastic resin pellets in your storm water discharges. BMPs to be considered for implementation (or their equivalents): minimizing spills; cleaning up of spills promptly and thoroughly; sweeping thoroughly; pellet capturing; employee education and disposal precautions.

6.Y.3 Monitoring and Reporting Requirements. (See also Part 5)

TABLE Y–1.—SECTOR-SPECIFIC NUMERIC EFFLUENT LIMITATIONS AND BENCHMARK MONITORING

Subsector	Parameter	Benchmark monitoring cut-off concentration	Numeric limitations
Part of Permit Affected/Supplemental Requirements			
Tires and Inner Tubes; Rubber Footwear; Gaskets, Packing and Sealing Devices; Rubber Hose and Belting; and Fabricated Rubber Products, Not Elsewhere Classified (SIC 3011–3069, rubber.	Total Recoverable Zinc	0.117 mg/L	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years.

6.Z Sector Z—Leather Tanning and Finishing

6.Z.1 Covered Storm Water Discharges

The requirements in Part 6.Z apply to storm water discharges associated with industrial activity from Leather Tanning and Finishing facilities as identified by the Activity Code specified under Sector Z in Table 1–1 of Part 1.2.1.

6.Z.2 Industrial Activities Covered by Sector Z

The types of activities that permittees under Sector Z are primarily engaged are leather tanning, curry and finishing; dry finishing operations; and haul roads, access roads and rail spurs.

6.Z.3 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.Z.3.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: processing and storage areas of the beamhouse, tanyard, and re-tan wet finishing and

6.Z.3.2 *Potential Pollutant Sources.* (See also Part 4.2.4) At a minimum, describe the following additional sources and activities that have potential pollutants associated with them (as appropriate): temporary or permanent storage of fresh and brine cured hides; extraneous hide substances and hair; leather dust, scraps, trimmings and shavings; chemical drums, bags, containers and above ground tanks; empty chemical containers and bags; spent solvents; floor sweepings/washings; refuse, waste piles and sludge; and significant dust/particulate generating processes (*e.g.*, buffing).

6.Z.3.3 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.Z.3.3.1 *Storage Areas for Raw, Semiprocessed or Finished Tannery Byproducts.* Pallets/bales of raw, semiprocessed or finished tannery byproducts (*e.g.*, splits, trimmings, shavings, etc.) should be stored indoors or protected by polyethylene wrapping, tarpaulins, roofed storage, etc. Consider placing materials on an impermeable surface, and enclosing or putting berms (or equivalent measures) around the area to prevent storm water runon/runoff.

6.Z.3.3.2 *Material Storage Areas.* Label storage containers of all materials (*e.g.*, specific chemicals, hazardous materials, spent solvents, waste materials). Describe and implement measures that prevent/minimize contact with storm water.

6.Z.3.3.3 *Buffing and Shaving Areas.* Describe and implement measures that prevent or minimize contamination of storm water runoff with leather dust from buffing/shaving areas. Consider dust collection enclosures, preventive inspection/maintenance programs or other appropriate preventive measures.

6.Z.3.3.4 *Receiving, Unloading, and Storage Areas.* Describe and implement measures that prevent or minimize contamination of storm water runoff from receiving, unloading, and storage areas. If these areas are exposed, consider (or their equivalent): Covering all hides and chemical supplies; diverting drainage to the process sewer;

or grade berming/curbing area to prevent runoff of storm water.

6.Z.3.3.5 *Outdoor Storage of Contaminated Equipment.* Describe and implement measures that prevent or minimize contact of storm water with contaminated equipment. Consider (or their equivalent): Covering equipment; diverting drainage to the process sewer; and cleaning thoroughly prior to storage.

6.Z.3.3.6 *Waste Management.* Describe and implement measures that prevent or minimize contamination of storm water runoff from waste storage areas. Consider (or their equivalent): Inspection/maintenance programs for leaking containers or spills; covering dumpsters; moving waste management activities indoors; covering waste piles with temporary covering material such as tarpaulins or polyethylene; and minimizing storm water runoff by enclosing the area or building berms around the area.

6.AA Sector AA—Fabricated Metal Products

6.AA.1 Covered Storm Water Discharges

The requirements in Part 6.AA apply to storm water discharges associated with industrial activity from Fabricated Metal Products facilities as identified by the Activity Code specified under Sector AA in Table 1–1 of Part 1.2.1.

6.AA.2 Industrial Activities Covered by Sector AA

The types of activities that permittees under Sector AA are primarily engaged in are:

6.AA.2.1 Fabricated metal products; except for electrical related industries;

6.AA.2.2 Fabricated metal products; except machinery and transportation equipment;

6.AA.2.3 Jewelry, silverware, and plated ware.

6.AA.3 Storm Water Pollution Prevention Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.AA.3.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: Raw metal storage areas; finished metal storage areas; scrap disposal collection sites; equipment storage areas; retention and detention basins; temporary/permanent diversion dikes or berms; right-of-way or perimeter diversion devices; sediment traps/barriers; processing areas including outside painting areas; wood preparation; recycling; and raw material storage.

6.AA.3.2 *Spills and Leaks.* (See also Part 4.2.5) When listing significant spills/leaks, pay attention to the following materials at a minimum: Chromium, toluene, pickle liquor, sulfuric acid, zinc and other water priority chemicals and hazardous chemicals and wastes.

6.AA.3.3 *Potential Pollutant Sources.* (See also Part 4.2.4) Describe the following additional sources and activities that have potential pollutants associated with them: Loading and unloading operations for paints, chemicals and raw materials; outdoor storage activities for raw materials, paints, empty containers, corn cob, chemicals, and scrap metals; outdoor manufacturing or processing activities such as grinding, cutting, degreasing, buffing, brazing, etc; onsite waste disposal practices for spent solvents, sludge, pickling baths, shavings, ingots pieces, refuse and waste piles.

6.AA.3.4 *Good Housekeeping Measures.* (See also Part 4.2.7.2.1.1)

6.AA.3.4.1 *Raw Steel Handling Storage.* Describe and implement measures controlling or recovering scrap metals, fines and iron dust. Include measures for containing materials within storage handling areas.

6.AA.3.4.2 *Paints and Painting Equipment.* Describe and implement measures to prevent or minimize exposure of paint and painting equipment to storm water.

6.AA.3.5 *Spill Prevention and Response Procedures.* (See also Part 4.2.7.2.1.4) Ensure the necessary equipment to implement a clean up is available to personnel. The following areas should be addressed:

6.AA.3.5.1 *Metal Fabricating Areas.* Describe and implement measures for maintaining clean, dry, orderly conditions in these areas. Consider the use of dry clean-up techniques.

6.AA.3.5.2 *Storage Areas for Raw Metal.* Describe and implement measures to keep these areas free of condition that could cause spills or leakage of materials. Consider the following (or their equivalents): maintaining storage areas such that there is easy access in the event of a spill; and labeling stored materials to aid in identifying spill contents.

6.AA.3.5.3 *Receiving, Unloading, and Storage Areas.* Describe and implement measures to prevent spills and leaks; plan for quick remedial clean up; and instruct employees on clean-up techniques and procedures.

6.AA.3.5.4 *Storage of Equipment.* Describe and implement measures for preparing equipment for storage and the proper storage of equipment. Consider the following (or their equivalents): protecting with covers; storing indoors; and cleaning potential pollutants from equipment to be stored outdoors.

6.AA.3.5.5 *Metal Working Fluid Storage Areas.* Describe and implement measures for storage of metal working fluids.

6.AA.3.5.6 *Cleaners and Rinse Water.* Describe and implement measures: to control/cleanup spills of solvents and other liquid cleaners; control sand buildup and disbursement from sand-blasting operations; and prevent exposure of recyclable wastes. Substitute environmentally-benign cleaners when possible.

6.AA.3.5.7 *Lubricating Oil and Hydraulic Fluid Operations.* Consider using monitoring equipment or other devices to detect and control leaks/overflows. Consider installing perimeter controls such as dikes, curbs, grass filter strips or other equivalent measures.

6.AA.3.5.8 *Chemical Storage Areas.* Describe and implement proper storage methods that prevent storm water contamination and accidental spillage. Include a program to inspect containers and identify proper disposal methods.

6.AA.3.6 *Inspections.* (See also Part 4.2.7.2.1.5) Include, at a minimum, the following areas in all inspections: raw metal storage areas; finished product storage areas; material and chemical storage areas; recycling areas; loading and unloading areas; equipment storage areas; paint areas; vehicle fueling and maintenance areas.

6.AA.3.7 *Comprehensive Site Compliance Evaluation.* (See also Part 4.9.2) As part of your evaluation, also inspect: areas associated with the storage of raw metals; storage of spent solvents and chemicals; outdoor paint areas; and drainage from roof. Potential pollutants include chromium, zinc, lubricating oil, solvents, aluminum, oil and grease, methyl ethyl ketone, steel and other related materials.

6.AA.4 Monitoring and Reporting Requirements

(See also Part 5)

TABLE AA–1.—SECTOR-SPECIFIC NUMERIC LIMITATIONS AND BENCHMARK MONITORING

Subsector (Discharges may be subject to requirements for more than one sector/subsector)	Parameter	Benchmark, monitoring, cutoff, concentration[1]	Numeric limitation
Part of Permit Affected/Supplemental Requirements			
Fabricated Metal Products Except Coating (SIC 3411–3471, 3482–3499, 3911–3915).	Total Recoverable Aluminum.	0.75 mg/L.	
	Total Recoverable Iron	1.0 mg/L.	
	Total Recoverable Zinc	0.117 mg/L.	
	Nitrate plus Nitrite Nitrogen	0.68 mg/L.	
Fabricated Metal Coating and Engraving (SIC 3479)	Total Recoverable Zinc	0.117 mg/L.	
	Nitrate plus Nitrite Nitrogen	0.68 mg/L.	

[1] Monitor once/quarter for the year 2 and year 4 Monitoring Years

6.AB Sector AB—Transportation Equipment, Industrial or Commercial Machinery

6.AB.1 Covered Storm Water Discharges

The requirements in Part 6.AB apply to storm water discharges associated with industrial activity from Transportation Equipment, Industrial or Commercial Machinery facilities as identified by the Activity Code specified under Sector AB in Table 1–1 of Part 1.2.1.

6.AB.2 Industrial Activities Covered by Sector AB

The types of activities that permittees under Sector AB are primarily engaged in are:

6.AB.2.1 Industrial and Commercial Machinery (except Computer and Office Equipment) (see Sector AC); and

6.AB.2.2 Transportation Equipment (except Ship and Boat Building and Repairing) (see Sector R).

6.AB.3 Storm Water Pollution Plan (SWPPP) Requirements

In addition to the following requirements, you must also comply with the requirements listed in Part 4.

6.AB.3.1 *Drainage Area Site Map.* (See also Part 4.2.2.3) Identify where any of the following may be exposed to precipitation/surface runoff: vents and stacks from metal processing and similar operations.

6.AB.3.2 *Non-Storm Water Discharges.* (See also Part 4.4) If your facility has a separate NPDES permit (or has applied for a permit) authorizing discharges of wastewater, attach a copy of the permit (or the application) to your SWPPP. Any new wastewater permits issued/reissued to you must then replace the old one in your SWPPP. If you discharge wastewater, other than solely domestic wastewater, to a Publicly Owned Treatment Works (POTW), you must notify the POTW of the discharge (identify the types of wastewater discharged, including any storm water). As proof of this notification, attach to your SWPPP a copy of the permit issued to your facility by the POTW or a copy of your notification to the POTW.

6.AC Sector AC—Electronic, Electrical Equipment and Components, Photographic and Optical Goods

6.AC.1 Covered Storm Water Discharges

The requirements in Part 6.AC apply to storm water discharges associated with industrial activity from facilities that manufacture Electronic, Electrical Equipment and Components, Photographic and Optical Goods as identified by the SIC Codes specified in Table 1–1 of Part 1.2.1.

6.AC.2 Industrial Activities Covered by Sector AC

The types of manufacturing activities that permittees under Sector AC are primarily engaged in are:

6.AC.2.1 Measuring, analyzing, and controlling instruments;

6.AC.2.2 Photographic, medical and optical goods;

6.AC.2.3 Watches and clocks; and

6.AC.2.4 Computer and office equipment.

6.AC.3 Additional Requirements

No additional sector-specific requirements apply to this sector.

6.AD Storm Water Discharges Designated by the Director as Requiring Permits

6.AD.1 Covered Storm Water Discharges

Sector AD is used to provide permit coverage for facilities designated by the Director as needing a storm water permit, or any discharges of industrial activity that do not meet the description of an industrial activity covered by Sectors A–AC. Therefore, almost any type of storm water discharge could be covered under this sector. You must be assigned to Sector AD by the Director and may NOT choose sector AD as the sector describing your activities on your own.

6.AD.1.1 *Eligibility for Permit Coverage.* Because this Sector only covers discharges designated by the Director as needing a storm water permit (which is an atypical circumstance) or your facility's industrial activities were inadvertently left out of Sectors A–AC, and your facility may or may not normally be discharging storm water associated with industrial activity, you must obtain the Director's written permission to use this permit prior to submitting a Notice of Intent. If you are authorized to use this permit, you will be required to ensure your discharges meet the basic eligibility provisions of this permit at Part 1.2.

6.AD.2 Storm Water Pollution Prevention Plan (SWPPP) Requirements

The Director will establish any additional Storm Water Pollution Prevention Plan requirements for your facility at the time of accepting your Notice of Intent to be covered by this permit. Additional requirements would be based on the nature of activities at your facility and your storm water discharges.

6.AD.3 Monitoring and Reporting Requirements

The Director will establish any additional monitoring and reporting requirements for your facility at the time of accepting your Notice of Intent to be covered by this permit. Additional requirements would be based on the nature of activities at your facility and your storm water discharges.

7. Reporting

7.1 Reporting Results of Monitoring

Depending on the types of monitoring required for your facility, you may have to submit the results of your monitoring or you may only have to keep the results with your Storm Water Pollution Prevention Plan. You must follow the reporting requirements and deadlines in Table 7–1 that apply to the types of monitoring that apply to your facility.

If required by the conditions of the permit that apply to your facility, you must submit analytical monitoring results obtained from each outfall associated with industrial activity (or a certification as per 5.3.1) on a Discharge Monitoring Report (DMR) form (one form must be submitted for each storm event sampled). An example of a form is found in the Guidance Manual for the Monitoring and Reporting Requirements of the NPDES Storm Water Multi-Sector General Permit. A copy of the DMR is also available on the Internet at *http://www.epa.gov/owm/sw/permits-and-forms/index.htm*. The signed DMR must be sent to: MSGP DMR (4203), US EPA, 1200 Pennsylvania Avenue NW., Washington, DC 20460.

Note: If EPA notifies dischargers (either directly, by public notice or by making information available on the Internet) of other DMR form options that become available at a later date (*e.g.*, electronic submission of forms), you may take advantage of those options to satisfy the DMR use and submission requirements of Part 7.

TABLE 7–1.—DMR/ALTERNATIVE CERTIFICATION SUBMISSION DEADLINES

Type of monitoring	Reporting deadline (postmark)
Monitoring for Numeric Limitation	Submit results by the 28th day of the month following the monitoring period.
Benchmark Monitoring:	
Monitoring Year 2001–2002	Save and submit all results for year in one package by January 28, 2003.
Monitoring Year 2003–2004	Save and submit all results for year in one package by January 28, 2005.
Biannual Monitoring for Metal Mining Facilities (see Part 6.G).	Save and submit all results for year in one package by January 28 of the year following the monitoring year.
Visual Monitoring	Retain results with SWPPP—do not submit unless requested to do so by Permitting Authority.
State/Tribal/Territory—Specific Monitoring	See Part 13 (conditions for specific States, Indian country, and Territories).

7.2 Additional Reporting for Dischargers to a Large or Medium Municipal Separate Storm Sewer System

If you discharge storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more), you must also submit signed copies of your discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in Table 7–1.

7.3 Miscellaneous Reports

You must submit any other reports required by this permit to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part 8.3.

8. Retention of Records

8.1 Documents

In addition to the requirements of Part 9.16.2, you must retain copies of Storm Water Pollution Prevention Plans and all reports and certifications required by this permit, and records of all data used to complete the Notice of Intent to be covered by this permit, for a period of at least three years from the date that the facility's coverage under this permit expires or is terminated. This period may be extended by request of the Director at any time.

8.2 Accessibility

You must retain a copy of the Storm Water Pollution Prevention Plan required by this permit (including a copy of the permit language) at the facility (or other local location accessible to the Director, a State, Tribal or Territorial agency with jurisdiction over water quality protection; local government officials; or the operator of a municipal separate storm sewer receiving discharges from the site) from the date of permit coverage to the date of permit coverage ceases. You must make a copy of your Storm Water Pollution Prevention Plan available to the public if requested to do so in writing.

8.3 Addresses

Except for the submittal of NOIs and NOTs (see Parts 2.1 and 11.2, respectively), all written correspondence concerning discharges in any State, Indian country land, Territory, or from any Federal facility covered under this permit and directed to the EPA, including the submittal of individual permit applications, must be sent to the address of the appropriate EPA Regional Office listed below:

8.3.1 Region 1: CT, MA, ME, NH, RI, VT

EPA Region 1, Office of Ecosystem Protection, One Congress Street—CMU, Boston, MA 02114.

8.3.2 Region 2: NJ, NY, PR, VI

United States EPA, Region 2, Caribbean Environmental Protection Division, Environmental Management Branch, Centro Europa Building, 1492 Ponce de Leon Ave., Suite 417, San Juan, PR 00907–4127.

8.3.3 Region 3: DE, DC, MD, PA, VA, WV

EPA Region 3, Water Protection Division (3WP13), Storm Water Coordinator, 1650 Arch Street, Philadelphia, PA 19103.

8.3.4 Region 4: AL, FL, GA, KY, MS, NC, SC, TN

Environmental Protection Agency, Region 4, Clean Water Act Enforcement Section, Water Programs Enforcement Branch, Water Management Division, Atlanta Federal Center, 61 Forsyth Street, SW., Atlanta, GA 30303.

8.3.5 Region 5: IL, IN, MI, MN, OH, WI

(Coverage Not Available Under This Permit.)

8.3.6 Region 6: AR, LA, OK, TX, NM

(Except see Region 9 for Navajo lands, and see Region 8 for Ute Mountain Reservation lands)

United States EPA, Region 6, Storm Water Staff, Enforcement and Compliance Assurance Division (GEN–WC), EPA SW MSGP, P.O. Box 50625, Dallas, TX 75205.

8.3.7 Region 7:

(Coverage Not Available Under This Permit.)

8.3.8 Region 8: CO, MT, ND, SD, WY, UT

(Except see Region 9 for Goshute Reservation and Navajo Reservation lands), the Ute Mountain Reservation in NM, and the Pine Ridge Reservation in NE

United States EPA, Region 8, Ecosystems Protection Program (8EPR–

EP), Storm Water Staff, 999 18th Street, Suite 300, Denver, CO 80202–2466.

8.3.9 Region 9: AZ, CA, HI, NV, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, the Goshute Reservation in UT and NV, the Navajo Reservation in UT, NM, and AZ, the Duck Valley Reservation in ID, Fort McDermitt Reservation in OR

United States EPA, Region 9, Water Management Division, WTR–5, Storm Water Staff, 75 Hawthorne Street, San Francisco, CA 94105.

8.3.10 Region 10: ID, WA, OR

(Except see Region 9 for Fort McDermitt Reservation.)

United States EPA, Region 10, Office of Water OW–130, 1200 6th Avenue, Seattle, WA 98101.

8.4 State, Tribal, and Other Agencies

See Part 13 for addresses of States or Tribes that require submission of information to their agencies.

9. Standard Permit Conditions

9.1 Duty To Comply

9.1.1 You must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of CWA and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

9.1.2 *Penalties for Violations of Permit Conditions:* The Director will adjust the civil and administrative penalties listed below in accordance with the Civil Monetary Penalty Inflation Adjustment Rule (**Federal Register**: December 31, 1996, Volume 61, Number 252, pages 69359–69366, as corrected, March 20, 1997, Volume 62, Number 54, pages 13514–13517) as mandated by the Debt Collection Improvement Act of 1996 for inflation on a periodic basis. This rule allows EPA's penalties to keep pace with inflation. The Agency is required to review its penalties at least once every four years thereafter and to adjust them as necessary for inflation according to a specified formula. The civil and administrative penalties listed below were adjusted for inflation starting in 1996.

9.1.2.1 *Criminal Penalties.*

9.1.2.1.1 *Negligent Violations.* The CWA provides that any person who negligently violates permit conditions implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

9.1.2.1.2 *Knowing Violations.* The CWA provides that any person who knowingly violates permit conditions implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $5,000 nor more than $50,000 per day of violation, or by imprisonment for not more than 3 years, or both.

9.1.2.1.3 *Knowing Endangerment.* The CWA provides that any person who knowingly violates permit conditions implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Act and who knows at that time that he is placing another person in imminent danger of death or serious bodily injury is subject to a fine of not more than $250,000, or by imprisonment for not more than 15 years, or both.

9.1.2.1.4 *False Statement.* The CWA provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act or who knowingly falsifies, tampers with, or renders inaccurate, any monitoring device or method required to be maintained under the Act, shall upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than two years, or by both. If a conviction is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or by both. (See section 309(c)(4) of the Clean Water Act.)

9.1.2.2 *Civil Penalties.* The CWA provides that any person who violates a permit condition implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a civil penalty not to exceed $27,500 per day for each violation.

9.1.2.3 *Administrative Penalties.* The CWA provides that any person who violates a permit condition implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to an administrative penalty, as follows:

9.1.2.3.1 *Class I Penalty.* Not to exceed $11,000 per violation nor shall the maximum amount exceed $27,500.

9.1.2.3.2 *Class II Penalty.* Not to exceed $11,000 per day for each day during which the violation continues nor shall the maximum amount exceed $137,500.

9.2 Continuation of the Expired General Permit

If this permit is not reissued or replaced prior to the expiration date, it will be administratively continued in accordance with the Administrative Procedures Act and remain in force and effect. Any permittee who was granted permit coverage prior to the expiration date will automatically remain covered by the continued permit until the earlier of:

9.2.1 Reissuance or replacement of this permit, at which time you must comply with the Notice of Intent conditions of the new permit to maintain authorization to discharge; or

9.2.2 Your submittal of a Notice of Termination; or

9.2.3 Issuance of an individual permit for your discharges; or

9.2.4 A formal permit decision by the Director not to reissue this general permit, at which time you must seek coverage under an alternative general permit or an individual permit.

9.3 Need To Halt or Reduce Activity Not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

9.4 Duty To Mitigate

You must take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

9.5 Duty To Provide Information

You must furnish to the Director or an authorized representative of the Director any information which is requested to determine compliance with this permit or other information.

9.6 Other Information

If you become aware that you have failed to submit any relevant facts or submitted incorrect information in the Notice of Intent or in any other report to the Director, you must promptly submit such facts or information.

9.7 Signatory Requirements

All Notices of Intent, Notices of Termination, Storm Water Pollution Prevention Plans, reports, certifications or information either submitted to the Director or the operator of a large or medium municipal separate storm sewer system, or that this permit requires be maintained by you, must be signed as follows:

9.7.1 All notices of intent and notices of termination must be signed as follows:

9.7.1.1 *For a corporation:* By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

9.7.1.2 *For a partnership or sole proprietorship:* By a general partner or the proprietor, respectively; or

9.7.1.3 *For a municipality, State, Federal, or other public agency:* By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes: (1) The chief executive officer of the agency, or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (*e.g.*, Regional Administrators of EPA).

9.7.2 All reports required by this permit and other information must be signed as follows:

9.7.2.1 All reports required by this permit and other information requested by the Director or authorized representative of the Director must be signed by a person described in Part 9.7.1 or by a duly authorized representative of that person.

9.7.2.2 A person is a duly authorized representative only if the authorization is made in writing by a person described Part 9.7.1 and submitted to the Director.

9.7.2.3 The authorization must specify either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

9.7.3 *Changes to Authorization.* If the information on the NOI filed for permit coverage is no longer accurate because a different operator has responsibility for the overall operation of the facility, a new Notice of Intent satisfying the requirements of Part 2 must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative. The change in authorization must be submitted within the time frame specified in Part 2.1, and sent to the address specified in Part 2.4.

9.7.4 *Certification.* Any person signing documents under Part 9.7 must make the following certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

9.8 Penalties for Falsification of Reports

Section 309(c)(4) of the Clean Water Act provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than two years, or by both.

9.9 Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve you from any responsibilities, liabilities, or penalties to which you are or may be subject under section 311 of the CWA or section 106 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

9.10 Property Rights

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

9.11 Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

9.12 Requiring Coverage Under an Individual Permit or an Alternative General Permit

9.12.1 Eligibility for this permit does not confer a vested right to coverage under the permit.

The Director may require any person authorized by this permit to apply for and/or obtain either an individual NPDES permit or an alternative NPDES general permit. Any interested person may petition the Director to take action under this paragraph. Where the Director requires a permittee authorized to discharge under this permit to apply for an individual NPDES permit, the Director will notify you in writing that a permit application is required. This notification will include a brief statement of the reasons for this decision, an application form, a statement setting a deadline for you to file the application, and a statement that on the effective date of issuance or denial of the individual NPDES permit or the alternative general permit as it applies to the individual permittee, coverage under this general permit will automatically terminate. Applications must be submitted to the appropriate Regional Office indicated in Part 8.3 of this permit. The Director may grant additional time to submit the application upon request of the applicant. If a permittee fails to submit in a timely manner an individual NPDES permit application as required by the Director under this paragraph, then the applicability of this permit to the individual NPDES permittee is automatically terminated at the end of the day specified by the Director for application submittal.

9.12.2 Any permittee authorized by this permit may request to be excluded from the coverage of this permit by applying for an individual permit. In such cases, you must submit an individual application in accordance with the requirements of 40 CFR 122.26(c)(1)(ii), with reasons supporting the request, to the Director at the address for the appropriate Regional

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Office indicated in Part 8.3 of this permit. The request may be granted by issuance of any individual permit or an alternative general permit if the reasons cited by you are adequate to support the request.

9.12.3 When an individual NPDES permit is issued to a permittee otherwise subject to this permit, or the permittee is authorized to discharge under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the effective date of the individual permit or the date of authorization of coverage under the alternative general permit, whichever the case may be. When an individual NPDES permit is denied to an owner or operator otherwise subject to this permit, or the owner or operator is denied for coverage under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the date of such denial, unless otherwise specified by the Director.

9.12.4 The Director's notification that coverage under an alternative permit is required does not imply that any discharge that did not or does not meet the eligibility requirements of Part 1.2 is or has been covered by this permit.

9.13 State/Tribal Environmental Laws

9.13.1 Nothing in this permit will be construed to preclude the institution of any legal action or relieve you from any responsibilities, liabilities, or penalties established pursuant to any applicable State/Tribal law or regulation under authority preserved by section 510 of the Act.

9.13.2 No condition of this permit releases you from any responsibility or requirements under other environmental statutes or regulations.

9.14 Proper Operation and Maintenance

You must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by you to achieve compliance with the conditions of this permit and with the requirements of Storm Water Pollution Prevention Plans. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee only when necessary to achieve compliance with the conditions of this permit.

9.15 Inspection and Entry

You must allow the Director or an authorized representative of EPA, the State/Tribe, or, in the case of a facility which discharges through a municipal separate storm sewer, an authorized representative of the municipal owner/operator or the separate storm sewer receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

9.15.1 Enter upon the your premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;

9.15.2 Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and

9.15.3 Inspect at reasonable times any facilities or equipment (including monitoring and control equipment).

9.16 Monitoring and Records

9.16.1 *Representative Samples/Measurements.* Samples and measurements taken for the purpose of monitoring must be representative of the monitored activity.

9.16.2 *Retention of Records.*

9.16.2.1 You must retain records of all monitoring information, and copies of all monitoring reports required by this permit for at least three (3) years from the date of sample, measurement, evaluation or inspection, or report. This period may be extended by request of the Director at any time. Permittees must submit any such records to the Director upon request.

9.16.2.2 You must retain the Storm Water Pollution Prevention Plan developed in accordance with Part 4 of this permit, including the certification required under Section 2.2.4.3 of this permit, for at least 3 years after the last modification or amendment is made to the plan.

9.16.3 *Records Contents.* Records of monitoring information must include:

9.16.3.1 The date, exact place, and time of sampling or measurements;

9.16.3.2 The initials or name(s) of the individual(s) who performed the sampling or measurements;

9.16.3.3 The date(s) analyses were performed;

9.16.3.4 The time(s) analyses were initiated;

9.16.3.5 The initials or name(s) of the individual(s) who performed the analyses;

9.16.3.6 References and written procedures, when available, for the analytical techniques or methods used; and

9.16.3.7 The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

9.16.4 *Approved Monitoring Methods.* Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

9.17 Permit Actions

This permit may be modified; revoked and reissued; or terminated for cause. Your filing of a request for a permit modification; revocation and reissuance; or your submittal of a notification of planned changes or anticipated non-compliance does not automatically stay any permit condition.

10. Reopener Clause

10.1 Water Quality Protection

If there is evidence indicating that the storm water discharges authorized by this permit cause, have the reasonable potential to cause, or contribute to a violation of a water quality standard, you may be required to obtain an individual permit or an alternative general permit in accordance with Part 3.3 of this permit, or the permit may be modified to include different limitations and/or requirements.

10.2 Procedures for Modification or Revocation

Permit modification or revocation will be conducted according to 40 CFR 122.62, 122.63, 122.64 and 124.5.

11. Transfer or Termination of Coverage

11.1 Transfer of Permit Coverage

Automatic transfers of permit coverage under 40 CFR 122.61(b) are not allowed for this general permit.

11.1.1 Transfer of coverage from one operator to a different operator (*e.g.,* facility sold to a new company): the new owner/operator must complete and file an NOI in accordance with Part 1.3 at least 2 days prior to taking over operational control of the facility. The old owner/operator must file an NOT (Notice of Termination) within thirty (30) days after the new owner/operator has assumed responsibility for the facility.

11.1.2 Simple name changes of the permittee (*e.g.,* Company "A" changes name to "ABC, Inc." or Company "B" buys out Company "A") may be done by filing an amended NOI referencing the facility's assigned permit number and requesting a simple name change.

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11.2 Notice of Termination (NOT)

You must submit a completed Notice of Termination (NOT) that is signed in accordance with Part 9.7 when one or more of the conditions contained in Part 1.4 (Terminating Coverage) have been met. The NOT form found in Addendum E will be used unless it has been replaced by a revised version by the Director. The Notice of Termination must include the following information:

11.2.1 The NPDES permit number for the storm water discharge identified by the Notice of Termination;

11.2.2 An indication of whether the storm water discharges associated with industrial activity have been eliminated (*i.e.*, regulated discharges of storm water are being terminated); you are no longer an operator of the facility; or you have obtained coverage under an alternative permit;

11.2.3 The name, address and telephone number of the permittee submitting the Notice of Termination;

11.2.4 The name and the street address (or a description of location if no street address is available) of the facility for which the notification is submitted;

11.2.5 The latitude and longitude of the facility; and

11.2.6 The following certification, signed in accordance with Part 9.7 (signatory requirements) of this permit. For facilities with more than one permittee and/or operator, you need only make this certification for those portions of the facility where the you were authorized under this permit and not for areas where the you were not an operator:

I certify under penalty of law that all storm water discharges associated with industrial activity from the identified facility that authorized by a general permit have been eliminated or that I am no longer the operator of the facility or construction site. I understand that by submitting this notice of termination, I am no longer authorized to discharge storm water associated with industrial activity under this general permit, and that discharging pollutants in storm water associated with industrial activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by a NPDES permit. I also understand that the submittal of this Notice of Termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

11.3 Addresses

All Notices of Termination must be submitted using the form provided by the Director (or a photocopy thereof) to the address specified on the NOT form.

11.4 Facilities Eligible for "No Exposure" Exemption for Storm Water Permitting

By filing a certification of "No Exposure" under 40 CFR 122.26(g), you are automatically removed from permit coverage and a NOT to terminate permit coverage is not required.

12. Definitions

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants to waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Commencement of Construction the initial disturbance of soils associated with clearing, grading, or excavating activities or other construction activities.

Control Measure as used in this permit, refers to any Best Management Practice or other method (including effluent limitations) used to prevent or reduce the discharge of pollutants to waters of the United States.

CWA means the Clean Water Act or the Federal Water Pollution Control Act, 33 U.S.C. 1251 *et seq.*

Director means the Regional Administrator of the Environmental Protection Agency or an authorized representative.

Discharge when used without qualification means the "discharge of a pollutant."

Discharge of Storm Water Associated with Construction Activity as used in this permit, refers to a discharge of pollutants in storm water runoff from areas where soil disturbing activities (*e.g.*, clearing, grading, or excavation), construction materials or equipment storage or maintenance (*e.g.*, fill piles, borrow areas, concrete truck washout, fueling), or other industrial storm water directly related to the construction process (*e.g.*, concrete or asphalt batch plants) are located. (See 40 CFR 122.26(b)(14)(x) and 40 CFR 122.26(b)(15) for the two regulatory definitions on regulated storm water associated with construction sites).

Discharge of Storm Water Associated with Industrial Activity is defined at 40 CFR 122.26(b)(14).

Facility or Activity means any NPDES "point source" or any other facility or activity (including land or appurtenances thereto) that is subject to regulation under the NPDES program.

Flow-Weighted Composite Sample means a composite sample consisting of a mixture of aliquots collected at a constant time interval, where the volume of each aliquot is proportional to the flow rate of the discharge.

Indian country, as defined in 18 USC 1151, means: (a) All land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and including rights-of-way running through the reservation; (b) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a state; and (c) all Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same. This definition includes all land held in trust for an Indian tribe.

Industrial Activity as used in this permit refers to the eleven categories of industrial activities included in the definition of "discharges of storm water associated with industrial activity".

Industrial Storm Water as used in this permit refers to storm water runoff associated with the definition of "discharges of storm water associated with industrial activity".

Large and Medium Municipal Separate Storm Sewer Systems are defined at 40 CFR 122.26(b)(4) and (7), respectively and means all municipal separate storm sewers that are either:

1. Located in an incorporated place (city) with a population of 100,000 or more as determined by the 1990 Census by the Bureau of Census (these cities are listed in Appendices F and G of 40 CFR 122); or
2. Located in the counties with unincorporated urbanized populations of 100,000 or more, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties (these counties are listed in Appendices H and I of 40 CFR 122); or
3. Owned or operated by a municipality other than those described in paragraph (i) or (ii) and that are designated by the Director as part of the large or medium

municipal separate storm sewer system.

Municipal Separate Storm Sewer is defined at 40 CFR 122.26.

No exposure means that all industrial materials or activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt and/or runoff.

NOI means Notice of Intent to be covered by this permit (see Part 2 of this permit.)

NOT means Notice of Termination (see Part 11.2 of this permit).

Owner or operator means the owner or operator of any "facility or activity" subject to regulation under the NPDES program.

Point source means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

Pollutant is defined at 40 CFR 122.2. A partial listing from this definition includes: dredged spoil, solid waste, sewage, garbage, sewage sludge, chemical wastes, biological materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial or municipal waste.

Runoff coefficient means the fraction of total rainfall that will appear at the conveyance as runoff.

Special Aquatic Sites, as defined at 40 CFR 230.3(q–1), means those sites identified in 40 CFR 230 Subpart E. They are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. (See 40 CFR 230.10(a)(3)).

Storm Water means storm water runoff, snow melt runoff, and surface runoff and drainage.

Storm Water Associated with Industrial Activity refers to storm water, that if allowed to discharge, would constitute a "discharge of storm water associated with industrial activity" as defined at 40 CFR 122.26(b)(14) and incorporated here by reference.

Waters of the United States means:

1. All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
2. All interstate waters, including interstate "wetlands";
3. All other waters such as interstate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

a. Which are or could be used by interstate or foreign travelers for recreational or other purposes;
b. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
c. Which are used or could be used for industrial purposes by industries in interstate commerce;

4. All impoundments of waters otherwise defined as waters of the United States under this definition;
5. Tributaries of waters identified in paragraphs (1) through (4) of this definition;
6. The territorial sea; and
7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs 1. through 6. of this definition.

Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the CWA (other than cooling ponds for steam electric generation stations per 40 CFR 423) which also meet the criteria of this definition) are not waters of the United States. Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA.

You and *Your* as used in this permit is intended to refer to the permittee, the operator, or the discharger as the context indicates and that party's facility or responsibilities. The use of "you" and "your" refers to a particular facility and not to all facilities operated by a particular entity. For example, "you must submit" means the permittee must submit something for that particular facility. Likewise, "all your discharges" would refer only to discharges at that one facility.

13. Permit Conditions Applicable to Specific States, Indian Country Lands, or Territories

The provisions of Part 13 provide modifications or additions to the applicable conditions of Parts 1 through 12 of this permit to reflect specific additional conditions required as part of the State or Tribal CWA Section 401 certification process, or Coastal Zone Management Act certification process, or as otherwise established by the permitting authority. The additional revisions and requirements listed below are set forth in connection with, and only apply to, the following States, Indian country lands and Federal facilities.

13.1 Region 1

13.1.1 *CTR05*##I:* Indian country lands within the State of Connecticut.

13.1.2 *MAR05*###:* Commonwealth of Massachusetts, except Indian country lands.

13.1.2.1 Discharges covered by the general permit must comply with the provisions of 314 CMR 3.00; 314 CMR 4.00; 314 CMR 9.00; and 310 CMR 10.00 and any other related policies adopted under the authority of the Massachusetts Clean Waters Act, M.G.L. c.21, ss. 26–53 and Wetlands Protection Act, M.G.L., s.40. Specifically, new facilities or the redevelopment of existing facilities subject to this permit must comply with applicable storm water performance standards prescribed by state regulation or policy. A permit under 314 CMR 3.04 is not required for existing facilities which meet state storm water performance standards. An application for a permit under 314 CMR 3.00 is required only when required under 314 CMR 3.04(2)(b) (designation of a discharge on a case-by-case basis) or is otherwise identified in 314 CMR 3.00 or Department policy as a discharge requiring a permit application. Department regulations and policies may be obtained through the State House Bookstore or online at *www.magnet.state.ma.us/dep.*

13.1.2.2 The department may request a copy of the Storm Water Pollution Prevention Plan (SWPPP) or conduct an inspection of any facility covered by this permit to ensure compliance with state law requirements, including state water quality standards. The Department may enforce its certification conditions.

13.1.2.3 The results of any quarterly monitoring required by this permit must be sent to the appropriate Regional

Office of the Department where the monitoring identifies violations of effluent limits or benchmarks for any parameter for which monitoring is required under this permit.

13.1.3 *MAR05*##I:* Indian country lands within the Commonwealth of Massachusetts.

13.1.4 *MER05*###:* State of Maine, except Indian country lands.

13.1.5 *MER05*##I:* Indian country lands within the State of Maine.

13.1.6 *NHR05*###:* State of New Hampshire.

13.1.7 *RIR05*##I:* Indian country lands within the State of Rhode Island.

13.1.8 *VTR05*##F:* Federal Facilities in the State of Vermont.

13.2. Region 2

13.2.1 *PRR05*###:* The Commonwealth of Puerto Rico. No additional requirements

13.3 Region 3

13.3.1 *DCR05*###:* The District of Columbia.

13.3.2 *DER05*##F:* Federal Facilities in the State of Delaware.

13.4 Region 4

13.4.1 *ALR05*##I:* Indian country lands within the State of Alabama.

13.4.2 *FLR05*##I:* Indian country lands within the State of Florida.

13.4.3 *MSR05*##I:* Indian country lands within the State of Mississippi.

13.4.4 *NCR05*##I:* Indian country lands within the State of North Carolina.

13.5 Region 5

Permit coverage not available.

13.6 Region 6

13.6.1 *LAR05*##I:* Indian Country lands within the State of Louisiana. No additional requirements.

13.6.2 *NMR05*###:* The State of New Mexico, except Indian Country lands.

13.6.2.1 *Discharges to Water Quality Impaired/Water Quality Limited Waters:* Any operator who intends to obtain authorization under the MSGP for all new and existing storm water discharges to water quality-impaired (303(d)) waters (see *http://www.nmenv.state.nm.us/*) from facilities where there is a reasonable potential to contain pollutants for which the receiving water is impaired must satisfy the following conditions prior to the authorization. Signature of the NOI (which includes certifying eligibility for permit coverage) will be deemed the operator's certification that this eligibility requirement has been satisfied.

13.6.2.1.1 Prior to submitting a Notice of Intent (NOI) for coverage under the MSGP, provide an estimate of pollutant loads in storm water discharges from the facility to the New Mexico Environment Department, Surface Water Quality Bureau (SWQB). This estimate must include the documentation upon which the estimate is based (*e.g.*, sampling data from the facility, sampling data from substantially identical outfalls at similar facilities, modeling, etc.). Existing facilities must base this estimate on actual analytical data, if available.

13.6.2.1.2 Eligibility Requirements for New Discharges.

13.6.2.1.2.1 If a Total Maximum Daily Load (TMDL) has been developed, permit coverage is available only if the operator has received notice from the SWQB confirming eligibility.

Note: Following receipt of the information required under Part 13.6.2.1.1, SWQB anticipates using the following process in making eligibility determinations for new discharges into 303(d) waters where a TMDL has been developed:

- SWQB will notify the facility operator and EPA that the estimated pollutant load is consistent with the TMDL and that the proposed storm water discharges meet the eligibility requirements of Part 1.2.3.8 of the MSGP and may be authorized under this NPDES permit; or
- SWQB will notify the facility operator and EPA that the estimated pollutant load is not consistent with the TMDL and that the proposed storm water discharges do not meet the eligibility requirements of Part 1.2.3.8 of the MSGP and can not be authorized under this NPDES permit.

13.6.2.1.2.2 If a Total Maximum Daily Load (TMDL) has not been developed, permit coverage is not available under this permit for discharges to 303(d) waters and the operator must seek coverage under a separate permit.

Note: Following receipt of the information required under Part 13.6.2.1.1, SWQB anticipates using the following process in making eligibility determinations for new discharges into 303(d) waters where a TMDL has not yet been developed: SWQB will notify the facility operator and EPA that the proposed storm water discharges do not meet the eligibility requirements of Part 1.2.3.8 of the MSGP and can not be authorized under this NPDES permit.

13.6.2.1.3 *Eligibility Requirements for Existing Discharges:*

13.6.2.1.3.1 If a Total Maximum Daily Load (TMDL) has been developed, permit coverage is available only if the operator has received notice from the SWQB confirming eligibility.

Note: Following receipt of the information required under Part 13.6.2.1.1, SWQB anticipates using the following process in making eligibility determinations for existing discharges into 303(d) waters where a TMDL has been developed:

- SWQB will notify the facility operator and EPA that the estimated pollutant load is consistent with the TMDL and that the proposed storm water discharges meet the eligibility requirements of Part 1.2.3.8 of the MSGP and may be authorized under this NPDES permit; or
- SWQB will notify the facility operator and EPA that the estimated pollutant load is not consistent with the TMDL and that the proposed storm water discharges do not meet the eligibility requirements of Part 1.2.3.8 of the MSGP and can not be authorized under this NPDES permit.

13.6.2.1.3.2 If a Total Maximum Daily Load (TMDL) has not been developed at the time of permit authorization, but is later developed during the term of this permit and identifies existing permitted discharges as having a reasonable potential to contain pollutants for which the receiving water is impaired, these discharges shall no longer be authorized by this permit unless, following notification by the SWQP:

- The operator completes revisions to his/her Storm Water Pollution Prevention Plan (SWPPP) to include additional and/or modified Best Management Practices (BMPs) designed to comply with any applicable Waste Load Allocation (WLA) established his/her discharges within 14 calendar days following notification by SWQB; and
- The operator implements the additional and/or modified BMPs before the next anticipated discharge following revision of the SWPPP; and
- A report is submitted to SWQB which documents actions taken to comply with this condition, including estimated pollutant loads, within 30 calendar days following implementation of the additional and/or modified BMPs.

13.6.2.1.4 Additional Monitoring—perform analytical monitoring for each outfall at least annually for any pollutant(s) for which the 303(d) water is impaired where there is a reasonable potential for discharges to contain any or all of these pollutants. Submit monitoring results to SWQB within 45 calendar days following sample collection. These monitoring requirements are not eligible for any waivers listed elsewhere in the permit.

13.6.2.2 Permit Eligibility Regarding Protection of Water Quality Standards and Compliance with State Anti-degradation Requirements: Storm water discharges associated with industrial activity to 303(d) waters as well as all other "waters of the State" that SWQB has determined to be or may reasonably be expected to be contributing to a violation of a water quality standard

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and/or that do not comply with the applicable anti-degradation provisions of the State's WQS are not authorized by this permit.

Note: Upon receipt of this determination, NMED anticipates that, within a reasonable period of time, EPA will notify the general permittee to apply for and obtain an individual NPDES permit for these discharges per 40 CFR 122.28(b)(3).

13.6.2.3 Signed Copies of discharge monitoring reports, individual permit applications, the data and reports addressed in Part 13.6.2.1, and all other reports required herein, shall be submitted to the appropriate state office address: New Mexico—Program Manager, Point Source Regulation Section, Surface Water Quality Bureau, New Mexico Environment Department, P.O. Box 26110, Santa Fe, New Mexico 87502.

13.6.3. NMR05*##I: Indian Country lands in the State of New Mexico, except Navajo Reservation lands (see Region 9) and Ute Mountain Reservation lands (see Region 8).

13.6.3.1 *Pueblo of Isleta* The following conditions apply only to discharges on the Pueblo of Isleta.

13.6.3.1.1 Copies of "Certification of Eligibility of Coverage" under Part 1.2.3.6.3 (Endangered Species) and Part 1.2.3.7 (Historical Properties), and their justifications, must be provided to the Tribe 10 days prior to filing the Notice of Intent (NOI).

13.6.3.1.2 A copy of the Storm Water Pollution Prevention Plan (SWPPP) must be provided to the Tribe 5 days prior to filing the NOI.

13.6.3.1.3 A copy of the NOI must be provided to the Tribe at the same time it is sent to the Environmental Protection Agency.

13.6.3.1.4 A copy of the Notice of Termination (NOT) must be provided to the Tribe at the same time it is sent to the Environmental Protection Agency.

13.6.3.1.5 Any notice of release of hazardous substances (Part 3.1.2) shall also be sent to the Tribe at the same time it is sent to the Environmental Protection Agency. Notification of a release of hazardous substances shall also be made to the Pueblo's Police Department (505–869–3030) or Governor's Office (505–869–3111) or Environment Department (505–869–5748).

13.6.3.1.6 Copies of all "Routine Inspection Reports: (Part 4.2.7.2.1.5) and "Comprehensive Inspection Reports" (Part 4.9) shall be sent to the Tribe within 5 days of completion.

13.6.3.1.7 All analytical data (*e.g.*, Discharge Monitoring Reports, etc.) shall be provided to the Tribe at the same time it is provided to the EPA.

13.6.3.1.8 Exceedance of any EPA-established "Benchmark Value" for any pollutant will require quarterly monitoring for that pollutant until such time as analytical results from 4 consecutive quarters are below the "Benchmark."

13.6.3.1.9 Any permittee in Sector F shall monitor for all Clean Water Act Section 307(a) priority pollutants used in any of their processes. Monitoring shall be on a quarterly basis.

13.6.3.1.10 Any permittee in Sector M shall monitor for total oil & grease, glycols, and those solvents regulated under Safe Drinking Water Act mandates at 40 CFR 141.61(a) in addition to those parameters identified in Table M–1. Monitoring shall be on a quarterly basis.

13.6.3.1.11 Any permittee in Sector N shall monitor for PCBs in addition to those parameters identified in Table N–1. Monitoring shall be on a quarterly basis.

13.6.3.1.12 All written reports shall be sent to: Director, Environment Department, Pueblo of Isleta, Isleta, NM 87022.

13.6.3.2 *Pueblo of Nambe.* The following conditions apply only to discharges on the Pueblo of Nambe.

No additional requirements.

13.6.3.3 *Pueblo of Picuris.* The following conditions apply only to discharges on the Pueblo of Picuris.

13.6.3.4 *Pueblo of Pojoaque.* The following conditions apply only to discharges on the Pueblo of Pojoaque.

13.6.3.4.1 Notices of Intent (NOI) and notices of Termination (NOT) shall be submitted to the Pueblo of Pojoaque Environment Department at the same time they are submitted to EPA.

13.6.3.4.2 Storm Water Pollution Prevention Plans (SWPPP) shall be submitted to the Pueblo of Pojoaque Environment Department 30 days before commencement of the project.

13.6.3.4.3 If requested by the Pueblo of Pojoaque Environment Department (PPED), the permittee shall provide additional information necessary for a "case by case" eligibility determination to assure compliance with Pojoaque Pueblo Water Quality Standards.

Note: Upon receipt of an determination by the Pueblo of Pojoaque that discharges from a facility have the reasonable potential to be causing or contributing to a violation of Pojoaque Pueblo Water Quality Standards, EPA would notify the general permittee to either improve their Storm Water Pollution Prevention Plan to achieve compliance with Pojoaque Pueblo Water Quality Standards or apply for and obtain an individual NPDES permit for these discharges per 40 CFR 122.28(b)(3).

13.6.3.4.4 All written reports shall be sent to: Pueblo of Pojoaque Environment Department, 2 W. Gutierrez, Santa Fe, NM 87501; Phone (505) 455–2087; FAX (505) 455–2177.

13.6.3.5 *Pueblo of San Juan.* The following conditions apply only to discharges on the Pueblo of San Juan.

13.6.3.5.1 Copies of the Notice of Intent (NOI) and Notice of Termination (NOT) shall be provided to the Pueblo five (5) days prior to the time it is provided to the Environmental Protection Agency. A copy of the Storm Water Pollution Prevention Plan shall be provided to the Pueblo five (5) days prior to the time the NOI is submitted to the Environmental Protection Agency.

13.6.3.5.2 All analytical data (*e.g.*, Discharge Monitoring Reports, etc.) shall be provided to the Pueblo at the same time it is provided to the Environmental Protection Agency. Monitoring activities must be coordinated with the Director of the Environment Department to insure consistency with the Pueblo of San Juan Surface Water Quality Monitoring Program.

13.6.3.5.3 Copies of all written reports required under the permit shall be sent to: Director, Environment Department, San Juan Pueblo, P.O. Box 717, San Juan Pueblo, NM 87566. For questions or coordination, you may contact the Director at (505) 852–4212.

13.6.3.6 *Pueblo of Sandia.* The following conditions apply only to discharges on the Pueblo of Sandia.

13.6.3.6.1 Copies of the Notice of Intent (NOI) and Notice of Termination (NOT) shall be provided to the Pueblo at the same time it is provided to the Environmental Protection Agency. A copy of the Storm Water Pollution Prevention Plan must also be provided to the Pueblo at the time the NOI is submitted.

13.6.3.6.2 All analytical data (e.g., Discharge Monitoring Reports, etc) shall be provided to the Pueblo at the same time it is provided to the Environmental Protection Agency.

13.6.3.6.3 All written reports shall be sent to: Director, Environment Department, Pueblo of Sandia, Box 6008, Bernalillo, NM 87004.

13.6.3.7 *Pueblo of Tesuque.* The following conditions apply only to discharges on the Pueblo of Tesuque. No additional requirements.

13.6.3.8 Santa Clara Pueblo. The following conditions apply only to discharges on the Santa Clara Pueblo. No additional requirements.

13.6.3.9 *All Other Indian Country lands in New Mexico.* No additional requirements.

13.6.4. OKR05*##I: Indian Country lands within the State of Oklahoma. No additional requirements.

13.6.5. OKR05*##F: Facilities in the State of Oklahoma not under the jurisdiction of the Oklahoma Department of Environmental Quality, except those on Indian Country lands.

13.6.5.1 Ineligible Discharges to the Oklahoma Scenic Rivers System and Outstanding Resource Waters—New or proposed discharges to the Oklahoma Scenic Rivers System, including the Illinois River, Flint Creek, Barren Fork Creek, Mountain Fork, Little Lee Creek, and Big Lee Creek or to any water designated an "Outstanding Resource Water" (ORW) in Oklahoma's Water Quality Standards are not eligible for coverage under the MSGP. Existing discharges of storm water in these watersheds may be permitted under the MSGP only from point sources existing as of June 25, 1992, whether or not such storm water discharges were permitted as point sources prior to June 25, 1992.

13.6.6. TXR05*###: The State of Texas, except Indian Country lands.

13.6.6.1 The following limitations, independently required under the Texas Water Quality Standards (31 TAC 319.22 and 319.23), apply to discharges authorized by the permit:

13.6.6.1.1 *All Discharges to Inland Waters:* The maximum allowable concentrations of each of the hazardous metals, stated in terms of milligrams per liter (mg/l), for discharges to inland waters are as follows:

Total metal	Monthly average	Daily composite	Single grab
Arsenic	0.1	0.2	0.3
Barium	1.0	2.0	4.0
Cadmium	0.05	0.1	0.2
Chromium	0.5	1.0	5.0
Copper	0.5	1.0	2.0
Lead	0.5	1.0	1.5
Manganese	1.0	2.0	3.0
Mercury	0.005	0.005	0.01
Nickel	1.0	2.0	3.0
Selenium	0.05	0.1	0.2
Silver	0.05	0.1	0.2
Zinc	1.0	2.0	6.0

13.6.6.1.2*All Discharges to Tidal Waters:* The maximum allowable concentrations of each of the hazardous metals, stated in terms of milligrams per liter (mg/l), for discharges to tidal waters are as follows:

Total metal	Monthly average	Daily composite	Single grab
Arsenic	0.1	0.2	0.3
Barium	1.0	2.0	4.0
Cadmium	0.1	0.2	0.3
Chromium	0.5	1.0	5.0
Copper	0.5	1.0	2.0
Lead	0.5	1.0	1.5
Manganese	1.0	2.0	3.0
Mercury	0.005	0.005	0.01
Nickel	1.0	2.0	3.0
Selenium	0.10	0.2	0.3
Silver	0.05	0.1	0.2
Zinc	1.0	2.0	6.0

13.6.6.1.3 Definitions:

Inland Waters—all surface waters in the State other than "tidal waters" as defined below.

Tidal Waters—those waters of the Gulf of Mexico within the jurisdiction of the State of Texas, bays and estuaries thereto, and those portions of the river systems which are subject to the ebb and flow of the tides, and to the intrusion of marine waters.

13.6.7. TXR05*##I: Indian Country lands within the State of Texas. No additional requirements.

13.7. *Region 7. Permit Coverage Not Available.*

13.8. *Region 8.*

13.8.1. COR05*##F: Federal Facilities in the State of Colorado, except those located on Indian country lands.

13.8.2. COR05*##I: Indian country lands within the State of Colorado, including the portion of the Ute Mountain Reservation located in New Mexico.

13.8.3. MTR05*##I: Reserved

13.8.4. NDR05*##I: Indian country lands within the State of North Dakota, including that portion of the Standing Rock Reservation located in South Dakota except for the Lake Traverse Reservation which is covered under South Dakota permit SDR05*##I listed below.

13.8.5. SDR05*##I: Indian country lands within the State of South Dakota, including the portion of the Pine Ridge Reservation located in Nebraska and the portion of the Lake Traverse Reservation located in North Dakota except for the Standing Rock Reservation which is covered under North Dakota permit NDR05*##I listed above.

13.8.6. UTR05*##I: Indian country lands in the State of Utah, except Goshute and Navajo reservation lands (see Region 9).

13.8.7. WYR05*##I: Indian country lands in the State of Wyoming.

13.9. *Region 9.*

13.9.1. ASR05*###: The Island of American Samoa.

13.9.1.1. Copies of NOIs shall also be submitted to the American Samoa Environmental Protection Agency at the following address concurrently with NOI submittal to EPA: American Samoa Environmental Protection Agency, Executive Office Building, Pago Pago, American Samoa 96799.

13.9.1.2. Updated storm water pollution prevention plans must be submitted to the American Samoa Environmental Protection Agency at the following address for review and approval as soon as they are completed: American Samoa Environmental Protection Agency, Executive Office Building, Pago Pago, American Samoa 96799.

13.9.2. AZR05*###: The State of Arizona, except Indian country lands.

13.9.2.1. Discharges authorized by this permit shall not cause or contribute to a violation of any applicable water quality standard of the State of Arizona (Arizona Administrative Code, Title 18, Chapter 11).

13.9.2.2. Notices of Intent (NOIs) shall also be submitted to the State of Arizona Department of Environmental Quality at the following address: Storm Water Coordinator, Arizona Department of Environmental Quality, 3033 N. Central Avenue, Phoenix, Arizona 85012. NOIs submitted to the State of Arizona shall include the well registration number if storm water associated with industrial activity is discharged to a dry well or an injection well.

13.9.2.3. Notices of Termination (NOTs) shall also be submitted to the State of Arizona Department of Environmental Quality at the following address: Storm Water Coordinator, Arizona Department of Environmental Quality, 3033 N. Central Avenue, Phoenix, Arizona 85012.

13.9.2.4. For facilities which submit a no exposure certification in accordance with Part 1.5 of the permit, the operator shall submit a copy of the no exposure certification to the State of Arizona Department of Environmental Quality at the following address: Storm Water Coordinator, Arizona Department of Environmental Quality, 3033 N. Central Avenue, Phoenix, Arizona 85012.

13.9.2.5. SARA Section 313 (Community Right to Know) facilities shall have the following requirement: Liquid storage areas for Section 313 water priority chemicals shall be operated to minimize discharges of such chemicals. Appropriate measures to minimize discharges of Section 313 chemicals shall include: provision of secondary containment for at least the entire contents of the largest tank plus sufficient freeboard to allow for the 25-year, 24-hour precipitation event; a strong spill contingency and integrity testing plan, and/or other equivalent measures.

13.9.2.6. Delineation of Facility Areas Within the 100-Year Floodplain. All facilities or any portion of a facility that is located at or within the 100-year floodplain shall be delineated on the site map. The base flood elevation, if known, shall also be reported.

13.9.2.7. Facilities subject to monitoring and reporting requirements shall also submit Discharge Monitoring Report Form(s) (DMR) and other required monitoring information to the State of Arizona Department of Environmental Quality at the following address: Storm Water DMR Coordinator, Arizona Department of Environmental Quality, 3033 N. Central Avenue Phoenix, Arizona 85012.

13.9.2.8. The term "Significant Sources of Non-Storm Water" includes, but is not limited to discharges which could cause or contribute to violations of water quality standards of the State of Arizona, and discharges which could include releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (see 40 CFR 110.10 and CFR 117.21) or Section 102 of CERCLA (see CFR 302.4).

13.9.2.9. The term "Base Flood Elevation" as defined by Federal Emergency Management Agency (FEMA) is the height of the base (100-year) flood in relation to a specified datum, usually the National Geodetic Vertical Datum of 1929 of North American Vertical Datum of 1988. This is the elevation of the 100-year flood waters relative to "mean sea level."

13.9.2.10. The term "100-year flood" means the flood having a one percent chance of being equaled or exceeded in magnitude in any given year.

13.9.2.11. The term "100-year floodplain" means that area adjoining a river, stream, or watercourse covered by water in the event of a 100-year flood.

13.9.3. AZR05*##I: Indian country lands within the State of Arizona, including Navajo Reservation lands in New Mexico and Utah.

13.9.3.1. White Mountain Apache Tribe. The following condition applies only on the White Mountain Apache Tribe: All NOIs for proposed storm water discharge coverage shall be provided to the following address: Tribal Environmental Planning Office, Attn: Brenda Pusher-Begay, P.O. Box 1000, Whiteriver, AZ 85941.

13.9.4. CAR05*##I: Indian country lands within the State of California No additional requirements.

13.9.5. GUR05*###: The Island of Guam.

13.9.5.1. Facilities ineligible for Multi-Sector General Permit coverage which are required to submit an individual NPDES permit application must send a copy to the following address at the time of submittal to EPA: Guam Environmental Protection Agency, P.O. Box 22439 GMF, Barrigada, Guam 96921.

13.9.5.2. Copies of NOIs shall also be submitted to the following address concurrently with NOI submittal to EPA: Guam Environmental Protection Agency, P.O. Box 22439 GMF, Barrigada, Guam 96921.

13.9.5.3. Permittees required by the Director to submit an individual NPDES permit application or alternative general NPDES permit application must send a copy to the following address at the time of submittal to EPA: Guam Environmental Protection Agency, P.O. Box 22439 GMF, Barrigada, Guam 96921.

13.9.6. JAR05*###: Johnston Atoll. No additional requirements.

13.9.7. MWR05*###: Midway Island and Wake Island. No additional requirements.

13.9.8. NIR05*###: Commonwealth of the Northern Mariana Islands (CNMI)

13.9.8.1. All conditions and requirements set forth in the USEPA final NPDES MSGP must be complied with.

13.9.8.2. A storm water pollution prevention plan (SWPPP) for storm water discharges associated with industrial activity must be approved by the Director of the CNMI DEQ prior to the submission of the NOI to USEPA. The CNMI address for the submittal of the SWPPP for approval is: Commonwealth of the Northern Mariana Islands, Office of the Governor, Director, Division of Environmental Quality (DEQ), P.O. Box 501304 C.K., Saipan, MP 96950–1304.

13.9.8.3. An NOI to be covered by the storm water MSGP for discharges associated with industrial activity must be submitted to CNMI DEQ (use above address) and USEPA, Region 9, in the form prescribed by USEPA, accompanied by a SWPPP approval letter from CNMI DEQ.

13.9.8.4. The NOI must be postmarked seven (7) calendar days prior to any stormwater discharges and a copy must be submitted to the Director of CNMI DEQ (use above address) no later than seven (7) calendar days prior to any stormwater discharges.

13.9.8.5. All monitoring reports required by the MSGP must be submitted to CNMI DEQ (use above address).

13.9.8.6. In accordance with section 10.3(h) and (i) of CNMI water quality standards, CNMI DEQ reserves the right to deny coverage under the MSGP and to require submittal of an application for an individual NPDES permit based on a review of the NOI or other information made available to the Director.

13.9.9. NVR05*##I: Indian country lands within the State of Nevada, including the Duck Valley Reservation in Idaho, the Fort McDermitt Reservation in Oregon and the Goshute Reservation in Utah. No additional requirements.

13.10. *Region 10.*

13.10.1. (The terms and conditions of the 1995 Multi-Sector General Permit are effective for facilities in the State of Alaska through February 9, 2001.)

13.10.2. AKR05*##I: Indian country Lands within the State of Alaska.

13.10.3. IDR05*### The State of Idaho, except Indian country lands.

13.10.4. IDR05*##I: Indian country lands within the State of Idaho, except Duck Valley Reservation lands (see Region 9).

13.10.5. ORR05*##I: Indian country lands in the State of Oregon except Fort McDermitt Reservation lands (see Region 9).

13.10.6. WAR05*##I: Indian country lands within the State of Washington

13.10.6.1 Permittees on Chehalis Reservation lands must also meet the following conditions:

1. The permittee shall be responsible for achieving compliance with Confederated Tribes of Chehalis Reservation's Water Quality Standards, and

2. The permittee shall be responsible for submitting all Storm Water Pollution Prevention Plans to the Chehalis Tribal Department of Natural Resources at the following address for review and approval prior to the beginning of any discharge activities taking place: Confederated Tribes of Chehalis Reservation, Department of Natural Resources, 420 Howanut Road, Oakville, WA 98568.

13.10.6.2 Permittees on Puyallup Reservation lands must also meet the following conditions:

1. The permittee shall be responsible for achieving compliance with Puyallup Tribe's Water Quality Standards;

2. The permittee shall submit a copy of the Notice of Intent to be covered by the general permit to the Puyallup Tribe Environmental Department at the address listed below at the same time it is submitted to U.S. EPA;

3. The permittee shall be responsible for submitting all Storm Water Pollution Prevention Plans to the Puyallup Tribe Environmental Department at the following address for review and approval prior to the beginning of any discharge activities taking place: Puyallup Tribe Environmental Department, 2002 East 28th Street, Tacoma, WA 98404.

13.10.7. WAR05*##F: Federal Facilities in the State of Washington, except those located on Indian country lands.

13.10.7.1 Discharges authorized by this permit shall not cause or contribute to a violation of any applicable water quality standard of the State of Washington. These standards are found at Chapter 173–201A WAC (Water Quality Standards for Surface Waters), Chapter 173–204 WAC (Sediment Management Standards) and the National Toxics Rule for human health standards (57 FR 60848–60923).

13.10.7.2 Any operator of a facility in Sectors A, D, E, F, G, H, J, L, M, N, or U who intends to obtain authorization under the MSGP–2000 for all new and existing storm water discharges must conduct and report benchmark monitoring for turbidity with a cutoff concentration of 50 NTU.

Addendum A—Endangered Species Guidance

I. Assessing Permit Eligibility Regarding Endangered Species

A. Background

To meet its obligations under the Clean Water Act and the Endangered Species Act (ESA) and to promote those Acts' goals, the Environmental Protection Agency (EPA) is seeking to ensure the activities regulated by this Multi-Sector General Permit (MSGP) pose no jeopardy to endangered and threatened species and critical habitat. To ensure that those goals are met, applicants for MSGP coverage are required under Part 1.2.3.6 to assess the impacts of their storm water discharges, allowable non-storm water discharges, and discharge-related activities on Federally listed endangered and threatened species ("listed species") and designated critical habitat ("critical habitat") by following the process listed below. EPA strongly recommends that you follow these steps at the earliest possible stage to ensure that measures to protect listed species and critical habitat are incorporated early in your planning process.

You also have an independent ESA obligation to ensure that your activities do not result in any prohibited "takes" of listed species.[1] Many of the measures required in the MSGP and in these instructions to protect species may also assist you in ensuring that your activities do not result in a prohibited take of species in violation of section 9 of the ESA. If you have or plan activities in areas that harbor endangered and threatened species, you may wish to ensure that you are protected from potential takings liability under ESA section 9 by obtaining an ESA section 10 permit or, if there is a separate federal action regarding the facility, by requesting formal consultation under ESA section 7 regarding that action. If you are not sure whether to pursue a section 10 permit or a section 7 consultation for takings protection, you should confer with the appropriate Fish and Wildlife Service (FWS) and/or National Marine Fisheries Service (NMFS) (collectively the "Services") office.

[1] Section 9 of the ESA prohibits any person from "taking" a listed species (*e.g.*, harassing or harming it) unless: (1) the taking is authorized through a "incidental take statement" as part of undergoing ESA section 7 formal consultation; (2) where an incidental take permit is obtained under ESA section 10 (which requires the development of a habitat conservation plan); or (3) where otherwise authorized or exempted under the ESA. This prohibition applies to all entities including private individuals, businesses, and governments.

B. How Does The Basic Eligibility Assessment Process Work?

In order to determine if you are eligible to use the permit, you need to go through a series of steps to determine:

1. Are there any listed endangered or threatened species or critical habitat in proximity to your facility or the point where your discharges reach a receiving water?

2. If there are listed species in proximity, are your discharges or discharge-related activities going to adversely affect them?

3. If adverse effects on listed species or critical habitat are likely, what can you do to eliminate or reduce these effects?

4. Have any adverse effects already been addressed under the Endangered Species Act?

5. Which, if any, of the eligibility criteria make you eligible for permit coverage?

C. What Are the Eligibility Criteria?

The Part 1.2.3.6 eligibility requirement may be satisfied by documenting that one or more of the following criteria has been met:

Criteria A. No Listed Species or Critical Habitat Are in Proximity to Your Facility or the Point Where Authorized Discharges Reach a Water of the United States (See Part 1.2.3.6.3.1)

Using the latest County Species List available from EPA and any other relevant information sources, you have determined that no listed species or critical habitat are in proximity to your facility. Listed species and critical habitat are in proximity to a facility when they are:

- Located in the path or immediate area through which or over which contaminated point source storm water flows from industrial activities to the point of discharge into the receiving water. This may also include areas where storm water from your facility enters groundwater that has a direct hydrological connection to a receiving water (*e.g.*, groundwater infiltrates at your facility and re-emerges to enter a surface waterbody within a short period of time.)
- Located in the immediate vicinity of, or nearby, the point of discharge into receiving waters.
- Located in the area of a facility where storm water BMPs are planned or are to be constructed.

Please be aware that no protection from incidental takings liability is provided under this criteria.

Criteria B. An ESA Section 7 Consultation Has Been Performed for a Separate Federal Action Regarding Your Facility (See Part 1.2.3.6.3.2)

A formal or informal ESA § 7 consultation on a separate federal action (*e.g.*, New Source review under NEPA, application for a dredge and fill permit under CWA § 404, application for an individual NPDES permit, etc.) addressed the effects of your discharges and discharge-related activities on listed species and critical habitat. If your facility was the subject of a formal consultation, it must have resulted in either a "no jeopardy opinion" or a "jeopardy opinion" and you agree to implement any reasonable and prudent alternatives or other conditions upon which the consultation was based. If your facility was the subject of an informal consultation, it must have resulted in a written concurrence by the Service(s) on a finding that the applicant's activities are not likely to adversely affect listed species or critical habitat (for informal consultation, see 50 CFR 402.13).

Criteria C. An Incidental Taking Permit Under Section 10 of the ESA was Issued for Your Facility (See Part 1.2.3.6.3.3)

You have a permit under section 10 of the ESA and that authorization addresses the effects of your wastewater and storm water discharges and discharge-related activities on listed species and critical habitat. Note: You must follow FWS/NMFS procedures when applying for an ESA section 10 permit (see 50 CFR 17.22(b)(1)).

Criteria D. You Have Determined Adverse Effects Are Not Likely (See Part 1.2.3.6.3.4)

Using best judgment, you have investigated potential effects your discharges and discharges-related activities may have on listed species and critical habitat and have no reason to believe there would be adverse effects. Any terms and/or conditions to protect listed species and critical habitat you relied on in order to determine adverse effects would be unlikely must be incorporated into your Storm Water Pollution Prevention Plan (required by the permit) and implemented in order to maintain permit eligibility.

Please be aware that no protection from incidental takings liability is provided under this criteria.

Criteria E. Your Facility Was Covered Under the Eligibility Certification of Another Operator for the Facility Area (See Part 1.2.3.6.3.5)

Your storm water discharges, allowable non-storm water discharges, and discharge-related activities were already addressed in another operator's certification of eligibility under Part 1.2.3.6.3 which covered your facility. By certifying eligibility under Part 1.2.3.6.3.4, you agree to comply with any measures or controls upon which the other operator's certification under Part 1.2.3.6.3 was based.

Please be aware that in order to meet the permit eligibility requirements by relying on another operator's certification of eligibility, the other operator's certification must apply to the location of your facility and must address the effects from your storm water discharges, allowable non-storm water discharges, and discharge-related activities on listed species and critical habitat. This situation will typically occur where an ownership of a facility covered by this permit changes or when there are multiple operators within an industrial park or an airport. However, before you rely on another operator's certification, you should carefully review that certification along with any supporting information. You also need to confirm that no additional species have been listed or critical habitat designated in the area of your facility since the other operator's endangered species assessment was done. If you do not believe that the other operator's certification provides adequate coverage for your facility, you should provide your own independent endangered species assessment and certification.

Please be aware that no protection from incidental takings liability is provided under this criteria.

D. What Procedures Do I Use To Determine if the Eligibility Criteria Can Be Satisfied?

Caution: Additional endangered and threatened species have been listed and critical habit designated since the 1995 MSGP was issued and will continue to be added after the effective date of this permit. You must verify any earlier determination of eligibility is still valid before relying on that assessment to certify eligibility for this permit. Where applicable, you may incorporate information from your previous endangered species analysis in your documentation of eligibility for this permit.

To determine eligibility, you must assess (or have previously assessed) the potential effects of your storm water discharges, allowable non-storm water discharges and discharge-related activities on listed species and critical habitat. PRIOR to completing and submitting a Notice of Intent (NOI) form, you must follow the steps outlined below and document the results of your eligibility determination.

Step One: Are There Any Endangered Species or Critical Habitat in Your County (or Other Area) and, if so, Are They in Proximity to Your Facility or Discharge Locations?

1–A. *Check for Listed Species* Look in the latest county species list to see if any listed species are found where your facility and discharge point(s) are located. If you are located close to the border of a county or your facility is located in one county and your discharge points are located in another, you must look under both counties. Since species are listed and de-listed periodically, you will need the most current list at the time you are doing your endangered species assessment. EPA's most current county-species list is on the Internet at *http://www.epa.gov/owm/esalst2.htm.*

=>Proceed to 1–B.

1–B. *Check for Critical Habitat* Some (but not all) listed species have designated critical habitat. Exact locations of such habitat is provided in the endangered species regulations at 50 CFR part 17 and part 226. To determine if facility or discharge locations are within designated critical habitat, you should either:

- Review those regulations (which can be found in many larger libraries); or
- Contact the nearest Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) Office. A list of FWS and NMFS offices is found at section II of this Addendum.; or
- Contact the State Natural Heritage centers. These centers compile and disseminate information on Federally listed and other protected species. They frequently have the most current information on listed species and critical habitat. A list of these centers is provided in section III of the Addendum.

=>Proceed to 1–C.

1–C. *Check for Proximity* If there are listed species in your county, are they in proximity to your facility or discharge locations? You will need to use the proximity criteria in Eligibility Criteria A to determine if the listed species are in your part of the county. The area in proximity to be searched/surveyed for listed species will vary with the size of the facility, the nature and quantity of the storm water discharges, and the type of receiving waters. Given the number of facilities potentially covered by the MSGP, no specific method to determine whether species are in proximity is required for permit coverage under the MSGP. Instead, you should use the method or methods which best allow you to determine to the best of your knowledge whether species are in proximity to your particular facility. These methods may include:

- Conducting visual inspections. This method may be particularly suitable for facilities that are smaller in size, facilities located in non-natural settings such as highly urbanized areas or industrial parks where there is little or no nature habitat; and facilities that discharge directly into municipal storm water collection systems. For other facilities, a visual survey of the facility site and storm water drainage areas may be insufficient to determine whether species are likely to be located in proximity to the discharge.
- Contacting the nearest State Wildlife Agency or U.S. Fish and Wildlife Service (FWS) or National Marine Fisheries Service (NMFS) offices. Many endangered and threatened species are found in well-defined areas or habitats. That information is frequently known to state or federal wildlife agencies. FWS has offices in every state. NMFS has regional offices in: Gloucester, Massachusetts; St. Petersburg, Florida; Long Beach, California; Portland, Oregon; and Juneau, Alaska.
- Contacting local/regional conservation groups. These groups inventory species and their locations and maintain lists of sightings and habitats.
- Conducting a formal biological survey. Larger facilities with extensive storm water discharges may choose to conduct biological surveys as the most effective way to assess whether species are located in proximity and whether there are likely adverse effects.

If neither your facility nor discharge locations are located in designated critical habitat, then you need not consider impacts to critical habitat when following Steps Two through Five below. If your facility or discharge locations are located within critical habitat, then you must look at impacts to critical habitat when following Steps Two through Five. EPA notes that many measures imposed to protect listed species under these

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steps will also protect critical habitat. However, obligations to protect habitat under this permit are separate from those to protect listed species. Thus, meeting the eligibility requirements of this permit may require measures to protect critical habitat that are separate from those to protect listed species.

=> Proceed to 1–D

1–D. *Check for Criteria "A" Eligibility* IF NO SPECIES WERE LISTED FOR YOUR COUNTY OR THE SPECIES THAT WERE LISTED WERE NOT IN PROXIMITY TO YOUR DISCHARGE *AND* YOUR FACILITY AND DISCHARGE LOCATIONS WERE NOT IN PROXIMITY TO CRITICAL HABITAT, YOU ARE ELIGIBLE UNDER CRITERIA "A". Document your endangered species assessment and certify eligibility under Part 1.2.3.6.3.1 of the permit. Congratulations, go to Step Five!

=> If there were listed species or critical habitat, proceed to Step Two

Step Two: Can You Meet Eligibility Criteria "B", "C", or "E"?

2–A *Check for Criteria "B", "C", or "E" Basis* Do one of the following apply:

- There was a completed consultation under ESA § 7 for your facility (Criteria B) => proceed to 2–B
- There is a previously issued ESA § 10 permit for your facility (Criteria C) => proceed to 2–C
- Another operator previously certified eligibility for the area where your facility is located (Criteria E) => proceed to 2–D

=> If no, proceed to Step Three

2–B *Check for Criteria "B" Eligibility* Did the previously completed ESA § 7 consultation consider all currently listed species and critical habitat and address your storm water, allowable non-storm water, and discharge related activities?

=> If no, proceed to Step Three

2-B–1 Did the ESA § 7 consultation result in either a "no jeopardy" opinion by the Service (for formal consultations) or a concurrence by the service that your activities would be "unlikely to adversely affect" listed species or critical habitat?

=> If no, proceed to Step Three

2–B–2 IF YOU AGREE TO IMPLEMENT ANY MEASURES UPON WHICH THE CONSULTATION WAS CONDITIONED, YOU ARE ELIGIBLE UNDER CRITERIA "B". Incorporate any necessary measures into your Storm Water Pollution Prevention Plan, document your endangered species assessment, and certify eligibility under Part 1.2.3.6.3.2. Congratulations, go to Step Five!

=> If you do not agree to implement conditions upon which the consultation was based, proceed to Step Three

2–C *Check for Criteria "C" Eligibility* IF YOUR ESA § 10 PERMIT CONSIDERED ALL CURRENTLY LISTED SPECIES AND CRITICAL HABITAT AND ADDRESSES YOUR STORM WATER, ALLOWABLE NON-STORM WATER, AND DISCHARGE RELATED ACTIVITIES, YOU ARE ELIGIBLE UNDER CRITERIA "C". Incorporate any necessary measures into your Storm Water Pollution Prevention Plan, document your endangered species assessment, and certify eligibility under Part 1.2.3.6.3.3 of the permit. Congratulations, go to Step Five!

=> If your ESA § 10 permit did not meet these criteria, proceed to Step Three

2–D Check for Criteria "E" Eligibility Did the other operator's certification of eligibility consider all currently listed species and critical habitat and address your storm water, allowable non-storm water, and discharge related activities?

=> If no, proceed to Step Three

2–D–1 IF YOU AGREE TO IMPLEMENT ANY MEASURES UPON WHICH THE OTHER OPERATOR'S CERTIFICATION WAS BASED, YOU ARE ELIGIBLE UNDER CRITERIA "E". Incorporate any necessary measures into your Storm Water Pollution Prevention Plan, document your endangered species assessment, and certify eligibility under Part 1.2.3.6.3.5 of the Permit. Congratulations, go to Step Five!

=> If you do not agree to implement conditions upon which another operator's certification was based, proceed to Step Three

Step Three: Are Listed Species or Critical Habitat Likely To Be Adversely Affected by Your Facility's Storm Water Discharges, Allowable Non-storm Water Discharges, or Discharge-related Activities?

If you are unable to certify eligibility under Criteria A, B, C, or E, you must assess whether your storm water discharges, allowable non-storm water discharges, and discharge-related activities are likely to pose jeopardy to listed species or critical habitat. "Storm water discharge-related activities" include:

Activities which cause, contribute to, or result in point source storm water pollutant discharges; and

Measures to control storm water discharges and allowable non-storm water discharges including the siting, construction, operation of best management practices (BMPs) to control, reduce or prevent water pollution.

Effects from storm water discharges, allowable non-storm water discharges, and discharge-related activities which could pose jeopardy include:

Hydrological. Wastewater or storm water discharges may cause siltation, sedimentation or induce other changes in receiving waters such as temperature, salinity or pH. These effects will vary with the amount of wastewater or storm water discharged and the volume and condition of the receiving water. Where a discharge constitutes a minute portion of the total volume of the receiving water, adverse hydrological effects are less likely.

Habitat. Excavation, site development, grading, and other surface disturbance activities, including the installation or placement of wastewater or storm water ponds or BMPs, may adversely affect listed species or their habitat. Wastewater or storm water associated with facility operation may drain or inundate listed species habitat.

Toxicity. In some cases, pollutants in wastewater or storm water may have toxic effects on listed species.

The scope of effects to consider will vary with each facility. If you are having difficulty in determining whether your facility is likely to pose jeopardy to a listed specie or critical habitat, then the appropriate office of the FWS, NMFS, or Natural Heritage Center listed in Sections II and III of this Addendum should be contacted for assistance.

Document the results of your assessment and make a preliminary determination on whether or not there would likely be any jeopardy to listed species or critical habitat. You will need to determine that your activities are either "unlikely to adversely affect" or "may adversely affect". Your determination may be based on measures that you implement to avoid, eliminate, or minimize adverse affects.

=> Proceed to Step Four

Step Four: Can You Meet Eligibility Criteria "D"?

Using best judgment, can you determine your facility's storm water discharges, allowable non-storm water discharges, and discharge-related activities are unlikely to pose jeopardy to listed species or critical habitat?

4–A IF STEP THREE DETERMINATION IS "UNLIKELY TO ADVERSELY AFFECT", YOU ARE ELIGIBLE UNDER CRITERIA "D". Incorporate appropriate measures upon which your eligibility was based into your Storm Water Pollution Prevention Plan and certify eligibility under Part 1.2.3.6.3.4 of the permit. Congratulations, go to Step Five.

=> If there may be adverse effects, proceed to Step 4–B

4–B *Step Three (or Step 4–A–1) Determination is "May Adversely Affect"* You must contact the Service(s) to discuss your findings and measures you could implement to avoid, eliminate, or minimize adverse affects.

4–B–1 IF YOU AND THE SERVICE(S) REACH AGREEMENT ON MEASURES TO AVOID ADVERSE EFFECTS, YOU ARE ELIGIBLE UNDER CRITERIA "D". Incorporate appropriate measures upon which your eligibility was based into your Storm Water Pollution Prevention Plan and certify eligibility under Part 1.2.3.6.3.4 of the permit. Congratulations, go to Step Five.

4–C *Endangered Species Issues Cannot be Resolved* If you cannot reach agreement with the Service(s) on measures to avoid, eliminate, or reduce adverse effects to an acceptable level; and if any likely adverse effects cannot otherwise be addressed through meeting the other criteria of Part 1.2.3.6; then you are not eligible for coverage under the MSGP at this time and must seek coverage under an individual permit. Proceed to 40 CFR 122.26(c) for individual permit application requirements.

Step Five: Submit Notice of Intent and Document Results of the Eligibility Determination

Once all other Part 1.2 eligibility requirements have been met, you may submit the Notice of Intent (NOI). Signature and submittal of the NOI is also deemed to constitute your certification, under penalty of law, of your eligibility for permit coverage.

You must include documentation of Part 1.2.3.6 eligibility in the pollution prevention plan required for the facility. Documentation required for the various eligibility criteria are as follows:

Criteria A—A copy of the County-Species List pages with the county(ies) where your facility and discharges are located and a statement on how you determined that no listed species or critical habitat was in proximity to your discharge.

Criteria B—A copy of the Service(s)'s Biological Opinion or concurrence on a finding of "unlikely to adversely effect" regarding the ESA § 7 consultation.

Criteria C—A copy of the Service(s)'s letter transmitting the ESA § 10 authorization.

Criteria D—Documentation on how you determined adverse effects on listed species and critical habitat were unlikely.

Criteria E—A copy of the documents originally used by the other operator of your facility (or area including your facility) to satisfy the documentation requirement of Criteria A, B, C or D.

E. Duty To Implement Terms and Conditions Upon Which Eligibility Was Determined

You must comply with any terms and conditions imposed under the eligibility requirements of Part 1.2.3.6.3 to ensure that your storm water discharges, allowable non-storm water discharges, and discharge-related activities do not pose jeopardy to listed species and/or critical habitat. You must incorporate such terms and conditions in your facility's Storm Water Pollution Prevention Plan as required by the permit. If the eligibility requirements of Part 1.2.3.6 cannot be met, then you may not receive coverage under this permit. You should then consider applying to the permitting authority for an individual permit.

II. U.S. Fish and Wildlife Service Offices

National Website For Endangered Species Information. Endangered Species Home page: http://www.fws.gov/r9endspp/endspp.html

Regional, State, Field and Project Offices

USFWS, Region One—Regional Office

Division Chief, Endangered Species, U.S. Fish and Wildlife Service, ARD Ecological Services, 911 NE 11 Avenue, Portland, OR 97232–4181, (503) 231–6121

State, Field, and Project Offices (Region One)

Field Supervisor, U.S. Fish and Wildlife Service, P.O. Box 50088, 300 Ala Moana Blvd., Rm 3108, Honolulu, HI 96850

Field Supervisor, U.S. Fish and Wildlife Service, Upper Columbia R. Basin F&W Office, 11103 East Montgomery Drive, Ste 2, Spokane, WA 99306

State Supervisor, U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office, 2600 S.E 98th Avenue Suite 100, Portland, OR 97266

Field Supervisor, U.S. Fish and Wildlife Service, Snake River Basin F&W Office, 1387 South Vinnell Way, Room 368, Boise, Idaho 83709

State Supervisor, U.S. Fish and Wildlife Service, Nevada State Office, 4600 Kietzke Lane, Building C, Rm. 125, Reno, NV 89502–5093

State Supervisor, U.S. Fish and Wildlife Service, Western Washington F&W Office, 510 Desmond Dr., Suite 102, Lacey, WA 98503–1273

Field Supervisor, U.S. Fish and Wildlife Service, Klamath Falls F&W Office, 6600 Washburn Way, Klamath Falls, OR 97603

Field Supervisor, U.S. Fish and Wildlife Service, Klamath River F&W Office, 1215 South Main, Suite 212, Yreka, CA 96097–1006

Field Supervisor, U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, 2730 Loker Avenue West, Carlsbad, CA 92008

Field Supervisor, U.S. Fish and Wildlife Service, Ventura Field Office, 2493 Portola Road, Suite B, Ventura, CA 93003

Project Leader, U.S. Fish and Wildlife Service, Coastal California Fish and Wildlife Office, 1125 16th St., Rm. 209, Arcata, CA 95521–5582

Project Leader, U.S. Fish and Wildlife Service, Northern Central Valley F&W Office, 10959 Tyler Road, Red Bluff, CA 96080

State Supervisor, U.S. Fish and Wildlife Service, California State Office, 3310 El Camino Avenue, Suite 120, Sacramento, CA 95821–6340

Field Supervisor, U.S. Fish and Wildlife Service, Sacramento Fish & Wildlife Office, 3310 El Camino Avenue, Suite 120, Sacramento, CA 95821–6340

USFWS Region Two—Regional Office

Division Chief, Endangered Species, U.S. Fish and Wildlife Service, ARD Ecological Services, P.O. Box 1306, Albuquerque, NM 87103

State, Field, and Project Offices (Region Two)

Field Supervisor, U.S. Fish and Wildlife Service, Corpus Christi Field Office, 6300 Ocean Dr., Campus Box 338, Corpus Christi, TX 78412

Field Supervisor, U.S. Fish and Wildlife Service, Arlington Field Office, 711 Stadium Dr., East, Suite 252, Arlington, TX 76011

Field Supervisor, U.S. Fish and Wildlife Service, Clear Lake Field Office, 17629 El Camino Real, Suite 211, Houston, TX 77058

Field Supervisor, U.S. Fish and Wildlife Service, Oklahoma Field Office, 222 S. Houston, Suite a, Tulsa, OK 74127

Field Supervisor, U.S. Fish and Wildlife Service, New Mexico Field Office, 2105 Osuna, NE, Albuquerque, NM 87113

Field Supervisor, U.S. Fish and Wildlife Service, Austin Ecological Serv. Field Office, 10711 Burnet Road, Suite 200, Austin, TX 78758

Field Supervisor, U.S. Fish and Wildlife Service, Arizona State Office, 2321 W. Royal Palm Road, Suite 103, Phoenix, AZ 85021–4951

USFWS Region Three—Regional Office

Division Chief, Endangered Species, U.S. Fish and Wildlife Service, ARD Ecological Services, BHW Federal Bldg, 1 Federal Drive, Fort Snelling, MN 55111–4056

State, Field, and Project Offices (Region Three)

Field Supervisor, U.S. Fish and Wildlife Service, Chicago, Illinois Field Office, 1000 Hart Rd., Suite 180, Barrington, IL 60010

Field Supervisor, U.S. Fish and Wildlife Service, East Lansing Field Office, 2651 Coolidge Road, East Lansing, MI 48823

Field Supervisor, U.S. Fish and Wildlife Service, Reynoldsburg Field Office, 6950 Americana Parkway, Suite H, Reynoldsburg, OH 43068–4132

Field Supervisor, U.S. Fish and Wildlife Service, Bloomington Field Office, 620 South Walker Street, Bloomington, IN 47403–2121

Field Supervisor, U.S. Fish and Wildlife Service, Twin Cities E.S. Field Office, 4101 East 80th Street, Bloomington, MN 55425–1665

Field Supervisor, U.S. Fish and Wildlife Service, Columbia Field Office, 608 East Cherry Street, Room 200, Columbia, MO 65201–7712

Field Supervisor, U.S. Fish and Wildlife Service, Green Bay Field Office, 1015 Challenger Court, Green Bay, WI 54311–8331

Field Supervisor, U.S. Fish and Wildlife Service, Rock Island Field Office, 4469 48th Avenue Court, Rock Island, IL 61201

Field Supervisor, U.S. Fish and Wildlife Service, Marion Suboffice, Route 3, Box 328, Marion, IL 62959–4565

USFWS Region Four—Regional Office

Division Chief, Endangered Species, U.S. Fish and Wildlife Service, ARD—Ecological Services, 1875 Century Blvd., Suite 200, Atlanta, GA 30345

State, Field, and Project Offices (Region Four)

Field Supervisor, U.S. Fish and Wildlife Service, Panama City Field Office, 1612 June Avenue, Panama City, FL 32405–3721

Field Supervisor, U.S. Fish and Wildlife Service, South Florida Ecosystem Field Office, 1360 U.S. Hwy 1, #5; P.O. Box 2676, Vero Beach, FL 32961–2676

Field Supervisor, U.S. Fish and Wildlife Service, Caribbean Field Office, P.O. Box 491, Boqueron, PR 00622

Field Supervisor, U.S. Fish and Wildlife Service, Puerto Rican Parrot Field Office, P.O. Box 1600, Rio Grande, PR 00745

Field Supervisor, U.S. Fish and Wildlife Service, Brunswick Field Office, 4270 Norwich Street, Brunswick, GA 31520–2523

Field Supervisor, U.S. Fish and Wildlife Service, Jacksonville Field Office, 6620 Southpoint Drive S., Suite 310, Jacksonville, FL 32216–0912

Field Supervisor, U.S. Fish and Wildlife Service, Charleston Field Office, 217 Ft. Johnson Road, P.O. Box 12559, Charleston, SC 29422–2559

Field Supervisor, U.S. Fish and Wildlife Service, Clemson F.O., Dept. of Forest Resources, 261 Lehotsky Hall, Box 341003, Clemson, SC 29634–1003

Field Supervisor, U.S. Fish and Wildlife Service, Raleigh Field Office, P.O. Box 33726, Raleigh, NC 27636–3726

Field Supervisor, U.S. Fish and Wildlife Service, Cookeville Field Office, 446 Neal Street, Cookeville, TN 38501

Field Supervisor, U.S. Fish and Wildlife Service, Asheville Field Office, 160 Zillicoa Street, Asheville, NC 28801
Field Supervisor, U.S. Fish and Wildlife Service, Daphne Field Office, P.O. Drawer 1190, Daphne, AL 36526
Field Supervisor, U.S. Fish and Wildlife Service, Vicksburg Field Office, 2524 S. Frontage Road, Suite B, Vicksburg, MS 39180–5269
Field Supervisor, U.S. Fish and Wildlife Svc., Lafayette Field Office, Brandywine II, Suite 102, 825 Kaliste Saloom Road, Lafayette, LA 70508
Field Supervisor, U.S. Fish and Wildlife Service, Jackson Field Office, 6578 Dogwood View Pkwy Suite A, Jackson, MS 39213

Region Five—Regional Office

Division Chief, Endangered Species, U.S. Fish and Wildlife Service, ARD Ecological Services, 300 Westgate Center Drive, Hadley, MA 01035–9589

State, Field and Project Offices (Region Five)

Project Leader, U.S. Fish and Wildlife Service, Delaware Bay Estuary Project, 2610 Whitehall Neck Road, Smyrna, DE 19977
Project Leader, U.S. Fish and Wildlife Service, Southern New England/NYBCE Program, Shoreline Plaza, Route 1A, P.O. Box 307, Charlestown, RI 02813
Project Leader, U.S. Fish and Wildlife Service, Gulf of Maine Project, 4 R Fundy Road, Falmouth, ME 04105
Project Leader U.S. Fish and Wildlife Service, Chesapeake Bay Field, Office, 177 Admiral Cochrane Drive, Annapolis, Maryland 21401
Project Leader, U.S. Fish and Wildlife Service, Virginia Field Office, P.O. Box 99, 6669 Short Lane, Gloucester, VA 23061
Project Leader, U.S. Fish and Wildlife Service, Southwestern Virginia Field Office, P.O. Box 2345, Abingdon, VA 24212
Project Leader, U.S. Fish and Wildlife Service, New England Field Office, 22 Bridge St., Unit #1, Concord, New Hampshire 03301–4986
Project Leader, U.S. Fish and Wildlife Service, Maine Field Office, 1033 South Main St., Old Town, Maine 04468
Project Leader, U.S. Fish and Wildlife Service, Rhode Island Field Office, Shoreline Plaza, Route 1A; P.O. Box 307, Charlestown, Rhode Island 02813
Project Leader, U.S. Fish and Wildlife Service, Vermont Field Office, 11 Lincoln Street, Winston Prouty Federal Building, Essex Junction, VT 05452
Project Leader, U.S. Fish and Wildlife Service, New Jersey Field Office, 927 North Main St., Bldg. D1, Pleasantville, New Jersey 08232
Project Leader, U.S. Fish and Wildlife Service, New York Field Office, 3817 Luker Road, Cortland, New York 13045
Project Leader, U.S. Fish and Wildlife Service, Long Island Field Office, P.O. Box 608, Islip, New York 11751–0608
Project Leader, U.S. Fish and Wildlife Service, Pennsylvania Field Office, 315 S. Allen St., Suite 322, State College, Pennsylvania 16801
Project Leader, U.S. Fish and Wildlife Service, Eastern Pennsylvania Field Office, 11 Hap Arnold Boulevard, Box H, Tobyhanna, Pennsylvania 18466–0080
Project Leader, U.S. Fish and Wildlife Service, West Virginia Field Office, Route 250, S.—Elkins Shopping Plaza, Elkins, West Virginia 26241

Region Six—Regional Office

Division Chief, Endangered Species, U.S. Fish and Wildlife Service, ARD-Ecological Services, P.O. Box 25486, DFC, Denver, CO 80225

State, Field, and Project Offices (Region Six)

Field Supervisor, U.S. Fish and Wildlife Service, Montana Field Office, 100 N. Park, Suite 320, Helena, MT 59601
Sub-Office Supervisor, U.S. Fish and Wildlife Service, Billings Sub-Office, 2900 4th Ave. North-Rm 301, Billings, MT 59101
Sub-Office Supervisor, U.S. Fish and Wildlife Service, Kalispell Sub-Office, 780 Creston Hatchery Road, Kalispell, MT 59901
Grizzly Bear Recovery Coordinator, U.S. Fish and Wildlife Service, Forestry Sciences Lab, University of Montana, Missoula, MT 59812
Field Supervisor, U.S. Fish and Wildlife Service, North Dakota Field Office, 1500 Capitol Avenue, Bismarck, ND 58501
Field Supervisor, U.S. Fish and Wildlife Service, Nebraska Field Office, 203 W. 2nd Street; Federal Bldg., 2nd Floor, Grand Island, NE 68801
Field Supervisor, U.S. Fish and Wildlife Service, Kansas Field Office, 315 Houston, Suite E, Manhattan, KS 66502
Field Supervisor, U.S. Fish and Wildlife Service, South Dakota Field Office, 420 S. Garfield Ave., Suite 400, Pierre, SD 57501–5408
Field Supervisor, U.S. Fish and Wildlife Service, Salt Lake City Field Office, Lincoln Plaza, 145 East 1300 South—Suite 404, Salt Lake City, UT 84115
Field Supervisor, U.S. Fish and Wildlife Service, Colorado Field Office, 730 Simms, Suite 290, Golden, CO 80401–4798
Field Supervisor, U.S. Fish and Wildlife Service, Western Colorado Field Office, 764 Horizon Drive South, Annex A, Grand Junction, CO 81506–3946
Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, 4000 Morrie Avenue, Cheyenne, WY 82001
E.S. Coordinator, U.S. Fish and Wildlife Service, Rocky Mountain Arsenal, National Wildlife Area, Building 111, Commerce City, CO 80022–1748
Colorado River Recovery Coordinator, U.S. Fish and Wildlife Service, P.O. Box 25486, DFC, Denver, CO 80225
U.S. Fish and Wildlife Service, Laramie Black Footed Ferret Office, 410 Grand Ave., Suite 315, Laramie, WY 80270

Region Seven—Regional Office

Division Chief, Endangered Species, U.S. Fish and Wildlife Service, ARD Ecological Services, 1011 E. Tudor Road, Anchorage, AK 99503

State, Field, and Project Offices (Region Seven)

Field Supervisor, U.S. Fish and Wildlife Service, Ecological Services, 605 West 4th Avenue, Room G–62, Anchorage, AK 99501
Field Supervisor, U.S. Fish and Wildlife Service, Ecological Services, 101 12th Avenue, Box 19 (Room 232), Fairbanks, AK 99701
Field Supervisor, U.S. Fish and Wildlife Service, Ketchikan Sub-office, 103 Main Street, P.O. Box 3193, Ketchikan, AK 99901
Field Supervisor, U.S. Fish and Wildlife Service, Ecological Services, 300 Vintage Blvd., Suite 201, Juneau, AK 99801
Region Eight—Has not yet been created out of the other FWS Regions at the time of this posting.

Region Nine

Janet Ady—Outreach, U.S. Fish and Wildlife Service, National Conservation Training Center, Route 3, Box 49, Kearneysville, WV 25430
Dan Benfield—Training, U.S. Fish and Wildlife Service, National Conservation Training Center, Route 3, Box 49, Kearneysville, WV 25430

III. National Marine Fisheries Service Offices

The National Marine Fisheries Service is developing a database to provide county and territorial water (up to three miles offshore) information on the presence of endangered and threatened species and critical habitat. The database should be found at the "Office of Protected Resources" site on the NMFS Homepage at http://www.nmfs.gov.

Regional and Field Offices—Northeast Region

Protected Resources Program, National Marine Fisheries Service, Northeast Region, One Blackburn Drive, Gloucester, Massachusetts 01930
Milford Field Office, National Marine Fisheries Service, 212 Rogers Avenue, Milford, Connecticut 06460
Oxford Field Office, National Marine Fisheries Service, 904 So. Morris Street, Oxford, Maryland 21654
Sandy Hook Field Office, James J. Howard Marine Sciences Laboratory, National Marine Fisheries Service, 74 Magruder Road, Highlands, New Jersey 07732
Protected Species Branch, National Marine Fisheries Service, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts 02543

Southeast Region

Protective Species Management Branch, National Marine Fisheries Service, Southeast Region, 9721 Executive Center Drive, St. Petersburg, Florida 33702–2432

Northwest Region

Protected Species Division, National Marine Fisheries Service, Northwest Region, 525 NE Oregon, Suite 500, Portland, Oregon 97232–2737
Boise Field Office, National Marine Fisheries Service, 1387 S. Vinnel Way, Suite 377, Boise, Idaho 83709
Olympia Field Office, National Marine Fisheries Service, 510 Desmond Drive, SE, Suite 103, Lacey, Washington 98503

Roseburg Field Office, National Marine Fisheries Service, 2900 Stewart Parkway NW, Roseburg, Oregon 97470

Rufus Field Office, National Marine Fisheries Service, P.O. Box 67, 704 "E" 1st, Rufus, Oregon 97050

Southwest Region

Protected Species Management Division, Southwest Region, National Marine Fisheries Service, 501 West Ocean Blvd., Suite 4200, Long Beach, California 90802-4213

Arcata Field Office, National Marine Fisheries Service, 1125 16th Street, Room 209, Arcata, California 95521

Eureka Field Office, National Marine Fisheries Service, 1330 Bayshore Way, Eureka, California 95501

Pacific Islands Area Field Office, National Marine Fisheries Service, 2570 Dole Street, Room 106, Honolulu, Hawaii 96822-2396

Santa Rosa Field Office, Protected Resources Program, National Marine Fisheries Service, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404

Alaska Region

Protected Resources Management, Division, Alaska Region, National Marine Fisheries Service, 709 West 9th Street, Federal Building 461, P.O. Box 21767, Juneau, Alaska 99802

Anchorage Office, 222 West 7th Avenue, Box 10, Anchorage, Alaska 99513-7577

IV. Natural Heritage Centers

The Natural Heritage Network comprises 85 biodiversity data centers throughout the Western Hemisphere. These centers collect, organize, and share data relating to endangered and threatened species and habitat. The network was developed to inform land-use decisions for developers, corporations, conservationists, and government agencies and is also consulted for research and educational purposes. The centers maintain a Natural Heritage Network Control Server Website (http://www.heritage.tnc.org) which provides website and other access to a large number of specific biodiversity centers. Some of these centers are listed below:

Alabama Natural Heritage Program, Huntingdon College, Massey Hall, 1500 East Fairview Avenue, Montgomery, AL 36106-2148, (334) 834-4519 Fax: (334) 834-5439, Internet: alnhp@wsnet.com

Alaska Natural Heritage Program, University of Alaska Anchorage, 707 A Street, Anchorage, AK 99501, 907/257-2702 Fax: 907/258-9139, Program Director: David Duffy, 257-2707, Internet: afdcd1@orion.alaska.edu

Arizona Heritage Data Management System, Arizona Game & Fish Department, WM-H, 2221 W. Greenway Road, Phoenix, AZ 85023, 602/789-3612 Fax: 602/789-3928, Internet: hdms@gf.state.az.us Internet: hdms1@gf.state.az.us

Arkansas Natural Heritage Commission, Suite 1500, Tower Building, 323 Center Street, Little Rock, AR 72201, 501/324-9150 Fax: 501/324-9618, Director: Harold K. Grimmett, -9614

California Natural Heritage Division, Department of Fish & Game, 1220 S Street, Sacramento, CA 95814, 916/322-2493 Fax: 916/324-0475

Colorado Natural Heritage Program, Colorado State University, 254 General Services Building, Fort Collins, CO 80523, 970/491-1309 Fax: 970/491-3349

Connecticut Natural Diversity Database, Natural Resources Center, Department of Environmental Protection, 79 Elm Street, Store Level, Hartford, CT 06106-5127, 860/424-3540 Fax: 860/424-4058

Delaware Natural Heritage Program, Division of Fish & Wildlife, Department of Natural Resources & Environmental Control, 4876 Hay Point Landing Road Smyrna, DE 19977, 302/653-2880 Fax: 302/653-3431

District of Columbia Natural Heritage Program, 13025 Riley's Lock Road, Poolesville, MD 20837, 301/427-1302 Fax: 301/427-1355

Florida Natural Areas Inventory, 1018 Thomasville Road, Suite 200-C, Tallahassee, FL 32303, 904/224-8207 Fax: 904/681-9364

Florida Natural Areas Inventory, Eglin Air Force Base, P.O. Box 1150, Niceville, FL 32588, 904/883-6451 Fax: 904/682-8381

Georgia Natural Heritage Program, Wildlife Resources Division, Georgia Department of Natural Resources, 2117 U.S. Highway 278 S.E., Social Circle, GA 30279, 706/557-3032 or 770/918-6411, Fax: 706/557-3033 or 706/557-3040 Internet: natural_heritage@mail.dnr.state.ga.us

Hawaii Natural Heritage Program, The Nature Conservancy of Hawaii, 1116 Smith Street, Suite 201, Honolulu, HI 96817, 808/537-4508 Fax: 808/545-2019

Idaho Conservation Data Center, Department of Fish & Game, 600 South Walnut Street, Box 25, Boise, ID 83707-0025, 208/334-3402 Fax: 208/334-2114

Illinois Natural Heritage Division, Department of Natural Resources, Division of Natural Heritage, 524 South Second Street, Springfield, IL 62701-1787, 217/785-8774 Fax: 217/785-8277

Illinois Nature Preserves Commission, Director: Carolyn Grosboll, Deputy Dir/Steward: Randy Heidorn, Deputy Dir/Protect: Don McFall, Office Specialist: Karen Tish, 217/785-8774 Fax: 217/785-8277

Indiana Natural Heritage Data Center, Division of Nature Preserves, Department of Natural Resources, 402 West Washington Street, Room W267, Indianapolis, IN 46204, 317/232-4052 Fax: 317/233-0133

Iowa Natural Areas Inventory, Department of Natural Resources, Wallace State Office Building, Des Moines, IA 50319-0034, Fax: 515/281-6794, Coordinator/Zoologist: Daryl Howell, 515/281-8524

Kansas Natural Heritage Inventory, Kansas Biological Survey, 2041 Constant Avenue, Lawrence, KS 66047-2906, 913/864-3453 Fax: 913/864-5093

Kentucky Natural Heritage Program, Kentucky State Nature Preserves Commission, 801 Schenkel Lane, Frankfort, KY 40601, 502/573-2886 Fax: 502/573-2355

Louisiana Natural Heritage Program, Department of Wildlife & Fisheries, P.O. Box 98000, Baton Rouge, LA 70898-9000, 504/765-2821 Fax: 504/765-2607

Maine Natural Areas Program, Department of Conservation (FedEx/UPS: 159 Hospital Street), 93 State House Station, Augusta, ME 04333-0093, 207/287-8044 Fax: 207/287-8040, Internet: mnap@state.me.us Web site: http://www.state.me.us/doc/mnap/home.htm

Maryland Heritage & Biodiversity Conservation Programs, Department of Natural Resources, Tawes State Office Building, E-1, Annapolis, MD 21401, 410/260-8540 Fax: 410/260-8595, Web site: http://www.heritage.tnc.org/nhp/us/md/

Massachusetts Natural Heritage & Endangered Species Program, Division of Fisheries & Wildlife, Route 135, Westborough, MA 01581 508/792-7270 ext. 200 Fax: 508/792-7275

Michigan Natural Features Inventory, Mason Building, 5th floor (FedEx/UPS: 530 W Allegan, 48933), Box 30444, Lansing, MI 48909-7944, 517/373-1552 Fax: 517/373-6705, Director: Leni Wilsmann, 373-7565, Internet: wilsmanl@wildlife.dnr.state.mi.us

Minnesota Natural Heritage & Nongame Research, Department of Natural Resources, 500 Lafayette Road, Box 7, St. Paul, MN 55155, 612/297-4964 Fax: 612/297-4961

Mississippi Natural Heritage Program, Museum of Natural Science, 111 North Jefferson Street, Jackson, MS 39201-2897, 601/354-7303 Fax: 601/354-7227

Missouri Natural Heritage Database, Missouri Department of Conservation, P.O. Box 180 (FedEx: 2901 West Truman Blvd), Jefferson City, MO 65102-0180, 573/751-4115 Fax: 573/526-5582

Montana Natural Heritage Program, State Library Building, 1515 E. 6th Avenue, Helena, MT 59620, 406/444-3009 Fax: 406/444-0581, Internet: mtnhp@nris.msl.mt.gov, Homepage/World Wide Web: http://nris.msl.mt.gov/mtnhp/nhp-dir.html

Navajo Natural Heritage Program, P.O. Box 1480, Window Rock, Navajo Nation, AZ 86515, (520) 871-7603, (520) 871-7069 (FAX)

Nebraska Natural Heritage Program, Game and Parks Commission, 2200 North 33rd Street, P.O. Box 30370, Lincoln, NE 68503, 402/471-5421 Fax: 402/471-5528

Nevada Natural Heritage Program, Department of Conservation & Natural Resources, 1550 E. College Parkway, Suite 145, Carson City, NV 89706-7921, 702/687-4245 Fax: 702/885-0868

New Hampshire Natural Heritage Inventory, Department of Resources & Economic Development, 172 Pembroke Street, P.O. Box 1856, Concord, NH 03302, 603/271-3623 Fax: 603/271-2629

New York Natural Heritage Program, Department of Environmental Conservation, 700 Troy-Schenectady Road, Latham, NY 12110-2400, 518/783-3932 Fax: 518/783-3916, Computer: 518/783-3946

North Carolina Heritage Program, NC Department of Environment, Health & Natural Resources, Division of Parks & Recreation, P.O. Box 27687, Raleigh, NC 27611-7687, 919-733-4181 Fax: 919/715-3085

North Dakota Natural Heritage Inventory, North Dakota Parks & Recreation

R0019907

Department, 1835 Bismarck Expressway, Bismarck, ND 58504, 701/328–5357 Fax: 701/328–5363

Ohio Natural Heritage Data Base, Division of Natural Areas & Preserves, Department of Natural Resources, 1889 Fountain Square, Building F-1, Columbus, OH 43224, 614/265–6453 Fax: 614/267–3096

Oklahoma Natural Heritage Inventory, Oklahoma Biological Survey, 111 East Chesapeake Street, University of Oklahoma, Norman, OK 73019–0575, 405/325–1985 Fax: 405/325–7702, Web site: http://obssun02.uoknor.edu/biosurvey/onhi/home.html

Oregon Natural Heritage Program, Oregon Field Office, 821 SE 14th Avenue, Portland, OR 97214 503/731–3070; 230–1221 Fax: 503/230–9639

Pennsylvania Natural Diversity Inventory (East, West, Central)

* Pennsylvania Natural Diversity Inventory—East, The Nature Conservancy, 34 Airport Drive, Middletown, PA 17057, 717/948–3962 Fax: 717/948–3957
* Pennsylvania Natural Diversity Inventory—West, Western Pennsylvania Conservancy, Natural Areas Program, 316 Fourth Avenue, Pittsburgh, PA 15222, 412/288–2777 Fax: 412/281–1792
* Pennsylvania Natural Diversity Inventory—Central, Bureau of Forestry, P.O. Box 8552, Harrisburg, PA 17105–8552, 717/783–0388 Fax: 717/783–5109

Puerto Rico Natural Heritage Program, Division de Patrimonio Natural, Area de Planificacion Integral, Departamento de Recursos Naturales y Ambientales de Puerto Rico, P.O. Box 5887, Puerta de Tierra, Puerto Rico 00906, Tel: 787–722–1726, Fax: 787–725–9526

Rhode Island Natural Heritage Program, Department of Environmental Management, Division of Planning & Development, 83 Park Street, Providence, RI 02903, 401/277–2776, x4308 Fax: 401/277–2069

South Carolina Heritage Trust, SC Department of Natural Resources, P.O. Box 167, Columbia, SC 29202, 803/734–3893 Fax: 803/734–6310 (Call first)

South Dakota Natural Heritage Data Base, SD Department of Game, Fish & Parks Wildlife Division, 523 E. Capitol Avenue, Pierre, SD 57501–3182, 605/773–4227 Fax: 605/773–6245

Tennessee Division of Natural Heritage, Department of Environment & Conservation, 401 Church Street, Life and Casualty Tower, 8th Floor, Nashville, TN 37243–0447, 615/532–0431 Fax: 615/532–0614

Texas Biological and Conservation Data System, 3000 South IH–35, Suite 100, Austin, TX 78704, 512/912–7011 Fax: 512/912–7058

U.S. Virgin Islands Conservation Data Center, Eastern Caribbean Center, University of the Virgin Islands, No. 2 John Brewers Bay, St. Thomas, VI 00802, (809) 693–1030 [Voice] (809) 693–1025, [Fax], Home Page: cdc.uvi.edu, E-Mail:dbarry@uvi.edu

Utah Natural Heritage Program, Division of Wildlife Resources, 1596 West North Temple, Salt Lake City, UT 84116, 801/538–4761 Fax: 801/538–4709

Vermont Nongame & Natural Heritage Program, Vermont Fish & Wildlife Department, 103 S. Main Street, 10 South, Waterbury, VT 05671–0501, 802/241–3700 Fax: 802/241–3295

Virginia Division of Natural Heritage, Department of Conservation & Recreation, Main Street Station, 1500 E. Main Street, Suite 312, Richmond, VA 23219, 804/786–7951 Fax: 804/371–2674

Washington Natural Heritage Program, Department of Natural Resources, (FedEx: 1111 Washington Street, SE), P.O. Box 47016, Olympia, WA 98504–7016, 360/902–1340 Fax: 360/902–1783

West Virginia Natural Heritage Program, Department of Natural Resources, Operations Center, Ward Road, P.O. Box 67, Elkins, WV 26241, 304/637–0245 Fax: 304/637–0250

Wisconsin Natural Heritage Program, Endangered Resources, Department of Natural Resources, 101 S. Webster Street, Box 7921, Madison, WI 53707, 608/266–7012 Fax: 608/266–2925

Wyoming Natural Diversity Database, 1604 Grand Avenue, Suite 2, Laramie, WY 82070, 307/745–5026 Fax: 307/745–5026 (Call first), Internet: wyndd@lariat.or

Addendum B—Historic Properties Guidance

Applicants must determine whether their facility's storm water discharges, allowable non-storm water discharges, or construction of best management practices (BMPs) to control such discharges, has potential to affect a property that is either listed or eligible for listing on the National Register of Historic Places.

For existing dischargers who do not need to construct BMPs for permit coverage, a simple visual inspection may be sufficient to determine whether historic properties are affected. However, for facilities which are new industrial storm water dischargers and for existing facilities which are planning to construct BMPs for permit eligibility, applicants should conduct further inquiry to determine whether historic properties may be affected by the storm water discharge or BMPs to control the discharge. In such instances, applicants should first determine whether there are any historic properties or places listed on the National Register or if any are eligible for listing on the register (*e.g.*, they are "eligible for listing").

Due to the large number of entities seeking coverage under this permit and the limited number of personnel available to State and Tribal Historic Preservation Officers nationwide to respond to inquiries concerning the location of historic properties, EPA suggests that applicants first access the "National Register of Historic Places" information listed on the National Park Service's web page (see Part I of this addendum). Addresses for State Historic Preservation Officers and Tribal Historic Preservation Officers are listed in Parts II and III of this addendum, respectively. In instances where a Tribe does not have a Tribal Historic Preservation Officer, applicants should contact the appropriate Tribal government office when responding to this permit eligibility condition. Applicants may also contact city, county or other local historical societies for assistance, especially when determining if a place or property is eligible for listing on the register.

The following three scenarios describe how applicants can meet the permit eligibility criteria for protection of historic properties under this permit:

(1) If historic properties are not identified in the path of a facility's storm water and allowable non-storm water discharges or where construction activities are planned to install BMPs to control such discharges (*e.g.*, diversion channels or retention ponds), then the applicant has met the permit eligibility criteria under Part 1.2.3.7.1.

(2) If historic properties are identified but it is determined that they will not be affected by the discharges or construction of BMPs to control the discharge, the applicant has met the permit eligibility criteria under Part 1.2.3.7.1.

(3) If historic properties are identified in the path of a facility's storm water and allowable non-storm water discharges or where construction activities are planned to install BMPs to control such discharges, and it is determined that there is the potential to adversely affect the property, the applicant can still meet the permit eligibility criteria under Part 1.2.3.7.2 if he/she obtains and complies with a written agreement with the appropriate State or Tribal Historic Preservation Officer which outlines measures the applicant will follow to mitigate or prevent those adverse effects. The contents of such a written agreement must be included in the facility's Storm Water Pollution Prevention Plan. The NOI form is being amended to include which option was selected to demonstrate compliance with NHPA provisions. EPA will notify applicants when the new NOI form takes effect.

In situations where an agreement cannot be reached between an applicant and the State or Tribal Historic Preservation Officer, applicants should contact the Advisory Council on Historic Preservation listed in Part IV of this addendum for assistance.

The term "adverse effects" includes but is not limited to damage, deterioration, alteration or destruction of the historic property or place. EPA encourages applicants to contact the appropriate State or Tribal Historic Preservation Officer as soon as possible in the event of a potential adverse effect to a historic property.

Applicants are reminded that they must comply with applicable State, Tribal and local laws concerning the protection of historic properties and places.

I. Internet Information on the National Register of Historic Places

An electronic listing of the "National Register of Historic Places," as maintained by the National Park Service on its National Register Information System (NRIS), can be accessed on the Internet at "http://www.nr.nps.gov/nrishome.htm". Remember to use small case letters when accessing Internet addresses.

II. State Historic Preservation Officers (SHPO)

SHPO and Deputy SHPO List:

Alabama

Dr. Lee Warner, SHPO, Alabama Historical Commission, 468 South Perry Street, Montgomery, AL 36130–0900, 334–242–3184 FAX: 334–240–3477, E-Mail: *lwarner@mail.preserveala.org/*

Deputy: Ms. Elizabeth Ann Brown, E-Mail: *ebrown@mail.preserveala.orgwww.preserveala.org*

Alaska

Ms. Judith Bittner, SHPO, Alaska Department of Natural Resources, Office of History & Archeology, 550 West 7th Avenue, Suite 1310, Anchorage, AK 99501–3565, 907–269–8721 FAX: 907–269–8908, E-Mail: *judyb@dnr.state.ak.us*

Deputy: Joan Antonson, *www.dnr.state.ak.us/parks/oha_web*

American Samoa

Mr. John Enright, HPO, Executive Offices of the Governor, American Samoa Historic Preservation Office, American Samoa Government, Pago Pago, American Samoa 96799, 011–684–633–2384 FAX: 684–633–2367, E-Mail: *enright@samoatelco.com*

Deputy: Mr. David J. Herdrich, E-Mail: *herdrich@samoatelco.com*

Arizona

Mr. James W. Garrison, SHPO, Arizona State Parks, 1300 West Washington, Phoenix, AZ 85007, 602–542–4174 FAX: 602–542–4180, E-Mail: *jgarrison@pr.state.az.us*

Deputy: Ms. Carol Griffith, E-Mail: *cgriffith@pr.state.az.uswww.pr.state.az.us*

Arkansas

Ms. Cathryn B. Slater, SHPO, Arkansas Historic Preservation Program, 323 Center Street, Suite 1500, Little Rock, AR 72201, 501–324–9880 FAX: 501–324–9184, E-Mail: *cathy@dah.state.ar.us*

Deputy: Mr. Ken Grunewald, 501–324–9356, E-Mail: *keng@dah.state.ar.us*

California

Daniel Abeyta, Acting SHPO, Ofc of Hist Pres, Dept Parks & Recreation, P.O. Box 942896, Sacramento CA 94296–0001, 916–653–6624 FAX: 916–653–9824, E-Mail: *dabey@ohp.parks.ca.gov*

Deputy: *http://cal-parks.ca.gov*

Colorado

Ms. Georgianna Contiguglia, SHPO, Colorado Historical Society, 1300 Broadway, Denver, CO 80203, 303–866–3395 FAX: 303–866–4464,

Deputy: Mr. Mark Wolfe, 303–866–2776, FAX: 303–866–2041, E-Mail: *mark.wolfe@chs.state.co.us*

Deputy: Dr. Susan M. Collins, 303–866–2736, E-Mail: *susan.collins@chs.state.co.us*

Tech Ser: Ms. Kaaren Hardy, 303–866–3398, E-Mail: *kaaren.hardy@chs.state.co.uswww.coloradohistory-oahp.org*

Connecticut

Mr. John W. Shannahan, SHPO, Connecticut Historical Commission, 59 So. Prospect Street, Hartford, CT 06106, 860–566–3005 FAX: 860–566–5078, E-Mail: *cthist@neca.com*

Deputy: Dr. Dawn Maddox, Pres Programs Sup

Delaware

Mr. Daniel Griffith, SHPO, Division of Historical and Cultural Affairs, P.O. Box 1401, Dover, DE 19903, 302–739–5313 FAX: 302–739–6711, E-Mail: *dgriffith@state.de.us*

Deputy: Ms. Joan Larrivee, Delaware State Hist Preservation Office, 15 The Green, Dover, DE 19901, 302–739–5685 FAX: 302–739–5660, E-Mail: *jlarrivee@state.de.us*

District of Columbia

Mr. Gregory McCarthy, SHPO, Historic Preservation Division, Suite 305, 941 N. Capitol Street, NE., Room 2500, Washington, DC 20002, 202–442–4570 FAX: 202–442–4860, *www.dcra.org*

Deputy: Mr. Stephen J. Raiche

Florida

Dr. Janet Snyder Matthews, SHPO, Director, Div of Historical Resources, Dept of State, R. A. Gray Building, 4th Floor, 500 S. Bronough St., Tallahassee, FL 32399–0250, 850–488–1480 FAX 850–488–3353, E-Mail: *jmatthews@mail.dos.state.fl.us* 800–847–7278 *www.dos.state.fl.us/dhr/contents.html*

Georgia

Mr. Lonice C. Barrett, SHPO, Historic Preservation Division/DNR, 156 Trinity Avenue, SW, Suite 101, Atlanta, GA 30303–3600, 404–656–2840 FAX 404–651–8739

Deputy: Dr. W. Ray Luce, Director, E-Mail: *ray_luce@mail.dnr.state.ga.us*

Deputy: Ms. Carole Griffith, E-Mail: *carole_griffith@mail.dnr.state.ga.us*

Deputy: Mr. Richard Cloues, E-Mail: *richard_cloues@mail.dnr.state.ga.uswww.dnr. state.ga.us/dnr/histpres/*

Guam

Lynda B. Aguon, SHPO, Guam Historic Preservation Office, Department of Parks & Recreation, PO Box 2950 Building 13–8 Tiyan, Hagatna, Guam 96932, 1–671–475–6290 FAX: 1–671–477–2822, E-Mail: *laguon@mail.gov.gu http://www.admin.gov.gu/dpr/hrdhome.html*

Hawaii

Mr. Timothy Johns, SHPO, Department of Land & Natural Resources, P.O. Box 621, Honolulu, HI 96809, 808–587–0401

Deputy: Ms. Janet Kawelo,

Deputy: Dr. Don Hibbard, State Historic Preservation Division, Kakuhihewa Building, Suite 555, 601 Kamokila Boulevard, Kapolei, HI 96707, 808–692–8015 FAX: 808–692–8020, E-Mail: *dlnr@pixi.comwww.hawaii.gov/dlnr*

Idaho

Steve Guerber, SHPO, Idaho State Historical Society, 1109 Main Street, Suite 250, Boise, ID 83702–5642, 208–334–2682

Deputy: Suzi Neitzel, 208–334–3847 FAX: 208–334–2775, E-Mail: *sneitzel@ishs.state.id.us*

Deputy: Ken Reid, 208–334–3861

Illinois

Mr. William L. Wheeler, SHPO, Associate Director, Illinois Historic Preservation Agency, 1 Old State Capitol Plaza, Springfield, IL 62701–1512, 217–785–1153 FAX: 217–524–7525

Deputy: Mr. Theodore Hild, Chief of Staff, E-Mail: *thild@hpa084r1.state.il.us,*

Deputy: Ms. Anne Haaker

Indiana

Mr. Larry D. Macklin, SHPO, Director, Department of Natural Resources, 402 West Washington Street, Indiana Govt. Center South, Room W256, Indianapolis, IN 46204, E-Mail: *dhpa@dnr.state.in.us*

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National Governors= Association, National Alliance of Preservation Commissions, National Trust for Historic Preservation, Preservation Action

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Keeper of the National Register of Historic Places, Carol Shull, 202–343–9536

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R0019911

National Park Service—Systems Support Offices

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Advisory Council on Historic Preservation—*http://www.achp.gov*

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III. Tribal Historic Preservation Officers (THPO)

In instances where a Tribe does not have a Tribal Historic Preservation Officer, please contact the appropriate Tribal government office when responding to this permit eligibility condition.

Tribal Historic Preservation Officers:

(THPO vacant), Tunica-Biloxi Indians of Louisiana, P.O. Box 331, Marksville, LA 71351

James Bird, Eastern Band of Cherokee Indians, Quallah Boundary, P.O. Box 455, Cherokee, NC 28719

Brenda Boyd, Mille Lacs Band of Ojibwe Indians, HCR 67, Box 194, Onamia, MN 56395

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Marcia Cross, Confederated Salish and Kootenai Tribes, P.O. Box 278, Pablo, MT 59855

William Day, Poarch Band of Creek Indians, 5811 Jack Springs Rd., Atmore, AL 36502

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For more information: National Association of Tribal Historic Preservation Officers, D. Bambi Kraus, President, 1411 K Street NW, Suite 700, Washington, DC 20005, Phone: (202) 628–8476, Fax (202) 628–2241

IV. Advisory Council on Historic Preservation

Advisory Council on Historic Preservation, 1100 Pennsylvania Avenue, NW., Suite 809, Washington, DC 20004 Telephone: (202) 606–8503/8505, Fax: (202) 606–8647/8672, E-mail: achp@achp.gov

Addendum C—New Source Environmental Assessments

Basic Format for Environmental Assessment

This is the basic format for the Environmental Assessment prepared by EPA from the review of the applicant's Environmental Information Document (EID) required for new source NPDES permits. Comprehensive information should be provided for those items or issues that are affected; the greater the impact, the more detailed information needed. The EID should contain a brief statement addressing each item listed below, even if the item is not applicable. The statement should at least explain why the item is not applicable.

A. General Information
1. Name of applicant
2. Type of facility
3. Location of facility
4. Product manufactured

B. Description Summaries
1. Describe the proposed facility and construction activity
2. Describe all ancillary construction not directly involved with the production processes
3. Describe briefly the manufacturing processes and procedures
4. Describe the plant site, its history, and the general area

C. Environmental Concerns
1. Historical and Archeological (include a statement from the State Historical Preservation Officer)
2. Wetlands Protection and 100-year Floodplain Management (the Army Corps of Engineers must be contacted if any wetland area or floodplain is affected)
3. Agricultural Lands (a prime farmland statement from the Soil Conservation Service must be included)
4. Coastal Zone Management and Wild and Scenic Rivers
5. Endangered Species Protection and Fish and Wildlife Protection (a statement from the U.S. Fish and Wildlife Service must be included)
6. Air, Water and Land Issues: quality, effects, usage levels, municipal services used, discharges and emissions, runoff and wastewater control, geology and soils involved, land-use compatibility, solid and hazardous waste disposal, natural and man-made hazards involved.
7. Biota concerns: floral, faunal, aquatic resources, inventories and effects
8. Community Infrastructures available and resulting effects: social, economic, health, safety, educational, recreational, housing, transportation and road resources.

BILLING CODE 6560–50–P

Addendum D—Notice of Intent Form

NPDES Form 3510-6

United States Environmental Protection Agency
Washington, DC 20460

Form Approved
OMB No. 2040-0086

Notice of Intent for Storm Water Discharges Associated with INDUSTRIAL ACTIVITY Under the Multi-sector NPDES General Permit

Submission of this completed Notice of Intent (NOI) constitutes notice that the entitiy in Section B intends to be authorized to discharge pollutants to waters of the United States, from the facility or site identified in Section C, undar EPA's Storm Water Multi-sector General Permit (MSGP). Submission of the NOI also constitutes notice that the party identified in Section B of this form has read, understands, and meets the eligibility conditions of Part I of the MSGP; agrees to comply with all applicable terms and conditions of the MSGP; understands that continued authorization under the MSGP is contigent on maintaining eligibility for coverage, and that implementation of the permittee's pollution prevention plan is required two days after a complete NOI is mailed. In order to be granted coverage, all information required on this form must be completed. Please read and make sure you comply with all permit requirements, including the requirement to prepare and implement a storm water pollution prevention plan.

A. Permit Selection

Permit number assigned to your facility under the previous permit: ☐☐☐☐☐☐☐☐☐

New Permit Number (EPA Use Only) ☐☐R05☐☐☐☐

B. Facility Operator Information

1. Name: ☐ 2. Phone: ☐
3. Mailing Address: a. Street or P.O. Box: ☐
b. City: ☐ c. State: ☐☐ d. Zip Code: ☐☐☐☐☐-☐☐☐☐

C. Facility/Site Information

1. Facility/Site Name: ☐
2. Location Address: a. Street: ☐
b. City: ☐ c. County: ☐
d. State: ☐☐ e. Zip Code: ☐☐☐☐☐-☐☐☐☐
3. a. Latitude: ☐☐° ☐☐' ☐☐" b. Longitude: ☐☐° ☐☐' ☐☐"
4. a. Permit Applicant: ☐ Federal ☐ State ☐ Tribal ☐ Private ☐ Other public entity
b. Is the facility located on Indian Country Lands? ☐ Yes ☐ No
5. Does the facility discharge storm water into:
a. Receiving water(s)? ☐ Yes ☐ No If yes, name(s) of receiving water(s): ☐
b. A municipal separate storm sewer system (MS4)? ☐ Yes ☐ No
If yes, name of the MS4 operator: ☐
6. The 4-digit Standard Industrial Classification (SIC) codes or the 2-letter Activity Codes that best represent the principal products produced or services rendered by your facility and major co-located activities:
Primary: ☐☐☐☐ Secondary (if applicable): ☐☐☐☐
7. Applicable sector(s) of industrial activity, as designated in Part 1.2.1 of the MSGP, that include associated discharges that you seek to have covered under this permit (choose up to three):

☐ Sector A	☐ Sector F	☐ Sector K	☐ Sector P	☐ Sector U	☐ Sector Z
☐ Sector B	☐ Sector G	☐ Sector L	☐ Sector Q	☐ Sector V	☐ Sector AA
☐ Sector C	☐ Sector H	☐ Sector M	☐ Sector R	☐ Sector W	☐ Sector AB
☐ Sector D	☐ Sector I	☐ Sector N	☐ Sector S	☐ Sector X	☐ Sector AC
☐ Sector E	☐ Sector J	☐ Sector O	☐ Sector T	☐ Sector Y	☐ Sector AD

8. Additional Facility/Site Requirements:
a. Based on the instructions provided in Addendum A of the MSGP, have the eligibility criteria for "listed species" and critical habitat been met? ☐ Yes ☐ No
b. Based on the instructions provided in Addendum B of the MSGP, have the eligibility criteria for protection of historic properties been met? ☐ Yes ☐ No

D. Certification

Do you certify under penalty of law that this document and all attachments were prepared under your direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted? Based on your inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, do you certify that the information submitted is, to the best of your knowledge and belief, true, accurate, and complete? Do you certify that you are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations?

Print Name: ☐

Signature: ______________________ Date: ☐☐☐☐☐☐

EPA Form 3510-6 (Revised 08-2000, Expires 04-2003)

R0019913

Instructions for Completing the Notice of Intent for Storm Water Discharges Associated with INDUSTRIAL ACTIVITY Under the Multi-sector General Permit

Who Must File a Notice of Intent?

Under the provisions of section 402(p) of the Clean Water Act (CWA) and regulations at 40 CFR Part 122, Federal law prohibits "point source" discharges of storm water associated with industrial activity to waters of the U.S. without a National Pollutant Discharge Elimination System (NPDES) permit. If you operate a facility which is described in Part 1.2.1. of the Multi-sector General Permit (MSGP) or if you have been designated as needing permit coverage for your storm water discharges by your NPDES permitting authority, and you meet the eligibility requirements in Part 1 of the permit, you may satisfy your CWA obligation for permit coverage by submitting a completed NOI to obtain coverage under the MSGP. If you have questions about whether you need a permit under the NPDES Storm Water Program, contact your NPDES permitting authority (i.e., your EPA Regional storm water coordinator or your State water pollution control agency).

One NOI must be submitted for each facility or site for which you are seeking permit coverage. Only one NOI need be submitted to apply for coverage for all of your activities at each facility (e.g., you do not need to submit a separate NOI for each type of industrial activity located at a facility or industrial complex, provided your storm water pollution prevention plan covers each area for which you are an operator). Finally, the NOI must be submitted in accordance with the deadlines established in Part 2.1 of the MSGP.

When to File the NOI Form

DO NOT FILE THE NOI UNTIL YOU HAVE OBTAINED A COPY OF THE MULTI-SECTOR GENERAL PERMIT. You will need it to determine your eligibility, prepare your storm water pollution prevention plan, and correctly answer all questions on the NOI form — all of which must be done before you can sign the certification statement on the NOI in good faith (and without risk of committing perjury).

If you have a new facility or are the new operator of an existing facility, this form must be postmarked at least 48 hours before you need permit coverage. If your facility was covered under the 1995 Multi-sector General Permit or if you are currently operating without a permit, see Part 2.1 of the MSGP for your deadlines. CAUTION: You must allow enough lead time to gather the information necessary to complete the NOI (especially that related to determining eligibility with regards to endangered species and historic properties) and prepare the pollution prevention plan required by Part 4 of the MSGP <u>prior</u> to submitting your NOI.

Where to File the NOI Form

NOIs must be sent to the following address (do not send Storm Water Pollution Prevention Plans (SWPPPs) to this address):

Storm Water Notice of Intent (4203)
U.S. EPA
1200 Pennsylvania Avenue, NW
Washington, DC 20460

(For overnight/express delivery of NOIs, add the phone number (202) 260-9541)

NOTE: While not currently available, EPA is exploring the possibility of offering the option to complete the NOI form electronically online via the Internet. If this option does become available, directions will be posted on EPA's web site. To check on the availability of the alternative Online NOI, please visit <u>http://www.epa.gov/ow/sw</u>. If the Online NOI is not available, you must file the NOI at the above address.

If your facility discharges through a municipal separate storm sewer system (MS4) that is permitted as a medium or large MS4 under the NPDES Storm Water Program, you must also submit a signed copy of the NOI to the operator of that MS4, in accordance with the deadlines established in Part 2.1 of the permit.

Completing the NOI Form

To complete this form, type or print, using uppercase letters, in the appropriate areas only. Please place each character between the marks (abbreviate if necessary to stay within the number of characters allowed for each item). Use one space for breaks between words. Please make sure you have addressed all applicable questions and have made a photocopy for your records before sending the completed form to the address above.

Section A. Permit Selection

You must indicate the NPDES storm water general permit under which you are applying for coverage. Find the generic permit "number" in Part 1.1 of the permit that covers the area where your facility is located. For example, if you are located in New Mexico (except Indian Country lands), the generic number would be NMR05*###. If you are located on Navajo lands in New Mexico, the generic permit number would be AZR05*##1. CAUTION: You <u>must</u> use the correct permit number or your permit coverage will be invalid since you are not located within the coverage area for that permit.

Section B. Facility Operator Information

1. Provide the legal name of the person, partnership, co-partnership, firm, company, corboration, association, joint stock company, trust, estate, governmental entity, or other legal entity that operates the facility or site described in this application. The name of the operator may or may not be the same as the name of the facility. The responsible party is the legal entity that controls the facility's operation, rather than the plant or site manager.
2. Provide the telephone number of the facility operator.
3. Provide the mailing address of the facility operator. Include the street address or P.O. Box, city, state, and zip code. All correspondence regarding the permit will be sent to this address, not the facility address in Section C.
4. Indicate the legal status of the facility operator as a Federal, State, Tribal private, or other public entity (other than Federal or State). This refers only to the operator, not the owner or the land the facility or site is located upon.

Section C. Facility/Site Information

1. Enter the official or legal name of the facility or site.
2. Enter the complete street address (If no street address exists, provide a geographic description [e.g., Intersection of Routes 9 and 55]), city county, state, and zip code. Do not use a P.O. Box.
3. Enter the latitude and longitude of the approximate center of the facility or site in degrees/minutes/seconds. Latitude and longitude can be obtained from U.S. Geological Survey (USGS quadrangle or topographic maps, by using a GPS unit, by calling 1-(888) ASK-USGS, by searching for your facility's address on several commercial "map" sites on the Internet, or by accessing EPA's web site at http://www.epa.gov/owm/sw/industry/index.htm and selecting Latitude and Longitude Finders under the Resources/Permit section.
4. Indicate whether the facility is located on Indian Country lands (e.g., a federally recognized reservation, etc,).
5. Indicate whether the facility or site discharges storm water into a receiving water(s) and/or a municipal separate storm sewer system (MS4). Enter the name(s) of the closest receiving water(s) and/or the MS4 (An MS4 is defined as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that is owned or operated by a state, city, town, borough, county, parish, district, association, or other public body and is designed or used for collecting or conveying storm water.)
6. List your primary and secondary four 4-digit Standard Industrial Classification (SIC) codes or 2-character Activity Codes that best describe the principal products or services provided at the facility or site identified in Section C of this application. For industrial activities defined in 40 CFR 122.26(b)(14)(i)-(ix) and (xi) that do not have SIC codes that accurately describe the principal products produced or services provided, use the following 2-character Activity Codes:
   HZ = Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under subtitle C of RCRA [40 CFR 122.26(b)(14)(iv)];
   LF = Landfills, land application sites, and open dumps that receive or have received any industrial wastes, including those that are subject to regulation under subtitle D of RCRA [40 CFR 122.26(b)(14)(v)];
   SE = Steam electric power generating facilities, including coal handling sites [40 CFR 122.26(b)(14)(vii)];
   TW = Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage [40 CFR 122.26(b)(14)(ix)]; or
   Alternatively, if your facility or site was specifically designated by your NPDES permitting authority (EPA), enter "AD."

Section D. Certification

Certification statement and signature. (CAUTION: An unsigned or undated NOI form will prevent the granting of permit coverage.) Federal statutes provide for severe penalties for submitting false information on this application form. Federal regulations require this application to be signed as follows:

For a corporation: by a responsible corporate officer, which means:

(i) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

(ii) the manager of one or more manufacturing, production, or operating facilities, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

For a partnership or sole proprietorship: by a general partner or the proprietor; or

For a municipal, State, Federal, or other public facility: by either a principal executive or ranking elected official.

Paperwork Reduction Act Notice

Public reporting burden for this certification is estimated to average 3.7 hours per certification, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose to provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments regarding the burden estimate, any other aspect of the collection of information, or suggestions for improving this form, including any suggestions which may increase or reduce this burden to: Director, Office of Environmental Information Services, Collection Services Division (2823), USEPA, 1200 Pennsylvania Avenue, NW, Washington, DC 20460. Include the OMB control number of this form on any correspondence. Do not send the completed NOI form to this address.

Addendum E—Notice of Termination Form

THIS FORM REPLACES PREVIOUS FORM 3510-7 (8-92)
Please See Instructions Before Completing This Form

Form Approved. OMB No. 2040-0086
Approval expires: 8-31-98

NPDES FORM

EPA

United States Environmental Protection Agency
Washington, DC 20460

Notice of Termination (NOT) of Coverage Under a NPDES General Permit for Storm Water Discharges Associated with Industrial Activity

Submission of this Notice of Termination constitutes notice that the party identified in Section II of this form is no longer authorized to discharge storm water associated with industrial activity under the NPDES program. ALL NECESSARY INFORMATION MUST BE PROVIDED ON THIS FORM.

I. Permit Information

NPDES Storm Water General Permit Number:

Check Here if You are No Longer the Operator of the Facility: ☐

Check Here if the Storm Water Discharge is Being Terminated: ☐

II. Facility Operator Information

Name: Phone:

Address:

City: State: ZIP Code:

III. Facility/Site Location Information

Name:

Address:

City: State: ZIP Code:

Latitude: Longitude: Quarter: Section: Township: Range:

IV. Certification: I certify under penalty of law that all storm water discharges associated with industrial activity from the identified facility that are authorized by a NPDES general permit have been eliminated or that I am no longer the operator of the facility or construction site. I understand that by submitting this Notice of Termination, I am no longer authorized to discharge storm water associated with industrial activity under this general permit, and that discharging pollutants in storm water associated with industrial activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by a NPDES permit. I also understand that the submittal of this Notice of Termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

Print Name: Date:

Signature:

Instructions for Completing Notice of Termination (NOT) Form

Who May File a Notice of Termination (NOT) Form

Permittees who are presently covered under an EPA-issued National Pollutant Discharge Elimination System (NPDES) General Permit (including the 1995 Multi-Sector Permit) for Storm Water Dicharges Associated with Industrial Activity may submit a Notice of Termination (NOT) form when their facilities no longer have any storm water discharges associated with industrial activity as defined in the storm water regulations at 40 CFR 122.26(b)(14), or when they are no longer the operator of the facilities.

For construction activities, elimination of all storm water discharges associated with industrial activity occurs when disturbed soils at the construction site have been finally stabilized and temporary erosion and sediment control measures have been removed or will be removed at an appropriate time, or that all storm water discharges associated with industrial activity from the construction site that are authorized by a NPDES general permit have otherwise been eliminated. Final stabilization means that all soil-disturbing activities at the site have been completed, and that a uniform perennial vegetative cover with a density of 70% of the cover for unpaved areas and areas not covered by permanent structures has been established, or equivalent permanent stabilization measures (such as the use of riprap, gabions, or geotextiles) have been employed.

Where to File NOT Form

Send this form to the the following address:

Storm Water Notice of Termination (4203)
401 M Street, S.W.
Washington, DC 20460

Completing the Form

Type or print, using upper-case letters, in the appropriate areas only. Please place each character between the marks. Abbreviate if necessary to stay within the number of characters allowed for each item. Use only one space for breaks between words, but not for punctuation marks unless they are needed to clarify your response. If you have any questions about this form, telephone or write the Notice of Intent Processing Center at (703) 931-3230.

EPA Form 3510-7 (8-98)

R0019915

Instructions - EPA Form 3510-7
Notice of Termination (NOT) of Coverage Under The NPDES General Permit for Storm Water Discharges Associated With Industrial Activity

Section I Permit Information

Enter the existing NPDES Storm Water General Permit number assigned to the facility or site identified in Section III. If you do not know the permit number, telephone or write your EPA Regional storm water contact person.

Indicate your reason for submitting this Notice of Termination by checking the appropriate box:

If there has been a change of operator and you are no longer the operator of the facility or site identified in Section III, check the corresponding box.

If all storm water discharges at the facility or site identified in Section III have been terminated, check the corresponding box.

Section II Facility Operator Information

Give the legal name of the person, firm, public organization, or any other entity that operates the facility or site described in this application. The name of the operator may or may not be the same name as the facility. The operator of the facility is the legal entity which controls the facility's operation, rather than the plant or site manager. Do not use a colloquial name. Enter the complete address and telephone number of the operator.

Section III Facility/Site Location Information

Enter the facility's or site's official or legal name and complete address, including city, state and ZIP code. If the facility lacks a street address, indicate the state, the latitude and longitude of the facility to the nearest 15 seconds, or the quarter, section, township, and range (to the nearest quarter section) of the approximate center of the site.

Section IV Certification

Federal statutes provide for severe penalties for submitting false information on this application form. Federal regulations require this application to be signed as follows:

For a corporation: by a responsible corporate officer, which means: (i) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions, or (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

For a partnership or sole proprietorship: by a general partner or the proprietor; or

For a municipality, State, Federal, or other public facility: by either a principal executive officer or ranking elected official.

Paperwork Reduction Act Notice

Public reporting burden for this application is estimated to average 0.5 hours per application, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate, any other aspect of the collection of information, or suggestions for improving this form, including any suggestions which may increase or reduce this burden to: Chief, Information Policy Branch, 2136, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460, or Director, Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

Addendum F—No Exposure Certification Form

NPDES FORM 3510-11

EPA

United States Environmental Protection Agency
Washington, DC 20460

Form Approved OMB No. 2040-0211

NO EXPOSURE CERTIFICATION for Exclusion from NPDES Storm Water Permitting

Submission of this No Exposure Certification constitutes notice that the entity identified in Section A does not require permit authorization for its storm water discharges associated with industrial activity in the State identified in Section B under EPA's Storm Water Multi-Sector General Permit due to the existence of a condition of no exposure.

A condition of no exposure exists at an industrial facility when all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. Industrial materials or activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product or waste product. A storm resistant shelter is not required for the following industrial materials and activities:

- drums, barrels, tanks, and similar containers that are tightly sealed, provided those containers are not deteriorated and do not leak. "Sealed" means banded or otherwise secured and without operational taps or valves;
- adequately maintained vehicles used in material handling; and
- final products, other than products that would be mobilized in storm water discharges (e.g., rock salt).

A No Exposure Certification must be provided for each facility qualifying for the no exposure exclusion. In addition, the exclusion from NPDES permitting is available on a facility-wide basis only, not for individual outfalls. If any industrial activities or materials are or will be exposed to precipitation, the facility is not eligible for the no exposure exclusion.

By signing and submitting this No Exposure Certification form, the entity in Section A is certifying that a condition of no exposure exists at its facility or site, and is obligated to comply with the terms and conditions of 40 CFR 122.26(g).

ALL INFORMATION MUST BE PROVIDED ON THIS FORM.

Detailed instructions for completing this form and obtaining the no exposure exclusion are provided on pages 3 and 4.

A. Facility Operator Information

1. Name: ______________________ 2. Phone: ____________
3. Mailing Address: a. Street: ______________________
   b. City: ______________ c. State: __ d. Zip Code: _____-____

B. Facility/Site Location Information

1. Facility Name: ______________________
2. a. Street Address: ______________________
   b. City: ______________ c. County: ____________
   d. State: __ e. Zip Code: _____-____
3. Is the facility located on Indian Lands? Yes ☐ No ☐
4. Is this a Federal facility? Yes ☐ No ☐
5. a. Latitude: ___° ___' ___" b. Longitude: ___° ___' ___"
6. a. Was the facility or site previously covered under an NPDES storm water permit? Yes ☐ No ☐
   b. If yes, enter NPDES permit number: ________________
7. SIC/Activity Codes: Primary: ____ Secondary (if applicable): ____
8. Total size of site associated with industrial activity: ______________ acres
9. a. Have you paved or roofed over a formerly exposed, pervious area in order to qualify for the no exposure exclusion? Yes ☐ No ☐
   b. If yes, please indicate approximately how much area was paved or roofed over. Completing this question does not disqualify you for the no exposure exclusion. However, your permitting authority may use this information in considering whether storm water discharges from your site are likely to have an adverse impact on water quality, in which case you could be required to obtain permit coverage.

   Less than one acre ☐ One to five acres ☐ More than five acres ☐

NPDES FORM 3510-11 | EPA | **NO EXPOSURE CERTIFICATION for Exclusion from NPDES Storm Water Permitting** | Form Approved OMB No. 2040-0211

C. Exposure Checklist

Are any of the following materials or activities exposed to precipitation, now or in the foreseeable future? (Please check either "Yes" or "No" in the appropriate box.) **If you answer "Yes" to any of these questions (1) through (11), you are not eligible for the no exposure exclusion.**

	Yes	No
1. Using, storing or cleaning industrial machinery or equipment, and areas where residuals from using, storing or cleaning industrial machinery or equipment remain and are exposed to storm water	☐	☐
2. Materials or residuals on the ground or in storm water inlets from spills/leaks	☐	☐
3. Materials or products from past industrial activity	☐	☐
4 Material handling equipment (except adequately maintained vehicles)	☐	☐
5. Materials or products during loading/unloading or transporting activities	☐	☐
6. Materials or products stored outdoors (except final products intended for outside use [e.g., new cars] where exposure to storm water does not result in the discharge of pollutants)	☐	☐
7. Materials contained in open, deteriorated or leaking storage drums, barrels, tanks, and similar containers	☐	☐
8. Materials or products handled/stored on roads or railways owned or maintained by the discharger	☐	☐
9. Waste material (except waste in covered, non-leaking containers [e.g., dumpsters])	☐	☐
10. Application or disposal of process wastewater (unless otherwise permitted)	☐	☐
11. Particulate matter or visible deposits of residuals from roof stacks and/or vents not otherwise regulated (i.e., under an air quality control permit) and evident in the storm water outflow	☐	☐

D. Certification Statement

I certify under penalty of law that I have read and understand the eligibility requirements for claiming a condition of "no exposure" and obtaining an exclusion from NPDES storm water permitting.

I certify under penalty of law that there are no discharges of storm water contaminated by exposure to industrial activities or materials from the industrial facility or site identified in this document (except as allowed under 40 CFR 122.26(g)(2)).

I understand that I am obligated to submit a no exposure certification form once every five years to the NPDES permitting authority and, if requested, to the operator of the local municipal separate storm sewer system (MS4) into which the facility discharges (where applicable). I understand that I must allow the NPDES permitting authority, or MS4 operator where the discharge is into the local MS4, to perform inspections to confirm the condition of no exposure and to make such inspection reports publicly available upon request. I understand that I must obtain coverage under an NPDES permit prior to any point source discharge of storm water from the facility.

Additionally, I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Print Name: ______________________________

Print Title: ______________________________

Signature: ______________________________

Date: __________

R0019918

NPDES FORM 3510-11 | EPA | **Instructions for the NO EXPOSURE CERTIFICATION for Exclusion from NPDES Storm Water Permitting** | Form Approved OMB No. 2040-0211

Who May File a No Exposure Certification

Federal law at 40 CFR Part 122.26 prohibits point source discharges of storm water associated with industrial activity to waters of the U.S. without a National Pollutant Discharge Elimination System (NPDES) permit. However, NPDES permit coverage is not required for discharges of storm water associated with industrial activities identified at 40 CFR 122.26(b)(14)(i)-(ix) and (xi) if the discharger can certify that a condition of "no exposure" exists at the industrial facility or site.

Storm water discharges from construction activities identified in 40 CFR 122.26(b)(14)(x) and (b)(15) are not eligible for the no exposure exclusion.

Obtaining and Maintaining the No Exposure Exclusion

This form is used to certify that a condition of no exposure exists at the industrial facility or site described herein. This certification is only applicable in jurisdictions where EPA is the NPDES permitting authority and must be re-submitted at least once every five years.

The industrial facility operator must maintain a condition of no exposure at its facility or site in order for the no exposure exclusion to remain applicable. If conditions change resulting in the exposure of materials and activities to storm water, the facility operator must obtain coverage under an NPDES storm water permit immediately.

Where to File the No Exposure Certification Form

Mail the completed no exposure certification form to:

Storm Water No Exposure Certification (4203)
USEPA
401 M Street, SW
Washington, D.C. 20460

Completing the Form

You <u>must</u> type or print, using uppercase letters, in appropriate areas only. Enter only one character per space (i.e., between the marks). Abbreviate if necessary to stay within the number of characters allowed for each item. Use one space for breaks between words. One form must be completed for each facility or site for which you are seeking to certify a condition of no exposure. Additional guidance on completing this form can be accessed through EPA's web site at www.epa.gov/owm/sw. Please make sure you have addressed all applicable questions and have made a photocopy for your records before sending the completed form to the above address.

Section A. Facility Operator Information

1. Provide the legal name of the person, firm, public organization, or any other entity that operates the facility or site described in this certification. The name of the operator may or may not be the same as the name of the facility. The operator is the legal entity that controls the facility's operation, rather than the plant or site manager.

2. Provide the telephone number of the facility operator.

3. Provide the mailing address of the operator (P.O. Box numbers may be used). Include the city, state, and zip code. All correspondence will be sent to this address.

Section B. Facility/Site Location Information

1. Enter the official or legal name of the facility or site.

2. Enter the complete street address (if no street address exists, provide a geographic description [e.g., Intersection of Routes 9 and 55]), city, county, state, and zip code. Do not use a P.O. Box number.

3. Indicate whether the facility is located on Indian Lands.

4. Indicate whether the industrial facility is operated by a department or agency of the Federal Government (see also Section 313 of the Clean Water Act).

5. Enter the latitude and longitude of the approximate center of the facility or site in degrees/minutes/seconds. Latitude and longitude can be obtained from United States Geological Survey (USGS) quadrangle or topographic maps, by calling 1-(888) ASK-USGS, or by accessing EPA's web site at <u>http://www.epa.gov/owm/sw/industry/index.htm</u> and selecting Latitude and Longitude Finders under the Resources/Permit section.

   Latitude and longitude for a facility in decimal form must be converted to degrees (°), minutes ('), and seconds (") for proper entry on the certification form. To convert decimal latitude or longitude to degrees/minutes/seconds, follow the steps in the following example.

   <u>Example</u>: Convert decimal latitude 45.1234567 to degrees (°), minutes ('), and seconds (").

   a) The numbers to the left of the decimal point are the degrees: 45°.

   b) To obtain minutes, multiply the first four numbers to the right of the decimal point by 0.006: 1234 x 0.006 = 7.404.

   c) The numbers to the left of the decimal point in the result obtained in (b) are the minutes: 7'.

   d) To obtain seconds, multiply the remaining three numbers to the right of the decimal from the result obtained in (b) by 0.06: 404 x 0.06 = 24.24. Since the numbers to the right of the decimal point are not used, the result is 24".

   e) The conversion for 45.1234567 = 45° 7' 24".

6. Indicate whether the facility was previously covered under an NPDES storm water permit. If so, include the permit number.

7. Enter the 4-digit SIC code which identifies the facility's primary activity, and second 4-digit SIC code identifying the facility's secondary activity, if applicable. SIC codes can be obtained from the <u>Standard Industrial Classification Manual, 1987</u>.

8. Enter the total size of the site associated with industrial activity in acres. Acreage may be determined by dividing square footage by 43,560, as demonstrated in the following example.

   <u>Example</u>: Convert 54,450 ft^2 to acres

   Divide 54,450 ft^2 by 43,560 square feet per acre:
   54,450 ft^2 ÷ 43,560 ft^2/acre = 1.25 acres.

9. Check "Yes" or "No" as appropriate to indicate whether you have paved or roofed over a formerly exposed, pervious area (i.e., lawn, meadow, dirt or gravel road/parking lot) in order to qualify for no exposure. If yes, also indicate approximately how much area was paved or roofed over and is now impervious area.

R0019919

NPDES FORM 3510-11

EPA

Instructions for the NO EXPOSURE CERTIFICATION for Exclusion from NPDES Storm Water Permitting

Form Approved OMB No. 2040-0211

Section C. Exposure Checklist

Check "Yes" or "No" as appropriate to describe the exposure conditions at your facility. If you answer "Yes" to ANY of the questions (1) through (11) in this section, a potential for exposure exists at your site and you cannot certify to a condition of no exposure. You must obtain (or already have) coverage under an NPDES storm water permit. After obtaining permit coverage, you can institute modifications to eliminate the potential for a discharge of storm water exposed to industrial activity, and then certify to a condition of no exposure.

Section D. Certification Statement

Federal statutes provide for severe penalties for submitting false information on this application form. Federal regulations require this application to be signed as follows:

For a corporation: by a responsible corporate officer, which means:

(i) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

(ii) the manager of one or more manufacturing, production, or operating facilities, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

For a partnership or sole proprietorship: by a general partner or the proprietor; or

For a municipal, State, Federal, or other public facility: by either a principal executive or ranking elected official.

Paperwork Reduction Act Notice

Public reporting burden for this certification is estimatedto average 1.0 hour per certification, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose to provide information to or for a Federal agency This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments regarding the burden estimate, any other aspect of the collection of information, or suggestions for improving this form, including any suggestions which may increase or reduce this burden to: Director, Office of Environmental Services, Collection Services Division (2823), USEPA, 1200 Pennsylvania Avenue, NW, Washington, D.C. 20460. Include the OMB control number of this form on any correspondence. Do not send the completed No Exposure Certification form to this address.

[FR Doc. 00-25469 Filed 10-27-00; 8:45 am]
BILLING CODE 6560-50-C

Second Preliminary Draft

Proposed Municipal Stormwater NPDES General Permit

December 6, 2000

ADMINISTRATIVE RECORD INDEX-
DOCUMENTS - STORM WATER
MANAGEMENT -
FOLDER: 3, ITEM#: 19

Permit No.____________
Coverage Date__________

Issuance Date:
Effective Date:
Expiration Date:

National Pollutant Discharge Elimination System and State Waste Discharge General Permit for Discharges from Municipal Separate Storm Sewers

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
OLYMPIA, WASHINGTON 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

Until this permit expires, is modified, or revoked, permittees that have properly obtained coverage under this permit are authorized to discharge to waters of the state in accordance with the special and general conditions which follow.

____

Megan White
Water Quality Program Manager
Department of Ecology

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SPECIAL CONDITIONS

S1. AUTHORIZED DISCHARGES.

A. This permit authorizes the discharge of stormwater to waters of the state from the municipal separate storm sewers owned or operated by permittees identified in Special Condition S2 as follows:

1. New and existing discharges from existing outfalls.
2. Discharges from new stormwater outfalls constructed after the issuance date of this permit that have received all applicable state and local permits and use authorizations, including compliance with Ch. 43.21C RCW (the State Environmental Policy Act), and that are in compliance with Special Condition S6.E.

B. This permit authorizes discharges of stormwater associated with industrial activity and non-stormwater flows (e.g., industrial process wastewater or non-process wastewater) from municipal separate storm sewers owned or operated by the permittee to waters of the state only under the following conditions:

1. Non-stormwater discharges must be authorized by another NPDES permit or identified by and in compliance with Special Condition S7.C.9; or
2. Stormwater associated with industrial activity must be authorized by a separate individual or general NPDES permit.

> Ecology is considering covering construction and industrial stormwater activities conducted by the municipal permittees under this permit, instead of the construction and industrial stormwater permits. We would like some feedback on this proposal.

C. This permit does not authorize illicit discharges except as allowed in Special Condition S7.C.9., nor does it relieve entities responsible for illicit discharges, including spills of oil or hazardous substances, from responsibilities and liabilities under state and federal laws and regulations pertaining to those discharges.

S2. PERMITTEES.

A. The following entities are covered under this permit as full permittees:

The City of Seattle

The City of Tacoma

King County

Snohomish County

Pierce County

Clark County

Washington State Department of Transportation

In regard to the Washington State Department of Transportation (WSDOT), this permit only covers municipal separate storm sewers owned or operated by WSDOT that are located in municipalities that are also listed as permittees in Special Condition S2.A.

B. Upon application and coverage in accordance with Special Condition S3.B, the following entities are covered under this permit as co-permittees with the municipality they are located in:

King-County through its Department of Metropolitan Services for municipal separate storm sewers it operates in the City of Seattle
Port of Seattle, not including Sea-Tac Airport
Port of Tacoma
Drainage districts located in the Counties listed above, which own or operate drainage systems serving non-agricultural land uses.

C. Any other owners or operators of municipal separate storm sewers required by Ecology or U.S. EPA to obtain a permit. The requirement to obtain a permit will be through an administrative order issued in accordance with RCW 90.48, Title 40 CFR Section 122.26, and Section 309 of the Clean Water Act.

D. Any other owners or operators of municipal separate storm sewers that apply for and are granted coverage in accordance with Special Condition S3.

S3. PERMIT COVERAGE

A. This permit covers all areas located in, served by, or otherwise contributing to discharges from municipal separate storm sewers owned or operated by permittees and co-permittees listed in Special Condition S2.

B. In order to obtain coverage under this permit, each entity identified under Special Condition S2.B. shall submit a Notice of Intent (NOI) (Appendix 5).

C. Each entity desiring coverage under this permit as allowed under Special Condition S2.D., shall submit an NOI and provide public notice of the application for coverage in accordance with WAC 173-226-130. The NOI shall constitute the application for coverage. Ecology will notify applicants in writing of their status concerning coverage under this permit within 90 days of Ecology's receipt of the NOI and demonstration that the public notice requirements have been met. If the applicant is granted coverage, the implementation schedule for the Stormwater Management Program is established in Special Condition S10, and the schedule for Stormwater Planning is in Special Condition S8.

S4. RESPONSIBILITIES OF PERMITTEES AND CO-PERMITTEES

A. Each permittee is responsible for full compliance with the terms of this permit for the municipal separate storm sewers it owns or operates.

B. Full compliance with the terms of the permit for the municipal separate storm sewers owned or operated by co-permittees shall be achievable through the combined authorities of the co-permittee and the municipality it is located in. Each co-permittee, through an agreement with the municipality it is located in, shall meet its responsibilities for permit conditions as described in Special Condition S9, Stormwater Management Program for Co-permittees.

S5. TOTAL MAXIMUM DAILY LOAD ALLOCATIONS

A. If a Total Maximum Daily Load (TMDL) is approved that includes requirements for control of stormwater discharges from municipal separate storm sewers owned or operated by the permittee, then the permittee must incorporate implementation of the TMDL into the Stormwater Planning required pursuant to Special Condition S8.

B. If a Total Maximum Daily Load (TMDL) is approved after the Stormwater plan is completed, then the permittee shall review the stormwater plan. If implementation of the stormwater will not result in meeting the TMDL implementation requirments, then the stormwater plan and it's implementation schedule must be modified to incorporate the TMDL implementation strategy into the stormwater plan within 12 months of the TMDL's approval.

S6. COMPLIANCE WITH STANDARDS

A. This permit authorizes discharges of stormwater to surface waters and to ground waters of the state.

B. Compliance with the requirements of this permit shall constitute reduction of the discharge of pollutants to the maximum extent practicable (MEP) during the term of this permit.

C. This permit does not authorize any alteration of physical, chemical or biological properties of waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare or to domestic, commercial, industrial, agricultural, recreational or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

D. Ecology recognizes that for discharges from existing stormwater outfalls a compliance schedule is necessary to meet water quality standards in cases where municipal stormwater discharges do not comply with those standards. For the purposes of this permit, development and implementation of a stormwater management program (S7 and S9), compliance with stormwater planning requirements (S8), and compliance with schedules for compliance with stormwater management program components (S10) represent ongoing efforts towards meeting those standards on an approved compliance schedule as allowed in those standards.

E. Discharges from a new stormwater outfall, constructed after the issuance date of this permit, shall not cause a violation of any applicable ground water quality, surface water quality, or sediment management standards.

1. For the purpose of this permit a new stormwater outfall means an outfall that is constructed at a location where a municipal separate stormwater discharge did not previously exist.
2. For the purpose of this permit the point of compliance for discharges from a new stormwater outfall is in the naturally-occurring or man-altered surface water body or ground water at the point of discharge.
3. To determine compliance with this provision Ecology will presume that a discharge is not causing a violation of applicable standards if all sources contributing to the discharge are controlled in accordance with the technical standards in Appendix 1 (or approved equivalent technical standards) unless additional information indicates otherwise.

F. Discharges associated with areas of new development shall not cause a violation of any applicable ground water quality, surface water quality or sediment management standards. Permittees and co-permittees covered under this permit shall use best available science in land use planning and the regulation of development to protect watersheds and portions of watersheds within their jurisdiction from further impacts to and loss of beneficial uses due to increased disruptions in the natural hydrologic cycle. Permittees and co-permittees covered under this permit are to use other actions as necessary (such as land use regulation and protection of forest cover), in addition to the site-by-site application of a Stormwater Management Manual, to prevent cumulative impacts to beneficial uses.

For the purpose of this permit areas of new development shall mean contiguous areas or sub-basins of less than 25% total impervious surface that receive multiple residential, commercial and/or industrial development projects, or multiple development sites within a single project, during the term of the permit.

Ecology is committed to addressing the cumulative impact of development on a regional scale, and ensuring that areas of new development do not cause a violation of standards. It is very difficult, however, to define the appropriate scale for application of this provision and we are requesting comments on this issue.

S7. STORMWATER MANAGEMENT PROGRAM

A. Each permittee shall implement a stormwater management program during the term of this permit. For the purpose of this permit a stormwater management program is a plan for the term of the permit to:

1. Ensure that new development does not cause a violation of applicable standards or increase degradation of already impaired waters;
2. Reduce the discharge of pollutants;

3. Reduce impacts to receiving waters;
4. Eliminate illicit discharges as described in S7.C10 (below); and
5. Make progress toward compliance with surface water, ground water and sediment standards, including protection and restoration of beneficial uses of Waters of the State

B. The stormwater management program shall be developed and implemented in accordance with the conditions of this permit. Permittees are to continue implementation of existing stormwater management programs prior to implementation of the updated stormwater management program for the term of this permit.

C. The stormwater management program shall consist of the components listed below, and Stormwater Planning in accordance with Special Condition S8, as referenced in S7C.6 and 7. All components are mandatory and must be fully implemented by each primary permittee. Co-permittees are responsible for implementation of Stormwater Management Programs as indicated in Special Condition S9.

In regard to WSDOT, compliance with this condition is required for pollution sources originating within the state right-of-way. Measures to control pollution sources originating outside of the state right-of-way are subject to the memorandums of agreement required by component 1.

1. Legal Authority

a. Each permittee shall establish or maintain adequate legal authority to control discharges to and from municipal separate storm sewers owned or operated by the permittee.

b. This legal authority, which may be a combination of statute, ordinance, permit, contract, order, or inter-jurisdictional agreements with other permittees that have existing legal authority, shall include the ability to:

i. Control the contribution of pollutants to municipal separate storm sewers owned or operated by the permittee from stormwater discharges associated with industrial activity, and control the quality of stormwater discharged from sites of industrial activity.

ii. Prohibit illicit discharges to the municipal separate storm sewer owned or operated by the permittee.

iii. Control the discharge of spills and the dumping or disposal of materials other than stormwater into the municipal separate storm sewers owned or operated by the permittee.

iv. Control, through interagency agreements or inter-jurisdictional agreements among permittees, the contribution of pollutants from one municipal separate storm sewer to another.

v. Require compliance with conditions in ordinances, permits, contracts, or orders.

vi. Within the limitations of state law, carry out all inspection, surveillance, and monitoring procedures necessary to determine compliance with local ordinances.

c. WSDOT shall comply with this condition for all discharges originating within the state right-of-way. For discharges originating outside of the state right-of-way, WSDOT shall enter into memorandums of understanding with Ecology and the local jurisdiction that has enforcement authority, establishing the terms of enforcement.. WSDOT and the appropriate entities shall sign the memorandums of understanding no later than 18 months after the effective date of this permit.

2. Monitoring Program

> Ecology is working on a proposal for this program component. The CWA goals of protection and restoration of designated uses will drive the monitoring requirements. Data generated must be useful to both permittees and Ecology to guide their stormwater programs and to determine their progress towards meeting the CWA goals i.e., "Are municipal stormwater influenced or dominated receiving waters improving or declining?" To achieve this, the permit requires that data be collected, analyzed, and reported in a standardized manner across jurisdictions and that the sampling parameters, locations, and frequencies are sufficient to answer this fundamental question reasonably and objectively.

3. Gathering, Maintaining, and Using Adequate Information

The SWMP shall include an ongoing program for gathering, maintaining, and using adequate information to conduct planning, priority setting, and program evaluation activities. The information and its form of retention shall include but not be limited to:

a. Mapping of known municipal separate storm sewer outfalls.

b. Mapping of tributary conveyances, and the associated drainage areas of major municipal separate storm sewer outfalls. Mapping of tributary conveyances for other outfalls shall be conducted through the Stormwater Planning process in accordance with Special condition S8. In lieu of 3.a. and b. above, WSDOT may retain as-built drawings of storm drainage systems and areas.

c. Map(s) depicting existing land use. In lieu of land use maps, WSDOT shall map existing highways, existing and predicted average daily traffic volumes for each of those highways, and future possible or planned highway expansions.

d. Map(s) depicting zoning.

e. A data base, including at least the following information.

i. Precipitation records.

ii. Stormwater quality and quantity records.

iii. Water quality and physical characteristics of receiving water that may be impacted by stormwater.

We will need to reassess this provision when developing the monitoring requirements.

iv. A description and location of major structural Best Management Practices (BMPs) and other structural controls for stormwater discharges.

4. Coordination

a. The SWMP shall include coordination mechanisms to ensure intergovernmental and intragovernmental coordination of stormwater-related policies, programs and projects among permittees within a watershed, and coordination among departments within each jurisdiction.

b. Minimum Performance Measures:

i. Establish a program ensuring intergovernmental and intragovernmental coordination will occur as follows:

(1) Intragovernmental coordination will include maximizing benefits and leveraging resources, minimizing duplication of efforts, and avoiding programmatic gaps.

(2) Coordinate on comprehensive land use plans, monitoring, data management, and BMP testing.

(3) Participation in Stormwater Planning in accordance with Special Condition S8 for shared waterbodies among permittees, including WSDOT.

ii. Each permittee shall participate in Stormwater Planning in accordance with Special Condition S8 for shared waterbodies among permittees. WSDOT shall participate in Stormwater Planning in all applicable basins where WSDOT has stormwater discharges.

iii. Each municipality is to enter into a memorandum of agreement with WSDOT establishing terms of enforcement for controlling discharges into WSDOT-owned storm drains, no later than 18 months after the effective date of this permit.

iv. Each municipality is to enter into an agreement with co-permittees located within their boundaries to control the contribution of pollutants into the system owned or operated by the co-permittee.

5. Public Involvement

a. The SWMP shall include ongoing programs that provide opportunities for public involvement through advisory councils, watershed committees, participation in developing rate structures, stewardship programs, environmental activities, or other similar activities.

b. Minimum performance measures:

   i. Adoption of a program or policy directive to create opportunities for the public to participate in the decision making process involving stormwater management programs, priorities, and Stormwater Planning.

   2. Implement a public involvement program, including public involvement in the Stormwater Planning process.

6. Controlling Runoff from New Development, Redevelopment and Construction Sites

   a. The SWMP shall include a program to control runoff from areas of new development and redevelopment, and from construction sites. The program must address site-specific development impacts and the cumulative effects of changes to watershed hydrology and increases in pollutant loads resulting from development throughout a basin.

   b. Minimum performance measures:

      i. The program must include ordinances (except WSDOT's program) and technical standards that include minimum requirements, definitions, and thresholds equivalent to those found in Appendix 1. The program must also include a BMP selection process and site planning guidance equivalent to those found in Volume 1 of the Stormwater Management Manual for Western Washington. The program must also include implementation of a manual that includes BMPs equivalent to those contained in Volumes II – V of Ecology's Stormwater Management Manual (2000 edition). The ordinance(s), technical standards, and manual must be adopted within 12 months of the effective date of this permit. The ordinances, technical standards, and manual shall apply to private and public development, including roads.

      ii. All development activities, except those identified in iii, below, which have not yet received all permits, approvals or authorizations from the permittee necessary to begin construction prior to (a date 12 months from the effective date of this permit) shall either comply with the provisions of the ordinance(s) and manual required under this permit condition or the municipal entity shall provide additional controls to ensure the technical standards in Appendix 1 are met. For WSDOT, all construction projects that have not been advertised for bid prior to (a date 12 months from the effective date of this permit) shall comply with the provisions of the technical standards and manual required under this permit condition.

      iii. After (date 12 months from the effective date of the permit), all new development on an undeveloped parcel must meet all the applicable technical standards in Appendix 1 at the time they are constructed.

      iv. The following criteria shall be used for determining if the local ordinance(s), technical standards, and manual are technically equivalent to Appendix 1 and the Stormwater Management Manual for Western Washington:

(1) The Minimum Requirements (in Appendix 1) for new development and redevelopment or their equivalents must be included in the ordinance adopted by the local government. More stringent requirements may be used, and/or the Minimum Requirements may be tailored to local circumstances through the use of basin plans.

(2) The thresholds for and definitions of new development, redevelopment, land disturbing activities, impervious surfaces, and pollution-generating surfaces should provide equivalent protection of receiving waters or equivalent levels of pollution treatment as those in Appendix 1.

(3) The substantially equivalent technical standards must include BMP selection and site planning processes that have outcomes that provide equivalent or greater protection to those in Volume 1 of the Stormwater Management Manual for Western Washington.

(4) The types of BMPs and design criteria for those BMPs specified by local governments must provide equivalent or greater protection than those contained in Volumes II through V of Ecology's manual.

(5) An exceptions and variance process similar in content to Section 2.8 of Volume 1 of the Stormwater Management Manual for Western Washington, must be included.

v. The program must establish legal authority through approval of new development to inspect private stormwater facilities and enforce maintenance standards.

vi. The program must include a uniform process of permits, plan review, inspections, and enforcement capability to meet the following standards for both private and public projects:

(1) Review, with qualified staff or consultants, all stormwater site plans required to be submitted for proposed development activities.

(2) Inspect, with qualified staff or consultants prior to clearing and construction, all development sites that are hydraulically near[1] a sediment/erosion-sensitive feature[2] or have a high potential for sediment transport as determined through plan review based on definitions and guidance in Appendix 2. The intent of this inspection is to promote proper installation of erosion and sediment controls.

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[1] Hydraulically near means runoff from the site discharges to the sensitive feature without significant natural attenuation of flows that allows for suspended solids removal. See Appendix 2 for a more detailed definition.

[2] Sediment/erosion-sensitive feature means an area subject to significant degradation due to the effect of construction runoff or areas requiring special protection to prevent erosion. See Appendix 2 for a more detailed definition.

(3) Inspect, with qualified staff or consultants, all permitted development sites during construction to ensure proper installation and maintenance of required erosion and sediment controls. Enforce as necessary based on the inspection. Note: this inspection may be combined with other inspections provided it is still performed by certified staff or consultants.

(4) Inspect, with qualified staff or consultants, all development sites upon completion of construction and prior to final approval/occupancy to ensure proper installation of permanent erosion controls and stormwater facilities/BMPs. Enforce as necessary based on the inspection. Note: this inspection may be combined with other inspections provided it is still performed by qualified staff or consultants.

vii. The program must require that proposed clearing and grading activities be reviewed and approved under or in conjunction with a permit approval or other approval as outlined in Appendix 3 so that appropriate standards and BMPs can be applied to mitigate the impacts of clearing and grading activities.

viii. The program must also include a process to make available copies of the "Notice of Intent for Construction Activity" and/or copies of the "Notice of Intent for Industrial Activity" to representatives of proposed new development and redevelopment. Permittees will continue to enforce local ordinances controlling runoff from construction sites that also require coverage under the Baseline General Permit for Discharges Associated with Industrial Stormwater and/or the General Permit for Stormwater Discharges Associated with Construction Activities.

ix.. The program must include Stormwater Planning to assess and evaluate the estimated cumulative impacts from projected new development, and recommend actions to prevent alteration of the physical, chemical or biological properties of any waters of the state as will or is likely to be harmful, detrimental or injurious to beneficial uses. Planning must be conducted in accordance with Special condition S8. In addition to adoption and implementation of the Stormwater Management Manual and control of stormwater discharges on a site-specific basis, the program must include actions as necessary based on stormwater planning recommendations (such as land use regulation, protection of forest cover and riparian buffers), to ensure that stormwater discharges associated with areas of new development do not cause or contribute to a violation of any applicable ground water quality, surface water quality or sediment management standards in accordance with Special Condition S6.F.

7. Stormwater Controls for Existing Developed Areas

a. The SWMP shall include a program, implemented through the Stormwater Planning requirement in Special condition S8, to address impacts to beneficial uses resulting from disturbances to watershed hydrology and stormwater pollutant discharges caused by stormwater discharges from areas of existing development. The program shall include Capital Improvement Projects (CIP) for the construction of projects such as regional flow control facilities, water quality treatment facilities, and retrofitting of existing flood control facilities. Permittees should also consider other means to address impacts from existing development, such as reduction of hydrologic changes through the use of on-site stormwater management BMPs and site design techniques, habitat acquisition or restoration of forest cover and riparian buffers, for compliance with this requirement. Permittees may not cite in-stream culvert replacement projects for compliance with this requirement.

b. Minimum Performance Measures:

   i. The program must include Stormwater Planning to evaluate the types of controls that are appropriate and necessary to mitigate impacts to basin hydrology and beneficial uses, and reduce pollutant loads, caused by stormwater discharges from existing development. The stormwater plans shall also recommend specific actions, including capital improvement projects, to prevent and reduce impacts from stormwater discharges, in accordance with Special condition S8.

   ii. The WSDOT program to control stormwater impacts from existing development shall identify treatment and flow control deficiencies for each discharge covered under this permit. WSDOT shall develop a prioritization for correction of those deficiencies. In accordance with requirements for Stormwater Planning in special condition S8, the prioritization must include a consideration of the needs, priorities, and strategies identified by local governments in their stormwater planning. The prioritization should also take into account transportation planning conducted by WSDOT, and construction schedules for transportation projects. The WSDOT CIP program schedule shall also be predicated on achieving correction of all identified deficiencies within 20 years from the issuance of this permit.

8. Source Control Program

   a. The SWMP shall include a program to reduce pollutants in runoff from existing developed areas that discharge to municipal separate storm sewers owned or operated by the permittee. The program shall include:

      i. Requiring application of source control BMPs (equivalent to Volume IV of the Ecology Stormwater Management Manual) on existing facilities and activities.

      ii. Inspections of commercial, industrial and multifamily properties to ensure implementation of BMPs to control pollution discharging into municipal separate storm sewers owned or operated by the permittee.

      iii. Unless otherwise agreed to by the permittee, a permittee will not be expected to enforce an industrial NPDES permit issued by Ecology, however, the permittee is expected to enforce local ordinances at all sites, including those with industrial NPDES permits. Municipalities may refer stormwater discharge problems associated with industrial (non-construction) NPDES permittees to Ecology unless the permittee has local ordinances that impose stricter stormwater standards than imposed through the permit issued by Ecology. Permittees will not be held liable by Ecology for water quality standard violations caused by industries covered under an NPDES permit issued by Ecology.

iv. Reduction of pollutants associated with the application of pesticides, herbicides, and fertilizer discharging into municipal separate storm sewers owned or operated by the permittee.

b. Minimum Performance Measures for Source Control Program:

i. Adoption of an ordinance requiring the application of source control BMPs (equivalent to Volume IV of the Ecology Stormwater Management Manual) for existing facilities and activities. Enforcement of source control requirements may be done through education and technical assistance programs, provided that regulatory authority is available to the permittee and is used for flagrant violations.

ii. Compile a list of existing commercial, multifamily, industrial and government sites which are potentially pollution generating (see Appendix 4 for guidance). The list shall be updated at least once every 5 years.

iii. An inspection program for all the listed sites, with adequate enforcement capability to ensure implementation of source control BMPs, including elimination of sanitary sewer or interior floor drain connections. The inspection program will perform inspections of at least 15% of the listed sites annually. 80% of the total of these properties will be inspected during the term of the permit. Adjust the inspection program as needed to incorporate new sites added to the list and reflect sites already inspected. Note: those sites where the property owner denies entry/inspection and there is no legal authority to enter/inspect may be excluded from onsite inspection, however, the permittee is still responsible for enforcement of the source control ordinance if evidence of a violation can be seen without entering the property.

iv. Adopt and implement policies and procedures to reduce pollutants associated with the application of pesticides, herbicides, and fertilizer on all public property owned or managed by the permittee, including parks and road right-of-ways.

v. Provide a minimum of two training sessions for inspection and other field staff to ensure adequate implementation of the source control program.

9. Illicit Discharge Reduction

a. The SWMP shall include an ongoing program to detect, remove and prevent illicit discharges and improper disposal, including spills, into the municipal separate storm sewers owned or operated by the permittee. The program shall include:

i. Effectively prohibiting illicit discharges to the municipal separate storm sewers owned or operated by the permittee other than those authorized under a separate NPDES permit. Unless identified by either the permittee or Ecology as significant sources of pollution to waters of the state, the illicit discharges listed in 40 CFR Section 122.26(d)(iv)(B)(1) need not be prohibited from entering the municipal separate storm sewers owned or operated by the permittee. As necessary, the permittee(s) shall incorporate appropriate control measures in the stormwater management program to ensure these discharges are not significant sources of pollutants to waters of the state.

ii. Detecting and removing sanitary sewer or interior floor drain connections to municipal separate storm sewers owned or operated by the permittee.

iii. On-going identification of illicit discharges, spills and improper disposal into the municipal separate storm sewer system, through inspections, monitoring and complaint response.

iv. Preventing, responding to, and cleaning up spills and improper disposal into the municipal separate storm sewers owned or operated by the permittee.

b. Minimum Performance Measures:

i. An on-going program to prevent, identify and respond to illicit discharges including illicit connections, spills and improper disposal through complaints/reports, construction inspections, maintenance inspections, source control inspections, and monitoring information.

ii. Provide appropriate training for municipal field staff to recognize and report illicit discharges, including spills, improper disposal and illicit connections.

iii. Adopt procedures for reporting and correcting or removing illicit connections, spills and other illicit discharges when they are suspected or identified.

iv. A well-publicized citizen complaints/reports telephone number.

v. Investigate or refer to the appropriate agency, within 7 days on average, any complaints/reports or monitoring information that indicates a potential illicit discharge, spill, or illegal dumping. Investigate or refer as soon as possible within 24 hours, those problems/violations judged to be urgent or severe.

10. Operation and Maintenance Program

a. The SWMP shall include a program to conduct maintenance activities that prevent or reduce stormwater impacts. The program shall include:

i. Maintenance standards and programs to ensure proper and timely maintenance of public and private stormwater facilities.

ii. Practices for operating and maintaining public streets, roads, and highways to reduce stormwater impacts.

iii. Policies and procedures to reduce pollutants associated with the application of pesticides, herbicides, and fertilizer.

iv. Practices for operating and maintaining fleet vehicles and maintenance yards to reduce stormwater impacts.

b. Minimum Performance Measures:

i. Adopt facility-specific maintenance standards that are as protective or more protective than those specified in Appendix 10A of Volume V of the Stormwater Management Manual for Western Washington.

ii. Adopt policies and procedures to establish a program to ensure proper and timely maintenance of public and private stormwater facilities.

iii. Adopt and implement an ordinance requiring maintenance of all privately owned permanent stormwater BMPs in accordance with adopted maintenance standards.

iv. Develop and implement an initial inspection schedule for all private stormwater facilities that ensures inspection of each facility at least once during the term of this permit to enforce compliance with adopted maintenance standards as needed based on the inspection. Note: those sites where the property owner denies entry/inspection and there is no legal authority to enter/inspect may be excluded from onsite inspection. In addition, jurisdictions shall not be held responsible for lack of compliance by the property owner if appropriate enforcement action has been taken in accordance with the policies and procedures established in ii and iii above.

v. Develop an on-going schedule for implementation after the initial schedule to ensure inspection of all private stormwater facilities annually. The annual inspection schedule may be changed to a lesser or greater frequency of inspection as appropriate to ensure compliance with maintenance standards based on maintenance records of double the number of years of the proposed inspction frequency.

vi. Manage maintenance activities to inspect all new flow control and water quality treatment facilities in subdivisions every 6 months during the period of heaviest house construction (i.e., 1 to 2 years following subdivision approval) to identify maintenance needs and enforce compliance with maintenance standards as needed.

vii. Manage maintenance activities to inspect all public stormwater facilities annually and take appropriate maintenance action in accordance with adopted maintenance standards. The annual inspection schedule may be changed to a lesser or greater frequency of inspection as appropriate to ensure compliance with maintenance standards based on maintenance records of double the number of years of the proposed inspction frequency.

viii. Manage maintenance activities to inspect all public stormwater facilities after major storm events if spot checks of some facilities indicate widespread damage/maintenance needs. Conduct repairs or take appropriate maintenance action in accordance with adopted maintenance standards based on the results of the inspections.

ix. Annually inspect public catchbasins and inlets on a "circuit basis" whereby a sampling of catchbasins and inlets within each circuit is inspected to identify maintenance needs. Include in the sampling an inspection of the catchbasin immediately upstream of any system outfall. Clean all catchbasins within a given circuit at one time if the inspection sampling indicates cleaning is needed to comply with adopted maintenance standards.

x. Require cleaning of private catchbasins and inlets whenever they are found to be out of compliance with adopted maintenance standards.

xi. Records of inspections and maintenance activities shall be maintained.

xii. Adopt practices to reduce stormwater impacts associated with runoff from public streets, roads, and highways within 12 months of the effective date of this permit. Ecology guidance for street waste disposal, the Municipal Stormwater Toolbox for Maintenance Practices (June 1998), developed by Oregon Association of Clean Water Agencies, (and consider adding the guidance on ditch maintenance being developed by the Center for Urban Water Resources management at UW), shall be used as guidance for developing this program. Implementation of practices shall begin no later than 18 months after the effective date of this permit, and continue on an ongoing basis throughout the term of the permit. The following activities must be addressed:

(1) Pipe cleaning

(2) Cleaning of culverts that convey stormwater in ditch systems

(3) Ditch maintenance

(4) Street cleaning

(5) Road repair and resurfacing, including pavement grinding

(6) Snow and ice control

(7) Bridge repair and maintenance

(8) Utility installation

(9) Maintaining roadside areas, including vegetation management .

(10) Dust control

(11) Pavement striping maintenance

xiii. Adopt and implement policies and procedures to reduce pollutants associated with the application of pesticides, herbicides, and fertilizer no later than 12 months after the effective date of this permit.

xiv. Conduct a minimum of 2 training sessions for employees of the permittee whose O&M job functions may impact stormwater quality. Training shall address the importance of protecting water quality, ways to perform their job activities to prevent or minimize impacts to water quality, and procedures for reporting water quality concerns, including potential illicit discharges.

xv. Develop and implement a Stormwater Pollution Prevention Plan (SWPPP) for all maintenance yards and vehicle maintenance facilities owned or operated by the permittee. The SWPPP is a documented plan to implement measures to identify, prevent, and control the contamination of discharges of stormwater to surface or ground water. The SWPPPs must be developed within 18 months of the effective date of this permit. Implementation of non-structural BMPs shall begin immediately after the pollution prevention plan is developed. A schedule for implementation of structural BMPs shall be included in the pollution prevention plan.

11. Education Program

a. The SWMP shall include an education program aimed at residents, businesses, industries, elected officials, policy makers, planning staff and other employees of the permittee. The goal of the education program is to change behaviors and practices that cause or contribute to adverse stormwater impacts so as to minimize and eventually eliminate such impacts. An education program may be developed locally or regionally.

b. Minimum Performance Measures:

i. Begin informal distribution of available materials as a first step towards achieving public education goals.

ii. Permittees shall implement or participate in an education program that uses different types of media (brochures alone are not adequate), and targets a wide range of interest groups to provide education on the topics listed in ii, below.

iii. The education program shall address the following areas:

(1) Provide education for all audiences about the importance of improving water quality, reducing impervious surfaces and protecting beneficial uses of waters of the state, about potential impacts caused by stormwater discharges, and methods for avoiding, minimizing, reducing and/or eliminating the adverse impacts of stormwater runoff.

(2) Provide and encourage participation in environmental stewardship activities.

(3) Provide information to the general public about actions individuals can take to improve water quality and reduce impervious surfaces (e.g., lawn care with less fertilizer and pesticides, more use of native vegetation for landscaping, proper disposal of pet wastes, etc.).

(4) Education on proper use and disposal of pesticides, herbicides, and fertilizers.

(5) Provide training for engineers, construction contractors, developers, development review staff, and land use planners on technical standards, the development of stormwater site plans and erosion control plans, and BMPs for mitigating contaminated runoff and the quantity of runoff from development sites.

(6) Provide education for engineers, contractors, developers, and the public on land development practices and non-structural BMPs that eliminate, avoid, or minimize adverse stormwater impacts.

(7) Provide education to explain the definition and impacts, and promote removal of illicit discharges.

(8) Provide education to promote proper management and disposal of toxic materials (e.g. used oil, batteries, vehicle fluids, home chemicals.)

S8 STORMWATER PLANNING

A. The SWMP shall include stormwater planning to assess and evaluate impacts to physical, chemical and biological properties of waters of the state caused by stormwater discharges from existing development and from projected new development. The stormwater plans will identify actions to prevent future impacts and mitigate existing impacts. Stormwater planning shall address impacts caused by changes in stormwater hydrology and pollutant loads affecting surface water, ground water and sediment quality.

B. The objectives of stormwater planning under the SWMP shall be:

1. To determine the need, opportunity, best alternative, priority, and funding for projects to reduce the stormwater impacts from existing development.

2. To encourage redevelopment and infill, and provide more efficient, effective runoff controls instead of requiring stormwater facilities through individual redevelopment projects.

3. To assess baseline conditions, including but not limited to biota, habitat, beneficial uses, water quality conditions, hydrologic conditions, current and projected land use.

4. To evaluate the need for basin specific stormwater control standards, and implement changes to standards if appropriate.

5. To site and fund projects to ensure flow control and water quality treatment to meet the technical standards in Appendix 1 where local governments allow projects to

continue being built to the old standards beyond the deadline established in Special Condition S7C.6. Notwithstanding the above, permittees are required to comply with the provisions of S7C.6.b.ii and iii.

6. To assess and evaluate the estimated cumulative impacts of stormwater discharges from projected new development, including impacts to summer low flows, and to recommend actions to prevent alteration of the physical, chemical, or biological properties of any waters of the state as will or is likely to be harmful, detrimental or injurious to beneficial uses.

7. To ensure that changes to stormwater quality and hydrology and resulting impacts to physical, chemical, and biological properties of waters of the state are assessed and that appropriate mitigation[3] will be provided when comprehensive land use planning, zoning, and other land use decisions are made.

8. To assess and evaluate stormwater impacts to receiving waters that are in non-attainment of water quality standards, and included on the State of Washington 303(d) list. To provide input into the development of Total Maximum Daily Loads (TMDLs) for those water bodies. Also, to develop implementation strategies for completed TMDLs.

C. The stormwater planning objectives may be accomplished through stormwater-specific basin planning, or other planning processes. The stormwater planning objectives must be considered in all basins, however, detailed planning efforts should focus on objectives most appropriate or necessary for individual basins.

D. Stormwater plans must include a recommended schedule for implementation and recommendations regarding funding of implementation. Stormwater plans must include a commitment to begin implementation according to the implementation schedule contained in the completed stormwater plan upon adoption by the participating entities. Adoption of the stormwater plan shall mean a legislative action (or an administrative action for WSDOT) accepting the plan and a financial commitment to begin funding plan implementation.

E. Stormwater planning must address all basins or portions thereof where the jurisdiction has authority within the urban growth boundaries established under the Growth Management Act, and outside the urban growth boundaries where land uses other than forestry and agriculture could cause stormwater impacts to receiving waters.

Note – The intention here is to address areas outside the UGB where existing platted densities are high or there are non-conforming uses that could cause stormwater impacts. We would appreciate suggestions on language on how best to describe these areas.

[3] Mitigate means, in the following order of preference, to eliminate, avoid, minimize, rectify, reduce, compensate, monitor and correct.

F. Ecology will develop guidance on how to meet the stormwater planning objectives in this condition. Any stormwater plans that have been completed or are near completion, and that adequately address stormwater impacts to salmonids and CWA objectives, are sufficient to meet the planning objectives in this condition. It is expected that stormwater planning will be integrated into existing planning efforts.

G. The Cities and Counties named as permittees under Special Condition S2.A. shall coordinate stormwater planning activities among WSDOT and co-permittees where those entities are located in basins subject to the planning requirement, and shall provide technical and administrative support for plan preparation.

H. WSDOT and co-permittees shall participate in Stormwater Planning and plan implementation when appropriate geographically and environmentally.

I. Minimum Performance Measures:

1. Within 18 months of the effective date of this permit, establish a schedule (or schedules for parallel processes) for conducting stormwater planning required under this condition. This schedule may be prioritized consistent with Clean Water Act objectives, including protection of beneficial uses and achieving proper functioning conditions for salmonids, or other factors as determined by the permittees.
2. By the end of the permit term, complete stormwater planning for at least 50% of the geographic area subject to the planning requirement.
3. By the end of the permit term, adopt and begin implementation of stormwater plans that cover 25% of the geographic area subject to the planning requirement, including implementation of action items that address stormwater discharges from both existing and new development.
4. For each plan establish an implementation schedule and funding strategy for both near term and long term capital improvement, regulatory, programmatic actions and land use. Short term actions are actions that must be taken to prevent additional stormwater impacts and to address critical existing impacts. Short term actions shall be implemented within 5 years. Long term actions are actions to achieve the water quality goals for the basin. Long term actions are to be implemented within 10 years. Short term land use actions are intended to prevent stormwater impacts. Long term land use actions are to address existing impacts. The implementation schedule for each stormwater plan may be adjusted upon completion of additional stormwater plans to accommodate newly identified high priority short term actions, provided that the long term schedule for implementation of actions for all the stormwater plans is 20 years.

S9. STORMWATER MANAGEMENT PROGRAM FOR CO-PERMITTEES

A. Each co-permittee shall implement a stormwater management program during the term of this permit. For the purpose of this permit a stormwater management program is a plan for the term of the permit to:

1. Ensure that new development does not cause a violation of applicable standards or increase degradation of already impaired waters;

5. Reduce the discharge of pollutants;

6. Reduce impacts to receiving waters;

3. Eliminate illicit discharges as described in S7.C10; and

4. Make progress toward compliance with surface water, ground water and sediment standards, including protection and restoration of beneficial uses.

C. **Port Districts** shall develop and implement the following Stormwater Management Program:

1. **Legal Authority**. Port districts shall enter into an agreement with the permitted entity they are located in to control the contribution of pollutants to the municipal separate storm sewers owned or operated by the Port. The agreement shall include the following provisions:

   a. Roles and Responsibilities. The agreement between the City and the County shall clarify roles and responsibilities for public involvement, public education, controlling runoff from new development and redevelopment, inspection, enforcement, monitoring, maintenance, planning, and capital improvements to ensure compliance with the terms of this permit.

   b. Spills. Immediately upon becoming aware of a spill into the drainage system owned or operated by the Port, the Port shall notify the City or County it is located in. The City/County shall respond immediately by taking direct action and notifying Ecology.

   c. Illicit Discharges. If the Port suspects an illicit discharge into the drainage system owned or operated by the Port, the Port shall notify the City or County it is located in within 24 hours. The City/County shall investigate within 7 days, on average.

   d. Other pollution sources and hydrologic impacts. The Port shall participate in the City/County stormwater planning process.

2. **Monitoring Program**. The Port shall participate in the City or County's monitoring program.

3. **Gathering, Maintaining, and Using Adequate Information**. The Port shall comply with S7.D.4.a.i., ii, and iii. This mapping information shall be provided to the City or County.

4. **Coordination**. The Port shall coordinate monitoring, and source control and illicit discharge control efforts with the City or County. The port shall also participate in stormwater planning, when appropriate geographically and environmentally.

5. **Public Involvement**. The Port shall participate in the City or County's public involvement program.

6. **Controlling Runoff from New Development, Redevelopment and Construction sites**. Through compliance with City or County ordinances and rules, the Port shall

ensure that all new development and re-development meets the technical standards in Appendix 1.

7. **Existing Developed Areas**. The port shall prepare Stormwater Pollution Prevention Plans (SWPPPs) for all port owned lands not covered under the Industrial Stormwater General Permit. The SWPPP is a documented plan to implement measures to identify, prevent and control the contamination of discharges of stormwater to surface or ground water. The SWPPPs must be developed within 18 months of the effective date of this permit. Implementation of non-structural BMPs shall begin immediately after the SWPPP is developed. A schedule for implementation of structural BMPs shall be included in the SWPPP. In addition, the Port shall participate in the City's stormwater planning program.
8. **Stormwater Planning**. The Port shall participate in stormwater planning in accordance with Special Condition S8, and implement plan actions as appropriate.
9. **Source Control Program**. The Port shall compile a list of sites that are potentially pollution generating (see Appendix 4 for guidance). The port will inspect all listed sites annually, and implement source control BMPs to prevent or reduce the discharge of pollutants. The port shall adopt and implement policies and procedures to reduce pollutants associated with the application of pesticides, herbicides and fertilizer on all port-owned property. Provide adequate training for inspection and other field staff to ensure adequate implementation of the source control program.
10. **Illicit Discharges**. The Port shall ensure that all sanitary sewer connections and floor drains in buildings on port owned property are not connected to municipal separate storm sewers. The port shall develop a program to prevent, identify, and respond to illicit discharges, including illicit connections, spills and improper disposal, through complaints/reports, maintenance inspections, and source control inspections. The port shall provide appropriate training for field staff to recognize and report illicit discharges, and adopt procedures for responding to and reporting illicit discharges.
11. **Operation and Maintenance Program**. The Port shall adopt facility-specific maintenance standards that are as protective or more protective than those specified in Appendix 10A of Volume V of the Stormwater Management Manual for Western Washington, and comply with the inspection frequencies for public stormwater facilities. The Port shall annually inspect and maintain catchbasins in accordance with S7.D.12.b.ix. Records of inspections and maintenance activities shall be maintained. The port shall provide appropriate training for maintenance staff.
12. **Education Program**. The Port shall participate in the City's public education program.

C. King County as a co-permittee with the City of Seattle shall develop and implement the following Stormwater Program:

1. **Legal Authority.** King County and Seattle shall enter into an agreement to control the contribution of pollutants to the municipal separate storm sewers operated by King County. The agreement shall include the following provisions:

a. Roles and Responsibilities. The agreement between the City and the County shall clarify roles and responsibilities for public involvement, public education, controlling runoff from new development and redevelopment, inspection, enforcement, monitoring, maintenance, planning, and capital improvements to ensure compliance with the terms of this permit.

b. Spills. Immediately upon becoming aware of a spill into the drainage system operated by King County, the County shall notify the City it is located in. The City shall respond immediately by taking direct action and notifying Ecology.

c. Illicit Discharges. If the King County suspects an illicit discharge into the drainage system operated by the County, the County shall first investigate the source and try to eliminate the problem. If the County cannot resolve the problem through education or voluntary actions it shall notify the City. The City shall investigate within 7 days, on average.

d. Other pollution sources and hydrologic impacts. The County shall participate in the City stormwater planning process.

e. Maps of the drainage system. The City shall provide the County with maps of the drainage system draining into the system operated by the County no later than 6 months after the effective date of this permit.

2. **Monitoring Program**. The County shall participate in the City's monitoring program.

3. **Coordination**. The County shall coordinate monitoring, and source control and illicit discharge control efforts with the City. The County shall also participate in stormwater planning, when appropriate geographically and environmentally.

4. **Public Involvement**. The County shall participate in the City's public involvement program.

5. **Stormwater Planning**. The County shall participate in stormwater planning in accordance with Special Condition S8 and implement recommended plan actions as appropriate, including construction of capital facilities where needed.

6. **Source Control Program**. The County and City shall jointly compile a list of sites that are potentially pollution generating (see Appendix 5 for guidance). The County will inspect all listed sites annually, and provide technical assistance and recommended source control BMPs to prevent or reduce the discharge of pollutants. Sites where enforcement is needed to correct urgent or persistent problems shall be referred to the City. The County shall provide adequate training for inspection and other field staff to ensure adequate implementation of the source control program.

7. **Illicit Discharges**. The County shall develop a program to prevent, identify, and respond to illicit discharges, including illicit connections, spills and improper disposal, through complaints/reports, and source control inspections. The County shall provide appropriate training for field staff to recognize and report illicit discharges, and adopt procedures for responding to and reporting illicit discharges.

8. **Operation and Maintenance Program**. The County shall adopt facility-specific maintenance standards that are as protective or more protective than those specified

in Appendix 10A of Volume V of the Stormwater Management Manual for Western Washington, and comply with the inspection frequencies for public stormwater facilities. The County shall ensure that catchbasins are annually inspected and maintained in accordance with S7.D.12.b.ix. Records of inspections and maintenance activities shall be maintained. The County shall provide appropriate training for maintenance staff.

9. **Education Program**. The County shall participate in the City's public education program, and conduct education activities in the areas served by the County's storm drainage system.

C. **Drainage Districts and all other Co-Permittees not otherwise identified** shall develop and implement the following Stormwater Management Program.

1. **Legal Authority**. Co-permittees shall enter into an agreement with the permitted entity they are located in to control the contribution of pollutants to the municipal separate storm sewers owned or operated by the co-permittee. The agreement shall include the following provisions:

   a. Roles and Responsibilities. The agreement between the co-permittee and the permittee shall clarify roles and responsibilities for public involvement, public education, controlling runoff from new development and redevelopment, inspection, enforcement, monitoring, maintenance, planning, and capital improvements to ensure compliance with the terms of this permit.

   b. Spills. Immediately upon becoming aware of a spill into the drainage system owned or operated by the co-permittee, the co-permittee shall notify the City or County it is located in. The City/County shall respond immediately by taking direct action and notifying Ecology.

   c. Illicit Discharges. If the co-permittee suspects an illicit discharge into the drainage system owned or operated by the co-permittee, the co-permittee shall notify the City or County it is located in within 24 hours. The City/County shall investigate within 7 days, on average.

   d. Other pollution sources and hydrologic impacts. The co-permittee shall participate in the City/County stormwater planning process.

2. **Gathering, Maintaining, and Using Adequate Information**. The co-permittee shall provide a map of the district's drainage system to the City/County, if they don't already have such a map. The co-permittee shall ensure the map is updated when any system changes occur.

3. **Stormwater Planning**. The Co-permittee shall participate in stormwater planning and implement plan actions as appropriate, when appropriate geographically and environmentally.

4. **Operation and Maintenance Program**. The co-permittee shall adopt facility-specific maintenance standards that are as protective or more protective than those specified in Appendix 10A of Volume V of the Stormwater Management Manual for Western Washington, and comply with the inspection frequencies for public stormwater facilities. The co-permittee shall ensure that catchbasins are annually

inspected and maintained in accordance with S7.D.12.b.ix. Records of inspections and maintenance activities shall be maintained. The co-permittee shall provide appropriate training for maintenance staff.

S10. SCHEDULES FOR COMPLIANCE WITH STORMWATER MANAGEMENT PROGRAM COMPONENTS

A. Each permittee shall continue all current activities that meet specific permit requirements in Special Condition S7. Whenever permittees must take actions to meet the program components in Special Condition S7, the actions shall be completed by the dates specified in the following implementation schedule. For permittees identified under Special Condition S2C. and D., the following implementation schedule shall apply unless an implementation schedule is issued through an administrative order at the time of permit coverage.

STORMWATER PROGRAM REQUIREMENT	IMPLEMENTATION SCHEUDLE[4] FOR PERMITTEES SPECIAL CONDITION S7	IMPLEMENTATION SCHEDULE[5] FOR PERMITTEES IDENTIFIED UNDER S2 C. AND D.
1. Legal Authority		
a. Maintain adequate legal authority	effective date of permit	12 months
c. WSDOT MOUs	18 months	Not applicable
2. Monitoring Program		
3. Gathering, Maintaining and Using Adequate Information	Effective date of permit, and in accordance with Stormwater Planning, S8.	12 months, and in accordance with Stormwater Planning, S8.
4. Coordination		
b. i. Establish coordination program	3 months	3 months
b. ii. Participate in Stormwater Planning	In accordance with S8	In accordance with S8

[4] All deadlines are measured from the effective date of the permit, unless otherwise noted.

[5] All deadlines are measured from the date of coverage under the permit.

STORMWATER PROGRAM REQUIREMENT	IMPLEMENTATION SCHEUDLE[4] FOR PERMITTEES SPECIAL CONDITION S7	IMPLEMENTATION SCHEDULE[5] FOR PERMITTEES IDENTIFIED UNDER S2 C. AND D.
b. iii. MOU with WSDOT	18 months	Not applicable
b. iv. Agreements with co-permittees	12 months	Not applicable
5. Public Involvement		
b.i. Adopt program or policy directive	6 months	6 months
b. ii. Implement public involvement program	18 months	18 months
6. Controlling Runoff from New Development, Redevelopment and Construction Sites		
b.i. Adopt ordinances, technical standards and manual	12 months	12 months
b. ii. Implement ordinances, technical standards and manual	12 months	12 months
b. iii. All new development on an undeveloped parcel must meet technical standards	12 months	12 months
b.v. Authority to inspect private stormwater facilities	12 months	12 months
b. vi. Permits, plan review, inspections and enforcement	24 months, provided that permittees must continue at least existing level of effort until full implementation is achieved.	[Need to develop appropriate implementation schedule]
b. vii. Clearing and grading in conjunction with a permit or approval	12 months	12 months
b. viii. Coordination with Ecology-administered construction and industrial stormwater permits	effective date of permit	3 months

STORMWATER PROGRAM REQUIREMENT	IMPLEMENTATION SCHEUDLE[4] FOR PERMITTEES SPECIAL CONDITION S7	IMPLEMENTATION SCHEDULE[5] FOR PERMITTEES IDENTIFIED UNDER S2 C. AND D.
b. ix. Stormwater Planning	In accordance with S8	In accordance with S8
7. Stormwater Controls for Existing Developed Areas		
b. i. Stormwater Planning	In accordance with S8	In accordance with S8
b. ii WSDOT prioritization for correction of deficiencies	12 months	Not applicable
8. Source Control Program		
b.i. Adopt ordinance	12 months	12 months
b.ii. Compile list of sites for inspection	12 months	12 months
b.iii. Inspection program	begin implementation no later than 24 months	begin implementation no later than 24 months
b.iv. reduce pollutants associated with pesticides, herbicides and fertilizer	12 months	12 months
b.v. Two training sessions	by the end of the permit term	by the end of the permit term
9. Illicit Discharge Reduction		
b.i. on-going illicit discharge program	effective date of permit	24 months
b.ii. training	12 months	18 months
b. iii. reporting and correction procedures	effective date of permit	24 months
b. iv. complaints/reports telephone number	effective date of permit	24 months
b.v. investigate complaints/reports	effective date of permit	24 months
10. Operation and Maintenance Program		
b.i. Adopt maintenance standards	12 months	12 months
b.ii. Adopt policies and procedures	18 months	18 months

STORMWATER PROGRAM REQUIREMENT	IMPLEMENTATION SCHEUDLE[4] FOR PERMITTEES SPECIAL CONDITION S7	IMPLEMENTATION SCHEDULE[5] FOR PERMITTEES IDENTIFIED UNDER S2 C. AND D.
b.iii. Adopt ordinance for maintenance of private facilities	12 months	12 months
b.iv. inspection of private facilities	18 months to develop inspection schedule complete initial inspections by end of permit term	18 months to develop inspection schedule [Need to develop appropriate schedule for completing initial inspections]
b.v. develop on-going inspection schedule for private facilities	by the end of the permit term	by the end of the permit term
b.vi. inspect new stormwater facilities	24 months	24 months
b.vii. inspect and maintain public facilities	24 months, provided that permittees must continue at least existing level of effort until full implementation is achieved.	[Need to develop appropriate schedule]
b.viii. inspect facilities after storms	24 months	24 months
b.ix. inspect and maintain public catch basins	24 months	24 months
b.x. cleaning of private catch basins as needed	12 months	12 months
b.xi. records maintenance	effective date of permit	[Need to develop appropriate schedule]
b.xii. adopt practices for roads and highways	12 months to adopt practices 18 months to begin on-going implementation	12 months to adopt practices 18 months to begin on-going implementation
b. xiii. reduce pollutants associated with pesticides, herbicides and fertilizer	12 months	12 months
b. xiv. training	by the end of the permit term	by the end of the permit term
b.xv. SWPPs for maintenance yards	• develop SWPP within 18	• develop SWPP within 18

STORMWATER PROGRAM REQUIREMENT	IMPLEMENTATION SCHEUDLE[4] FOR PERMITTEES SPECIAL CONDITION S7	IMPLEMENTATION SCHEDULE[5] FOR PERMITTEES IDENTIFIED UNDER S2 C. AND D.
	months • begin implementation of non-structural BMPs immediately after SWPP is complete • schedule for structural BMPs in the SWPP	months • begin implementation of non-structural BMPs immediately after SWPP is complete • schedule for structural BMPs in the SWPP
11. Education Program		
b.i. informal education program	effective date of permit	6 months
b.ii. implement comprehensive education program	18 months	18 months

B. Each Co-permittee shall continue all current activities that meet the specific permit requirements of Special Condition S9. Whenever co-permittees must take actions to meet the program components in Special Condition S9, the actions shall be completed by the dates specified in the following implementation schedule:

This implementation schedule has not been written yet.

S11. REPORTING REQUIRMENTS

Reporting requirements have not been written yet. We are intending to address the following:

- Ecology is planning to minimize the up front review and approval of programs, therefore, annual reports will be used to determine permit compliance.
- Simplified reports for years 1,2, 3, and 5, with standard formatting provided for reporting on performance measures.
- Status of stormwater planning and implementation in all reports.
- Detailed 4th year reports that include implementation actions for stormwater plans that will be implemented under the next permit.
- The timing for report submittal needs to be determined, suggestions would be appreciated.

GENERAL CONDITIONS

The only general condition I'm currently planning to change is:

G10. REMOVED SUBSTANCES. REMOVED SUBSTANCES

With the exception of decant from street waste vehicles, the permittee shall not allow collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to be resuspended or reintroduced to the storm sewer system or to waters of the state. Decant from street waste vehicles resulting from cleaning stormwater facilities may be reintroduced only when other practical means are not available and only to catch basins remote from the discharge point to waters of the state.

G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this permit shall be consistent with the terms and conditions of this permit.

G2. PROPER OPERATION AND MAINTENANCE

The permittee shall at all times properly operate and maintain all facilities and systems of collection, treatment, and control (and related appurtenances) which are installed or used by the Permittee for pollution control to achieve compliance with the terms and conditions of this permit.

G3. NOTIFICATION OF SPILL

If a permittee has knowledge of a spill into a municipal storm sewer which could constitute a threat to human health, welfare, or the environment, the permittee shall notify the Ecology regional office and other appropriate spill response authorities immediately but in no case later than within 24 hours of obtaining that knowledge.

G4. BYPASS PROHIBITED

The intentional bypass of stormwater from all or any portion of a stormwater treatment BMP whenever the design capacity of the treatment BMP is not exceeded, is prohibited unless the following conditions are met:

A. Bypass is: (1) unavoidable to prevent loss of life, personal injury, or severe property damage; or (2) necessary to perform construction or maintenance-related activities essential to meet the requirements of the Clean Water Act (CWA); and

B. There are no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated stormwater, or maintenance during normal dry periods.

"Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss.

G5. RIGHT OF ENTRY

The permittee shall allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law at reasonable times:

A. To enter upon the permittee's premises where a discharge is located or where any records must be kept under the terms and conditions of this permit;

B. To have access to, and copy at reasonable cost and at reasonable times, any records that must be kept under the terms of the permit;

C. To inspect at reasonable times any monitoring equipment or method of monitoring required in the permit;

D. To inspect at reasonable times any collection, treatment, pollution management, or discharge facilities; and

E. To sample at reasonable times any discharge of pollutants.

G6. DUTY TO MITIGATE.

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

G7. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G8. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in the permit shall be construed as excusing the permittee from compliance with any other applicable federal, state, or local statutes, ordinances, or regulations.

G9. MONITORING.MONITORING

A. Representative Sampling:

Samples and measurements taken to meet the requirements of this permit shall be representative of the volume and nature of the monitored discharge, including representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions affecting effluent quality.

B. Records Retention:

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least five years. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the permittee or when requested by the Director. On request, monitoring data and analysis shall be provided to Ecology.

C. Recording of Results:

For each measurement or sample taken, the permittee shall record the following information: (1) the date, exact place and time of sampling; (2) the individual who performed the sampling or measurement; (3) the dates the analyses were performed; (4) who performed the analyses; (5) the analytical techniques or methods used; and (6) the results of all analyses.

D. Test Procedures:

All sampling and analytical methods used to meet the monitoring requirements specified in the approved stormwater management program shall conform to the Guidelines Establishing Test Procedures for the Analysis of Pollutants contained in 40 CFR Part 136, unless otherwise specified in this permit or approved in writing by Ecology.

E. Flow Measurement:

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements are consistent with the accepted industry standard for that type of device. Frequency of calibration shall be in conformance with manufacturer's recommendations or at a minimum frequency of at least one calibration per year. Calibration records should be maintained for a minimum of three years.

F. Lab Accreditation:

All monitoring data, except for flow, temperature, conductivity, pH, total residual chlorine, and other exceptions approved by Ecology, shall be prepared by a laboratory registered or accredited under the provisions of, Accreditation of Environmental Laboratories, Chapter 173-50 WAC. Soils and hazardous waste data are exempted from this requirement pending accreditation of laboratories for analysis of these media by Ecology.

G. Additional Monitoring:

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G10. REMOVED SUBSTANCES

With the exception of decant from street waste vehicles, the permittee shall not allow collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to be resuspended or reintroduced to the storm sewer system or to waters of the state. Decant from street waste vehicles resulting from cleaning stormwater facilities may be reintroduced only when other practical means are not available and only to catch basins remote from the discharge point to waters of the state.

G11. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

G12. REVOCATION OF COVERAGE

The director may terminate coverage under this General Permit in accordance with Chapter 43.21B RCW and Chapter 173-226 WAC. Cases where coverage may be terminated include, but are not limited to the following:

A. Violation of any term or condition of this general permit;

B. Obtaining coverage under this general permit by misrepresentation or failure to disclose fully all relevant facts;

C. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge;

D. A determination that the permitted activity endangers human health or the environment, or contributes significantly to water quality standards violations;

E. Failure or refusal of the permittee to allow entry as required in rcw 90.48.090;

F. Nonpayment of permit fees assessed pursuant to rcw 90.48.465;

Revocation of coverage under this general permit may be initiated by Ecology or requested by any interested person.

G13. TRANSFER OF COVERAGE

The director may require any discharger authorized by this general permit to apply for and obtain an individual permit in accordance with Chapter 43.21B RCW and Chapter 173-226 WAC.

G14. GENERAL PERMIT MODIFICATION AND REVOCATION

This general permit may be modified, revoked and reissued, or terminated in accordance with the provisions of WAC 173-226-230. Grounds for modification, revocation and reissuance, or termination include, but are not limited to the following:

A. A change occurs in the technology or practices for control or abatement of pollutants applicable to the category of dischargers covered under this general permit;

B. Effluent limitation guidelines or standards are promulgated pursuant to the cwa or chapter 90.48 rcw, for the category of dischargers covered under this general permit;

C. A water quality management plan containing requirements applicable to the category of dischargers covered under this general permit is approved; or

D. Information is obtained which indicates that cumulative effects on the environment from dischargers covered under this general permit are unacceptable.

G15. REPORTING A CAUSE FOR MODIFICATION OR REVOCATION

A permittee who knows or has reason to believe that any activity has occurred or will occur which would constitute cause for modification or revocation and reissuance under Condition G12, G14, or 40 CFR 122.62 must report such plans, or such information, to Ecology so that a decision can be made on whether action to modify, or revoke and reissue this permit will be required. Ecology may then require submission of a new or amended application. Submission of such application does not relieve the permittee of the duty to comply with this permit until it is modified or reissued.

G16. APPEALS

A. The terms and conditions of this general permit, as they apply to the appropriate class of dischargers, are subject to appeal within thirty days of issuance of this general permit, in accordance with Chapter 43.21B RCW, and Chapter 173-226 WAC.

B. The terms and conditions of this general permit, as they apply to an individual discharger, are appealable in accordance with chapter 43.21b rcw within thirty days of the effective date of coverage of that discharger. Consideration of an appeal of general permit coverage of an individual discharger is limited to the general permit's applicability or nonapplicability to that individual discharger.

C. The appeal of general permit coverage of an individual discharger does not affect any other dischargers covered under this general permit. If the terms and conditions of this general permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to ecology for consideration of issuance of an individual permit or permits.

D. Modifications of this permit are appealable in accordance with chapter 43.21B RCW and chapter 173-226 WAC.

G17. PENALTIES

40 CFR 122.41(a)(2) and (3), 40 CFR 122.41(j)(5), and 40 CFR 122.41(k)(2) are hereby incorporated into this permit by reference.

DEFINITIONS AND ACRONYMS

"Best Management Practices" ("BMPs") means the schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.

Bypass means the diversion of stormwater from any portion of a stormwater treatment facility.

"CWA" means Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub.L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. (6-483 and Pub. L. 97-117, 33 U.S.C. 1251 et.seq.

"Component" or "Program Component" means the elements of the stormwater management program listed in Special Condition S7.

"Co-permittee" means an owner or operator of a municipal separate storm sewer (other than an incorporated city) located within a large or medium muncipality, and that is only responsible for permit conditions relating to the discharge for which it is operator.

"Director" means the Director of the Washington State Department of Ecology, or an authorized representative.

"Discharge" for the purpose of this permit, unless indicated otherwise, refers to discharges from Municipal Separate Storm Sewers of the permittees.

"40 CFR" means Title 40 of the Code of Federal Regulations, which is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government.

"General Permit" means a permit which covers multiple dischargers of a point source category within a designated geographical area, in lieu of individual permits being issued to each discharger.

"Illicit discharge" means any discharge to a municipal separate storm sewer that is not composed entirely of storm water except discharges pursuant to a NPDES permit (other than the NPDES permit for discharges from the municipal separate storm sewer) and discharges resulting from fire fighting activities.

"Large Municipality" means an incorporated place with a population of 250,000 or more, a County with unincorporated urbanized areas with a population of 250,000 or more according to the 1990 decennial census by the Bureau of Census.

"Major Municipal Separate Storm Sewer Outfall" means a municipal separate storm sewer outfall from a single pipe with an inside diameter of 36 inches or more, or its equivalent (discharge from a single conveyance other than circular pipe which is associated with a drainage area of more than 50 acres); or for municipal separate storm sewers that receive stormwater from lands zoned for industrial activity (based on comprehensive zoning plans or the equivalent), an outfall that discharges from a single pipe with an inside diameter of 12 inches or more or from its equivalent (discharge from other than a circular pipe associated with a drainage area of 12 acres or more).

"Medium Municipality" means an incorporated place with a population of more than 100,000 but less than 250,000, or a county with unincorporated urbanized areas of more than 100,000 but less than 250,000 according to the 1990 decennial census by the Bureau of Census.

"Municipal Separate Storm Sewer" means a conveyance, or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains): (i) owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State Law) having jurisdiction over disposal of wastes, storm water, or other wastes, including special districts under State Law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to waters of the United States; (ii) designed or used for collecting or conveying stormwater; (iii) which is not a combined sewer; and (iv) which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

"National Pollutant Discharge Elimination System" (NPDES) means the national program for issuing, modifying, revoking, and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the state from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington Department of Ecology.

"Notice of Intent" (NOI) means the application for, or a request for coverage under this General Permit pursuant to WAC 173-226-200.

"Notice of Intent for Construction Activity," and "Notice of Intent for Industrial Activity" mean the application forms for coverage under the "Baseline General Permit for Stormwater Discharges Assoicated with Industrial Activities."

"Outfall" means point source as defined by 40 CFR 122.2 at the point where a municipal separate storm sewer discharges to waters of the State and does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels, or other conveyances which connect segments of the same stream or other waters of the State and are used to convey waters of the State.

"Runoff" see Stormwater.

"Shared Waterbodies" means waterbodies, including downstream segments, lakes and estuaries, that receive discharges from more than one permittee.

"Stormwater," for the purpose of this permit, means rainfall or snow melt runoff.

"Stormwater Associated with Industrial Activity" means the discharge from any conveyance which is used for collecting and conveying stormwater, which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant, and is required to have an NPDES permit in accordance with 40 CFR 122.26.

"Storm Water Management Manual for Western Washington" means the 5-volume technical manual (Publication Nos. 99-11 through 15) prepared by Ecology for use by local governments that contains BMPs to prevent, control, or treat pollution in storm water.

"Waters of the State" includes those waters as defined as "waters of the United States" in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and "waters of the state" as defined in Chapter 90.48 RCW which includes lakes, rivers, ponds, streams, inland waters, underground waters, salt waters and all other surface waters and water courses within the jurisdiction of the State of Washington.

"Water Quality Standards" means Surface Water Quality Standards, Chapter 173-201A WAC, Ground Water Quality Standards, Chapter 173-200 WAC, and Sediment Management Standards, Chapter 173-204 WAC.

APPENDIX 1 – Minimum Technical Requirements for All New Development and Re-Development

This Appendix is an excerpt from the August 2000 (final draft) Stormwater Management Manual for Western Washington. After the final manual is published, this appendix will be revised to reflect the final language in the manual.

Definitions

Effective surface Those surfaces, pervious or impervious, that are connected via sheet flow or discrete conveyance to a drainage system.

Impervious surface. A hard surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces.

Land disturbing activity Any activity that results in a change in the existing soil cover (both vegetative and nonvegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to demolition, construction, clearing, grading, filling, excavation, and compaction.

Major Receiving Water A surface waterbody of sufficient size such that adequate background water is available for dilution of treated stormwater discharges, and such that, within specified limits, stormwater may be discharged undetained without risk of significantly increasing the natural erosional forces on downgradient stream channels. An initial listing of major receiving waters is included in Appendix C. Local governments may petition for additions to or subtractions from the list.

New development Land disturbing activities, including Class IV -general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of impervious surfaces; subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. All other forest practices and commercial agriculture are not considered new development.

Pollution-generating impervious surface (PGIS)

Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities; or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall. Erodible or leachable materials, wastes, or chemicals are those substances which, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples include erodible soils, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage. Metal roofs are also considered to be PGIS unless they are treated to prevent leaching.

A surface, whether paved or not, shall be considered subject to vehicular use if it is regularly used by motor vehicles. The following are considered regularly-used surfaces: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unfenced fire lanes, vehicular equipment storage yards, and airport runways.

The following are not considered regularly-used surfaces: road shoulders primarily used for emergency parking, paved bicycle pathways, bicycle lanes adjacent to unpaved or paved road shoulders primarily used for emergency parking, fenced firelanes, and infrequently used maintenance access roads.

Pollution-generating pervious surfaces (PGPS)

Any non-impervious surface subject to use of pesticides and fertilizers or loss of soil. Typical PGPS include lawns, landscaped areas, golf courses, parks, cemeteries, and sports fields.

Project site

That portion of a property or properties subject to proposed project improvements including those required by this manual.

Redevelopment

On an already developed site, the creation or addition of impervious surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including an increase in gross floor area and/or exterior construction or remodeling; replacement of impervious surface that is not part of a routine maintenance activity; land disturbing activities associated with structural or impervious redevelopment

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are not considered redevelopment.

Replaced impervious surface — For structures, the removal and replacement of any exterior surfaces or foundation. For other impervious surfaces, the removal down to bare soil or base course and replacement, excluding impervious surfaces removed for the sole purpose of installing underground utilities.

Site — The legal boundaries of a parcel or parcels of land that is (are) subject to new or redevelopment.

Source control BMP — A BMP that is intended to prevent pollutants from entering stormwater. This manual separates source control BMPs into two types. *Structural Source Control BMPs* are physical, structural, or mechanical devices that are intended to prevent pollutants from entering stormwater. *Operational BMPs* are schedules of activities, prohibition of practices, and other managerial practices to prevent or reduce pollutants from entering stormwater. See Volume IV for details.

Threshold Discharge Area — An onsite area draining to a single natural discharge location or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flowpath). The examples in Figure 2.1 below illustrate this definition.

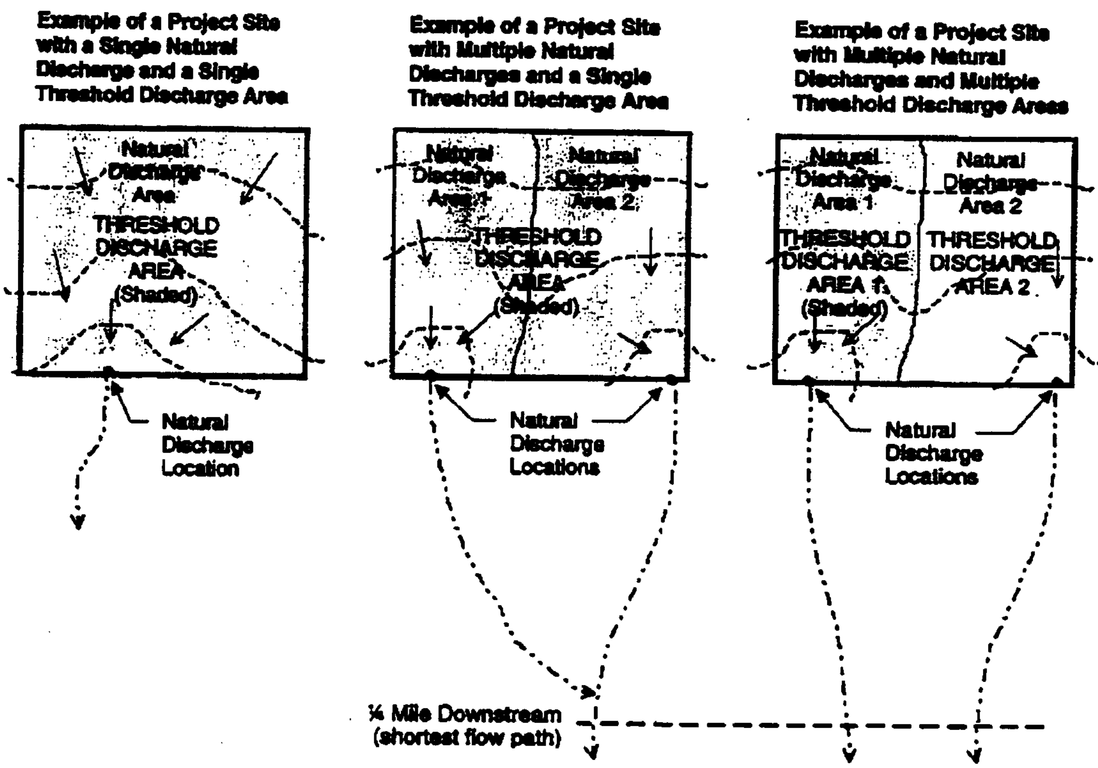

Figure 2.1. Threshold Discharge Areas

Exemptions

Forest practices regulated under Title 222 WAC, except for Class IV General forest practices that are conversions from timber land to other uses, are exempt from the provisions of the minimum requirements.

Commercial agriculture practices involving working the land for production are generally exempt. However, the conversion from timberland to agriculture, and the construction of impervious surfaces are not exempt.

All other new development is subject to the minimum requirements.

Thresholds for Application of Minimum Requirements to New Development and Redevelopment

New Development

All new development that includes the creation or addition of 2,000 square feet or greater, of new impervious surface area, and/or land disturbing activity of 7,000 square feet or greater, shall comply with Minimum Requirements #1 through #5. Projects not exceeding those thresholds shall apply Minimum Requirement #2.

All new development that:

- Creates or adds 5,000 square feet, or greater, of new impervious surface area, or
- Converts ¾ acres of pervious surfaces to lawn or landscaped areas, or
- Converts 2.5 acres of forested area to pasture,

shall comply with Minimum Requirements #1 through # 10

Redevelopment

All redevelopment projects in which the new, replaced, or total of *new plus replaced* impervious surfaces is 2,000 square feet or more, or that disturb 7,000 square feet or more of land, must comply with Minimum Requirements #1 through #5 for the new and replaced impervious surfaces and the land disturbed. Projects not exceeding those thresholds shall apply Minimum Requirement #2.

Redevelopment projects that:

- Add 5,000 square feet or more of *new* impervious surfaces, or

- Convert ¾ acres of pervious surfaces to lawn or landscaped areas, or
- Convert 2.5 acres of forested area to pasture,

must comply with Minimum Requirements #1 through #10 for the new impervious surfaces and the converted pervious surfaces. If the runoff quantity from the new surfaces is not separated from runoff from other surfaces prior to treatment or flow control, the stormwater facilities must be sized for the entire flow. Alternatively, the local government may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site. For public roads' projects, the equivalent area must drain to the same receiving water.

Application of stormwater requirements to the entire site:

Local governments shall adopt a threshold(s) for redevelopment projects which, if exceeded, shall cause an entire site undergoing redevelopment to comply with Minimum Requirements #1 through #10. This includes the new, replaced, and existing pervious and impervious surfaces. Ecology will use the following as the standards against which to judge alternative requirements:

- For public transportation projects, runoff from the existing, replaced, and new impervious surfaces (including pavement, shoulders, curbs, and sidewalks) shall meet all the Minimum Requirements if the new impervious surfaces total 5,000 square feet or more and total 50% or more of the existing impervious area within the project limits.
- Other types of redevelopment projects, in which the total of new plus replaced impervious surfaces is 5,000 square feet or more, and whose valuation of proposed improvements – including interior improvements – exceeds 50% of the assessed value of the existing site improvements (or, exceeds 50% of the replacement value as determined by the Marshall Valuation System, or some similar replacement value system), shall comply with all the Minimum Requirements for the entire site.

A local government may exempt redevelopment projects from compliance with Minimum Requirements for treatment, flow control, and wetlands protection if the local government has adopted a plan that fulfills those requirements in regional facilities that will discharge to the same receiving water, AND if they have an implementation plan and a schedule for completing construction of those facilities within five years. Redevelopment projects for public roads may be exempted from Minimum Requirements for treatment, flow control, and wetlands protection for the entire site (i.e., the exemption does not extend to new surfaces that add impervious area) if the local government constructs stormwater facilities for an equivalent amount of existing road surface within two years.

Minimum Requirements

Minimum Requirement #1 Preparation of Stormwater Site Plans

All projects shall prepare a stormwater site plan for local government review.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPP)

All new development and redevelopment shall comply with Construction SWPP Elements #1 through #12 below.

Projects that add or replace 2,000 square feet or more of impervious surface or clear more than 7,000 square feet must prepare a Construction SWPPP that is reviewed by the Plan Approval Authority of the local government. Each of the twelve elements must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the SWPPP.

Projects that add or replace less than 2,000 square feet of impervious surface or clearing projects of less than 7,000 square feet are not required to prepare a Construction SWPPP, but must consider all of the twelve Elements of Construction Stormwater Pollution Prevention and develop controls for all elements that pertain to the project site.

Element 1: Mark Clearing Limits

- Prior to beginning earth disturbing activities, including clearing and grading, all clearing limits, , sensitive areas and their buffers, and trees that are to be preserved within the construction area should be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
    - Plastic, metal, or stake wire fence may be used to mark the clearing limits.

Element 2: Establish Construction Access

- Construction vehicle access and exit shall be limited to one route if possible.
  - Access points shall be stabilized with quarry spall or crushed rock to minimize the tracking of sediment onto public roads.
  - Wheel wash or tire baths should be located on-site, if applicable.
  - Public roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.
  - Street wash wastewater shall be controlled by pumping back on-site, or otherwise be prevented from discharging into systems tributary to state surface waters.

Element 3: Control Flow Rates

- Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by local plan approval authority.
  - Downstream analysis is necessary if changes in offsite flows could impair or alter conveyance systems, streambanks, bed sediment or aquatic habitat. See Volume 1, Chapter 3 for offsite analysis
  - Stormwater detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e.g. impervious surfaces).
  - The local permitting agency may require pond designs that provide additional or different stormwater flow control if necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
  - If permanent infiltration ponds ar used for flow control during construction, these facilities should be protected from siltation during the construction phase.

Element 4: Install Sediment Controls

- The duff layer, native top soil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.
    - Prior to leaving a construction site, or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3, bullet #1. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The Local Permitting Authority shall inspect and approve areas stabilized by means other than pavement or quarry spalls.
    - Sediment ponds vegetated buffer strips, sediment barriers or filters, dikes, and other BMPs intended to trap sediment on-site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
    - Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.

Element 5: Stabilize Soils

- All exposed and unworked soils shall be stabilized by application of effective BMPs, that protect the soil from the erosive forces of raindrop impact and flowing water, and wind erosion.
    - From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This condition applies to all soils on site, whether at final grade or not. These time limits may be adjusted by the local permitting authority if it can be shown that the average time between storm events justifies a different standard.
    - Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, soil application of polyacrylamide

(PAM), and the early application of gravel base on areas to be paved and dust control.

- Soil stabilization measures selected should be appropriate for the time of year, site conditions, estimated duration of use, and potential water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized and protected with sediment trapping measures.
- Work on linear construction sites and activities, including right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall not exceed the capability of the individual contractor for his portion of the project to install the bedding materials, roadbeds, structures, pipelines, and/or utilities, and to re-stabilize the disturbed soils, meeting the timing conditions (From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days).

Element 6: Protect Slopes

- Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion.
  - Consider soil type and its potential for erosion.
  - Reduce slope runoff velocities by reducing the continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
  - Divert upslope drainage and run-on waters from off-site with interceptors at top of slope. Off-site stormwater should be handled separately from stormwater generated on the site. Diversion of off-site stormwater around the site may be a viable option. Diverted flows shall be redirected to the natural drainage location at or before the property boundary.
  - Contain downslope collected flows in pipes, slope drains, or protected channels.
  - Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
  - Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
  - Check dams shall be placed at regular intervals within trenches, which are cut down a slope.
  - Stabilize soils on slopes, as specified in Element #5.

Element 7: Protect Drain Inlets

- All storm drain inlets made operable during construction shall be protected so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
    - All approach roads shall be kept clean, and all sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to a water of the State.

Element 8: Stabilize Channels and Outlets

- All temporary on-site conveyance channels shall be designed, constructed and stabilized to prevent erosion from the expected velocity of flow from a 2 year, 24-hour frequency storm for the developed condition.
    - Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes and downstream reaches shall be provided at the outlets of all conveyance systems.

Element 9: Control Pollutants

- All pollutants, including waste materials and demolition debris, that occur on-site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater.
    - Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).
    - Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
    - Wheel wash, or tire bath wastewater, shall be discharged to a separate on-site treatment system or to the sanitary sewer.
    - Application of agricultural chemicals, including fertilizers and pesticides, shall be conducted in a manner and at application rates that will not result in loss of

chemical to stormwater runoff. Manufacturers' recommendations shall be followed for application rates and procedures.

- Management of pH-modifying sources shall prevent contamination of runoff and stormwater collected on the site. These sources include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters.

Element 10: Control De-Watering

- All foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system, prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element #8.
  - Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of the receiving waters. These clean waters should not be routed through sediment ponds with stormwater.
  - Highly turbid or otherwise contaminated dewatering water, such as from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam, shall be handled separately from stormwater at the site.
  - Other disposal options, depending on site constraints, may include: 1) infiltration, 2) transport off-site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters, 3) on-site treatment using chemical treatment or other suitable treatment technologies, or 4) sanitary sewer discharge with local sewer district aproval if there is no other option.

Element 11: Maintain BMPs

- All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repair shall be conducted in accordance with BMPs.
  - Sediment control BMPs shall be inspected weekly or after a runoff-producing storm event during the dry season and daily during the wet season.

- All temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element 12: Manage The Project

- Phasing of construction

  Development projects shall be phased where feasible in order to prevent, to the maximum extent practicable, the transport of sediment from the development site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

  Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance/compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by local jurisdictions, shall be delineated on the site plans and the development site.

- Seasonal work Limitations

  From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the construction site through a combination of the following:

  1. Site conditions including existing vegetative coverage, slope, soil type and proximity to receiving waters; and
  2. Limitations on activities and the extent of disturbed areas; and
  3. Proposed erosion and sediment control measures.

  Based on the information provided, and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance. If, during the course of any construction activity or soil disturbance during the seasonal limitation period, silt-laden runoff leaving the construction site causes a violation of the surface water quality standard or if clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained, the local permitting authority shall take enforcement action, including, but not limited to a notice of violation, administrative order, penalty, or stop-work order.

The following activities are exempt from the seasonal clearing and grading limitations:

1. Routine maintenance and necessary repair of erosion and sediment control BMPs;

2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and

3. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities

- Coordination with utilities and other contractors

  The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

- Inspection and Monitoring

  All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function.

  A Certified Professional in Erosion and Sediment Control shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. Certification may be through the WSDOT/AGC Construction Site Erosion and Sediment Control Certification Program or any equivalent local or national certification and/or training program.

  Sampling and analysis of the stormwater discharges from a construction site may be necessary on a case-by-case basis to ensure compliance with standards. Monitoring and reporting requirements may be established by the local permitting authority when necessary.

Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, the SWPPP shall be modified, as appropriate, in a timely manner.

- Maintenance of the Construction SWPPP

  The Construction SWPPP shall be retained on-site or within reasonable access to the site. The Construction SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP.

Minimum Requirement #3: Source Control Of Pollution

All known, available and reasonable source control BMPs shall be applied to all projects. Source control BMPs shall be selected, designed, and maintained according to this manual.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Natural drainage patterns shall be maintained, and discharges from the site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and downgradient properties. All outfalls require energy dissipation.

Minimum Requirement #5: On-site Stormwater Management

Projects shall employ Onsite Stormwater Management BMPs to infiltrate, disperse, and retain stormwater runoff onsite to the maximum extent practicable without causing flooding or erosion impacts.

Minimum Requirement #6: Runoff Treatment

Thresholds. The following require construction of stormwater treatment facilities that are sized to treat runoff from the water quality design storm:

- Projects in which the total of effective, pollution-generating impervious surface (PGIS) is 5,000 square feet or more in a threshold discharge area of the project, or
- Projects in which the total of effective, pollution-generating pervious surfaces (PGPS) is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site.

Treatment Facility Sizing. Treatment facilities shall be sized to treat runoff from the water quality design storm, defined as the 24-hour rainfall amount with a 6-month return frequency. Approved single event hydrograph methods identified in Volume III shall be used to identify runoff volumes and peak flow rates for design purposes. Alternative methods can be used if they identify volumes and flow rates that are at least equivalent.

That portion of any development project in which the above PGIS or PGPS thresholds are not exceeded in a threshold discharge area shall apply On-site Stormwater Management BMPs in accordance with Minimum Requirement #5.

Table 2.1 Treatment Requirements by Threshold Discharge Area

	< ¾ acres of PGPS	≥ ¾ acres PGPS	< 5,000 sf PGIS	≥ 5,000 sf PGIS
Treatment Facilities		✔		✔
Onsite Stormwater BMPs	✔	✔	✔	✔

PGPS = pollution-generating pervious surfaces

PGIS = pollution-generating impervious surfaces

sf = square feet

Required Treatment Levels

Basic Treatment. Stormwater discharges to major receiving waters and waters not otherwise designated below shall provide facilities that meet the Basic Treatment Performance Goal of 80% removal of total suspended solids for storms up through the water quality design storm event. The Basic Treatment Menu in Volume V identifies treatment options to achieve the goal.

Enhanced Treatment. Stormwater discharges from industrial, commercial, and multi-family sites, and from arterials and highways to fish-bearing streams, to waters tributary to fish-bearing streams, and to small lakes shall provide facilities that meet the Enhanced Treatment Performance Goal of increased capacity for dissolved metals removal for storms up through the water quality design storm event. The Enhanced Treatment Menu in Volume V identifies treatment options to achieve the goal.

Phosphorus Treatment. Stormwater discharges to waters that drain to lakes where eutrophication concerns have been identified by local governments shall provide facilities that meet the Phosphorus

Treatment Performance Goal of 50% total phosphorus removal for storms up through the water quality design storm event. The Phosphorus Treatment Menu in Volume V identifies treatment options to achieve the goal.

Oil Control. Stormwater discharges from High-Use Sites shall provide facilities that meet the Oil Control Performance Goals of no visible sheen and 10 mg/l of Total Petroleum Hydrocarbons (TPH). The Oil Control Menu in Volume V identifies treatment options.

Additional Requirements. Direct discharge of untreated stormwater from pollution-generating impervious surfaces to ground water is prohibited, except for that achieved by infiltration or dispersion of runoff through use of Onsite Stormwater BMPs. All treatment facilities shall be selected, designed, and maintained according to a local government manual deemed equivalent to this manual.

Minimum Requirement #7: Flow Control

Applicability. Projects must provide flow control to reduce the impacts of increased stormwater runoff from new impervious surfaces and land cover conversions._The requirement below applies wherever stormwater runoff is discharged to surface waters unless the discharge qualifies for a direct discharge exemption to a major receiving water, or the discharge is to a wetland. This requirement must be met in addition to meeting Minimum Requirement #6, Runoff Treatment.

Thresholds. The following require construction of flow control facilities and/or land use management BMPs that will achieve the standard requirement for Western Washington:

- Projects in which the total of effective impervious surfaces is 10,000 square feet or more in a threshold discharge area, or
- Projects that convert ¾ acres or more of pervious surfaces to lawn or landscape, or convert 2.5 acres or more of forested area to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site.

That portion of any development project in which the above thresholds are not exceeded in a threshold discharge area shall apply Onsite Stormwater Management BMPs in accordance with Minimum Requirement #5 .

Table 2.2 Flow Control Requirements by Threshold Discharge Area

	< ¾ acres conversion to lawn/land-	≥ ¾ acres conversion to lawn/land-	< 10,000 square feet of effective	≥ 10,000 square feet of effective

	scape, or < 2.5 acres of forest to pasture	scape, or ≥ 2.5 acres of forest to pasture	impervious area	impervious area
Flow Control Facilities		✔		✔
Onsite Stormwater Management BMPs	✔	✔	✔	✔

Western Washington Standard Requirement: Applies to the geographic areas designated as regions 3 and 4 in NOAA Atlas #2 (Miller et al, 1973)(9).

Stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. In addition, the developed peak discharge rates shall not exceed the pre-developed peak discharge rates for 2-,10-, and 50-year return periods.

Unless reasonable, historic, site-specific information is provided to the contrary, the applicant shall use the historic vegetation map in the Ecology Hydrology Model to determine the pre-developed condition.

This standard requirement is waived for sites that will reliably infitrate all the runoff from impervious surfaces and converted pervious surfaces.

Western Washington Alternative Requirement. An alternative requirement may be established through application of watershed-scale hydrological modeling and supporting field observations. Possible reasons for an alternative flow control requirement include:

- Establishment of a stream–specific threshold of significant bedload movement other than the assumed 50% of the 2-year peak flow;
- Zoning and Land Clearing Ordinance restrictions that, in combination with an alternative flow control standard, maintain or reduce the naturally occurring erosive forces on the stream channel; or

- A duration control standard is not necessary for protection, maintenance, or restoration of designated beneficial uses or Clean Water Act compliance.

Additional Requirement. Flow Control BMPs shall be selected, designed, and maintained according to a local government manual deemed equivalent to this manual.

Direct Discharge Exemption. A threshold discharge area is exempt from Minimum Requirement #7 if it drains to one of the major receiving waters listed in the glossary, AND meets all of the following criteria for direct discharge (i.e., undetained discharge) to that receiving water:

1. The area must be drained by a conveyance system that is comprised entirely of manmade conveyance elements (e.g., pipes, ditches, outfall protection, etc.) and extends to the ordinary high water line of the major receiving water. If such a system does not currently exist, one may be provided subject to the following conditions:
   - The new conveyance system (entirely man-made) must not divert flow from or increase flows to an existing wetland, stream, or near-shore habitat sufficient to cause a significant adverse impact, AND
   - If the new conveyance system drains to a river designated as a major receiving water and some or all of the new portion of the system is within one-quarter mile of the 100-year floodplain for that river, the area qualifying for the exemption must be limited to existing parcels that discharge to the system within the on-quarter mile distance.
2. Any erodible elements of the manmade conveyance system for the area must be adequately stabilized to prevent erosion.
3. Surface water from the area must not be diverted from or increased to an existing wetland, stream, or near-shore habitat sufficient to cause a significant adverse impact.

Minimum Requirement #8: Wetlands Protection

Applicability. The requirements below apply only to situations where stormwater discharges directly or indirectly through a conveyance system into a wetland, and must be met in addition to meeting Minimum Requirement #6, Runoff Treatment.

Thresholds. The thresholds identified in Minimum Requirement #6 – Runoff Treatment, and Minimum Requirement #7 – Flow Control shall also be applied for discharges to wetlands.

Standard Requirement. Discharges to wetlands shall maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing and designated uses unless an assessment is completed consistent with the criteria listed in "Wetlands and Stormwater Management Guidelines" of the publication, "Wetlands and Urbanization, Implications for the Future", the final report of the Puget Sound Wetland and Stormwater Management Research Program, 1997. Those guidelines (see Appendix D) shall be used for discharges to natural wetlands and wetlands constructed as mitigation.

Additional Requirements. The standard requirement does not excuse any discharge from the obligation to apply whatever technology is necessary to comply with state water quality standards, Chapter 173-201A WAC, or state ground water standards, Chapter 173-200 WAC. Additional treatment requirements to meet those standards may be required by federal, state, or local governments.
Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for necessary conveyance systems as approved by the local government.

An adopted and implemented basin plan (Minimum Requirement #9), or a Total Maximum Daily Load (TMDL, also known as a Water Clean-up Plan) may be used to develop requirements for wetlands that are tailored to a specific basin.

Minimum Requirement #9: Basin/Watershed Planning

Projects may be subject to equivalent or more stringent minimum requirements for erosion control, source control, treatment, wetlands protection, and operation and maintenance, and alternative requirements for flow control as identified in Basin/Watershed Plans. Basin/Watershed plans shall evaluate and include, as necessary, retrofitting urban stormwater BMPs into existing development and/or redevelopment in order to achieve watershed-wide pollutant reduction and flow control goals that are consistent with requirements of the federal Clean Water Act. Standards developed from basin plans shall not modify any of the above minimum requirements until the basin plan is formally adopted and implemented by the local governments within the basin, and approved or concurred with by the Department of Ecology.

Minimum Requirement #9: Operation and Maintenance

An operation and maintenance manual that is consistent with the local government standards shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. At private facilities, a copy of the manual shall be retained onsite or within reasonable access to the site, and shall be transferred with the property to the new owner. For public facilities, a copy of the manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken and where waste was disposed of shall be kept and be available for inspection by the local government.

APPENDIX 2

GUIDANCE FOR DETERMINING CONSTRUCTION SITE SEDIMENT TRANSPORT POTENTIAL

The following rating system allows objective evaluation of a particular development site's potential to discharge sediment.

1. Using the rating system below, determine the total points for each development site. The definitions and soil categorization information to be used in the rating system are listed in items #2 and #3.

CONSTRUCTION SITE SEDIMENT TRANSPORT POTENTIAL

	Points
A. Existing slope of site (average, weighted by areal extent):	
2% or less	0
>2-5%	5
>5-10%	15
>10-15%	30
>15%	50
B. Site Area to be cleared and/or graded:	
<5,000 sq. ft.	0
5,000 sq. ft. – 2 acre	30
>2 acres	50
C. Quantity of cut and/or fill on site:	
<500 cubic yards	0
500 – 5,000 cubic yards	5
>5,000 – 10,000 cubic yards	10
>10,000 – 20,000 cubic yards	25
>20,000 cubic yards	40
D. Runoff potential of predominant soils (Soil Conservation Service):	
Hydrologic soil group A	0
Hydrologic soil group B	10
Hydrologic soil group C	20
Hydrologic soil group D	40
E. Erosion Potential of predominant soils (Unified Classification System):	
GW, GP, SW, SP soils	0
Dual classifications (GW-GM, GP-GM, GW-GC, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC)	10
GM, GC, SM, SC soils	20
ML, CL, MH, CH soils	40
F. Depth of cut or height of fill >10 feet	25
G. Clearing and grading will occur in the wet season (October 1 – May 1)	50
TOTAL	________

2. Definitions Used in the Rating System

A. Hydraulic nearness – runoff from the site discharges to the sensitive feature without significant natural attenuation of flows that allows for suspended solids removal. The conditions that render a site hydraulically near to a sensitive feature include, but are not limited to, the following:

   i. the site is 200 feet or less uphill from the sensitive feature or its buffer; or
   ii. runoff from the site is tightlined to the sensitive feature or flows to the sensitive feature through a channel or ditch; or
   iii. one of the following does not occur before runoff from the site enters the sensitive feature: sheet flow through a vegetated area with dense ground cover; flow through a wetland not included as a sensitive feature; or a significant shallow or adverse slope, not in a conveyance channel, between the site and the sensitive feature.

B. Sediment/erosion sensitive feature – areas subject to significant degradation due to the effect of construction runoff or areas requiring special protection to prevent erosion. These areas include, but are not limited to, the following:

   i. Salmonid bearing fresh water streams and their tributaries or freshwater streams that would be Salmonid bearing if not for anthropogenic barriers;
   ii. Lakes;
   iii. Category I, II, and III wetlands;
   iv. Marine near-shore habitat;
   v. Sites containing contaminated soils where erosion could cause dispersal of contaminants; and
   vi. Steep slopes (25% or greater) associated with one of the above features.

3. Soil Categorization for Use in Rating System

If soil testing has been performed on site, the results should be used to determine the predominant soil type on the site. Otherwise, soil information should be obtained from the county soil survey for the classification and runoff potential of the site's predominant soils.

When using the Soil Survey, the dominant soil type may be in question, particularly when the site falls on a boundary between two soil types or when one of two soil types may be present on a site. In this case, the soil type resulting in the most points on the rating system will be assumed unless site soil tests indicate that another soil type dominates the site.

4. Use the point score from Step #1 to determine whether the development site has a high potential for sediment transport.

Total Score	Erosion Potential
<80	Low
≥80	High

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Appendix 3

CLEARING & GRADING APPROVAL

All proposed clearing and grading activities must be reviewed and approved by the local jurisdiction.

Suggested activities to be exempted include:

(a) Agricultural crop management;

(b) Cemetery graves;

(c) Routine landscape management;

(d) Road maintenance or other public infrastructure maintenance consistent with the 4(d) rule;

(e) Minor landscape installation;

(f) Emergency and/or hazard situations;

(g) Minor excavation work (e.g., less than 100 cubic yards/5 foot cut);

(h) Minor fill work (e.g., less than 100 cubic yards/3 foot fill); and

(i) Clearing less than one thousand square feet where the existing zoning is single-family residential within the urban growth boundary.

The jurisdiction may review and approve clearing and grading activities through one or more of the following mechanisms:

1. Building permit.
2. Clearing and/or grading permit.
3. Conditional use permit.
4. Approval of a forest management plan.
5. Approval of utility extension plans.
6. Approval of a property access road to an existing developed property.
7. Approval of street, water, storm and sanitary sewer capital improvement projects.
8. Approval of street, water, storm and sanitary sewer construction drawings for a preliminary plat, approved short plat, or other approved development.
9. Approval of a shorelines substantial development permit or shorelines management exemption for the subject property by the local permitting authority and after expiration of all appeal periods pursuant to WAC 173-14-180.
10. Special permission of the permit authority for site work under 500 cubic yards based on a demonstration that extenuating circumstances are present and that the project is consistent with the intent and purposes of the 4(d) rule, in conjunction with a clearing, grading, and drainage plan with erosion and sedimentation control, landscaping, soil stabilization and surface groundcover elements including continuing maintenance.
11. Other permits or approvals as approved by the 4(d) rule certifying agency.

Appendix 4

GUIDANCE FOR IDENTIFYING SITES REQUIRING SOURCE CONTROL INSPECTIONS

Use this attachment to identify sites with potential outdoor pollutant-generating sources that should be inspected to identify and enforce applicable source control standards (*note: see last page for additions, deletions, and qualifiers*). The following types of land uses/businesses (manufacturing, transportation, communication, wholesale, retail, service - based on the 1987 Standard Industrial Classification codes, and public agencies) should be included on the jurisdiction's inspection list and 5-year inspection schedule/plan.

Manufacturing Businesses

Cement
SIC: 3241 **
Description: These businesses produce Portland cement, the binder used in concrete for paving, buildings, pipe and other structural products. The three basic steps in cement manufacturing are 1) proportioning, grinding, and blending raw materials; 2) heating raw materials to produce a hard, stony substance known as clinker; and 3) combining the clinker with other materials and grinding the mixture into a fine powdery form. The raw materials include limestone, silica, alumina, iron, chalk, oyster shell marl, or shale. Waste materials from other industries are often used such as slag, fly ash and spent blasting sand. Raw materials are crushed, mixed and heated in a kiln to produce the correct chemical composition. Kilns typically are coal, gas, or oil fired. The output of the kiln is a clinker that is ground to produce the final product.

The basic process may be wet or dry. In the wet process water is mixed with the raw ingredients in the initial crushing operation and in some cases is used to wash the material prior to use. Water may also be used in the air pollution control scrubber. The most significant waste material from cement production is the kiln dust. Concrete products may also be produced at ready-mix concrete facilities. Refer to "Concrete Products" for a description of the BMPs appropriate to these activities.

Potential Pollutant Generating Sources: Stormwater may be contaminated during the crushing, grinding, storage, and handling of kiln dust, limestone, shale, clay, coal, clinker, gypsum, anhydrite, slag, sand and product and at the vehicle and equipment maintenance, fueling, and cleaning areas. Total suspended solids, aluminum, iron and other heavy metals, pH, COD, potassium, sulfate, and oil and grease are some of the potential pollutants. The following mean concentrations in stormwater discharges have been reported EPA's multi-sector permit fact sheet (7) : TSS=1067, COD=107.5, aluminum=72.6, iron=7.5, all in mg/L, and pH=2-12. These values may be useful in characterizing stormwater contaminants at cement manufacturing facilities.

Chemicals Manufacturing
SIC: 2800 **, 3861 **
Description: This group is engaged in the manufacture of chemicals, or products based on chemicals such as acids, alkalis, inks (2893) ** , chlorine, industrial gases, pigments, chemicals used in the production of synthetic resins (2869 **), fibers and plastics, synthetic rubber, soaps and cleaners (2840) ** , pharmaceuticals (2834) * , cosmetics, paints (2850) * , varnishes, resins (2861) * , photographic materials, chemicals (3861), organic chemicals (2869) ** , agricultural chemicals (2879) ** , adhesives, sealants (2891) ** , and ink (2893) ** .

Potential Pollutant Generating Sources: Activities that can contaminate stormwater include bagging, blending, packaging, crushing, milling, shredding, granulation, grinding, storage, distribution, loading/unloading, and processing of materials; equipment storage; application of fertilizers; foundries; lime application; use of machinery; material handling and warehousing; cooling towers; fueling; boilers; hazardous waste treatment, storage and disposal; wastewater treatment; plant yard areas of past industrial activity; access roads and tracks; drum washing, and maintenance and repair.

Chemical businesses in the Seattle area surveyed for Dangerous Wastes have been found to produce waste caustic solutions, soaps, heavy metal solutions, inorganic and organic chemicals, solvents, acids, alkalis, paints, varnishes, pharmaceuticals, and inks. The potential pollutants include BOD, TSS, COD, oil and grease, pH, total phosphorus, nitrates, nitrites, total Kjeldahl nitrogen, ammonia, specific organics, and heavy metals. EPA stormwater multi-sector permit fact sheet data (7) includes the following mean values in mg/L except pH: BOD, 4.4-143.2; TSS, 35-493; COD, 42.36-245.3; Oil and Grease, 0.3-6.0; NO2+NO3, 0.3-35.9; TKN, 1.3-108.9; tot. P, 0.1-65.7; ammonia, 40.45-73.22; Al, 1.20-1.78; Cu, .12-19; Mn, .56-. 71; Zn, 1.74-2.11; Fe, 2.24-3.52 and pH, 3.5- 10.4. This data could be helpful in characterizing stormwater pollutants at the facility.

Concrete Products
SIC: 3270 **
Description: Businesses that manufacture ready-mix concrete, gypsum products, concrete blocks and bricks, concrete sewer or drainage pipe, septic tanks, and prestressed concrete building components. Concrete is prepared on-site and poured into molds or forms to produce the desired product. The basic ingredients of concrete are sand, gravel, Portland cement, crushed stone, clay, and reinforcing steel for some products. Admixtures including fly ash, calcium chloride, triethanolamine, lignosulfonic acid, sulfonated hydrocarbon, fatty acid glyceride, vinyl acetate, may be added to obtain desired characteristics, such as slower or more rapid curing times.

The first stage in the manufacturing process is proportioning cement, aggregate, admixtures and water, and then transporting the product to a rotary drum, or pan mixer. The mixture is then fed into an automatic block-molding machine that rams, presses, or vibrates the mixture into its final form. The final product is then stacked on iron framework cars where it cures in four hours. After being mixed in a central mixer, concrete is molded in the same manner as concrete block. The concrete cures in the forms for a number of hours. Forms are washed for reuse, and the concrete products are stored until they can be shipped.

Potential Pollutant Generating Sources: *Pollutant* generating activities/sources include stockpiles; washing of waste concrete from trucks, forms, equipment, and the general work area; and water from the curing of concrete products. Besides the basic ingredients for making concrete products, chemicals used in the curing of concrete and the removal of forms may end up in stormwater. These chemicals can include latex sealants, bitumastic coatings and release agents. Trucks and equipment maintained on-site may generate waste oil and solvents, and other waste materials. Potential pollutants include TSS, COD, BOD, pH, lead, iron, zinc, and oil and grease.

Electrical Products
SIC: 3600 *, 3800 *
Description: A variety of products are produced including electrical transformers and switchgear (3610) *, motors, generators, relays, and industrial controls (3620)*; communications equipment for radio and TV stations and systems (3660) * ; electronic components and accessories including semiconductors (3670) * ; printed board circuits; electromedical and electrotherapeutic apparatus (3690) * ; and electrical instrumentation (3800) * . Manufacturing processes include electroplating, machining, fabricating, etching, sawing, grinding, welding, and parts cleaning. Materials used include metals, ceramics, quartz, silicon, inorganic oxides, acids, alkaline solutions, arsenides, phosphides, cyanides, oils, fuels, solvents, and other chemicals.

Potential Pollutant Generating Sources: Pollutant generating activities/sources include bulk storage of raw materials, by-products or finished products; loading and unloading of liquid materials from truck or rail;

temporary storage of waste oil and solvents from cleaning manufacturing equipment; used equipment temporarily stored on site that could drip oil and residual process materials; maintenance and repair of vehicles and equipment; and temporary storage of Dangerous Wastes.

Waste liquids which are sometimes stored outside include spent acetone and solvents, ferric chloride solutions, soldering fluxes mixed with thinner or alcohol, spent acids, and oily waste. Several of these liquid wastes contain chlorinated hydrocarbons, ammonium salts, and metals such as chromium, copper, lead, silver, zinc, nickel, and tin. Waste solids include soiled rags and sanding materials.

Wastewater consists of solutions and rinses from electroplating operations, and the wastewaters from cleaning operations. Water may also be used to cool saws and grinding machines. Sludges are produced by the wastewater treatment process. Potential pollutants include TSS, oil and grease, organics, pH, BOD, COD, Total Kjeldahl Nitrogen, Nitrate and Nitrite Nitrogen, copper, zinc, lead and silver.

Food Products
SIC: 2000 *
Description: Businesses in this category include meat packing plants, poultry slaughtering and processing, sausage and prepared meats, dairy products, preserved fruits and vegetables, flour, bakery products, sugar and confectioneries, vegetable and animal oils, beverages, canned, frozen or fresh fish, pasta products, snack foods, and manufactured ice. Food processing typically occurs inside buildings. Exceptions are meat packing plants where live animals may be kept outside, and fruit and vegetable plants where the raw material may be temporarily stored outside. Meat production facilities include stockyards, slaughtering, cutting and deboning, meat processing, rendering, and materials recovery. Dairy production facilities include receiving stations, clarification, separation, and pasteurization followed by culturing, churning, pressing, curing, blending, condensing, sweetening, drying, milling, and packaging. Canned frozen and preserved fruits and vegetables are typically produced by washing, cutting, blanching, and cooking followed by drying, dehydrating, and freezing.

Grain mill products are processed during washing, milling, debranning, heat treatment, screening, shaping, and vitamin and mineral supplementing. Bakery products processing includes mixing, shaping, of dough, cooling, and decorating. Operations at an edible oil manufacturer include refining, bleaching, hydrogenation, fractionation, emulsification, deodorization, filtration, and blending. Beverage production includes brewing, distilling, fermentation, blending, and packaging. Wine processors often crush grapes outside the process building and/or store equipment outside when not in use. Some wine producers use juice from grapes crushed elsewhere. Some vegetable and fruit processing plants use caustic solutions.

Pollutant Generating Sources: The following are potential stormwater pollutant causing activities/sources: loading/unloading of materials, equipment/vehicle maintenance, liquid storage in tanks and drums, air emissions (ovens, vents), solid wastes handling and storage, wastewater treatment, pest control, animal containment and transit, and vegetable storage. Materials exposed to stormwater include acids, ammonia, activated carbon, bleach, blood, bone meal, brewing residuals, caustic soda, chlorine, coke oven tar, detergents, eggs, feathers, feed, ferric chloride, fruits, vegetables, coffee beans, gel bone, grain, hides, lard, manure, milk, salts, skim powder, starch, sugar, tallow, ethyl alcohol, oils, fats, whey, yeast, and wastes. The following are the pollutants typically expected from this industry segment: BOD, TSS, Oil and Grease, pH, Kjeldahl Nitrogen, copper, manganese, fecal coliform, and pesticides.

Glass Products
SIC: 3210**, 3220**, 3230**
Description: The glass form produced may be flat or window glass, safety glass, or container glass, tubing, glass wool or fibers. The raw materials are sand mixed with a variety of oxides such as aluminum, antimony, arsenic, lead, copper, cobalt oxide, and barium. The raw materials are mixed and heated in a furnace. Processes that vary with the intended product shape the resulting molten material. The cooled glass may be edged, ground, polished,

annealed and/or heat-treated to produce the final product. Air emissions from the manufacturing buildings are scrubbed to remove particulates.

Pollutant Generating Sources: Raw materials are generally stored in silos except for crushed recycled glass and materials washed off recycled glass. Contamination of stormwater and/or ground water can be caused by raw materials lost during unloading operations, errant flue dust, equipment/vehicle maintenance and engine fluids from mobile lifting equipment that is stored outside. The maintenance of the manufacturing equipment will produce waste lubricants and cleaning solvents. The flue dust is likely to contain heavy metals such as arsenic, cadmium, chromium, mercury, and lead. Potential pollutants include suspended solids, oil and grease, high/low pH, and heavy metals such as arsenic, cadmium, chromium, mercury, and lead.

Industrial Machinery and Equipment, Trucks and Trailers, Aircraft, Aerospace, and Railroad
SIC: 3500, 3713/14 *, 3720 *, 3740 *, 3760 *, 3800 *
Description: This category includes the manufacture of a variety of equipment including engines and turbines, farm and garden equipment, construction and mining machinery, metal working machinery, pumps, computers and office equipment, automatic vending machines, refrigeration and heating equipment, and equipment for the manufacturing industries. This group also includes many small machine shops, and the manufacturing of trucks, trailers and parts, airplanes and parts, missiles, spacecraft, and railroad equipment and instruments.

Manufacturing processes include various forms of metal working and finishing, such as electroplating, anodizing, chemical conversion coating, etching, chemical milling, cleaning, machining, grinding, polishing, sand blasting, laminating, hot dip coating, descaling, degreasing, paint stripping, painting, and the production of plastic and fiberglass parts. Raw materials include ferrous and non-ferrous metals, such as aluminum, copper, iron, steel, and their alloys, paints, solvents, acids, alkalis, fuels, lubricating and cutting oils, and plastics.

Potential Pollutant Generating Sources: Potential pollutant sources include fuel islands, maintenance shops, loading/unloading of materials, and outside storage of gasoline, diesel, cleaning fluids, equipment, solvents, paints, wastes, detergents, acids, other chemicals, oils, metals, and scrap materials. Air emissions from stacks and ventilation systems are potential areas for exposure of materials to rain water.

Metal Products
SIC: 2514, 2522 *, 2542 *, 3312 **, 3314- 17 **, 3320 **, 3350 **, 3360 **, 3400 *, 3590 *
Description: This group includes mills that produce basic metals and primary products, as well as foundries, electroplaters, and fabricators of final metal products. Basic metal production includes steel, copper, and aluminum. Mills that transform metal billets, either ferrous or nonferrous such as aluminum, to primary metal products are included. Primary metal forms include sheets, flat bar, building components such as columns, beams and concrete reinforcing bar, and large pipe.

Steel mills in the Pacific Northwest use recycled metal and electric furnaces. The molten steel is cast into billets or ingots that may be reformed on site or taken to rolling mills that produce primary products. As iron and steel billets may sit outside before reforming, surface treatment to remove scale may occur prior to reforming. Foundries pour or inject molten metal into a mold to produce a shape that cannot be readily formed by other processes. The metal is first melted in a furnace. The mold is made of sand or metal die blocks that are locked together to make a complete cavity. The molten metal is ladled in and the mold is cooled. The rough product is finished by quenching, cleaning and chemical treatment. Quenching involves immersion in a plain water bath or water with an additive.

Businesses that fabricate metal products from metal stock provide a wide range of products. The raw stock is manipulated in a variety of ways including machining of various types, grinding, heating, shearing, deformation, cutting and welding, soldering, sand blasting, brazing, and laminating. Fabricators may first clean the metal by sand blasting, descaling, or solvent degreasing. Final finishing may involve electroplating, painting, or direct plating by fusing or vacuum metalizing. Raw materials, in particular recycled metal, are stored outside prior to use, as are billets before reforming. The descaling process may use salt baths, sodium hydroxide, or acid (pickling).

Primary products often receive a surface coating treatment. Prior to the coating the product surface may be prepared by acid pickling to remove scale or alkaline cleaning to remove oils and greases. The two major classes of metallic coating operations are hot and cold coating. Zinc, tin and aluminum coatings are applied in molten metal baths. Tin and chromium are usually applied electrolytically from plating solutions.

Potential Pollutant Generating Sources: Potential pollutant generating sources include outside storage of chemicals, metal feedstock, byproducts (fluxes), finished products, fuels, lubricants, waste oil, sludge, waste solvents, Dangerous Wastes, piles of coal, coke, dusts, fly ash, baghouse waste, slag, dross, sludges, sand refractory rubble, and machining waste; unloading of chemical feedstock and loading of waste liquids such as spent pickle liquor by truck or rail; material handling equipment such as cranes, conveyors, trucks, and forklifts; particulate emissions from scrubbers, baghouses or electrostatic precipitators; fugitive emissions; maintenance shops; erosion of soil from plant yards; and floor, sink, and process wastewater drains.

Based on EPA's multi-sector industrial stormwater permit/fact sheet (7) the following are ranges of mean composite/grab pollutant concentrations from this industrial group (values are in mg/L except pH): BOD at 34.1/32.2; COD at 109.8/221.3; NO2+NO3 N at 1.38/1.17; TKN at 3.05/3.56; Oil and grease at 8.88 (grab); pH at 2.6-10.3 (range-grab); total phosphorus at .52/1.25; TSS at 162/368; copper at 2.28/3.53; lead at .19/. 79; zinc at 6.60/8.90; aluminum at 2.6/4.8; iron at 32.30/45.97; cadmium at 0.015/0.074; chromium at 2.2/5.053; nickel at 0.75/0.7; manganese at .59/.68; ammonia at .55/.85; and pyrene at .01/.06.

Paper and Pulp
SIC: 2610 **, 2620 **, 2630 **

Description: Large industrial complexes in which pulp and/or paper, and/or paperboard are produced. Products also include newsprint, bleached paper, glassine, tissue paper, vegetable parchment, and industrial papers. Raw materials include; wood logs, chips, wastepaper, jute, hemp, rags, cotton linters, bagasse, and esparto. The chips for pulping may be produced on-site from logs, and/or imported.

The following manufacturing processes are typically used: raw material preparation, pulping, bleaching, and papermaking. All of these operations use a wide variety of chemicals including caustic soda, sodium and ammonium sulfites, chlorine, titanium oxide, starches, solvents, adhesives, biocides, hydraulic oils, lubricants, dyes, and many chemical additives.

Potential Pollutant Sources: The large process equipment used for pulping is not enclosed. Thus, precipitation falling over these areas may become contaminated. Maintenance of the process equipment produces waste products similar to that produced from vehicle and mobile equipment maintenance. Logs may be stored, debarked and chipped on site. Large quantities of chips are stored outside. Although this can be a source of pollution, the volume of stormwater flow is relatively small because the chip pile retains the majority of the precipitation. Mobile equipment such as forklifts, log stackers, and chip dozers are sources of leaks/spills of hydraulic fluids. Vehicles and equipment are fueled and maintained on site.

Paper Products
SIC: 2650 *, 2670 *

Description: Included are businesses that take paper stock and produce basic paper products such as cardboard boxes and other containers, and stationery products such as envelopes and bond paper. Wood chips, pulp, and paper can be used as feedstock.

Potential Pollutant Generating Sources: The following are potential pollutant sources:
1. Outside loading/unloading of solid and liquid materials.
2. Outside storage and handling of dangerous wastes, and other liquid and solid materials.
3. Maintenance and fueling activities.
4. Outside processing activities comparable to Pulp and Paper
5. processing in preceding section.

Petroleum Products
SIC: 2911 **, 2950 **
Description: The petroleum refining industry manufactures gasoline, kerosene, distillate and residual oils, lubricants and related products from crude petroleum, and asphalt paving and roofing materials. Although petroleum is the primary raw material, petroleum refineries also use other materials such as natural gas, benzene, toluene, chemical catalysts, caustic soda and sulfuric acid. Wastes may include filter clays, spent catalysts, sludges, and oily water.

Asphalt paving products consist of sand, gravel and petroleum-based asphalt that serves as the binder. Raw materials include stockpiles of sand and gravel and asphalt emulsions stored in aboveground tanks. Waste products may include small dumps of unused asphalt and the usual materials from vehicle maintenance.

Potential Pollutant Generating Sources:

1. Outside processing such as distillation, fractionation, catalytic cracking, solvent extraction, coking, desulfuring, reforming, and desalting.
2. Petrochemical and fuel storage and handling.
3. Outside liquid chemical piping and tankage,
4. Mobile liquid handling equipment such as tank trucks, fork lifts, etc.
5. Maintenance and parking of trucks and other equipment.
6. Waste Piles.
7. Waste treatment and conveyance systems.

The following are potential pollutants at oil refineries: oil and grease, BOD5, COD, TOC, phenolic compounds, PAH, ammonia nitrogen, TKN, sulfides, TSS, low and high pH, and chromium (total and hexavalent).

Printing
SIC: 2700 *
Description: This industrial category includes the production of newspapers, periodicals, commercial printing materials and businesses that do their own printing and those that perform services for the printing industry, for example bookbinding. Processes include typesetting, engraving, photoengraving, and electrotyping.

Potential Pollutant Generating Sources: Various materials used in modifying the paper stock include inorganic and organic acids, resins, solvents, polyester film, developers, alcohol, vinyl lacquer, dyes, acetates, and polymers. Waste products may include waste inks and ink sludge, resins, photographic chemicals, solvents, acid and alkaline solutions, chlorides, chromium, zinc, lead, spent formaldehyde, silver, plasticizers, and used lubricating oils. As the printing operations occur indoors, the only likely points of potential contact with stormwater are the outside temporary storage of waste materials, offloading of chemicals at external unloading bays, and vehicle/equipment repair and maintenance. Pollutants of concern include TSS, pH, heavy metals, oil and grease, and COD.

Rubber and Plastic Products
SIC: 3000

Description: Although different in basic feedstock and processes used, businesses that produce rubber, fiberglass and plastic products belong to the same SIC group. Products in this category include rubber tires, hoses, belts, gaskets, seals; and plastic sheet, film, tubes, pipes, bottles, cups, ice chests, packaging materials, and plumbing fixtures. The rubber and plastics industries use a variety of processes ranging from polymerization to extrusion using natural or synthetic raw materials. These industries use natural or synthetic rubber, plastics components, pigments, adhesives, resins, acids, caustic soda, zinc, paints, fillers and curing agents.

Potential Pollutant Generating Sources: Pollutant generating sources/activities include storage of liquids, other raw materials or by-products, scrap materials, oils, solvents, inks and paints; unloading of liquid materials from trucks or rail cars; washing of equipment; waste oil and solvents produced by cleaning manufacturing equipment; used equipment that could drip oil and residual process materials; and maintenance shops.

Based on data in EPA's multi-sector permit fact sheet (7) the following are mean pollutant concentrations in mg/L, except for pH (unitless) and 1,1,1 trichloroethane, methylene chloride, toluene, zinc, oil/grease which are min.-max. grab sample values: BOD at 11.21-13.92, COD at 72.08-100.0, NO3 + NO2 Nitrogen at 86-1.26, TKN at 1.55-2.34, total phosphorus at .34-.41, TSS at 119.32-188.55, pH range of 2.56-10.1, trichloroethane at 0.00-0.38, methylene chloride at 0.00-13.0, toluene at 0.00-3.8, zinc at .011-7.60 and oil and grease at 0.0-91.0. These data may be helpful in characterizing potential stormwater pollutants.

Ship and Boat Building and Repair Yards
SIC: 3730 **

Description: Businesses that build or repair ships and boats. Typical activities include hull scraping, sandblasting, finishing, metal fabrication, electrical repairs, engine overhaul, and welding, fiberglass repairs, hydroblasting and steam cleaning.

Potential Pollutant Generating Sources: *Outside* boatyard activities that can be sources of stormwater pollution include pressure washing, surface preparation, paint removal, sanding, painting, engine/vessel maintenance and repairs, and material handling and storage. Secondary sources of stormwater contaminants are cooling water, pump testing, gray water, sanitary waste, washing down the work area, and engine bilge water. Engine room bilge water and oily wastes are typically collected and disposed of through a licensed contracted disposal company. Two prime sources of copper are leaching of copper from anti-fouling paint and wastes from hull maintenance. Wastes generated by boatyard activities include spent abrasive grits, spent solvent, spent oils, fuel, ethylene glycol, washwater, paint over spray, various cleaners/detergents and anti-corrosive compounds, paint chips, scrap metal, welding rods, wood, plastic, resins, glass fibers, dust, and miscellaneous trash such as paper and glass. WDOE, local shipyards and METRO have sampled pressure wash wastewater. The effluent quality has been variable and frequently exceeds water quality criteria for copper, lead, tin, and zinc. From monitoring results received to date, metal concentrations typically range from 5 to 10 mg/L, but have gone as high as 190 mg/L copper with an average 55 mg/L copper.

Wood
SIC 2420 **, 2450 **, 2434 *, 2490 **, 2511/12 *, 2517 *, 2519 *, 2521 *, 2541 *

Description: This group includes sawmills, and all businesses that make wood products using cut wood, with the exception of wood treatment businesses. Wood treatment as well as log storage and sorting yards are covered in other sections of this chapter. Included in this group are planing mills, millworks, and businesses that make wooden containers and prefab building components, mobile homes, and glued-wood products like laminated beams, as well as office and home furniture, partitions, and cabinets. All businesses employ cutting equipment whose by-products are chips and sawdust. Finishing is conducted in many operations.

Potential Pollutant Generating Sources: Businesses may have operations that use paints, solvents, wax emulsions, melamine formaldehyde and other thermosetting resins, and produce waste paints and paint thinners, turpentine, shellac, varnishes and other waste liquids. Outside storage, trucking, and handling of these materials can also be pollutant sources.

Potential pollutants reported in EPA's draft multi-sector permit/ fact sheet (7) include the following (all are grab/composite mean values, in mg/L, except for oil and grease and pH): BOD at 39.6/45.4, COD at 297.6/242.5, NO3 + NO2-N at 0.95/0.75, TKN at 2.57/2.32, Tot. Phosphorus at 23.91/6.29; TSS at 1108/575, arsenic at .025/.028, copper at .047/.041, total phenols at .02/.007, oil and grease at 15.2, and pH at 3.6. These data may help in characterizing the potential stormwater pollutants at the facility.

Wood Treatment
SIC: 2491 **
Description: This group includes both anti-staining and wood preserving. The wood stock must be brought to the proper moisture content prior to treatment, which is achieved by either air-drying or kiln drying. Some wood trimming may occur. After treatment, the lumber is typically stored outside. Forklifts are used to move both the raw and finished product. Wood treatment consists of a pressure process using the chemicals described below. Anti-staining treatment is conducted using dip tanks or by spraying. Wood preservatives include creosote, creosote/coal tar, pentachlorophenol, copper naphthenate or inorganic arsenicals such as chromated copper arsenate dissolved in water. The use of pentachlorophenol is declining in the Puget Sound region.

Potential Pollutant Generating Sources: Potential pollutant generating sources/activities include the retort area, handling of the treated wood, outside storage of treated materials/products, equipment/vehicle storage and maintenance, and the unloading, handling, and use of the preservative chemicals. Based on EPA's multi-sector permit/fact sheet (7) the following stormwater contaminants have been reported: COD, TSS, BOD, and the specific pesticide(s) used for the wood preservation.

Other Manufacturing Businesses
SIC: 2200 *, 2300 *, 2873/74 **, 3100 *, 3200 **, 3250-69 **, 3280 **, 3290 **
Description: Includes manufacturing of textiles and apparel, agricultural fertilizers, leather products, clay products such as bricks, pottery, bathroom fixtures; and nonmetallic mineral products.

Potential Pollutant Generating Sources: Pollutant generating sources at facilities in these categories include fueling, loading & unloading, material storage and handling (especially fertilizers), and vehicle and equipment cleaning and maintenance. Potential pollutants include TSS, BOD, COD, Oil and Grease, heavy metals and fertilizer components including nitrates, nitrites, ammonia nitrogen, Kjeldahl Nitrogen and phosphorous compounds.

Transportation and Communication

Airfields and Aircraft Maintenance
SIC: 4513 **, 4515 **
Description: Industrial activities include vehicle and equipment fueling, maintenance and cleaning, and aircraft/runway deicing.

Potential Pollutant Generating Sources: Fueling is accomplished by tank trucks at the aircraft and is a source of spills. Dripping of fuel and engine fluids from the aircraft and at vehicle/equipment maintenance/cleaning areas application of deicing materials to the aircraft and the runways are potential sources of stormwater contamination. Aircraft maintenance and cleaning produces a wide variety of waste products, similar to those found with any vehicle or equipment maintenance, including: used oil and cleaning solvents, paints, oil filters, soiled rags, and soapy wastewater. Deicing materials used on aircraft and/or runways include ethylene and propylene glycol, and urea. Other chemicals currently considered for ice control are sodium and potassium acetates, isopropyl alcohol, and sodium fluoride. Pollutant constituents include oil and grease, TSS, BOD, COD, TKN, pH and specific deicing components such as glycol and urea.

Fleet Vehicle Yards
SIC: 4100 **, 4210 **, 4230 **, 7381/2, 7510
Description: Includes all businesses which own, operate and maintain or repair large vehicle fleets, including cars, buses, trucks and taxis, as well as the renting or leasing of cars, trucks, and trailers.

Potential Pollutant Generating Sources:
1. Spills/leaks of fuels, used oils, oil filters, antifreeze, solvents, brake fluid, and batteries, sulfuric acid, battery acid sludge, and leaching from empty contaminated containers and soiled rags.
2. Leaking underground storage tanks that can cause ground water contamination and is a safety hazard.
3. Dirt, oils and greases from outside steam cleaning and vehicle washing.
4. Dripping of liquids from parked vehicles.
5. Solid and liquid wastes (noted above) that are not properly stored while awaiting disposal or recycling.
6. Loading and unloading area.

Research by the Municipality of Metropolitan Seattle (Metro) of its bus bases indicates that mean concentrations of oil and grease typically range from 10 to 20 mg/l with individual samples commonly exceeding 50 mg/l. This level greatly exceeds Ecology's guideline of no more than 10 mg/l (24 hour average) and indicates need for conscientious source control measures. Potential pollutants can include Oil and grease, TSS, BOD, and heavy metals.

Railroads
SIC: 4011 ** /13 **
Description: Railroad activities are spread over a large geographic area: along railroad lines, in switching yards, and in maintenance yards. Railroad activity occurs on both property owned or leased by the railroad and at the loading or unloading facilities of its customers. Employing BMPs at commercial or public loading and unloading areas is the responsibility of the particular property owner.

Potential Pollutant Generating Sources: The following are potential sources of pollutants: dripping of vehicle fluids onto the road bed, leaching of wood preservatives from the railroad ties, human waste disposal, litter, locomotive sanding areas, locomotive/railcar/equipment cleaning areas, fueling areas, outside material storage areas, the erosion and loss of soil particles from the bed, and herbicides used for vegetation management. Maintenance activities include maintenance shops for vehicles and equipment, track maintenance, and ditch cleaning. In addition to the railroad stock, the maintenance shops service highway vehicles and other types of equipment. Waste materials can include waste oil, solvents, degreasers, antifreeze, radiator flush, acid solutions, brake fluids, soiled rags, oil filters, sulfuric acid and battery sludge, and machine chips with residual machining oil and any toxic fluids or solids lost during transit. The following are potential pollutants at railyards: Oil and grease, TSS, BOD, organics, pesticides, and heavy metals.

Warehouses and Mini-Warehouses
SIC: 4220 **
Description: Businesses that store goods in buildings and other structures.

Potential Pollutant Generating Sources: The following are potential pollutant sources from warehousing operations: Loading and unloading areas, outside storage of materials and equipment, fueling and maintenance areas. Potential pollutants include oil and grease and TSS.

Other Transportation and Communication
SIC: 4700-4900
Description: This group includes travel agencies, communication services such as TV and radio stations, cable companies, and electric and gas services. It does not include railroads, airplane transport services, airlines, pipeline companies, and airfields.

Potential Pollutant Generating Sources: Gas and electric services are likely to own vehicles that are washed, fueled and maintained on site. Communication service companies can generate used oils and Dangerous Wastes. The following are the potential pollutants: Oil and grease, TSS, BOD, and heavy metals.

Retail and Wholesale Businesses

Gas Stations
SIC: 5540
Refer to BMP S1.10-Fueling Stations in Chapter 2 to select applicable BMPs.

Recyclers and Scrap Yards
SIC: 5093 **, 5015 **
Description: Businesses that reclaim various materials for resale or for scrap, such as vehicles and vehicle/equipment parts, construction materials, metals, beverage containers and papers.

Potential Pollutant Generating Sources: *Potential* sources of pollutants include paper/plastic/metal scrap debris, engines, transmissions, radiators, batteries, and other materials that contain fluids or are contaminated with fluids. Other pollutant sources include leachate from metal components and contaminated soil and the erosion of soil. Activities that can generate pollutants include:

1. Transferring/dismantling/crushing of vehicles, and scrap metal.
2. Transferring and removing fluids.
3. Maintenance & cleaning of vehicles, parts, and equipment.
4. Storage of fluids, parts for resale, solid wastes, scrap parts, and materials/equipment/vehicles that contain fluids, generally in uncovered areas.

Potential pollutants typically found at vehicle recycle and scrap yards include oil and grease, ethylene and propylene glycol, total suspended solids, BOD, heavy metals, and acidic pH.

Applicable Best Management Practices: For *facilities subject to Ecology's Industrial Stormwater General Permit refer to BMP Guidance Document #94-146, "Best Management Practices to Prevent Stormwater Pollution at Vehicle Recycler Facilities", Washington Department of Ecology, September 1994 for selection of operational and structural source control, and treatment BMPs for vehicle recycler facilities. The BMPs in that guidance document can also be applied to scrap material recycling facilities depending on the pollutant sources existing at those facilities.*

Commercial Composting
SIC 2875
Description: This typically applies to businesses that have numerous compost piles that require large open areas to break down the wastes. Composting can contribute nutrients, organics, coliform bacteria, low pH, color, and suspended solids to stormwater runoff.

Restaurants/Fast Food
SIC: 5800
Description: Businesses that provide food service to the general public, including drive through facilities.
Potential Pollutant Generating Sources: *Potential* pollutant sources include high-use customer parking lots and garbage dumpsters. The cleaning of roofs and other outside areas of restaurant and cooking vent filters in the parking lot can cause cooking grease to be discharged to the storm drains. The discharge of washwater or grease to storm drains or surface water is not allowed.

Retail/General Merchandise SIC: 5300, 5600, 5700, 5900, and 5990
Description: This group includes general merchandising stores such as department stores, shopping malls, variety stores, 24-hour convenience stores, and general retail stores that focus on a few product types such as clothing and shoes. It also includes furniture and appliance stores.

Potential Pollutant Generating Sources: Of particular concern are the high-use parking lots of shopping malls and 24-hour convenience stores. Furniture and appliance stores may provide repair services in which Dangerous Wastes may be produced.

Retail/Wholesale Vehicle and Equipment Dealers
SIC: 5010, 5080, and 5500 excluding fueling stations (5540)
Description: This group includes all retail and wholesale businesses that sell cars, trucks, boats, trailers, mobile homes, motorcycles and recreational vehicles. It includes both new and used vehicle dealers. It also includes sellers of heavy equipment for construction, farming, and industry. With the exception of motorcycle dealers, these businesses have large parking lots. Most retail dealers that sell new vehicles and large equipment also provide repair and maintenance services.

Potential Pollutant Generating Sources: *Oil* and other materials that have dripped from parked vehicles can contaminate stormwater at high-use parking areas. Vehicles are washed regularly generating vehicle grime and detergent pollutants. The storm or washwater runoff will contain oils and various organics, metals, and phosphorus. Repair and maintenance services generate a variety of waste liquids and solids including used oils and engine fluids, solvents, waste paint, soiled rags, and dirty used engine parts. Many of these materials are Dangerous Wastes.

Retail/Wholesale Nurseries and Building Materials
SIC: 5030, 5198, 5210, 5230, and 5260
Description: These businesses are placed in a separate group because they are likely to store much of their merchandise outside of the main building. They include nurseries, and businesses that sell building and construction materials and equipment, paint (5198, 5230) and hardware.

Potential Pollutant Generating Sources: *Some* businesses may have small fueling capabilities for forklifts and may also maintain and repair their vehicles and equipment. Some businesses may have unpaved areas, with the potential to contaminate stormwater by leaching of nutrients, pesticides, and herbicides. Businesses in this group surveyed in the Puget Sound area for Dangerous Wastes were found to produce waste solvents, paints and used oil. Storm runoff from exposed storage areas can contain suspended solids, and oil and grease from vehicles and forklifts and high-use customer parking lots, and other pollutants. Runoff from nurseries may contain nutrients, pesticides and/or herbicides.

Retail/Wholesale Chemicals and Petroleum
SIC: 5160, 5170
Description: These businesses sell plastic materials, chemicals and related products. This group also includes the bulk storage and selling of petroleum products such as diesel oil, automotive fuels, etc.

Potential Pollutant Generating Sources: The general areas of concern are the spillage of chemicals or petroleum during loading and unloading, and the washing and maintenance of tanker trucks and other vehicles. Also, the fire code requires that vegetation be controlled within a tank farm to avoid a fire hazard. Herbicides are typically used. The concentration of oil in untreated stormwater is known to exceed the water quality effluent guideline for oil and grease. Runoff is also likely to contain significant concentrations of benzene, phenol, chloroform, lead, and zinc.

Retail/Wholesale Foods and Beverages
SIC 5140, 5180
Description: Included are businesses that provide retail food stores including general groceries, fish and seafood, meats and meat products, dairy products, poultry, soft drinks, and alcoholic beverages.

Potential Pollutant Generating Sources: Vehicles may be fueled, washed and maintained at the business. Spillage of food and beverages may occur. Waste food and broken contaminated glass may be temporarily stored in containers located outside. High-use customer parking lots may be sources of oil and other contaminants.

Other Retail/Wholesale Business
SIC: 5010 (not 5012), 5040, 5060, 5070, 5090
Description: Businesses in this group include sellers of vehicle parts, tires, furniture and home furnishings, photographic and office equipment, electrical goods, sporting goods and toys, paper products, drugs and apparel.

Potential Pollutant Generating Sources: Pollutant sources include high-use parking lots, and delivery vehicles that may be fueled, washed and maintained on premises.

Service Businesses

Animal Care Services
SIC: 0740, 0750
Description: This group includes racetracks, kennels, fenced pens, veterinarians and businesses that provide boarding services for animals including horses, dogs and cats.

Potential Pollutant Generating Sources: *The* primary sources of pollution include animal manure, waste products from animal treatment, runoff from pastures where larger livestock are allowed to roam, and vehicle maintenance and repair shops. Pastures may border streams and direct access to the stream may occur. Both surface water and ground water may be contaminated. Potential stormwater contaminants include fecal coliform, oil and grease, suspended solids, BOD, and nutrients.

Commercial Car and Truck Washes
SIC: 7542
Description: Facilities include automatic systems found at individual businesses or at gas stations and 24-hour convenience stores, as well as self-service. There are three main types: tunnels, rollovers and hand-held wands. The tunnel wash, the largest, is housed in a long building through which the vehicle is pulled. At a rollover wash the vehicle remains stationary while the equipment passes over. Wands are used at self-serve car washes. Some car washing businesses also sell gasoline.

Potential Pollutant Generating Sources: *Wash* wastewater may contain detergents and waxes. Wastewater should be discharged to sanitary sewers. In self-service operations a drain is located inside each car bay. Although these businesses discharge the wastewater to the sanitary sewer, some washwater can find its way to the storm drain, particularly with the rollover and wand systems. Rollover systems often do not have air-drying. Consequently, as it leaves the enclosure the car sheds water to the pavement. With the self-service system, washwater with detergents can spray outside the building and drain to storm sewer. Users of self-serve operations may also clean engines and change oil, dumping the used oil into the storm drain. Potential pollutants include oil and grease, detergents, soaps, BOD, and TSS.

Equipment Repair
SIC: 7353, 7600
Description: This group includes several businesses that specialize in repairing different equipment including communications equipment, radio, TV, household appliances, and refrigeration systems. Also included are businesses that rent or lease heavy construction equipment (7353) as miscellaneous repair and maintenance may occur on site.

Potential Pollutant Generating Sources: *Potential* pollutant sources include storage and handling of fuels, waste oils and solvents, and loading/unloading areas. Potential pollutants include oil and grease, low/high pH, and suspended solids.

Laundries and Other Cleaning Services
SIC: 7211 through 7217
Description: This category includes all types of cleaning services such as laundries, linen suppliers, diaper services, coin-operated laundries and dry cleaners, and carpet and upholstery services. Wet washing may involve the use of acids, bleaches and/or multiple organic solvents. Dry cleaners use an organic-based solvent, although small amounts of water and detergent are sometimes used. Solvents may be recovered and filtered for further use. Carpets and upholstery may be cleaned with dry materials, hot water extraction process, or in-plant processes using solvents followed by a detergent wash.

Potential Pollutant Generating Sources: Wash liquids are discharged to sanitary sewers. Stormwater pollutant sources include: loading and unloading of liquid materials, particularly at large commercial operations, disposal of spent solvents and solvent cans, high-use customer parking lots, and outside storage and handling of solvents and waste materials. Potential stormwater contaminants include oil and grease, chlorinated and other solvents, soaps and detergents, low/high pH, and suspended solids.

Marinas and Boat Clubs
SIC: 7999
Description: Marinas and yacht clubs provide moorage for recreational boats. Marinas may also provide fueling and maintenance services. Other activities include cleaning and painting of boat surfaces, minor boat repair, and pumping of bilges and sanitary holding tanks. Not all marinas have a system to receive pumped bilge water.

Potential Pollutant Generating Sources: *Both* solid and liquid wastes are produced as well as stormwater runoff from high-use customer parking lots. Waste materials include sewage and bilge water. Maintenance by the tenants will produce used oils, oil filters, solvents, waste paints and varnishes, used batteries, and empty contaminated containers and soiled rags. Potential stormwater contaminants include oil and grease, suspended solids, heavy metals, and low/high pH.

Golf and Country Clubs
SIC: 7992, 7997
Description: Public and private golf courses and parks are included.

Potential Pollutant Generating Sources: Maintenance of grassed areas and landscaped vegetation has historically required the use of fertilizers and pesticides. Golf courses contain small lakes that are sometimes treated with algaecides and/or mosquito larvicides. The fertilizer and pesticide application process can lead to inadvertent contamination of nearby surface waters by overuse, misapplication, or the occurrence of storms shortly after application. Heavy watering of surface greens in golf courses may cause pesticides or fertilizers to migrate to surface and shallow ground water resources. The use of pesticides and fertilizers generates waste containers. Equipment must be cleaned and maintained.

Miscellaneous Services
SIC: 4959, 7260, 7312, 7332, 7333, 7340, 7395, 7641, 7990, 8411
Description: This group includes photographic studios, commercial photography, funeral services, amusement parks, furniture and upholstery repair and pest control services, and other professional offices. Pollutants from these activities can include pesticides, waste solvents, heavy metals, pH, and suspended solids, soaps and detergents, and oil and grease.

Potential Pollutant Generating Sources: *Leaks* and spills of materials from the following businesses can be sources of stormwater pollutants:

1. Building maintenance produces wash and rinse solutions, oils, and solvents.
2. Pest control produces rinsewater with residual pesticides from washing application equipment and empty containers.
3. Outdoor advertising produces photographic chemicals, inks, waste paints, organic paint sludges containing metals.
4. Funeral services produce formalin, formaldehyde, and ammonia.
5. Upholstery and furniture repair businesses produce oil, stripping compounds, wood preservatives and solvents.

Professional Services
SIC: 6000, 7000 and 8000, not listed elsewhere
Description: The remaining service businesses include theaters, hotels/motels, finance, banking, hospitals, medical services, nursing homes, schools/universities, and legal, financial and engineering services. Stormwater from parking lots will contain undesirable concentrations of oil and grease, suspended particulates, and metals such as lead, cadmium and zinc. Dangerous wastes might be generated at hospitals, nursing homes and other medical services.

Potential Pollutant Generating Sources: *The* primary concern is runoff from high use parking areas, maintenance shops, and storage and handling of dangerous wastes.

Vehicle Maintenance and Repair
SIC: 4000 **, 7530, 7600
Description: This category includes businesses that paint, repair and maintain automobiles, motorcycles, trucks, and buses and battery, radiator, muffler, lube, tune-up and tire shops, excluding those businesses listed elsewhere in this manual.

Potential Pollutant Generating Sources: Pollutant sources include storage and handling of vehicles, solvents, cleaning chemicals, waste materials, vehicle liquids, batteries, and washing and steam cleaning of vehicles, parts, and equipment. Potential pollutants include waste oil, solvents, degreasers, antifreeze, radiator flush, acid solutions with chromium, zinc, copper, lead and cadmium, brake fluid, soiled rags, oil filters, sulfuric acid and battery sludge, and machine chips in residual machining oil.

Multi-Family Residences
SIC: NA
Description: Multifamily residential buildings such as apartments and condominiums. The activities of concern are vehicle parking, vehicle washing and oil changing, minor repairs, and temporary storage of garbage.

Potential Pollutant Generating Sources: *Stormwater* contamination can occur at vehicle parking lots and from washing of vehicles. Runoff from parking lots may contain undesirable concentrations of oil and grease, suspended particulates, and metals such as lead, cadmium and zinc.

Construction Businesses
SIC: 1500, 1600, 1700
Description: This category includes builders of homes, commercial and industrial buildings, and heavy equipment as well as plumbing, painting and paper hanging, carpentry, electrical, roofing and sheet metal, wrecking and demolition, stonework, drywall and masonry contractors. It does not include construction sites.

Potential Pollutant Generating Sources: Potential pollutant sources include leaks/spills of used oils, solvents, paints, batteries, acids, strong acid/alkaline wastes, paint/varnish removers, tars, soaps, coatings, asbestos, lubricants, anti-freeze compounds, litter, and fuels at the headquarters, operation, staging, and maintenance/ repair locations of the businesses.

Demolition contractors may store reclaimed material before resale. Roofing contractors generate residual tars and sealing compounds, spent solvents, kerosene, and soap cleaners, as well as non-hazardous waste roofing materials. Sheet metal contractors produce small quantities of acids and solvent cleaners such as kerosene, metal shavings, adhesive residues and enamel coatings, and asbestos residues that have been removed from buildings. Asphalt paving contractors are likely to store application equipment such as dump trucks, pavers, tack coat tankers and pavement rollers at their businesses. Stormwater passing through this equipment may be contaminated by the petroleum residuals. Potential pollutants include oil and grease, suspended solids, BOD, heavy metals, pH, COD, organic compounds, etc.

ADDITIONS, QUALIFIERS, AND EXCEPTIONS

Additions:
Food Stores: Industry Groups: 541, 542, 543
Wholesale Trade – Nondurable Goods: Industry Group 515
Hospitals: 806
Medical and Dental Laboratories: Industry Group 807
Automotive Rental and Leasing: Industry Group 751

Qualifiers: Only for proper solid waste handling:
Food Stores: Industry Groups 544, 545, 546, 549,
Miscellaneous Retail: Industry Groups: 591, 592
Wholesale Trade – Nondurable Goods: Industry Groups: 511, 512, 514, 518
Equipment Repair: Major Group 76 (except businesses in 7623, 7692, and (some, not all) 7699 can have other source control needs)

Exceptions: (i.e., no onsite inspections required)
Retail/General Merchandise: Major Groups 53, 56, 57
Miscellaneous Retail: Industry Groups: 593, 594, 596, 599
Wholesale Trade-Nondurable Goods: Industry Groups: 513
Other Retail/Wholesale Businesses: Industry Groups 502, 504, 506, 507, 509 (not including 5093).
Professional Services not listed elsewhere in Appendix 1: Major Groups: 6000, 7000 and 8000

Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California

(Phase 1 of the Inland Surface Waters Plan and the Enclosed Bays and Estuaries Plan)

2000

STATE WATER RESOURCES CONTROL BOARD

California Environmental Protection Agency

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 2000 - 015

ADOPTION OF THE POLICY FOR THE IMPLEMENTATION OF TOXICS STANDARDS FOR INLAND SURFACE WATERS, ENCLOSED BAYS, AND ESTUARIES OF CALIFORNIA (PROPOSED POLICY)

WHEREAS:

1. Section 303(c)(2)(B) of the Federal Clean Water Act (CWA) requires that states adopt numeric criteria for priority pollutants as part of the states' water quality standards.

2. In 1991, the State Water Resources Control Board (SWRCB) adopted the Inland Surface Waters Plan (ISWP) and the Enclosed Bays and Estuaries Plan (EBEP); in part, to comply with CWA section 303(c)(2)(B). The SWRCB amended the plans in 1993.

3. In 1994, the SWRCB rescinded the ISWP and the EBEP in response to a court ruling invalidating the plans. Since then, California has been without statewide water quality standards for the majority of priority pollutants for the State's non-ocean surface waters.

4. After rescission of the plans, the SWRCB and the U.S. Environmental Protection Agency (U.S. EPA) agreed to pursue a collaborative approach to reestablish the regulatory framework of the rescinded ISWP and EBEP and to bring California into compliance with CWA section 303(c)(2)(B). This approach consists of two phases. In Phase 1, the U.S. EPA will promulgate numeric water quality criteria for priority pollutants for California in accordance with CWA section 303(c)(2)(B), and the SWRCB will adopt statewide measures to implement those criteria in a statewide policy. In Phase 2, the SWRCB will consider the adoption of appropriate statewide water quality objectives for toxic pollutants.

5. The U.S. EPA is scheduled to promulgate the final California Toxics Rule (CTR) (proposed at 62 Federal Register 42160-42208, August 5, 1997) to be codified at 40 Code of Federal Regulations section 131.38 in March or April 2000. The CTR will establish statewide water quality criteria for priority toxic pollutants for California.

6. The SWRCB may formulate and adopt State policy for water quality control in accordance with California Water Code sections 13140-13147.

7. The SWRCB prepared and circulated drafts of the Functional Equivalent Document (FED) for a proposed Policy to implement the draft CTR in accordance with the provisions of the California Environmental Quality Act (CEQA) and California Code of Regulations, title 14, section 15251(g), and title 23, sections 3775-3782, as follows:

a. The First Public Draft of the proposed Policy and FED was released for public review on September 11, 1997; a Supplement to the FED was released on October 16, 1997; and an Addendum to the Supplement was released on October 28, 1997.

b. The Second Public Draft of the proposed Policy and FED was released for public review on November 12, 1999; Appendix G to the 1999 FED (responses to public comments on the first draft Policy) was released on December 7, 1999.

c. The Third Public Draft of the proposed Policy was released for public review on January 24, 2000; the third draft of the FED was released for public review on January 31, 2000; Appendix G to the 2000 FED (responses to public comments on the second draft Policy) was released on February 11, 2000.

d. Supplement 1 to Appendix G to the November 12, 1999 FED and Appendix G to the January 31, 2000 FED were released on February 11, 2000.

e. Supplement 2 to Appendix G to the November 12, 1999 FED and Supplement to Appendix G to the January 31, 2000 FED will be released at the March 2, 2000 SWRCB Meeting.

8. The SWRCB has conducted public hearings in Sacramento on November 17, 1997 and in Newport Beach on December 3, 1997 and a public workshop in Sacramento on December 6, 1999 to solicit comments regarding the proposed Policy. The SWRCB has reviewed and carefully considered all comments received on the first, second, and third drafts of the proposed Policy and FED. The SWRCB considered the information contained in the FED prior to approval of the proposed Policy.

9. The SWRCB submitted the first and second drafts of the proposed Policy and FED for external scientific peer review of the scientific basis for the proposed Policy under the requirements of Health and Safety Code section 57004.

10. By letter dated January 21, 2000 from Alexis Strauss, Director of the Water Division at U.S. EPA, Region 9, to Walt Pettit, SWRCB Executive Director (January 21 letter), the U.S. EPA notified the SWRCB of the more important changes that U.S. EPA staff has proposed to the U.S. EPA Administrator for the final CTR. The SWRCB has reviewed the proposed CTR changes, and it finds that they do not require revisions to the proposed Policy or FED.

11. Further, the SWRCB does not anticipate that any additional changes to the final CTR will require the SWRCB to revise the adopted Policy (Policy) or final FED. If, however, the final CTR is substantially changed from the CTR as proposed and with the changes referenced in the January 21 letter, and if these changes will require revisions in the Policy or major revisions in the final FED, the SWRCB will reconsider the Policy.

12. In order to expedite the effective date of the Policy, the SWRCB has decided to adopt the Policy now, but to delay its effective date until the effective date of the CTR.

13. In addition, the regulatory provisions of the Policy will not become effective until they are approved by the Office of Administrative Law (OAL) in accordance with Government Code section 11349.3(a).

14. The SWRCB makes the following specific findings regarding its CEQA responsibilities:

    a. The Third Public Draft FED has been completed in compliance with CEQA (Public Resources Code section 21000 et seq.), the CEQA guidelines, and the procedures of the State of California for Certified Regulatory Programs (Public Resources Code section 21080.5, California Code of Regulations, title 14, sections 15250-15253, and title 23, sections 3775-3782); the SWRCB has reviewed and considered the Third Public Draft FED prior to its decision to approve the proposed Policy; and the Third Public Draft FED reflects the independent judgment of the SWRCB.

    b. The Third Public Draft FED identified potentially significant adverse environmental effects related to only one Policy provision. These potential effects stem from Policy provisions allowing RWQCB authorization of a longer compliance schedule where necessary to develop and implement a Total Maximum Daily Load (TMDL) and accompanying wasteload allocations and load allocations. As compared to the CTR, under the Policy dischargers could be allowed up to ten additional years to accommodate development of TMDLs. Adverse environmental effects could occur during this period because water quality standards for priority pollutants established to protect human health and aquatic life may not be met. Such potential adverse effects could occur to surface and ground water quality; endangered, threatened, or rare species; locally designated species or natural communities; wetland or other fish and wildlife habitat; human health; or recreational opportunities.

    c. The Policy contains provisions to lessen or avoid potentially significant adverse effects on the environment stemming from the TMDL compliance schedule provisions. These provisions include the following:

(1) The compliance schedule provisions are narrowly written to apply only to those situations where the discharger demonstrates that it is infeasible to achieve immediate compliance with the CTR criteria;

(2) The compliance schedule provisions do not apply to new discharges;

(3) The discharger must submit the following justification before compliance schedules may be authorized in a permit:

   (a) Documentation that diligent efforts have been made to quantify pollutant levels in the discharge and the sources of the pollutant in the waste stream, and the results of those efforts,

   (b) Documentation of source control and/or pollution minimization efforts currently underway or completed,

   (c) A proposed schedule for additional source control measures, pollutant minimization actions, or waste treatment (i.e., facility upgrades), and

   (d) A demonstration that the proposed schedule is as short as practicable;

(4) The schedule of compliance must be as short as practicable and must include specified required actions that demonstrate progress toward attainment of the CTR criterion or effluent limitation;

(5) Longer compliance schedules for TMDL development will be authorized only if the discharger has made appropriate commitments to support and expedite the development of the TMDL;

(6) If a compliance schedule is granted, the Policy requires that the Regional Water Quality Control Board (RWQCB) establish interim requirements and dates for their achievement in the National Pollutant Discharge Elimination System (NPDES) permit;

(7) If the compliance schedule exceeds one year, the RWQCB must establish limitations for the priority pollutant in the NPDES permit and may also impose interim requirements to control the pollutant, such as pollutant minimization and source control measures;

(8) Numeric limitations must be based on current treatment facility performance or existing NPDES permit limitations, whichever is more stringent; and

(9) The Policy requires each discharger to report, in writing, its compliance or noncompliance with the interim requirements. Both the interim requirements and reporting requirements are fully enforceable NPDES permit conditions.

d. Alternatives to the Policy provisions for TMDL-based compliance schedules for implementing the CTR identified in the FED are infeasible. These alternatives are discussed below:

Alternative 1. No Action. If the SWRCB does not adopt Policy provisions for compliance schedules for implementation of the CTR, compliance schedules for discharges which receive effluent limitations that are not based on TMDLs are substantially the same. Both the CTR and the Policy would allow compliance schedules of up to five years from NPDES permit issuance, reissuance, or modification with a maximum deadline of ten years from the effective date of the CTR or Policy, respectively. (It is anticipated that the Policy and CTR effective dates will differ only by a few weeks.) There is no significant difference in these time frames; therefore, no significant impacts to the environment would result.

Under this alternative, longer compliance schedules to coincide with TMDL schedules could not be authorized by the RWQCBs. The SWRCB finds that this is not a feasible alternative because eliminating these compliance schedules for TMDLs is unrealistic. Currently, over 500 water bodies are listed as impaired on the CWA section 303(d) list. More than 1400 impairments are cited for these waters. Existing U.S. EPA policy requires that the states develop schedules for TMDL development of up to 13 years, beginning with the 1998 lists. U.S. EPA has proposed, however, in draft TMDL regulations published in August 1999, that the states develop schedules for establishing TMDLs as expeditiously as practicable, but no later than 15 years from the date of the initial listing. The draft regulations also contemplate that each TMDL include an implementation plan containing a timeline, including interim milestones, for implementing control actions and management measures necessary to achieve the wasteload allocations and load allocations. The implementation plan also must include an estimate of the time required to achieve water quality standards. In the draft rule, U.S. EPA recognizes that relatively longer time frames may be necessary for problems that are extremely difficult to solve. The Policy's TMDL compliance schedule provisions are consistent with U.S. EPA's direction.

Alternatives 2-5. Adopt a compliance schedule of: up to 3 years from the effective date of the proposed Policy (Alternative 2); up to 10 years from the effective date of the proposed Policy (Alternative 3); up to 15 years from the effective date of the proposed Policy (Alternative 4); or up to 5 years from the date of permit issuance, reissuance, or modification (Alternative 5).

The SWRCB finds that these are not feasible alternatives for TMDL-based compliance schedules for the reasons explained under Alternative 1.

e. The SWRCB finds that there are no feasible alternatives or additional feasible mitigation measures available to the SWRCB that would substantially lessen any potentially significant adverse environmental effects associated with the Policy provisions authorizing longer compliance schedules for TMDLs.

f. The SWRCB has eliminated or substantially lessened all significant adverse effects on the environment associated with the Policy provisions authorizing longer compliance schedules for TMDLs. The remaining Policy provisions will not have a significant effect on the environment.

g. To the extent that the potential for any impacts remains associated with longer compliance schedules for TMDLs, the SWRCB finds that there are overriding considerations that outweigh any adverse environmental effects that may potentially occur due to the TMDL-based compliance schedules provisions of the Policy.

Implementing TMDLs for priority pollutants may result in greater overall improvements to water quality because all significant sources of a pollutant will be addressed. If a TMDL is under development, the discharger must still immediately comply with CTR-based effluent limitations if it is feasible to do so. If it is infeasible, the discharger must comply with RWQCB interim requirements that demonstrate progress toward meeting the CTR criterion or effluent limitation. The Policy provides that the RWQCB can impose requirements for source control and pollution minimization/prevention during the compliance schedule period. However, to require the discharger to install expensive treatment controls to comply with a CTR-based effluent limitation while the TMDL is under development could result in unnecessary costs and unnecessary secondary environmental effects due to construction of the treatment controls.

THEREFORE BE IT RESOLVED THAT:

The SWRCB:

1. Approves the FED for the proposed Policy.

2. Adopts the proposed Policy, provided that the Policy shall not go into effect unless and until the final CTR is effective and the regulatory provisions of the Policy have been approved by OAL in compliance with the Administrative Procedure Act.

3. Intends to reconsider the Policy if the final CTR is substantially changed from the CTR, as proposed and with the changes referenced in the January 21 letter, and if these changes require revisions in the Policy or major revisions in the final FED.

4. Authorizes the Executive Director or his designee to transmit the Policy to OAL for review and approval in compliance with the Administrative Procedure Act and subsequently to transmit the OAL-approved Policy to the U.S. EPA for review and approval in compliance with section 303(c) of the CWA.

5. Intends to reassess and modify, as appropriate, the Minimum Level values in Appendix 4 of the Policy during triennial reviews to consider and reflect the availability and use of more sensitive analytical methods. Prior to adoption of new a Minimum Level, the SWRCB will consider its environmental and economic effects.

6. Intends to reassess and modify, as appropriate, applicable water quality standards for water bodies that may depend on the discharge of wastewater to support its beneficial uses, including an evaluation of the appropriateness of priority pollutant criteria established by the CTR during Phase 2 of the development of the ISWP and the EBEP.

7. Requires the RWQCBs to report annually to the SWRCB on progress in implementing priority pollutant standards in accordance with the Policy.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on March 2, 2000.

Maureen Marché

Maureen Marché
Administrative Assistant to the Board

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 2000 - 030

AMENDING RESOLUTION NO. 2000-15 REGARDING ADOPTION OF THE POLICY FOR THE IMPLEMENTATION OF TOXICS STANDARDS FOR INLAND SURFACE WATERS, ENCLOSED BAYS, AND ESTUARIES OF CALIFORNIA (PROPOSED POLICY)

WHEREAS:

1. On March 2, 2000, the State Water Resources Control Board (SWRCB), in Resolution No. 2000-15, adopted a Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (Policy).

2. The Policy establishes implementation procedures for three categories of priority pollutant criteria or water quality objectives. These are priority pollutant: (1) criteria promulgated by the U.S. Environmental Protection Agency (U.S. EPA) in the National Toxics Rule that apply in California; (2) criteria proposed by U.S. EPA in the California Toxics Rule; and (3) water quality objectives contained in Regional Water Quality Control Board (RWQCB) water quality control plans (basin plans).

3. Under Resolution No. 2000-015, the Policy is effective when the Policy is approved by the Office of Administrative Law and the California Toxics Rule becomes effective.

4. U.S. EPA has experienced delays in promulgating the California Toxics Rule as a final rule.

5. Priority pollutant criteria in the National Toxics Rule and water quality objectives in RWQCB basin plans are currently in effect.

6. The SWRCB does not wish to delay implementation of the Policy with respect to applicable National Toxics Rule criteria and water quality objectives for priority pollutants.

THEREFORE BE IT RESOLVED THAT:

The SWRCB amends Resolution No. 2000-015 as follows:

1. Resolved No. 2 is deleted and replaced with:

   "2. Adopts the proposed Policy."

2. New Resolved Nos. 3 and 4 are added and existing Resolved Nos. 3 through 7 are renumbered accordingly:

"3. Provides that the Policy shall go into effect with respect to National Toxics Rule priority pollutant criteria that are applicable in California and priority pollutant water quality objectives in RWQCB basin plans upon approval by the Office of Administrative Law."

"4. Provides that the Policy shall go into effect with respect to California Toxics Rule criteria when the Policy is approved by the Office of Administrative Law and the California Toxics Rule becomes effective."

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on April 26, 2000.

Maureen Marché

Maureen Marché
Administrative Assistant to the Board

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R0020011

POLICY FOR IMPLEMENTATION OF TOXICS STANDARDS FOR INLAND SURFACE WATERS, ENCLOSED BAYS, AND ESTUARIES OF CALIFORNIA

INTRODUCTION

This state policy for water quality control (Policy), adopted by the State Water Resources Control Board (SWRCB) on March 2, 2000 and effective by May 22, 2000 (See "Note" below), applies to discharges of toxic pollutants into the *inland surface waters, *enclosed bays, and *estuaries of California subject to regulation under the State's Porter-Cologne Water Quality Control Act (Division 7 of the Water Code) and the federal Clean Water Act (CWA). Such regulation may occur through the issuance of National Pollutant Discharge Elimination System (NPDES) permits, the issuance or waiver of waste discharge requirements (WDRs), or other relevant regulatory approaches.[1] The goal of this Policy is to establish a standardized approach for permitting discharges of toxic pollutants to non-*ocean surface waters in a manner that promotes statewide consistency. As such, this Policy is a tool to be used in conjunction with watershed management approaches and, where appropriate, the development of Total Maximum Daily Loads (TMDLs) to ensure achievement of water quality standards (i.e., water quality criteria or objectives, and the beneficial uses they are intended to protect, as well as the State and federal antidegradation policies).

This Policy establishes: (1) implementation provisions for priority pollutant criteria promulgated by the U.S. Environmental Protection Agency (U.S. EPA) through the National Toxics Rule (NTR)[2] (promulgated on December 22, 1992 and amended on May 4, 1995) and through the California Toxics Rule (CTR)[3], and for priority pollutant objectives established by Regional Water Quality Control Boards (RWQCBs) in their water quality control plans (basin plans)[4]; (2) monitoring requirements for 2,3,7,8-TCDD equivalents; and (3) chronic toxicity control provisions. In addition, this Policy includes special provisions for certain types of discharges and factors that could affect the application of other provisions in this Policy. With respect to nonpoint source discharges, only section 5.1 applies.

Note: This Policy was effective on April 28, 2000 with respect to the priority pollutant criteria promulgated for California by the U.S. EPA through the National Toxics Rule and to the priority pollutant objectives established by Regional Water Quality Control Boards in their water quality control plans (basin plans), with the exception of the provision on alternate test procedures in section 2.3., item (1). The alternate test procedures provision was effective on May 22, 2000. This Policy was effective on May 18, 2000 with respect to the priority pollutant criteria promulgated by the U.S. EPA through the California Toxics Rule.

1 This Policy does not apply to discharges of toxic pollutants from combined sewer overflows. These discharges will continue to be regulated in accordance with the federal "Combined Sewer Overflow (CSO) Control Policy," published April 19, 1994 (59 Fed. Register 18688-18698). This Policy does not apply to regulation of storm water discharges. The SWRCB has adopted precedential decisions addressing regulation of municipal storm water discharges in Orders WQ 91-03, 91-04, 96-13, 98-01, and 99-05. The SWRCB has also adopted two statewide general permits regulating the discharge of pollutants contained in storm water from industrial and construction activities. See SWRCB Orders 99-08-DWQ and 97-03-DWQ.

2 40 CFR 131.36

3 65 Fed. Register 31682-31719 (May 18, 2000), adding Section 131.38 to 40 CFR.

4 If a water quality objective and a CTR criterion are in effect for the same priority pollutant, the more stringent of the two applies.

With the exception of Appendix 5 (Special Studies) and Appendix 6 (Watershed Management and TMDLs), the provisions of this Policy have full regulatory effect. Appendix 5 is provided as guidance that may be followed in planning and conducting special studies that may be needed to implement the provisions of this Policy. Appendix 6 is provided as information on the role of watershed management approaches and TMDL development in achieving water quality standards.

Except as provided in section 4, this Policy supersedes basin plan provisions to the extent that (1) they apply to implementation of water quality standards for priority pollutants, and (2) they regard the same subject matter as that addressed in this Policy with respect to priority pollutant standards. For example, the Policy supersedes basin plan mixing zone provisions to the extent that they apply to implementation of water quality standards for priority pollutants.

Reference to a RWQCB also refers to SWRCB, where appropriate. Terms indicated with an asterisk (*) are defined in Appendix 1.

1. ESTABLISHING WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR PRIORITY POLLUTANT CRITERIA/OBJECTIVES

The following sections address the issues of: (1) applicable priority pollutant criteria and objectives (section 1.1); (2) data requirements and adjustments (section 1.2); (3) determining priority pollutants requiring water quality-based effluent limitations (section 1.3); (4) calculating effluent limitations (section 1.4); (5) translators for metals and selenium (section 1.4.1); (6) mixing zones and dilution credits (section 1.4.2); (7) ambient background concentrations (section 1.4.3); and (8) intake water credits (section 1.4.4). Notwithstanding the provisions of these sections, effluent limitations must protect beneficial uses and comply with the State and federal antidegradation policies[5], federal antibacksliding requirements[6], and other applicable provisions of law.

1.1 Applicable Priority Pollutant Criteria and Objectives

Federal water quality criteria and State water quality objectives for priority pollutants have been established for non-ocean surface waters of California by the U.S. EPA and some RWQCBs, respectively. Federal priority pollutant criteria have been promulgated by the U.S. EPA in the 1992 NTR (amended in 1995) and in the 2000 CTR. For California, the criteria in the CTR supplement the criteria in the NTR (i.e., the CTR does not change or supersede any criteria previously promulgated for California in the NTR, but it does include them in the table of criteria for convenience). State priority pollutant objectives are contained in RWQCB basin plans.[4]

The RWQCB basin plans designate the beneficial uses that apply to the surface water bodies within their respective regions. Priority pollutant criteria/objectives are specifically established for the protection of aquatic life and human health beneficial uses designated in basin plans. Aquatic life criteria/objectives are established for fresh and salt waters. The CTR specifies the salinities to which the freshwater and saltwater criteria apply. The CTR also states that, except as specified in the CTR, the federal criteria apply to all waters assigned any aquatic life or human health use

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5 SWRCB Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California), and 40 CFR 131.12 (revised as of July 1, 1996), respectively.

6 CWA Sections 402(o)(1) and 303(d)(4), and 40 CFR 122.44(l) and 40 CFR 122.62 (revised as of July 1, 1996).

designated in basin plans. It further states that the application of the criteria are based on the presence in all waters of some aquatic life designation and the presence or absence of the municipal and domestic supply (MUN) designation (i.e., the aquatic life criteria and the human health criteria for consuming water and organisms apply to MUN-designated water bodies; the aquatic life criteria and the human health criteria for consuming organisms only apply to non-MUN water bodies).

Designated beneficial uses to which aquatic life criteria or objectives would apply include, but are not necessarily limited to, warm freshwater habitat (WARM), cold freshwater habitat (COLD), and estuarine habitat (EST). Designated beneficial uses to which human health criteria/objectives would apply include, but are not necessarily limited to, municipal and domestic supply (MUN) and water contact recreation (REC1). Human health criteria/objectives are differentiated by whether organisms alone from the water body are consumed compared to whether both organisms and water from the water body are consumed. Where MUN is designated, the latter situation applies.

1.2 Data Requirements and Adjustments

The RWQCB shall issue Water Code Section 13267 or 13383 letters to all NPDES dischargers within their respective regions requiring the submittal of data sufficient to conduct the determination based on the analysis in section 1.3 and to calculate water quality-based effluent limitations in accordance with section 1.4 (excluding the development of a translator in accordance with section 1.4.1). The letter shall specify a time schedule for providing the data to the RWQCB that is as short as practicable but <u>not to exceed three years from the effective date of this Policy</u>. If the NPDES permit is reissued prior to completing the requirements, the schedule shall be included in the permit as interim requirements (in accordance with section 2.2.2). The permit shall be reopened to establish water quality-based effluent limitations, if necessary.

It is the discharger's responsibility to provide all data and other information requested by the RWQCB before the issuance, reissuance, or modification of a permit to the extent feasible. When implementing the provisions of this Policy, the RWQCB shall use all available, valid, relevant, representative data and information, as determined by the RWQCB. The RWQCB shall have discretion to consider if any data are inappropriate or insufficient for use in implementing this Policy. Instances where such consideration is warranted include, but are not limited to, the following: evidence that a sample has been erroneously reported or is not representative of effluent or ambient receiving water quality; questionable quality control/quality assurance practices; and varying seasonal conditions. The lack of a site-specific objective for a priority pollutant shall not be considered insufficient data.

When implementing the provisions of this Policy, the RWQCB shall ensure that criteria/objectives are properly adjusted for hardness or pH, if applicable, using the hardness or pH values for the receiving water, and that translators are appropriately applied (in accordance with section 1.4.1), if applicable. The RWQCB shall also ensure that pollutant and flow data are expressed in the appropriate forms and units for purposes of comparability and calculations.

1.3 Determination of Priority Pollutants Requiring Water Quality-Based Effluent Limitations

The RWQCB shall conduct the analysis in this section for each priority pollutant with an applicable criterion or objective, excluding priority pollutants for which a Total Maximum Daily Load (TMDL) has been developed, to determine if a water quality-based effluent limitation is required in the discharger's permit. It is the discharger's responsibility to provide all information requested by the RWQCB for use in the analysis. The RWQCB shall use all available, valid, relevant, representative information, as described in section 1.2, to determine whether a discharge may: (1) cause, (2) have a reasonable potential to cause, or (3) contribute to an excursion above any applicable priority pollutant criterion or objective. If the following analysis (which is depicted as a flowchart in Appendix 2) indicates that a limitation for a pollutant is required, the RWQCB shall establish the limitation in accordance with section 1.4.

Step 1: Identify applicable water quality criteria and objectives for priority pollutants as described in section 1.1. Determine the lowest (most stringent) water quality criterion or objective for the pollutant applicable to the receiving water (C). Adjust the criterion or objective, if applicable, as described in section 1.2. If it is necessary to express a dissolved metal or selenium criterion/objective as total recoverable and a site-specific translator has not yet been developed, as described in section 1.4.1, the RWQCB shall use the applicable U.S. EPA conversion factor (Appendix 3).

Step 2: Identify all effluent data for the pollutant as described in section 1.2 and proceed with *Step 3*. If effluent data are unavailable or insufficient, proceed with *Step 5*.

Step 3: Determine the observed maximum pollutant concentration for the effluent (MEC). If the pollutant was **not** detected in any of the effluent samples **and** any of the reported detection limits are below the C, use the lowest detection limit as the MEC and proceed with *Step 4*. If the pollutant was **not** detected in any of the effluent samples **and** all of the reported detection limits are greater than or equal to the C value, proceed with *Step 5*.

Step 4: Adjust the MEC from *Step 3*, if applicable, as described in section 1.2. Compare the MEC from *Step 3* or the adjusted MEC to the C from *Step 1*. If the MEC is greater than or equal to the C, an effluent limitation is required and the analysis for the subject pollutant is complete. If the MEC is less than the C, proceed with *Step 5*.

Step 5: Determine the observed maximum ambient background concentration for the pollutant (B) as described in section 1.4.3.1 and proceed with *Step 6*. If B data are unavailable or insufficient, proceed with *Step 7*.

Step 6: Adjust the B from *Step 5*, if applicable, as described in section 1.2. Compare the B from *Step 5* or the adjusted B to the C from *Step 1*. If the B is greater than the C, an effluent limitation is required and the analysis for the subject pollutant is complete. If the B is less than or equal to the C, proceed with *Step 7*.

Step 7: Review other information available to determine if a water quality-based effluent limitation is required, notwithstanding the above analysis in *Steps 1* through *6*, to protect beneficial uses.

Information that may be used includes: the facility type, the discharge type, solids loading analysis, lack of dilution, history of compliance problems, potential toxic impact of discharge, fish tissue residue data, water quality and beneficial uses of the receiving water, CWA 303(d) listing for the pollutant, the presence of endangered or threatened species or critical habitat, and other information. If data or other information is unavailable or insufficient to determine if a water quality-based effluent limitation is required, proceed with *Step 8*.

Step 8: If data are unavailable or insufficient to conduct the above analysis for the pollutant, or if all reported detection limits of the pollutant in the effluent are greater than or equal to the C value, the RWQCB shall establish interim requirements, in accordance with section 2.2.2, that require additional monitoring for the pollutant in place of a water quality-based effluent limitation. Upon completion of the required monitoring, the RWQCB shall use the gathered data to conduct the analysis in *Steps 1* through *7* above and determine if a water quality-based effluent limitation is required.

The RWQCB shall require periodic monitoring (at least once prior to the issuance and reissuance of a permit) for pollutants for which criteria or objectives apply and for which no effluent limitations have been established; however, the RWQCB may choose to exempt low volume discharges, determined to have no significant adverse impact on water quality, from this monitoring requirement.

1.4 Calculation of Effluent Limitations

When a RWQCB determines, using the procedures described in section 1.3, that water quality-based effluent limitations are necessary to control a priority pollutant in a discharge, the permit shall contain effluent limitations developed using one or more of the following methods:

A. If a TMDL is in effect, assign a portion of the loading capacity of the receiving water to each identified priority pollutant source of waste, point and nonpoint, based on the TMDL (see Appendix 6);

B. Use the following procedure based on a steady-state model:

Step 1: For each priority pollutant identified in section 1.3, identify the applicable water quality criteria/objectives for the pollutant as described in section 1.1. Adjust the criterion or objective, if applicable, as described in section 1.2. If it is necessary to express a dissolved metal or selenium criterion/objective as total recoverable and a site-specific translator has not yet been developed, as described in section 1.4.1, the RWQCB shall use the applicable U.S. EPA conversion factor (Appendix 3). If data are insufficient to calculate the effluent limitation, the RWQCB shall establish interim requirements in accordance with section 2.2.2.

Step 2: For each water quality criterion/objective, calculate the effluent concentration allowance (ECA) using the following steady-state mass balance equation:

$ECA = C + D(C - B)$ when $C > B$, and
$ECA = C$ when $C \leq B$,

where C = the priority pollutant criterion/objective, adjusted (as described in section 1.2), if necessary, for hardness, pH, and translators (as described in section 1.4.1);
D = the dilution credit (as determined in section 1.4.2); and
B = the ambient background concentration. The ambient background concentration shall be the observed maximum as determined in accordance with section 1.4.3.1 with the exception that an ECA calculated from a priority pollutant criterion/objective that is intended to protect human health from carcinogenic effects shall use the ambient background concentration as an arithmetic mean determined in accordance with section 1.4.3.2.

The concentration units for C and B must be identical. Both C and B shall be expressed as total recoverable, unless inappropriate. The dilution credit is unitless.

Step 3: For each ECA based on an aquatic life criterion/objective, determine the long-term average discharge condition (LTA) by multiplying the ECA with a factor (multiplier) that adjusts for effluent variability. The multiplier shall be calculated as described below, or shall be found in Table 1. To use Table 1, the *coefficient of variation (CV) for the effluent pollutant concentration data must first be calculated. If (a) the number of effluent data points is less than ten, or (b) at least 80 percent of the data are reported as not detected, the CV shall be set equal to 0.6. When calculating CV in this procedure, if an effluent data point is below the detection limit for the pollutant in that sample, one-half of the detection limit shall be used as a value in the calculations. Multipliers for acute and chronic criteria/objectives that correspond to the CV can then be found in Table 1.

ECA Multipliers

$$\text{ECA multiplier}_{\text{acute99}} = e^{(0.5\sigma^2 - z\sigma)}$$

$$\text{ECA multiplier}_{\text{chronic99}} = e^{(0.5\sigma_4^2 - z\sigma_4)}$$

Where
σ = *standard deviation
σ = $[ln(CV^2 + 1)]^{0.5}$
σ^2 = $ln(CV^2 + 1)$
σ_4 = $[ln(CV^2/4 + 1)]^{0.5}$
σ_4^2 = $ln(CV^2/4 + 1)$
z = 2.326 for 99th percentile probability basis

Table 1. Effluent Concentration Allowance (ECA) Multipliers for Calculating Long-Term Averages (LTAs)

Coefficient of Variation (CV)	Acute Multiplier	Chronic Multiplier
	99th Percentile Occurrence Probability	99th Percentile Occurrence Probability
0.1	0.797	0.891
0.2	0.643	0.797
0.3	0.527	0.715
0.4	0.440	0.643
0.5	0.373	0.581
0.6	0.321	0.527
0.7	0.281	0.481
0.8	0.249	0.440
0.9	0.224	0.404
1.0	0.204	0.373
1.1	0.187	0.345
1.2	0.174	0.321
1.3	0.162	0.300
1.4	0.153	0.281
1.5	0.144	0.264
1.6	0.137	0.249
1.7	0.131	0.236
1.8	0.126	0.224
1.9	0.121	0.214
2.0	0.117	0.204
2.1	0.113	0.195
2.2	0.110	0.187
2.3	0.107	0.180
2.4	0.104	0.174
2.5	0.102	0.168
2.6	0.100	0.162
2.7	0.098	0.157
2.8	0.096	0.153
2.9	0.094	0.148
3.0	0.093	0.144
3.1	0.091	0.141
3.2	0.090	0.137
3.3	0.089	0.134
3.4	0.088	0.131
3.5	0.087	0.128
3.6	0.086	0.126
3.7	0.085	0.123
3.8	0.084	0.121
3.9	0.083	0.119
4.0	0.082	0.117

LTA Equations

LTA_{acute} = ECA_{acute} * ECA $multiplier_{acute99}$ (from Table 1 or as calculated above)

$LTA_{chronic}$ = $ECA_{chronic}$ * ECA $multiplier_{chronic99}$ (from Table 1 or as calculated above)

Step 4: Select the lowest (most limiting) of the *LTA*s for the pollutant derived in *Step 3*.

Step 5: Calculate water quality-based effluent limitations (an *average monthly effluent limitation, AMEL, and a *maximum daily effluent limitation, MDEL) by multiplying the most limiting *LTA* (as selected in *Step 4*) with a factor (multiplier) that adjusts for the averaging periods and exceedance frequencies of the criteria/objectives and the effluent limitations, and the effluent monitoring frequency as follows:

$AMEL_{aquatic\ life}$ = *LTA* * AMEL $multiplier_{95}$ (from Table 2 or as calculated below)
$MDEL_{aquatic\ life}$ = *LTA* * MDEL $multiplier_{99}$ (from Table 2 or as calculated below)

The AMEL and MDEL multipliers shall be calculated as described below, or shall be found in Table 2 using the previously calculated *CV* and the monthly sampling frequency (*n*) of the pollutant in the effluent. If the sampling frequency is four times a month or less, *n* shall be set equal to 4. For this method only, maximum daily effluent limitations shall be used for publicly-owned treatment works (POTWs) in place of average weekly limitations.

AMEL and MDEL Multipliers

$$AMEL\ multiplier_{95} = e^{(z\sigma_n - 0.5\sigma_n^2)}$$

Where
$\sigma_n = [ln(CV^2/n + 1)]^{0.5}$
$\sigma_n^2 = ln(CV^2/n + 1)$
z = 1.645 for 95th percentile probability basis
n = number of samples per month

$$MDEL\ multiplier_{99} = e^{(z\sigma - 0.5\sigma^2)}$$

Where
$\sigma = [ln(CV^2 + 1)]^{0.5}$
$\sigma^2 = ln(CV^2 + 1)$
z = 2.326 for 99th percentile probability basis

Step 6: For the applicable human health criterion/objective, set the AMEL equal to the *ECA* (from *Step 2*).

$AMEL_{human\ health}$ = ECA

To calculate the MDEL for a human health criterion/objective, multiply the *ECA* by the ratio of the MDEL multiplier to the AMEL multiplier.

Table 2. Long-Term Average (LTA) Multipliers for Calculating Effluent Limitations

Coefficient of Variation	MDEL Multiplier	AMEL Multiplier			MDEL/AMEL Multiplier		
	99th Percentile Occurrence Probability	95th Percentile Occurrence Probability			MDEL = 99th Percentile AMEL = 95th Percentile Occurrence Probability		
(CV)		n = 4	n = 8	n = 30	n = 4	n = 8	n = 30
0.1	1.25	1.08	1.06	1.03	1.16	1.18	1.22
0.2	1.55	1.17	1.12	1.06	1.33	1.39	1.46
0.3	1.90	1.26	1.18	1.09	1.50	1.60	1.74
0.4	2.27	1.36	1.25	1.12	1.67	1.82	2.02
0.5	2.68	1.45	1.31	1.16	1.84	2.04	2.32
0.6	3.11	1.55	1.38	1.19	2.01	2.25	2.62
0.7	3.56	1.65	1.45	1.22	2.16	2.45	2.91
0.8	4.01	1.75	1.52	1.26	2.29	2.64	3.19
0.9	4.46	1.85	1.59	1.29	2.41	2.81	3.45
1.0	4.90	1.95	1.66	1.33	2.52	2.96	3.70
1.1	5.34	2.04	1.73	1.36	2.62	3.09	3.93
1.2	5.76	2.13	1.80	1.39	2.70	3.20	4.13
1.3	6.17	2.23	1.87	1.43	2.77	3.30	4.31
1.4	6.56	2.31	1.94	1.47	2.83	3.39	4.47
1.5	6.93	2.40	2.00	1.50	2.89	3.46	4.62
1.6	7.29	2.48	2.07	1.54	2.93	3.52	4.74
1.7	7.63	2.56	2.14	1.57	2.98	3.57	4.85
1.8	7.95	2.64	2.20	1.61	3.01	3.61	4.94
1.9	8.26	2.71	2.27	1.64	3.05	3.65	5.02
2.0	8.55	2.78	2.33	1.68	3.07	3.67	5.09

Notes:
n = monthly sampling frequency of the effluent concentration data.

Table 2 continued.

Coefficient of Variation	MDEL Multiplier	AMEL Multiplier			MDEL/AMEL Multiplier		
	99th Percentile Occurrence Probability	95th Percentile Occurrence Probability			MDEL = 99th Percentile AMEL = 95th Percentile Occurrence Probability		
(CV)		n = 4	n = 8	n = 30	n = 4	n = 8	n = 30
2.1	8.83	2.85	2.39	1.72	3.10	3.70	5.14
2.2	9.09	2.91	2.45	1.75	3.12	3.72	5.19
2.3	9.34	2.97	2.50	1.79	3.15	3.73	5.22
2.4	9.58	3.03	2.56	1.82	3.17	3.74	5.25
2.5	9.81	3.08	2.61	1.86	3.18	3.75	5.27
2.6	10.0	3.13	2.67	1.90	3.20	3.76	5.29
2.7	10.2	3.18	2.72	1.93	3.22	3.76	5.30
2.8	10.4	3.23	2.77	1.97	3.23	3.77	5.30
2.9	10.6	3.27	2.82	2.00	3.25	3.77	5.30
3.0	10.8	3.31	2.86	2.04	3.26	3.77	5.30
3.1	11.0	3.35	2.91	2.07	3.27	3.77	5.29
3.2	11.1	3.38	2.95	2.11	3.29	3.77	5.28
3.3	11.3	3.42	2.99	2.14	3.30	3.77	5.27
3.4	11.4	3.45	3.03	2.17	3.31	3.77	5.25
3.5	11.6	3.48	3.07	2.21	3.32	3.77	5.24
3.6	11.7	3.51	3.10	2.24	3.33	3.76	5.22
3.7	11.8	3.53	3.14	2.27	3.34	3.76	5.20
3.8	11.9	3.56	3.17	2.30	3.35	3.76	5.18
3.9	12.1	3.58	3.21	2.34	3.36	3.76	5.16
4.0	12.16	3.60	3.24	2.37	3.37	3.76	5.14

Notes:
n = monthly sampling frequency of the effluent concentration data.

$$\text{MDEL/AMEL multiplier} = \text{MDEL multiplier}_{99} \div \text{AMEL multiplier}_{95}$$

$$\text{MDEL}_{\text{human health}} = \text{ECA} * \text{MDEL/AMEL multiplier}$$

Step 7: Identify the lower of (1) the AMEL and MDEL calculated based on the aquatic life criteria/objectives, and (2) the AMEL and MDEL calculated based on the human health criterion/objective.

C. Apply a *dynamic model, approved by the RWQCB, where sufficient effluent and receiving water data exist; or

D. Establish effluent limitations that consider intake water pollutants according to section 1.4.4.

The RWQCB shall impose more restrictive water quality-based effluent limitations (e.g., discharge prohibitions established in accordance with Water Code Section 13243) where necessary for the protection of beneficial uses or where otherwise required by law.[7] Seasonal effluent limitations may be established, where appropriate (such as in applying translators and mixing zones/dilution credits). Any significant change in effluent quantity or quality shall be cause for reevaluation of effluent limitations.

Regardless of which method is used for deriving water quality-based effluent limitations, the calculated water quality-based effluent limitations shall be compared to the technology-based effluent limitations for the pollutant, and the most protective of the two types of limitations shall be included in the permit.

Effluent limitations shall apply to the total effluent of a waste discharge at the end-of-pipe, except in the rare situations where it is impractical or infeasible (e.g., where the final discharge point is inaccessible, or the pollutants are so diluted by cooling water as to make monitoring impractical, or interferences among pollutants make analysis infeasible). In these cases, some effluent limitations and monitoring requirements for the discharge may be modified to apply to internal waste streams instead, provided that the permit fact sheet fully states the circumstances for allowing this to occur and the permit also contains the unmodified effluent limitations (see 40 CFR 122.45(h), revised as of July 1, 1996).

For pollutants that are so diluted by cooling water as to make monitoring impractical, effluent limitations for internal waste streams shall be based on the same averaging periods as the unmodified effluent limitations and shall be calculated as follows:

[7] For example, to implement the State and federal antidegradation policies, and the federal antibacksliding requirements.

$$IL = EL + (EL - CC) * CF/IF$$
$$IL = EL + (EL - CC) * (EF - IF)/IF$$

where IL = the limitation for the internal waste stream;
EL = the unmodified effluent limitation;
CC = the concentration of the pollutant in the cooling water;
CF = the cooling water flow, which is equal to the effluent flow minus the internal waste stream flow;
IF = the internal waste stream flow; and
EF = the effluent flow.

These equations do not apply when intake water credits (as described in section 1.4.4) are being provided.

1.4.1 Translators for Metals and Selenium

To derive total recoverable effluent limitations for aquatic life metals and selenium criteria/objectives that are expressed in the dissolved form, a translator first must be applied to the criterion/objective to express it as total recoverable. The translator shall be the U.S. EPA conversion factor (see Appendix 3) that applies to the dissolved aquatic life metals criterion as specified in the CTR (i.e., the dissolved criterion/objective would be divided by the applicable U.S. EPA conversion factor to calculate a total recoverable criterion) unless:

A. the discharger, in the permit application, (1) commits to (a) completing a defensible site-specific translator study and (b) proposing a dissolved to total recoverable translator to the RWQCB, and (2) describes the method(s) to be used in developing the translator; and

B. the discharger, within a time period specified by the RWQCB not exceeding two years from the date of issuance/reissuance of the permit, submits to the RWQCB (1) the proposed translator, and (2) all data and calculations related to its derivation.

Site-specific translators can be developed from field data by either direct determination of the fraction dissolved, or by development of a site-specific partition coefficient that relates the fraction dissolved to ambient background conditions such as pH, suspended load, or organic carbon. The fraction of metal that is dissolved in a water body can vary depending on when and where measurements are taken. A site-specific translator must (1) account for spatial and/or seasonal variability in areas of the water body that are affected by the discharger's effluent and (2) protect against toxic effects during critical conditions. The translator shall be derived using the *median of data for translation of chronic criteria and the *90^{th} percentile of observed data for translation of acute criteria. If systematic seasonal variation in the translator is demonstrated, seasonal effluent limitations may be justified. If a spatial gradient in the translator is demonstrated, the highest translator value should be used unless the permit allows for a mixing zone (in accordance with section 1.4.2), in which case measurements should be taken outside the mixing zone. The site-specific study plan (including sampling design) must be approved by the RWQCB, after consultation with the California Department of Fish and Game, prior to conducting the study. Translator studies may be conducted by one or more dischargers discharging to the same receiving water body, as described in the permit application, subject to approval by the RWQCB. The planning and undertaking of the study may follow the guidelines presented in Appendix 5, as applicable.

Alternatively, the RWQCB may consider applying a previously approved site-specific translator or translator based on a study completed prior to the adoption of this Policy if the RWQCB believes the translator adequately reflects existing conditions (including spatial and/or seasonal variability) in the areas of the water body affected by the discharger's effluent.

While a translator study is being conducted, a final effluent limitation based on the applicable U.S. EPA conversion factor shall be included in the provisions of the permit and interim requirements shall be established (in accordance with section 2.2.2). An interim deadline to submit the results of the study shall be specified by the RWQCB, and shall not exceed two years from the date of issuance/reissuance of the permit. Once the translator is developed by the discharger(s) and approved by the RWQCB, the RWQCB shall reopen the permit and a new effluent limitation shall be calculated using a method described in section 1.4 after adjusting the dissolved metal or selenium criterion/objective by dividing it by the translator. In the event a translator study is not completed within the specified time, the U.S. EPA conversion factor-based effluent limitation in the provisions of the permit shall become effective as a default limitation.

1.4.2 Mixing Zones and Dilution Credits

With the exception of effluent limitations derived from TMDLs, in establishing and determining compliance with effluent limitations for applicable human health, acute aquatic life, or chronic aquatic life priority pollutant criteria/objectives or the toxicity objective for aquatic life protection in a RWQCB basin plan, the RWQCB may grant *mixing zones and *dilution credits to dischargers in accordance with the provisions of this section. To the extent permitted by applicable law, mixing zones may be considered for TMDL-derived effluent limitations. Effluent limitations based on a TMDL shall meet the mixing zone conditions specified in section 1.4.2.2.A.

The applicable priority pollutant criteria and objectives are to be met throughout a water body except within any mixing zone granted by a RWQCB. The allowance of mixing zones is discretionary and shall be determined on a discharge-by-discharge basis. A RWQCB may consider allowing mixing zones and dilution credits only for discharges with a physically identifiable point of discharge that are regulated through an NPDES permit issued by the RWQCB.

1.4.2.1 <u>Dilution Credits</u>

The dilution credit, D, is a numerical value associated with the mixing zone that accounts for the receiving water entrained into the discharge. The dilution credit is a value used in the calculation of effluent limitations (described in section 1.4). Dilution credits may be limited or denied on a pollutant-by-pollutant basis, which may result in a dilution credit for all, some, or no priority pollutants in a discharge.

Before establishing a mixing zone and a dilution credit for a discharge, it must first be determined if, and how much (if any), receiving water is available to dilute the discharge. In determining the appropriate available receiving water flow, the RWQCBs may take into account actual and seasonal variations of the receiving water and the effluent. For example, a RWQCB may prohibit mixing zones during seasonal low flows and allow them during seasonal high flows. However, for year-round mixing zones, the mixing zone and dilution credit shall be determined using the parameters specified in Table 3.

Table 3. Effluent and Receiving Water Flows for Calculating Dilution Ratios

In calculating a dilution ratio for:	Use the critical receiving water flow[8] of:	Use the discharged effluent flow of:
Acute aquatic life criteria/objectives	*1Q10	*maximum daily flow during period of discharge
Chronic aquatic life criteria/objectives Chronic toxicity objective for aquatic life[9]	*7Q10	*four-day average of daily maximum flows during period of discharge
Human health criteria/objectives	*harmonic mean	*long-term arithmetic mean flow during period of discharge

The approach to making a mixing zone determination also depends on whether a discharge is *completely-mixed or *incompletely-mixed with the receiving water as discussed below.

Completely-Mixed Discharges

For completely-mixed discharges, as determined by the RWQCB and based on information provided by the discharger, the amount of receiving water available to dilute the effluent shall be determined by calculating the *dilution ratio (i.e., the critical receiving water flow divided by the effluent flow) using the appropriate flows in Table 3. In no case shall the RWQCB grant a dilution credit that is greater than the calculated dilution ratio. The dilution credit may be set equal to the dilution ratio only if the site-specific conditions concerning the discharge and the receiving water do not indicate that a smaller dilution credit is necessary to protect beneficial uses and meet the conditions of this Policy. If, however, dilution ratios that are calculated using the Table 3 parameters are inappropriate for use due to site-specific issues, the mixing zone and dilution credit shall be determined using site-specific information and procedures detailed for incompletely-mixed discharges.

[8] U.S. EPA's *biologically-based receiving water flows may be used in place of these critical receiving water flows where sufficient data are available.

[9] These objectives are included in RWQCB basin plans and may address both chronic and acute toxicity to aquatic life. The flows in Table 3 apply to the chronic component of the objective.

Incompletely-Mixed Discharges

Dilution credits and mixing zones for incompletely-mixed discharges shall be considered by the RWQCB only after the discharger has completed an independent mixing zone study and demonstrated to the satisfaction of the RWQCB that a dilution credit is appropriate. Mixing zone studies may include, but are not limited to, tracer studies, dye studies, modelling studies, and monitoring upstream and downstream of the discharge that characterize the extent of actual dilution. These studies may be conducted in accordance with the procedures outlined in Appendix 5.

1.4.2.2 Mixing Zone Conditions

A mixing zone shall be as small as practicable. The following conditions must be met in allowing a mixing zone:

A. A mixing zone shall not:

(1) compromise the integrity of the entire water body;
(2) cause *acutely toxic conditions to aquatic life passing through the mixing zone;
(3) restrict the passage of aquatic life;
(4) adversely impact biologically sensitive or critical habitats, including, but not limited to, habitat of species listed under federal or State endangered species laws;
(5) produce undesirable or nuisance aquatic life;
(6) result in floating debris, oil, or scum;
(7) produce objectionable color, odor, taste, or turbidity;
(8) cause *objectionable bottom deposits;
(9) cause nuisance;
(10) dominate the receiving water body or overlap a mixing zone from different outfalls; or
(11) be allowed at or near any drinking water intake. A mixing zone is not a *source of drinking water. To the extent of any conflict between this determination and the Sources of Drinking Water Policy (SWRCB Resolution No. 88-63), this determination supersedes the provisions of that policy.

B. The RWQCB shall deny or significantly limit a mixing zone and dilution credit as necessary to protect beneficial uses, meet the conditions of this Policy, or comply with other regulatory requirements. Such situations may exist based upon the quality of the discharge, hydraulics of the water body, or the overall discharge environment (including water column chemistry, organism health, and potential for bioaccumulation). For example, in determining the extent of or whether to allow a mixing zone and dilution credit, the RWQCB shall consider the presence of pollutants in the discharge that are *carcinogenic, *mutagenic, *teratogenic, *persistent, *bioaccumulative, or attractive to aquatic organisms. In another example, the RWQCB also shall consider, if necessary to protect the beneficial uses, the level of flushing in water bodies such as lakes, reservoirs, enclosed bays, estuaries, or other water body types where pollutants may not be readily flushed through the system. In the case of multiple mixing zones, proximity to other outfalls shall be carefully considered to protect the beneficial uses.

If a RWQCB allows a mixing zone and dilution credit, the permit shall specify the method by which the mixing zone was derived, the dilution credit granted, and the point(s) in the receiving water where the applicable criteria/objectives must be met. The application for the permit shall include, to the extent feasible, the information needed by the RWQCB to make a determination on allowing a mixing zone, including the calculations for deriving the appropriate receiving water and effluent flows, and/or the results of a mixing zone study. If the results of the mixing zone study are unavailable by the time of permit issuance/reissuance, the RWQCB may establish interim requirements in accordance with section 2.2.2.

1.4.3 Ambient Background Concentrations

Ambient background concentration, B, of a priority pollutant in the receiving water body shall be calculated on a pollutant-by-pollutant basis and on a discharge-by-discharge or water body-by-water body basis at the RWQCB's discretion. The ambient background concentration shall be the observed maximum ambient water column concentration in accordance with section 1.4.3.1 or the *arithmetic mean of observed ambient water concentrations in accordance with section 1.4.3.2 where these sections are specifically referenced in this Policy (i.e., sections 1.3 and 1.4).

1.4.3.1 Ambient Background Concentration as an Observed Maximum

Step 1: Identify all available, applicable ambient background data for the pollutant in accordance with section 1.2. If possible, preference should be given to ambient water column concentrations measured immediately upstream or near the discharge, but not within an allowed mixing zone for the discharge. The RWQCB shall have discretion to consider if any samples are invalid for use as applicable data due to evidence that the sample has been erroneously reported or the sample is not representative of the ambient receiving water column that will mix with the discharge. For example, the RWQCB shall have discretion to consider samples to be invalid that have been taken during peak flows of significant storm events.

Step 2: If all samples are below the reported detection limits, the ambient background concentration shall be set equal to the lowest of the individual reported detection limits. If any sample is reported with a detected concentration, as either measured or estimated by the laboratory, the ambient background concentration shall be set equal to the maximum of the individual reported measured or estimated concentrations.

1.4.3.2 Ambient Background Concentration as an Arithmetic Mean

Step 1: Identify all available, applicable ambient background data for the pollutant in accordance with section 1.2. If possible, preference should be given to ambient water column concentrations measured immediately upstream or near the discharge, but not within an allowed mixing zone for the discharge. The RWQCB shall have discretion to consider if any samples are invalid for use as applicable data due to evidence that the sample has been erroneously reported or the sample is not representative of the ambient receiving water column that will mix with the discharge.

Step 2: If all samples are below the reported detection limits, the ambient background concentration shall be set equal to the lowest of the individual reported detection limits. If any sample is reported with a detected concentration, as either measured or estimated by the laboratory, the ambient background concentration shall be set equal to the arithmetic mean of the individual reported measured or estimated concentrations. The arithmetic mean shall be calculated using the reported detection limits for samples that are reported below detection limits.

1.4.4 Intake Water Credits

A RWQCB may consider priority pollutants in intake water on a pollutant-by-pollutant and discharge-by-discharge basis when establishing water quality-based effluent limitations, provided that the discharger has demonstrated to the satisfaction of the RWQCB that the following conditions are met:

(1) The observed maximum ambient background concentration, as determined in section 1.4.3.1, and the intake water concentration of the pollutant exceed the most stringent applicable criterion/objective for that pollutant;

(2) The intake water credits provided are consistent with any TMDL applicable to the discharge that has been approved by the RWQCB, SWRCB, and U.S. EPA;

(3) The intake water is from the same water body as the receiving water body. The discharger may demonstrate this condition by showing that:

(a) the ambient background concentration of the pollutant in the receiving water, excluding any amount of the pollutant in the facility's discharge, is similar to that of the intake water;

(b) there is a direct hydrological connection between the intake and discharge points;

(c) the water quality characteristics are similar in the intake and receiving waters; and

(d) the intake water pollutant would have reached the vicinity of the discharge point in the receiving water within a reasonable period of time and with the same effect had it not been diverted by the discharger.

The RWQCB may also consider other factors when determining whether the intake water is from the same water body as the receiving water body;

(4) The facility does not alter the intake water pollutant chemically or physically in a manner that adversely affects water quality and beneficial uses; and

(5) The timing and location of the discharge does not cause adverse effects on water quality and beneficial uses that would not occur if the intake water pollutant had been left in the receiving water body.

Where the above conditions are met, the RWQCB may establish effluent limitations allowing the facility to discharge a mass and concentration of the intake water pollutant that is no greater than the mass and concentration found in the facility's intake water. A discharger may add mass of the pollutant to its waste stream if an equal or greater mass is removed prior to discharge, so there is no net addition of the pollutant in the discharge compared to the intake water. Where proper operation and maintenance of a facility's treatment system results in the removal of an intake water pollutant, the RWQCB may establish limitations that reflect the lower mass and concentration of the pollutant achieved by such treatment.

Where intake water for a facility is provided by a municipal water supply system and the supplier provides treatment of the raw water that removes an intake water pollutant, the concentration of the intake water pollutant shall be determined at the point where the water enters the water supplier's distribution system.

Where a facility discharges pollutants from multiple sources that originate from the receiving water body and from other water bodies, the RWQCB may derive an effluent limitation reflecting the flow-weighted amount of each source of the pollutant provided that adequate monitoring to determine compliance can be established and is included in the permit. When calculating the flow-weighted effluent limitation, the pollutant from the receiving water body shall be assumed to have a concentration that is no greater than the concentration in the facility's intake water; the same pollutant from other sources shall be assumed to have a concentration that is no greater than the most stringent applicable criterion/objective.

The permit shall specify how compliance with mass- and concentration-based limitations for the intake water pollutant will be assessed. This may be done by basing the effluent limitation on ambient background concentration data. Alternatively, the RWQCB may determine compliance by simultaneously monitoring the pollutant concentrations in the intake water and in the effluent. This monitoring may be supplemented by monitoring internal waste streams or by a RWQCB evaluation of the use of *best management practices.

2. DETERMINING COMPLIANCE WITH PRIORITY POLLUTANT CRITERIA/OBJECTIVES AND WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR PRIORITY POLLUTANT CRITERIA/OBJECTIVES

Compliance with priority pollutant criteria/objectives and water quality-based effluent limitations established pursuant to section 1 shall be determined according to the following provisions for (1) compliance schedules (section 2.1), (2) interim requirements (section 2.2), (3) monitoring requirements (section 2.3), and (4) reporting requirements including compliance determinations (section 2.4). In determining compliance with effluent limitations based on intake water credits, only the monitoring requirements (section 2.3) and the reporting requirements (section 2.4) apply. In determining compliance with effluent limitations derived from TMDLs, only the compliance schedule provisions (section 2.1) apply.

2.1 Compliance Schedules

Based on an *existing discharger's request and demonstration that it is *infeasible for the discharger to achieve immediate compliance with a CTR criterion[10], or with an effluent limitation based on a CTR criterion, the RWQCB may establish a compliance schedule in an NPDES permit. Compliance schedules shall not be allowed in permits for *new dischargers.

A schedule of compliance shall include a series of required actions to be undertaken for the purpose of achieving a CTR criterion and/or effluent limitations based on a CTR criterion. These actions shall demonstrate reasonable progress toward the attainment of a CTR criterion and/or effluent limitations. The compliance schedule shall include a schedule for completion that reflects a realistic assessment of the shortest practicable time required to perform each task. The compliance schedule shall contain a final compliance date based on the shortest practicable time required to achieve compliance. The deadlines to complete each action in the compliance schedule shall be specified in the NPDES permit and shall be accompanied by interim requirements as described in section 2.2.1. When a compliance schedule exceeds one year from the date of permit issuance, interim limitations with specific compliance dates (as described in section 2.2.1) shall be included in the NPDES permit. If the final compliance date extends beyond the permit term, the final compliance date and supporting explanation shall be included in the permit findings.

The discharger shall submit to the RWQCB the following justification before compliance schedules may be authorized in a permit: (a) documentation that diligent efforts have been made to quantify pollutant levels in the discharge and the sources of the pollutant in the waste stream, and the results of those efforts; (b) documentation of source control and/or pollution minimization efforts currently underway or completed; (c) a proposed schedule for additional or future source control measures, *pollutant minimization actions, or waste treatment (i.e., facility upgrades); and (d) a demonstration that the proposed schedule is as short as practicable.

The schedule of compliance for point source dischargers in an NPDES permit shall be as short as practicable but in no case exceed the following:

A. Up to <u>five</u> years <u>from the date of permit issuance, reissuance, or modification</u> to complete actions (such as pollutant minimization or facility upgrades) necessary to comply with CTR criterion-based effluent limitations that are derived with or without a TMDL. Such actions shall include the development and adoption of a site-specific objective, if appropriate, as provided in section 5.2.

B. Up to <u>15</u> years <u>from the effective date of this Policy</u> to develop and adopt a TMDL, and accompanying Waste Load Allocations (WLAs) and Load Allocations (LAs), as described in section 2.1.1, below.

In no case (unless an exception has been granted in accordance with section 5.3) shall a compliance schedule for these dischargers exceed, from the effective date of this Policy: (a) 10 years to establish and comply with CTR criterion-based effluent limitations; or (b) 20 years

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[10] CTR criteria, for purposes of this section, exclude NTR criteria.

to develop and adopt a TMDL, and to establish and comply with WLAs derived from a TMDL for a CTR criterion (i.e., up to 15 years to complete the TMDL and up to five years to comply with a TMDL-derived effluent limitation).

2.1.1 TMDL-Based Compliance Schedule

The compliance schedule provisions for the development and adoption of a TMDL only apply when: (a) the discharger requests and demonstrates that it is *infeasible for the discharger to achieve immediate compliance with a CTR criterion, or with an effluent limitation based on a CTR criterion; and (b) the discharger has made appropriate commitments to support and expedite the development of the TMDL. In determining appropriate commitments, the RWQCB should consider the discharge's contribution to current loadings and the discharger's ability to participate in TMDL development.

For *bioaccumulative priority pollutants for which the receiving water has been included on the CWA Section 303(d) list, the RWQCB should consider whether the mass loading of the bioaccumulative pollutant(s) should be limited to representative, current levels pending TMDL development in order to implement the applicable water quality standard.

2.2 Interim Requirements

If a compliance schedule is allowed (in accordance with section 2.1) or a schedule is allowed to collect and provide data needed to establish water quality-based effluent limitations for a CTR criterion (in accordance with provisions in section 1), interim requirements shall be included in an NPDES permit.

2.2.1 Interim Requirements Under a Compliance Schedule

If a compliance schedule is granted (in accordance with section 2.1), the RWQCB shall establish interim requirements and dates for their achievement in the NPDES permit. If the compliance schedule exceeds one year, the RWQCB shall establish interim numeric limitations for the priority pollutant in the permit and may also impose interim requirements to control the pollutant, such as *pollutant minimization and source control measures. Numeric interim limitations for the pollutant must be based on current treatment facility performance or on existing permit limitations, whichever is more stringent. If the existing permit limitations are more stringent, and the discharger is not in compliance with those limitations, the noncompliance under the existing permit must be addressed through appropriate enforcement action before the permit can be reissued, unless antibacksliding provisions are met.

There shall be no more than one year between interim dates. The interim requirements shall state that the discharger must notify the RWQCB, in writing, no later than 14 days following each interim date, of its compliance or noncompliance with the interim requirements.

If the compliance schedule is within the term of the permit, the final effluent limitations shall be included in the permit provisions. If the compliance schedule exceeds the length of the permit, the final effluent limitations shall be included in the permit findings. In the latter case, the findings shall include: (1) the water quality to be achieved; (2) the reason that a final water quality-based effluent limitation is not being incorporated into the permit as an enforceable limitation at this time; (3) a statement that it is the intent of the RWQCB to include, in a subsequent permit revision, the final water quality-based effluent limitation as an enforceable limitation (based either on the CTR criterion directly or on future regulatory developments, such as TMDL or site-specific objective development). The permit findings shall also state the appropriate enforcement actions that may be taken by the RWQCB if interim limitations and requirements are not met.

2.2.2 Interim Requirements for Providing Data

The RWQCB may determine, based on a discharger's request and/or a demonstration of necessity, that it is appropriate to establish a schedule of interim requirements regarding the implementation of a CTR criterion. Such interim schedules may be established based on a consideration of time needed to collect sufficient data to: (1) determine whether effluent limitations are needed (as described in section 1.3); and (2) calculate effluent limitations (as described in section 1.4), including developing a site-specific translator (as described in section 1.4.1) and conducting a mixing zone study (as described in section 1.4.2).

If a discharger makes a successful demonstration, as determined by the RWQCB, that available data are insufficient, the permit provisions shall specify a schedule <u>not to exceed three years from the effective date of this Policy</u>[11] that contains interim requirements and dates for their achievement. There shall be no more than one year between interim dates. The interim requirements shall state that the discharger must notify the RWQCB, in writing, no later than 14 days following each interim date, of its compliance or noncompliance with the interim requirements (or must submit a progress report, if applicable). Additional requirements that are specific to two situations follow:

A. Insufficient Data to Determine if an Effluent Limitation for a CTR Criterion is Needed

The RWQCB shall <u>not</u> establish in the NPDES permit numeric interim limitations, and source control or *pollutant minimization measures, for the pollutant, but shall instead require the discharger to collect the needed data. These data requirements should be sufficient to contribute to the data needs for both sections 1.3 and 1.4. When the needed data have been provided in accordance with the interim requirements, the RWQCB shall determine, based on the data and the section 1.3 procedure, if water quality-based effluent limitations are necessary for the pollutant. If the RWQCB determines that effluent limitations are needed, the RWQCB shall calculate them, reopen the permit, and include the calculated effluent limitations in the permit provisions.

B. Insufficient Data to Calculate a Final Effluent Limitation for a CTR Criterion

The RWQCB shall establish in the NPDES permit numeric interim limitations, and may also establish other interim requirements such as requiring the discharger to implement *pollutant minimization and/or source control measures and participate in the activities necessary to develop final effluent limitations. Numeric interim limitations for the pollutant must be based on current treatment facility performance or on existing permit limitations, whichever is more

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[11] Note that the schedule to submit a translator for approval by the RWQCB is up to two years from the date of issuance/reissuance of the permit (as described in section 1.4.1).

stringent. If the existing permit limitations are more stringent, and the discharger is not in compliance with those limitations, the noncompliance under the existing permit must be addressed through appropriate enforcement action before the permit can be reissued, unless antibacksliding provisions are met.

Permit findings shall also state the appropriate enforcement actions that may be taken by the RWQCB if interim limitations and requirements are not met. Except as provided in section 1.4.1 (for a translator study), the permit provisions shall not include a final effluent limitation, but the permit findings shall include: (1) the water quality to be achieved; (2) the reason that a final water quality-based effluent limitation is not being incorporated into the permit as an enforceable limitation at this time; (3) a statement that it is the intent of the RWQCB to include the final water quality-based effluent limitation as an enforceable limitation in a subsequent permit revision, and that the final water quality-based effluent limitation will be based either on the water quality criterion or on future regulatory developments; and (4) a schedule for development of a final water quality-based effluent limitation. When interim requirements have been completed, the RWQCB shall calculate final water quality-based effluent limitations for that pollutant based on the collected data, reopen the permit, and include the final effluent limitations in the permit provisions. Once final limitations become effective, the interim limitations will no longer apply.

2.3 Monitoring Requirements

The RWQCB shall require dischargers to conduct self-monitoring programs and shall clearly state in all permits the objective and purpose of the monitoring. Furthermore, the RWQCB shall determine, and specify under the monitoring and reporting requirements, the sampling parameters, monitoring frequencies, locations, and analytical methods to be used. To evaluate compliance with effluent limitations, effluent and ambient monitoring should occur within a brief enough period to be able to evaluate the effect of the effluent on the ambient water quality. All data shall be reported in accordance with section 2.4. Options for analytical methods are:

(1) those methods listed in Appendix 4 and described in Tables 1A, 1B, 1C, 1D, and 1E of 40 CFR 136.3 (revised as of May 14, 1999); or alternate test procedures for individual discharges that have been approved by the U.S. EPA Regional Administrator pursuant to 40 CFR 136.4 (a) through (c), inclusive, and 40 CFR 136.5 (a) through (d), inclusive (revised as of May 14, 1999); or

(2) where no methods are specified for a given pollutant in the tables described in (1) above, methods approved by the SWRCB or RWQCB.

Laboratories analyzing monitoring samples shall be certified by the Department of Health Services, in accordance with the provision of Water Code Section 13176, and must include quality assurance/quality control data with their reports.

Dischargers are also encouraged to submit monitoring data in electronic formats approved by the SWRCB or RWQCB.

Furthermore, it is the policy of the SWRCB that individual permit monitoring complement and be coordinated with water body, watershed, and regional monitoring programs to the extent practicable.

2.4 Reporting Requirements

The discharger shall submit to the RWQCB reports necessary to determine compliance with effluent limitations for priority pollutants in permits. The reports shall comply with the requirements of sections 2.4.1 through 2.4.4.

2.4.1 Reporting Levels

The RWQCB shall require in the permit that the discharger shall report with each sample result:

1. The applicable *Minimum Level (ML) (selected from Appendix 4 in accordance with section 2.4.2 or established in accordance with section 2.4.3); this ML is the "reported ML"; and

2. The laboratory's current *Method Detection Limit (MDL), as determined by the procedure found in 40 CFR 136 (revised as of May 14, 1999).

2.4.2 Selection and Use of Appropriate ML Value

<u>ML Selection</u>: When there is more than one ML value for a given substance, the RWQCB shall cite for inclusion in the permit all ML values, and their associated analytical methods, listed in Appendix 4 that are below the calculated effluent limitation. The discharger may select any one of those cited analytical methods for compliance determination. If no ML value is below the effluent limitation, then the RWQCB shall select the lowest ML value, and its associated analytical method, listed in Appendix 4 for inclusion in the permit.

<u>ML Usage</u>: The ML value in Appendix 4 represents the lowest quantifiable concentration in a sample based on the proper application of all method-based analytical procedures and the absence of any matrix interferences. Assuming that all method-specific analytical steps are followed, the ML value will also represent, after the appropriate application of method-specific factors, the lowest standard in the calibration curve for that specific analytical technique. Common analytical practices sometimes require different treatment of the sample relative to calibration standards. Some examples are given below:

Substance or Grouping	Method-Specified Treatment	Most Common Method-Specific Factor(s)
Volatile organic	No differential treatment	1
Semi-Volatile organic	Samples concentrated by extraction	1000
Metals	Samples diluted or concentrated	½, 2, and 4
Pesticides	Samples concentrated by extraction	100

Other factors may be applied to the ML depending on the specific sample preparation steps employed. For example, the treatment typically applied in cases where there are matrix-effects is to dilute the sample or sample aliquot by a factor of ten. In such cases, this additional factor must be applied in the computation of the reporting limit. Application of such factors will alter the reported ML (as described in section 2.4.1).

Dischargers are to instruct laboratories to establish calibration standards so that the ML value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard. At no time is the discharger to use analytical data derived from *extrapolation* beyond the lowest point of the calibration curve. The discharger's laboratory(ies) may, as allowed for by the rules governing alterations to ML values in section 2.4.3 below, employ a calibration standard lower than the ML value in Appendix 4.

2.4.3 Deviation from MLs Listed in Appendix 4

The RWQCB, in consultation with the SWRCB's Quality Assurance Program, shall establish an ML that is not contained in Appendix 4 to be included in the discharger's permit in any of the following situations:

1. When the pollutant under consideration is not included in Appendix 4.

2. When the discharger and the RWQCB agree to include in the permit a test method that is more sensitive than those specified in 40 CFR 136 (revised as of May 14, 1999).

3. When a discharger agrees to use an ML that is lower than those listed in Appendix 4.

4. When a discharger demonstrates that the calibration standard matrix is sufficiently different from that used to establish the ML in Appendix 4 and proposes an appropriate ML for their matrix.

5. When the discharger uses a method whose quantification practices are not consistent with the definition of an ML. Examples of such methods are the U.S. EPA-approved method 1613 for dioxins and furans, method 1624 for volatile organic substances, and method 1625 for semi-volatile organic substances. In such cases, the discharger, the RWQCB, and the SWRCB shall agree on a lowest quantifiable limit and that limit will substitute for the ML for reporting and compliance determination purposes.

2.4.4 Reporting Protocols

The discharger shall report the results of analytical determinations for the presence of chemical constituents in a sample using the following reporting protocols:

1. Sample results greater than or equal to the reported ML shall be reported as measured by the laboratory (i.e., the measured chemical concentration in the sample).

2. Sample results less than the reported ML, but greater than or equal to the laboratory's MDL, shall be reported as "Detected, but Not Quantified," or DNQ. The *estimated chemical concentration of the sample shall also be reported.

For the purposes of data collection, the laboratory shall write the estimated chemical concentration next to DNQ as well as the words "Estimated Concentration" (may be shortened to "Est. Conc."). The laboratory may, if such information is available, include numerical estimates of the data quality for the reported result. Numerical estimates of data quality may be percent accuracy (± a percentage of the reported value), numerical ranges (low to high), or any other means considered appropriate by the laboratory.

3. Sample results less than the laboratory's MDL shall be reported as "Not Detected," or ND.

2.4.5 Compliance Determination

Compliance with effluent limitations shall be determined as follows:

1. Dischargers shall be deemed out of compliance with an effluent limitation if the concentration of the priority pollutant in the monitoring sample is greater than the effluent limitation and greater than or equal to the reported ML.

2. Dischargers shall be required to conduct a Pollutant Minimization Program (PMP) in accordance with section 2.4.5.1 when there is evidence (e.g., sample results reported as DNQ when the effluent limitation is less than the MDL, sample results from analytical methods more sensitive than those methods included in the permit in accordance with sections 2.4.2 or 2.4.3 above, presence of whole effluent toxicity, health advisories for fish consumption, results of benthic or aquatic organism tissue sampling) that the priority pollutant is present in the effluent above an effluent limitation and either:

   a. A sample result is reported as DNQ and the effluent limitation is less than the reported ML; or

   b. A sample result is reported as ND and the effluent limitation is less than the MDL.

   RWQCBs may include special provisions in the permit to require the gathering of evidence to determine whether the constituent of concern is present in the effluent at levels above a calculated effluent limitation.

When determining compliance with an AMEL and more than one sample result is available in a month, the discharger shall compute the arithmetic mean unless the data set contains one or more reported determinations of DNQ or ND. In those cases, the discharger shall compute the median in place of the arithmetic mean in accordance with the following procedure:

1. The data set shall be ranked from low to high, reported ND determinations lowest, DNQ determinations next, followed by quantified values (if any). The order of the individual ND or DNQ determinations is unimportant.

2. The median value of the data set shall be determined. If the data set has an odd number of data points, then the median is the middle value. If the data set has an even number of data points, then the median is the average of the two values around the middle unless one or both

of the points are ND or DNQ, in which case the median value shall be the lower of the two data points where DNQ is lower than a value and ND is lower than DNQ.

If a sample result, or the arithmetic mean or median of multiple sample results, is below the reported ML, and there is evidence that the priority pollutant is present in the effluent above an effluent limitation <u>and</u> the discharger conducts a PMP (as described in section 2.4.5.1), the discharger shall <u>not</u> be deemed out of compliance.

2.4.5.1 <u>Pollutant Minimization Program</u>

The goal of the PMP shall be to reduce all potential sources of a priority pollutant(s) through *pollutant minimization (control) strategies, including *pollution prevention measures as appropriate[12], to maintain the effluent concentration at or below the water quality-based effluent limitation. The RWQCB may consider cost-effectiveness when establishing the requirements of a PMP. The program shall include, but not be limited to, the following actions and submittals acceptable to the RWQCB:

1. An annual review and semi-annual monitoring of potential sources of the reportable priority pollutant(s), which may include fish tissue monitoring and other bio-uptake sampling;

2. Quarterly monitoring for the reportable priority pollutant(s) in the influent to the wastewater treatment system;

3. Submittal of a control strategy designed to proceed toward the goal of maintaining concentrations of the reportable priority pollutant(s) in the effluent at or below the effluent limitation;

4. Implementation of appropriate cost-effective control measures for the reportable priority pollutant(s), consistent with the control strategy; and

5. An annual status report that shall be sent to the RWQCB including:

    a. All PMP monitoring results for the previous year;

    b. A list of potential sources of the reportable priority pollutant(s);

    c. A summary of all actions undertaken pursuant to the control strategy; and

    d. A description of actions to be taken in the following year.

The permit shall contain a reopener clause authorizing modifications, or revocation and reissuance of the permit, as a result of the detection of a reportable priority pollutant generated by special conditions included in the permit. These special conditions in the permit may be, but are

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[12] Pollution prevention measures may be particularly appropriate for persistent bioaccumulative priority pollutants where there is evidence that beneficial uses are being impacted.

not limited to, fish tissue sampling, whole effluent toxicity tests, monitoring requirements on internal waste stream(s), and monitoring for surrogate parameters. Additional requirements may be included in the permit as a result of the special condition monitoring data.

The completion and implementation of a pollution prevention plan, required pursuant to Water Code Section 13263.3(d), shall be considered to fulfill the PMP requirements of this section.

3. 2,3,7,8-TCDD EQUIVALENTS

The CTR includes criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). In addition to this compound, there are many congeners of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) that exhibit toxic effects similar to those of 2,3,7,8-TCDD. The U.S. EPA has published toxic equivalency factors (TEFs) for 17 of the congeners. The TEFs express the relative toxicities of the congeners compared to 2,3,7,8-TCDD (whose TEF equals 1.0). In June 1997, participants in a World Health Organization (WHO) expert meeting revised TEF values for 1,2,3,7,8-PentaCDD, OctaCDD, and OctaCDF. The current TEFs for the 17 congeners, which include the three revised values, are shown in Table 4:

Table 4. Toxic Equivalency Factors (TEFs) for 2,3,7,8-TCDD Equivalents

Congener	TEF
2,3,7,8-TetraCDD	1
1,2,3,7,8-PentaCDD	1.0
1,2,3,4,7,8-HexaCDD	0.1
1,2,3,6,7,8-HexaCDD	0.1
1,2,3,7,8,9-HexaCDD	0.1
1,2,3,4,6,7,8-HeptaCDD	0.01
OctaCDD	0.0001
2,3,7,8-TetraCDF	0.1
1,2,3,7,8-PentaCDF	0.05
2,3,4,7,8-PentaCDF	0.5
1,2,3,4,7,8-HexaCDF	0.1
1,2,3,6,7,8-HexaCDF	0.1
1,2,3,7,8,9-HexaCDF	0.1
2,3,4,6,7,8-HexaCDF	0.1
1,2,3,4,6,7,8-HeptaCDF	0.01
1,2,3,4,7,8,9-HeptaCDF	0.01
OctaCDF	0.0001

TEF Reference: Van den Berg, M., et al. (22 additional authors). 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs, for humans and wildlife. Environmental Health Perspectives 106(12):775-792.

Whether or not an effluent limitation is required for 2,3,7,8-TCDD in accordance with section 1.3 of this Policy, each RWQCB shall require (as described below) major and minor POTW and industrial dischargers in its region to conduct effluent monitoring for the 2,3,7,8-TCDD congeners listed above. The purpose of the monitoring is to assess the presence and amounts of the congeners being discharged to inland surface waters, enclosed bays, and estuaries for the development of a strategy to control these chemicals in a future multi-media approach.

Within one year of the effective date of this Policy, each RWQCB shall either (1) amend the NPDES permits, or (2) send a written request for the information pursuant to California Water Code Section 13267 or 13383, for NPDES permittees in their respective regions, requiring, for a period of three consecutive years from the date the permit is amended or the request is sent, that: (1) each major POTW and major industrial discharger monitor its effluent for the presence of the 17 congeners once during dry weather and once during wet weather each of the three years; and (2) each minor POTW and minor industrial discharger monitor its effluent for the presence of the 17 congeners once during dry weather and once during wet weather for one year during the three-year period.

The RWQCB should coordinate this region-wide monitoring to provide data that are consistent with the purpose of the provisions of this section to the extent possible. The RWQCB shall encourage public and private dischargers, and local governments, to develop a coordinated, cooperative regional monitoring program to gather this information.

The RWQCB shall require the discharger to report for each congener the analytical results of the effluent monitoring, including the quantifiable limit[13] and the MDL, and the measured or estimated concentration. In addition, the RWQCB shall require the discharger to multiply each measured or estimated congener concentration by its respective TEF value (presented above) and report the sum of these values. This information shall be submitted to the RWQCB as part of the discharger's self-monitoring reports, in accordance with section 2.3. The RWQCB shall, subsequently, submit the information to the SWRCB.

Based on the monitoring results, the RWQCB may, at its discretion, increase the monitoring requirement (e.g., increase sampling frequency) to further investigate frequent or significant detections of any congener. At the conclusion of the three-year monitoring period, the SWRCB and RWQCBs will assess the data (a total of six samples each from major POTWs and industrial dischargers, and a total of two samples each from minor POTWs and industrial dischargers), and determine whether further monitoring is necessary.

4. TOXICITY CONTROL PROVISIONS

This section establishes minimum toxicity control requirements for implementing the narrative toxicity objectives for aquatic life protection in RWQCB basin plans. These provisions are intended to supplement basin plan requirements and do not supersede existing RWQCB toxicity requirements.

[13] As determined by the procedure found in section 2.4.3, number 5.

Water Quality-Based Toxicity Control

A chronic toxicity effluent limitation is required in permits for all discharges that will cause, have reasonable potential to cause, or contribute to chronic toxicity in receiving waters.

To determine compliance with the chronic aquatic life toxicity objective in a RWQCB basin plan, or an effluent limitation based on the objective, the RWQCB shall require, in a permit or other appropriate order, the use of short-term chronic toxicity tests. At least three test species with approved test protocols shall be used to measure compliance with the toxicity objective. If possible, the test species shall include a vertebrate, an invertebrate, and an aquatic plant. After a screening period, monitoring may be reduced to the most sensitive species. Dilution and control waters should be obtained from an area unaffected by the discharge in the receiving waters. For rivers and streams, dilution water should be obtained immediately upstream of the wastewater outfall. Standard dilution water can be used if the above sources exhibit toxicity or if approved by the RWQCB. The sensitivity of the test organisms to a reference toxicant shall be determined concurrently with each bioassay and reported with the test results.

The tests contained in Appendix II, "Chapter IV. Compliance With Toxicity Limitations and Objectives", of the California Ocean Plan (amended March 20, 1997 and effective July 23, 1997) are incorporated by reference and one or more of these tests shall be used to measure toxicity in salt water. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. One or more of the tests in Table 5 shall be used to measure chronic toxicity in fresh water.

Table 5. Short-term Methods for Estimating Chronic Toxicity–Fresh Water

Species	Effect	Test duration (days)
fathead minnow (Pimephales promelas)	larval survival; growth	7
water flea (Ceriodaphnia dubia)	survival; number of young	6 to 8
alga (Selenastrum capricornutum)	growth rate	4

Toxicity Test Reference: U.S. EPA. 1994. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms. Third edition. U.S. EPA Environmental Monitoring Systems Laboratory, Cincinnati, Ohio. EPA/600/4-91-002.

Toxicity Reduction Requirements

If a discharge causes or contributes to chronic toxicity in a receiving water body, a *toxicity reduction evaluation (TRE) is required. Where multiple dischargers to the same water body are required to conduct TREs, the TREs may be coordinated with the approval of the RWQCB. The TRE shall include all reasonable steps to identify the source(s) of toxicity. Once the source of toxicity is identified, the discharger shall take all reasonable steps necessary to eliminate toxicity.

The following shall be incorporated into permits: (1) a requirement to conduct a TRE if repeated tests reveal toxicity as a result of the waste discharge; (2) a provision requiring a discharger to take all reasonable steps to control toxicity once the source of toxicity is identified; and (3) a statement that failure to conduct required toxicity tests or a TRE within a designated period shall result in the establishment of effluent limitations for chronic toxicity in a permit or appropriate enforcement action.

5. SPECIAL PROVISIONS

The following sections include provisions that address certain discharges and factors that could affect the application of other provisions in this Policy. They include: (1) nonpoint source discharges (section 5.1); (2) site-specific objectives (section 5.2); and (3) exceptions to the Policy provisions (section 5.3).

5.1 Nonpoint Source Discharges

It is the intent of the SWRCB, in adopting this Policy, that the implementation of the priority pollutant criteria/objectives and other requirements of this Policy for nonpoint source discharges shall be consistent with the State's "three-tiered approach" for nonpoint sources. The three tiers, listed in order of increasing stringency, are:

Tier 1. Self-determined implementation of management practices (such as BMPs).

Tier 2. Regulatory-based encouragement of BMPs (through, e.g., WDR waivers conditioned on BMP implementation or management agency agreements between the SWRCB and/or RWQCBs and other agencies with authority to enforce BMPs).

Tier 3. Effluent limitations and enforcement (through, e.g., WDRs, time schedule orders, cease and desist orders, and cleanup and abatement orders).

The RWQCBs may select the appropriate tier, or combination of tiers, to address nonpoint source discharges of priority pollutants. The SWRCB, in adopting this Policy, understands that nonpoint source pollution control can best be achieved through the cooperative efforts of the dischargers, other interested persons, and the SWRCB and RWQCBs.

5.2 Site-Specific Objectives

If a priority pollutant criterion or objective is inappropriate for a particular water body (i.e., it does not protect the beneficial uses or, based on site-specific conditions, a less stringent standard may be warranted), a water quality objective that differs from the applicable criterion or objective may be developed for the site. A RWQCB may develop site-specific objectives whenever it determines, in the exercise of its professional judgement, that it is appropriate to do so. Where a priority pollutant criterion or objective is not being attained in the water body, under certain circumstances, it may be more appropriate to pursue other approaches to achieve the applicable criterion or objective rather than develop a site-specific objective. These approaches include, but are not limited to, watershed management and development of TMDLs (see Appendix 5 and Appendix 6). The RWQCB may investigate, facilitate, or implement such approaches as appropriate.

Regardless of an action taken by the RWQCB as described above, the RWQCB shall, at a public meeting, consider initiating the development of a site-specific objective under the following conditions:

(1) A written request for a site-specific study, accompanied by a preliminary commitment to fund the study, subject to development of a workplan[14], is filed with the RWQCB; and

(2) Either:

(a) a priority pollutant criterion or objective is not achieved in the receiving water; or
(b) a holder of an NPDES permit demonstrates that they do not, or may not in the future, meet an existing or potential effluent limitation based on the priority pollutant criterion or objective; and

(3) A demonstration that the discharger cannot be assured of achieving the criterion or objective and/or effluent limitation through reasonable treatment, source control, and *pollution prevention measures. This demonstration may include, but is not limited to, as determined by the RWQCB:

(a) an analysis of compliance and consistency with all relevant federal and State plans, policies, laws, and regulations;
(b) a thorough review of historical limits and compliance with those limits;
(c) a thorough review of current technology and technology-based limits; and
(d) an economic analysis of compliance with the priority pollutant criterion or objective of concern.

During the period when site-specific objectives studies are being conducted, the RWQCB shall place effluent limitations based upon the applicable priority pollutant criteria or objectives into permits only in conjunction with an appropriate compliance schedule and interim requirements, as described in sections 2.1 and 2.2.

A discharger subject to a schedule for compliance with a CTR criterion or CTR criterion-based effluent limitations, as described in section 2.1, may choose to, concurrently with the actions necessary to achieve compliance, conduct the studies necessary to support the development and adoption of a site-specific objective.[15]

Following adoption of a site-specific objective by the RWQCB, existing effluent limitations shall be replaced with effluent limitations (calculated as described in section 1.4) based on the adopted site-specific objective if the analysis in section 1.3 indicates that a limitation for the pollutant is

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14 The elements presented under the "Special Studies Process" in Appendix 5 should be considered in developing the site-specific objectives workplan.

15 A RWQCB may include a compliance schedule in a water quality standard based on a site-specific objective. Such a compliance schedule is separate and distinct from the compliance schedules established by this Policy.

required. In the event that, for reasons beyond the control of the discharger, a decision whether or not to adopt site-specific objectives has not been made by the RWQCB before the end of the compliance schedule, the compliance schedule shall be extended for an additional period to allow time for a decision whether or not to adopt the objective. However, in no event may a compliance schedule exceed the maximum time period allowed for compliance with the CTR criteria (as described in section 2.1) or priority pollutant objectives (as described in the basin plan, if applicable), unless an exception has been granted (in accordance with section 5.3).

Development of Site-Specific Objectives

Water quality objectives shall be developed in a manner consistent with State and federal law and regulations. In accordance with the State's Porter-Cologne Water Quality Control Act (Division 7 of the Water Code), objectives must provide for the reasonable protection of beneficial uses based on consideration of the factors listed in Water Code Section 13241. In accordance with federal law (CWA) and regulations (40 CFR 131.11, revised as of July 1, 1997), the objectives must be based on sound scientific rationale and protect the designated beneficial uses of the receiving water.

The RWQCB shall use scientifically defensible methods appropriate to the situation to derive the objectives. Such methods may include U.S. EPA-approved methods (e.g., Water Effects Ratio [WER] procedure, recalculation procedure, a combination of recalculation and WER procedures, Resident Species Procedure), and/or other methods specified in the workplan.

A site-specific objective adopted by the RWQCB may include a compliance schedule. However, if attainment of the potential objective(s) developed under the study is anticipated to be infeasible (as defined in 40 CFR 131.10(g), revised as of July 1, 1997), or if the RWQCB otherwise determines it is appropriate, a *use attainability analysis (UAA) may be conducted. The RWQCB shall conduct, with the participation of interested persons, as appropriate, the UAA in accordance with 40 CFR 131.10(j) (revised as of July 1, 1997). If the UAA shows that attainment of the designated beneficial use(s) is not feasible (pursuant to 40 CFR 131.10(g), revised as of July 1, 1997), the RWQCB shall designate an alternative beneficial use or subcategory of use, and develop appropriate water quality objectives to protect the new use(s). Both the use(s) and the objective(s) established to protect it would be reevaluated during the triennial reviews of the State's water quality standards.

5.3 Exceptions

Categorical and case-by-case exceptions to this Policy may be granted pursuant to the provisions below.

Categorical Exceptions

The RWQCB may, after compliance with the California Environmental Quality Act (CEQA), allow short-term or seasonal exceptions from meeting the priority pollutant criteria/objectives if determined to be necessary to implement control measures either:

1. for resource or pest management (i.e., vector or weed control, pest eradication, or fishery management) conducted by *public entities to fulfill statutory requirements, including, but not limited to, those in the California Fish and Game, Food and Agriculture, Health and Safety, and Harbors and Navigation codes; or

2. regarding drinking water conducted to fulfill statutory requirements under the federal Safe Drinking Water Act or the California Health and Safety Code. Such categorical exceptions may also be granted for draining water supply reservoirs, canals, and pipelines for maintenance, for draining municipal storm water conveyances for cleaning or maintenance, or for draining water treatment facilities for cleaning or maintenance.

For each project, the discharger shall notify potentially affected public and governmental agencies. Also, the discharger shall submit to the Executive Officer of the appropriate RWQCB, for approval:

(1) A detailed description of the proposed action, including the proposed method of completing the action;

(2) A time schedule;

(3) A discharge and receiving water quality monitoring plan (before project initiation, during the project, and after project completion, with the appropriate quality assurance and quality control procedures);

(4) CEQA documentation;

(5) Contingency plans;

(6) Identification of alternate water supply (if needed); and

(7) Residual waste disposal plans.

Additionally, upon completion of the project, the discharger shall provide certification by a qualified biologist that the receiving water beneficial uses have been restored.

To prevent unnecessary delays in taking emergency actions or to expedite the approval process for expected or routine activities that fall under categorical exceptions, the discharger is advised to file with the appropriate RWQCB, in advance of seeking RWQCB approval, the information required in items (1)-(7) above, to the extent possible.

Case-by-Case Exceptions

Where site-specific conditions in individual water bodies or watersheds differ sufficiently from statewide conditions and those differences cannot be addressed through other provisions of this

Policy, the SWRCB may, in compliance with the CEQA, subsequent to a public hearing, and with the concurrence of the U.S. EPA, grant an exception to meeting a priority pollutant criterion/objective or any other provision of this Policy where the SWRCB determines:

1. The exception will not compromise protection of enclosed bay, estuarine, and inland surface waters for beneficial uses; and

2. The public interest will be served.

An example of where a case-by-case exception would be appropriate is where it is necessary to accommodate wastewater reclamation or water conservation.

APPENDIX 1

Definition of Terms

ACUTELY TOXIC CONDITIONS, as used in the context of mixing zones, refers to lethality that occurs to mobile aquatic organisms that move or drift through the mixing zone.

ARITHMETIC MEAN (μ), also called the average, is the sum of measured values divided by the number of samples. For ambient water concentrations, the arithmetic mean is calculated as follows:

Arithmetic mean = $\mu = \Sigma x / n$ where:

- Σx is the sum of the measured ambient water concentrations, and
- n is the number of samples.

AVERAGE MONTHLY EFFLUENT LIMITATION (AMEL) means the highest allowable average of daily pollutant discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of measurements.

BEST MANAGEMENT PRACTICES (BMPs) are methods, measures, or practices designed and selected to reduce or eliminate the discharge of pollutants to surface waters from point and nonpoint source discharges including storm water. BMPs include structural and non-structural controls, and operation and maintenance procedures, which can be applied before, during, and/or after pollution producing activities.

BIOACCUMULATIVE pollutants are those substances taken up by an organism from its surrounding medium through gill membranes, epithelial tissue, or from food and subsequently concentrated and retained in the body of the organism.

BIOLOGICALLY-BASED RECEIVING WATER FLOW refers to the method for determining receiving water flows developed by the U.S. EPA Office of Research and Development which directly uses the averaging periods and exceedance frequencies specified in the acute and chronic aquatic life criteria for individual pollutants (e.g., 1 day and 3 years for acute criteria, and 4 days and 3 years for the chronic criteria). Biologically-based flows can be calculated using the program DFLOW.

CARCINOGENIC pollutants are substances that are known to cause cancer in living organisms.

COEFFICIENT OF VARIATION (*CV*) is a measure of the data variability and is calculated as the estimated standard deviation divided by the arithmetic mean of the observed values.

COMPLETELY-MIXED DISCHARGE condition means not more than a 5 percent difference, accounting for analytical variability, in the concentration of a pollutant exists across a transect of the water body at a point within two stream/river widths from the discharge point.

DILUTION CREDIT is the amount of dilution granted to a discharge in the calculation of a water quality-based effluent limitation, based on the allowance of a specified mixing zone. It is calculated from the dilution ratio or determined through conducting a mixing zone study or modelling of the discharge and receiving water.

DILUTION RATIO is the critical low flow of the upstream receiving water divided by the flow of the effluent discharged.

DYNAMIC MODELS used for calculating effluent limitations predict the effects of receiving water and effluent flow and of concentration variability. The outputs of dynamic models can be used to base effluent limitations on probability estimates of receiving water concentrations rather than critical conditions (which are used in the steady-state model). The three dynamic modeling techniques recommended by the U.S. EPA for calculating effluent limitations are continuous simulation, Monte Carlo simulation, and lognormal probability modeling.

EFFLUENT CONCENTRATION ALLOWANCE (ECA) is a value derived from the water quality criterion/objective, dilution credit, and ambient background concentration that is used, in conjunction with the coefficient of variation for the effluent monitoring data, to calculate a long-term average (LTA) discharge concentration. The ECA has the same meaning as waste load allocation (WLA) as used in U.S. EPA guidance (Technical Support Document For Water Quality-based Toxics Control, March 1991, second printing, EPA/505/2-90-001).

ENCLOSED BAYS means indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between the headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. Enclosed bays include, but are not limited to, Humboldt Bay, Bodega Harbor, Tomales Bay, Drake's Estero, San Francisco Bay, Morro Bay, Los Angeles-Long Beach Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay. Enclosed bays do not include inland surface waters or ocean waters.

ESTIMATED CHEMICAL CONCENTRATION is the estimated chemical concentration that results from the confirmed detection of the substance by the analytical method below the ML value.

ESTUARIES means waters, including coastal lagoons, located at the mouths of streams that serve as areas of mixing for fresh and ocean waters. Coastal lagoons and mouths of streams that are temporarily separated from the ocean by sandbars shall be considered estuaries. Estuarine waters shall be considered to extend from a bay or the open ocean to a point upstream where there is no significant mixing of fresh water and sea water. Estuarine waters include, but are not limited to, the Sacramento-San Joaquin Delta, as defined in Water Code Section 12220, Suisun Bay, Carquinez Strait downstream to the Carquinez Bridge, and appropriate areas of the Smith, Mad, Eel, Noyo, Russian, Klamath, San Diego, and Otay rivers. Estuaries do not include inland surface waters or ocean waters.

EXISTING DISCHARGER means any discharger that is not a new discharger. An existing discharger includes an "increasing discharger" (i.e., an existing facility with treatment systems in place for its current discharge that is or will be expanding, upgrading, or modifying its existing permitted discharge after the effective date of this Policy).

FOUR-DAY AVERAGE OF DAILY MAXIMUM FLOWS is the average of daily maximums taken from the data set in four-day intervals.

HARMONIC MEAN flows are expressed as $Q_{hm} = (n)/(\Sigma^{n}_{i=1} 1/x_i)$, where x_i = specific data values and n = number of data values.

INCOMPLETELY-MIXED DISCHARGE is a discharge that contributes to a condition that does not meet the meaning of a completely-mixed discharge condition.

INFEASIBLE means not capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

INLAND SURFACE WATERS are all surface waters of the State that do not include the ocean, enclosed bays, or estuaries.

LOAD ALLOCATION (LA) is the portion of a receiving water's total maximum daily load that is allocated to one of its nonpoint sources of pollution or to natural background sources.

LONG-TERM ARITHMETIC MEAN FLOW is at least two years of flow data used in calculating an arithmetic mean as defined in this appendix.

MAXIMUM DAILY FLOW is the maximum flow sample of all samples collected in a calendar day.

MAXIMUM DAILY EFFLUENT LIMITATION (MDEL) means the highest allowable daily discharge of a pollutant, over a calendar day (or 24-hour period). For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the arithmetic mean measurement of the pollutant over the day.

MEDIAN is the middle measurement in a set of data. The median of a set of data is found by first arranging the measurements in order of magnitude (either increasing or decreasing order). If the number of measurements (n) is odd, then the median = $X_{(n+1)/2}$. If n is even, then the median = $(X_{n/2} + X_{(n/2)+1})/2$ (i.e., the midpoint between the $n/2$ and $n/2+1$).

METHOD DETECTION LIMIT (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, as defined in 40 CFR 136, Appendix B, revised as of May 14, 1999.

MINIMUM LEVEL (ML) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.

MIXING ZONE is a limited volume of receiving water that is allocated for mixing with a wastewater discharge where water quality criteria can be exceeded without causing adverse effects to the overall water body.

MUTAGENIC pollutants are substances that are known to cause a mutation (i.e., change in a gene or chromosome) in living organisms.

NEW DISCHARGER includes any building, structure, facility, or installation from which there is, or may be, a discharge of pollutants, the construction of which commenced after the effective date of this Policy.

OBJECTIONABLE BOTTOM DEPOSITS are an accumulation of materials or substances on or near the bottom of a water body which creates conditions that adversely impact aquatic life, human health, beneficial uses, or aesthetics. These conditions include, but are not limited to, the accumulation of pollutants in the sediments and other conditions that result in harm to benthic organisms, production of food chain organisms, or fish egg development. The presence of such deposits shall be determined by RWQCB(s) on a case-by-case basis.

OCEAN WATERS are the territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. Discharges to ocean waters are regulated in accordance with the SWRCB's California Ocean Plan.

PERSISTENT pollutants are substances for which degradation or decomposition in the environment is nonexistent or very slow.

POLLUTANT MINIMIZATION means waste minimization and pollution prevention actions that include, but are not limited to, product substitution, waste stream recycling, alternative waste management methods, and education of the public and businesses.

POLLUTION PREVENTION means any action that causes a net reduction in the use or generation of a hazardous substance or other pollutant that is discharged into water and includes, but is not limited to, input change, operational improvement, production process change, and product reformulation (as defined in Water Code Section 13263.3). Pollution prevention does not include actions that merely shift a pollutant in wastewater from one environmental medium to another environmental medium, unless clear environmental benefits of such an approach are identified to the satisfaction of the SWRCB or RWQCB.

PROCESS OPTIMIZATION means minor changes to the existing facility and treatment plant operations that optimize the effectiveness of the existing treatment processes.

PUBLIC ENTITY includes the federal government or a state, county, city and county, city, district, public authority, or public agency.

SOURCE OF DRINKING WATER is any water designated as municipal or domestic supply (MUN) in a RWQCB basin plan.

STANDARD DEVIATION (σ) is a measure of variability that is calculated as follows:

$$\sigma = (\Sigma[(x - \mu)^2]/(n - 1))^{0.5}$$

where:

x is the observed value;

μ is the arithmetic mean of the observed values; and

n is the number of samples.

TERATOGENIC pollutants are substances that are known to cause structural abnormalities or birth defects in living organisms.

TOXICITY REDUCTION EVALUATION (TRE) is a study conducted in a step-wise process designed to identify the causative agents of effluent or ambient toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in toxicity. The first steps of the TRE consist of the collection of data relevant to the toxicity, including additional toxicity testing, and an evaluation of facility operations and maintenance practices, and best management practices. A Toxicity Identification Evaluation (TIE) may be required as part of the TRE, if appropriate. (A TIE is a set of procedures to identify the specific chemical(s) responsible for toxicity. These procedures are performed in three phases [characterization, identification, and confirmation] using aquatic organism toxicity tests.)

USE ATTAINABILITY ANALYSIS is a structured scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological, and economic factors as described in 40 CFR 131.10(g) (40 CFR 131.3, revised as of July 1, 1997).

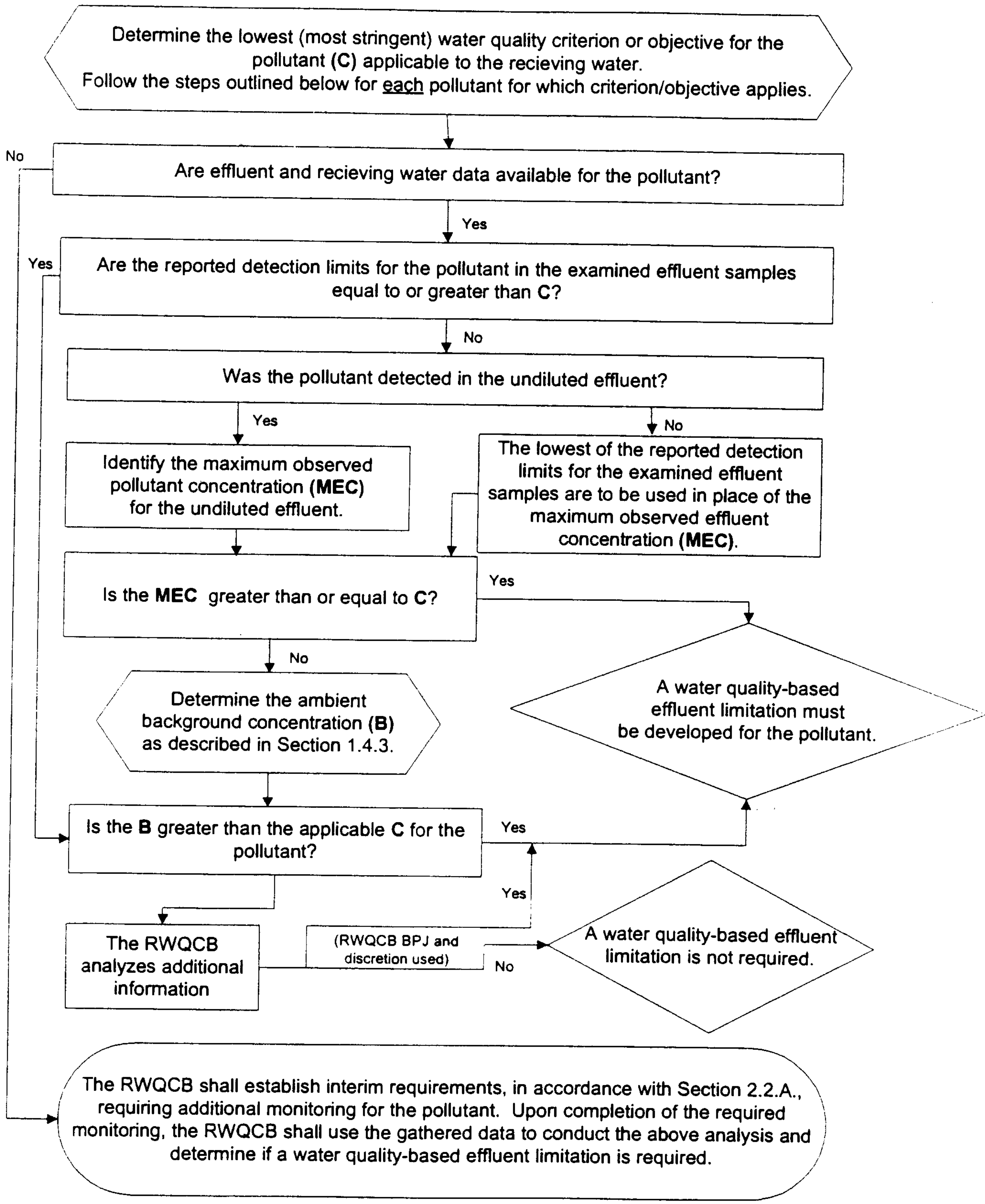
1Q10 is the lowest flow that occurs for one day with a statistical frequency of once every 10 years.

7Q10 is the average low flow that occurs for seven consecutive days with a statistical frequency of once every 10 years.

90th PERCENTILE OF OBSERVED DATA is the measurement in the ordered set of data (lowest to highest) where 90 percent of the reported measurements are less than or equal to that value.

APPENDIX 2

Determination of Pollutants Requiring Water Quality-Based Effluent Limitations



APPENDIX 3

U.S. Environmental Protection Agency Conversion Factors

Metal	Conversion Factor (CF) for Freshwater Acute Criteria	CF for Freshwater Chronic Criteria	CF for Saltwater Acute Criteria	CF(a) for Saltwater Chronic Criteria
Antimony	(d)	(d)	(d)	(d)
Arsenic	1.000	1.000	1.000	1.000
Beryllium	(d)	(d)	(d)	(d)
Cadmium (b)	0.944	0.909	0.994	0.994
Chromium (III)	0.316	0.860	(d)	(d)
Chromium (VI)	0.982	0.962	0.993	0.993
Copper	0.960	0.960	0.83	0.83
Lead (b)	0.791	0.791	0.951	0.951
Mercury	0.85	0.85	0.85	0.85
Nickel	0.998	0.997	0.990	0.990
Selenium	(c)	(c)	0.998	0.998
Silver	0.85	(d)	0.85	(d)
Thallium	(d)	(d)	(d)	(d)
Zinc	0.978	0.986	0.946	0.946

Footnotes:

(a) Conversion Factors for chronic marine criteria are not currently available. Conversion Factors for acute marine criteria have been used for both acute and chronic marine criteria.

(b) Conversion Factors for these pollutants are hardness dependent. CFs are based on a hardness of 100 mg/L as calcium carbonate ($CaCO_3$). Other hardness can be used; CFs should be recalculated using the following equations:
Cadmium: Acute: CF = 1.136672 - [(ln {hardness})(0.041838)]
Cadmium: Chronic: CF = 1.101672 - [(ln {hardness})(0.041838)]
Lead: Acute and Chronic: CF = 1.46203 - [ln {hardness})(0.145712)]

(c) Bioaccumulative compound and inappropriate to adjust to percent dissolved.

(d) U.S. EPA has not published an aquatic life criterion value.

NOTE: The term "Conversion Factor" represents the recommended conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria," October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available from the Water Resource Center, USEPA, 401 M St. SW., mail code RC 4100, Washington, DC 20460; and 40 CFR §131.36(b)(1).

Source: CTR (65 Fed. Register 31682-31719, May 18, 2000), adding Section 131.38 to 40 CFR).

APPENDIX 4

SWRCB Minimum Levels in ppb (μg/L)

The Minimum Levels (MLs) in this appendix are for use in reporting and compliance determination purposes in accordance with section 2.4 of this Policy. These MLs were derived from data for priority pollutants provided by State certified analytical laboratories in 1997 and 1998. These MLs shall be used until new values are adopted by the SWRCB and become effective. The following tables (Tables 2a - 2d) present MLs for four major chemical groupings: volatile substances, semi-volatile substances, inorganics, and pesticides & PCBs.

Table 2a - VOLATILE SUBSTANCES*	GC	GCMS
1,1 Dichloroethane	0.5	1
1,1 Dichloroethene	0.5	2
1,1,1 Trichloroethane	0.5	2
1,1,2 Trichloroethane	0.5	2
1,1,2,2 Tetrachloroethane	0.5	1
1,2 Dichlorobenzene (volatile)	0.5	2
1,2 Dichloroethane	0.5	2
1,2 Dichloropropane	0.5	1
1,3 Dichlorobenzene (volatile)	0.5	2
1,3 Dichloropropene (volatile)	0.5	2
1,4 Dichlorobenzene (volatile)	0.5	2
Acrolein	2.0	5
Acrylonitrile	2.0	2
Benzene	0.5	2
Bromoform	0.5	2
Bromomethane	1.0	2
Carbon Tetrachloride	0.5	2
Chlorobenzene	0.5	2
Chlorodibromo-methane	0.5	2
Chloroethane	0.5	2
Chloroform	0.5	2
Chloromethane	0.5	2
Dichlorobromo-methane	0.5	2
Dichloromethane	0.5	2
Ethylbenzene	0.5	2
Tetrachloroethene	0.5	2
Toluene	0.5	2
trans-1,2 Dichloroethylene	0.5	1
Trichloroethene	0.5	2
Vinyl Chloride	0.5	2

*The normal method-specific factor for these substances is 1, therefore, the lowest standard concentration in the calibration curve is equal to the above ML value for each substance.

Table 2b - SEMI-VOLATILE SUBSTANCES*	GC	GCMS	LC	COLOR
1,2 Benzanthracene	10	5		
1,2 Dichlorobenzene (semivolatile)	2	2		
1,2 Diphenylhydrazine		1		
1,2,4 Trichlorobenzene	1	5		
1,3 Dichlorobenzene (semivolatile)	2	1		
1,4 Dichlorobenzene (semivolatile)	2	1		
2 Chlorophenol	2	5		
2,4 Dichlorophenol	1	5		
2,4 Dimethylphenol	1	2		
2,4 Dinitrophenol	5	5		
2,4 Dinitrotoluene	10	5		
2,4,6 Trichlorophenol	10	10		
2,6 Dinitrotoluene		5		
2- Nitrophenol		10		
2-Chloroethyl vinyl ether	1	1		
2-Chloronaphthalene		10		
3,3' Dichlorobenzidine		5		
3,4 Benzofluoranthene		10	10	
4 Chloro-3-methylphenol	5	1		
4,6 Dinitro-2-methylphenol	10	5		
4- Nitrophenol	5	10		
4-Bromophenyl phenyl ether	10	5		
4-Chlorophenyl phenyl ether		5		
Acenaphthene	1	1	0.5	
Acenaphthylene		10	0.2	
Anthracene		10	2	
Benzidine		5		
Benzo(a) pyrene(3,4 Benzopyrene)		10	2	
Benzo(g,h,i)perylene		5	0.1	
Benzo(k)fluoranthene		10	2	
bis 2-(1-Chloroethoxyl) methane		5		
bis(2-chloroethyl) ether	10	1		
bis(2-Chloroisopropyl) ether	10	2		
bis(2-Ethylhexyl) phthalate	10	5		
Butyl benzyl phthalate	10	10		
Chrysene		10	5	
di-n-Butyl phthalate		10		
di-n-Octyl phthalate		10		
Dibenzo(a,h)-anthracene		10	0.1	
Diethyl phthalate	10	2		
Dimethyl phthalate	10	2		
Fluoranthene	10	1	0.05	
Fluorene		10	0.1	
Hexachloro-cyclopentadiene	5	5		

Table 2b - SEMI-VOLATILE SUBSTANCES*	GC 608	GCMS 625	LC	COLOR
Hexachlorobenzene	5	1		
Hexachlorobutadiene	5	1		
Hexachloroethane	5	1		
Indeno(1,2,3,cd)-pyrene		10	0.05	
Isophorone	10	1		
N-Nitroso diphenyl amine	10	1		
N-Nitroso-dimethyl amine	10	5		
N-Nitroso -di n-propyl amine	10	5		
Naphthalene	10	1	0.2	
Nitrobenzene	10	1		
Pentachlorophenol	1	5		
Phenanthrene		5	0.05	
Phenol **	1	1		50
Pyrene		10	0.05	

* With the exception of phenol by colorimetric technique, the normal method-specific factor for these substances is 1000, therefore, the lowest standard concentration in the calibration curve is equal to the above ML value for each substance multiplied by 1000.

** Phenol by colorimetric technique has a factor of 1.

Table 2c – INORGANICS*	FAA	GFAA	ICP	ICPMS	SPGFAA	HYDRIDE	CVAA	COLOR	DCP
Antimony	10	5	50	0.5	5	0.5			1000
Arsenic		2	10	2	2	1		20	1000
Beryllium	20	0.5	2	0.5	1				1000
Cadmium	10	0.5	10	0.25	0.5				1000
Chromium (total)	50	2	10	0.5	1				1000
Chromium VI	5							10	
Copper	25	5	10	0.5	2				1000
Cyanide								5	
Lead	20	5	5	0.5	2				10,000
Mercury				0.5			0.2		
Nickel	50	5	20	1	5				1000
Selenium		5	10	2	5	1			1000
Silver	10	1	10	0.25	2				1000
Thallium	10	2	10	1	5				1000
Zinc	20		20	1	10				1000

* The normal method-specific factor for these substances is 1, therefore, the lowest standard concentration in the calibration curve is equal to the above ML value for each substance.

Table 2d - PESTICIDES – PCBs*	GC
4,4'-DDD	0.05
4,4'-DDE	0.05
4,4'-DDT	0.01
a-Endosulfan	0.02
a-Hexachloro-cyclohexane	0.01
Aldrin	0.005
b-Endosulfan	0.01
b-Hexachloro-cyclohexane	0.005
Chlordane	0.1
d-Hexachloro-cyclohexane	0.005
Dieldrin	0.01
Endosulfan Sulfate	0.05
Endrin	0.01
Endrin Aldehyde	0.01
Heptachlor	0.01
Heptachlor Epoxide	0.01
Lindane(g-Hexachloro-cyclohexane)	0.02
PCB 1016	0.5
PCB 1221	0.5
PCB 1232	0.5
PCB 1242	0.5
PCB 1248	0.5
PCB 1254	0.5
PCB 1260	0.5
Toxaphene	0.5

* The normal method-specific factor for these substances is 100, therefore, the lowest standard concentration in the calibration curve is equal to the above ML value for each substance multiplied by 100.

Techniques:

GC - Gas Chromatography
GCMS - Gas Chromatography/Mass Spectrometry
HRGCMS - High Resolution Gas Chromatography/Mass Spectrometry (i.e., EPA 1613, 1624, or 1625)
LC - High Pressure Liquid Chromatography
FAA - Flame Atomic Absorption
GFAA - Graphite Furnace Atomic Absorption
HYDRIDE - Gaseous Hydride Atomic Absorption
CVAA - Cold Vapor Atomic Absorption
ICP - Inductively Coupled Plasma
ICPMS - Inductively Coupled Plasma/Mass Spectrometry
SPGFAA - Stabilized Platform Graphite Furnace Atomic Absorption (i.e., EPA 200.9)
DCP - Direct Current Plasma
COLOR - Colorimetric

APPENDIX 5

Special Studies

Pre-Evaluation for Special Studies
Decision Tree with Attached Narrative Discussion

A special study is sometimes conducted as part of a regulatory process (standard setting and permit writing) and may be conducted as part of a collaborative watershed planning effort. Special studies can provide site-specific data that can assist in decision-making regarding water quality and beneficial use issues.

Many water quality problems may be best addressed on a watershed or water body basis. The SWRCB believes that stakeholders should be able to develop flexible and innovative solutions for water quality problems in their watershed. For special studies conducted as part of a watershed management plan, the watershed management group should be involved in the design of the study, and study information should be provided back to the committee. Watershed or water body studies may gather data regarding topics such as:

- TMDLs, WLAs, and LAs (see Appendix 6);
- Regional ambient monitoring (regional ambient monitoring is the collection of scientific information regarding water quality and impacts to beneficial uses for a specified portion of, or an entire, watershed or water body); and
- Contaminant fate and transport monitoring (contaminant fate and transport monitoring is the gathering of scientific information regarding how a specific pollutant[s] moves through the environment and how the pollutant[s] degrades or is otherwise transformed in the environment).

These types of studies are useful to collect integrated, comprehensive, and systematic data regarding:

- Baseline concentrations of toxic pollutants in the water and sediment;
- Seasonal, annual, and long-term trends in water quality;
- Causes and effects of water quality problems;
- Effectiveness of a water quality control effort;
- Greater certainty regarding existing monitoring data; etc.

Any of the studies discussed below may be undertaken as part of a watershed approach to addressing regional water quality issues. Information collected as part of a watershed or water body study can be used as a way to define parameters (e.g., ambient background concentrations, mixing zones, etc.) related to the development of effluent limitations as part of the permitting process or to evaluate whether changes in water quality standards are appropriate. A watershed or water body approach is also useful to dischargers because information collected as a part of one effluent limitation or standard-setting study can be shared with other stakeholders in the same water body.

Studies for Setting Effluent Limitations

Studies regarding establishing effluent limitations can be done as part of the permitting process. Such studies may be simpler and there may be fewer interested stakeholders than studies involving more than one discharger, or an entire water body or watershed. However, when such studies are undertaken individually, the discharger, the RWQCB, and other stakeholders do not gain the benefit of data collected from others in the watershed.

Special studies may address topics such as the following:

- Determining pollutants requiring effluent limitations (see section 1.3);
- Metals translators (see section 1.4.1); or
- Mixing zones (see section 1.4.2).

Studies For Changes to Water Quality Standards

Establishing or modifying water quality standards (i.e., beneficial uses and water quality criteria/objectives) may involve complex and resource intensive studies. A detailed workplan will normally be needed because early planning and coordination with the RWQCB and U.S. EPA is critical to the development of a successful study. In addition, a workplan will normally be appropriate because there will be more stakeholder interest and involvement of other public agencies (e.g., Department of Fish and Game, U.S. Fish and Wildlife Service, etc.). Involvement in a watershed management planning effort would facilitate the sharing of information among stakeholders in the watershed, both in gathering information for the study and in sharing the results. Studies related to changes in water quality standards may address topics such as the following:

- Site-specific objective studies (see section 5.2), and
- Use attainability analysis (UAA) (see section 5.2).

Pre-Evaluation

As a first step in determining whether and how to conduct a special study, the RWQCB or other stakeholders may want to evaluate whether it would be appropriate to address a water quality issue through a watershed management approach. To do that, the factors in the following flowchart may be considered:

1. Is there a watershed management group?[a]

↓ Yes

2. Has a watershed management approach been developed?[b] →→→→→ No → GO TO start of Decision Tree[d] if water issue involves toxics.

↓ Yes

3. Are toxic pollutants part of the reason beneficial uses are impaired or water quality objectives are exceeded?[c] →→→→→ No → Issue is outside scope of this Policy.

↓ Yes

GO TO #9 in Decision Tree[d], or other point in Decision Tree as determined by stakeholders.

The decision tree and associated narrative discussion in Appendix 5 are provided to assist RWQCBs and stakeholders in identifying whether there is a current or potential water quality issue requiring attention [Compliance Status], the nature of the identified water quality issue [Screening-level Evaluation], and possible action to address the issue [Potential Options].

Based on this information, the RWQCB and stakeholders can determine whether a special study is needed and the scope of the study. This approach can help avoid initiation of costly and time-consuming studies which are not appropriately designed to resolve the specific issue in question. The decision tree is not meant to preclude the exploration of any other creative solutions; it is meant to encourage constructive dialogue among stakeholders.

Two specific considerations should be kept in mind when conducting the pre-evaluation suggested by this decision tree. First, users must be familiar with the quality of the data under review and the potential need to augment data which are not of adequate quality. Second, users should know what the existing beneficial uses are (i.e., uses attained since 1975).

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[a] Is there a committee of local interests in both the public and private sectors that are actively involved in the management of the watershed area?

[b] Has a watershed management approach that identifies key issues, boundaries, objectives, and early actions been developed?

[c] A study may be necessary to determine whether toxics are part of the cause of the impairment of beneficial uses. This Policy applies only to the CTR and NTR criteria, and applicable chemical-specific basin plan objectives for priority toxic pollutants.

[d] The decision tree is on page APPENDIX 5 - 6.

Special Studies Process

A. Workplan

If appropriate, the RWQCB may participate in developing a detailed workplan with interested persons (which can include, but are not limited to, U.S. EPA, the RWQCB, the SWRCB, and affected dischargers) prior to proceeding with a special study. The workplan may include the following elements:

(1) Formation of a project team for the workplan, which may include the Department of Fish and Game, the U.S. Fish and Wildlife Service, and other stakeholders;

(2) Purpose of the workplan;

(3) Responsibilities of the persons associated with the workplan;

(4) Budget and cost-sharing plan. This plan must be determined on a case-by-case basis; however, the SWRCB encourages sharing of costs (based on availability of funding), where there are multiple persons who wish to support the goals of the study;

(5) Development of the following elements:

(a) Identification of tasks(s),
(b) Purpose of tasks(s),
(c) Method by which task(s) will be implemented,
(d) Products of the tasks(s),
(e) Schedule for the task(s),
(f) Responsibility for implementing the task(s), and
(g) Budget and funding for the task(s);

(6) Administrative policies and procedures to govern oversight of the special studies process (e.g., amending the workplan, conflict resolution, etc.); and

(7) Project schedule.

B. Scientific Review Panel

If, during the data interpretation phase of a special study, the RWQCB, SWRCB, U.S. EPA, or other stakeholders have differing opinions with regard to the interpretation of data, the RWQCB and stakeholders may want to seek the advice of an independent scientific review panel. The method of selecting the panel, cost reimbursement, and other details regarding the conflict resolution process could be included in the workplan.

C. Compliance Schedule

A permit compliance schedule (as described in section 2.1) may allow sufficient time for collection of data, completion of a study, and determination of compliance measures. While special studies are being conducted, interim requirements may be established by the RWQCB (as described in section 2.2). However, in no event may a compliance schedule exceed the time period allowed in this Policy, unless an exception has been granted.

D. Environmental and Economic Impacts

To ensure that environmental and economic impacts are adequately addressed, the RWQCB staff shall, as part of the special study workplan:

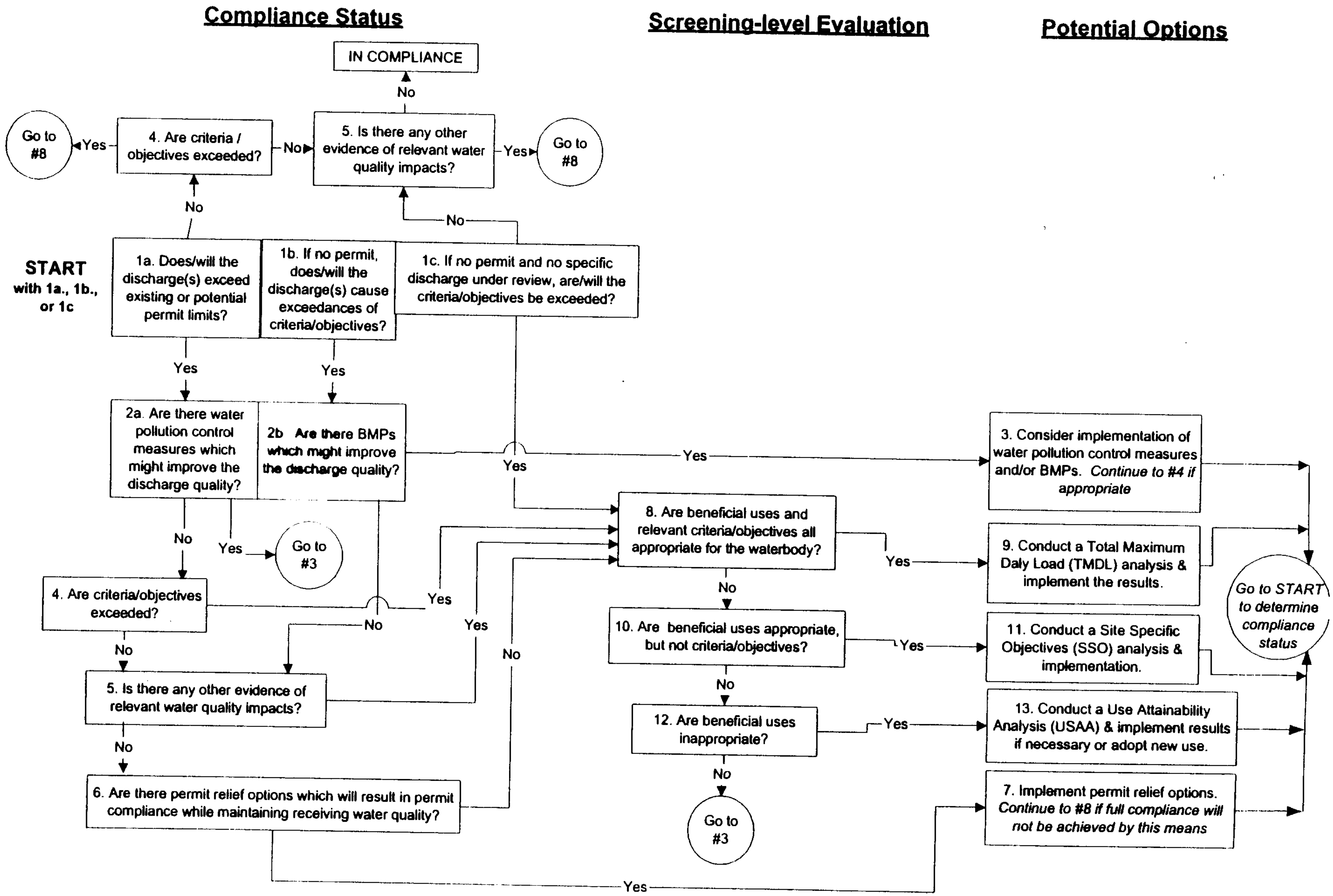
(1) Comply with CEQA, if applicable; and

(2) Direct the preparation of an analysis documenting economic impacts if site-specific objectives or a change in designated beneficial uses is being considered under 40 CFR 131.10(g)(6), revised as of July 1, 1997.

E. Antidegradation and Other Legal Requirements

RWQCB staff shall, as part of the special study workplan, ensure compliance with SWRCB Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California) and any other applicable legal requirements.

Pre-Evaluation for Special Studies
Decision Tree with Attached Narrative Discussion



APPENDIX 5 - 6

R0020064

Narrative Discussion of Decision Tree:

1a. Does/will a discharge exceed existing or potential permit limits for toxic pollutants? This question applies to discharges regulated by a National Pollutant Discharge Elimination System (NPDES) permit or Waste Discharge Requirements (WDRs). If the discharge(s) in question is not regulated by a discharge permit, proceed to #1b. It is assumed that data used to answer this question are reliable.

1b. If no permit, does the discharge(s) cause exceedances of criteria/objectives? This question primarily applies to nonpoint discharges, though it could conceivably apply to point source discharges which are not currently permitted. It is assumed that data used to answer this question are reliable.

1c. If no permit and no specific discharge(s) are under review, are criteria/objectives exceeded? It is assumed that data used to answer this question are reliable.

2a. Are there water pollution control measures which might improve the water quality? A water pollution control program may include, as appropriate: pollution control technologies; pretreatment requirements; and pollution prevention, waste minimization, and source control measures. This question is meant to elicit consideration of effluent quality control measures which could be implemented as a full or partial solution to the identified permit noncompliance issue. It is not intended as a barrier to the exploration of other potential forms of regulatory adjustment.

2b. Are there Best Management Practices (BMPs) which might improve water quality? BMPs are pollution management measures designed to reduce the water quality impacts, where they exist, associated primarily with non-point source discharges. As with #2a above, this question is meant to elicit consideration of discharge control measures which could be implemented as a full or partial solution to the identified noncompliance issue. It is not intended as a barrier to the exploration of other potential forms of regulatory adjustment.

3. Consider whether implementation of water pollution control measures and/or BMPs will lead to compliance. Simultaneously, continue to #4 if deemed appropriate, considering such questions as whether or not full compliance will be achieved by these means, or whether it would be cost effective. As stated, the simple determination that implementation of pollution control measures and/or BMPs might improve the discharge or water quality should not preclude the exploration of other potential regulatory adjustment options, as well. For clarity, the reviewer should proceed not to box four prime, but to box four.

4. Are criteria/objectives exceeded? It is assumed that data used to answer this question are reliable and appropriate hardness adjustments have been made.

5. Is there any other evidence of relevant water quality impacts? This question is meant to capture those situations where the criteria/objective for the pollutant of concern do not exist

or appear to be under protective. "Other evidence" might include: bioconcentration or biocriteria data, population studies, food web analyses, etc. Impacts to wildlife should be considered as should impacts to threatened and endangered species. The potential for impacts to be of a seasonal nature should also be considered in this pre-evaluation. "Relevant water quality impacts" are those impacts which have a demonstrable relationship to the pollutant(s) of concern.

6. Are there permit relief options which will result in permit compliance while maintaining receiving water quality? Permit relief options might include, where appropriate: development of a mixing zone, modification of the averaging periods, adoption of a variance, etc. For unpermitted discharges or pre-evaluations involving no specific discharges, the user should continue to box #8.

7. Implement permit relief options. Continue to #8 if full compliance will not be achieved by these means. The development of permit relief options would occur through a request to the RWQCB.

8. Are beneficial uses and criteria/objectives both appropriate for the water body? To answer this question, a screening-level evaluation may be necessary, including an evaluation of the associated regulatory history, the site-specific conditions, and the status of current, applicable scientific understanding. It is assumed that data used to answer this question are reliable.

   This question is best answered when a watershed stakeholder group has formed and collectively either: 1) evaluated the condition of the watershed through a watershed management plan, 2) evaluated the condition of the watershed through less formal means, or 3) convened discussions regarding the condition of the watershed. If one does not currently exist, a watershed stakeholder group should be formed if it appears to be a useful forum for discussion and review. The following more specific questions may apply:

- Is the water effluent dominated, agricultural drainage water dominated, etc.? These water bodies may be likely candidates for the appropriate application of regulatory adjustments (e.g., SSO or UAA).

- Were the current beneficial uses applied on a national, state-wide, or region-wide basis or have they been specifically designated for the water body in question? While not the only candidates, water bodies for which beneficial uses have been applied on a national, state-wide, or region-wide basis may be candidates for the appropriate application of regulatory adjustments (e.g., SSO).

- Are there rare, threatened, or endangered species, or ecological conditions which the currently applied beneficial uses do not adequately describe or the water quality objectives do not fully protect?

- Has the beneficial use and the water quality necessary to maintain the beneficial use been attained since 1975?

- How do anti-degradation requirements apply?

- Are elevated constituents the result of 1) natural phenomena or 2) anthropogenic activities that ceased prior to 1975?

- Do the currently designated beneficial uses protect all existing and appropriate potential uses?

- Are natural, ephemeral, intermittent, or low flow conditions or water levels preventing the attainment of the designated non-existing uses?

- Are there human-caused conditions or sources of pollution which prevent attainment of the uses but either cannot be remedied or would cause greater environmental damage if corrected?

- Does the presence of dams, diversions, or other types of hydrologic modifications preclude the attainment of designated non-existing beneficial uses?

- Do the physical conditions of the water body preclude attainment of aquatic life protection uses (i.e., lack of proper substrate, cover, flow, depth, pools, riffles, and the like)?

- Does attainment of designated beneficial uses require the application of controls which would result in substantial and widespread economic and social impact?

- Have the appropriate water characteristics (e.g., hardness, pH) been accounted for in the CTR criteria?

- Has an appropriate set of species been evaluated in setting the CTR criteria and toxicity objective?

9. Conduct a total maximum daily load analysis and implement the results. Conducting a TMDL could result in, among other things, waste load allocations, BMP implementation for non-point dischargers, and/or effluent trading options for point and non-point source dischargers. (See Appendix 6 regarding TMDLs.)

10. Are beneficial uses appropriate but not criteria/objectives for toxic pollutants? See #8 above.

11. Conduct a site-specific objectives analysis. An SSO study will include one or more of the following activities:

    - Recalculation of objective;
    - Water effects ratio or other similar method; or
    - Any scientifically defensible process.

U.S. EPA's "Guidelines for Deriving Numerical Aquatic Site Specific Water Quality Criteria by Modifying National Criteria," dated 1984 (EPA-600/3-84-099), provides guidance for conducting an SSO study.

U.S. EPA's "Water Quality Standards Handbook," dated 1994, also provides general guidance in this area.

12. Are beneficial uses inappropriate? See #8 above.

13. Conduct a use attainability analysis (UAA) and implement the results. When a use is proposed for dedesignation, i.e., removed or replaced with a subcategory requiring less stringent standards, a UAA is necessary. In a case where a use is proposed to be added, a UAA is not necessary. A new use designation can be added for a water body following the normal public review process. A UAA will determine if physical, chemical, and/or biological factors affect the attainability of a designated use via a water body survey and assessment. An analysis of economic factors can also be included to determine whether substantial and widespread economic and social impacts would be caused by stringent pollution control requirements.

    U.S. EPA's "Technical Support Manual: Water body Survey and Assessment for Conducting Use Attainability Analyses," dated 1983, provides guidance for conducting a UAA as does Region 9's Interim Final "Guidance for Modifying Water Quality Standards and Protecting Effluent-Dependent Ecosystems," dated 1992. U.S. EPA's "Water Quality Standards Handbook," dated 1994, also provides general guidance in this area.

APPENDIX 6

Watershed Management and TMDLs

Watershed Management

The SWRCB will utilize and promote, to the extent feasible, a watershed approach to address water quality issues involving toxic pollutants. Compared to the more traditional, programmatic approach to water management, the watershed approach can look at all types of pollution and all sources of pollution. One consequence of the more global perspective is that attention can be trained on the most effective strategies for management (rather than the most programmatically expedient). Another consequence is that a much larger universe of interested persons becomes important to the management of water quality, and the ability to work with these people creates added value for water management. In utilizing the watershed approach, the SWRCB will work to marshall the expertise and resources of other agencies and the private sector to collaboratively manage water quality.

In a collaborative, stewardship effort, local interests are engaged with State and federal interests, and land managers, to work with water managers to solve complex resource management problems. A watershed perspective can also enhance interagency coordination by focusing programs on resource needs throughout the watershed.

Watershed management is an integrated holistic approach for restoring and protecting aquatic ecosystems and protecting human health in a geographic area. Watershed management may include diverse issues as defined by the watershed's stakeholders (persons with some interest in the watershed) to ensure comprehensive solutions. It reflects a growing consensus that many of the existing water quality problems can be best addressed by a more integrated, basin-wide approach. The purpose of watershed management is variously viewed as (1) a method for increasing participation at the local level in water quality protection, (2) an approach to reducing the impact of nonpoint sources, (3) a strategy for integrating management of all components of aquatic ecosystems, and (4) a process for optimizing the cost effectiveness of a blend of point and nonpoint source control efforts.

Whichever purpose or blend of purposes predominates, watershed management is not a new centralized program that competes with or replaces existing programs. The significant advantage of the watershed management approach is that it encourages a collaborative, stewardship-driven process where diverse interests (individuals, landowners, farmers, POTWs, industries, environmentalists, and agencies) can work in conjunction with SWRCB and RWQCB staff to develop a consensus on, and share responsibility for, addressing water quality problems. The watershed approach assumes all stakeholders are brought to the table; therefore, there should be one watershed group that can develop a plan for the watershed that addresses the interests of stakeholders in the watershed. Furthermore, watershed management provides a mechanism for considering social and economic interests, in the context of resolving water quality issues. The SWRCB and RWQCBs will work to preserve the integrity of the watershed process and facilitate an open and timely resolution of issues.

In some cases, there is no active watershed management group that has evolved far enough to have identified key issues, boundaries, objectives, and early actions. In these instances, a group of government agencies may work together to define the conditions in a water body and to identify the specific parameters contributing to beneficial use impairments. In any event, the RWQCBs may have to act more or less independently to meet legal requirements using primarily in-house staff. Participation from other interested persons, under these circumstances, is accomplished through the SWRCB and RWQCB public hearing processes.

Watershed management planning and implementation actions will occur primarily at the RWQCB and local level. However, the SWRCB will provide training in stewardship and watershed management, and support educational efforts involving K through 12 programs as well as land owners/managers.

TMDLs and Watershed Management

TMDLs are required for all waters listed pursuant to CWA Section 303(d)(1)(A). The SWRCB is committed to expeditiously addressing these water quality problems.

A TMDL establishes the amount of a pollutant that may be discharged into a water body and still maintain water quality standards with seasonal variations and a margin of safety that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. The TMDL process is defined in federal regulations (40 CFR 130.7, revised as of July 1, 1996) and generally consists of five steps:

(1) Identification by each state of water quality-limited waters that do not now, or are not expected to, attain state water quality standards after implementation of technology-based effluent limitations, more stringent effluent limitations required by federal, State, or local authority, and other pollution control requirements (e.g., best management practices) required by local, State, or federal authority, and identification of impairment;

(2) Establishment of priority rankings for the development of TMDLs;

(3) Development of waste load allocations (WLAs), load allocations (LAs), and TMDLs;

(4) Incorporation of the loadings in the RWQCB basin plans; and

(5) Submittal of segments identified, priority ranking, and loads established to U.S. EPA for approval.

Development of TMDLs can utilize the watershed approach to assess and identify water quality-limited segments and pollutants causing impairment, identify sources, and allocate pollutant loads. The watershed approach may address a broader range of issues than the TMDLs, but the approach can: (1) result in achieving or maintaining water quality standards so that waters are not added to the 303(d) list; (2) result in attainment of water quality standards, through means other than the TMDL process, so that waters can be removed from the 303(d) list; or (3) be used to develop TMDLs. A watershed group can develop a TMDL if the TMDL complies with applicable federal requirements.

BEST MANAGEMENT PRACTICES
FOR
STORM WATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITIES

DEQ

State of Oregon
Department of Environmental Quality

Guidance for Reducing or Eliminating
Pollutants in Storm Water Discharges
Associated with Industrial Activities

DEQ Northwest Region Document

Revised – January 2001

R0020071

Background: In 1998 a Total Maximum Daily Load (TMDL) was developed and approved by the U.S. Environmental Protection Agency for the Columbia Slough. This TMDL indicated that additional and more effective environmental pollution prevention practices were required to meet water quality standards and the basin beneficial uses criteria and that more commercial and industrial businesses would be required to participate in the permitting process in order to achieve water quality standards and restore those beneficial uses within the Slough. This lead to the development of the Best Management Practices (BMPs) addressed in this document and the concept of treating the potential point sources that may contribute to the non-point storm water discharges.

Best Management Practices: BMPs are practices or procedures that include methods to prevent toxic and hazardous substances from reaching receiving waters. They are designed to address the quality of a facility's practices with respect to storm water leaving the site, and may ultimately affect the ability of the facility to meet environmental control standards or benchmarks. They are most effective when organized into a comprehensive Storm Water Pollution Control Plan. Many different practices can be used to achieve similar environmentally protective results. With facility-specific or activity-specific pollutant(s) of concern as the major consideration(s) in selecting appropriate BMPs, this flexibility allows a facility to tailor a Storm Water Pollution Control Plan to meet its needs using the capabilities and resources available.

The BMPs included in this document, for the most part, address activities and operations that take place outdoors or have a direct impact on the areas outside of the buildings. These BMPs are to be considered a work-in-process and are by no means to be considered a complete list of appropriate pollution control measures. Additional BMPs will be added periodically to this document.

Contributing Agencies: Assistance in developing these BMPs was provided by the Columbia Slough Technical Advisory Committee. This document was compiled by Dennis Jurries, Environmental Engineer with the Department of Environmental Quality, and formatted by Carolyn Sharp, an intern also with DEQ.

Best Usage: The best way to use this guide is to assess your site and your storm water discharge(s). Determine the pollutants in the storm water discharge(s) and the potential sources of those pollutants on site, then determine which potential sources have the most significant impact on the discharge(s). Select BMP(s) that will be most effective in controlling pollution in the storm water discharges for the resources and costs that will be required to implement those BMPs. Implement the BMPs selected and sample the storm water discharges to check the results of the BMP implementation and determine if more BMPs will be required in order to meet the benchmarks for the various pollutants of concern.

Caution: The efficiencies provided in this document should be used as indicators of the potential effects the implementation of any particular BMP may provide. The efficiencies can be variable depending on a number of factors including flow, maintenance of BMP, loading, and other factors.

Acknowledgment: Partial funding for the writing, initial publishing, and revision of this document came from a Pollution Prevention Grant provided by EPA.

BMP Selection Table			
Pollutant	**Activity**	**BMP №**	**Page №**
Heavy Metals, BOD_5, Bacteria, Fungicides Oil, Corrosion Inhibitors, Emulsifiers, Biocides, pH	Mechanical metal removal	CS1	1
Oily air emissions, Metal Particles, Gaseous Metal, Vaporized Flux	Cutting and welding of metal	CS2	2
Oil, Hydraulic Fluid, Antifreeze, Paint, Solvent, Cleaners, Petroleum Hydrocarbons, Toluene, Ethylene Glycol	Oil (& Other Fluids) Dispensing & Outside Storage	CS3	3
Oils, Diesel, Gasoline(Petroleum Hydrocarbons), Antifreeze(Ethylene Glycol), and Solvents(Toluene, Mineral Oil)	Storage of liquids in bulk containers or tanks.	CS4	5
Zinc	Galvanized corrugated sheet metal roof and/or outside walls on buildings	CS5	6
Petroleum Hydrocarbons	Parts & equipment cleaning in Parts Cleaners containing mineral spirits/oil or petroleum products	CS6	6
Grease (Petroleum Hydrocarbons with heavy metal additives)	Vehicle maintenance, equipment maintenance, involving grease	CS7	7
Degreasers, Soap, Heavy Metals, Oil, Grease	Pressure washing/steam cleaning of equipment and/or vehicles.	CS8	8
Oil, Grease, Suspended Solids	Steel, equipment, or vehicles stored outside	CS9	15
Oil	Use of compressed air at the site.	CS10	16
Oil & Grease, Suspended Solids	Retrofiting standard catch basins and drains with sediment and oil retention catch basins	CS11	17
Metal Fines, Suspended Solids	Arc furnace or mechanical removal operations creating dust that is collected in baghouses.	CS12	18
Biocides, Algaecides, Fungicides, Corrosion Inhibitors(BOD_5, COD), Suspended Solids, Zinc, Copper, pH	The use of cooling towers with the associated water treatment chemicals & blowdown discharges.	CS13	19
Copper, Zinc, Total Suspended Solids	Exposed copper/galvanized piping, galvanized siding /roofing, or exposed copper, brass, or zinc coated materials exposed to storm water, heavy vehicle traffic.	CS14	20

BMP Selection Table			
Pollutant	**Activity**	**BMP №**	**Page №**
Total Suspended Solids, Copper, Zinc	Exposed copper/galvanized piping, galvanized siding/roofing, other copper, brass, and/or zinc coated materials exposed; heavy vehicle traffic; particulate discharge from vehicular traffic.	CS15	22
Oils, Suspended Solids, Heavy Metals, Organics	Disposal of waste water from street and floor scrubbing	CS16	24
Lead, Nickel, Cadmium, Sulfuric Acid	Replacement or storage of lead/acid or nickel/cadmium batteries or long time storage of vehicles or powered equipment outside.	CS17	24
Antifreeze (ethylene glycol), gasoline, oil, grease, brake fluid, diesel	Wrecked or damaged vehicle storage.	CS18	25
Hazardous stripping chemicals, lead from old lead based paints, zinc chromate from old paint preparations, metal particulate, low pH, and increased suspended solids	Stripping metal or wood surfaces outdoors.	CS19	26
Asbestos, Copper, Total Suspended Solids	Vehicle repair/brake shoe replacement.	CS20	27
Any and all	Employee environmental education and training.	CS21	28
Total Suspended Solids	Any site that stores material outside.	CS22	29
Fertilizers, Pesticides, Herbicides, Fungicides, Phosphorus, Nitrogen, Zinc, Copper, pH	Facilities with lawns or vegetated areas.	CS23	31
Suspended Solids, Nutrients, Bacteria, Dioxin, Chemicals	Storage of general rubbish or food rubbish outside in dumpsters.	CS24	35
Petroleum Hydrocarbons, Antifreeze, Other Potentially Toxic or Hazardous Liquids	Pumping liquids from storage tanks into site buildings or into vehicles.	CS25	33
Oil and Grease	Trucking firms or other operations where semi-trailers are parked on site and dollies are used to attach to the trailers to move the trailers around the site or operations in which fifth wheel tractors are used on site.	CS26	36
Gasoline and Diesel Fuels (Petroleum Hydrocarbons)	Fueling operations performed by employees on-site or through restricted access systems such as Cardlock sites.	CS27	37
Sediment(TSS), Metals, BOD, Phosphorus, Hydrocarbons(Oil & Grease)	Vegetated filter (buffer).	CS28	38
Sediment(TSS), Metals, BOD, Phosphorus, Hydrocarbons(Oil & Grease)	Catch Basin Filter System.	CS29	39
Sediment(TSS), Metals, BOD, Phosphorus, Hydrocarbons(Oil & Grease)	Constructed Wetland.	CS30	41

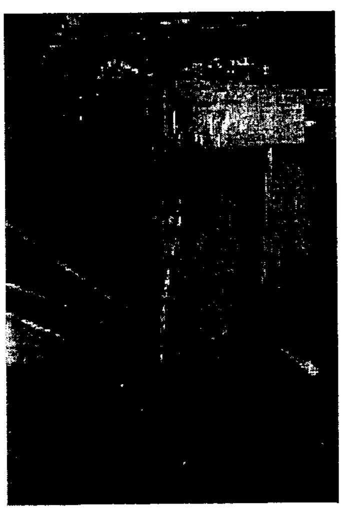
BMP Selection Table			
Pollutant	**Activity**	**BMP №**	**Page №**
Sediment(TSS), Metals, BOD, Phosphorus, Hydrocarbons(Oil & Grease)	Grassy Bioswale.	CS31	44
Heavy Metals	Sand Filter.	CS32	45
Sediment(TSS), Metals, BOD, Phosphorus, Hydrocarbons(Oil & Grease)	Storm Treat System.	CS33	47
Sediment(TSS), Metals, BOD, Phosphorus, Hydrocarbons(Oil & Grease)	Multi-Chambered Treatment Train (MCTT).	CS34	48
Sediment(TSS), Metals, BOD, Phosphorus, Hydrocarbons(Oil & Grease)	Flocculation System.	CS35	50
TSS and Heavy Metals	ElectroFloc..	CS36	54

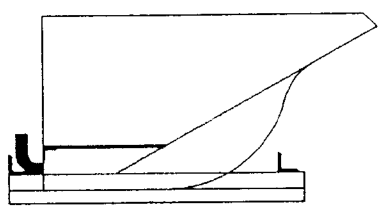
BMP Nº CS1 (Reference #2 &7)

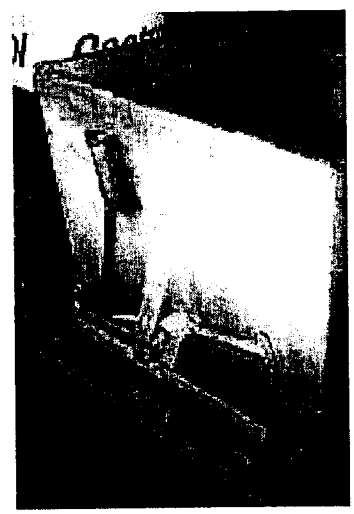
Activity: Mechanical metal removal through the use of high-speed equipment and the associated discharge of metal fines in the form of swarf, grindings, chips, etc.

Typical Pollutants: Heavy metals, i.e. chromium, copper, manganese, lead, zinc; Dissolved Oxygen consuming organisms, i.e. bacteria, fungi; Chemicals in the coolant, i.e. corrosion inhibitors, emulsifiers, biocides, and etc.; Tramp oil; and Decreased pH

Typical Problem: Swarf and turnings are discharged into a hopper along with varying amounts of coolant and tramp oil. The hopper is transported outside and dumped into a dumpster or special portable scrap bin supplied by a scrap dealer. Typically the outside bin or dumpster is not liquid proof nor is it covered. The coolants, metal fines, and tramp oil leak out of the outside bin or are spilled in the process of loading onto a transport vehicle. Quite often the discharge continues as the truck carries the scrap down the highway.







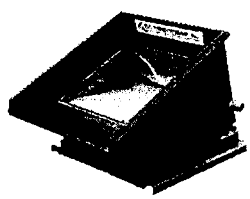
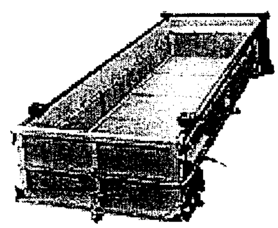
BMP: Locating the outside scrap bin on a concrete pad that drains into a dead-end containment sump and is bermed to prevent storm water run-on may resolve the potential source providing that the sump is emptied periodically. The sump should either be double contained or be coated on the inside with a flexible epoxy to minimize any seepage from any small cracks that may develop in the concrete sump.

Another approach that works is to modify the scrap hopper located at the metal removing machinery for coolant/oil separation from the swarf while the coolant/oil is warm and less viscous. This approach would minimize or eliminate leakage outdoors by removing most of the potential contaminants at the source.
A removable plate, either solid or with small perforations, either screened or unscreened,

can be added to the bottom of the swarf/chip hopper. This creates a sump for the coolant and oils to drain into while the liquid is very hot and thus less viscous. A piping connection should be made into the lower chamber sized to fit the hose end on your sump sucker. If holes are made in the bottom plate, the number of holes will be determined with experimentation. They should be sufficient to provide the air draw of the sump sucker and should be located to encourage the best flow out of the lower chamber when the liquid is sucked out.

Coolant should be of the synthetic type and should be recycled on site. Small package recycling units are available from several manufacturers.

A few manufacturers will modify existing hoppers or sell new hoppers that have a filtering screen and filter material separating the scrap from the liquid chamber.

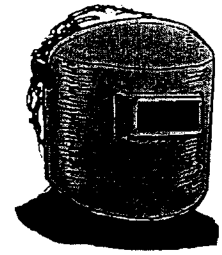
Two commercially available bins with built in screening.

As the scrap bins are moved outside, pause at the outside door where someone should use a sump sucker to draw the liquid/fines out of the lower chamber for either proper disposal or recycling of the coolant.

Efficiency/Impact: Virtually all liquid and metal fines from this activity are eliminated by implementation of this BMP provided the outside scrap dumpster/bin is covered when scrap from inside bins are not being discharged in to it. This point source should no longer be a significant contributor of pollutants to the storm water discharge.

BMP Nº CS2

Activity: Metal cutting with gas burners, oxygen/acetylene torches, and welding of metal with stick, wire, or gas welders.



Typical Pollutants: Oily air emissions;
Metal particles;
Gaseous metal; and
Vaporized flux

Typical Problem: The fume from the metal cutting/welding operation is

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exhausted to the outside where it comes in contact with rain and precipitates out into the storm water. Indoor air quality is also of concern.

BMP: Welding creates an oily soot type smoke. The amount of smoke produced from the welding process can be estimated using the table below.

Fume Ratio:

MIG (Wire Feed)	**0.005-0.01 lb. of smoke/lb. of rod**
TIG	**0.004 lb. of smoke/lb. of rod**
Oxy-acetylene torch	**0.004 lb. of smoke/lb. of rod**
Stick	**0.015 lb. of smoke/lb. of rod**
Flux core	**0.02 lb. of smoke/lb. of rod**

This fume has products that can be very small, submicron in size. There are two methods to control this fume. If it is properly maintained, the use of a self-washing electrostatic precipitator mounted near the room ceiling is the most efficient and cost effective. Air extraction units with HEPA and charcoal filters can also be used.

Efficiency/Impact: Implementation of one of these BMPs will mostly eliminate this source of pollutants, not only to storm water but also to air, and significantly improve indoor air quality. As an added benefit, if the air inside of a building is heated, it may be possible to recycle the air and provide a significant energy cost savings in the winter months. This point source should no longer be a significant contributor to the storm water discharge concerns.

BMP № CS3 (Reverence # 43 & 44)

Activity: Oil (& other fluids) dispensing and outside storage

Typical Pollutants: Oil, hydraulic fluid, antifreeze, paint, solvent, cleaners, etc.
i.e. petroleum hydrocarbons, toluene, ethylene glycol, etc.

Typical Problem: Drums, pails, and small containers of liquids are stored outside in unbermed, noncontained areas, which through expansion and contraction of the container, can damage the container, or the container bungs casing leaks, or filling/dispensing operations can discharge pollutants to the ground in the vicinity. Rain and snow contact this material and transport it off site or into the ground water.

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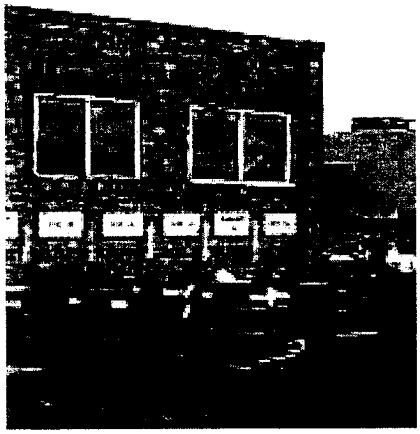
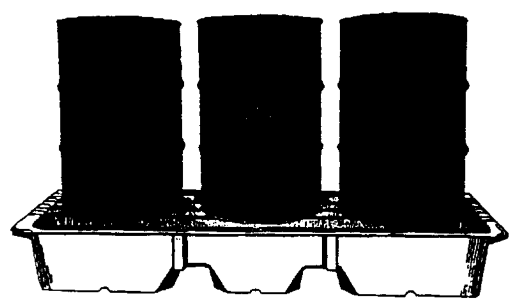


Dispensing oil, antifreeze, and other potentially hazardous liquids usually results in spills and leaks around the dispensing area. This leaked liquid can be tracked to other locations, or can seep through cracks and floor joints into the soil and groundwater beneath the floor. Rain and snow melt transport these pollutants off site. Containment pallets made from steel or plastic will contain the liquid.



For large numbers of drums a portable containment building will keep containers protected from the elements and provide containment in the event of leaks.

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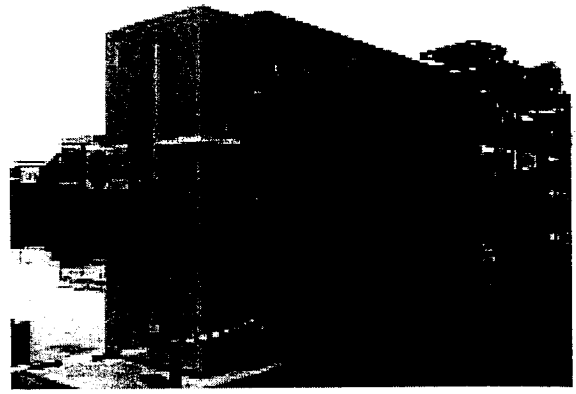
Oil & Flammable Storage:



Outdoor storage of oil and flammable liquids such as paint, usually results in leakage and spillage of the liquids into the environment. The purchase and placing of portable metal storage buildings with built-in containment reduces this risk and better protects the liquid containers from damage and possible contamination. Environmental controls, i.e. heating and air conditioning, and fire protection are usually available in these preconstructed units.

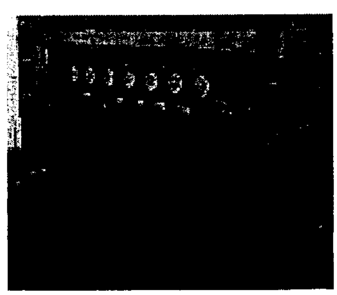
Efficiency/Impact: The use of containment pallets or portable containment/storage buildings will greatly reduce or eliminate storm water contamination from these sources. Some risk of contamination will still exist from the material handling activities associated with moving containers of these liquids to and from the pallets or storage buildings.

BMP Nº CS4

Activity: Storage of liquids in bulk containers or tanks.

Typical Pollutants: Oils, diesel, gasoline (petroleum hydrocarbons); antifreeze (ethylene glycol); and solvents (toluene, mineral oil)

Typical Problem: Leakage or spillage occurs around tanks from filling, dispensing, deterioration of pipe connections or failure of secondary containment



BMP: Bulk storage tanks should have secondary containment in the form of a curbed enclosure with a liner to prevent migration of the liquids through the enclosure walls and floor. The liner can be in the form of a compatible flexible epoxy or a liner membrane compatible with the fluids being contained. If a roof is not provided to keep out rain and snow, then the volume of the enclosure should be 110% of the volume of the largest bulk tank inside of the enclosure. Fill locations should have drip trays that drain into a drum or other container. Dispensing areas should have their own containment. When dispensing into secondary containers, the containment should drain into a drum or other container. Hoses on dispensing stations should not be able to extend beyond the containment area. For dispensing area containment, the volume of the containment area should be equal to the tank being dispensed from. Dispensing areas should be under roof or some other protection from storm water. Caution should be used to ensure that incompatible materials are not contained within the same enclosure.

Double-walled, aboveground storage tanks maybe used instead of single walled storage tanks with containment structures. Filling and dispensing areas associated with double-walled tanks should have containment and protection from storm water.

Efficiency/Impact: Implementation of this BMP will reduce the risk of exposure to storm water of the contaminants associated with the delivery, dispensing, and storage of the materials in bulk tanks.

BMP Nº CS5

Activity: Runoff from buildings with corrugated galvanized sheet metal roofs and/or siding.

Typical Pollutants: Zinc

Typical Problem: As the sheet metal ages zinc from the galvanized coating is released to storm water runoff.

BMP: Avoid using galvanized sheeting on new construction. Clean and paint the exposed galvanized sheet with a good enamel paint. Be sure to contain and collect any liquids used in cleaning for proper disposal. Instigate a regular inspection and maintenance program concerning the building painting.

Efficiency/Impact: With proper maintenance of the painted surface the zinc runoff can be decreased from this source to the non-detect level.

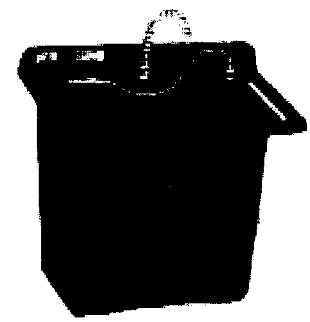
BMP Nº CS6 (Reference #14 & 42)

Activity: Cleaning of parts and equipment in Parts Cleaners containing mineral spirits/oil or petroleum products.

Typical Pollutants: Petroleum hydrocarbons

Typical Problem: The use of petroleum based cleaners leads to the requirement for either storage of the spent cleaner or recycling companies periodically removing old cleaner solution/sludge and adding new solution. This results in spent cleaner storage on site and/or frequent handling of both the clean and contaminated cleaner. This increases the risk of spills and leakage getting into storm water. The spent cleaning solution/sludge must be treated as a hazardous waste and be properly handled and disposed.

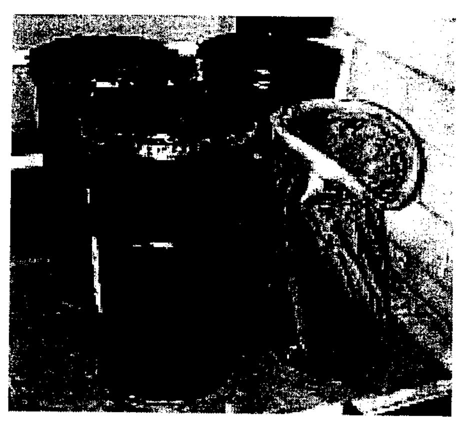
BMP: Large parts and frames are generally cleaned in a shot blast machine. Smaller parts should be cleaned in an aqueous based solution (caustic or other) or in a biological solution. These units typically are heated and may involve agitation. Parts cleaners other than these typically have a sludge residue or the solution has to be replaced periodically. The sludge or removed solution is usually considered a hazardous waste somewhere in its cycle. The sludge from an aqueous based or biological parts washer is not typically hazardous and solutions are only added, never removed. The SmartWasher shown to the right is an example of a biological unit.



Efficiency/Impact: Use of water based or biological parts cleaning solutions could potentially result in no hazardous waste generation, improved health for employees, and overall cost savings in material, labor, and waste disposal. Generally, cleaning with these solutions takes employee involvement in the acceptance of the use of the material and usually takes a little bit longer to perform the cleaning operation.

BMP № CS7

Activity: Vehicle maintenance, equipment maintenance, and construction involving the addition of grease to joints, couplings, bearings, etc.



Typical Pollutants: Grease (Petroleum Hydrocarbons with heavy metal additives)

Typical Problem: Grease containers when emptied still contain fair amounts of grease residue in them. Should water mix with this grease, potential adverse impact to the environment in the form of oil/water spillage may occur.

BMP: Some suppliers provide returnable containers (bulk) that, when sealed after use, minimize the potential adverse impact. Another environment friendly option is a container that is lined. After emptying, the liners can be removed and more of the grease squeezed out. The liners can then be placed in a drum for accumulation and properly disposed.

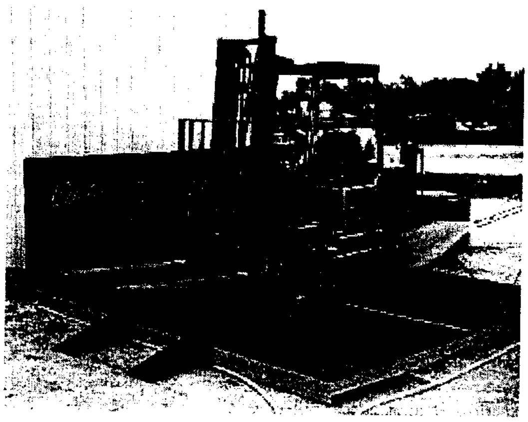
Efficiency/Impact: An increase in the amount of grease available at very little increase in labor cost will result from implementation of this BMP. If the lined containers are used, properly accumulated and disposed of after use or bulk returnable containers are used, very little risk of environmental contamination through storm water discharges will be present from this source.

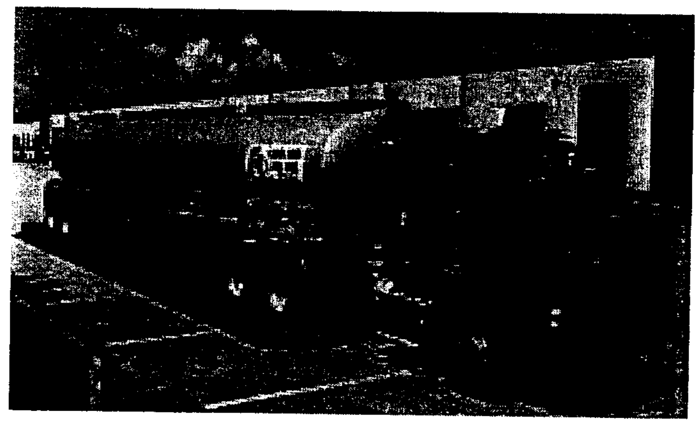
BMP Nº CS8 (Reference #14, 50, & 51)

Activity: Pressure washing or steam cleaning of equipment and/or vehicles. Equipment includes forklifts, backhoes, graders, tractors, and similar commercial implements. Equipment does not include motors, engines, generators, compressors, and similar commercial machinery.

Typical Pollutants: Degreasers, soap, heavy metals, oil and grease

Typical Problem: When equipment and/or vehicles are washed outside, contaminants in the washwater and the overspray mix with the storm water runoff.





BMP: Normally wash areas should be located on well-constructed and maintained, impervious surfaces with drains piped to the sanitary sewer. The wash area should extend at least 4 feet in every direction from the perimeter of the vehicle or equipment being washed. When sanitary sewer is not available there are several different approaches to this concern that can be taken depending on the size of the site and the resources available, such as:

- discharging the storm water to a properly sized grassy swale,
- discharging the washwater and storm water to a collection sump for later disposal,
- discharging the storm water through an oil/water separator,
- relocating the washing operations to a commercial washing facility, and/or
- discharging the storm water to a constructed wetland.

Selection of the cleaning detergent to be used is critical to good oil/water separation and retention in control devices. Ensure that the detergents used do not emulsify oils as this would allow the oils and grease to flow though the oil/water separator instead of being separated from the effluent. The detergent should be a low sudsing, low phosphate,

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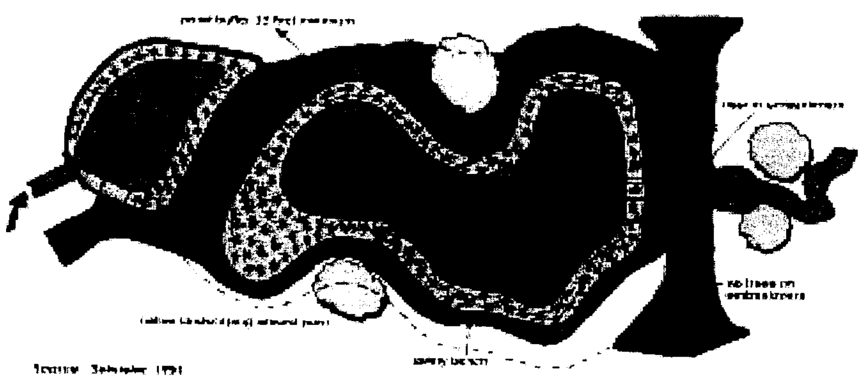
biodegradable type. Design the cleaning area with walls to keep the dirty overspray from leaving the wash area. Place an oil/water interceptor or separator in the wash area's drain to separate out the oil and grease before the effluent is sent to the sanitary sewer. Should sanitary sewer not be available, discharge should be through an oil/water separator into a bioswale or pond and thus to storm water conveyances provided a permit is applied for and granted. Should the site not be large enough for a bioswale or pond, collection of the washwater can be made by using a portable containment enclosure. The wastewater can then be extracted and placed in a suitable holding tank for later oil/water separation and discharge into a sanitary sewer, or other disposal method such as collection and transportation or the waste to a sewage treatment plant. Discharge of wash water and pad rinse water may require a vehicle wash water discharge permit from DEQ. Typically the discharge of washwater from washing activities is not allowed to the Slough. Pressure washing without chemical usage and with treatment BMPs may be eligible for a permit.



Washing systems are available that will recycle the washwater for reuse in washing operations.

General BMPs for Vehicle and Equipment Washing Activities - Site and Activity Conditions

1. Vehicle/equipment washing that occurs on an impermeable surface (i.e. concrete, plastic, or other) should utilize an impervious area which extends to minimum of four (4) feet on all sides of the vehicle/equipment to trap all overspray. Washing areas should be properly graded so that all washwater can be collected from the impermeable surface.

2. Impervious surfaces used for cleaning operations should be marked to indicate the boundaries of the washing area and the area draining to the designated collection point; exceptions include wash areas covered by a roof or wash areas that use portable impervious material with boom collection.

3. Vehicles should not be washed near uncovered repair areas or chemical storage facilities such that chemicals could be transported in washwater runoff. All washwater runoff

should be drained away from a shop area or chemical storage facility.

4. For washing operations that use detergents, soaps, cleaners, hot water or steam, and other chemicals, the washwater should be collected in a manner which prevents the mixture or wash-down of pollutants with storm water runoff. Preventative measures may include:
   a) designating a wash area in an area under a roof,
   b) in open areas, draining to a dead-end sump or grit trap and pump or siphon washwater to sanitary sewer, recycling equipment, or treatment equipment,
   c) a catch basin may be used as a sump provided a positive control valve can close the outlet to the storm drainage system while washing occurs,
   d) as a temporary condition, an existing catch basin may be used as a sump provided the outlet pipe is sealed by a plug (plumber's balloon) to prevent washwater from entering the storm drainage system, or
   e) collecting washwater with a portable vacuum recovery unit.

5. For washing operations that use detergents, soaps, cleaners, hot water or steam, and other chemicals that drain to a catch basin with separate outlets to storm and sanitary sewer, the basin should contain a positive control valve. The positive control valve is open during washing so that washwater discharges to sanitary sewer, and closed during non-washing periods so that storm water runoff discharges to storm sewer. The designated wash area should be thoroughly rinsed after washing activities.

6. At all permanent washwater facilities and catch basins with a valved sanitary sewer outlet, the owner should post a "warning" to customers, employees and others not to dump vehicle fluids, pesticides, herbicides, solvents, fertilizers, organic chemicals, or toxic chemicals; a sign or stenciled note on pavement next to the grit trap or catch basin should be in a visible location and maintained for readability.

7. Washing operations at train yards that use detergents, soaps, cleaners, hot water, steam, solvents, or other chemicals should occur in common area such that all washwater is collected, treated, and discharged properly as approved of in writing by DEQ. Wash areas in train yards should employ an impermeable surface to collect washwater. The impermeable surface may be a concrete pad or a double-lined geotextile material under the railroad ballast. The wash area should be properly graded to direct washwater into a grit trap.

8. All parking lots/stalls of dealerships, vehicle rental agencies, and government/company fleets that wash exterior vehicle surfaces with cold water should furnish or retrofit catch basins with sediment traps and an inverted elbow outlet to trap floating oil. Design guidelines for this type of catch basin are described in Section 4.4 of the Oregon DEQ washing document. Catch basins should be cleaned of solids and oil when the basin becomes 30% full with solids, or at least once a year. Catch basins should be cleaned during dry weather to prevent discharge of pollutants into the storm sewer. Solids and oil must be disposed of in a manner that complies with all State administrative rules.

9. Paved areas where washing will occur (i.e., roads, parking lots, driveways, sidewalks,

and other surfaces) should be cleaned of excessive debris. If excessive debris lies on the pavement surface, the surface should be dry swept or blown and debris collected and disposed of properly.

10. In washing operations involving the washing of buildings and pavement areas and that use detergents, soaps, or cleaners, the washwater should be collected and discharged to sanitary sewer or a treatment system, or discharged to the ground surface provided a minimum buffer of 20 feet exists to the nearest surface water or pavement area that drains directly to storm sewer. A buffer should consist of vegetated ground with a relatively level slope, and soil with adequate permeability to prevent runoff.

11. Washing exterior surfaces of buildings with water only may drain to a catch basin with sediment trap and inverted elbow outlet. Catch basins should be cleaned of solids and oil when the basin becomes 30% full with solids, or at least once a year. Catch basins should be cleaned during dry-weather to prevent discharge of pollutants into the storm sewer. Solids and oil must be disposed of in a manner that complies with all State administrative rules.

12. Wash down of construction vehicles and equipment should prevent soil erosion and runoff from the construction rite. Silt ponds may be used to control erosion.

13. Cleaning operations should be modified to minimize paint residues (chips), heavy metals, or any other potentially hazardous materials that detach from surfaces. Modifications may include a change of cleaning agent or reduction in water pressure. Detached metals should not enter storm sewers or surface waters.

14. The use of acids and/or solvents as cleaning agents for building exteriors and pavement areas should be avoided if possible. Dry or semi-dry methods may be used to clean these surfaces (i.e., sand or other particle blasting, grind-off and vacuum technology, and ice blast technology). If blasting is used as an alternative, all solids should be swept or vacuumed and disposed of properly.

15. For washing operations on painted or metal surfaces, detergents should not possess abrasive properties. Cleaned surfaces should not leave paint residues (chips) or detach heavy metals such that these particles can enter storm sewers or surface waters.

16. Detergents and soaps used in washing activities should be phosphate-free and possess the ability to rapidly biodegrade.

17. At all designated washing areas, spill prevention, control, and management should be planned and designed to prevent any spills of pollutants from entering a publicly- or privately-owned treatment works or surface waters.

18. A chemical management plan should be implemented for cleaning operations that utilize metal brighteners, caustics/acids, halogenated hydrocarbons, or solvents; the plan should include as a minimum:

a) lists of chemicals used,
b) the method of disposal used, such as reclamation or contract hauling, and
c) procedures for assuring that *toxic* chemicals are not discharged into the waters of the State.

Sanitary Sewer Discharge

19. Prior to disposal of washwater to sanitary sewer, minimum pretreatment requirements must be met as required by the local Sewer Authority. Pretreatment may consist of grit removal, followed by free oil removal. Solids can be removed by a grit trap and/or a properly-sized detention tank. Free oil can be removed by a coalescing-type oil/water separator or comparable treatment unit. Grit traps used for pretreatment should be inspected daily. Sludge, grit, and other solids in a grit trap and/or detention tank should be removed by a certified waste hauler and disposed of in a manner that complies with all State administrative rules. Design guidelines for such treatment are described in Section 4.4 of the Oregon DEQ washing document.

20. Pretreatment units should be operated and maintained in accordance with manufacturer specifications and as required by the local Sewer Authority.

Recycling Treatment

21. Recycling treatment equipment should be properly operated and maintained to achieve compliance with all conditions of the permit. Backwash water or concentrate water should be properly discharged to sanitary sewer. Liquid concentrate discharged to the sanitary sewer should meet all pretreatment standards and other requirements of the local Sewer Authority. Solids, grit, or sludge should be disposed in a manner that complies with State administrative rules.

Equipment Treatment - Discharge to Surface Waters, Ground Surface, or Vegetated Swale

22. For cleaning operations that use metal brighteners, caustics/acids, halogenated hydrocarbons, or solvents, washwater should be treated and effluent disposed of either by no discharge methods or by discharge to surface waters not exceeding permit limitations. Treatment may consist of a combination of various process units (e.g., a grit trap can be used to remove suspended solids, an oil/water separator can be used to remove floating oil, a pH adjustment unit can be used to neutralize acids or caustics, an air stripper can be used to remove volatile organics, a dissolved air flotation unit can be used to remove fine solids, polymer chemical mixing and flocculation units, and a sand filtration unit can be used to remove dissolved solids and metals, an ultrafiltration unit can be used to remove solids, a carbon column can be used to remove organics and metals, and a reverse osmosis unit can be used to remove metals).

23. For cleaning operations that use detergents, soaps, cleaners, hot-water, or steam, washwater should be treated and effluent disposed of either by no discharge methods or by discharge to surface waters not exceeding permit limitations.

The following treatment alternatives may be developed:

24a. Washwater may be treated with, in sequence, a grit trap, an oil/water separator, a dosing tank with siphons or pumps, and a multi-media filter bed with underdrains. Discharge from underdrains must meet effluent limitations set forth by the DEQ. Design guidelines for the treatment system units are described in Section 4.4 of the Oregon DEQ washing document. Maintenance of a multi-media filter should consist of cleaning, removing the top inch of sand once every six months; when the total depth of filter sand fall below 18-inches, the sand should be replaced; if clogging and/or short circuiting occurs as observed by uneven infiltration in the filter or formation of surface cracks, the sand should be replaced.

24b. Washwater may be treated with adequately-sized units of grit trap and oil-water separator, or comparable units such as a water quality inlet to remove sediments and floating oils; pH adjustment may be needed as additional treatment. Effluent may be applied on vegetated land by irrigation equipment. Design guidelines for the grit trap and coalescing oil/water separator, and water quality inlet are described in Section 4.4 of the Oregon DEQ washing document. Land irrigation should occur on nonagricultural vegetation with a 20-foot buffer. Treated washwater should not result in surface runoff. All criteria set forth in OAR 340-40 must be met for groundwater quality protection.

24c. Washwater may be treated with adequately-sized units of: grit trap and oil/water separator, or comparable units such as a water quality inlet to remove sediments and floating oils. Effluent may be disposed of to an evaporative storage lagoon or constructed wetlands. The lagoon or constructed wetlands should be designed with no discharge and thus should be designed with sufficient storage. Design guidelines for treatment units are described in Section 4.4 of the Oregon DEQ washing document. An impermeable fabric liner may be needed for the lagoons or constructed wetlands to protect groundwater. All criteria set forth in OAR 340-40 must be met for groundwater quality protection.

On-site disposal (septic tank and drainfield) was evaluated for treatment of washwater that contain detergents, soaps, or cleaners. Lack of data on treatment performance data prohibited its use currently. Groundwater must be protected according to OAR 340-40.

25. If an oil/water separator is used as a treatment component, detergents used as cleaning agents must meet emulsion stability requirements to improve the efficiency of the treatment unit; emulsion stability should meet the fats, oil, and grease (FOG) test, which involves testing a 1,000 ml detergent mixture at an one percent (1%) working concentration of the detergent; one liter of a 50:50 mixture of//2 diesel fuel and 30-weight motor oil is added to the detergent mixture, shaken for 20 seconds and allowed to stand for 30 minutes; an acceptable test performance is less than 20 mg/L total fats, oil, and grease remaining in emulsion.

26. The treatment system must be, at all times, properly operated and maintained to achieve compliance with all conditions of the permit. Records of maintenance activities should be

maintained on-site for DEQ inspection.

27. A Spill Prevention, Control and Countermeasure (SPCC) Plan, in accordance with 40 CFR 112, should be prepared and implemented to prevent the entry of pollutant loads beyond the capabilities of the treatment system.

28. For small cleaning operations that use detergents, soaps, cleaners (i.e., private and nonprofit vehicle/equipment washing, and building and pavement washing, or commercial facilities which wash less than eight of their own vehicles, trailers, or pieces of equipment during any week), washwater can be disposed of onto the ground surface.

Disposal alternatives to ensure contaminated water does not enter surface waters are as follow:

29a. Washwater may be collected in a sump, grit trap, or containment structure to be pumped or siphoned to a vegetated area so that complete percolation into the ground occurs.

29b. Disposal of washwater should occur on ground surfaces with vegetated cover, preferably grasses.

29c. Washwater may be disposed to a dry grassy swale, a minimum of 250 feet in length before a surface water body. Complete percolation in the swale should occur with no direct discharge to the surface water. Discharge into a grassy swale for treatment should not occur within 24 hours after a rainfall event or if water remains ponded in the swale. Guidelines for design of a grassy swale or use of an existing grassy swale to reduce pollutants are in Section 4.4 of the Oregon DEQ washing document. A distance of 250 feet was based on a hydraulic conductivity of 0.2 gal/ft/day, volume per day of 150 gallons, and a swale with a width of 3 feet.

29d. Washwater runoff may be disposed of into an infiltration basin/trench. Guidelines for design of an infiltration basin/trench to reduce pollutants are described in Section 4.4 of the Oregon DEQ washing document.

29e. Commercial mobile washers that use detergents, soaps, or other chemicals should use a portable impervious surface material when washing on a porous surface. A portable wash pit, vacuum recovery unit, or comparable device must be used on location to collect washwater for proper disposal.

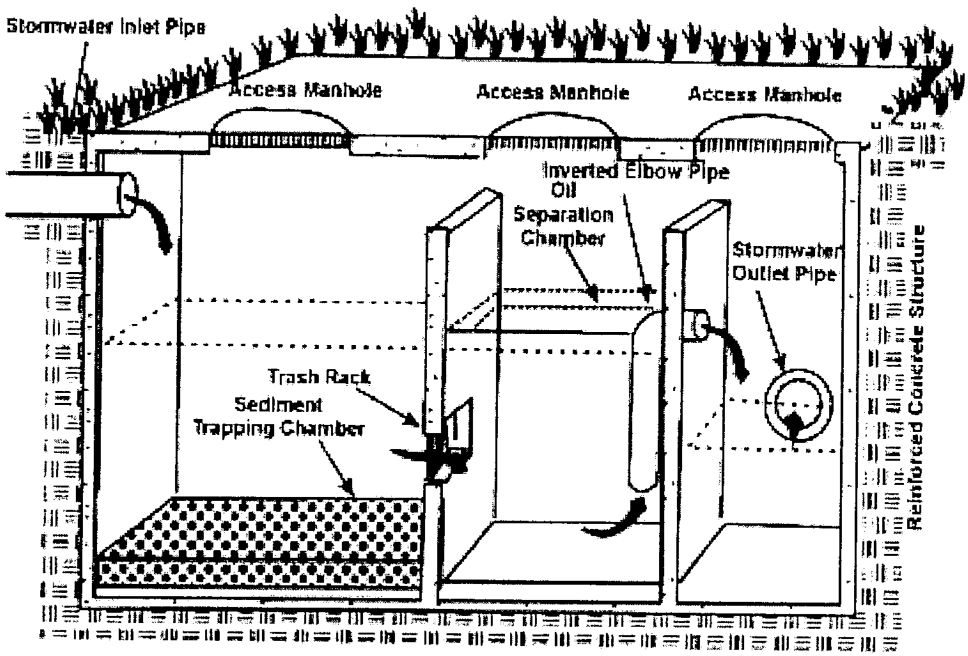
Efficiency/Impact: The use of a recycling system will not only reduce or eliminate the contaminant discharge to storm water or sanitary sewer but it will greatly reduce the amount of water used in the process. The use of a bioswale with an oil/water separator will likewise virtually eliminate the total suspended solids, oil and grease, and heavy metals discharged provided both are properly sized. A portable collection system will provide the collection of the contaminants provided the collection system is large enough to capture significant amounts of the overspray.

BMP Nº CS9 (Reference # 21 & 41)

Activity: Any site that has steel, equipment, or vehicles stored outside and has a potential for oily storm water discharges.

Typical Pollutants: Oil and grease and suspended solids

Typical Problem: Structural steel and plate arrives on the site from the supplier coated with oil to inhibit corrosion. As storm water comes in contact with the steel the oil disperses and runs off. Equipment stored outside has grease and oil on it that washes off when contacted by storm water. Vehicles not only have the normal oil and grease associated with them but they also have road film which contains oil.



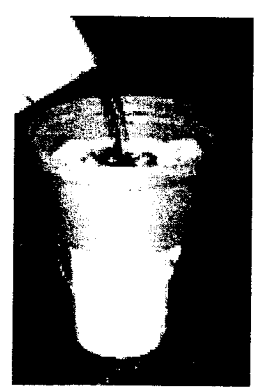
BMP: Installation of a properly sized oil/water separator can reduce the amount of both Total Suspended Solids and Oil and Grease in the storm water run-off. Several types of oil/water separators are available (Gravity, Coalescing, Centrifugal, Carbon Absorption, Ultrafiltration, etc.). Gravity Oil/Water Separators are generally the most economical provided emulsifying chemicals have not been used upstream of the separator, dirt is not a major contaminant, and high shear centrifugal pumps are not used to pump the water to the separator.

There are three basic types of oil/water separators, spill control (SC), API (longer retaining time), and coalescing plate (CPS) recommended for use in all pipe drainage systems conveying runoff from paved areas, subject to vehicular use or storage of chemicals, prior to discharge from the project site or into an open drainage feature. All three types have the following basic application/selection criteria:

- Urban residential runoff usually low flows
- Suitable for smaller sites, draining 5 or less acres
- Land uses associated with include: industrial, transportation, log storage, airports, fleet yard, railroad, gas station, vehicle/equipment dealers and repair, construction and petroleum
- SC can be effective at retaining small spills but does not remove dispersed oil droplets because they have a short residence
- SC type should be required when the site stores petroleum based products and spills are
- API used where there is a relatively high likelihood of dispersed oil contamination.
- API/CPS should be used in areas with high traffic volumes (2,500 vehicles per day), at sites that are used for petroleum storage/transfer, scrap and wrecking yards, or at sites where heavy equipment is stored and/or maintained.
- Oil/water separators cannot deal well with heavy sediment
- Should be used in conjunction with detention, biofiltration, or water quality treatment system to protect groundwater.
- CPS consist of a bundle of plates made of fiberglass or polypropylene installed in a concrete vault. The plates improve the removal of oil and fine suspended sediments and assist in concentrating the pollutants for
- CPS requires frequent inspection and maintenance to operate as
- A mechanism should exist for the system to be bypassed, so the system can be taken off line for maintenance.
- Oil and sediment removed from devices may qualify as hazardous waste and should be tested prior to
- Oil separators should be sized for a local six-month reoccurring 24-hour design storm. Larger storms should be diverted from the separators.

Efficiency/Impact: The use of gravity oil/water separators in the storm water outflow can greatly reduce the free oil droplets larger than 0.015cm (150 microns). Ultrafiltration can virtually eliminate oil in the storm water outflow. Fouling of membranes may become a concern with Ultrafiltration although some newer vibrating membranes show great promise for keeping the membranes clear during backflushing.

BMP № CS10

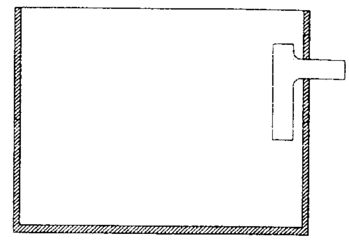


Activity: The use of compressed air.

Typical Pollutants: Oil

Typical Problem: Compressed air systems typically absorb or condense moisture from the ambient air. Fine oil is released to the compressed air in the compression cycle. The condensed water is either manually drained out of the compressor, filters, and/or the air receiver tank or is automatically drained by a timed valve system. This condensate may be discharged to the ground or to a location that can leak or be spilled into the outside environment. Storm water then flushes this oil to the storm water outfall.

BMP: Install an oil/water separator especially made for compressors and receiver tanks or manufacture a simple separator similar to the one shown on the following page and siphon off the oil. Discharge the remaining water to the sanitary sewer if it is available on-site.



Efficiency/Impact: Oil from this source can be greatly reduced or eliminated and loading to the storm water conveyances will be reduced.

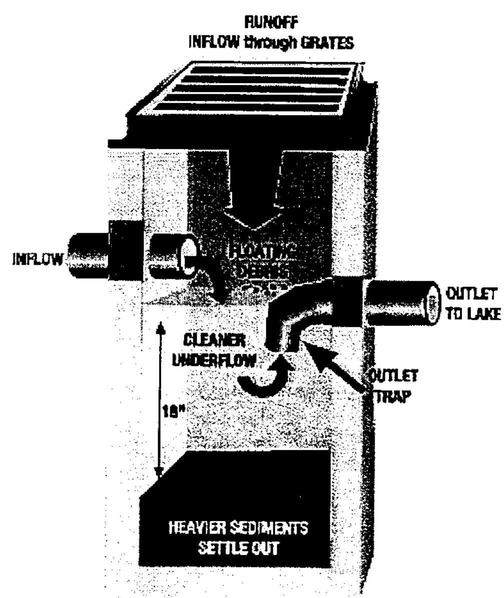
BMP Nº CS11

Activity: Storm water runoff from commercial or industrial sites to standard catch basins or drains.

Typical Pollutants: Oil and sediment

Typical Problem: On sites that use standard catch basins or drains there is no retention of any oils or sediments. This could result in excessive discharges to storm water of these pollutants.

BMP: Retrofitting drains to standard sediment and oil trap catch basins properly designed for the flow-through rate and properly maintained can reduce oil and grease levels in the storm water discharge.



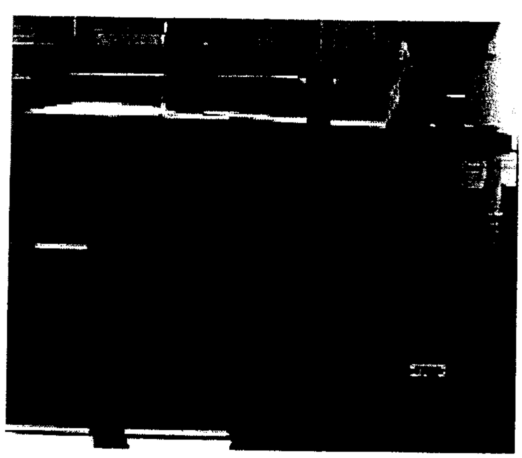
Efficiency/Impact: Proper sizing and maintenance can reduce the discharge concentrations of oil and grease to below 10mg/l and settleable solids to some degree.

BMP Nº CS12

Activity: Arc furnace or mechanical removal operations (grinding, sanding, shot blasting, etc.) that create dust which is collected in baghouses.

Typical Pollutants: Metal fines, suspended solids in storm water

Typical Problem: Mechanical removal operations involving the removal of metal, paint, wood, and other materials generate dust that is collected in bag filter houses. Arc furnaces will generate a metallic fume that condenses out as a dust on the way to the baghouse. The baghouses must discharge the dust collected to a dumpster, drum, or bin. If the connection between the baghouse and the collection container is not airtight then, dust leaks out into the environment. Storm water will contact this dust and convey it off-site, typically causing a TSS discharge problem.

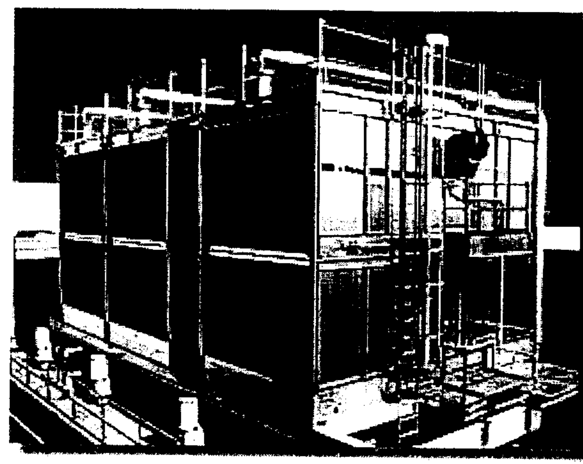


BMP: If a drum is being used for collection of the dust, manufacture from a removable drum top a flange or sleeve that a flexible boot can be clamped to and attach the sleeve to both the discharge point on the baghouse and to the drum sleeve. Use quick release clamps to attach the removable drum top to the drum. If a dumpster or other large container is used to collect the dust, manufacture a solid reinforced cover for the container using rubber sealing strips and clamps or bolts to hold the cover in place. The cover should have a sleeve or flange that attaches to a flexible boot which is attached to the discharge point on the baghouse. It may be necessary to also include a vent line from the dust receiving container back into the dust collector in order to relieve the air pressure resulting from the dust dropping down in to the collection container.

Spillage that occurs from connecting and disconnecting to the flexible boot should be immediately cleaned up using a vacuum. A fixed vacuum duct may be plumbed into the inlet of the dust collector with a valve so that the spillage can be reintroduced into the dust collector. Also, frequent vacuum sweeping of the area around the dust collector should be performed.

Efficiency/Impact: Through the use and proper maintenance of the container covers most of the dust can be contained significantly reducing the amount of dust that could leak out to the environment. This would, in turn, greatly reduce the impact from this source of suspended solids and metals to the storm water discharge.

BMP № CS13 (Reference #29)



Activity: The use of cooling towers with the associated water treatment chemicals and blowdown discharges.

Typical Pollutants: Biocides, algaecides, fungicides, and corrosion inhibitors (BOD, COD); suspended solids; zinc; and copper

Typical Problem: Chemicals such as Biocides, Algaecides, and Corrosion Inhibitors are added to cooling towers to prevent biological growth, and to reduce scaling and corrosion. Periodically cooling tower water must be blown down in order to remove sediment and particulate buildup in the cooling tower sump. This water should be discharged to sanitary sewer but may not be in areas where a sanitary sewer is not available. Even when the water is discharged to a sanitary sewer an upset can occur in which the cooling tower sump water is discharged to outside areas and comes in contact with storm water. This water can contain elevated levels of copper, zinc, and chemicals with high BOD_5 and COD.

BMP: Use ozone instead of chemicals to control biological growth and scaling. Ozone is a powerful oxidizing agent. It has one and one-half times the oxidizing potential of chlorine. A properly operated and controlled ozone treatment system will not allow microorganisms that secrete the glue-like substance called mucilage to survive and will break down existing mucilage. Microbiological induced corrosion(MIC) can be controlled through the use of ozone. The pH of the water when using ozone is around 8 in comparison to levels typically below 7 when using chemical treatment. Cooling tower sumps can be vacuumed out using a swimming pool type vacuum. With little or no biological growth, the absence of chemical additives, and the absence of scaling sediment, particulate accumulation can be restricted to airborne particulates for the most part which should reduce the frequency for the need to remove sediments and particulates by blowing down the sump. Use of a swimming pool vacuum cleaner could eliminate almost all blowdown.

An alternative to introducing ozone is the use of ultraviolet light disinfection to control microbial growth in cooling tower water. In this case the cooling tower is recirculated through the UV unit which kills organisms attempting to grow in the water. Blowdown will still have to occur but will probably be required at a reduced frequency over that necessary when chemicals are used. The computer chip industry has used this method for their ultrapure water processes for years and the machinery coolant recycling equipment industry has also been using UV treatment units to eliminated biological growth in their coolant recycling equipment.

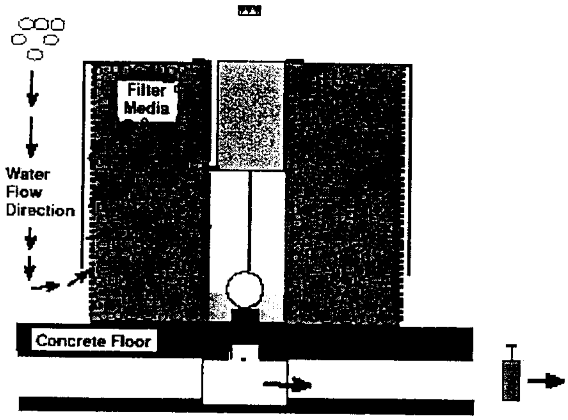
Efficiency/Impact: By replacing chemical additives with ozone or UV treatment and using a swimming pool vacuum cleaner for sediment removal, potential pollutants from this source to the storm water conveyances can be reduced or eliminated.

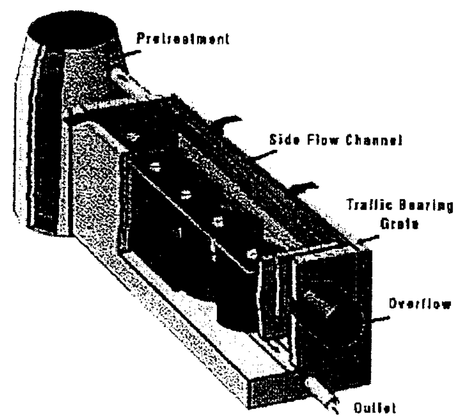
BMP Nº CS14 (Reference # 34)

Activity: Operations with exposed copper and/or galvanized piping, galvanized siding and/or roofing materials, cathodic protection coatings of copper such as may be found on boats, or other exposed copper, brass, and/or zinc coated materials that are exposed to storm water may have significant levels of these metals present in their storm water discharge. Operations involving heavy vehicle traffic may also have metals in their storm water discharge such as copper from brake shoes and clutches or zinc from tire wear.

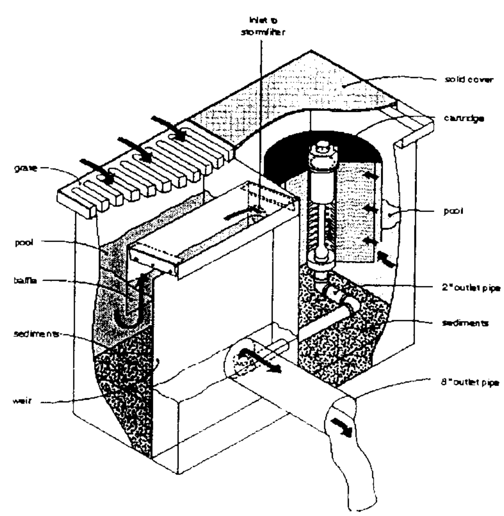
Typical Pollutants: Copper, zinc, and Total Suspended Solids

Typical Problem: Dust from tires (1% Zinc wear rate = 90mg/km/tire) and clutch/brake mechanisms, deterioration from galvanized building materials or corrosion and/or oxidation of copper piping and fixtures cause discharges of particulate and dissolved chemical forms of copper and zinc to the environment when contacted by storm water. Copper based cathodic protection on boats and other equipment generates chemical and particulate forms of copper that becomes combined with storm water.





BMP: The installation of properly sized compost filtration units can remove significant amounts of both chemical and particulate forms of some heavy metals, including copper and zinc, and reduce TSS levels in the storm water discharge. Colloidal particulate levels from clay soils should also be reduced effectively.

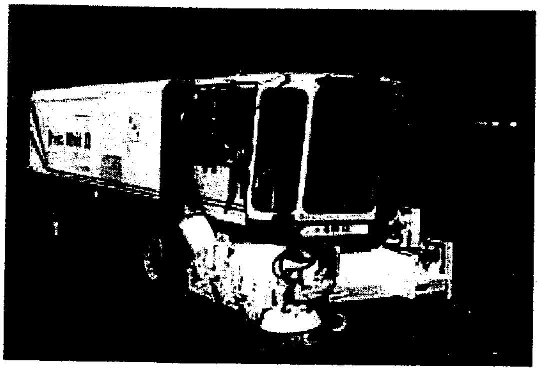


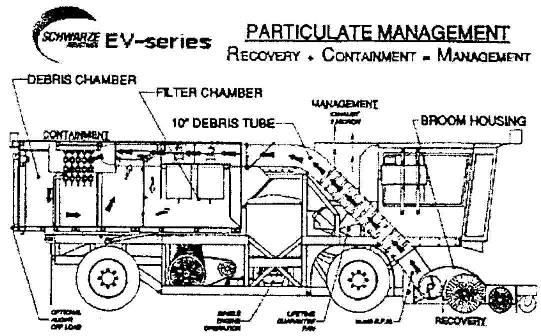
Effectiveness/Impact: Evaluation of existing sites over a three-year period show that the mean reductions of pollutants in storm water for the following were achieved:

TDS	**22.4%**	**Turbidity**	**91.8%**
COD	**70.4%**	**Total Phosphorus**	**44.9%**
Lead	**44.9%**	**Zinc**	**83.2%**
Copper	**65.3%**	**Oil & Grease**	**80.9%**

In general, reductions for Heavy Metals can be expected to be in the range of 65 to 95% and for Oil & Grease up to 85% for a properly designed and sized system.

BMP № CS15 (Reference #32 & 45)





Activity: Operations that have exposed copper and/or galvanized piping, galvanized siding and/or roofing materials, or other exposed copper, brass, and/or zinc coated materials exposed to storm water can have significant levels of these metals present in the storm water discharge. Operations involving heavy vehicle traffic also produce elevated metal levels in storm water from vehicle brake shoes or clutches (copper) and tire particles (1% zinc wear rate = 90mg/km/tire).

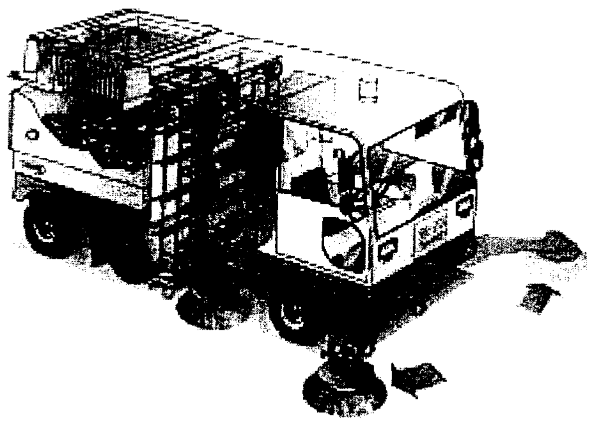
Typical Pollutants: Total Suspended Solids, copper, zinc.

Typical Problem: Dust from tires and clutch or brake mechanisms, deterioration from galvanized building materials, or corrosion and/or oxidation of copper piping and fixtures cause discharges of particulate and dissolved chemical forms of copper and zinc to the environment when contacted by storm water. Copper based cathodic protection on boats and other equipment also generate dissolved chemical and particulate forms of copper that can become combined with storm water.

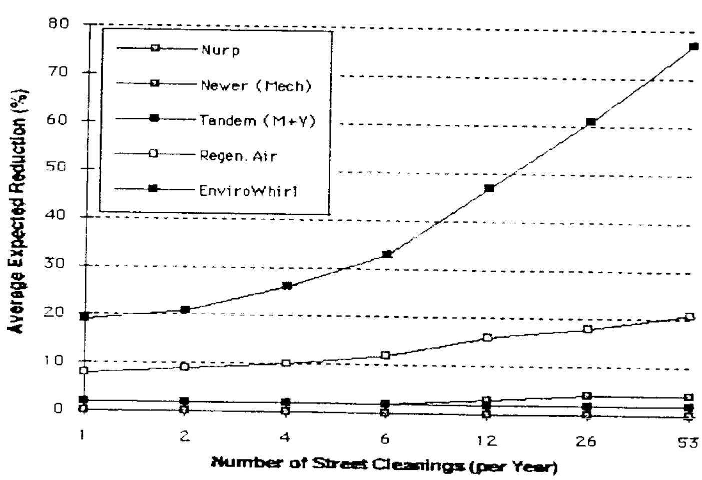
BMP: Sweeping of paved roads, parking lots, and storage areas with a type of vacuum sweeper that incorporates HEPA filtration or other high efficiency method of filtration of the exhaust air from the sweeper to trap the very fine metallic particles found in road or parking lot dust can reduce these discharges to storm water.

Ensure that good control measures are implemented when dumping the contents of the sweeper and practice proper disposal methods for the emptied contents to ensure that there is no adverse environmental impact after spending so much effort in the initial clean-up.

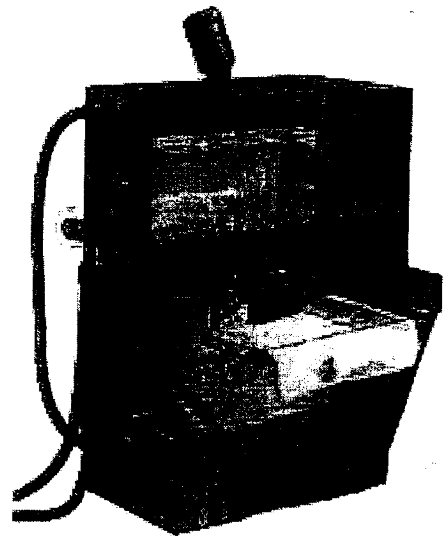
Efficiency/Impact: This type of Sweeper is capable of collecting and containing up to 99.6% of particles as small as 2.5 microns in size. The elimination of particulates in storm water is related to the frequency of sweeping as is shown comparisons of various types of sweepers in the following graph.



Tennant Company also produces a series of sweepers, ranging from a small, walk-behind model to as large as municipal street sized sweepers. The unique feature of Tennant's products is a stainless steel hopper built in to the sweeper to collect dust and debris as it is picked up from the floor and passed through a polyester filter. When the hopper is full, it can be emptied directly into a dumpster or dump truck, minimizing the chance of particulate matter being re-released into the air. Information from the manufacturer reports that the sweepers will retain particles 10 microns, or 0.001 mm, or larger. The smaller size of the model and four-wheel steering makes it easy to maneuver in small spaces that traditional sweepers would not fit.



BMP № CS16



Activity: The disposal of wastewater associated with street or floor scrubbing activities.

Typical Pollutants: Oil emulsions, heavy metals, organics and suspended solids

Typical Problem: When floors, streets and other paved surfaces are cleaned with scrubbing or wet-vacuum type machines, the resulting waste water is frequently disposed of over a catch basin that runs into the storm water system.

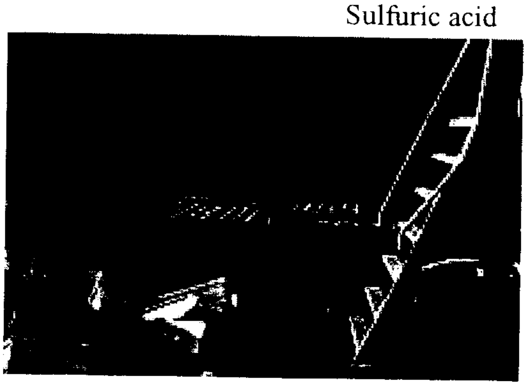
BMP: One option is to make sure that all waste water is disposed of into the sanitary system where it can be treated and cleaned. A solution reclaimer system can also be used to separate contaminants from dirty scrubber solution. Dirty water is pumped into the top of the reservoir, and a chemical compound added to separate out the contaminants. The chemicals encapsulate and separate metals, oils, solids, dust and oils in approximately 20 minutes. The clarified solution is drained out of the reservoir, through a filter, and can then be reused. The remaining solids contain only 10% of the original volume, and dry waste disposal is less costly and has fewer environmental issues associate with it.

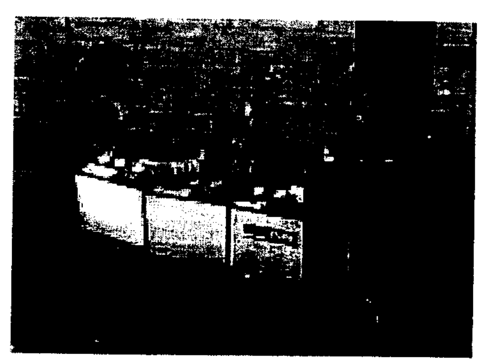
Efficiency/Impact: With appropriate solid waste disposal, a solution reclaimer system can minimize or eliminate the adverse storm water impact from this potential source of contamination.

BMP № CS17

Activity: The outdoor replacement or storage of lead/acid or nickel/cadmium batteries and the long time storage of vehicles or battery powered equipment outside.

Typical Pollutants: Soluble metals such as lead, nickel, or cadmium
Sulfuric acid





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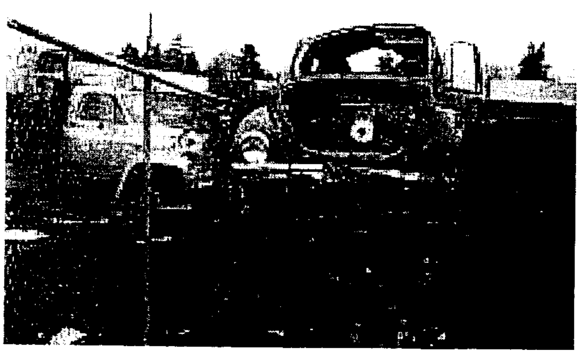
Typical Problem: When batteries are replaced, the used batteries are generally stored around a site until enough have been collected to make it feasible to either have them picked up or shipped out to a battery recycler. These batteries are usually stored on the shop floor or outside without containment and with no thought of exposure to storm water. Sometimes electric lift trucks, pallet jacks, welders, portable powered pumps, etc. are stored outside with the batteries used for starting or for operation left in place and poorly protected from storm water contact. Lead sulfate usually present on lead/acid batteries or in the spillage of the lead/acid or nickel-cadmium/acid solution can create soil contamination and a storm water run-off problem.

BMP: Batteries should be stored in a contained area protected from the weather. Containment pallets can be used to collect any acid spillage. The pallets should be placed inside of buildings to keep storm water from coming into contact with the batteries.

Efficiency/Impact: Containment, protection from the weather, and frequent shipment to the recycler can minimize or eliminate the adverse storm water impact from this potential source of contamination.

BMP Nº CS18



Activity: Wrecked or Damaged Vehicle Storage

Typical Pollutants: Antifreeze (ethylene glycol), gasoline, oil, grease, brake fluid, diesel

Typical Problem: Depending on the damage to the vehicle, fluids may leak due to the damage incurred and/or the damage may expose oily components of the vehicle that would normally be protected from the weather. Storm water will contact these contaminants and infiltrate the ground, contaminating the soil and groundwater at the site and combining with storm water runoff, depending on the rainfall and soil conditions, to waters of the State.

BMP: Provide containment of wrecked vehicles on impervious surfaces. If wrecked vehicles are stored on impervious surfaces, the drainage from those surfaces should pass through an oil/water separator prior to discharging to a storm water drainage system or to a storm water sewer. Insure that all fluids are completely drained from wrecked vehicles. If possible, provide a roofed storage area to prevent storm water contact with wrecked or damaged vehicles.

Remove engine oil, transmission oil, rear-end oil, antifreeze, freon, and any other fluids before storing the vehicles on the site.

Efficiency/Impact: Storage of all vehicles under a roof with a storm water divergence berm should, by eliminating storm water contact and allowing collection of potential contaminants, eliminate storm water concerns. Providing an impervious surface for the vehicles should eliminate the concern for groundwater contamination. Draining of the vehicle fluids would minimize but not eliminate the contaminant(s) concern.

BMP Nº CS19

Activity: Stripping coatings (paint, plastic, etc.) from metal and wood surfaces outdoors.

Typical Pollutants: Hazardous stripping chemicals, lead from old lead based paints, zinc chromate from old paint preparations, metal particulate, low pH, and increased suspended solids

Typical Problem: Stripping of wood and metal parts is usually accomplished with the use of chemicals that have health and environmental hazards. High pressure water blasting can cause increased runoff and can, in the case of blasting wood, damage the surface. Sand blasting creates a large amount of solids to dispose, i.e. the sand plus the paint removed which may be considered hazardous waste.

BMP: Consider using dry ice or baking soda abrasion type removal of old surface coatings instead of chemical or sand blasting. The dry ice system removes the surface coating and leaves only the material removed on the ground, which can be vacuumed or swept up. Using baking soda as the blasting agent leaves the material removed plus baking soda which is not typically harmful and can be fairly easily separated from the paint removed with it by using reclamation equipment or through dissolving the baking soda in water and separating the paint by sedimentation and then evaporating the water. Use a removable ground cover before blasting to ease the cleanup efforts at job completion.

Efficiency/Impact: By placing a removable ground cover such as a plastic tarp down prior to conducting the work and using one of the blasting methods mentioned, virtually all of the removed material can easily be cleaned up with minimal volumes of material involved. Disposal will be less costly when less volume of combined materials are involved over the conventional sand blasting methods. The overall impact to the environment and especially to storm water discharges will be minimized or eliminated.

BMP № CS20

Activity: Vehicle repair/brake shoe replacement including materials handling vehicles.

Typical Pollutants: Asbestos, copper, total suspended solids

Typical Problem: Dust in the brake shoe/wheel housing is typically disturbed and can be released into the environment when brake shoes are replaced. This dust will migrate from inside buildings to outside areas creating an asbestos and/or increased copper discharge when contacted by storm water.

BMP: Use the Low Pressure/Wet Cleaning Method described below for dust removal in brake shoe housings. Some older brake shoes may still be present which contain asbestos. Some new brake shoes on mobile equipment still contain asbestos. Brake shoes contain copper compounds in addition to other materials. The dust in the brake shoe housing can, because of its micron and submicron size, escape the shop area and contaminate the site to a level that, when contacted by storm water, may exceed the copper discharge benchmark. If a vacuum is used, ensure that it is of a type that has a HEPA filtration system that can retain the micron sized particles.

Low Pressure/Wet Cleaning Method

- A drip pan shall be placed under the brake assembly, positioned to avoid splashes and spills.

- The reservoir shall contain water containing an organic solvent or wetting agent. The flow of liquid shall be controlled such that the brake assembly is gently flooded to prevent the asbestos-containing brake dust from becoming airborne.

- The aqueous solution shall be allowed to flow between the brake drum and brake support before the drum is removed.

- After removing the brake drum, the wheel hub and back of the brake assembly shall be thoroughly wetted to suppress dust.

- The brake support plate, brake shoes and brake components used to attach the brake shoes shall be thoroughly washed before removing the old shoes.

- In systems using filters, the filters, when full, shall be first wetted with a fine mist of water, then removed and placed immediately in an impermeable container, properly labeled and disposed.

- Any spills of asbestos-containing aqueous solution or any asbestos-containing waste material shall be cleaned up immediately and properly disposed.

- The use of dry brushing during low pressure/wet cleaning operations is prohibited.

Efficiency/Impact: Use of the wet method for removing the dust in the wheel/brake housing or the use of a HEPA vacuum will significantly reduce or eliminate this practice as a source for copper or asbestos in storm water. It will also significantly reduce the potential health hazard associated with asbestos exposure to employees.

BMP Nº CS21

Activity: Employee environmental education and training.

Typical Pollutants: All

Typical Problem: Many employees are not aware of the potential adverse impact the company's business may have on the environment or how they personally can effect those impacts. They may not have even thought about environmental impacts and can not recognize bad practices. Some may not know whom to inform of upsets or potential problems.

BMP: Provide periodic training that describes the potential adverse environmental impacts of the business and methods for preventing those impacts. The training should:

- Describe how the company is being environmentally responsible.
- Encourage employees to bring forth suggestions for improving the environmental performance of the business.
- Describe how and to whom the employee should report potential environmentally relate concerns.
- Inform the employee of what to do.
- Providc incentives to employees to offer ideas for improvement.

Record attendance of the training. Show graphics in the presentation such as pictures of the various parts of the site under discussion during the presentation. Schedule regular inspections of the site looking for possible conditions or operations that could produce potential adverse environmental impacts. Use a team approach to this inspection, as it is too easy, even for professionals, to acquire tunnel vision during the inspection. During the site inspections, write up every questionable item or practice for later thought or resolution. To resolve or dismiss a suggestion or question during the inspection may distract from the process of the inspection or discourage employees from providing their input. Do not associate biodegradable with environmentally safe. Verify that the company is not moving wastes from one media to another, i.e. water to air, storm water to groundwater, etc.

Before the training takes place, analyze the potential problem areas of the site and the potential for how the site's manufacturing process can adversely impact the environment. Develop the training program presentation around these areas. Ask the question "what message am I trying to present?" and thoroughly provide the information necessary to answer the question. How and to whom should it be reported? Involve employees in the presentation through discussion items. Don't over look providing this training to temporary employees.

Efficiency/Impact: By making employees aware of the potential adverse impacts of the business and encouraging employees to offer ideas and suggestions, employers will see, not only a decrease in pollutants in their storm water discharge but, potentially in air, hazardous waste, and other media.

BMP № CS22

Activity: Any site that stores material outside.

Typical Pollutants: Total suspended solids from erosion, oil and grease, BOD_5, heavy metals.

Typical Problem: Poor housekeeping inside and outside on a site provide a possible indicator of the degree of the site's compliance with environmental, health and safety regulations. In addition, poor outside housekeeping tends to discharge paper, cardboard, wood, pallet and box strapping, and other wastes to the storm water conveyance system. These wastes can plug the storm water conveyances, and divert storm water flows causing increased erosion and localized flooding.

BMP: Good housekeeping includes:

- Orderly storage of bags, drums, and piles of materials and chemicals; prompt cleanup of spilled liquids;
- Frequent sweeping, vacuuming, or other cleanup methods for accumulated dry chemicals and materials can cut down on possible storm water contamination;
- Proper disposal of toxic and hazardous wastes, and
- Removal of accumulated scrap and spare parts.

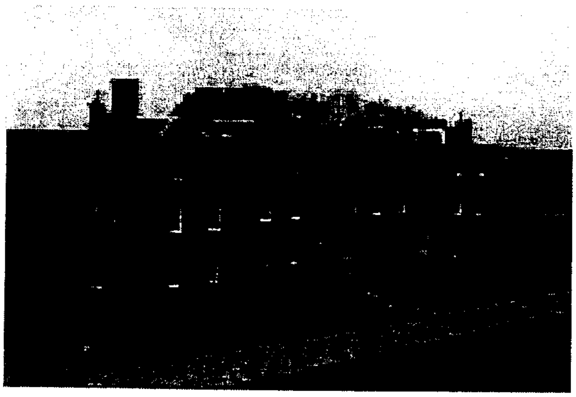
Good housekeeping doesn't just happen. It occurs when it is well planned, scheduled, and when upper management demonstrates its importance by participating in regular inspections. Set aside time in the work schedule for cleanup activities.

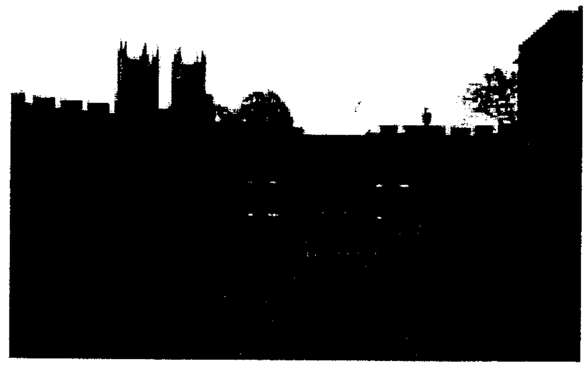
- Schedule personnel to be responsible for the cleanup and rotate every employee through the schedule.
- Periodic inspections and regular site clean up can prevent problems from occurring. The frequency of outside inspections should be increased during the October through May rainy period.
- Encourage employees to pick up trash when it is seen and to report when more intensive clean up is needed.

Every site that is environmentally responsible has good housekeeping activities. Most sites with environmental problems do not have good housekeeping activities.

Efficiency/Impact: The implementation of a formal housekeeping program with education and encouragement of employees can reduce or eliminate pollution by bringing the importance of how materials are stored and how trash can effect the storm water discharges to their attention along with the importance that management places on the issue. A regular maintenance schedule for storm water conveyances minimizes erosion and visually verifies the condition of the storm water discharges. Several typical pollutants in storm water can readily be identified by visual observance.

BMP № CS23 (References #15, 22, 31, 52)





Activity: Facilities having lawns or vegetated areas.

Typical Pollutants: Fertilizers, pesticides, herbicides, fungicides, phosphorus, nitrogen, zinc, copper, and pH.

Typical Problem: Lawn care entails the application of fertilizers, herbicides, pesticides, and water in order to achieve a rich vibrant lawn. Weeds are quite often controlled through the application of chemicals. Over fertilizing and the over-application of pesticides and herbicides can contaminate storm water. Too much irrigation can wash these chemicals off the site into storm water conveyances, streams, rivers, and lakes. The nutrients, phosphorus, nitrogen, and pH can be detrimental to slow moving water bodies by encouraging algae growth. Herbicides and pesticides can adversely impact human health, fish and other wildlife. All of these pollutants can significantly effect the beneficial uses of water bodies.

BMP: If a landscape contractor is hired to take care of the lawn and other vegetated areas of the site, ensure that they do their part to protect the environment by applying the appropriate amount of chemicals. Encourage them to investigate more environmentally friendly alternatives to the use of chemicals.

A few simple precautions can minimize adverse environmental impacts from lawn care. No matter what chemicals are used, over-watering can move the chemicals in to the storm water conveyance system. Use rain measuring equipment to automatically prevent automatic lawn sprinklers from turning on. In the Northwest, watering to a depth of six inches a couple of times a week is sufficient for a lush green growth. Always water in the morning, between 6 a.m. and noon.

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Fertilization:

For lawn fertilization, 1,000 square feet of lawn requires 0.5 pound of nitrogen per month of active growth(~8 months in Portland area ~ 4 pounds). A good ratio for fertilizer is 3 parts nitrogen to 1 part phosphorus to 2 parts potassium to 1 part sulfur(3:1:2:1). Use a slow release fertilizer such as one containing water insoluble nitrogen(WIN). After determining the amount of fertilizer to use per year based upon the growing season, apply the fertilizer in four equal applications of approximately one pound per 1,000 square feet each application, i.e. 1/4 in early spring, 1/4 in late spring, 1/4 in late summer, and 1/4 in the fall.

Have your site's soil tested to determine if other materials such as iron(for low pH soil < 6.8), boron, chlorine, copper, manganese, molybdenum, nickel, and zinc should be added for a healthy lawn. If soil testing indicates that one or more of the additives above is needed, contact your county Extension Agent, a lawn and garden center, or a master gardener for advise on how much of the additives to apply for optimum growing conditions.

Fertilizer over-use, over watering, and watering at the wrong time of the day set up a good environment for many grass diseases and for invasion by weeds that are very competitive with the grasses in the lawn.

Pest Management:

Pest management can be conducted in an environmentally friendly manner through:

- **Knowledge**
  1. knowing the variety of grass in your lawn;
  2. knowing its growth characteristics; and

- **Identification**
  1. identifying the weeds present;
  2. identifying the grass disease present; and/or
  3. identifying the insect pests present
    a). Note where the pest is located on the lawn
    b). Draw a picture of the pest or collect a sample
      i. Research in books for a match of the pest found to a photograph;
      ii. Contact local County Extension office for assistance and advice; or
      iii. Take sample to local home and garden center for identification.

Weed removal is best accomplished by hand-pulling.

Maintain a buffer strip next to waterways. Do not apply fertilizer or pesticides to this strip. It is used to absorb excess fertilizer from the care of the rest of the lawn.

It will also retain excess nutrients and sediments.

Healthy Lawn

Step 1: Lawn conversion	Convert lawn areas into groundcover, trees, shrubs, or meadow plantings. For a low input approach, replace the grass underneath mature trees with groundcover. For an even lower input approach, examine your lawn for potential conversion areas and plant groundcovers, trees, shrubs, or perennials in all areas where grass is hard to grow. For the lowest input approach, use turf only where it is the best plant to fulfill a particular function, such as providing a children's sports area.
Step 2: Soil building	Provide a strong foundation for the lawn. For a low input lawn, get a soil test to determine the soil's pH and fertility. You may not need to add any lime or fertilizer to your lawn. For a lower input lawn, test for soil compaction. Can you sink a screwdriver into the ground without pounding or is the soil compacted? If the soil is compacted, aerate with a hand corer or mechanical aerator. For the lowest input lawn, examine the soil's texture- neither extremely sandy soils nor extremely heavy clay soils make for good lawns. Next count earthworms-if none can be found in a square foot of soil, there's a problem. A healthy soil community has over 10 per square foot. With this basic understanding of soil acidity, fertility, compaction, texture, and earth-worms, one can build soil that supports dense, healthy turf.
Step 3: Grass selection	Choose the type of grass that will be easiest to grow. For a low input lawn, select hardy grass species adapted your the region's climate. For a lower input lawn, select named grass varieties to meet your specific needs. For the lowest input lawn, try the new low-input slow-growing or dwarf grass mixes.
Step 4: Mowing and thatch management	Mow to the right height at the right time and recycle clippings. For a low input lawn, leave clippings on the lawn to provide nutrients and moisture. For a lower input lawn, set mowing height as high as possible. For the lowest input lawn, adjust mowing height and frequency during the growing season and monitor thatch levels.
Step 5: Minimal fertilization	Give the lawn what it needs but don't overfeed. For a low input lawn, recycle clippings and (in the right season) apply commercial fertilizer at half the recommended rate; avoid

weed and feed formulations and don't fertilize if rain is imminent. For a lower input lawn, fertilize as above but use encapsulated nitrogen or an organic product instead-and fertilize only if soil tests show it's needed. For the lowest input lawn, substitute home generated compost for commercial organic or encapsulated products.

Step 6: Weed control and tolerance

Establish a realistic tolerance level for weeds and use least toxic control methods to maintain it. For a low input lawn use least toxic weed control methods such as: cultivation, solarization, flaming, mowing, or herbicidal soap. For a lower input lawn, grow strong healthy grass and it will crowd out weeds. For the lowest input lawn, broaden your definition of "lawn" to include weeds that perform desirable functions.

Step 7: Integrated pest management

Establish a realistic tolerance level for pests and use least toxic control methods to maintain it. For a low input lawn, use least toxic control methods such as removing or trapping pests, introducing biological control agents, or apply least toxic chemical controls such as insecticidal soaps. For a lower input lawn, grow strong, healthy grass that can resist attack. For the lowest input lawn, use cultural controls to prevent infestation, protect natural predators, and add beneficial soil microbes.

Step 8: Sensible irrigation

Practice water conserving landscaping techniques. For a low input lawn, water infrequently, in the early morning, but soak the lawn well. For a lower input lawn, water only when the lawn definitely needs it, and calibrate sprinklers. For the lowest input lawn, accept that the grass may not be green year round.

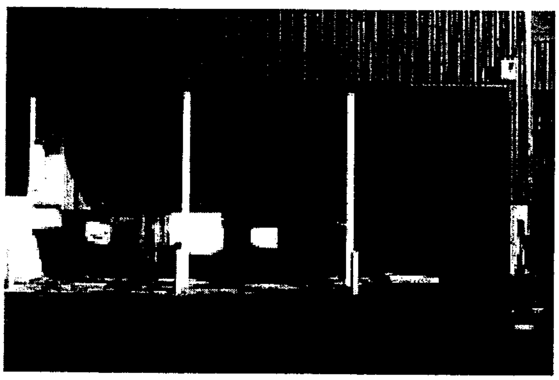
Efficiency/Impact: Proper maintenance of lawns and vegetative strips can be pleasing to the eye and provide environmental benefits such as reduced pollution to streams, rivers, and lakes, cooler runoff, reduce sediments in the runoff, and in some cases reduce other pollutants from the site. The degree that this BMP will be effective is directly proportional to the degree of involvement in the care of the lawn or the degree of caution exercised in selecting a lawn care contractor and the degree that the watering system is in tune with the lawn and the weather.

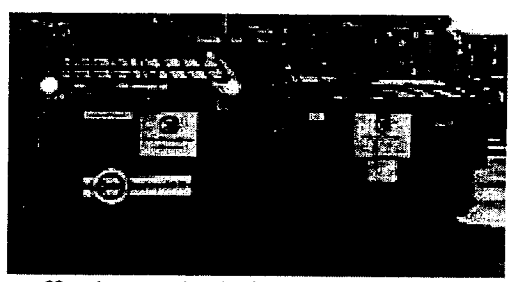
BMP Nº CS24

Activity: Storage of general rubbish or food rubbish outside in dumpsters.

Typical Pollutants: Suspended solids, nutrients, bacteria, dioxin, chemicals

Typical Problem: Waste materials are typically removed from inside the site buildings to a collection container(dumpster) outside of the buildings. If these dumpsters have an open top or the top is left open at times when materials are not being dumped into them, storm water makes contact and will mix with the wastes and leak out to the storm water discharge conveyances for the site.





BMP: There are two effective methods for addressing this concern. At the end of a building, extend the roof over the area where the dumpsters will be placed to keep storm water out. Slope the floor that the dumpsters are sitting on to a drain where the contaminated storm water/dumpster drainage can be collected and discharged to a sanitary sewer, if necessary.

The other method is to ensure that covers are on all of the dumpsters and that the covers are lowered when wastes are not being discharged into them. The second method has the most risk in that this method relies on employees always performing the proper procedure and many different situations can arise that may interrupt the procedure and prevent it from occurring. No matter which method is used, ensure that no storm water catch basin is located close by.

Efficiency/Impact: Either method for protecting wastes from storm water exposure will minimize or eliminate storm water pollution from this source. The method that relies on the least effort from employees is usually the most reliable.

BMP № CS25

Activity: Pumping liquids from storage tanks into the site buildings or into vehicles.

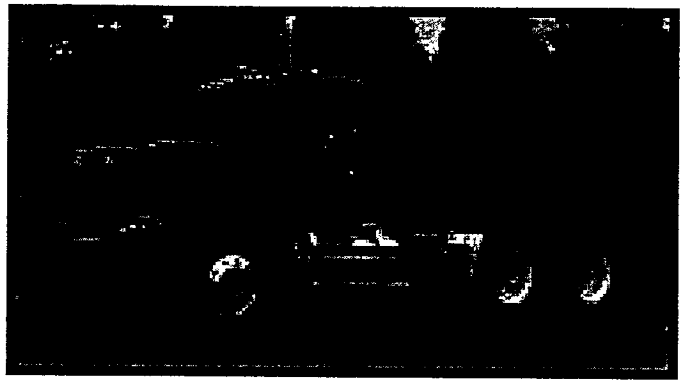
Typical Pollutants: Petroleum hydrocarbons, antifreeze, other potentially toxic or hazardous liquids

Typical Problem: Pumps and piping can leak the liquids being pumped. Pumps located inside of buildings without containment can leak fluids that may contaminate storm water runoff.

BMP: Spill or leak containment should be constructed around the pumps. Place a curb across door openings and seal the floor and wall/curb with an epoxy compatible with the liquid being pumped. This measure will contain liquids within the enclosure and, unless a catastrophic failure of the discharge piping occurs, the liquid will not escape the building to adversely impact storm water runoff. Periodic inspections of the containment should be made to ensure that a build up of the leakage does not eventually rise to the point that it will pass over the containment berm. The contained liquids should be periodically removed and properly disposed.

Efficiency/Impact: Ensuring that pump houses can provide containment and frequent inspections of the containment within the pump house will minimize or eliminated storm water runoff contamination from this source.

BMP № CS26



Activity: Trucking firms or other operations in which semi trailers are parked on site and dollies are used to attach to the trailers to move the trailers around the site or operations in which semi tractors are used on site.

Typical Pollutants: Oil and grease

Typical Problem: Fifth wheel hitching mechanisms used to attach semi-tractors or tow dollies to semi-trailers have a thick coating of grease on them to minimize the friction encountered and to ease the attachment process during connection of tractors or dollies to the trailers. When the dollies or semi-tractors are parked and not attached to trailers the grease on the fifth wheel is exposed to storm water. This allows the storm water runoff to pick up the oil and grease.

BMP: Manufacture or purchase a quick install cover to slip over the hitch. A simple lightweight inexpensive cylindrical slip-on cover could be made out of fiberglass. Ensure that all operators of the equipment are instructed to place the cover over the hitches when they are not being used. Changing from the lubricated type fifth wheel hitch to a teflon non-lubricated type is a better approach but, if rental or transit trailers are in use frequently this may not be a viable option due to the requirement that both the trailer and the tractor fifth wheel slider plates need to be coated with the teflon.

Efficiency/Impact: While there will always be some exposure especially at the times the covers are removed for making the connections and the moving of the trailers, this method should minimize the adverse impact that the practice has on the storm water runoff.

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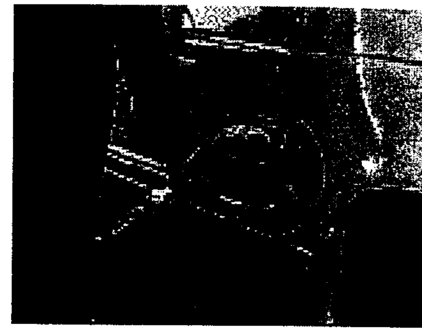
BMP Nº CS27



Activity: Fueling operations performed by employees on-site or through restricted access systems such as Cardlock sites in various locals across the State.

Typical Pollutants: Gasoline and diesel fuels (Petroleum Hydrocarbon)

Typical Problem: Fueling nozzles can stick in the open or on position when fueling vehicles. Employees some times are not instructed in the correct methods for spill clean-up. Frequently, spill clean-up materials are not available at the dispensing pumps. Fueling stations may not have roofed areas or properly sloped or contained areas for collecting spilled fuel. All of these situations and conditions can result in fuel contacting storm water and entering the site runoff.

BMP: The fueling area should be designed and operated to minimize contact between spilled fuel and leaked fluids and storm water.

- Use a damp cloth on the pumps and a damp mop on the pavement for area clean up.
- Clean up spills immediately:
  - ➢ Spread absorbent material and sweep it up with a broom.
  - ➢ Perform a hazardous waste determination on the absorbed material.
  - ➢ Dispose of the absorbed material properly.
- Ensure that the overfill nozzle protection is in working order.
- Remove any nozzle locking mechanism which allows the fuel to stay on with the operator absent. The operator should be present at all times to ensure that overfilling and spillage does not occur.
- Cover fueling areas and berm/slope the pavement under the roof to a drain system that is connected to a holding tank or contains the spillage at the surface for easy clean up.
- Provide an easily accessible and well-marked emergency shutoff for pumps with plainly written instructions on how to operate the shutoff.
- Never hose down the fueling area.
- Don't drain spills to the sanitary or the storm water sewers.
- Ensure that the fueling area has an undamaged continuous paved or otherwise impervious surface.
- Ensure that spill clean up materials are readily available.
- For areas where multiple customers or operators from multiple companies have access, provide highly visible, simple instructions on how to clean up spills and report the incidence.
- Provide well placed, understandable instructions on the proper procedures to

follow in the event of an emergency, including reporting information.

Efficiency/Impact: Implementation of this BMP can virtually eliminate this potential source of storm water contamination provided site inspection is frequently performed.

BMP № CS28

Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks. Unused excess land may be necessary to implement these BMPs.

Typical Pollutants: Sediment(TSS), metals, BOD, phosphorus, and hydrocarbons(Oil & Grease)

Typical Problem: When the implementation of specific point source BMPs has not eliminated or reduced the contaminants in the storm water to the specific benchmarks, end of the pipe or final discharge BMPs may be necessary.

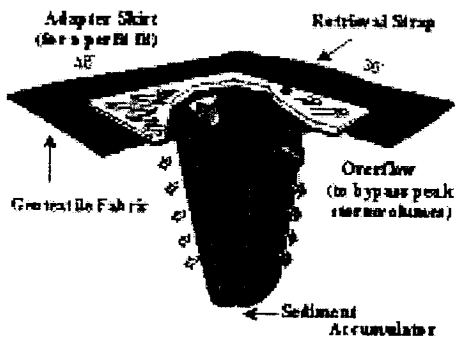
BMP: Install a grassy filter strip and ensure that the storm water passes through the strip in sheet flow. Vegetated filter (buffer) strips are best used on sites with sheet runoff, such as parking lots.

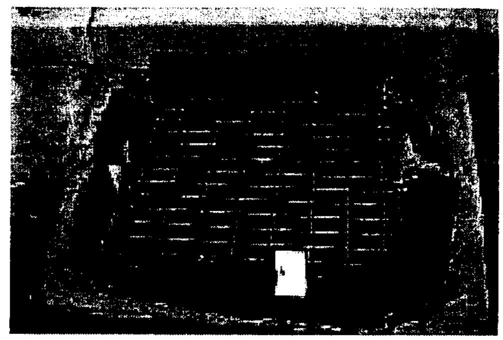
- Effective filter strip widths range from a minimum of 50 feet to a maximum of 200 feet.
- Best for smaller drainage basins, five acres or less.
- Not suitable on slopes or sites with shallow depth to bedrock .
- Best for sheet flow. Do not use on slopes over 10%.
- Good for conventional pollutants.
- Cannot be used to convey larger storms, or concentrated flow discharges as their effectiveness will be destroyed plus they could become sources of pollution through erosion.
- Best grasses is tall fescue, followed by western wheatgrass, annual or Italian Ryegrass, Kentucky Bluegrass.
- Rectangular and V shaped cross sections are the least desirable.
- Design to create a low velocity flow, bent grass is not as good a filter.
- Curbing for impervious areas draining to the filter strips should have a one-foot gap every five feet.

Efficiency/Impact: Properly sized and maintained vegetated filter strips can have a removal efficiency of up to 80 percent for suspended solids.

BMP № CS29 (References # 9, 21)

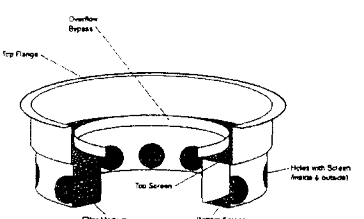
Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks. Unused excess land may be necessary to implement these BMPs.

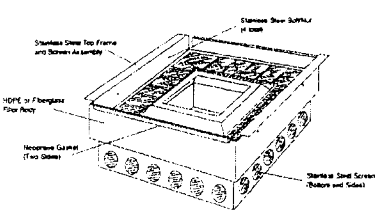




Typical Pollutants: Sediment(TSS), metals, BOD, phosphorus, and hydrocarbons(Oil & Grease)

Typical Problem: When the implementation of specific point source BMPs has not eliminated or reduced the contaminants in the storm water to the specific benchmarks, end of the pipe or final discharge BMPs may be necessary.





BMP: Install a catch basin filter system: a catch basin coupled with a sump and sediment traps. May also be used with an inlet device, prefiltering insert and screens (see other facilities and retrofit). The inserts consist of several filtering trays suspended from the inlet grate. Common filters are charcoal, wood fibers or fiberglass.

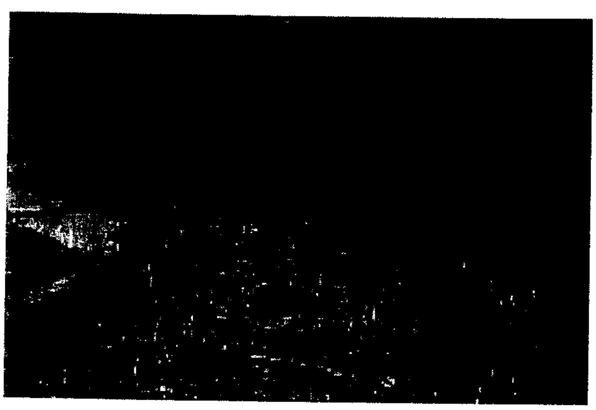
- Retains small particles, partially effective with high levels of particulate heavy metals, oil/grease, and TSS. Moderate reduction in TSS and turbidity. However, few pollutants are associated with these coarser solids.
- Disadvantage: When 60% full, the suspended solid deposition is in equilibrium with scour, and the capture efficiency is reduced to zero.
- Best in small basins and with treatment of highly turbid runoff prior to

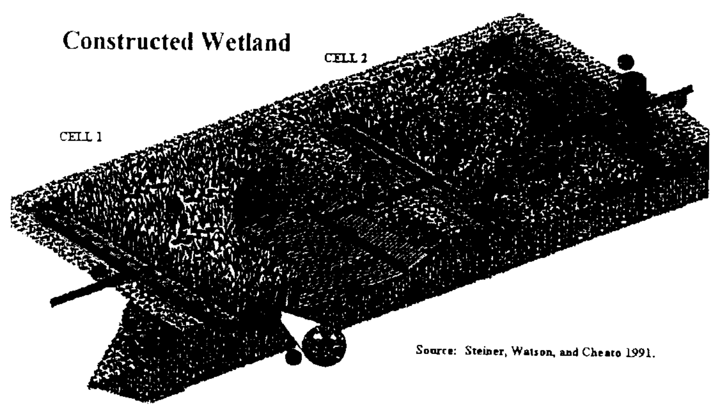
discharge to catch basin.

- Do not use on unstable or steep slopes.
- Usually used with vaults, tanks, sumps or inverted (hood) inlet. Inlet can be coupled with a filtration system (see retrofit).
- Maintenance is critical and must be at least semiannual. Require a maintenance schedule and plan for disposal of material removed by the catch basin.
- Insert maintenance is required quarterly and should be inspected more frequently during wet periods.
- Catch basins with a restrictor device (multiple orifice and weir/riser section) for controlling outflow provide minimal control for floatables and petroleum based products.
- Design the size of catch basin sump to handle the site runoff rate, TSS concentration in runoff and how often it will be cleaned out.
- To minimize groundwater pollution problems, be careful where infiltrating catch basins are used (residential areas) and pre-treat the infiltration water.

Efficiency/Impact: Catch Basin Filter System Efficiency: TSS up to 22%, and Turbidity up to 38%

BMP № CS30 (Reference #21 & 46)





Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks. Unused excess land may be necessary to implement these BMPs.

Typical Pollutants: Sediment(TSS), metals, BOD, phosphorus, and hydrocarbons(Oil & Grease)

Typical Problem: When the implementation of specific point source BMPs has not eliminated or reduced the contaminants in the storm water to the specific benchmarks, end of the pipe or final discharge BMPs may be necessary.

BMP: Install a constructed wetland. Constructed wetlands are constructed by a combination of excavation and/or berming. The basic types of constructed wetlands are: shallow marsh, a 2 or 3 celled pond/marsh, extended-detention wetland and pocket wetland.

Storm water treatment facilities are not considered waters of the State, however, their discharge is regulated in the same way as any treatment system. Created wetlands built as mitigation for loss of wetlands under the Clean Water Act Section 404, are considered waters of the State. Created wetlands are protected as natural wetlands and cannot be used for conveyance or treatment of wastewater, unlike constructed wetlands.

- Extended-detention wetland and pocket wetlands are less effective in removal of some types of pollution than other types of wetlands.
- The constructed wetland should be lined when located over permeable soils for permanent pool maintenance. This is to prevent potential groundwater and soil contamination. Use a Bentonite clay (12" thick) or commercial heavy plastic pond liner (minimum 40 ml). Place a minimum of 18" thick compacted soil over the liner prior to seeding.
- The permanent pool depth should be between three to six feet in depth, plus one foot of dead storage for sediment. Six feet is the minimum depth or the pond will stratify in summer and create low oxygen conditions which result in the re-release of phosphorus and other pollutants. In addition, if the pond is deeper than six feet, it will likely pollute the groundwater.
- Suitable for larger sites up to 100 acres.
- Soils should be tested to determine suitability. Best when located in clay loams, silty clay loams, sandy clays, silty clays and clays.
- Cannot be used in areas with shallow depth to bedrock or unstable slopes.
- Good for removal of nutrients and conventional pollutants such as oil and grease and some heavy metals.
- Needs to have a shallow marsh system in association to deal with nutrients.
- Should be multi-celled, preferably three of equal sizes. The first cell should be three feet deep to trap coarse sediments and slow turbulence. They need to be designed as a flow through facility, and the pond bottom should be flat to facilitate sedimentation.
- Need to be designed with periodic maintenance in mind by using an overhead scooping device.
- Side slopes should be 2:1, not steeper than 3:1, and 10 to 20 feet in width. A length to width ratio of 5:1 is preferred, with a minimum ratio of 2:1 to enhance water quality benefits. The longer length allows more travel time and opportunity for infiltration, biofiltration and sedimentation.
- Pond berm embankments over six feet should be designed by a registered

engineer. Berm tops should be 15 feet wide for maintenance access and should be fenced for public safety.

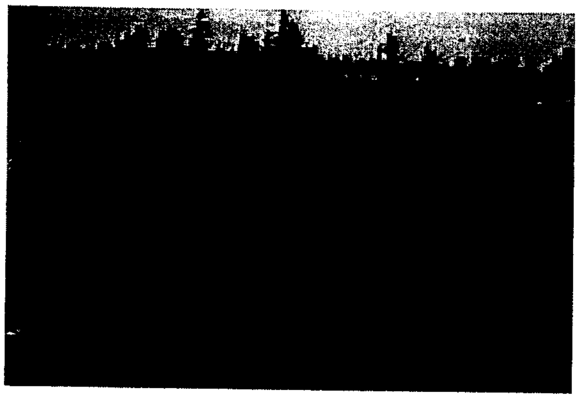
- Shape should be long, narrow, and irregular since these are less prone to short circuiting, are more effective, and maximize the treatment area.
- Baffles can be used to increase the flow path and water residence time.
- Should have an overflow system/emergency spillway to accommodate a 100 year, 24 hour flood and a gravity drain.
- Maintenance is of primary importance. The site must be responsibly selected. A maintenance plan needs to address removal of dead vegetation (that release nutrients) prior to the winter wet season, debris removal from trash racks, sediment monitoring in forbays and in basin are likely to contain significant amounts of heavy metals and organics (regular testing is advised).
- Access to the wet pond is to be restricted with a gate and posted signs.
- For mosquito control, either stock the pond with fish or allow it to be drained for short periods of time (do not kill the marsh vegetation).
- Constructed wetland is more complex, with more vegetation, and shallower with greater surface area, hydrologic factors (flow) play a larger part in siting.
- Selection of vegetation should be done by a wetland specialist.
- Oil/water separators can be used prior to the constructed wetland, depending upon the surrounding land uses.
- Relatively low maintenance costs.
- Fence off for safety (children), to protect plants/wildlife.
- Disadvantages/constructed wetlands:
  a.) Constructed wetlands have a larger land requirement for equivalent service compared to a wet pond.
  b.) Relatively high construction costs.
  c.) Delayed efficiency until plants are well established (1–2 seasons).
- Buffer width 25 to 50 feet.
- Limit water level fluctuations, as they kill plants.

Efficiency/Impact: Wet pond/wetland removal efficiencies:*

a) Heavy metals = 40 to 80%;
b) Total Phosphorus = 40 to 80%
c) Total Nitrogen = 40 to 60%
d) TSS = 70%
e) Soluble reactive phosphorus 75%
f) Nitrate = 65%
g) Ammonia = -43
h) COD = 2
i) Total copper, lead and zinc = 80 to 95%

* Higher efficiencies are associated with use of O/G trap, larger pond/marsh area and volume. These efficiencies assume that the intensity of the storm water inflow does not exceed the capacity of the wetlands and that the pollutants are not in a concentrated form from a large spill or discharge.

BMP Nº CS31 (Reference #21 & 46)



Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks. Unused excess land may be necessary to implement these BMPs.

Typical Pollutants: Sediment(TSS), metals, BOD, phosphorus, and hydrocarbons(Oil & Grease)

Typical Problem: When the implementation of specific point source BMPs has not eliminated or reduced the contaminants in the storm water to the specific benchmarks, end of the pipe or final discharge BMPs may be necessary.

BMP: Install a grassy bioswale. Swales basically act as filters for runoff from frequent storms. The principle form of treatment is the settling out of pollutants and the use of vegetation to take up the dissolved fraction. For best results a swale should be designed to deal with the peak runoff for a two year, 24 hour storm event.

- Does well with first flush runoff, economically feasible, improves aesthetics and has minimal environmental impacts. Best in median strips and parking lot islands.
- The organic topsoil layer is good for degrading petroleum solvents, heavy metals, nutrients and hydrocarbons.
- Critical design elements: size of drainage area to be treated, location of bioretention areas, sizing guidelines, calculate water budget.
- Biofiltration is suitable for smaller sites 10 or less acres.
- Needs a minimum width of 20 feet.

- Must be graded to create sheet flow, not a concentrated stream. Sheet flow decreases the chance of producing gully erosion and distributes contaminants over a wider area. Level spreaders (i.e. slotted curbs) can be used to facilitate sheet flow.
- Can be placed anywhere with careful site design.
- Do not use on steep, unstable slopes or landslides.
- Can reduce peak flow rates.
- Best when used for treatment and conveyance of storm water after a settling pond.
- Good for nutrient removal and conventional pollutants such as suspended solids and some heavy metals.
- Best at 200 feet in length, in tight spaces obtain more length by using a curved path. Should have a maximum bottom width of 50 feet. One foot high check dams should be installed every 50 feet starting 20 feet downstream from the inflow point.
- Good when used at a storm water outfall, commercial development or roadside.

Efficiency/Impact: Bioswales can, when sized correctly and when incorporated with an upstream settling pond, provide similar pollutant removal efficiencies to those achieved by a biopond or constructed wetland.

Removal efficiencies:

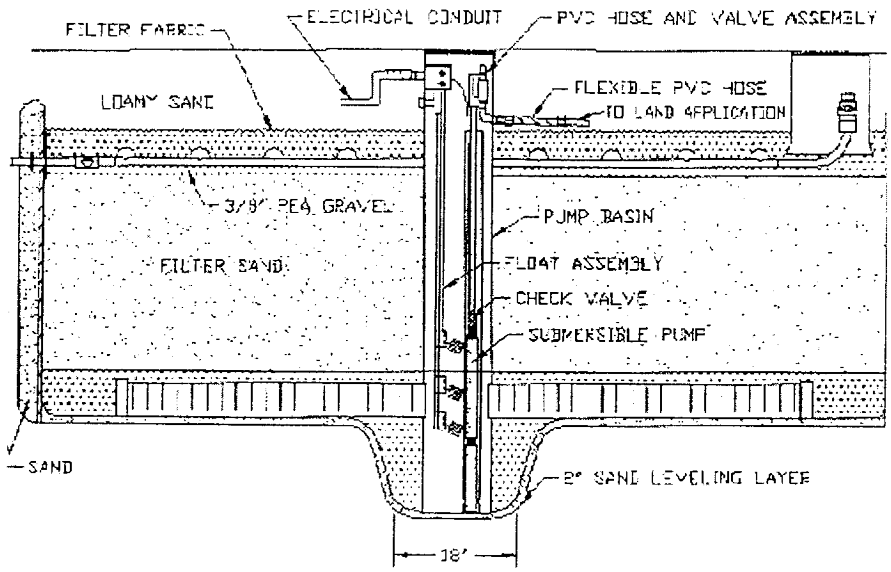
a) TSS = 83 to 92%
b) Lead = 67%
c) Copper = 46%
d) Total phosphorus = 29 to 80%
e) Total zinc and aluminum = 63%
g) Oil/grease/TPH = 75%
h) Nitrate-N = 39 to 89%

BMP № CS32 (Reference 38, 39, & 40)

Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks.

Typical Pollutants: Phosphorus, Heavy metals.

Typical Problem: When the implementation of specific point source BMPs has not eliminated or reduced the contaminants in the storm water to the specific benchmarks, end of the pipe or final discharge BMPs may be necessary.

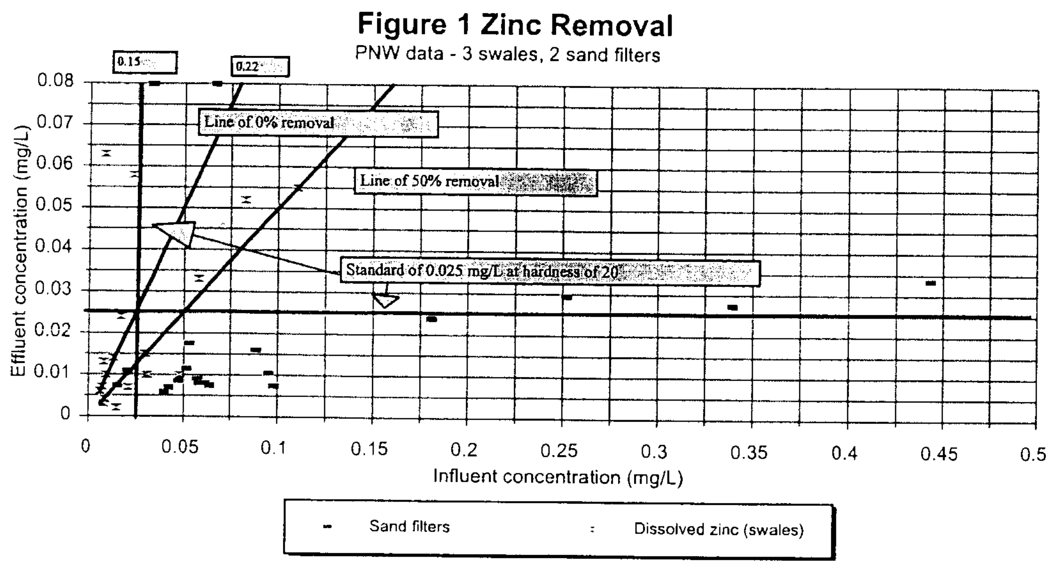


BMP: Installation of a sand filter has shown to reduce some heavy metals.

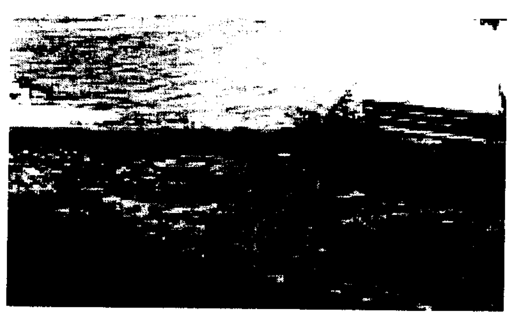
Efficiency/Impact: Research has shown zinc to be reduced to as little as 8% of the original concentration. More research is needed to determine the effect a sand filter will have on other metals. The mechanism for the removal of the metals is not completely understood at this time. Due to the particle size, this method should have negligible effect on the dissolved metals.

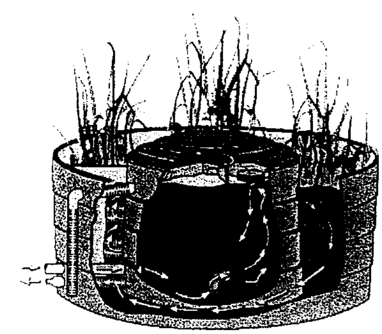
Typical Pollutant Removal Efficiency

Pollutant	Percent Removal	Pollutant	Percent Removal
Biochemical Oxygen Demand (BOD)	70	Total Kjeldahl Nitrogen (TKN)	46
Total Suspended Solids (TSS)	70	Total Phosphorus (TP)	33
Total Organic Carbon (TOC)	48	Iron (Fe)	45
Total Nitrogen (TN)	21	Lead (Pb)	45
Zinc (Zn)	45		



BMP Nº CS33 (Reference #47 & 48)





Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks. Unused excess land may be necessary to implement these BMPs.

Typical Pollutants: Sediment(TSS), metals, BOD, phosphorus, and hydrocarbons(Oil & Grease)

Typical Problem: When the implementation of specific point source BMPs has not eliminated or reduced the contaminants in the storm water to the specific benchmarks, end of the pipe or final discharge BMPs may be necessary.

BMP: Storm Treat System uses a 4 x 9 chambered treatment tank (sedimentation and filtration) that discharges to a small constructed wetland, catch basin, swale or sump near the pollution source. The system can capture and treat the first flush runoff when located high in the watershed and near the source of pollution. The number of units used depends upon the design storm, size of sub-drainage area and needed detention volume.

- Significantly smaller (5-10%) than other systems. Good for constrained sites, such as roadside wetlands.
- Discharge is slow enough for discharge to a constructed wetland or groundwater, so it can be located in low permeability soils with a high water table (self-anchored).
- Closed system with no standing water (public health/safety issue) and can be shut off in case of a local spill.
- Requires sediment removal every three to five years by suction pump and annual inspection of skimmers and screens.
- Can connect to existing drainage structure, usually a catch basin, swale or sump to provide treatment.

Efficiency/Impact: Storm Treat System removal efficiency:
a) Fecal coliform = 97%
b) TSS = 99%
c) COD = 82%
d) Total dissolved nitrogen = 44%
e) Total petroleum hydrocarbons = 90%
f) Lead = 77%
g) Chromium = 98%
h) Phosphorus = 90%; and
i) Zinc = 90%

BMP Nº CS34

Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks. Unused excess land may be necessary to implement these BMPs.

Typical Pollutants: Sediment(TSS), metals, BOD, phosphorus, and hydrocarbons(Oil & Grease)

Typical Problem: When the implementation of specific point source BMPs has not eliminated or reduced the contaminants in the storm water to the specific benchmarks, end of the pipe or final discharge BMPs may be necessary.

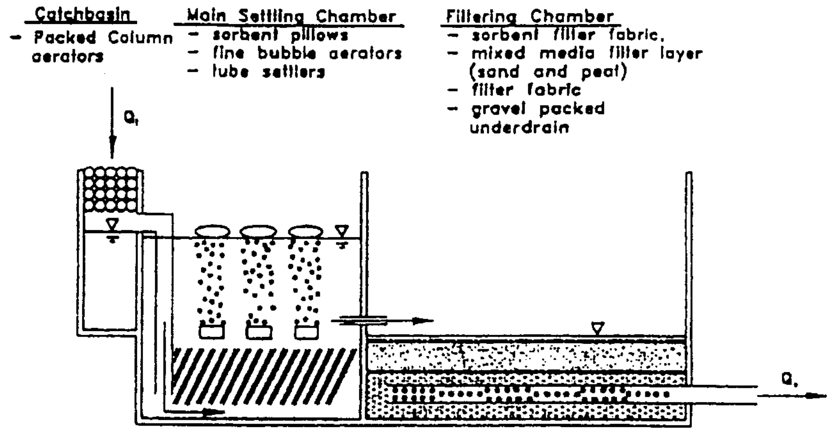


Figure 9. General Schematic of MCTT

BMP: Multi-Chambered Treatment Train (MCTT) uses a catch basin/sump and two chambers: initial grit catch basin for large sedimentation and volatiles, main settling chamber (aeration and sorbent pillows) for the removal of fine sediment, associated toxicants, and floating hydrocarbons (settling time 1-3 days); and a sand/peat filter/ion exchange unit to remove filterable toxicants.

- Best in small, isolated, paved critical source areas (0.25 to 2.5 acres).
- Suggested for the following land uses: vehicle service facilities, convenience store parking areas, equipment storage areas and salvage yards.
- Uses 1/3 the area of a wet detention pond.
- Very effective removal rates for both filtered and particulate storm water toxicants and suspended solids.
- Very new technology, so costs are currently high, but are expected to drop with pre-fabrication. Can be used in retrofitting; preliminary experimental costs at a gas station were $54,000
- Design is very site specific and highly dependent upon local rains (depth, intensity and inter-event time). The size of the main chamber increases as the annual rain volume increases. The inter-event period and rain volume determines the specific runoff treatment volume requirements. Seattle requires a small MCTT because of the small rain depths for each rain.

Efficiency/Impact: Multi-Chambered Treatment Train removal efficiencies:

a) Total toxicity = 96%
b) Filtered toxicity = 98%
c) Suspended solids = 83 to 95%
d) COD = 60 to 90%
e) Turbidity = 40 to 90%

f) Lead = 95%
g) Zinc = 85 to 90%
h) Cadmium = 90%
i) Copper = 65 to 90%
j) Pyrene = 75 to 85%
k) Phosphorus = 80 to 90%
l) Ammonia = 50%
m) n-Nitro-di-n-proplamine = 100%, and
n) pH decreased by 25 to 50%

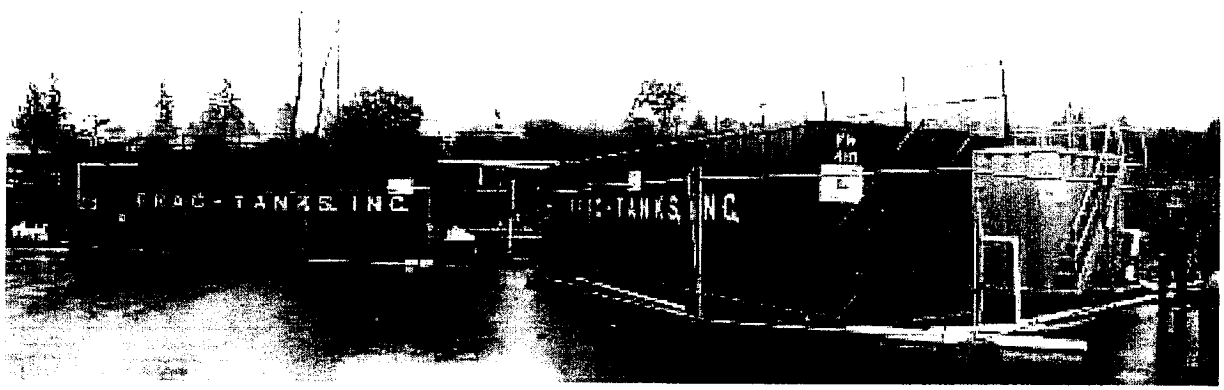
Color increased by 25 to 50% and nitrate nitrogen had low removal rates.

BMP № CS35 (Reference #30)

Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks. Unused excess land may be necessary to implement these BMPs.

Typical Pollutants: Sediment (TSS), metals, BOD, phosphorus, and hydrocarbons (Oil & Grease)

Typical Problem: When implementation of specific point source BMPs have not managed or eliminated the contaminants in the storm water to the benchmarks or below or where potential point sources for the contaminants can not be identified, end of the pipe or final discharge BMPs may be necessary.

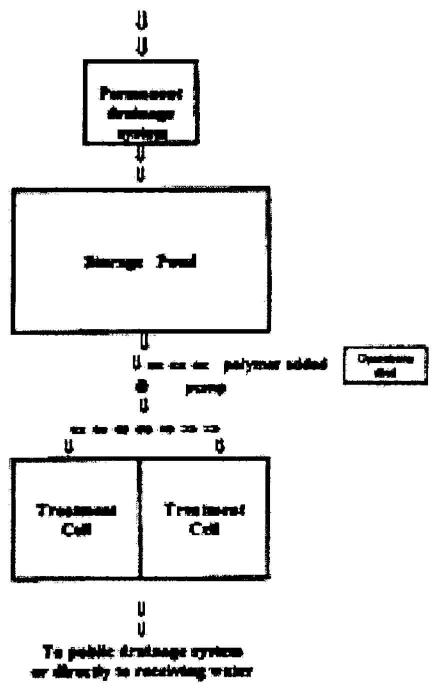


BMP: Install a flocculation system using a flocculent such as Calgon Cat Floc 2953 or a Polyaluminum Chloride such as Sumalchlor-50 or other.

Fine particles suspended in water give it a milky appearance, usually measured as turbidity or total suspended solids. Their small size, often much less than 0.001 mm in diameter, give them a very large surface area relative to their volume. These fine particles typically carry a negative surface charge. Largely because of these two factors, small size and negative charge, these particles tend to stay in suspension for extended periods of time. Because of this, removal is not practical by settling alone. Polymers and inorganic chemicals speed the process of clarification. The added chemical destabilizes the suspension and causes the smaller particles to agglomerate. The process consists of three steps: coagulation, flocculation, and settling or clarification.

The conditions under which clarification is achieved can affect performance.

Currents can reduce settling efficiency. Currents can be produced by wind, by differences between the temperature of the incoming water and the water in the clarifier, and by flow conditions near the inlets and outlets. Calm water such as that which occurs during batch clarification provides a good environment for effective performance, as many of these factors become less important in comparison to flow-through clarification basins. One source of currents that is likely important in batch systems is movement of the water leaving the clarifier unit. Given that flocs are relatively small and light the exit velocity of the water must be as low as possible. Sediment on the bottom of the basin can be resuspended and removed by fairly modest velocities.



Coagulants and flocculant-aids:

Polymers are large organic molecules that are made up of subunits linked together in a chain-like structure. Polymers that carry groups with positive charges are called cationic. Cationic polymers can be used as primary coagulants to destabilize negatively-charged turbidity particles present in storm water. Inorganic chemicals such as aluminum or ferric sulfate and aluminum or ferric chloride can also be used, as these chemicals become positively charged when dispersed in water.

In practice, the only way to determine whether a polymer is effective for a specific application is to perform preliminary or on-site testing. Polymer effectiveness can degrade with time and also from other influences. Thus, manufacturers' recommendations for storage should be followed.

Application of coagulants and flocculent-aids at the appropriate concentration or

dosage rate for optimum turbidity removal is important for management of chemical cost, as well as for effective performance. The optimum dose in a given application depends on several site-specific features. The turbidity of untreated water is a primary determinant. The surface charge of particles to be removed is also important, as previously noted. Environmental factors that can influence dosage rate are water temperature, pH, and the presence of constituents that consume or otherwise affect polymer effectiveness (for example, color, oils). Preparation of working solutions and thorough dispersal of polymers in water to be treated is also important to establish the appropriate dosage rate.
Design engineers wishing to review more detailed presentations on this subject are referred to the following textbooks:

- Fair, G., J. Geyer and D. Okun, *Water and Wastewater Engineering*, Wiley and Sons, NY, 1968.
- American Water Works Association, *Water Quality and Treatment*, McGraw-Hill, NY, 1990.
- Weber, W.J, *Physiochemical Processes for Water Quality Control*, Wiley and Sons, NY, 1972.

Comparisons

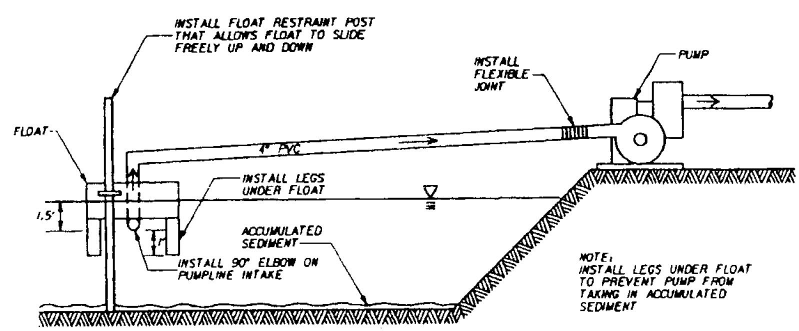
The above discussion indicates that the design and operation of a polymer system should take into consideration the factors that determine optimum, cost-effective performance. It may not be possible to fully incorporate all of the classic concepts into the design because of practical limitations at construction sites. Nonetheless it is important to recognize the following:

- The right polymer must be used at the right dosage. A dosage that is either too low or too high will not produce the lowest turbidity. There is an optimum dosage rate. This is a situation where the adage "more is always better" does not apply.
- The coagulant must be mixed rapidly into the water to ensure proper dispersion.
- A flocculation step is important to increase the rate of settling, to produce the lowest turbidity and to keep the dosage rate as low as possible.
- Too little energy input into the water during the flocculation stage results in flocs that are too small and/or insufficiently dense. Too much energy can rapidly destroy floc as it is formed.
- Since the volume of the basin is a determinant in the amount of energy per unit volume, a basin can be too big relative to the size of the energy input system.
- Care must be taken in the design of the withdrawal system to minimize outflow velocities.

Number and volume of treatment cells

There are three reasons for having two rather than one treatment cell. First, if something goes wrong with the treatment of a particular batch, the contractor can continue treatment in the second cell while dealing with the problem in the first cell. The second reason is the uncertainty over the time required to achieve satisfactory clarification. If one had confidence that satisfactory settling could be achieved consistently within 30 to 60 minutes, it might be reasonable to conclude that only one cell is needed since turnover could occur rapidly. The third reason is the time to empty the cell after treatment. It therefore seems appropriate to use two cells.

The second consideration is the volume of the individual treatment cell. There are two opposing considerations in sizing the treatment cells. There is a desire to have a large cell- so as to be able to treat a large volume of water each time a batch is processed. However, the larger the cell the longer the time required to empty the cell. It is also possible that the larger the cell the less effective the flocculation process, and therefore the settling. The simplest approach to sizing the treatment cell is to multiply the allowable discharge rate by the desired draw-down time. The desired draw-down time is about four hours.
A four-hour draw-down time allows one batch per cell per eight hour work period. A batch can be prepared in the morning including an hour or so of flocculation followed by about two hours of settling followed by discharge, although discharge could occur after hours. Or a batch can be prepared in the afternoon, followed by settling overnight, with discharge the following morning. The main point is that it appears to be most logical to size the cell to fit the desired drawdown time, constrained by the allowable release rate.



FLOATING PUMPLINE INTAKE (TYP.)

Configuration of the outlet device

The withdrawal device used for removing the liquid from the settling pond should be designed so that pulling settled sediments from the bottom of the treatment cell in the vicinity of the device does not occur. Whether this is a problem is not known but it should be evaluated. One approach is to place the discharge outlet near the area where treated water enters the cell. At this location there will be relatively little accumulation of solid because of the turbulence created by the incoming water.

A second approach is to use the float configuration as in the diagram shown above. The use of four rather than one inlet pipe reduces the inlet velocity. Reduced inlet velocity reduces the possibility that sediments will be picked up and discharged from the settling pond.

A third approach is to modify the float to include a square circular weir that the water enters before reaching the outlet pipe. A circular weir with, say, 10 feet of circumference would significantly reduce the overflow rates(velocity) over the weir. As an example, examine how exit velocities are kept as low as possible in water and wastewater clarifiers. These clarifiers include what is known as effluent launders. They are long troughs, placed at the outlet end the clarifier or around the outside circumference in the case of circular clarifiers, into which the water flows. Actually weirs, they reduce the exit velocity of the water leaving the clarification area of the clarifier.

The weir may provide at least one and possibly two benefits with the treatment of storm water. First, it may reduce the carry-out of floc that is still settling while the cell is being drawn down, could result in lower final effluent turbidities and/or allow a reduction in the settling time to achieve the same effluent turbidity. Secondly, the weir could reduce if not eliminate the tendency for the withdrawal pipe to suck-up previously settled sediment.

FLOCCULATION SYSTEMS SHOULD BE DESIGNED BY KNOWLEDGEABLE PERSONNEL. A CONSULTANT SHOULD BE CONTRACTED WITH TO DEVELOP AND IMPLEMENT A SYSTEM. OPERATING PERSONNEL NEED TO BE SPECIFICALLY TRAINED TO OPERATE THESE SYSTEMS.

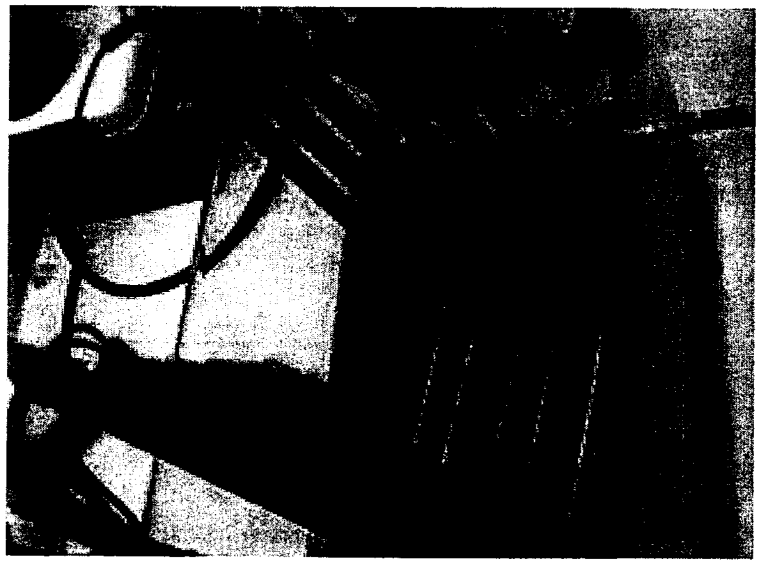
Efficiency/Impact: Mean turbidity reductions can be achieved in the 95.5% to 99.4% range.

BMP № CS36

Activity: Sites with surface water runoff contamination that have implemented specific non-point source BMPs for pollution prevention but have been unable to reduce the pollutant discharges in their storm water runoff to levels below the benchmarks.

Typical Pollutants: Sediment (TSS), metals, BOD, phosphorus, and turbidity

Typical Problem: When implementation of specific point source BMPs have not managed or eliminated the contaminants in the storm water to the benchmarks or below or where potential point sources for the contaminants can not be identified, end of the pipe or final discharge treatment BMPs may be necessary.



BMP: Experiments with a process tentatively called ElectroFloc indicates that it may be possible to use electricity to floc dissolved metals, TSS, and turbidity from storm water runoff. By charging aluminum plates with about 40 volts DC in a batch process, it has been shown to create an approximately equal number of charged particles in suspension. These dissimilar charged particles attract each other and due to aluminum ions present remain in contact with each other in as little as five minutes per liter. This works for TSS and turbidity in the lab and should work for dissolved metals as the metals usually are not really dissolved but submicron in size particles. Dissolved oxygen is increased in the water due to the splitting of the water molecule into hydrogen and oxygen in which the hydrogen leaves the water and the oxygen saturates the volume.

Efficiency/Impact: Lab tests have repeatedly show that TSS and turbidity can be reduced by 98% and the dissolved oxygen content can be increased to around 16 mg/l. To date, no tests have been performed on heavy metals.

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DR.

ASCE American Society of Civil Engineers

Urban Watershed Best Management Practices

An ASCE Continuing Education Seminar

Presented by Dan O'Leary

February 16, 2001
Los Angeles

New Advances in Urban BMP's

- Stormwater Ponds
- Stormwater Wetlands
- Infiltration
- Filtering Systems
- Open Channel Designs
- Updated Pollutant Removal Data and Costs
- New Design Variations

R0020135

BMP Definitions

DA	=	Drainage Area
Re_v	=	Recharge Capability
WQ_v	=	Pollutant Removal Capability (80% TSS)
Cp_v	=	Channel Protection Capability
Q_p	=	Overbank Flood Protection
TSS	=	Total Suspended Solids
TP	=	Total Phosphorus
TN	=	Total Nitrogen

BMP Definitions (continued)

Maintenance	=	**maintenance score**
Comm. Accept.	=	**community acceptance score**
Cost	=	**construction cost score**

Score ranked from 1 to 5, with a lower score indicating either a high benefit or low drawback, and a higher score indicating either low benefit or high drawback.

First Generation SWM Ponds

Generally Detention (Dry) Ponds

Added as Afterthought to Completed Site Plans

Minimal Water Quality Benefits

Out of Sight...Out of Mind

Maintenance?

New Advances in Stormwater Ponds

P-1 Micropool Extended Detention Pond
P-2 Wet Pond
P-3 Wet Extended Detention Pond
P-4 Multiple Pond System Pond
P-5 "Pocket" Pond

P-1 Micropool ED Pond: Design Notes

- Micropool and forebay prevent resuspension and clogging
- Useful for "fingerprinting" = limited clearing
- Low community acceptance
- Inundation may harm trees
- Cost effective urban retrofit option

Release time = 24 hours

R0020140

[BMP score sheet]

P -1 Micropool ED Pond

DA = > 10 acres

Maintenance = 3.5

Comm. Accept.= 4.0

Cost = 1.0

Treatment

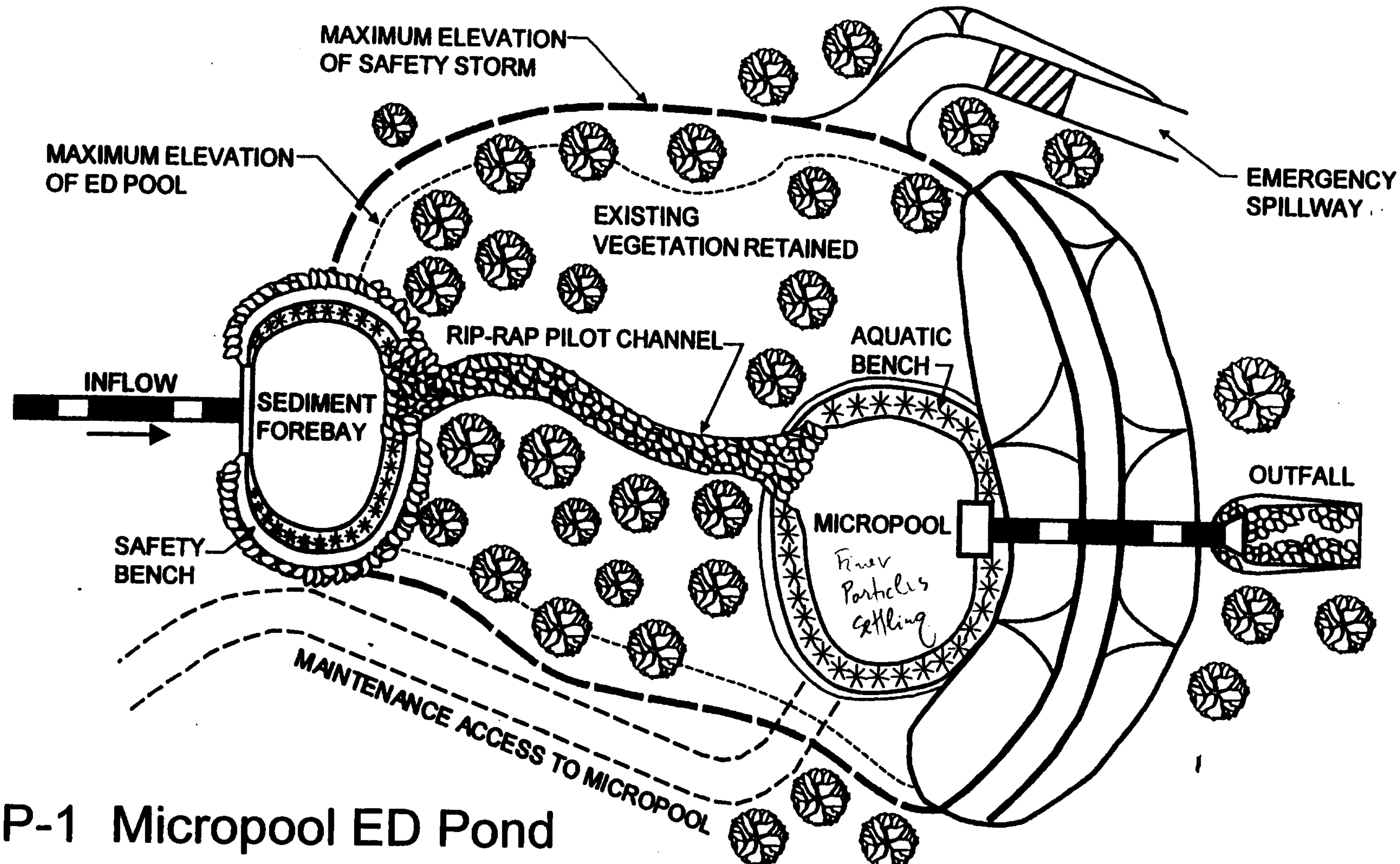
Re_v	
Cp_v	x
WQ_v	?
Q_{p2}	x

Pollutant Removal

TSS = 50%

TP = 30%

TN = 30%



P-1 Micropool ED Pond Plan

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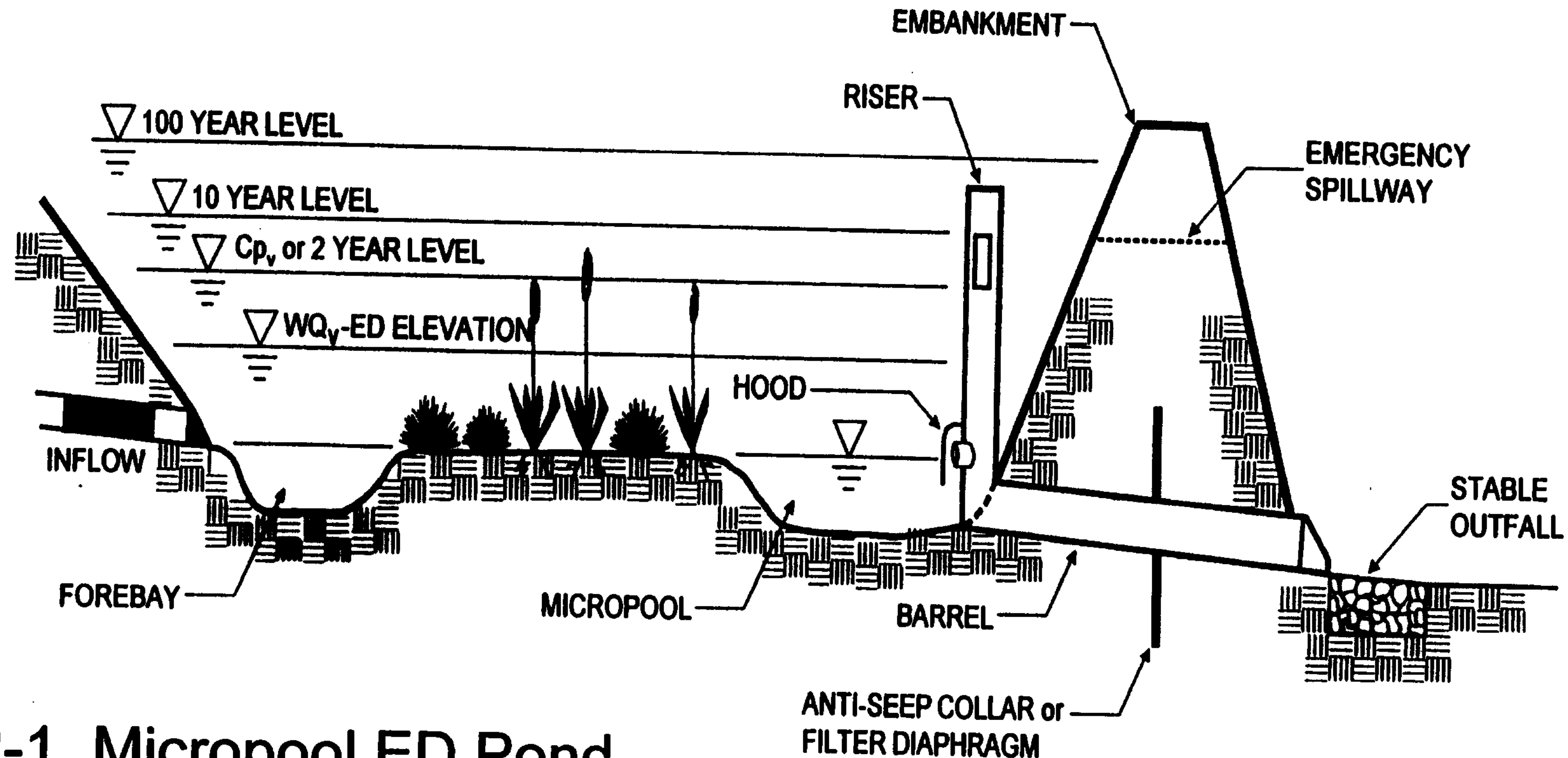


P-1 Micropool ED Pond Profile

R0020143

P-2 Wet Pond: Design Notes

- Algal uptake/settling increases nutrient removal
- Documented improvement in adjacent property values
- Careful location to prevent environmental impacts
- Stream warming limits use in trout streams (Use III & IV)
- Benches create fringe wetlands

P-2 Wet Pond

!! Careful with the water budget - so it does not dry out

DA = > 25 acres *

* unless groundwater intercepted

Maintenance = 1.5

Comm. Accept.= 1.5

Cost = 2.0

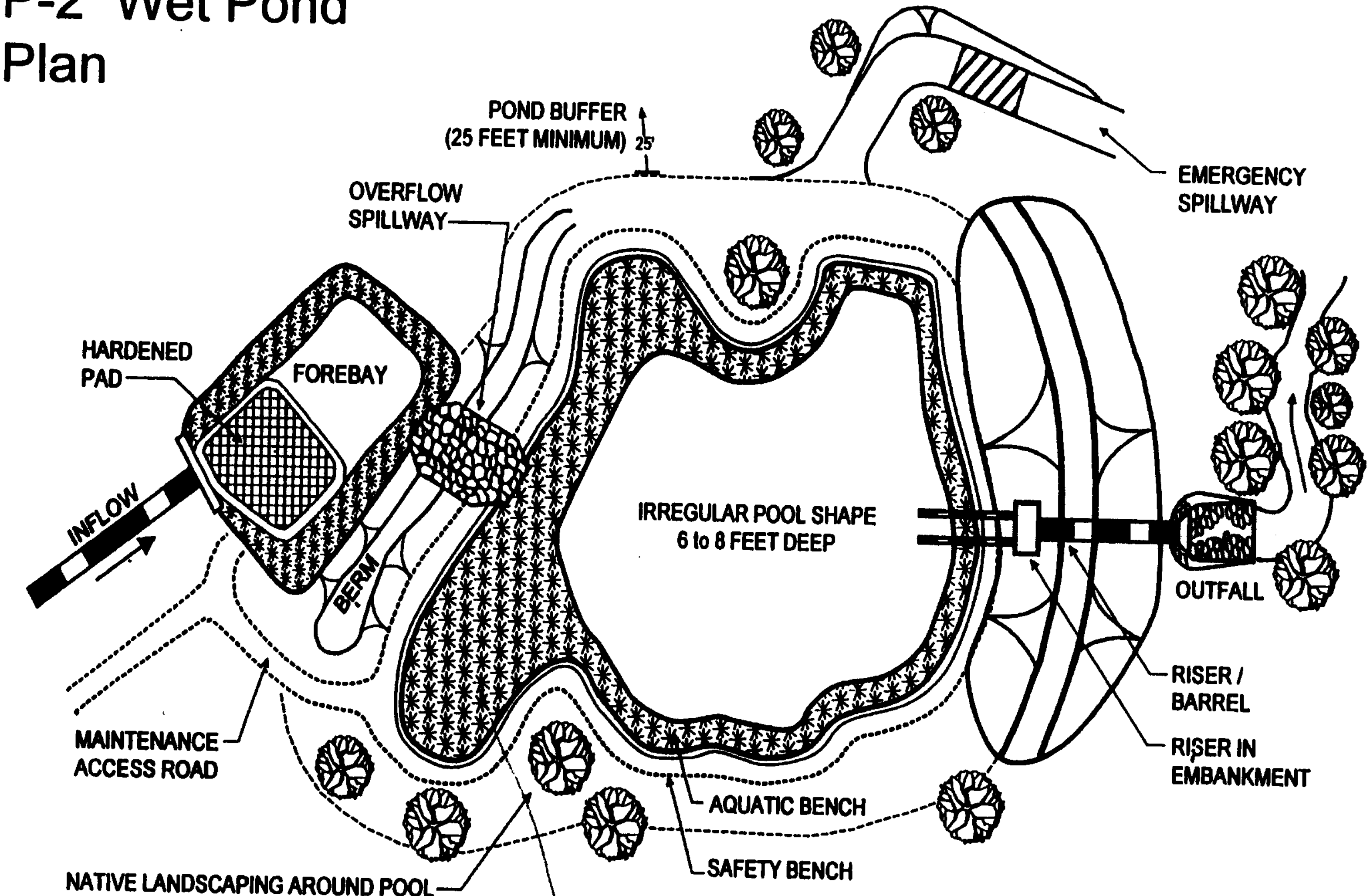
Treatment

Re_v	
Cp_v	x
WQ_v	x
Q_{p2}	x

Pollutant Removal

- TSS = 80%
- TP = 50%
- TN = 40%

P-2 Wet Pond Plan



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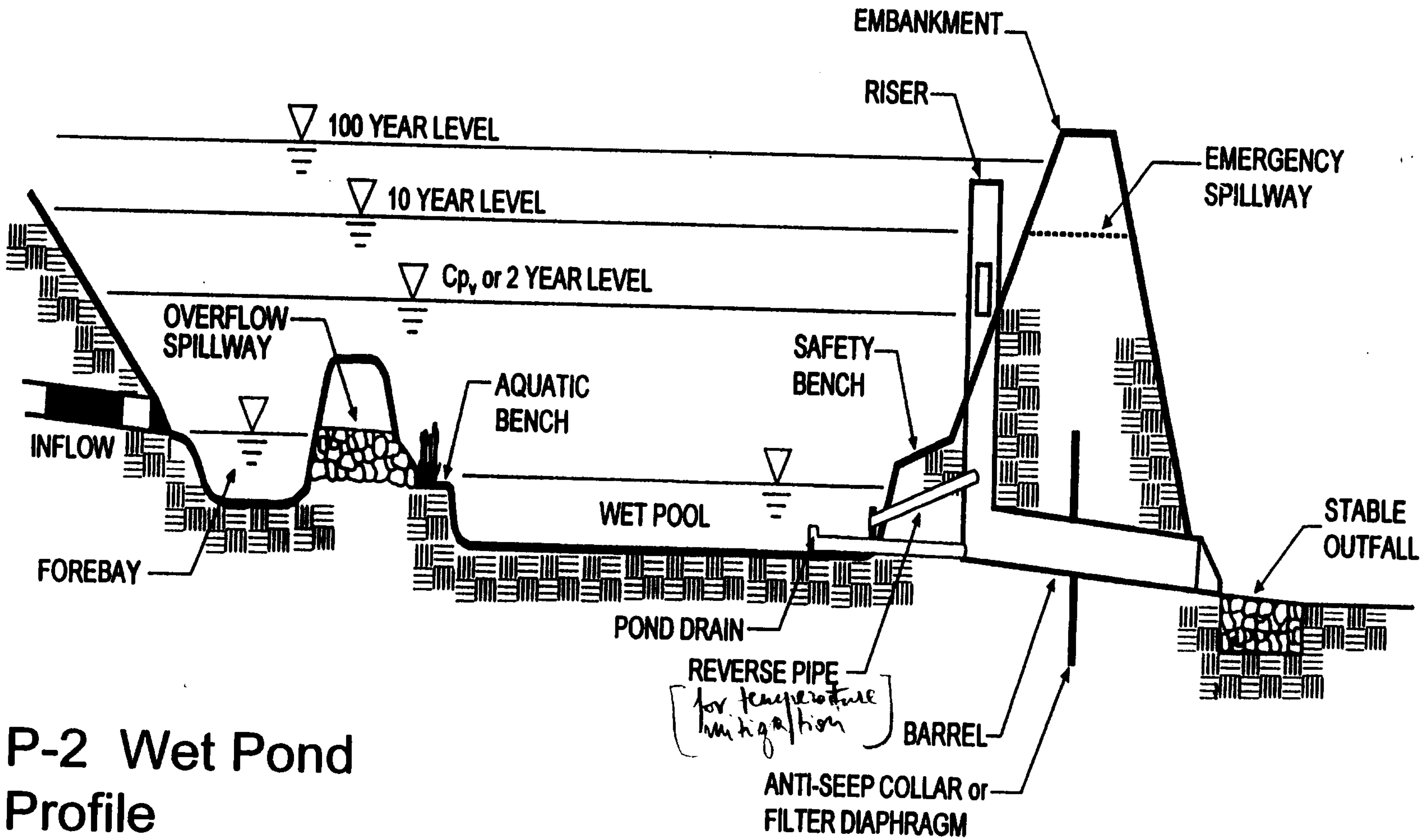

P-2 Wet Pond Profile

R0020147

P-3 Wet ED Pond: Design Notes

- Features Similar to Wet Ponds
- Added Benefit of Extended Draw Down Time
  - Downstream Channel Protection
  - Increased Residence Time
- Enhances Wetland Component of Fringe Areas
- Reduces Resuspension

R0020148

P-3 Wet extended detention pond

DA = > 25 acres

Maintenance = 2.0

Comm. Accept.= 2.0

Cost = 2.0

Treatment

Re_v	
Cp_v	x
WQ_v	x
Q_{p2}	x

Pollutant Removal

- TSS = 75%
- TP = 65%
- TN = 40%

P-4 Multiple Pond System: Design Notes

- Highest pollutant removal observed of any pond option
- Long flow path is key in removal
- Useful option at complex or linear sites
- Internal cells formed by gabions or embankment

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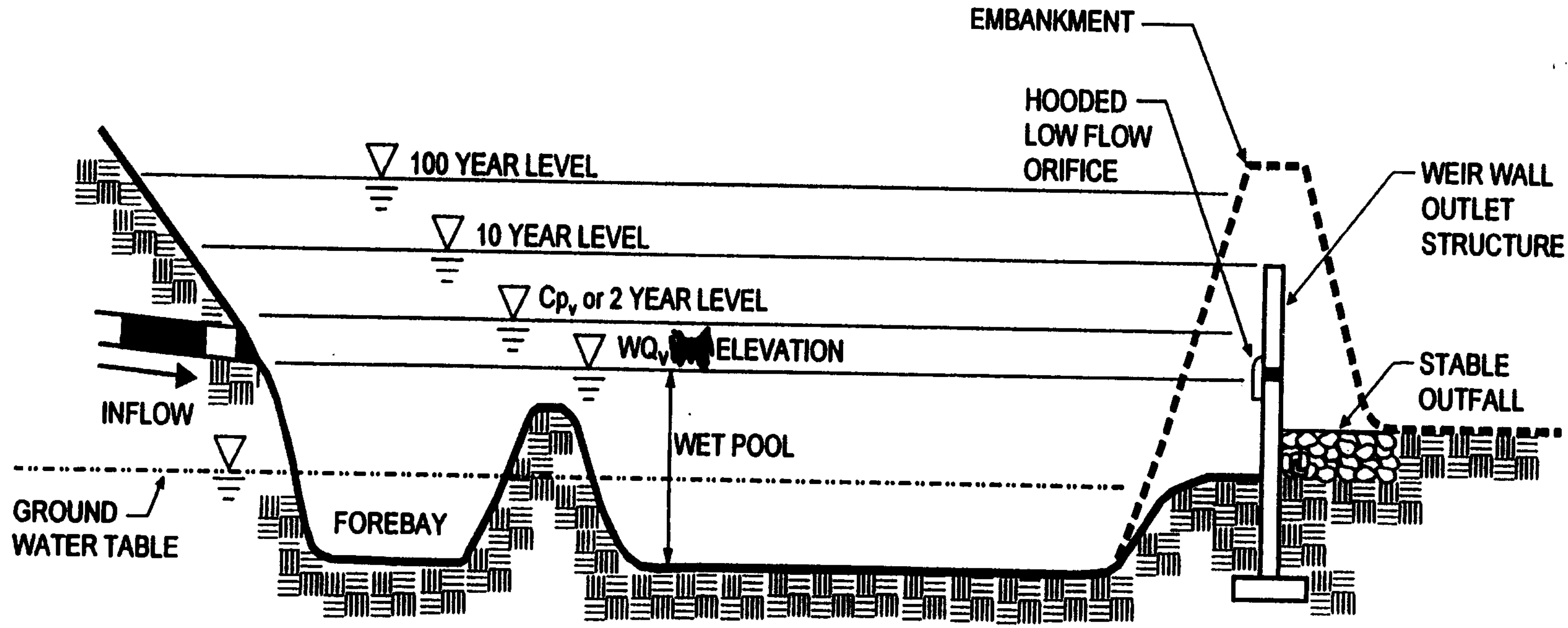


P-5 "Pocket Pond"
Profile

P-4 Multiple Pond System

DA = > 25 acres

Maintenance = 2.0

Comm. Accept.= 1.5

Cost = 3.0

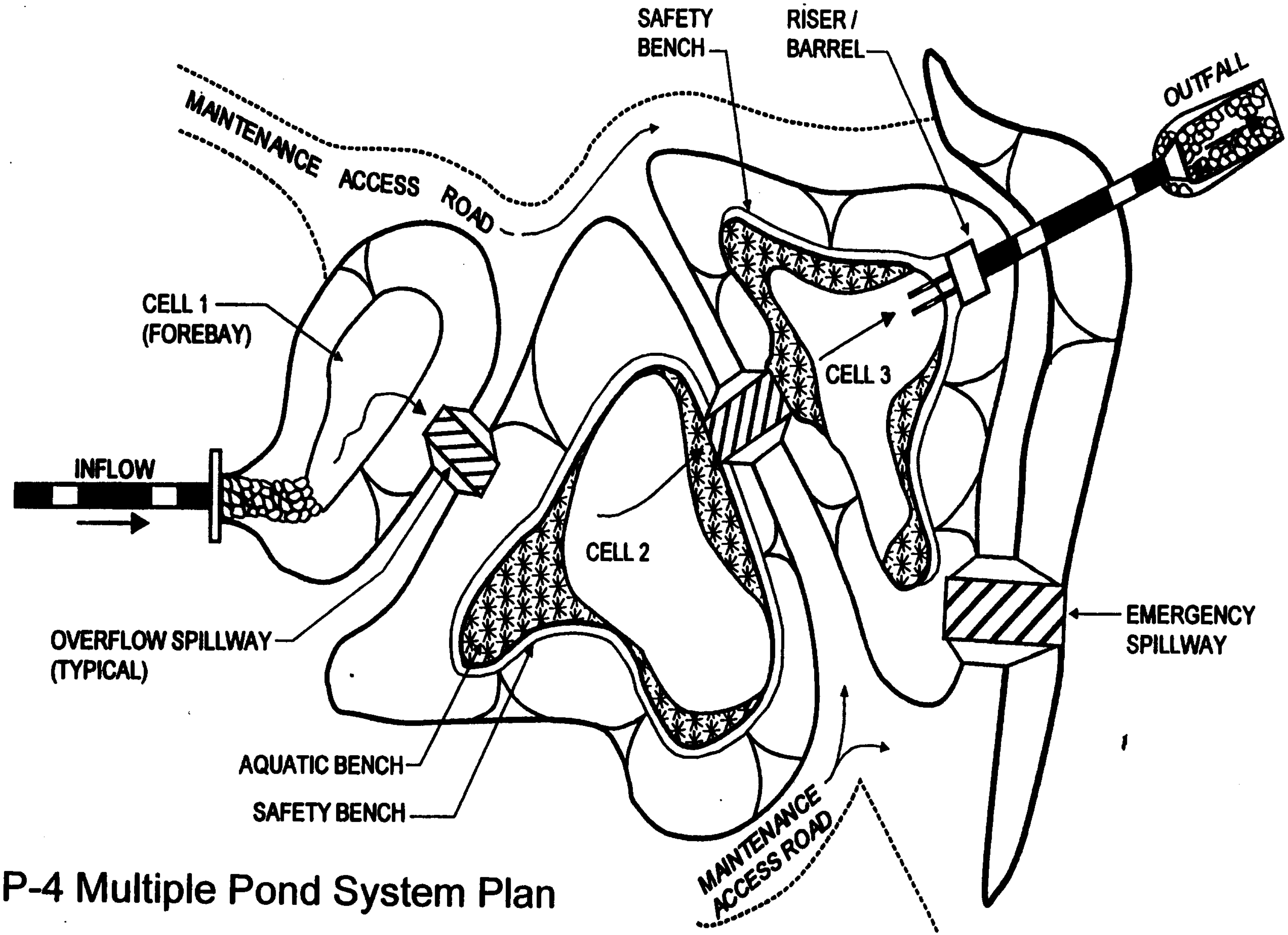
Treatment

Re_v	
Cp_v	x
WQ_v	x
Q_{p2}	x

Pollutant Removal

- TSS = 80 *
- TP = 65 *
- TN = 45 *

* limited pollutant removal data



P-4 Multiple Pond System Plan

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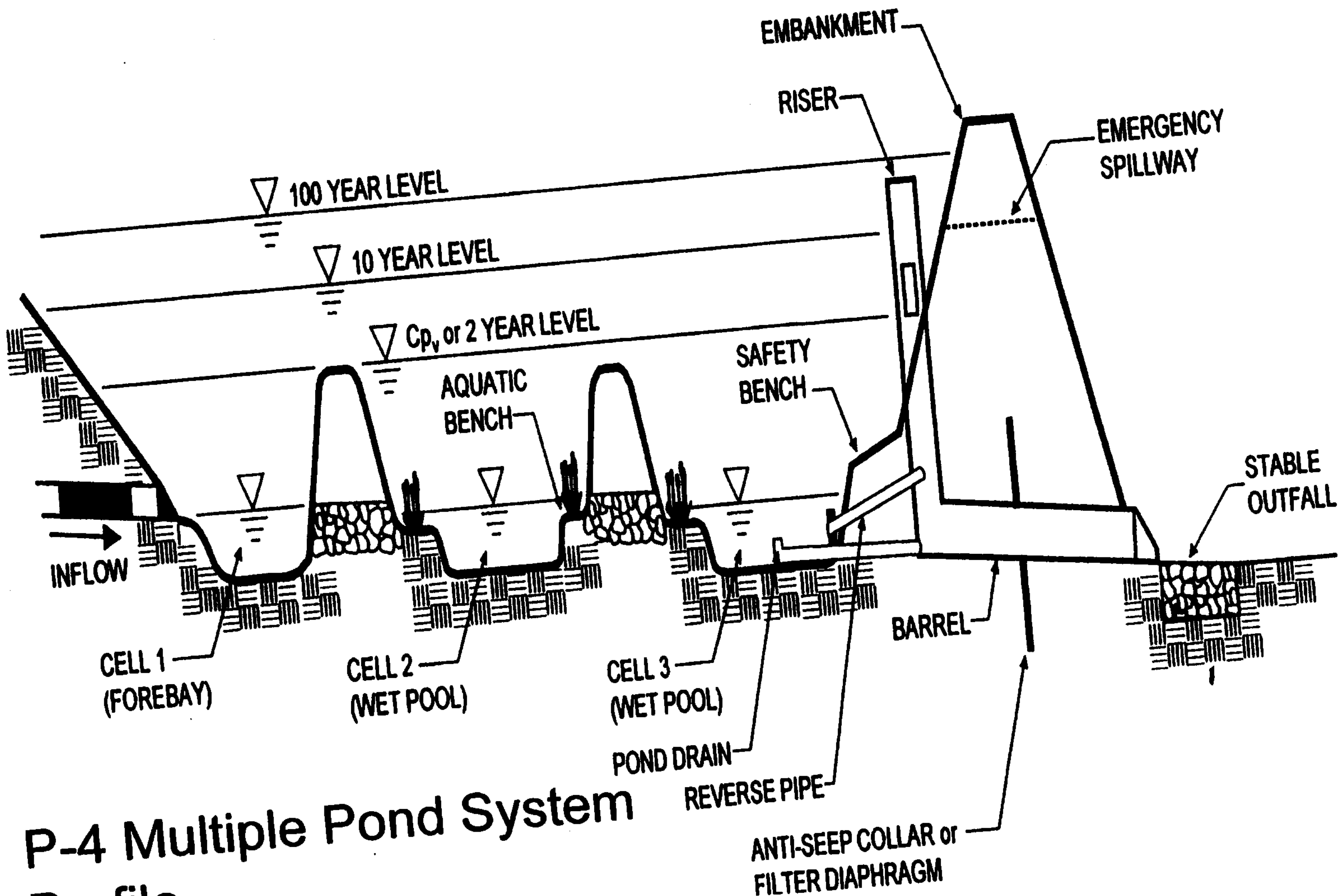


P-4 Multiple Pond System Profile

P-5 "Pocket Pond": Design Notes

- Excavate to groundwater to create pool
- Not a good option for residential developments
- Pool levels will fluctuate
- Low habitat and amenity value

P-5 "Pocket Pond"

DA = < 5 acres

Maintenance = 4.0

Comm. Accept.= 3.0

Cost = 1.5

Treatment

Treatment	
Re_v	
Cp_v	X
WQ_v	X
Qp_2	X

Pollutant Removal

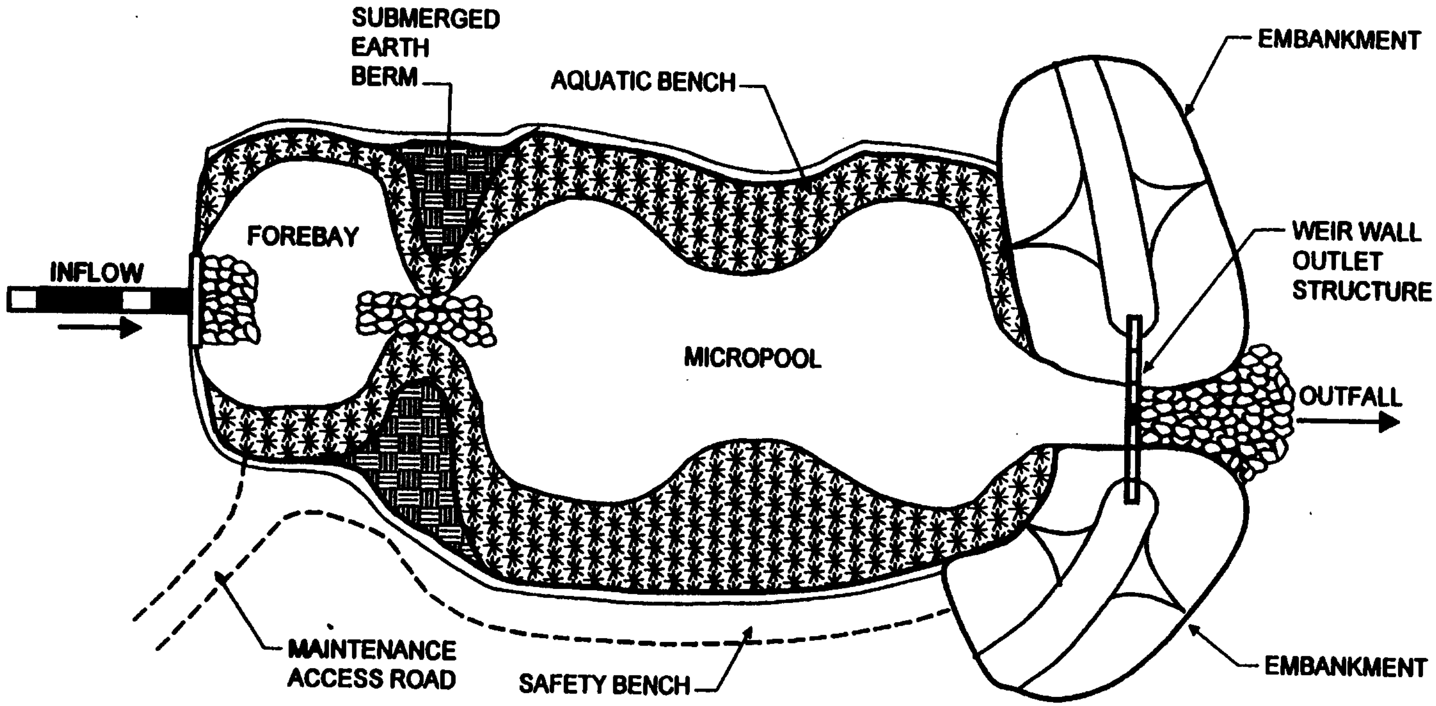
TSS = 70 *

TP = 50 *

TN = 30 *

* limited pollutant removal data

See Profile back @ P.4



P-5 “Pocket Pond”
Plan

R0020157

Urban Watershed BMP's

dleary@pbworld.com
Instructor: Daniel J. O'Leary, P.E. (410) 385 4178

Table of Contents		Schedule
1.	Introduction	8:30 a.m.
2.	New Advances in Stormwater Ponds Micropool ED Pond Wet Pond Wet ED Pond Multiple Pond System Pocket Pond	9:00 a.m. to 10:15 a.m.
3.	Pollutant Removal of Ponds 20 Elements of an Effective Design	(15 min Break)
4.	Pond Design Example	10:30 a.m. to 12:00 p.m. (Lunch)
5.	New Advances in Stormwater Wetlands Shallow Marsh ED Shallow Wetland Pond / Wetland System Pocket Marsh Submerged Gravel Wetlands	1:00 p.m. to 2:00 p.m.
6.	Stormwater Wetlands Design Principles Elements of Effective Designs Landscaping Design Guidance Wetlands Planting Guide	(15 min Break)
7.	Wetland Design Example	2:15 p.m. to 3:00 p.m.
8.	Infiltration Practices Infiltration Trench Infiltration Basin Porous Pavement	3:00 p.m. to 3:30 p.m.
9.	Filtering Practices Surface Sand Filter Underground Sand Filter Perimeter Sand Filter Organic Filter Pocket Sand Filter Bioretention	3:30 p.m. to 4:00 p.m.

10. Sand Filter Design Example

11. Open Channel Practices — (Time Permitting)

    Dry Swale
    Wet Swale
    Off-Line Bioretention

12. BMP Selection and Location — 4:00 p.m. to 4:30 p.m.

13. Appendix — (Adjourn)

    Construction Plan Examples

    Publications List

    List of WWW Information Sources

Note: Talk with the presenter for the planned conference to focus some of his presentation on dry weather (Southwestern U.S. climate) potentially adapted for dry areas of the country.

Date: 02/14/2001
Time: 13:03:47

American Society of Civil Engineers
Event Management System
Attendee Listing
S48-2001 URBAN WATERSHED BMP'S 2/16 2001 REG -URBAN WATERSHED BMP'S 2/16

Name	Company	Address	Telephone
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Losey, Bradley	ASL CONSULTING ENGINEERS DESIGN ENGINEER	16241 LAGUNA CANYON ROAD, SUITE 200, IRVINE, CA 92618	949-727-7099
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	DESIGN ENGINEER		
MERENDA, HEATHER	CITY OF CALABASAS	26135 MUREAU ROAD, CALABASAS, CA 91302	818-784-4242 X293
	STRMWTR PROJ MGR.		
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	SUP CE III		
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	Pres		
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	ENG MANAGER		
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	EIT		
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	WRCE		
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	Project Engineer		
PESTRELLA, MARK	LAC DPW	900 S. FREMONT AVE, ALHAMBRA, CA 91803	626-458-3172
	SUP CE IV		
PHILLIPS, WENDY	CA REGIONAL WATER QUALITY CONTROL BOARD	320 WEST 4TH STREET, SUITE 200, LOS ANGELES, CA 90013	213-576-6802
	EPM I		
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	WRCE		
RIDGEWAY, IVAR	CA REG. WATER QUAL. CNTL BD.	320 WEST 4TH SUITE 200, LOS ANGELES, CA 90013	213-576-6802
	ES I		
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	SR. SEA		
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	SR EG		
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Umshler, Sue	LAW & RESOURCE PLANNING ASSOC. Engineer	201 THIRD STREET NW, SUITE 1370, ALBUQUERQUE, NM 87102	505-346-0998
URRUNAGA, CARLOS	CA REG, WATER QUAL. CNTL BD ES III	320 WEST 4TH ST. SUITE 200, LOS ANGELES, CA 90013	213-576-6802
Warren, Robert	Ramseyer & Assocs VP PARTNER	1881 KNOLL DRIVE, VENTURA, CA 93003	805-654-1088
WILLIAMS, LISA	LSA Associates	1 Park Plaza, Ste 500, Irvine, CA 92614	949-553-0666
WOODS, TRACY	CA REG WATER QUAL CNTL BD. ES III	320 WEST 4TH ST, SUITE 200, LOS ANGELES, CA 90013	213-576-6802
YAGER, MATT	CA REG. WATER QUAL CNTL BD. ES II	320 WEST 4TH ST, SUITE 200, LOS ANGELES, CA 90013	213-576-6802
Yean, Jungtsun	Fuscoe Engineering Engineer	16795 VON KARMAN, SUITE 100, IRVINE, CA 92606	949-474-1960
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Total 51

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Features of the Standard Pond Systems (cont'd)

11 Embankment Specifications
12 Inlet Protection
13 Adequate Outfall Protection
14 Pond Benches
15 Safety Features
16 Pondscaping Plan
17 Wetland Elements
18 Pond Buffers and Setbacks
19 Maintenance Measures
20 Maintenance Access

Features of the Standard Pond System.
(revised 1/5/95)

Source: Design of Stormwater Pond Systems (Available, 1995).

#1. Adequate Water Quality Treatment Volume.

Provide water quality treatment storage of at least one-inch per contributing impervious acre through any combination of permanent pool, extended detention or marsh.

An additional 0.25 inch per contributing impervious acre should be reserved for pretreatment in the form of a forebay or micropool, or both.

Water quality storage can be provided in multiple cells

It is generally desirable to provide water quality treatment off-line when topography, head and space permit. (i.e, apart from stormwater quantity storage)

2. Multiple Treatment Pathways.

Performance is enhanced when multiple or redundant treatment is provided. either using multiple cells, longer flowpaths, high surface area to volume ratios. complex microtopography, and/or treatment methods (pool, ED, marsh)

Features of the Standard Pond Systems

1 Adequate Water Quality Treatment Volume 3/4 inch as per SUSMP
2 Multiple Treatment Pathways
3 Minimum Pond Geometry
4 Sediment Forebay
5 Non-clogging Low Flow Orifice
6 Riser in Embankment
7 Adjustable Gate Valve
8 Pond Drain
9 Principal Spillway
10 Emergency Spillway

R0020165

Table 1

Comparative Storage Allocations for the Ten Stormwater Pond/Wetland Options
(% of Total Treatment Volume)

	DEEP POOL	MARSH	ED
1. Conventional Dry Pond (Quantity Only)	0	0	0
2. Dry Extended Detention Pond	0	10 (ls)	90
3. Micropool ED	30 (f,m)	0	70
4. Wet Pond	80	20 (b)	0
5. Wet ED Pond	50	10 (b)	40
6. Shallow Marsh	40 (f,m,c)	60	0
7. ED Wetlands	20 (f,m)	30	50
8. Pocket Wetland	20 (f)	80	0
9. Pocket Pond	80	20 (b)	0
10. Pond/Marsh System	70	30 (b,m)	0

Note: the storage allocations shown are approximate targets only;

ls = lower stage of ED pond often assumes marsh characteristics
f = forebay
m = micropool
c = channels
b = aquatic bench

(a:\user\tab1 pond)

R0020166

Table 3

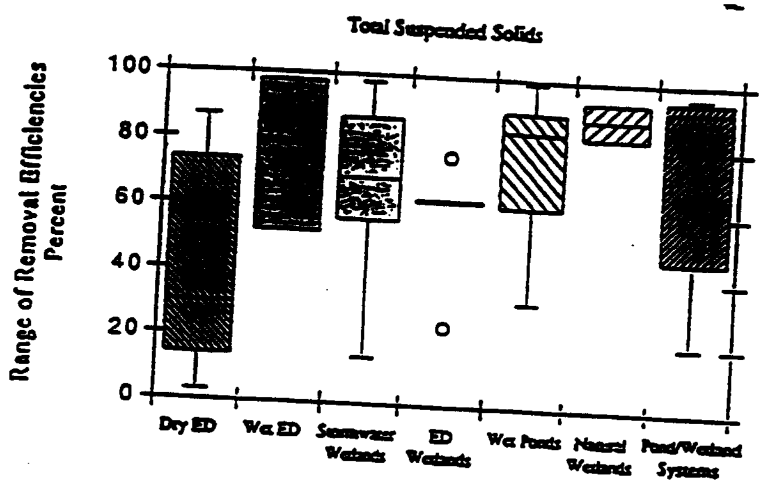
Comparative Capability of Ten Pond/Wetland Alternatives
Physical, Environmental and Maintenance Constraints

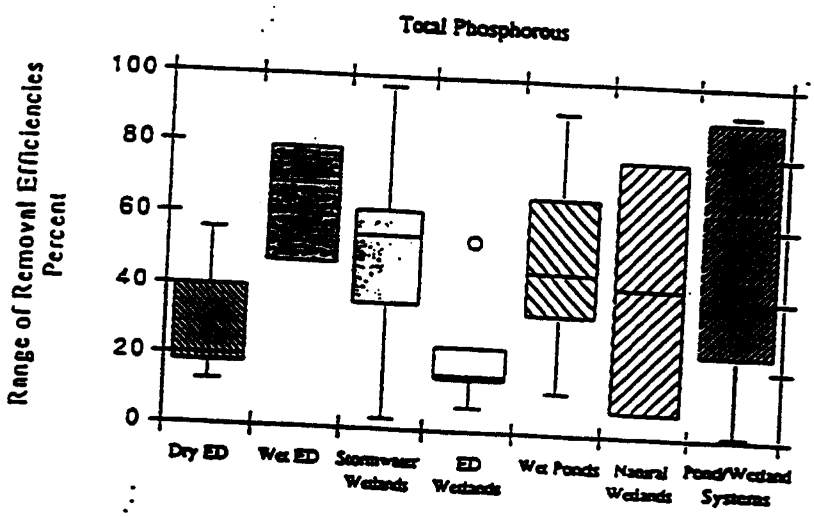
	MINIMUM DRAINAGE AREA (A)	SPACE INDEX (B)	WATER BALANCE	CLOGGING RISK	SEDIMENT CLEANOUT	WATERS OF US (404)	STREAM WARMING	SAFETY RISK
1. Conventional Dry	5	.5	No Restrictions	MOD	Basin (10-20)	?	LO	LO
2. Dry ED	10	1.0	No Restrictions	HIGH	Basin (10-20)	Yes	MOD	LO
3. Micropool ED	15	1.0	May Require Baseflow	LO	Forebay (2-5 yrs)	Yes	MOD	LO
4. Wet Pond	25+	1.0	Climate	LO	Forebay (2-5 yrs)	Yes	HI	HI
5. Wet ED	25+	1.0	Climate	LO	Forebay (2-5 yrs)	Yes	HI	HI
6. Shallow Marsh	25+	2.5	Climate Baseflow	LO	Forebay (2-5 yrs)	Yes	HI	MOD
7. ED Wetlands	10+	1.5	Climate, Baseflow	LO	Forebay (2-5 yrs)	?	HI	MOD
8. Pocket Wetland	1-5	2.0	Climate, Groundwater	MOD	Basin (5-10 yrs)	No	MOD	MOD
9. Pocket Pond	1-5	1.0	Climate, Groundwater	MOD	Basin (5-10 yrs)	No	MOD	MOD
10. Pond/March Systems	25+	1.5	Climate, Baseflow	LO	Pool (10-15 yrs)	Yes	HI	HI

Notes: (A) maximum acreage of 400 acres in most cases.

(B) space consumption index (1 = space required for wet pond).

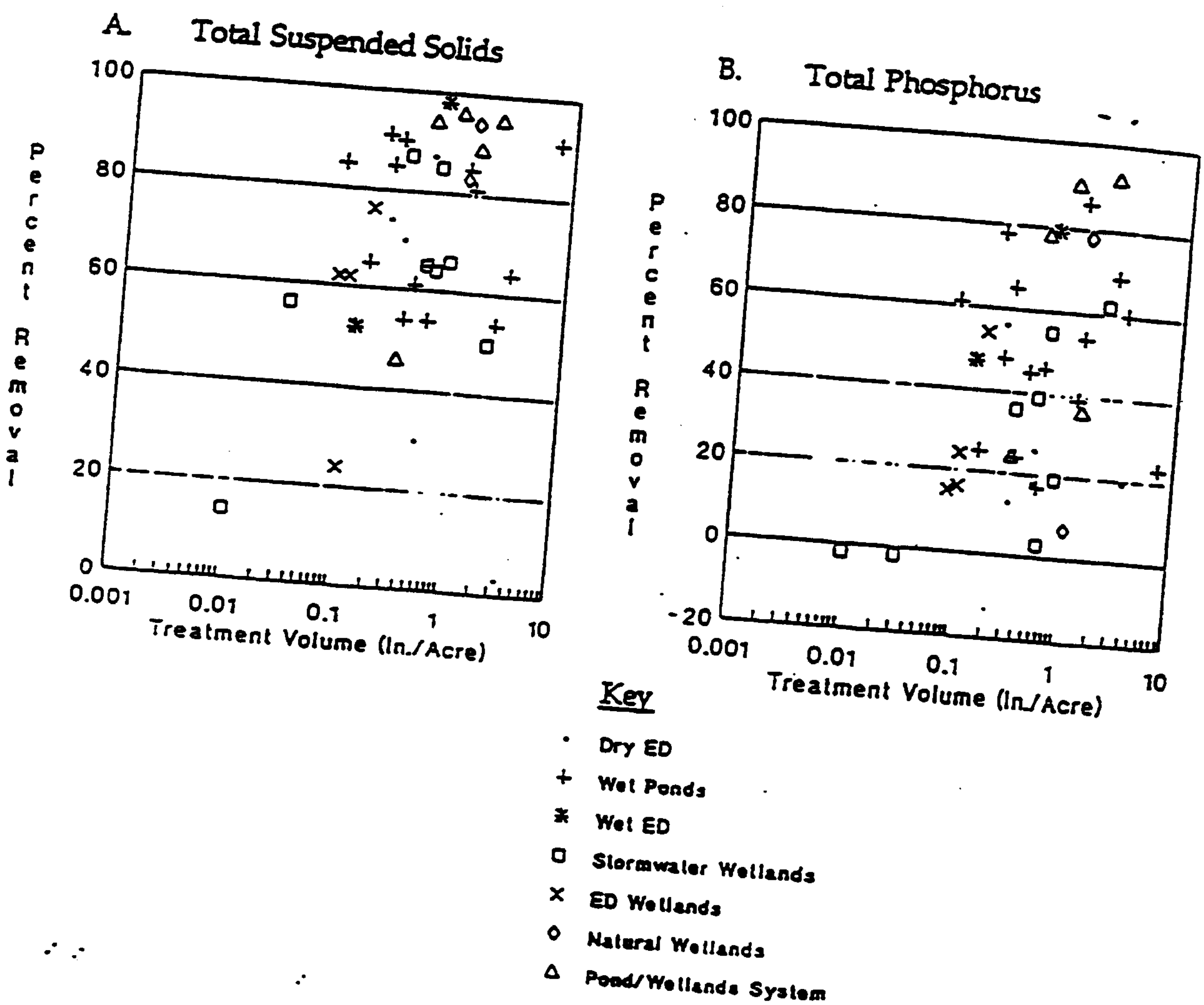
Pollutant Removal Performance of Stormwater Ponds and Wetlands: By Pond Type





"Box and whiskers" plots are used to illustrate the difference in removal rates for seven different kinds of stormwater pond and wetland systems. The "whiskers" show the range of reported values, whereas the lines within the box define the 25th, 50th and 75th percentile values (from top to bottom). Plots were adapted from a program developed by Pagenkoff, and the full data for each study can be found in Appendix A of Schueler et al, 1991.

Pollutant Removal Performance of Stormwater Ponds and Wetlands: By Treatment Volume



Pollutant removal rates for nearly 50 stormwater pond and wetland designs are reported for (a) totoal suspended solids and (b) totoal phosphorus. Additional data on each wetland performance study can be found in Appendix A. Note that pollutant removal is only loosely related to total treatment volume. (i.e., other design factors appear to be equally important in defining removal rate).

Selecting the Right Pond Design

- Pollutant Removal Target
- Downstream Channel Protection
- Wetland Creation
- Wildlife Habitat
- Safety Risk
- Community Acceptance
- Delta-T
- Land Consumption
- Required Catchment Area
- Environmental Restrictions
- Maintenance Burden
- Construction Cost

Pollutant Removal of Ponds

Only partially related to treatment volume (Vt).
Internal geometry very important (length to width ratio).
Removal increases when multiple treatment mechanisms are combined or multiple cells are used.
Wet ED ponds are more effective than Dry ED ponds.
Dry ED subject to resuspension and failure to meet target ED times.
Most other pond/wetland options provide comparable removal.
Large waterfowl populations reduce nutrient/bacteria removal.
Declines during ice cover and/or snowmelt.
Off-line ponds appear to be more retentive than on-line ponds.

STORMWATER POND DESIGN PRINCIPLES

20 ELEMENTS OF AN EFFECTIVE DESIGN

16. Pondscaping Plan

A pondscaping plan shall be prepared that indicates how aquatic and terrestrial areas will be vegetatively stabilized.

Specific pondscaping guidance is provided in Design of Stormwater Wetland Systems (Schueler, 1992).

17. Wetland Elements.

Wherever possible, wetland plants should be encouraged in the pond design, either along the aquatic bench (fringe wetlands), the safety bench and sideslopes (ED wetlands) or within shallow areas of the pool itself.

The best elevations for establishment of wetland plants, either through transplantation or volunteer colonization, are within six inches (plus or minus) of the normal pool.

18 Pond Buffers and Setbacks.

A pond buffer shall be provided that extends 25 feet outward from the maximum water surface elevation of the pond. The pond buffer should be contiguous with other buffer areas, as are required by local regulation (e.g., stream buffers).

An additional 15 foot setback shall be provided to permanent structures.

Trees should be preserved in the buffer area during construction, should they exist.

Trees, shrubs and native ground covers should be planted in the buffer if they do not presently exist.

The only mowing required within the buffer is along maintenance right of ways and the embankment. The remaining buffer can be managed as a meadow (mowing twice a year) or forest.

19 Maintenance Measures.

Maintenance responsibility for the pond and the pondscape shall be vested with a responsible authority by means of legally binding and enforceable maintenance agreement.

The pond shall be inspected annually in wet-weather conditions.

Sediment removal in the forebay should occur every 5 to 7 years, or after one foot of sediment deposition has been recorded in the forebay.

Suitable on-site sediment disposal area should be reserved.

20 Maintenance Access.

A 25 foot wide maintenance right of way easement shall extend to the pond from a public or private road.

Maintenance access shall have a maximum slope of no more than 15% and shall be stabilized to withstand heavy equipment

The maintenance access shall extend to the forebay, safety bench and riser, and be designed to allow vehicles to turnaround.

Access within the riser is to be provided by lockable manhole covers, and manhole steps within easy reach of valves and other controls.

12. Inlet Protection.

Inlet pipes to the pond can be partially submerged in warmer climates.

A forebay must be provided at each inlet, unless it provides less than 10% of the total design storm inflow rate to the pond.

13. Adequate Outfall Protection.

Flared end pipe sections that discharge at or near the stream invert are preferred.

The channel immediately below the pond outfall shall be modified to conform to natural dimensions, and lined with large rip-rap placed over filter cloth.

A stilling basin shall be used to reduce flow velocities from the primary spillway to non-erosive velocities.

If the pond daylights to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance. Excessive use of rip-rap should be avoided to reduce stream warming.

If the pond has a dry pilot channel, a PVC underdrain pipe shall be located 2 to 3 feet below the riprap to prevent excessive warming of dry weather flows. The pilot channel can also be protected by shade trees.

14. Pond Benches.

The perimeter of all deep pool areas (four feet or greater in depth) shall be surrounded by two benches:

A safety bench that extends 15 feet outward from the shoreline to the toe of the pond sideslope. The maximum slope of the safety bench shall be 3%.

An aquatic bench that extends 15 feet inward from the normal shoreline, that has a maximum depth of eighteen inches below the normal pool water surface elevation.

15. Safety Features.

Fencing of ponds is not generally desirable.

Safety is provided by managing the contours of the pond to eliminate dropoffs and other hazards.

Sideslopes to the pond shall not exceed 3:1 (h:v), and shall terminate on a safety bench.

Both the safety bench and the aquatic bench may be landscaped to prevent access to the pool.

The primary spillway opening shall not permit access by small children.

Outfall pipes above 48 inches in diameter should be fenced.

Warning signs prohibiting swimming and skating may be posted

8. Pond Drain.

Each pond shall have a ductile iron drain pipe that can completely or partially drain the pond.

The drain pipe shall have an inverted elbow within the pond to prevent sediment deposition.

The diameter of the pipe shall be sufficient to drain the pond within 24 hours.

Care shall be exercised during pond drawdowns to prevent downstream discharge of sediments or anoxic water.

9. Principal Spillway.

The principal spillway shall be designed in accordance with SCS Pond Specifications Code 378 (revised).

The principal spillway shall have the capacity to accommodate the design stormwater storm for the given drainage area and height to emergency spillway crest (usually the five and/or ten year storm event) (Note: applies only to online ponds)

The crest elevation of the primary spillway shall be no less than one foot below the emergency spillway crest.

The inlet or riser size for pipe drops shall be such that the flow through the structure goes from weir flow control to pipe flow control without going into orifice control in the riser.

The use of reinforced concrete pipe and cast-in-place reinforced concrete box culverts are recommended for the primary spillway to increase its longevity.

The primary spillway should be equipped with a removable trash rack.

10. Emergency Spillway.

The emergency spillway is provided to convey large flood flows safely past the earthen embankment, and should be designed in accordance in SCS Pond Code 378, National Engineering Handbook, or local equivalent.

Excavated earthen spillways shall be trapezoidal and located in undisturbed earth. (up to the 100 year depth)

Side-slopes should be no greater than 2:1 (h:v).

The emergency spillway shall have an inlet channel, level section and an exit channel. The spillway shall have a minimum width of 8 feet, and be designed for non-erosive velocities through the control section and exit channel.

11. Embankment Specifications

The embankment shall be designed and constructed in a manner to prevent dam breach or seepage, and the exact criteria depend on the NEH dam safety criteria. Some of the key requirements include:

minimum top width of 10 feet (or 16 to 26' if it is a roadway embankment)

the dam height shall be increased to account for settlement (often 5 to 10%)

combined upstream and downstream side slopes of embankment shall not be steeper than 5:1 (h:v), with neither slope exceeding 2:1

provision of freeboard, depending on dam classification (usually 1 to 2 feet)

Cutoff trench and impervious core located along centerline of dam.

Anti-seep collars or seepage diapraghms shall be provided for all conduit pipes through the embankment greater than six inches in diameter.

3 Minimum Pond Geometry

Ponds should be wedge-shaped, narrowest at the inlet and widest at the outlet.

The minimum length to width ratio for the pond is 1.0 (i.e., length equal to width). Greater flowpaths are recommended.

Maximum depth of the permanent pool should not exceed eight feet, with an average of 4 to 6 feet.

4. Sediment Forebay

Each pond shall have a sediment forebay. The forebay shall consist of a separate cell, formed by an earthen berm, gabion or rip-rap wall.

The forebay shall be sized to contain 0.25 inches per impervious acre of contributing drainage (with a minimum of 0.1 inches per impervious acre), and shall be 4 to 6 feet deep.

Exit velocities from the forebay shall not be erosive during for the two year design storm.

Direct maintenance access by heavy equipment should be provided to the forebay.

The bottom of the forebay may be hardened to make sediment removal easier.

A fixed vertical sediment depth marker shall be installed in the forebay to measure sediment deposition over time.

5. Non-clogging Low Flow Orifice.

The preferred method is a submerged reverse-slope pipe that extends downward from the riser to a release point one foot below the normal pool elevation.

The low flow orifice shall have a minimum internal diameter of 3 inches.

An alternative method is to employ a broad crested weir that is protected by a half-round CMP that extends at least 18 inches below the normal pool.

The use of horizontal perforated pipes protected by gravel are not recommended as means to provide extended detention. Vertical pipes may be used as an alternative if at least one foot of standing water is present..

6. Riser in Embankment.

The riser shall be located within the embankment for purposes of maintenance access, safety and aesthetics.

Access to the riser will be by manholes with lockable nuts.

The riser can be "fenced" with pipe or rebar at 8 inch intervals for safety purposes.

7. Adjustable Gate Valve.

Both the ED pipe and the pond drain shall be equipped with an adjustable gate valve (typically a handwheel activated knife gate valve)

Both the ED pipe and the pond drain shall be sized one pipe schedule higher than the calculated design diameter.

Valves shall be located inside of the riser at a point where they (a) will remain dry and (b) can be operated in a safe and convenient manner.

To prevent vandalism, the handwheel shall be chained to a ringbolt, manhole step or other fixed object.

POND DESIGN EXAMPLE

STEP-BY-STEP EXAMPLE OF AN ACTUAL DESIGN
REVIEW OF SCS METHODS (TR-55, TR-20)
HYDRAULIC COMPUTATIONS

Stormwater Management

Pond Design Example

For

Extended Detention Wet Pond

Richard A. Claytor, Jr., P.E.

The Center for Watershed Protection
8737 Colesville Road, Suite 300
Silver Spring, MD 20910

December 1995

R0020182

Pond Design Example

Design Assumptions

- Pond serves a townhouse development project
- Located in Mid-Atlantic Piedmont (Frederick Co. MD)
- Receiving water is a warm-water fishery (MD CL. I)
- Low hazard pond (SCS Class a, minimal property damage, no loss of life potential)
- Water quality storage volume (WQV) based on 90% rule — corrected
- Soils adequate for embankment & wet pond
- No disturbance to non-tidal wetlands
- No forest removal or re-forestation required

Pond Design Example

Design Steps - I

1. Assemble necessary background information
2. Confirm design criteria
3. Establish hazard classification
4. Conduct site visit/confirm facility location
5. Perform Hydrologic computations
   - D.A., land use, soils, t_c
   - Compute peak discharges for pre- and post-developed conditions
6. Determine storage requirements
   - Compute required water quality storage (WQV)
   - Estimate required quantity storage (TR-55 short cut method)

Pond Design Example

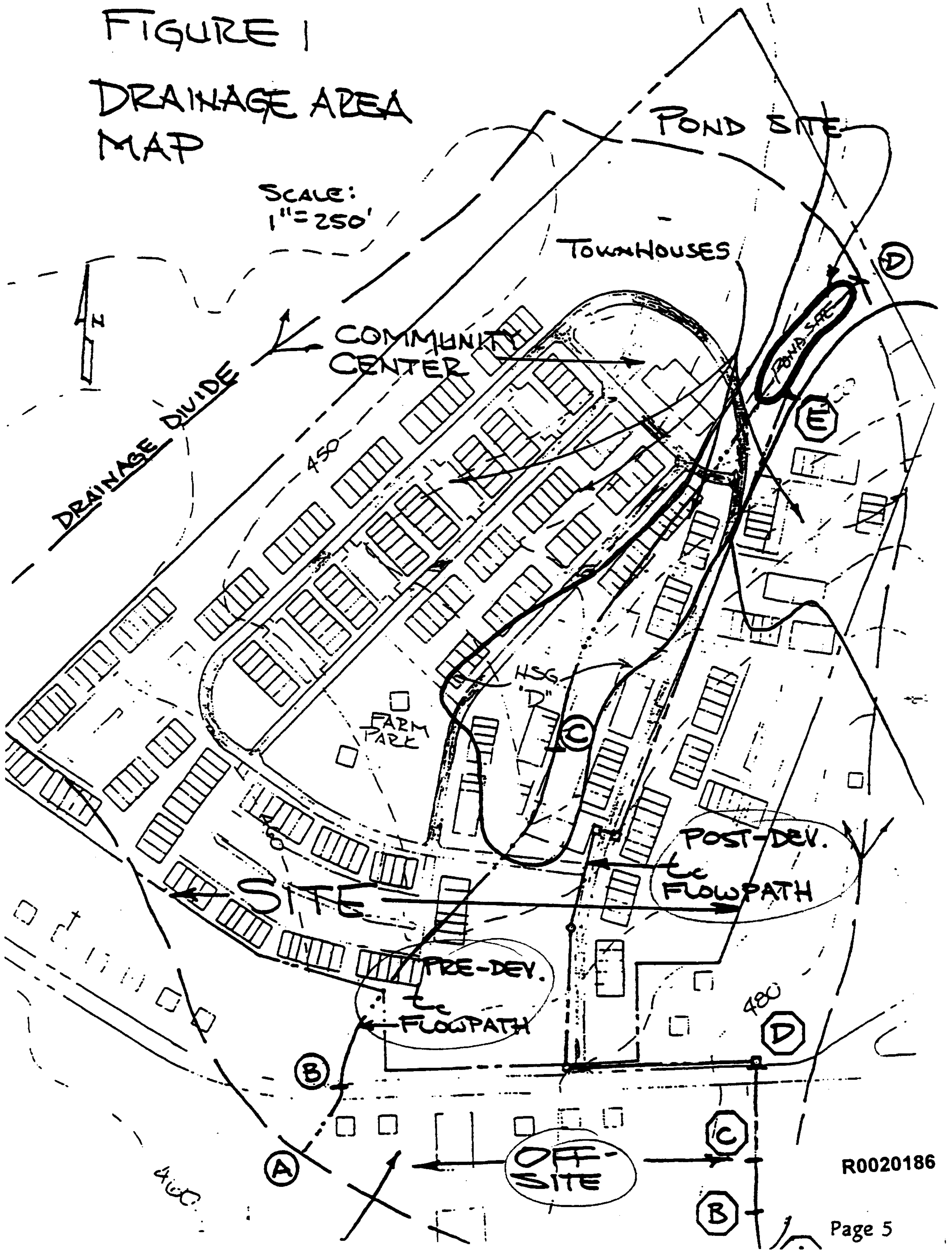
Design Steps - II

7. Perform pond grading
8. Compute provided storage (elevation- storage relationship)
9. Determine permanent pool, forebay, and ED volume elevations
10. Perform hydraulic calculations
    - Extended detention outlet
    - 2 year storm outlet
    - 10 year storm outlet
    - Riser and barrel sizing & capacity
    - Emergency spillway
11. Prepare storage-elevation-discharge table
12. Conduct pond routing
13. Perform additional computations (as applicable)
14. Draw profiles and details

Center for Watershed Protection

FIGURE 1

DRAINAGE AREA MAP



R0020186

Pond Design Example

Hydrology Computations

- Pre-, post-, and ultimate developed conditions curve number determination
- Time of concentration computations (t_c)
- TR-55 computer version
- TR-20 input data
- TR-20 results data

"Urban Hydrology for Small Watersheds"
SCS TR-55 June 1986 Version +
Technical Notes !!
Updates

Worksheet 2: Runoff curve number and runoff

Project DESIGN EXAMPLE By RAC Date 12/94

Location FREDERICK CO. MD Checked ____ Date ____

Circle one: Present Developed PRE-DEV. (MEADOW)

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x area
GLENELG CHESTER ELIOAK MANOR B	LAND USE MEADOW (GOOD)	58			60.8	3526.4
LINGANORE C	MEADOW (GOOD)	71			4.4	312.4
WORSHAM D	MEADOW (GOOD) assumed	78			7.2	561.6
	100 means	100%		runoff		
	higher CN = low infiltration					

1/ Use only one CN source per line. Totals = 72.4 | 4400.4

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{4400.4}{72.4} = 60.78$; Use CN = $\boxed{61}$

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency .... (Return Period)	yr	2	10	100
Rainfall, P (24-hour) (FRED. CO. MD)	in	3.1	5.0	7.0
Runoff, Q .... (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in	0.40 in	1.37 in	2.70 in

of depth

R0020188

Worksheet 2: Runoff curve number and runoff

Project DESIGN EXAMPLE By RAC Date 12/94

Location FREDERICK CO. MD Checked ____ Date ____

Circle one: Present Developed POST DEV. CONDITIONS (ONSITE ONLY)

1. Runoff curve number (CN) • FOR 2 AND 10 YEAR MANAGEMENT

	Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	Fig. 2-3	Fig. 2-4	Area ☒acres ☐mi² ☐%	Product of CN x area
ONSITE 49.6AC	GLENELG CHESTER ELIOAK MANOR B	TOWNHOUSES; 45% IMP ROADS (GOOD H. COND)	* 78			36.8	2870.4
	GLENELG CHESTER ELIOAK MANOR B	COMMUNITY CENTER (GOOD H.C.) (POOL, BATHHOUSE, ETC) 65% IMP.	85			1.6	136.0
	LINGANORE C	TOWNHOUSES: 45% IMP. (GOOD H. COND.)	85			4.0	340.0
	WORSHAM D	TOWNHOUSES: 45% IMP. (GOOD H.C.)	88			6.7	589.6
	WORSHAM D	COMMUNITY CENTER 65% IMP. : (GOOD H.C)	92			0.5	46.0
OFFSITE 2.8AC	B	ASSUMED AS PRESENT CONDITION (10% IMP)	65			22.4	1456.0
	C	ASSUMED AS PRESENT CONDITION (PASTURE)	74			0.4	29.6
					Totals =	72.4	5467.6

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{5467.6}{72.4} = 75.52$; Use CN = $\boxed{76}$ VS. 61

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	2	10	
Rainfall, P (24-hour)	in	3.1	5.0	
Runoff, Q (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in	1.08	2.53	

* SAMPLE CN COMP. : CN = 0.45(98) + 0.55(61) = 77.65 USE 78

Worksheet 2: Runoff curve number and runoff

Project DESIGN EXAMPLE By RAL Date 12/94

Location FREDERICK CO. MD Checked ____ Date ____

Circle one: Present **Developed** ULTIMATE CONDITIONS (OFFSITE + ONSITE) FOR 100 YEAR SAFETY STORM

1. Runoff curve number (CN)

	Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Fig. 2-3	CN [1/] Fig. 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x area
SITE 49.6 AC	→	FROM PREVIOUS COMPUTATION (FOR 2 AND 10 YR MANAGEMENT)	80.28			49.6	3982.0
				weighted from previous calculation			
SITE 22.8 AC.	B	COMMERCIAL (85% IMP)	92			6.6	607.2
	B	TOWNHOUSES (45% IMP)	78			15.8	1232.4
	C	TOWNHOUSES (45% IMP)	85			0.4	34.0

[1/] Use only one CN source per line.

Totals = 72.4 | 5855.6

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{5855.6}{72.4} = 80.87$; Use CN = $\boxed{81}$

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr			100
Rainfall, P (24-hour)	in			7.0
Runoff, Q .... (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in			4.81

R0020190

careful with assumptions

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project: DESIGN EXAMPLE By: RAL Date: 12/94

Location: FREDERICK CO, MD Checked: ____ Date: ____

Circle one: **Present** Developed PRE-DEV. CONDITIONS

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)

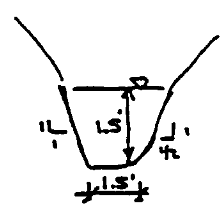
Segment ID		A-B		
1. Surface description (table 3-1)		DENSE GRASS		
2. Manning's roughness coeff., n (table 3-1)		0.24		
3. Flow length, L (total L $\le$ 300 ft)	ft	150'		
4. Two-yr 24-hr rainfall, P_2	in	3.1"		
5. Land slope, s	ft/ft	0.02		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.33	+ —	= 0.33

Shallow concentrated flow

Segment ID		B-C		
7. Surface description (paved or unpaved)		UNPAVED		
8. Flow length, L	ft	820		
9. Watercourse slope, s	ft/ft	.045		
10. Average velocity, V (figure 3-1)	ft/s	3.4		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.07	+ —	= 0.07

Channel flow

Segment ID		C-D		
12. Cross sectional flow area, a	ft^2	3.94		
13. Wetted perimeter, P_w	ft	5.30		
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft	0.743		
15. Channel slope, s	ft/ft	.027		
16. Manning's roughness coeff., n		.04		
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	5.0		
18. Flow length, L	ft	1100		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+ —	= .06
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr			0.46



R0020191

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project DESIGN EXAMPLE By RAL Date 12/94

Location FREDERICK CO, MD Checked ___ Date ___

Circle one: Present **Developed** ULTIMATE DEVELOPMENT.

Circle one: **T_c** T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)

		Segment ID	
		A-B	
1. Surface description (table 3-1)		GRASS	
2. Manning's roughness coeff., n (table 3-1)		0.15	
3. Flow length, L (total L ≤ 300 ft)	ft	100'	
4. Two-yr 24-hr rainfall, P_2	in	3.1	
5. Land slope, s	ft/ft	0.02	
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t	hr	0.17 + –	= 0.17

Shallow concentrated flow

		Segment ID	
		B-C	C-D
7. Surface description (paved or unpaved)		UNPAVED	PAVED
8. Flow length, L	ft	100'	200
9. Watercourse slope, s	ft/ft	.02	.02
10. Average velocity, V (figure 3-1)	ft/s	2.3	2.9
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.01 +	0.02 = 0.03

Channel flow

		Segment ID	
		D-E*	
12. Cross sectional flow area, a	ft^2	3.14	
13. Wetted perimeter, p_w	ft	6.28	
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft	0.50	
15. Channel slope, s	ft/ft	.028	
16. Manning's roughness coeff., n		0.013	
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s	12.1	
18. Flow length, L	ft	1500	
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.04 + –	= .04
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr		0.24

*ASSUME AVG S.D. SIZE = 24" RC

VS 0.46

earlier peak

PEAK DISCHARGE SUMMARY

JOB: DESIGN EXAMPLE

DRAINAGE AREA NAME TOTAL DA, PRE-DEVELOPED COND

RAC
30-Mar-95

COVER DESCRIPTION	SOIL NAME	GROUP A,B,C,D?	CN from TABLE 2-2	AREA (In acres)
MEADOW	GLENELG	B	58	60.80 Ac.
MEADOW	LINGANORE	C	71	4.40 Ac.
MEADOW	WORSHAM	D	78	7.20 Ac.
			AREA SUBTOTALS:	72.40 Ac.

Time of Concentration 2-Yr 24 Hr Rainfall = 3.1 in	Surface Cover Cross Section	Manning 'n' Wetted Per	Flow Length Avg Velocity	Slope Tt (Hrs)
Sheet Flow	dense grass	'n'=0.24	150 Ft.	2.00% 0.33 Hrs
Shallow Flow	UNPAVED		820 Ft. 3.42 F.P.S.	4.50% 0.07 Hrs.
Channel Flow Hydraulic Radius =0.74	3.9 SqFt	'n'=0.040 5.3 Ft.	1100 Ft. 5.02 F.P.S.	2.70% 0.06 Hrs.

Total Area in Acres =	72.40 Ac.	Total Sheet Flow=	Total Shallow Flow=	Total Channel Flow =
Weighted CN =	61			
Time Of Concentration =	0.46 Hrs.	0.33 Hrs.	0.07 Hrs.	0.06 Hrs.
Pond Factor =	1	RAINFALL TYPE II		

STORM	Precipitation (P) inches	Runoff (Q)	Qp, PEAK DISCHARGE	TOTAL STORM Volumes
1 Year	2.5 In.	0.2 In.	5.3 CFS	51,480 Cu. Ft.
2 Year	3.1 In.	0.4 In.	15.8 CFS	106,125 Cu. Ft.
5 Year	4.0 In.	0.8 In.	40 CFS	213,529 Cu. Ft.
10 Year	5.0 In.	1.4 In.	74 CFS	359,817 Cu. Ft.
25 Year	5.4 In.	1.6 In.	89 CFS	424,538 Cu. Ft.
50 Year	6.1 In.	2.1 In.	117 CFS	544,736 Cu. Ft.
100 Year	7.0 In.	2.7 In.	156 CFS	710,104 Cu. Ft.

TR-55 COMPUTER VERSION

PRE-DEV. CONDITIONS

R0020193

PEAK DISCHARGE SUMMARY				
JOB:	DESIGN EXAMPLE			
DRAINAGE AREA NAME	TOTAL DA, POST-DEVELOPED COND.			RAC 30-Mar-95
COVER DESCRIPTION	SOIL NAME	GROUP A,B,C,D?	CN from TABLE 2-2	AREA (In acres)
ONSITE				
TOWNHS. (45% IMP)	GLENELG, et.al	B	78	36.80 Ac.
COMM CNTR (65% I)	GLENELG, et.al.	B	85	1.60 Ac.
TOWNHS. (45% IMP)	LINGANORE	C	85	4.00 Ac.
TOWNHS. (45% IMP)	WORSHAM	D	88	6.70 Ac.
COMM CNTR (65%I)	WORSHAM	D	92	0.50 Ac.
OFFSITE				
PRESENT COND. *	GLENELG, et.al.	B	65	22.40 Ac.
PRESENT COND. *	LINGANORE	C	74	0.40 Ac.
*OFFSITE IS ASSMD.				
PRESENT COND.				
FOR STORMMGT.				
		AREA SUBTOTALS:		72.40 Ac.

Time of Concentration 2-Yr 24 Hr Rainfall = 3.1 In	Surface Cover Cross Section	Manning 'n' Wetted Per	Flow Length Avg Velocity	Slope Tt (Hrs)
Sheet Flow	short grass	'n'=0.15	100 Ft.	2.00% 0.17 Hrs
Shallow Flow (a)	UNPAVED		100 Ft. 2.28 F.P.S.	2.00% 0.01 Hrs.
(b)	PAVED		290 Ft. 2.87 F.P.S.	2.00% 0.02 Hrs.
Channel Flow Hydraulic Radius =0.50	3.1 SqFt	'n'=0.013 6.3 Ft.	1900 Ft. ########	2.80% 0.04 Hrs.

Total Area in Acres =	72.40 Ac.	Total Sheet Flow= 0.17 Hrs.	Total Shallow Flow= 0.03 Hrs.	Total Channel Flow = 0.04 Hrs.
Weighted CN =	76			
Time Of Concentration =	0.24 Hrs.			
Pond Factor =	1	RAINFALL TYPE II		

STORM	Precipitation (P) Inches	Runoff (Q)	Qp, PEAK DISCHARGE	TOTAL STORM Volumes
1 Year	2.5 In.	0.7 In.	52.0 CFS	182,534 Cu. Ft.
2 Year	3.1 In.	1.1 In.	84.1 CFS	284,616 Cu. Ft.
5 Year	4.0 In.	1.7 In.	140 CFS	456,909 Cu. Ft.
10 Year	5.0 In.	2.5 In.	209 CFS	666,364 Cu. Ft.
25 Year	5.4 In.	2.9 In.	238 CFS	753,916 Cu. Ft.
50 Year	6.1 In.	3.5 In.	290 CFS	911,053 Cu. Ft.
100 Year	7.0 In.	4.3 In.	358 CFS	############

TR-55
COMPUTER
VERSION

POST-DEV.
CONDITIONS

R0020194

PEAK DISCHARGE SUMMARY

JOB:	DESIGN EXAMPLE			
DRAINAGE AREA NAME	TOTAL DA, ULTIMATE CONDITIONS			RAC 30-Mar-95
COVER DESCRIPTION	SOIL NAME	GROUP A,B,C,D?	CN from TABLE 2-2	AREA (In acres)
ONSITE				
TOWNHS. (45% IMP)	GLENELG, et.al	B	78	36.80 Ac.
COMM CNTR (65% I)	GLENELG, et.al.	B	85	1.60 Ac.
TOWNHS. (45% IMP)	LINGANORE	C	85	4.00 Ac.
TOWNHS. (45% IMP)	WORSHAM	D	88	6.70 Ac.
COMM CNTR (65%I)	WORSHAM	D	92	0.50 Ac.
OFFSITE *				
COMMERCIAL (85%I)	GLENELG, et.al.	B	92	6.60 Ac.
TOWNHS. (45% IMP)	GLENELG, et.al.	B	78	15.80 Ac.
TOWNHS. (45% IMP)	LINGANORE	C	85	0.40 Ac.
*OFFSITE AS ULT.				
FOR DAM SAFETY				
		AREA SUBTOTALS:		72.40 Ac.

Time of Concentration 2-Yr 24 Hr Rainfall = 3.1 In	Surface Cover Cross Section	Manning 'n' Wetted Per	Flow Length Avg Velocity	Slope Tt (Hrs)
Sheet Flow	short grass	'n'=0.15	100 Ft.	2.00% 0.17 Hrs
Shallow Flow (a)	UNPAVED		100 Ft. 2.28 F.P.S.	2.00% 0.01 Hrs.
(b)	PAVED		200 Ft. 2.87 F.P.S.	2.00% 0.02 Hrs.
Channel Flow Hydraulic Radius =0.50	3.1 SqFt	'n'=0.013 6.3 Ft.	1900 Ft. ########	2.80% 0.04 Hrs.

Total Area in Acres =	72.40 Ac.	Total Sheet Flow= 0.17 Hrs.	Total Shallow Flow= 0.03 Hrs.	Total Channel Flow = 0.04 Hrs.
Weighted CN =	81			
Time Of Concentration =	0.24 Hrs.			
Pond Factor =	1	RAINFALL TYPE II		

STORM	Precipitation (P) inches	Runoff (Q)	Qp, PEAK DISCHARGE	TOTAL STORM Volumes
1 Year	2.5 In.	0.9 In.	74.1 CFS	247,671 Cu. Ft.
2 Year	3.1 In.	1.4 In.	112.4 CFS	365,523 Cu. Ft.
5 Year	4.0 In.	2.1 In.	176 CFS	557,552 Cu. Ft.
10 Year	5.0 In.	3.0 In.	251 CFS	784,580 Cu. Ft.
25 Year	5.4 In.	3.3 In.	281 CFS	878,145 Cu. Ft.
50 Year	6.1 In.	4.0 In.	334 CFS	############
100 Year	7.0 In.	4.8 In.	404 CFS	############

TR-55 (Computer Version

Ultimate Conditions

TR-20

INPUT - FILE

***************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*****************

```
JOB TR-20                               FULLPRINT
TITLE      DESIGN EXAMPLE--HYDROLOGY (DESIGN.EXM)          NOPLOTS
TITLE      HYDROLOGIC RUN FOR PRE & POST DEV 2, 10, 100 YR. EVENTS   DEC. '94  RAC
 6 RUNOFF 1    1     7 0.113      61.0       0.462       1 0   0 0 1 - PRE-DEV.
 6 RUNOFF 1    2     6 0.113      76.0       0.241       1 0   0 0 1 - POST-DEV.
 6 RUNOFF 1    3     5 0.113      81.0       0.241       1 0   0 0 1 - ULT. DEV
   ENDATA
 7 INCREM 6           0.1
 7 COMPUT 7    1     2 0.0        3.1        1.0         2 2   1   1 - 2-YEAR
   ENDCMP 1
 7 COMPUT 7    1     2 0.0        5.0        1.0         2 2   1   2 - 10-YEAR
   ENDCMP 1
 7 COMPUT 7    3     3 0.0        7.0        1.0         2 2   1   3 - 100-YEAR
   ENDCMP 1
   ENDJOB 2
```

rainfall

*******************************END OF 80-80 LIST*********************************

TR-20

TR20 XEQ 12/21/94
REV 09/01/83

DESIGN EXAMPLE--HYDROLOGY (DESIGN.EXM) DEC. '94 RAC
HYDROLOGIC RUN FOR PRE & POST DEV 2, 10, 100 YR. EVENTS

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1 - 2-YEAR													
STRUCTURE 1	RUNOFF	.11	2	2	.10	.0	3.10	24.00	.40	—	12.25	16.02	141.8 PRE
STRUCTURE 2	RUNOFF	.11	2	2	.10	.0	3.10	24.00	1.08	—	12.07	89.32	790.4 POST
ALTERNATE 1 STORM 2 - 10-YEAR													
STRUCTURE 1	RUNOFF	.11	2	2	.10	.0	5.00	24.00	1.37	—	12.21	78.36	693.4 PRE
STRUCTURE 2	RUNOFF	.11	2	2	.10	.0	5.00	24.00	2.54	—	12.05	212.24	1878.3 POST
ALTERNATE 1 STORM 3 - 100 YEAR													
STRUCTURE 3	RUNOFF	.11	2	2	.10	.0	7.00	24.00	4.81	—	12.04	392.06	3469.6

spillway

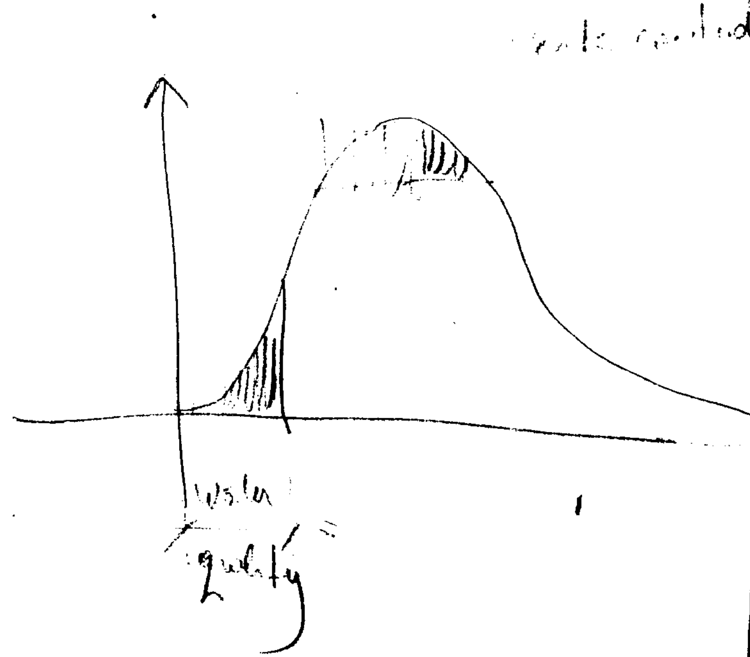
Frequent storm control is an issue when introducing storm water control.

R0020197

Pond Design Example

Storage Requirements

- Water Quality
  - Permanent pool
  - Forebay
  - Extended detention
- Water Quantity
  - 2 year storm
  - 10 year storm



Permanent Pool and Extended Detention

Water Quality Volume (WQV) TOTAL

DA=72.4 ac
(for 50% Impervious)
$WQV = 1.25" \times R_v \times DA$
$R_v = 0.05 + 0.009(I) = 0.5$

$WQV = 1.25"(0.5)(72.4\ ac)/12"/ft = 3.77\ ac\text{-}ft$

Water Quality Storage - II

(PAGE 23 IN BOOKLET)

Permanent Pool Volume

50% of WQV = 0.5(3.77 ac-ft) = 1.89 ac-ft
Minimum length to width ratio = 2:1
Max depth = 8ft, 4ft to 6ft avg.
70% of shoreline in shallow aquatic shelves

Sediment Forebay

tenth of an inch

Minimum Vol. required: 0.1"(0.5)(72.4 ac)/(12"/ft) = <u>0.3 ac-ft</u>

Extended Detention

Vol. required: ½ * (WQV) = ½ * (3.77 ac-ft) = <u>1.89 ac-ft</u>

Water Quantity Storage - I

(*PAGE 24 IN BOOKLET*)

Preliminary Storage for 2 Year Storm Event

2 year pre-developed runoff = 16.0 cfs
2 year post-developed discharge = 89.3 cfs

From TR-55 Figure 6.1 [short cut method for routing]

$Q_o/Q_i = 16.0/89.3 = 0.18$

$V_s/V_R = 0.47$: for CN = 76, and 3.1" rainfall; $V_r = 1.08"$

Storage Volume: $V_s = 0.47(1.08")(72.4 \text{ ac}/12 \text{ "/ft}) = 3.06$ ac-ft.

Add 10% due to E.D. below — for ease of calculations (conservative we do not do iteration)

3.06(1.1) = 3.37 ac-ft

Water Quantity Storage - II

(PAGE 24 IN BOOKLET)

Preliminary Storage for 10 Year Storm Event

10 year pre-developed runoff = 78.4 cfs
10 year post-developed runoff = 212.2 cfs ← Dimensionless Value

$Q_o/Q_i = 78.4/212.2 = 0.37$
$V_s/V_r = 0.34$: for CN = 76, and 5.0" rainfall; $V_r = 2.54"$
Storage Volume: $V_s = 0.34(2.54)(72.4/12) = 5.21$ ac-ft

add 10% due to E.D. below
5.21(1.1) = 5.73 ac-ft

Pond Design Example

Pond Grading

- Storage provided
  - Permanent pool
  - Stormwater management

FIGURE 10

WET, EXTENDED DETENTION POND

PLAN VIEW

SCALE: 1"=80'

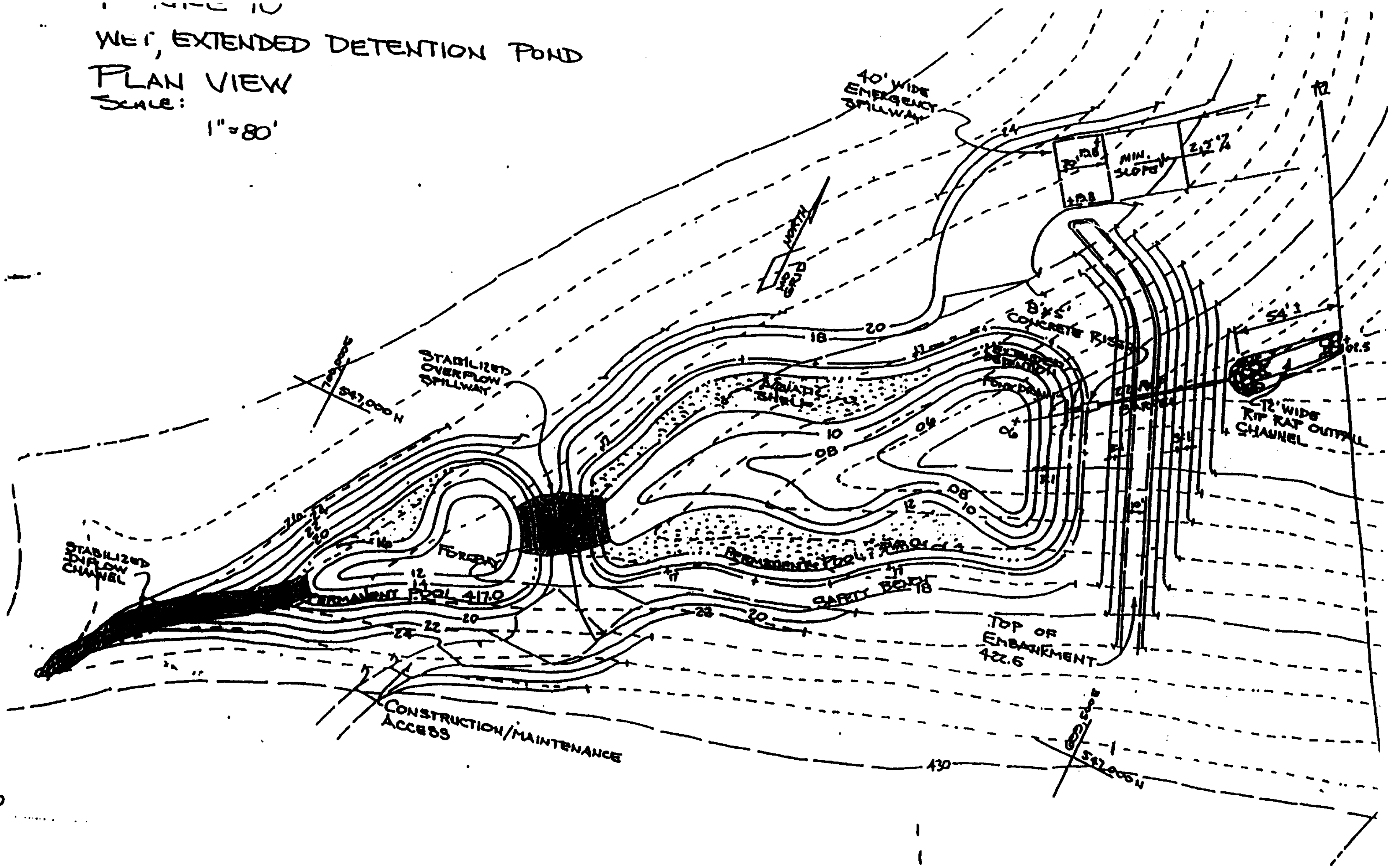
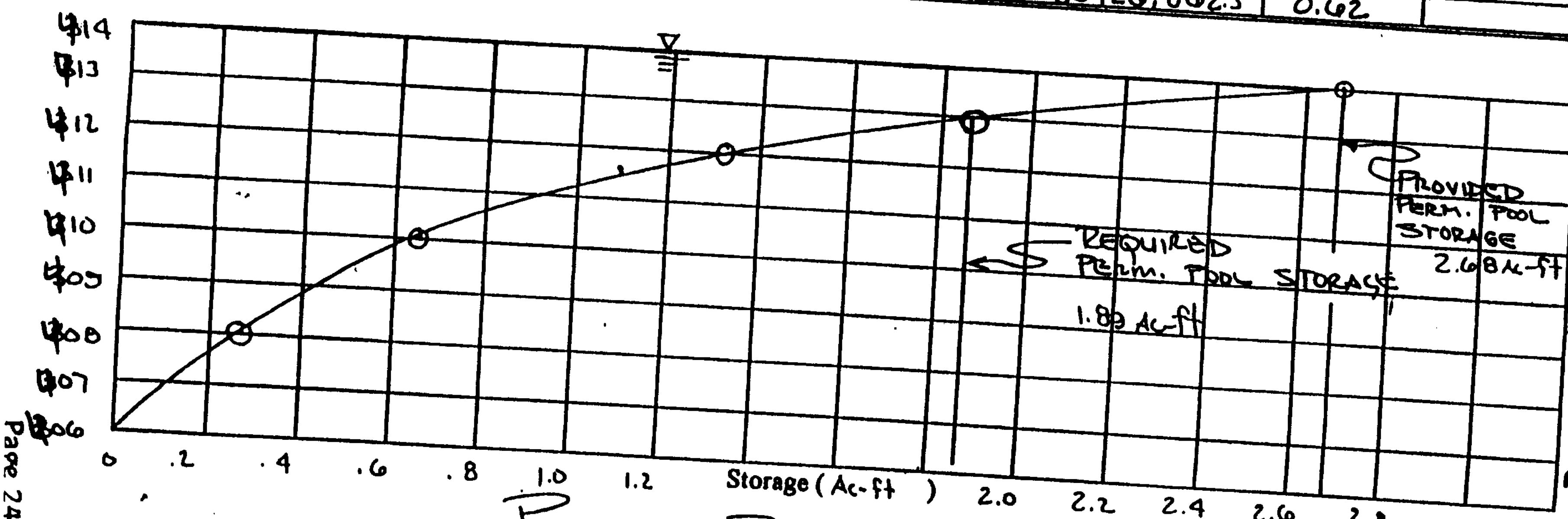


FIGURE 2

Elevation - Storage Data

	Elevation (MSL)	Area (in²)	Area (ft²)	Average Area (ft²)	Depth (ft)	Volume (ft³)	Σ Volume (ft³)	Σ Volume (ac-ft)	Σ Volume above permanent pool (ac-ft)
Perm Pool	406	1.51	3775						
	408	3.20	8000	5887.50	2	11,775	11,775	0.27	
	410	5.34	13,350	10,675.00	2	21,350	33,125	0.76	
	412	7.88	19,700	16,525.00	2	33,050	66,175	1.52	
	414	12.31	30,775	25,237.50	2	50,475	116,650	2.68	
Forebay	412	1.06	2500						
	414	1.84	4600	3550	2	7,100	7,100	0.16	
	417	3.43	8575	6587.50	3	19,762.50	26,862.5	0.62	



PERMANENT-POOL ELEVATION-STORAGE CURVE

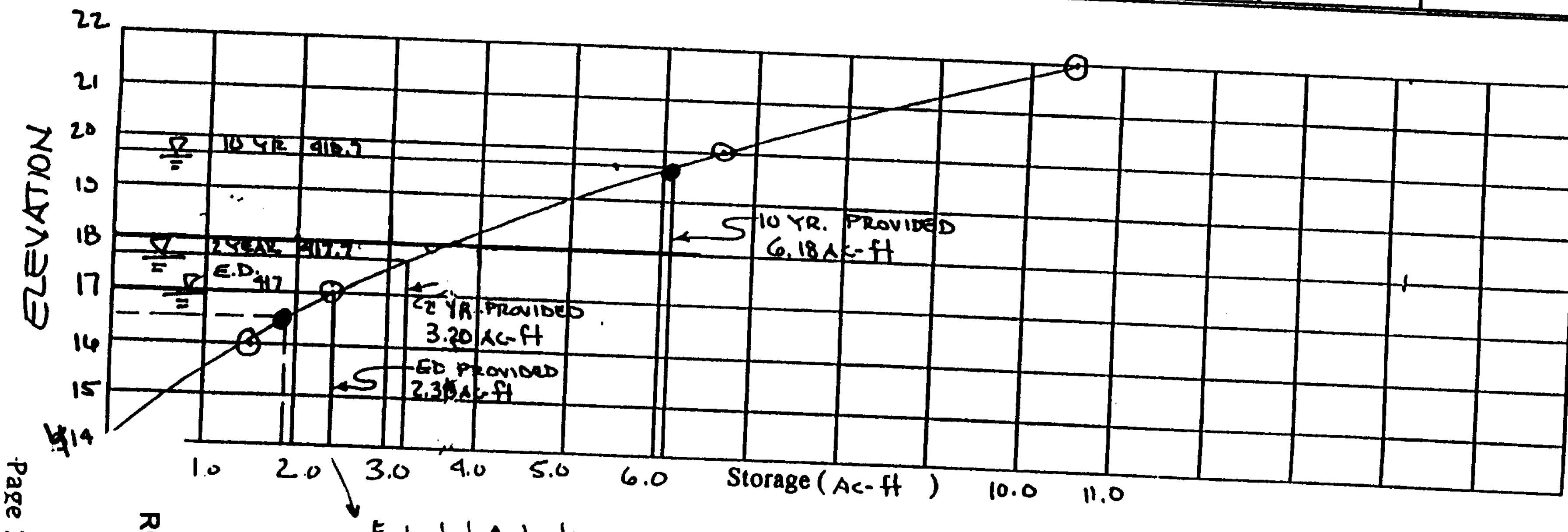
DESIGN EXAMPLE
PERMANENT POOL VOLUME
SEDIMENT FOREBAY VOLUME

Elevation - Storage Data

Elevation (MSL)	Area (in²)	Area (ft²)	Average Area (ft²)	Depth (ft)	Volume (ft³)	Σ Volume (ft³)	Σ Volume (ac-ft)	Σ Volume above permanent pool (ac-ft)
414	12.31	30,775						
416	14.43	36,075	33,425	2	66,850.0	66,850		
417.	15.28	38,200	37,137.50	1	37,137.50	103,987.5		1.53
418	25.21	63,025	50,612.5	1	50,612.50	154,600		2.38
420	28.72	71,800	67,412.5	2	134,825.0	289,425		3.55 ← 3.37 @417
422	38.06	95,150	83,475	2	166,950	456,375		6.64 ← 5.73 @419
								10.48

FIGURE 3

ELEVATION-STORAGE DATA AND CURVE ABOVE PERMANENT POOL



Extended Detention

R0020206

Pond Design Example

Hydraulic Computations

- Extended detention
- 2 year storm
- 10 year storm
- Riser
- Barrel
- Emergency spillway
- Storage-elevation-discharge table
- TR-20 input data
- TR-20 results data

(PAGE 27 IN BOOKLET)

(1) Extended Detention

For extended detention of 1.89 ac-ft

Using the elevation-storage table and curve
Read elev. 416.6, use 417.0 ✓

Average release rate:

Q_{avg} = (1.89 ac-ft(43,560 ft²/ac))/ (24hr(3600 sec/hr)) = 0.95 cfs
maximum release rate ~~is assumed~~ to be $Q_{max} = 2 * (Q_{avg})$
$Q_{max} = 2 * (0.95) = 1.9$ cfs @ elev.. 417.0

$Q = C * A * (2gh)^{1/2}$ H to center of orifice => $\boxed{h\text{-WSEL} - (\text{INV} + \frac{d}{2})}$

Try 6" diameter orifice Use oriffice equation

$Q = 0.6 * (.196\ ft^2) * [(64.4\ ft/sec^2)(2.75\ ft)]^{1/2} = 1.56\ ft^3/sec$, 1.56 < 1.90 OK

Result: Use 6" diameter orifice, invert elevation, 414.0

assumes free outfall

Hydraulic Computations - II

(PAGE 27 IN BOOKLET)

(2.0) 2 Year Stormwater Management

Set invert elevation at ED water surface elevation (417.0)
Allowable release rate = 16.0 cfs existing Q_{in}

For storage of 3.37 ac-ft, read elevation = 417.8 (Figure 3)
At elevation 417.8, $Q_{ED\ orifice}$ = 1.8 cfs $417.8 - 414.0 + \frac{6''}{2(12)} = 1.8$
2 year slot maximum release rate = 16.0 cfs - 1.8 cfs = 14.2 cfs. $H_{ED} = 3.8' - \frac{1}{2}$ Diam (OR
$H_{2YR} = 0.8'$ WEIR

$$Q_o = C * A * (2gh)^{1/2} \text{ or } Q_w = C * L * H^{3/2}$$

Try 4' x 1' horizontal slot, with invert set at 417.0 Weir or orifice the more restrictive will control?

orifice $Q_o = 0.6 * (4.0\ ft^2) * [(64.4\ ft/sec^2)(0.3\ ft)]^{1/2}$ = 10.5 cfs + 1.8 cfs = 12.3 cfs
cfs (which is < 16.0 cfs). usable head

weir $Q_w = 3.1(4\ ft)(0.8)^{3/2}$ = 8.9 cfs + 1.8 cfs = 10.7 cfs (which is < 16.0 cfs) Weir Controls Who controls

Result: Use 4 ft x 1 ft slot, invert elevation, 417.0 $H_{Max} = 0.8'$ (9.6")

Page 28

R0020209

(PAGE 28 IN BOOKLET)

(2.1) 10 Year Stormwater Management

Set invert elevation above 2 year elevation at 418.0
Allowable 10 year release rate = 78.3 cfs

For storage = 5.73 ac-ft, read elevation 419.5 (Figure 3)
At elev. 419.5 $Q_{ED\ orifice}$ = 2.2 cfs and $Q_{2yr\ slot}$ = 27.2 cfs
Q_{10} Release = 78.3 cfs - (2.2 cfs + 27.2 cfs) = 48.9 cfs

$H_{ED} = 5.5'$ (Minus 0.25') ORIFICE
$H_{2YR} = 2.5'$ (MINUS 0.5') ORIFICE
$H_{10YR} = 1.5'$ WEIR

Try 10' x 2' slot (actually, 2 - 5' x 2' slots) → Design detail

Weir: $Q_w = 3.1(10\text{ ft})(1.5\text{ ft})^{3/2} = 57.0$ cfs > 48.9 cfs
(may be too large, but want the barrel to control flow)

who controls

Orifice: $Q_o = 0.6 * (20\text{ ft}) * [(64.4\text{ ft/sec}^2)(0.5\text{ ft})]^{1/2} = 68.1$ cfs > 57.0 cfs
from weir equation

So WEIR CONTROLS

Result: Use two 5 ft x 2 ft slots, invert elevation, 418.0

(PAGE 28 IN BOOKLET)

(3.0) Riser

Size riser to accommodate all flow through control openings
- 6" ED Orifice
- 4' x 1' 2-Year Slot
- Two 5' x 2' 10-Year Slots
- 27" RCP Barrel (see following computations)

<u>Try 8' x 5' Reinforced Concrete Box</u>

Check orifice control at elevation 419.5 (this condition is rarely a limiting factor)

$Q_{\text{base orifice}} = 0.6 * (40\ ft^2) * [(64.4\ ft/sec^2)(1.5)]^{1/2} = 236$ cfs
which is >> slot orifice

Result: **<u>Use 8' x 5' Reinforced Concrete Box Riser</u>**

Hydraulic Computations - V

(PAGE 29 IN BOOKLET)

(3.1) Barrel

Upstream invert = 405.0
Downstream invert = 403.65

At elevation 419.5 the barrel should control flow and release less than 78.3 cfs.

Try 27" RCP Barrel

Inlet Control Condition

Use Culvert Charts

For 27" RCP, $H_w/d = (419.5 - 405.0)/2.25\ \text{ft} = 6.44$ ft

Read Q = 70 cfs ±

70 cfs < 78.3 cfs

Outlet Control Condition

Use SCS pipe flow equation FHA orifice method,

$Q = A * [2gh/(1 + k_m + k_pL)]^{1/2}$

$Q = 3.98\ \text{ft}^2 * [(\cancel{64.4\ \text{ft/sec}^2})(14.73)/2 + .01016(81)]^{1/2} = 73.0\ \text{cfs} > 70$ cfs so barrel is in inlet control

Result: **Use 27" RCP Barrel**

(PAGE 29 IN BOOKLET)

(4) Emergency Spillway

Set invert elevation above 10 year water surface elevation (419.7)
Set crest elevation = 419.8

Size spillway to pass ultimate 100 year discharge with at least 1 foot of freeboard to top of embankment (Q_{100} inflow = 392.0 cfs).

<u>Try 40' wide, vegetated, emergency spillway with 3:1 side slopes</u>

Using SCS, Design Data for Earth Spillways
$H = 421.5 - 419.8 = 1.7$ ft
$Q_{ES} = 222.0$ cfs
$Q_{Principal\ Spillway} = 77$ cfs.
$Q_{ES} + Q_{PS} = 299$ cfs, less than 392cfs, however pond storage attenuation will ensure passage of ultimate 100 year flow

due to routing effect of the pond

(PAGE 31 IN BOOKLET)

(1) **Extended Detention - 6" orifice**

$Q = C * A * (2gh)^{1/2}$ $h = w.s.e. - 414.25$

$\underline{Q = 0.943 * h^{1/2}}$

(2.0) **2 Year Slot - 4' x 1' slot**

Orifice:

$h = w.s.e. - 417.5$

$\underline{Q = 19.25 * h^{1/2}}$

Weir:

$H = w.s.e. - 417.0$

$\underline{Q_w = 12.4 * H^{3/2}}$

(2.1) **10 Year Slot - two 5' x 2' slots**

Weir:

$H = w.s.e. - 418.0$

$\underline{Q_w = 31.0 * H^{3/2}}$

Orifice:

$h = w.s.e. - 419.0$

$\underline{Q = 96.25 * h^{1/2}}$

(PAGE 31 IN BOOKLET)

(3.0) **Riser - 8' x 5' box**

Orifice:

h = w.s.e. - 418.0

$\underline{Q_{base\ orifice} = 192.61 * h^{1/2}}$

(note: slot orifice more restrictive than base, use slot orifice in storage-elevation-discharge data table)

(3.1) **Barrel - 27" RCP**

Inlet control:

Use FHA Culvert Chart No. 2 where, H_w/D = (w.s.e. - 405.0)/2.25

Outlet control:

$Q = A* [(2gh/1 + k_m + k_pL)]^{1/2}$

h = w.s.e. - 404.78

$\underline{Q = 19.00 * h^{1/2}}$

(4) **Emergency Spillway**

Use Engineering Field Manual, Design Data for Earth Spillways

where H_p = w.s.e.) - 419.8

XEQ 9/21/95
V 09/01/83

DESIGN EXAMPLE—ROUTING (DESIGNEX.ROT) MAR. '95 RAC
ROUTING RUN FOR POST DEV. FOR 2, 10,& ULT. DEV. FOR 100 YR

UMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

ECTION/ RUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1 - 2-YEAR													
UCTURE 1	RUNOFF	.11	2	2	.10	.0	3.10	24.00	1.08	—	12.07	89.32	790.4
RUCTURE 2	RESVOR	.11	2	2	.10	.0	3.10	24.00	.80	417.70	13.12	9.28	82.1
ALTERNATE 1 STORM 2 - 10-YEAR													
UCTURE 1	RUNOFF	.11	2	2	.10	.0	5.00	24.00	2.54	—	12.05	212.24	1878.3
UCTURE 2	RESVOR	.11	2	2	.10	.0	5.00	24.00	2.23	419.66	12.34	70.53	624.2
ALTERNATE 1 STORM 3 - 100 YEAR													
UCTURE 3	RUNOFF	.11	2	2	.10	.0	7.00	24.00	4.81	—	12.04	392.06	3469.6
CTURE 2	RESVOR	.11	2	2	.10	.0	7.00	24.00	4.49	421.41	12.18	279.92	2477.1

422.5 for top of dam

R0020216

Pond Design Example

Profiles and Details

- Profile through centerline of pond
- Profile through centerline of principal spillway
- Profile through centerline of pond (typical grading)
- Schematic riser detail

R0020218

TABLE 1

Elevation (MSL)	Storage (ac-ft)	Low Flow (1) (EXT. DET.)		Riser (3.0) 2 YEAR SLOT (2.0)		High Stage Slo (2.1) Orifice		High Stage Slo (2.1) Weir		(3.1) Barrel 27" RCP Inlet FHWA CULVERT CH.		Barrel Pipe SCS PIPE EQ.		Emergency Spillway (4) 40' WIDE		Total Discharge
Top of Permanent Pond		H (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	Hw/d (ft)	Q (cfs)	H (ft)	Q (cfs)	H (ft)	Q (cfs)	(cfs)
414.0	0	–	–													0
414.5	0.38	0.25	0.5													0.5
415.0	0.77	0.75	0.8													0.8
416.0	1.53	1.75	1.2													1.2
417.0	2.38	2.75	1.6	0.0	0.0	(INVERT 2 YEAR SLOT)										1.6
417.5	2.97	3.25	1.7	0.5*	4.4											6.1
418.0	3.55	3.75	1.8	1.0*	12.4	0	0	0	0	(INVERT 10 YEAR SLOT)						14.2
419.0	5.10	4.75	2.1	1.5**	23.6	–		1.0	31	6.2	69	13.88	71.0			56.7
419.5	5.87	5.25	2.2ℓ	2.0**	27.0 ℓ	–		1.5	57.0ℓ	6.4	70ℓ	14.38	72.3			70.0
419.8	6.33	–	–	2.3	29.2	–		1.8	74.9	6.6	71	14.68	73.0	0	0	71.0
420.0	6.64	–	–	2.5**	30.4	1.0	36.3	2.0	87.7	6.7	72.5	14.88	73.5	0.2	5±	77.5
420.5	7.60	–	–	–	–	–	–	–	–	6.9	74	15.38	74.7	0.7	49	123
421.0	8.56	–	–	–	–	–	–	–	–	7.1	75	15.88	75.9	1.2	122	197
421.5	9.52	–	–	–	–	–	–	–	–	7.3	76.5	16.38	77.1	1.7	222	298.5

Storage - Elevati Discharge Data

Project Name: DESIGN EXAMPLE Date: MARCH '95 By: RAC

* WEIR FLOW → free surface flow

** ORIFICE → under pressure

ℓ NOTE: THAT BARREL FLOW CONTROLS OVER HIGH STAGE ORIFICE

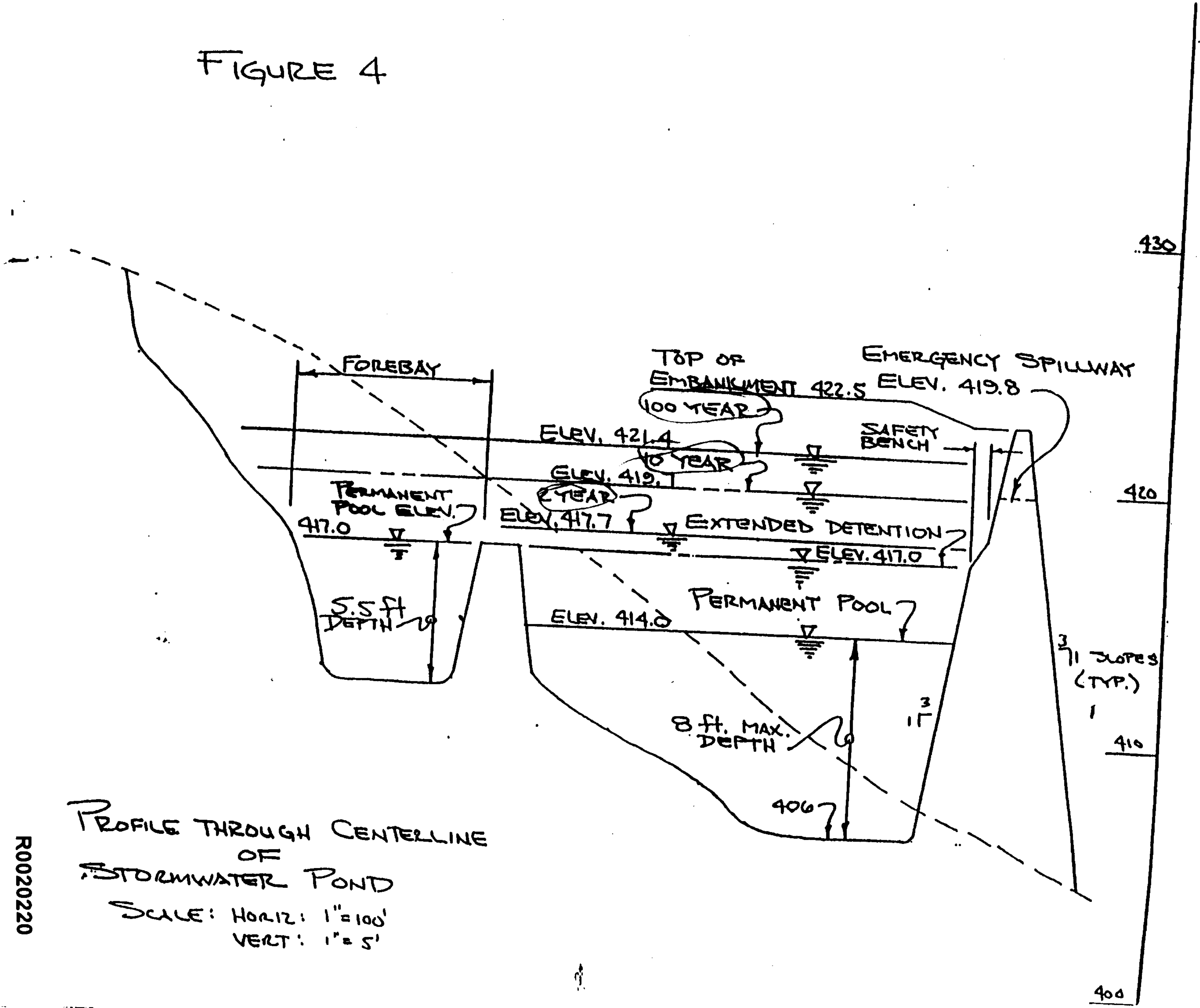
(2.1) NOTE: NUMBERS IN PARENTHESES CORRESPOND TO HYDRAULIC EQUATIONS ON PAGE 31

```
******************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*****************   INPUT FILE
JOB TR-20                        FULLPRINT
TITLE     DESIGN EXAMPLE--ROUTING (DESIGNEX.ROT)    MAR. '95  RAC       NOPLOTS
TITLE     ROUTING RUN FOR POST DEV. FOR 2, 10,& ULT. DEV. FOR 100 YR
 3 STRUCT      2
 8
 8                     414.0      0.0       0.0
 8                     414.5      0.5       0.38
 8                     415.0      0.8       0.77
 8                     416.0      1.2       1.53             Structure Data
 8                     417.0      1.6       2.38
 8                     417.5      6.1       2.97   <------ HYDRAULIC
 8                     418.0     14.2       3.55           CHARACTERISTICS
 8                     419.0     56.7       5.10           DATA
 8                     419.5     70.0       5.87
 8                     419.8     71.0       6.33
 8                     420.0     77.5       6.64
 8                     420.5    123.0       7.60
 8                     421.0    197.0       8.56
 8                     421.5    298.5       9.52
 9 ENDTBL
 6 RUNOFF 1     1     6 0.113    76.0      0.241
 6 RESVOR 2     2 6   7 414.0                       1 1   1 0 1   POST DEV. INFLOW
 6 RUNOFF 1     3     1 0.113                       1 1 1 1 0 1   POST DEV. ROUTING
 5 RESVOR 2     2 1   2 414.0    81.0      0.241    1 1   1 0 1   ULT. DEV. INFLOW
   ENDATA                                           1 1 1 1 0 1   ULT. DEV. ROUTING
   INCREM 6             0.1
   COMPUT 7     1     2 0.0      3.1       1.0
   ENDCMP 1                                         2 2   1   1   2-YEAR
   COMPUT 7     1     2 0.0      5.0       1.0
   ENDCMP 1                                         2 2   1   2   10-YEAR
   COMPUT 7     3     2 0.0      7.0       1.0
   ENDCMP 1                                         2 2   1   3   100-YEAR
   ENDJOB 2

****************************END OF 80-80 LIST*********************************
```

R0020219

FIGURE 4



PROFILE THROUGH CENTERLINE OF STORMWATER POND

SCALE: HORIZ: 1"=100'
VERT: 1"=5'

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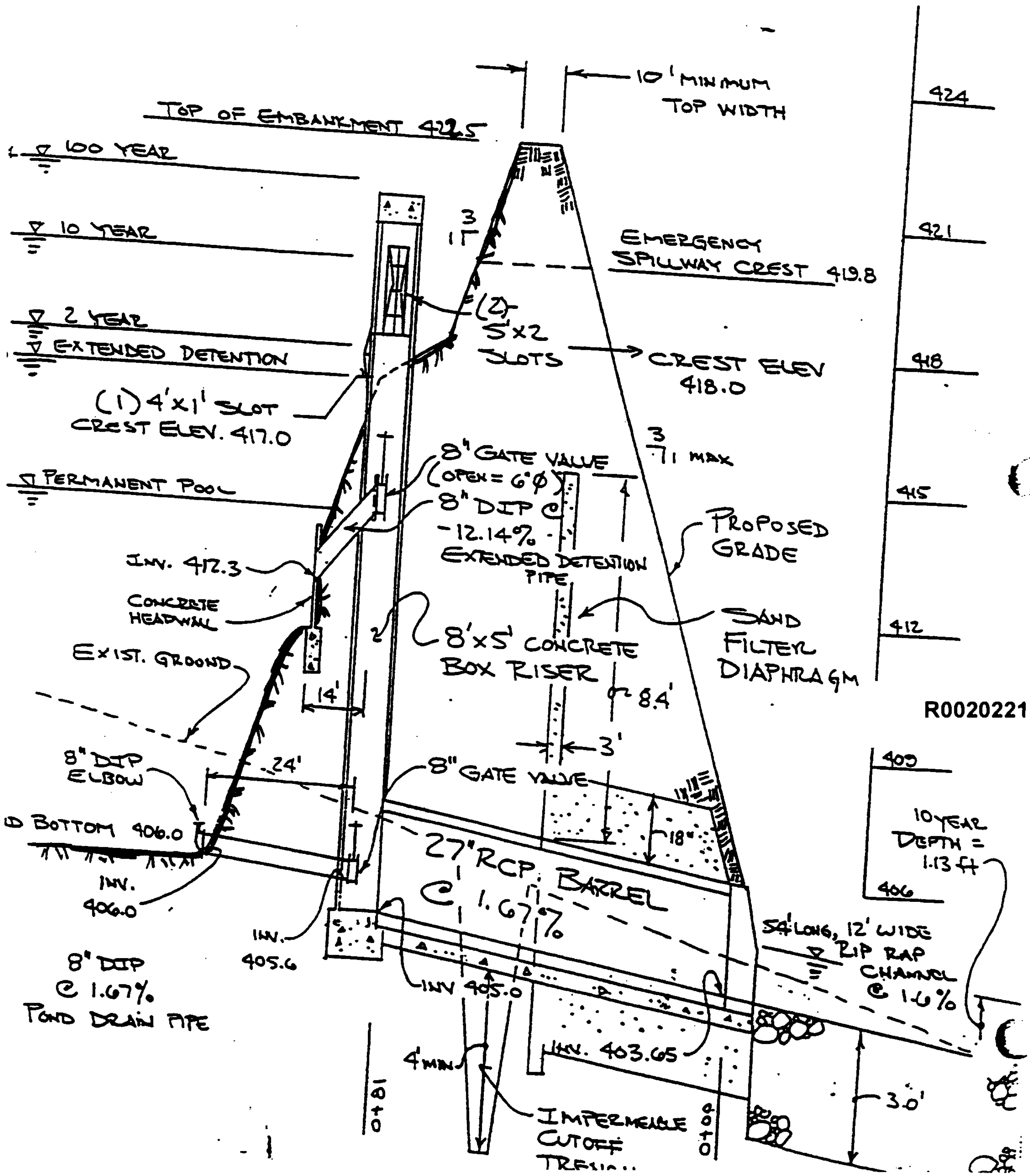
Silver Spring, MD 20910

FIGURE 11

Center for Watershed Protection
8737 Colesville Road, Suite 300
Silver Spring, MD 20910

PROFILE THROUGH
CENTERLINE OF
PRINCIPAL SPILLWAY

SCALE: HORIZ: 1" = 30'
VERT: 1" = 3'



R0020221

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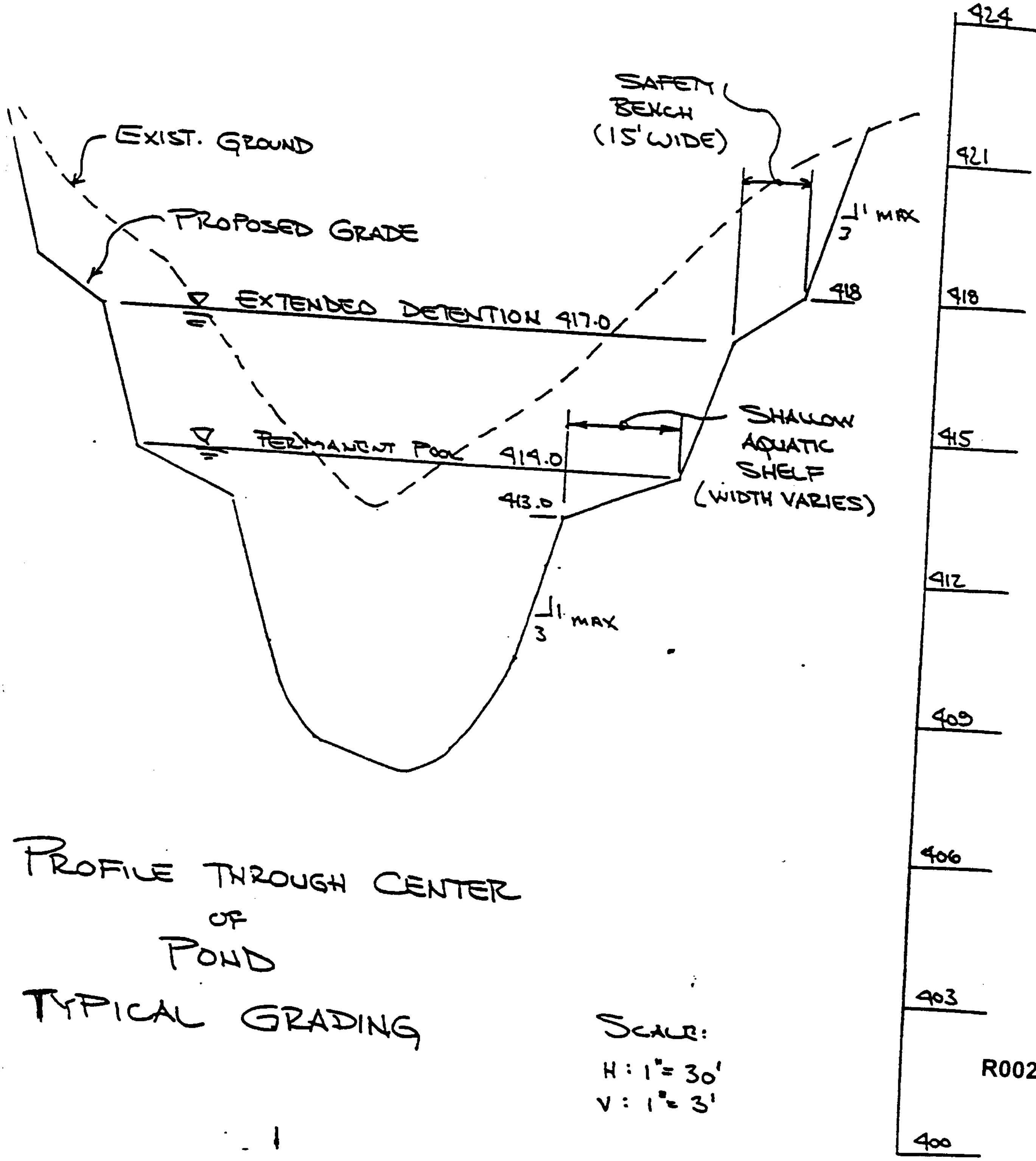
8737 Colesville Road, Suite 300
Silver Spring, MD 20910

FIGURE 12



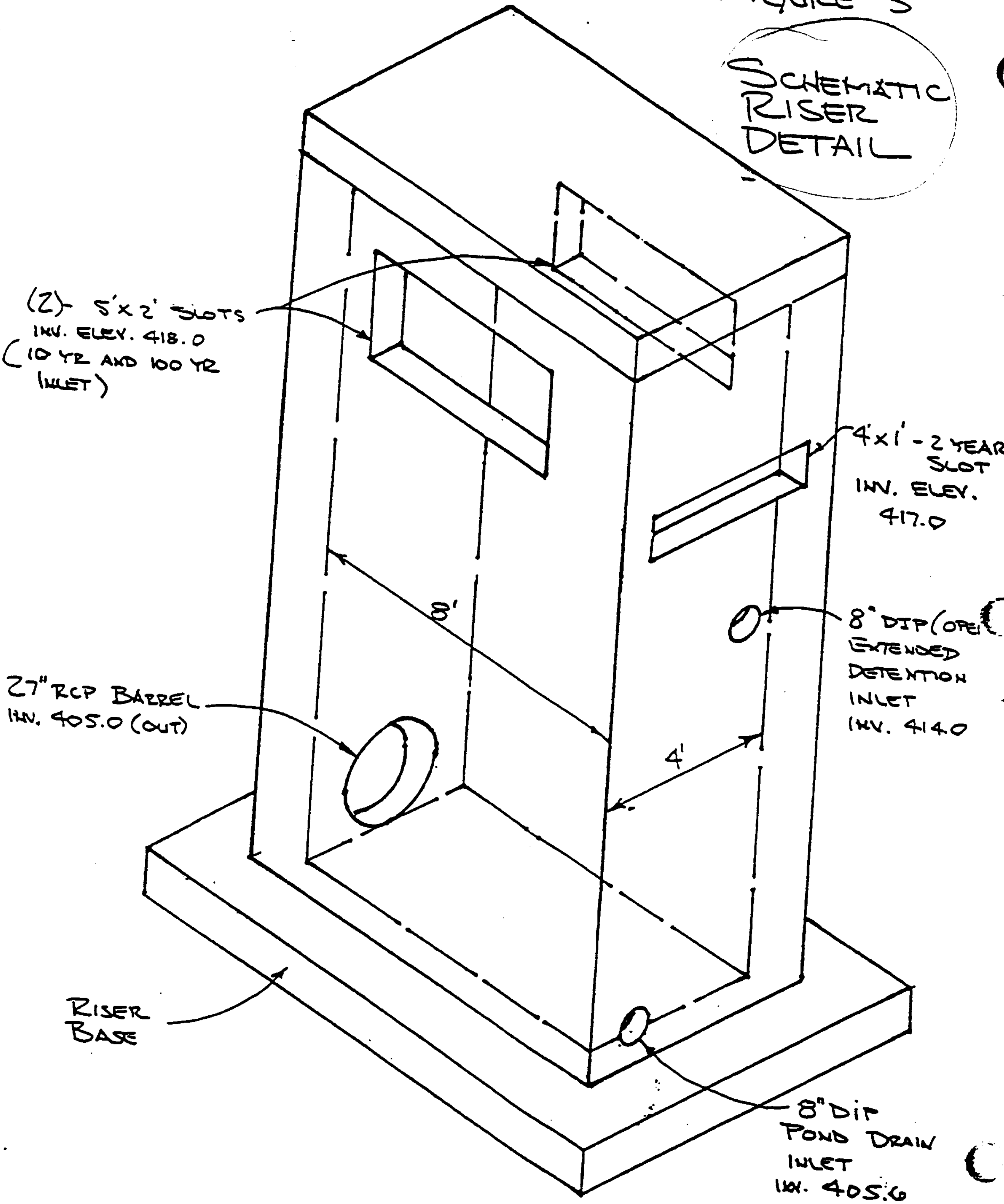
PROFILE THROUGH CENTER
OF
POND
TYPICAL GRADING

SCALE:
H : 1" = 30'
V : 1" = 3'

R0020222

FIGURE 5

SCHEMATIC RISER DETAIL



R0020223

Pond Design Example

Miscellaneous Computations

- Barrel outlet channel
- Water balance
- Pond drain
- Seepage control
- Anti-floatation → assuming orifices of the riser clogged + drain check
- Slope stability
- Structural concrete
- Inflow channels
- Geotechnical
- Cost estimate
- Spillway between forebay and pond

12. Inlet Protection.

Inlet pipes to the pond can be partially submerged in warmer climates.

A forebay must be provided at each inlet, unless it provides less than 10% of the total design storm inflow rate to the pond.

13. Adequate Outfall Protection.

Flared end pipe sections that discharge at or near the stream invert are preferred.

The channel immediately below the pond outfall shall be modified to conform to natural dimensions, and lined with large rip-rap placed over filter cloth.

A stilling basin shall be used to reduce flow velocities from the primary spillway to non-erosive velocities.

If the pond daylights to a channel with dry weather flow, care should be taken to minimize tree clearing along the downstream channel, and to reestablish a forested riparian zone in the shortest possible distance. Excessive use of rip-rap should be avoided to reduce stream warming.

If the pond has a dry pilot channel, a PVC underdrain pipe shall be located 2 to 3 feet below the riprap to prevent excessive warming of dry weather flows. The pilot channel can also be protected by shade trees.

14. Pond Benches.

The perimeter of all deep pool areas (four feet or greater in depth) shall be surrounded by two benches:

A safety bench that extends 15 feet outward from the shoreline to the toe of the pond sideslope. The maximum slope of the safety bench shall be 3%.

An aquatic bench that extends 15 feet inward from the normal shoreline, that has a maximum depth of eighteen inches below the normal pool water surface elevation.

15. Safety Features.

Fencing of ponds is not generally desirable.

Safety is provided by managing the contours of the pond to eliminate dropoffs and other hazards.

Sideslopes to the pond shall not exceed 3:1 (h:v), and shall terminate on a safety bench.

Both the safety bench and the aquatic bench may be landscaped to prevent access to the pool.

The primary spillway opening shall not permit access by small children.

Outfall pipes above 48 inches in diameter should be fenced.

Warning signs prohibiting swimming and skating may be posted

16. Pondscaping Plan

A pondscaping plan shall be prepared that indicates how aquatic and terrestrial areas will be vegetatively stabilized.

Specific pondscaping guidance is provided in Design of Stormwater Wetland Systems (Schueler, 1992).

17. Wetland Elements.

Wherever possible, wetland plants should be encouraged in the pond design, either along the aquatic bench (fringe wetlands), the safety bench and sideslopes (ED wetlands) or within shallow areas of the pool itself.

The best elevations for establishment of wetland plants, either through transplantation or volunteer colonization, are within six inches (plus or minus) of the normal pool.

18 Pond Buffers and Setbacks.

A pond buffer shall be provided that extends 25 feet outward from the maximum water surface elevation of the pond. The pond buffer should be contiguous with other buffer areas, as are required by local regulation (e.g., stream buffers).

An additional 15 foot setback shall be provided to permanent structures.

Trees should be preserved in the buffer area during construction, should they exist.

Trees, shrubs and native ground covers should be planted in the buffer if they do not presently exist.

The only mowing required within the buffer is along maintenance right of ways and the embankment. The remaining buffer can be managed as a meadow (mowing twice a year) or forest.

19 Maintenance Measures.

Maintenance responsibility for the pond and the pondscape shall be vested with a responsible authority by means of legally binding and enforceable maintenance agreement.

The pond shall be inspected annually in wet-weather conditions.

Sediment removal in the forebay should occur every 5 to 7 years, or after one foot of sediment deposition has been recorded in the forebay.

Suitable on-site sediment disposal area should be reserved.

20 Maintenance Access.

A 25 foot wide maintenance right of way easement shall extend to the pond from a public or private road.

Maintenance access shall have a maximum slope of no more than 15% and shall be stabilized to withstand heavy equipment

The maintenance access shall extend to the forebay, safety bench and riser, and be designed to allow vehicles to turnaround.

Access within the riser is to be provided by lockable manhole covers, and manhole steps within easy reach of valves and other controls.

Stormwater Wetlands

W-1	Shallow Marsh
W-2	ED Shallow Wetland
W-3	Pond/Wetland System
W-4	"Pocket" Marsh
W-5	Submerged Gravel Wetland

W-1 Shallow Marsh: Design Notes

- Deeper forebay and micropool are essential
- Shallow depths over remaining surface area
- High Surface Area to Volume Ration
- Complex internal microtopography
- Potential Wildlife Habitat Creation
- Consumes most land of any pond/wetland option

W-1 Shallow Marsh

DA = > 25 acres

Comm. Accept.= 2.0

Maintenance = 3.5

Cost = 3.5

Treatment

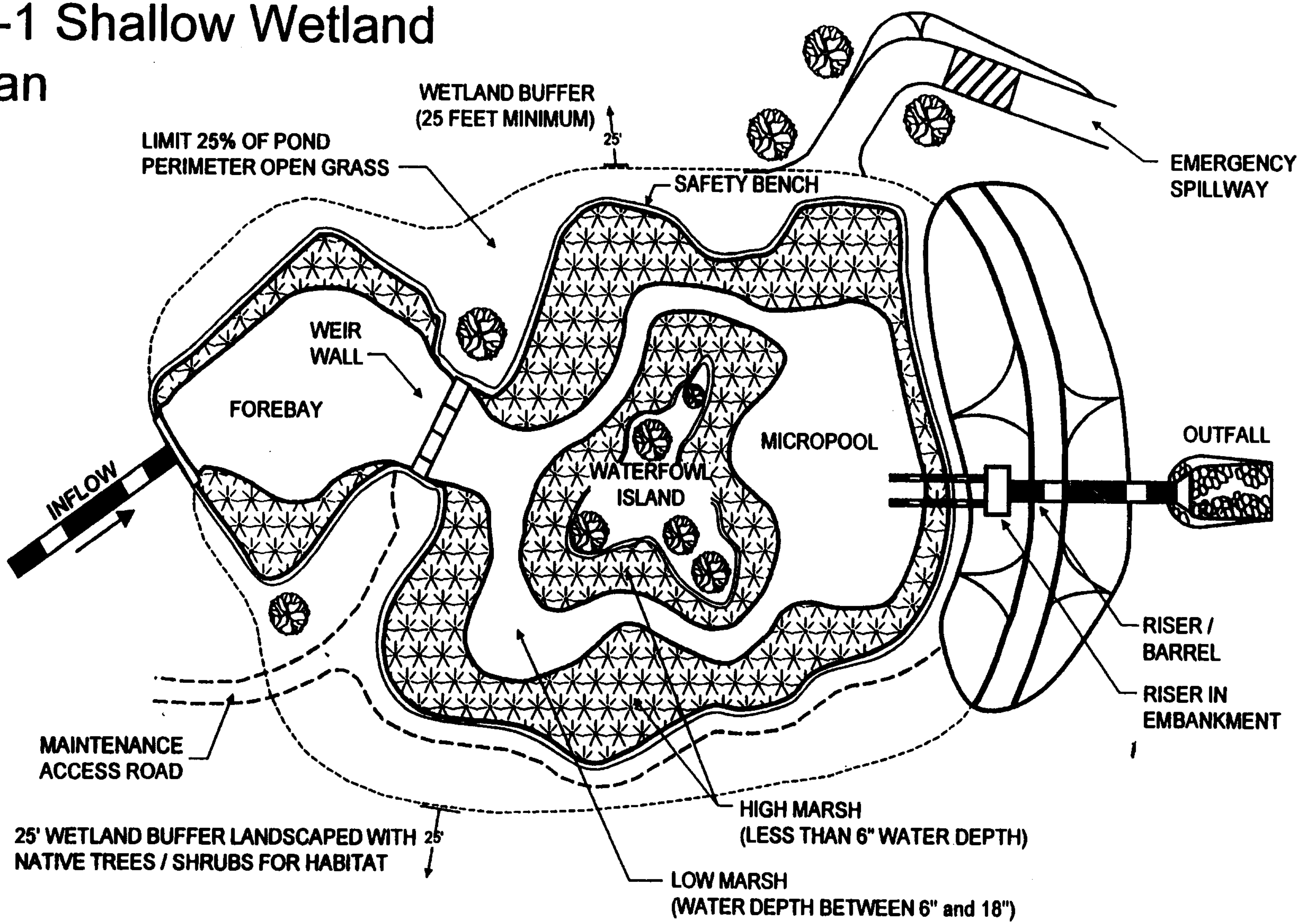
Re_v	
Cp_v	x
WQ_v	x
Q_{p2}	x

Pollutant Removal

- TSS = 80%
- TP = 45%
- TN = 30%

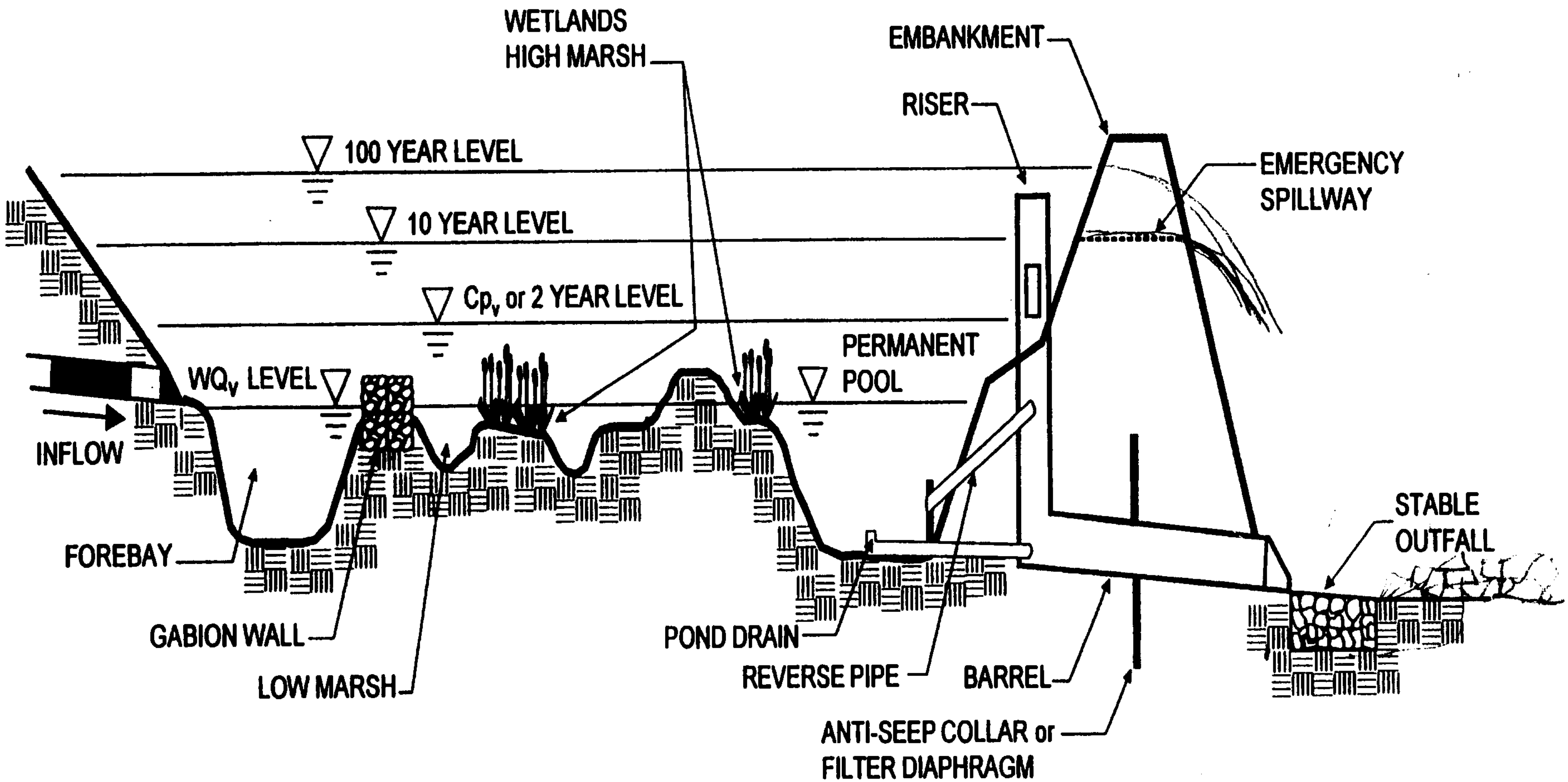
Center for Watershed Protectio

W-1 Shallow Wetland Plan



R0020232

W-1 Shallow Wetland Profile



R0020233

W-2 ED Shallow Wetland: Design Notes

- Early monitoring efforts had design flaws
- Range of Depth Zones essential
- 2-3 Foot Maximum Vertical ED Limit depends on the slopes
- Sharply reduces land consumption for wetlands

R0020234

W-2 ED Shallow Wetland

DA = > 25 acres

Comm. Accept.= 2.5

Maintenance = 3.0

Cost = 2.5

Treatment

Re_v	
Cp_v	X
WQ_v	X
Q_{p2}	X

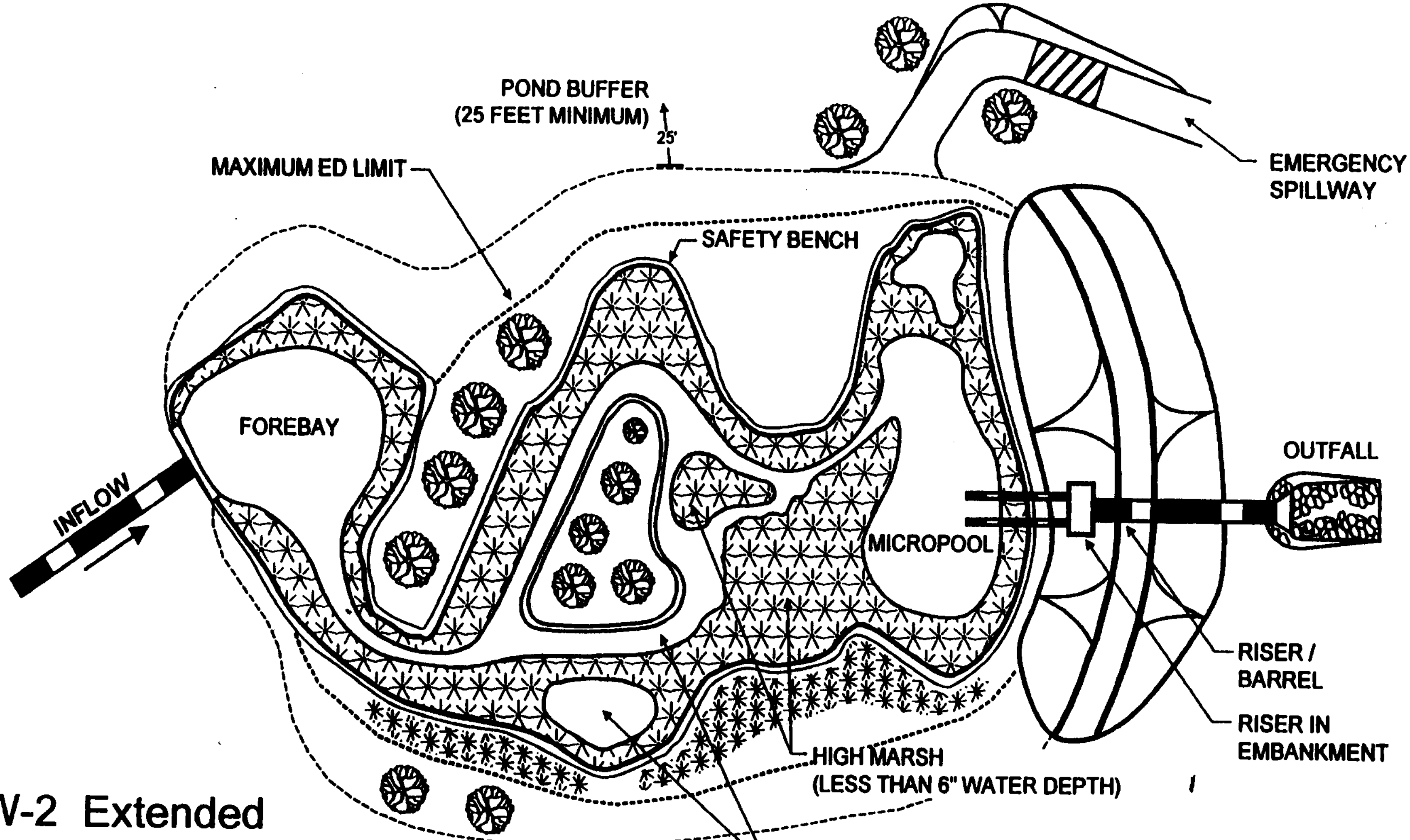
Pollutant Removal

TSS =60 *

TP =40 *

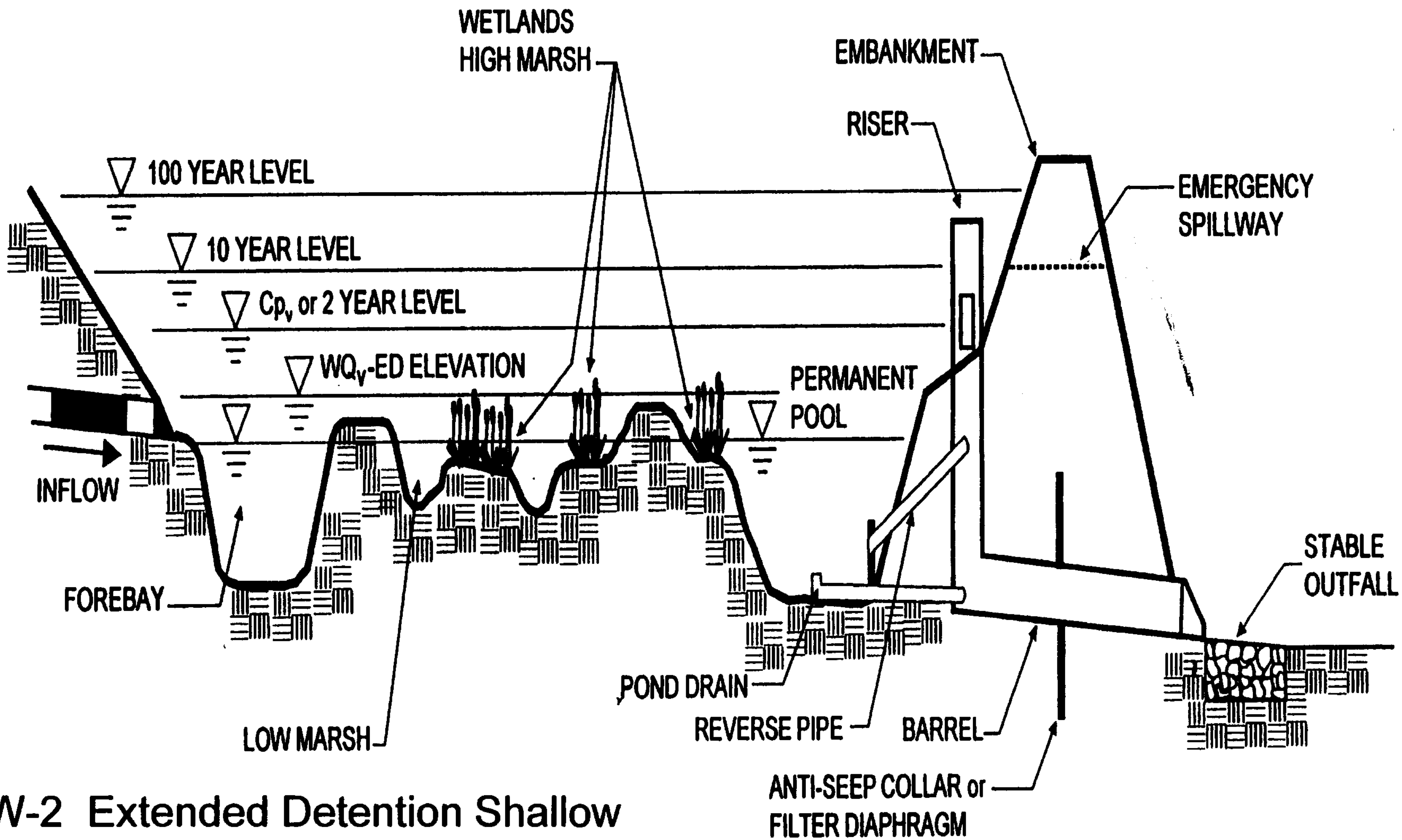
TN =20 *

* limited pollutant removal data



W-2 Extended
Detention Shallow Wetland
Plan

R0020236



W-2 Extended Detention Shallow Wetland Profile

R0020237

W-3 Pond/Wetland System: Design Notes

- Redundant pollutant removal pathways
- First cell is a deeper pool
- Highest removal recorded for pond/wetland options
- Saves space

W-3 Pond/Wetland System

DA = > 25 acres

Maintenance = 2.0

Comm. Accept.= 1.5

Cost = 3.0

Treatment

Re_v	
Cp_v	x
WQ_v	x
Q_{p2}	x

Pollutant Removal

TSS = 85%

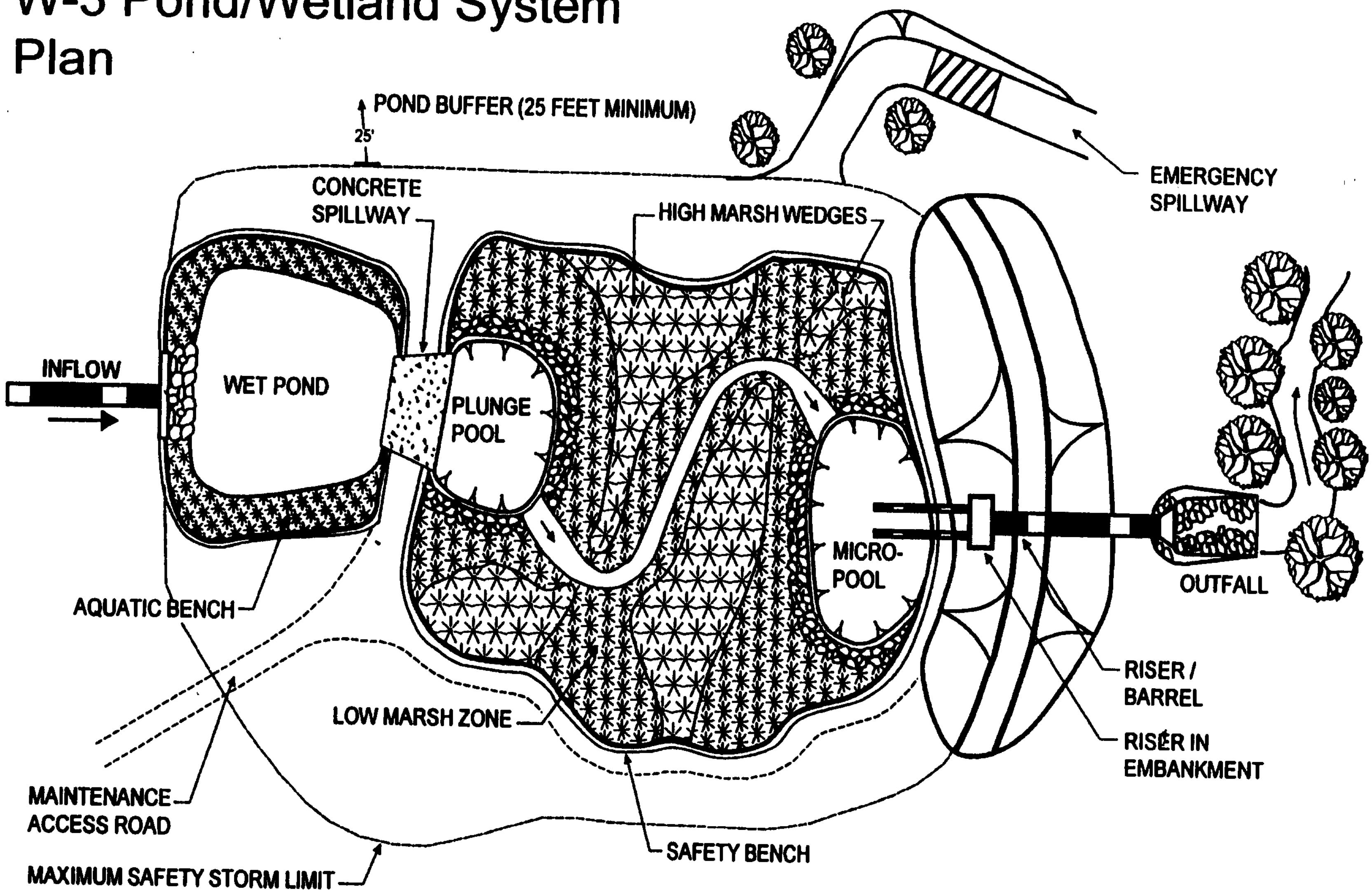
TP = 60%

TN = 35%

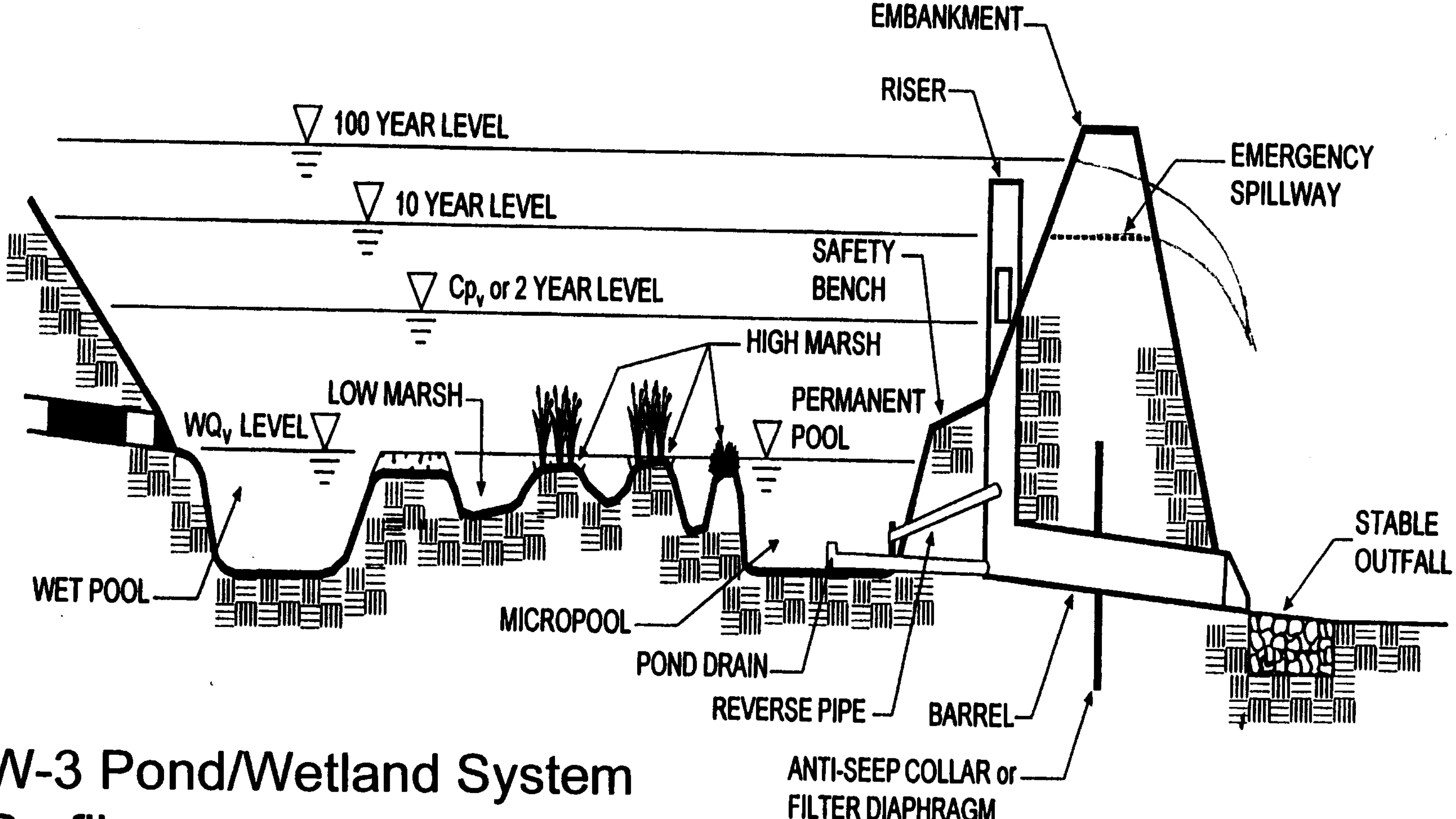
R0020239

Center for Watershed Protectio

W-3 Pond/Wetland System Plan



R0020240



W-3 Pond/Wetland System Profile

W-4 “Pocket” Marsh: Design Notes

- Excavate to Groundwater
- Water Elevations Tend to Fluctuate
- On-site Sediment Stockpiling/Disposal Needed
- More difficult to maintain
- Risk of stagnation, odor, mosquitos
- Not a high visibility practice

R0020242

W-4 "Pocket" Marsh

DA = < 5 acres

Comm. Accept.= 3.0

Maintenance = 4.0

Cost = 2.0

Treatment

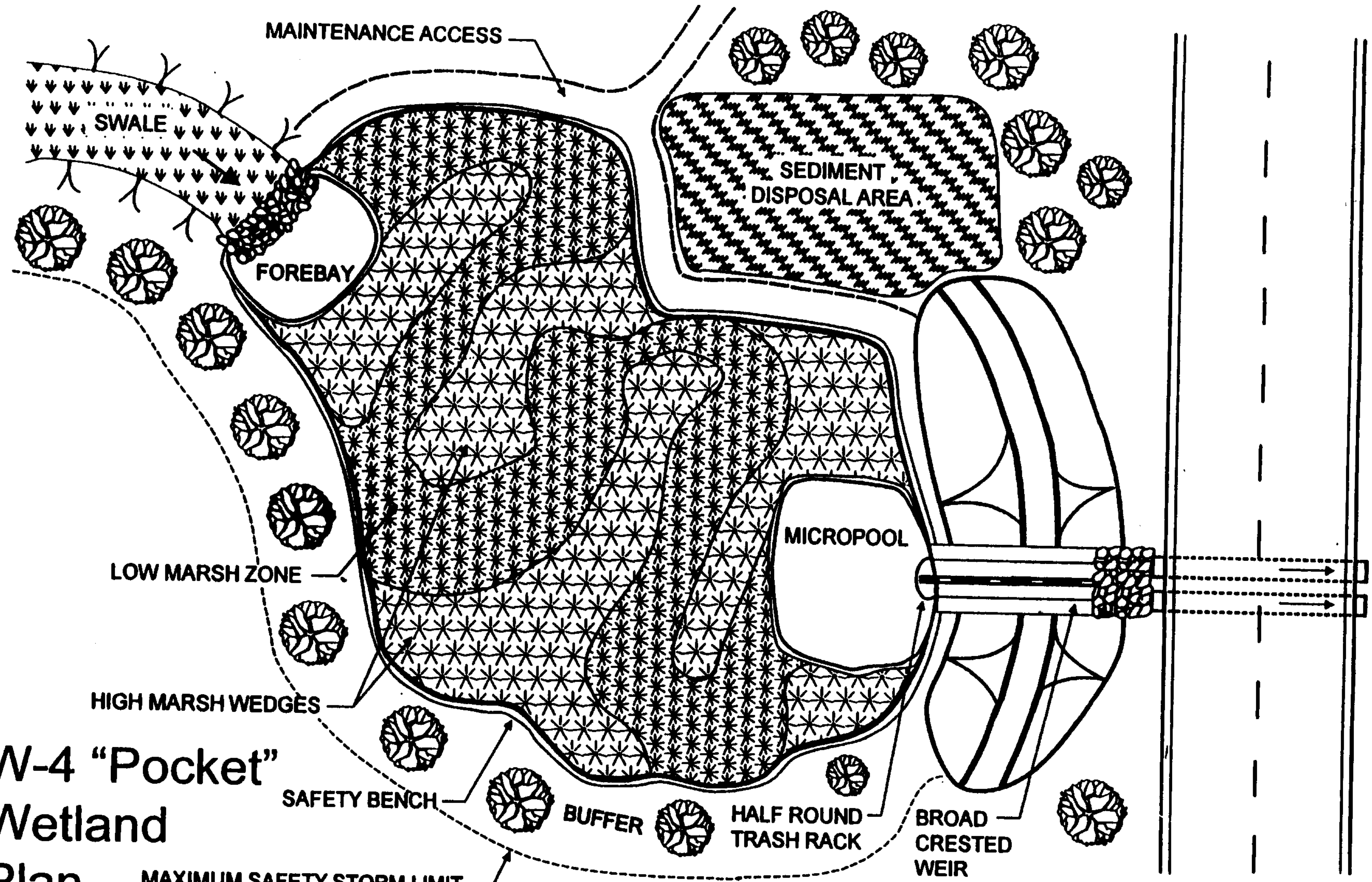
Re_v	
Cp_v	
WQ_v	x
Q_{p2}	?

Pollutant Removal

- TSS = 55 *
- TP = 35 *
- TN = 60 *

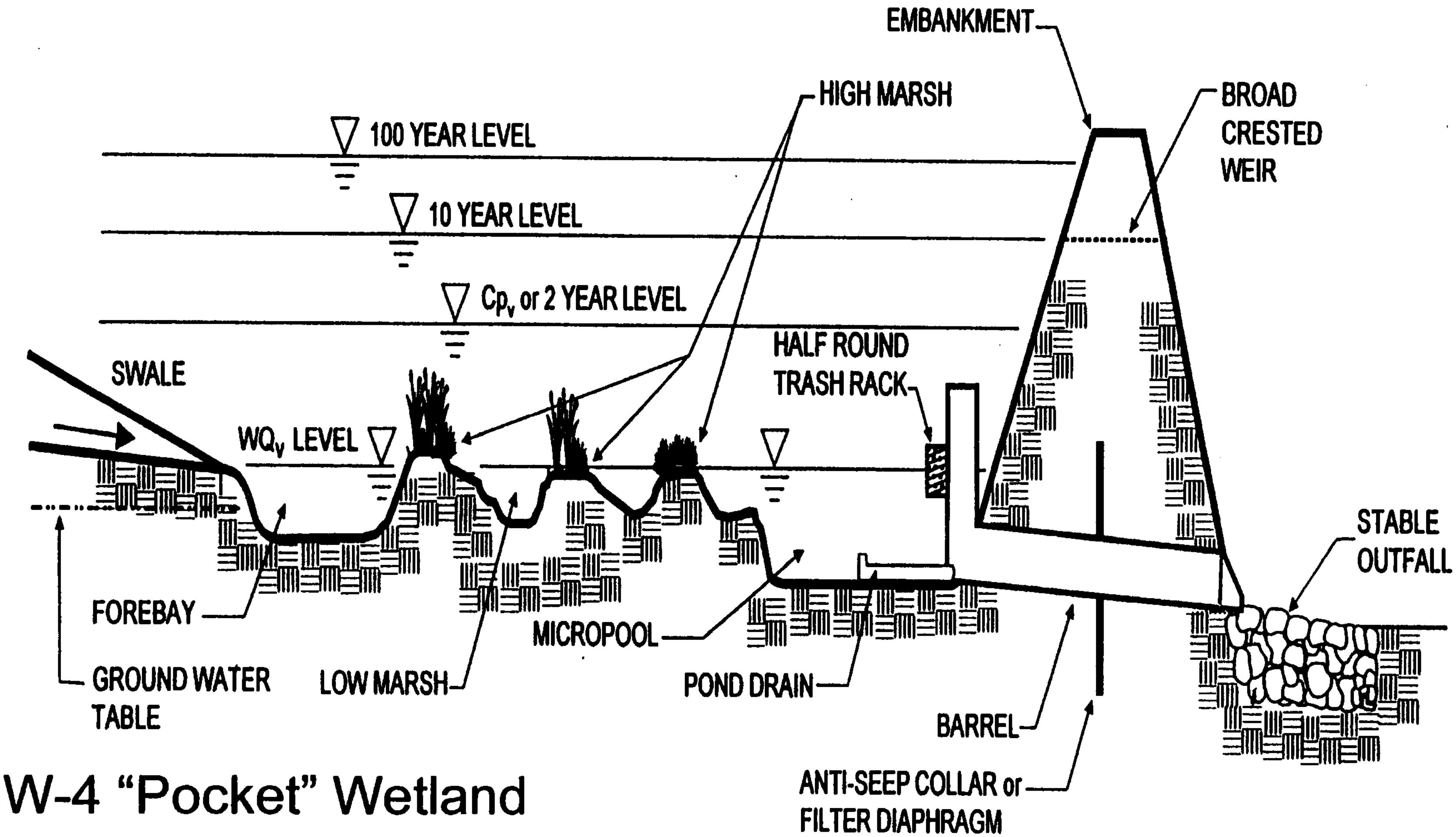
* limited pollutant removal data

R0020243



W-4 "Pocket" Wetland Plan

R0020244



W-4 "Pocket" Wetland
Profile

R0020245

W-5 Submerged Gravel Wetland: Design Notes

- Adapted from wastewater treatment
- Algal growth on rock surfaces promotes greater uptake
- Maintenance needs uncertain
- Odor, clogging problems not well understood

R0020246

W-5 Submerged Gravel Wetland

DA = < 5 acres

Maintenance = 4.0

Comm. Accept. = 4.0

Cost = 3.0

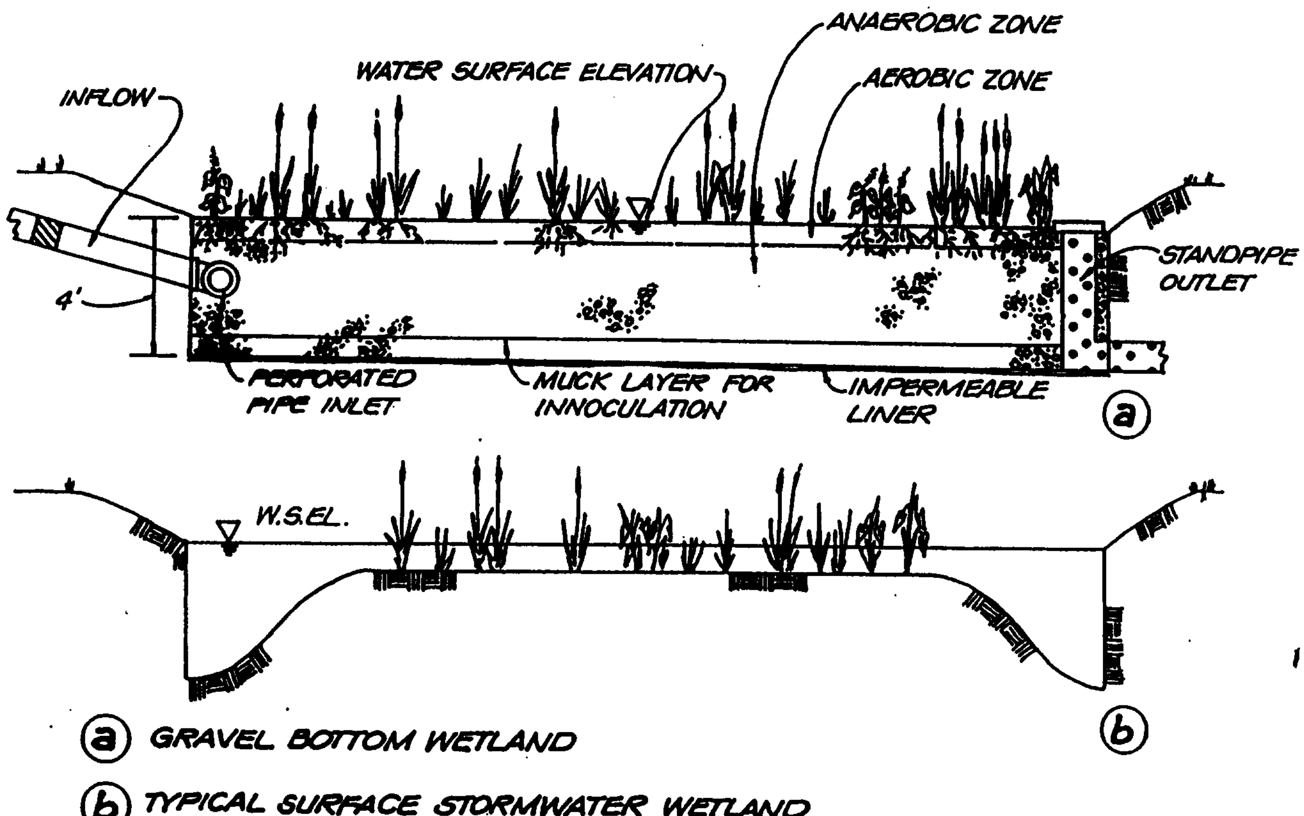
Treatment

Re_v	
Cp_v	
WQ_v	x
Q_{p2}	?

Pollutant Removal

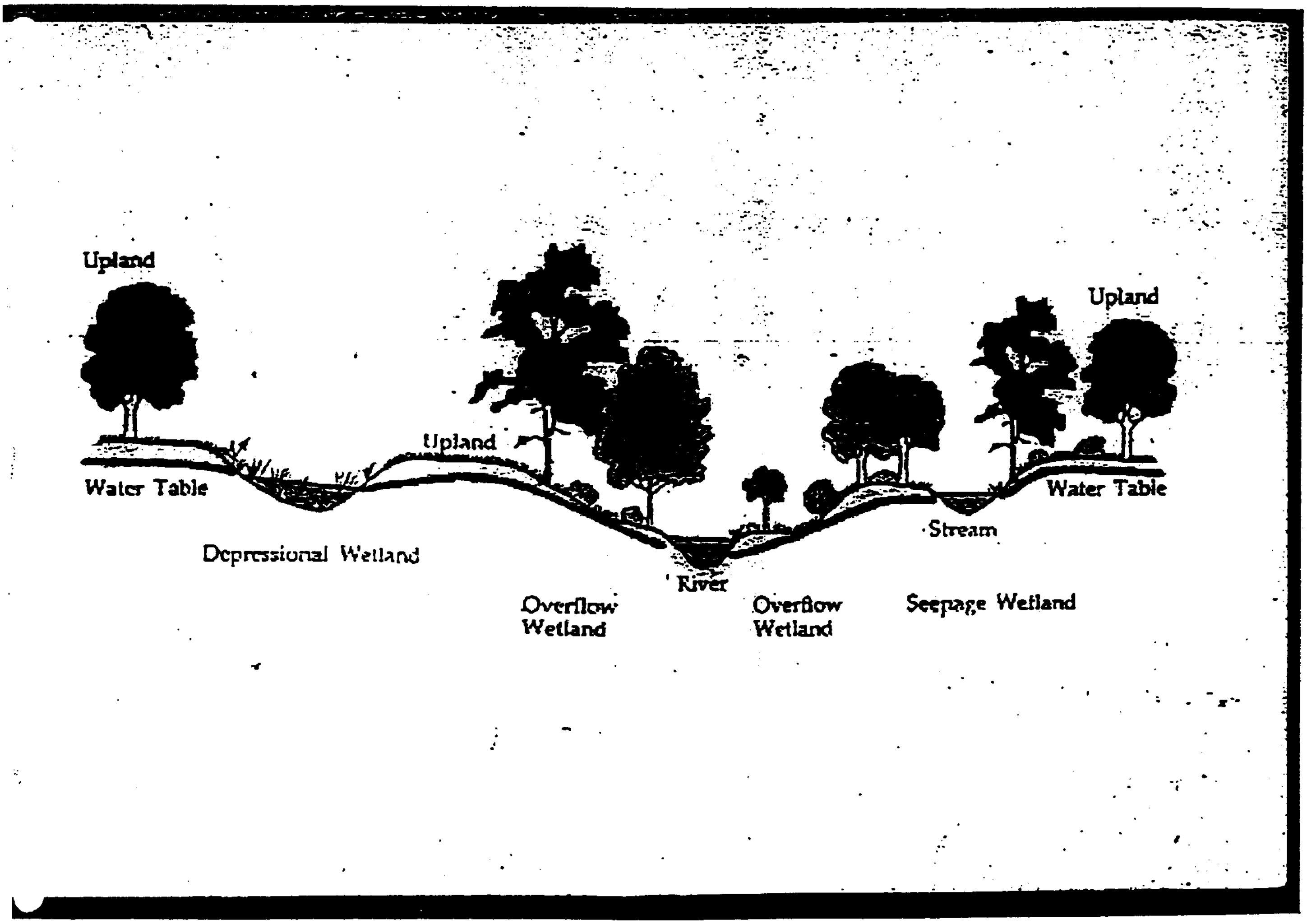
TSS = 90	TP = 70	TN = 60

W-5: Submerged Gravel Wetland



STORMWATER WETLANDS DESIGN PRINCIPLES

ELEMENTS OF EFFECTIVE DESIGNS
LANDSCAPE DESIGN GUIDANCE
WETLANDS PLANTING GUIDE


Upland
Upland
Upland
Water Table
Water Table
Depressional Wetland
Stream
River
Overflow Wetland
Overflow Wetland
Seepage Wetland

R0020250

Stormwater vs. Natural Wetlands

Factor	Stormwater wetlands	Natural wetlands
diversity	low,most emergent	high,many forms
dominants	exotic/invasive	few dominants
maintenance	active management	self-maintaining
sediments	enriched	not enriched
habitat quality	low	high

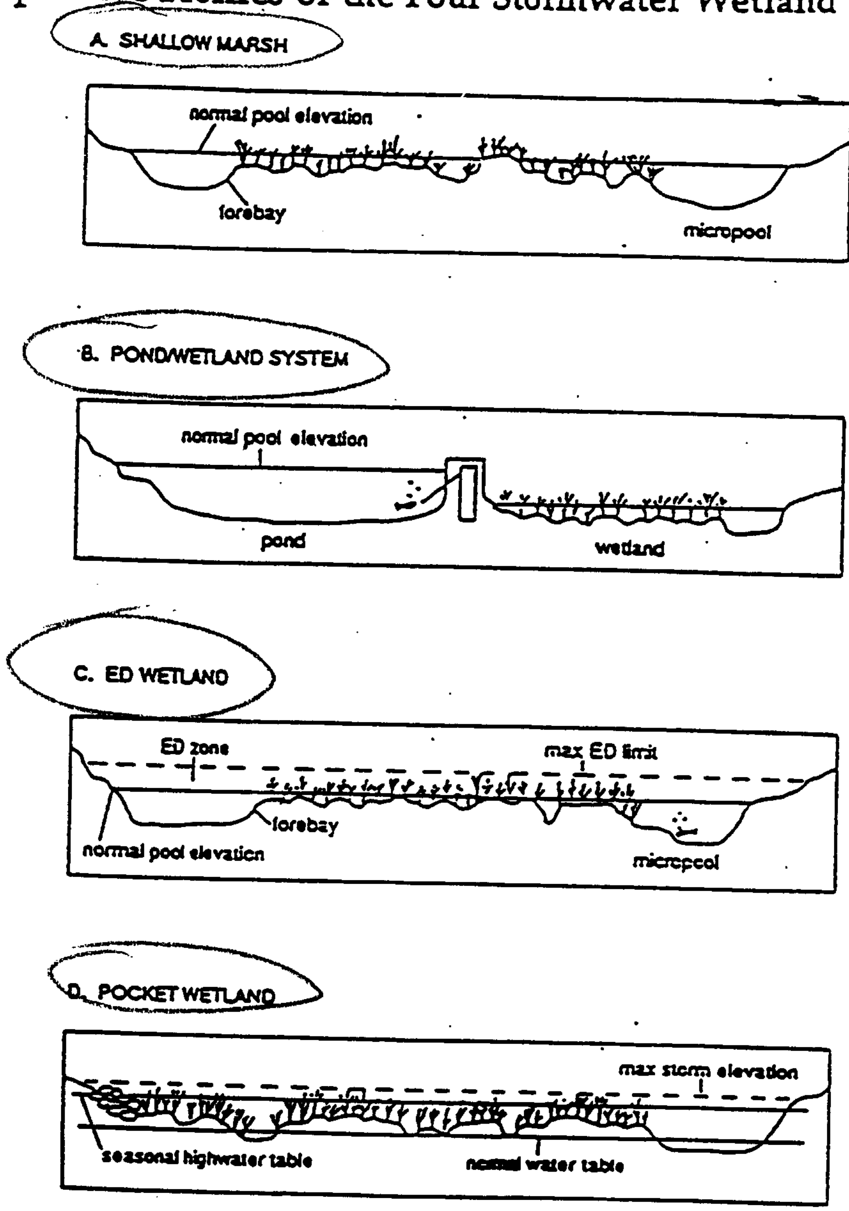
Center for Watershed Protection

Stormwater vs. Natural Wetlands

Factor	Stormwater wetlands	Natural wetlands
water balance	surface Runoff	groundwater
hydroperiod	"semi-tidal"	gradual/seasonal
standing water	year round	seasonal
establishment	by planting	by seedbank
structure	simple	complex

Center for Watershed Protection

Comparative Profiles of the Four Stormwater Wetland Designs



Not to scale

Cross-sectional profiles of the four stormwater wetlands are not drawn to scale. In Panel A, the majority of the shallow marsh is devoted to shallow depths that support emergent wetland plants. The pond/wetland system (Panel B) is composed of deep and a shallow pool. In ED wetlands (Panel C), the runoff storage of the wetland is augmented by temporary, vertical ED storage. Pocket wetlands (Panel D) are excavated to the groundwater table to provide a more or less constant water elevation.

R0020252

Pollutant Removal Pathways within Stormwater Wetlands

Sedimentation

Adsorption to Sediments/Vegetation/Detritus

Physical Filtration of Runoff

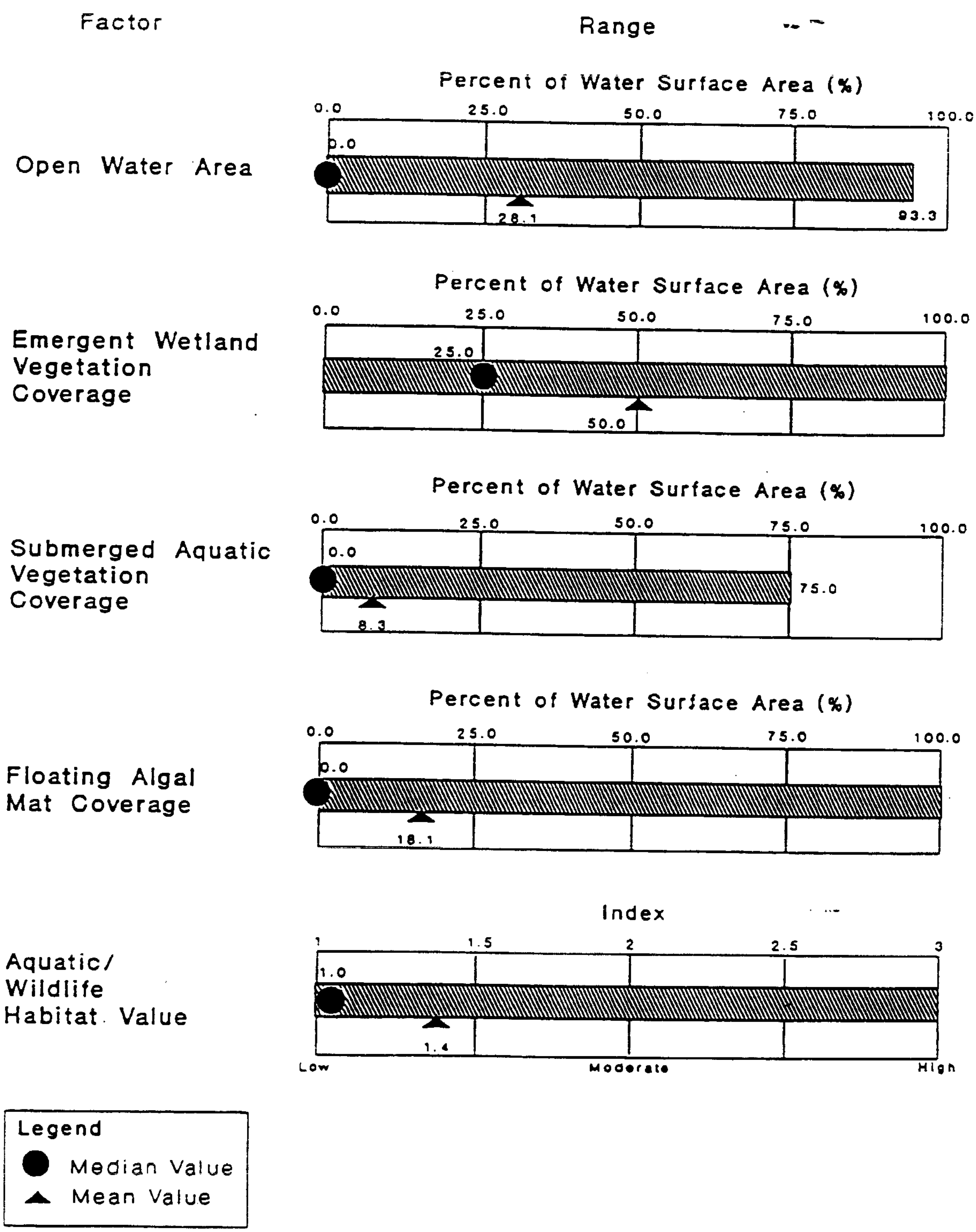
Microbial Uptake/Transformation

Uptake by Wetland Plants

Uptake by Algae

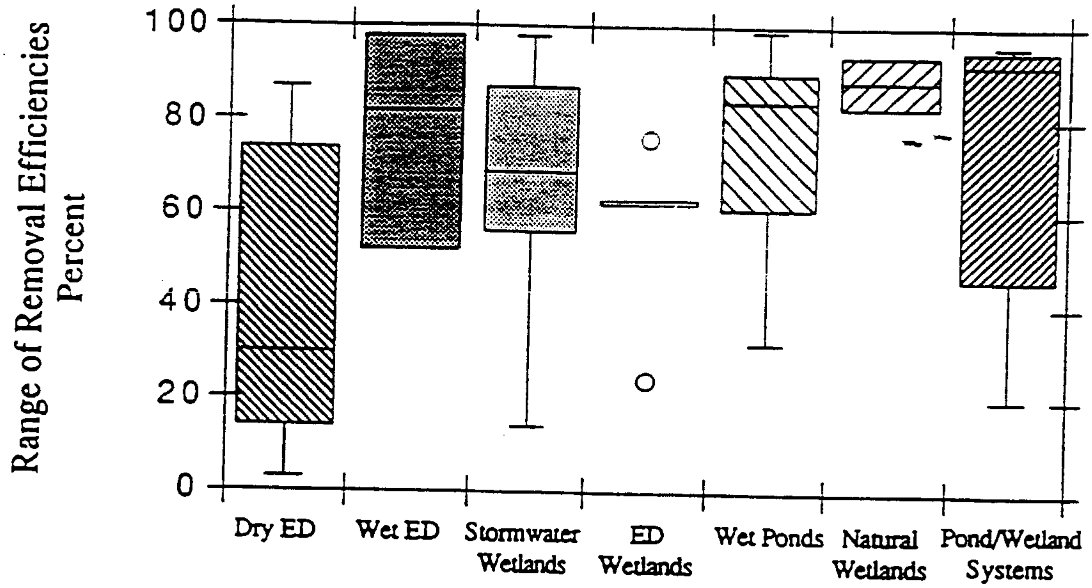
Extra Detention and/or Retention

Figure X. Artificial Marshes: Environmental Attributes (N=9)



R0020254

Total Suspended Solids



Total Phosphorous

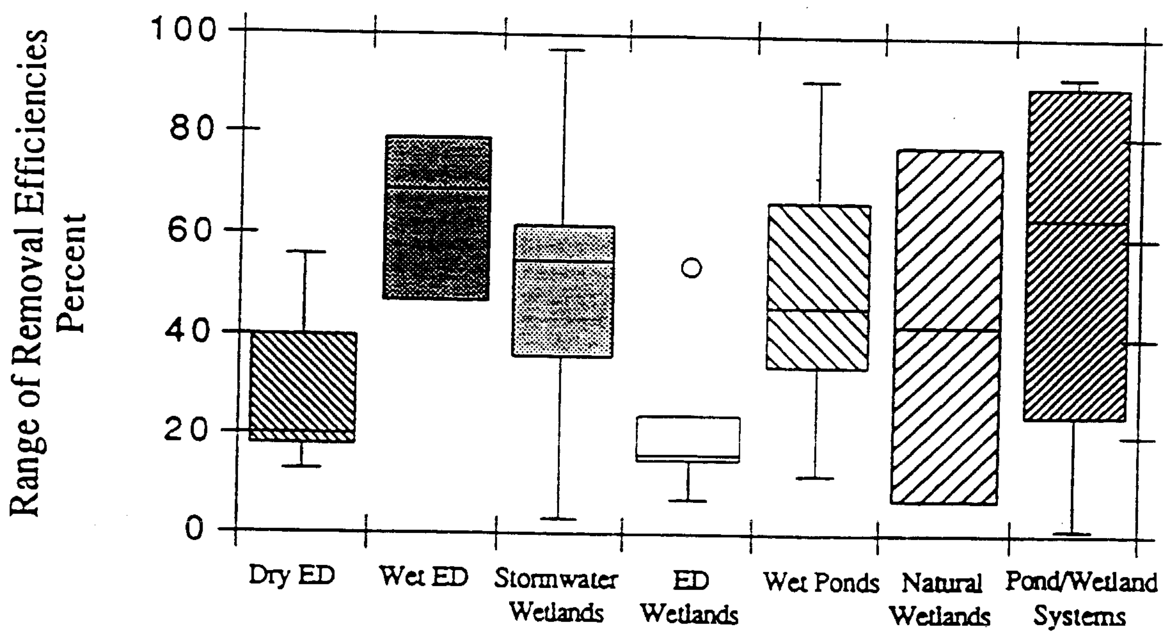


Table 7

Design Techniques to Enhance Pollutant Removal Performance of Stormwater Wetland Systems

1. **Increase the Volume of Runoff Treatment**
   - Capture greater percentage of annual runoff volume
   - provide for longer residence time in wetland for most storm events

2. **Increase the Surface Area to Volume Ratio**
   - increase the total area of the wetland, or
   - increase the internal structural complexity of the wetland, by adding complex microtopography, establishing extensive and dense wetland plant cover

3. **Increase the Effective Flow Path Through the Wetland**
   - extend distance between the inlet and outlet (berms)
   - maximize sinousity of dry weather flow path with hi marsh wedges
   - create some areas with extremely shallow flow path (i.e., hi marsh)
   - use multiple cells within the wetland system

4. **Provide Runoff Pre-Treatment and Energy Dissipation**
   - use forebay or pond cell near inlet, with broad crested weirs to spread flow between cells

5. **Utilize Redundant Pollutant Removal Pathways**
   - provide extended detention to keep removal rates reliable during non-growing season, or
   - utilize permanent pool to increase algal uptake and sedimentation

R0020256

Suggested Sizing Criteria for Stormwater Wetlands

1. Treat 90% of Annual Runoff Volume (V_T)
2. Minimum Wetland/Watershed Area Ratio
3. Allocate Depth Zones, by Surface Area
4. Allocate Depth Zones, by Treatment Volumes
5. Minimum Effective Flow Path
6. Adequate Water Balance to Sustain Pool
7. Small Storm ED, If Needed

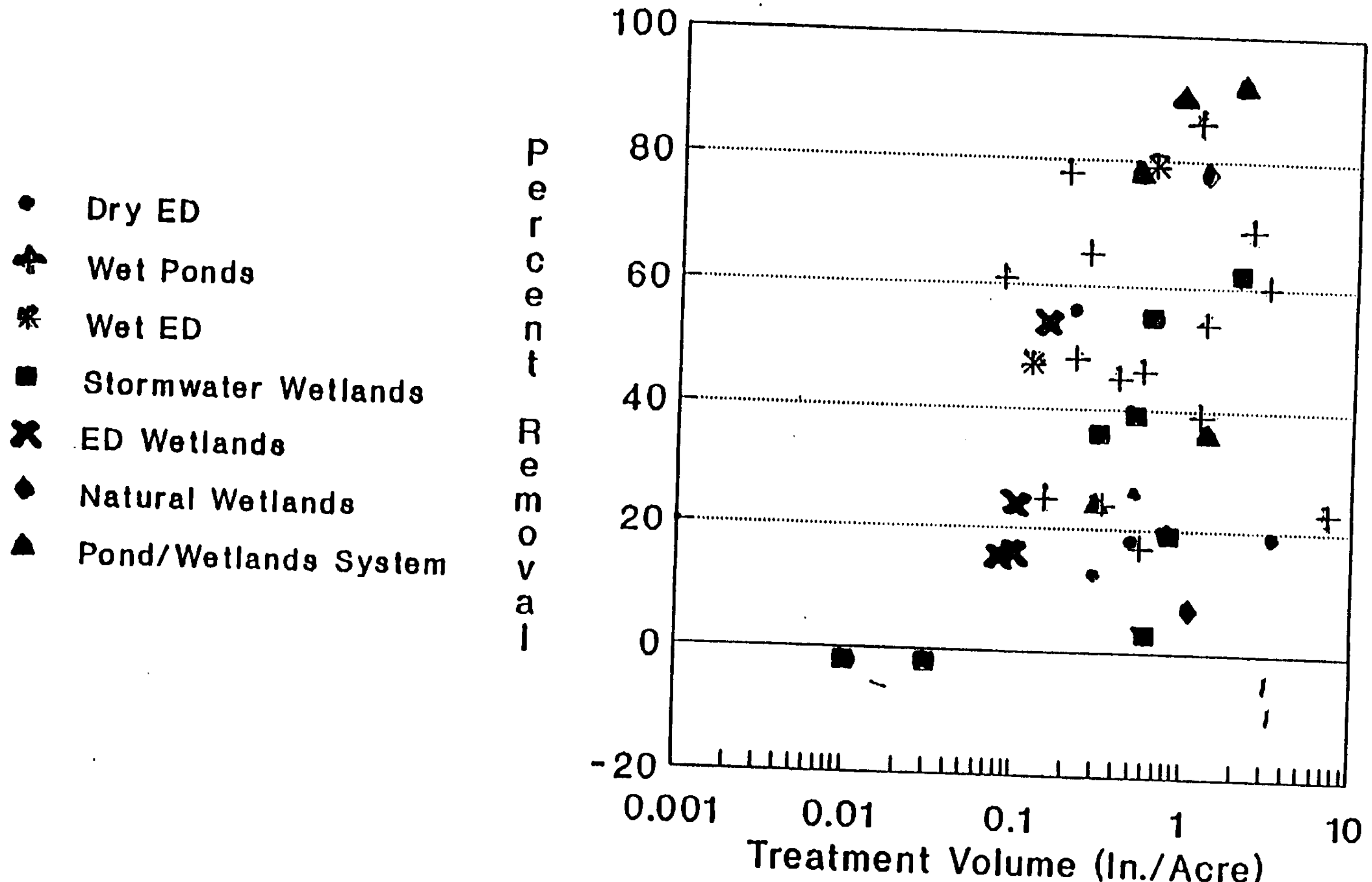
Criteria No. 1: 90% V_T

- Derived from Regional RFS Analysis
- 90% Runoff Producing Event = 1.25 Inches
- $V_T = (1.25)(Rv)(A)$
- V_T Increases with I
- Minimum V_T of 0.25 Inches/Acre
- 50% Storms Are 1/3 of V_T
- RFS Criteria Generally Comparable to Other Criteria

R0020258

Pollutant Removal Efficiency

Total Phosphorus, Rain



11/15/91--Revision

R0020259

Criteria No. 2: Surface Area Requirements

- o Wetland to Watershed Area Ratio (WWAR)
- o Gross Measure of SA/V Ratio
- o Removal Rates Increases If Ratio Exceeds 2%
- o Minimum WWAR's (general target)
  - Shallow Marsh = 2.0
  - ED and Pond/Wetlands = 1.0
  - Pocket Wetlands = 1.0

R0020260

Criteria No. 3: Area Allocations for Depth Zones

Percentage of Total Surface Area

	Deepwater	Low Marsh	High Marsh
Design 1	20	40	40
Design 2	45	25	30
Design 3	20	35	45
Design 4	10	40	50

R0020261

Maximum Water Depths For Emergent Wetland Plant Species

Emergent Wetland Species	Maximum Depth
A. Primary Species	
Sagittaria latifolia (duck potato)	12 inches
Scirpus pungens (common three square)	6 inches
Scirpus validus (softstem bulbrush)	12 inches
B. Secondary Species	
(Acorus Calamus (sweet flag)	3 inches
Cephalanthus occidentalis (button bush)	2 feet
Hisbiscus Moscheutos (rose mallow)	3 inches
Hibiscus Laevis (Halbered-leaved r. mallow)	3 inches
Leersia oryzoides (rice cutgrass)	3 inches
Nuphar luteum (spatterdock)	5 feet (2ft. min.)
Peltandra virginica (arrow-arum)	12 inches
Pondederia cordata (pickerel weed)	12 inches
Saururus Cernuus (lizards tail)	6 inches
C. Exotic or Invasive Species (not recommended)	
Phramities australus (common reed)	3 inches
Typha Latifolia (common cattail)	12 - 18 inches
Typha angustifolia (narrow-leaved cattail)	12 inches

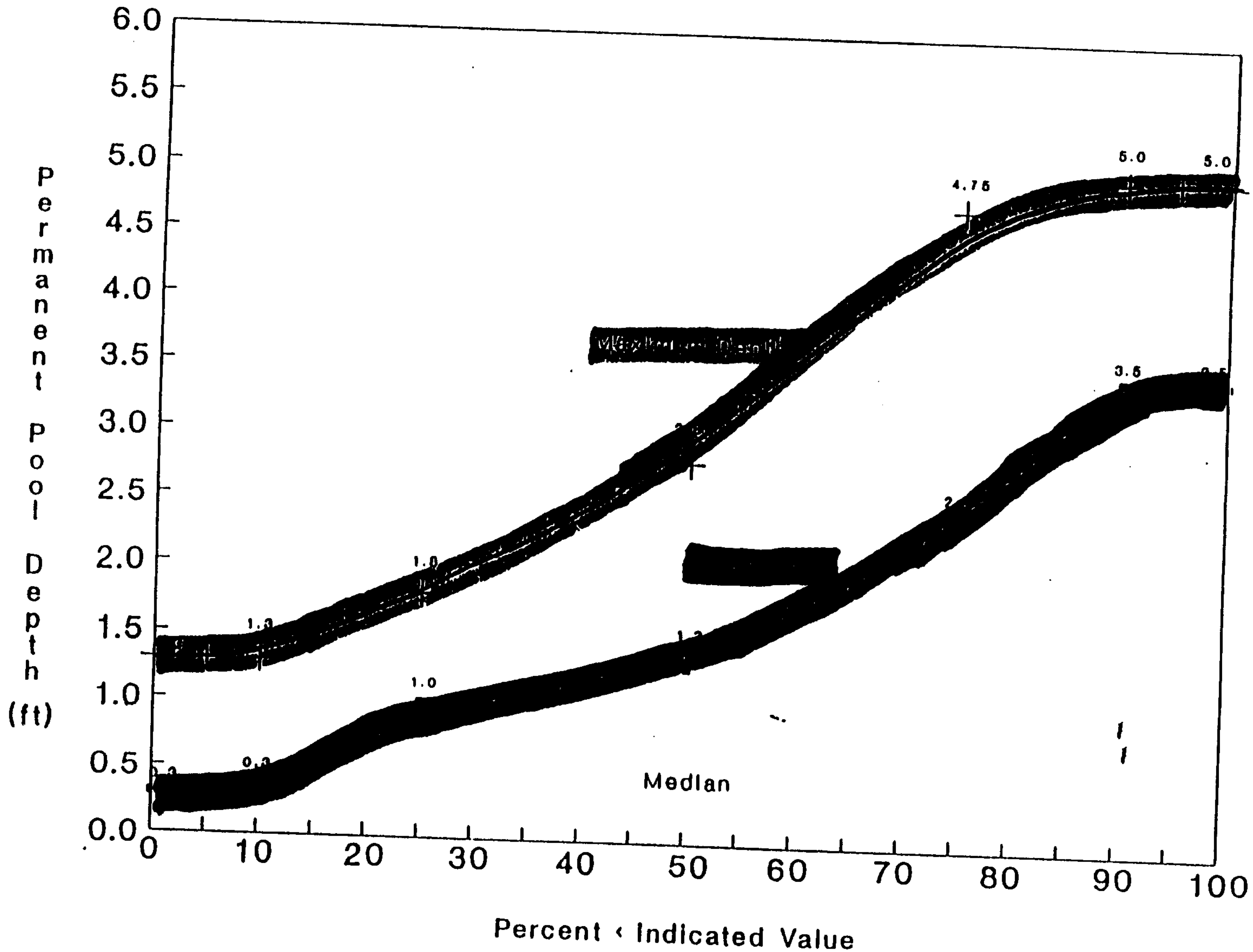
Note: These depths can be tolerated, but plant growth and survival may decline under permanent inundation at these depths.

Primary species are rapid colonizers; secondary species do not spread as rapidly.

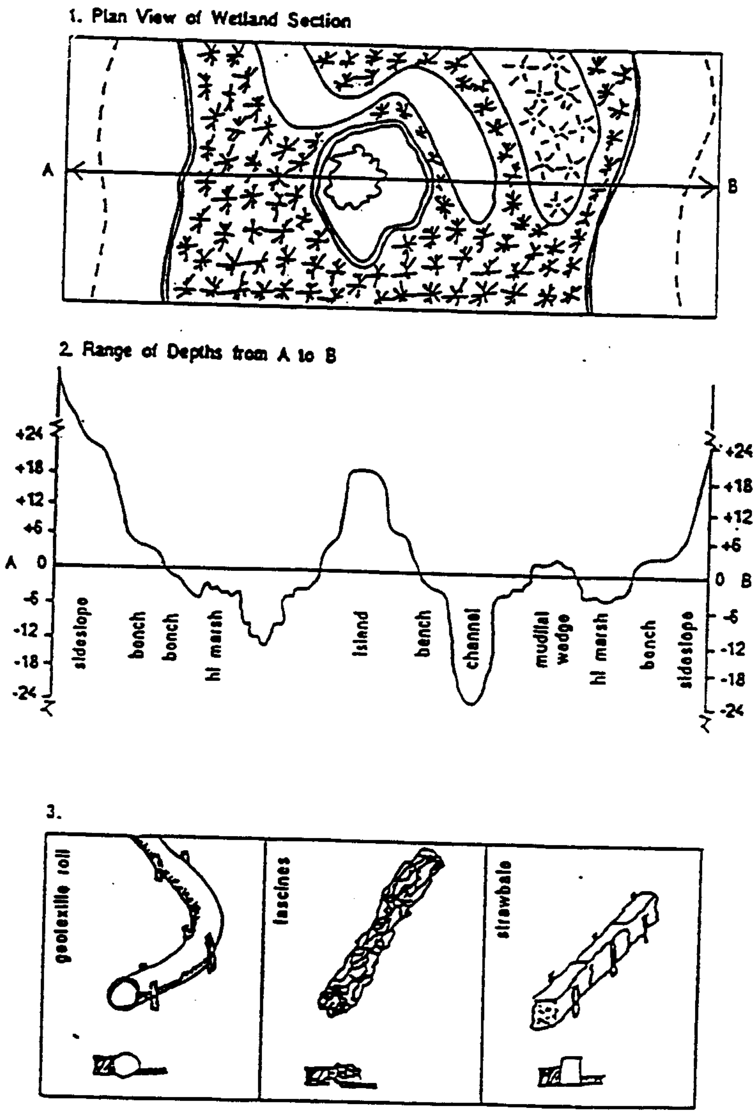
Table adapted from Athanas (1986).

R0020262

Figure X. Artificial Marshes: Maximum and Mean Permanent Pool Depths (N=9)



Complex Microtopography Across a Stormwater Wetland Enhances Removal Performance



Complex microtopography across a stormwater wetland (panel A) creates a range of depth zones (panel B) that increases total surface area available for adsorption and microbial activity, and creates better conditions for sedimentation and filtration. Panel C illustrates some techniques for maintaining microtopographic elevations in high energy or soupy substrate environments.

R0020264

Criteria No. 4: Volume Allocations for Depth Zones

Percentage of Total Treatment Volume (V_T)

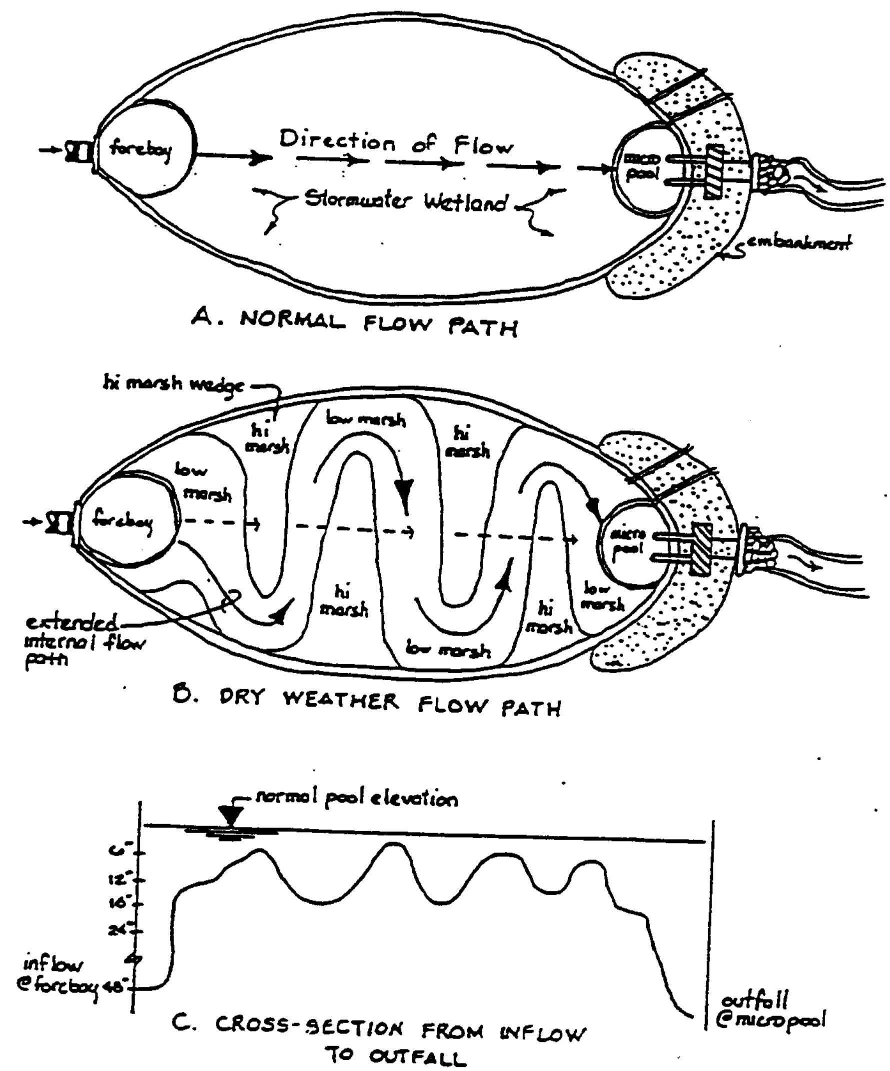
	Deepwater	Marsh	ED
Design 1	40	60	0
Design 2	70	30	0
Design 3	20	30	50 ✓
Design 4	10	100	0

R0020265

Criteria No. 5: Minimum Effective Flow Path

- Minimum Length to Width Ratio of 1 (1 + O/W)
- Preferred Ratio Is 2:1 or 3:1 (Berms)
- Minimum Dry Weather Flow Path of 2:1
- Use of Hi Marsh Wedges for Sinuosity
- No Minimum for Pocket Wetlands

Use of Hi Marsh Wedges to Extend the Internal Flow Path Through a Stormwater Wetland



Although the flow path of runoff during storms is governed by the distance between the inlet and outlet of the pond, the effective flow path during dry weather can be much greater if wedges of hi marsh (1 to 6 inches deep) are placed at right angles to the normal direction of flow.

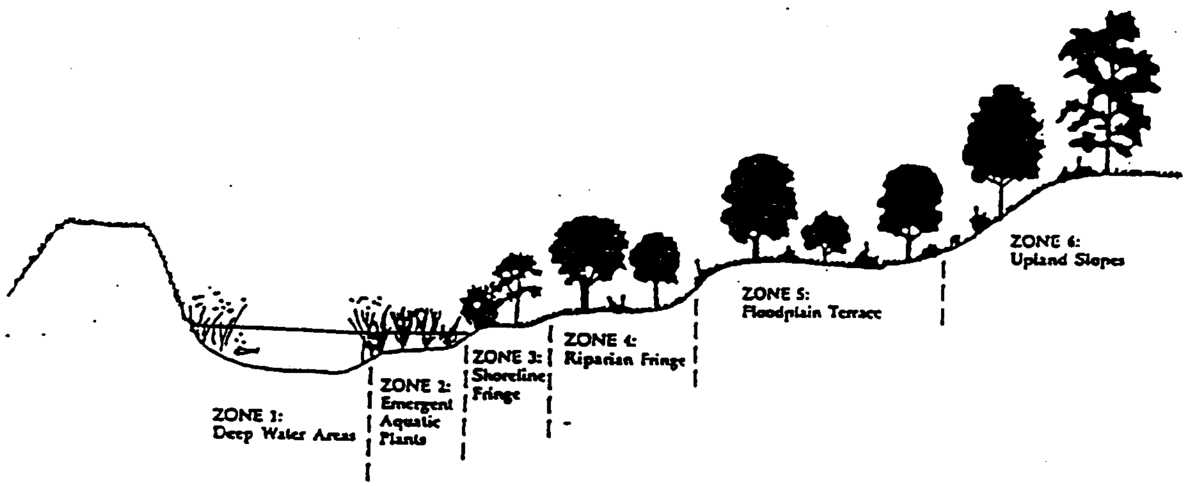
Criteria No. 6: Adequate Water Balance

- Field Confirmation of Baseflow
- 0.10 CFS / 50 Acres ROT
- Wetland Sealing Reduces Exfiltration
- Karst, Fractured Bedrock, Gravel Sands Cause Problems
- In Most Cases, Drawdown = Evaporation
- Pocket Wetlands - Excavate to Groundwater

Criteria No. 7: Extended Detention (Where Applicable)

- ED Volume No More Than 1/2 V_T
- ED Time 12 to 24 Hours
- Max Vertical ED Zone: 2 Feet
- Adjustable Gate Valve Adds Flexibility
- Protected ED: Reverse Pipe or Proportional Weir

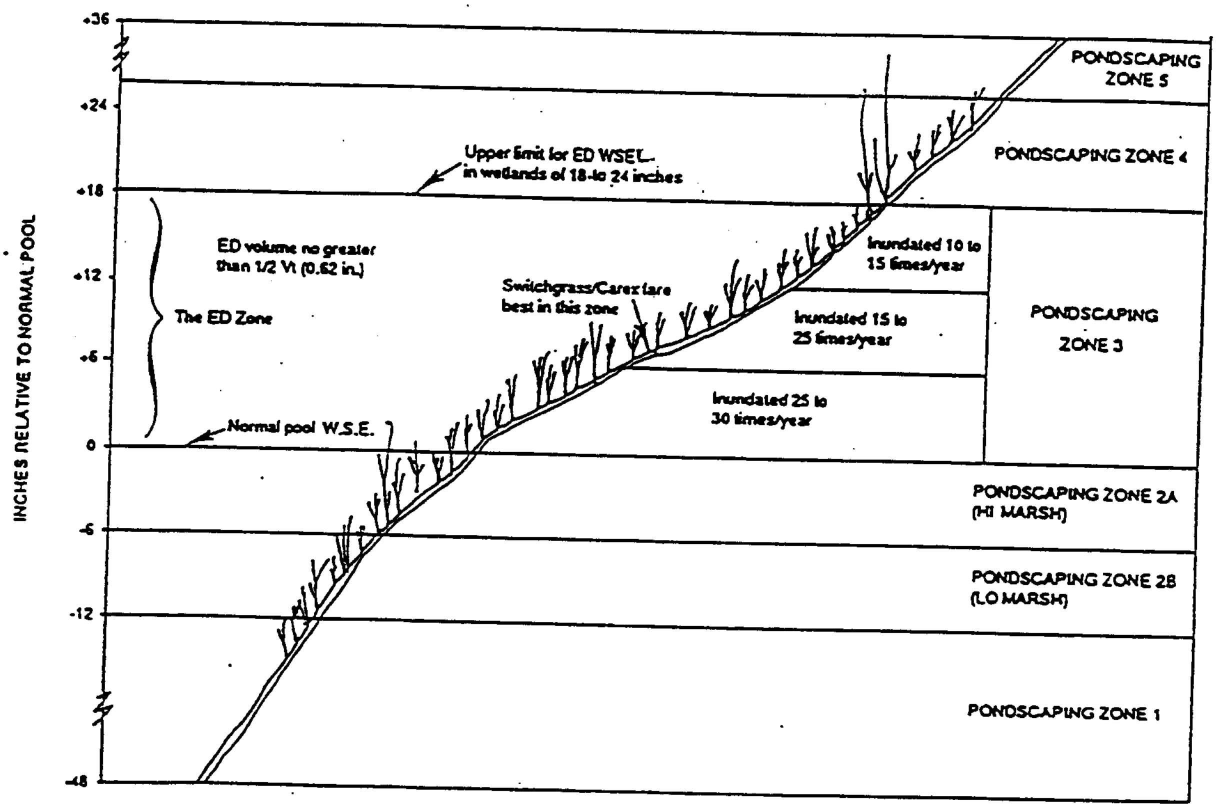
Pondscaping Zones in a Stormwater Wetland
(Cross-sectional view)



The pondscaping zones as they appear in cross-section. Note that the width of the pondscaping zones is related to the side-slope angle, i.e, the steeper the slope; the narrower the width of the pondscaping zones.

R0020270

The ED Zone in a Stormwater Wetland



The effort of extended detention (ED) in stormwater wetlands is to create a unique pondscaping zone (No.3) that is subject to frequent but brief periods of inundation. The frequent change in water levels imposes severe physiological stress on the plant community in this zone. The increased frequency of inundation can also have an impact on the lo marsh zone (2B). Therefore, a maximum upper limit of 2 to 3 feet of ED is recommended.

R0020271

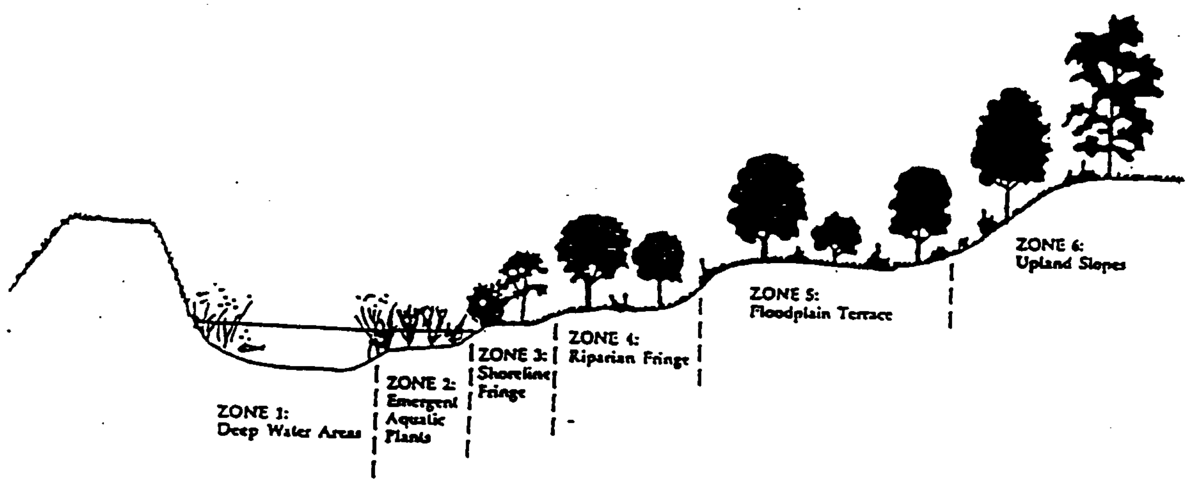
The ED Zone in Stormwater Wetlands

- Inundation Frequency: 5 to 40 Times / Yr
- Sharp Gradient in Inundation Frequency
- 2-3 Foot Vertical Limit to ED Zone
- Severe Physiological Constraints on Plants
- Difficult to Establish a Vigorous Ground Cover

Stages of Stormwater Wetland Design and Construction

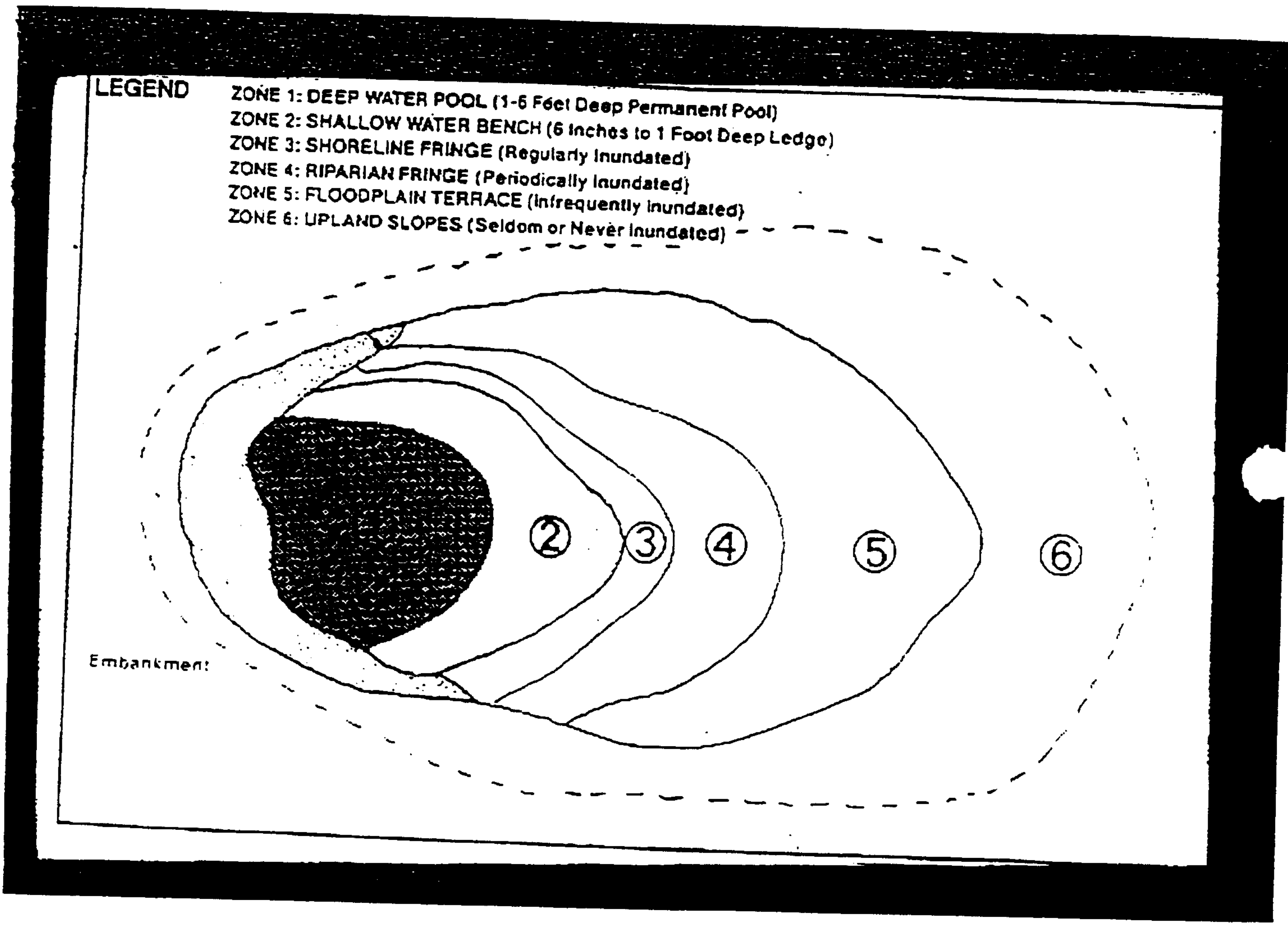
1. Evaluate the Feasibility of a Stormwater Wetland at the Site.
2. Develop the Initial Concept Design.
3. Size the Stormwater Wetland for Maximum Pollutant Removal.
4. Incorporate Standard Design Features into the Stormwater Wetland.
5. Develop a Pondscaping Plan for the Wetland and Its Buffer
6. Prepare the Wetland Bed for Planting
7. Establish and Maintain the Pondscape
8. Inspect and Manage the Wetland After Construction

Pondscaping Zones in a Stormwater Wetland
(Cross-sectional view)



The pondscaping zones as they appear in cross-section. Note that the width of the pondscaping zones is related to the side-slope angle, i.e, the steeper the slope; the narrower the width of the pondscaping zones.

R0020274


LEGEND
ZONE 1: DEEP WATER POOL (1-6 Feet Deep Permanent Pool)
ZONE 2: SHALLOW WATER BENCH (6 Inches to 1 Foot Deep Ledge)
ZONE 3: SHORELINE FRINGE (Regularly Inundated)
ZONE 4: RIPARIAN FRINGE (Periodically Inundated)
ZONE 5: FLOODPLAIN TERRACE (Infrequently Inundated)
ZONE 6: UPLAND SLOPES (Seldom or Never Inundated)
2
3
4
5
6
Embankment

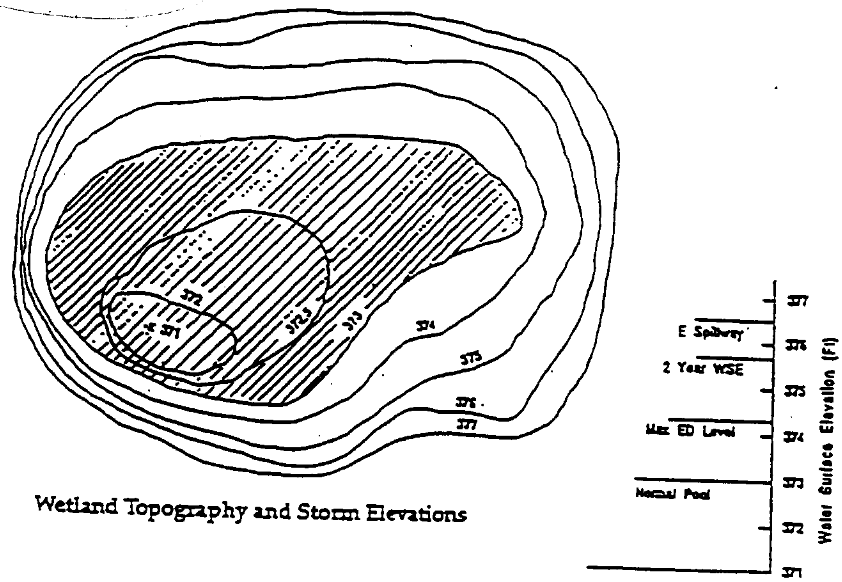
R0020275

Pondscaping Zones

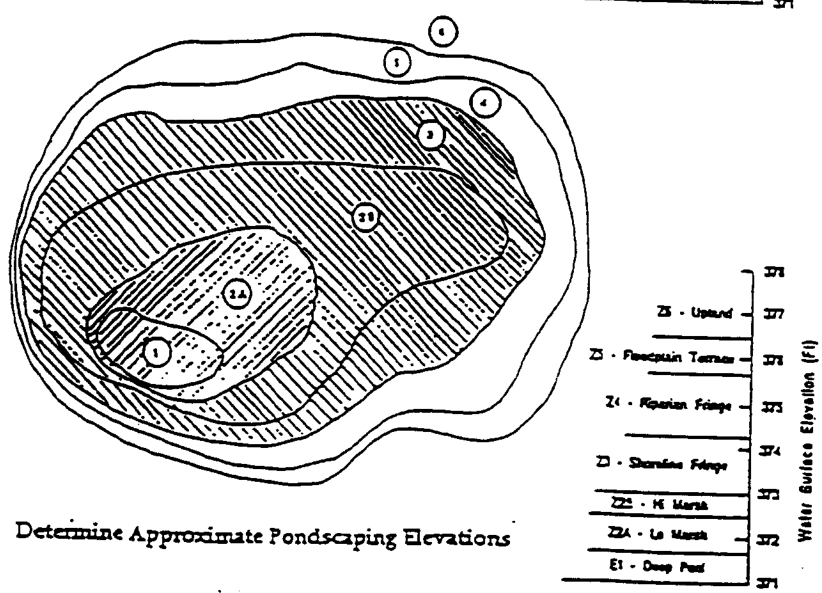
1.	Deepwater	-1.5 to -6.0
2.	Shallow Marsh	-1.5 to -0.0
3.	Shoreline Fringe	0.0 to 1.0
4.	Riparian Fringe	1.0 to 3.0
5.	Floodplain Terrace	3 to 6
6.	Upland Areas	6 Feet +

Width of Zones Related to Sideslope

Pondscaping Zones in a Stormwater Wetland (Plan view)



Wetland Topography and Storm Elevations



Determine Approximate Pondscaping Elevations

The pondscaping zones of a stormwater wetland can be estimated by examining the water surface elevations for the various design storms that the wetland has been engineered to control. The next step is to define the inundation frequencies that correspond to the storm elevations, and thereby set the appropriate pondscaping zones.

R0020277

Creating Effective and Diverse Stormwater Wetlands

- If possible, let basin sit for a few months to establish actual planting depths
- Select 2-3 dense growing, aggressive species
- Bulrush, Dickerweed, Arrow Arum, Three-Square or Rice Cutgrass
- Plant in clumps, 18" OC, over 50% SA of wetland
- Add 5 other wetland species to promote diversity
- Avoid Cattails, Phragmites and Loose Strite
- Measure depths, stake and flag
- Followup after first growing season with reinforcement planting
- Transplanting window and post-nursery care is very important

Center for Watershed Protection

PLANT MATERIALS By Pondscaping Zone

KEY	SPECIES	QTY	SIZE
▶ **Zone 1: Deep Pool**			
1	Wild Celery	25	Tubers, chooseclolh sinkers.
▶ **Zone 2A: Low Marsh**			
2	Duck Potato	375	Containers or peat pot 18" o.c.
3	Pickerelweed	300	
4	Arrow Arum	275	
5	Wild Rice	150	
▶ **Zone 2B: High Marsh**			
6	Common 3-Square	500	Container or peat pot 18" o.c.
7	Softstem Bulrush	500	
8	Lizards Tail	150	
9	Sweet Flag	150	
10	Rice Cutgrass	150	
11	Sedge spp.	150	
▶ **Zone 3: Shoreline**			
12	Switchgrass over Red Fescue		
13	Button Bush	8	Container
14	River Birch	6	Container
21	Black Willow	12	1" caliper container.
▶ **Zone 4: Riparian**			
15	Tall Fescue, wildlife mix	100 lbs/ac	Hydroseed
13	Button Bush	4	Container
16	Green Ash	4	2" B & B
17	Arrowood Viburnum	24	Container on embankments.
18	Silky Dogwood	4	2" B & B
19	Sycamore	4	2" B & B

KEY	SPECIES	QTY	SIZE
▶ **Zone 5: Floodplain**			
15	Tall Fescue	100 lbs/ac	Hydroseed
18	Silky Dogwood	4	2" B & B
26	Tulip Poplar	4	2" B & B
20	Elder Berry	9	Container
21	Black Willow	12	1" B & B
22	Shad Bush	4	1" B & B
▶ **Zone 6: Upland**			
23	Willow Oak	6	2" B & B
24	Spice Bush	3	Container
19	Tulip Poplar	4	2" B & B
18	Silky Dogwood	2	2" B & B
▶ **Embankment**			
23	Periwinkle	48	Container

PONDSCAPING SEQUENCE

1. Temporary stabilization of all disturbed areas within 72 hours of final grade.
2. Aquatic planting window 4/1 - 6/15.
3. Reconfirm planting elevations one week prior to planting.
4. Revise plan, stake and flag.
5. De-water wetland 24 hrs before planting.
6. Plant wetland, remaining trees/shrubs.
7. Mulch, water stock, as needed.
8. Inspect pondscape twice/yr.
9. Reinforce planting at end of 1st and 2nd growing season.
10. Restrict mowing to designated areas.
11. Suppress weeds/vines on trees/shrubs during years 2 and 3.

PONDSCAPING NOTES

1. No trees in embankment or along mowed maintenance access area.
2. Tree-save line denotes limit of disturbance during wetland excavation.
3. Pondscaping zones and marsh planting zones to be confined in field after excavation.
4. Existing topsoil to be stockpiled and used to dress pondscaping zones 4,5,6.
5. Reinforcement planting after first growing season based on field inspection of marsh plant survival / colonization rates.
6. Three soil pit tests taken to confirm general soil properties.
7. Switchgrass overseeded on Red Fescue in Pondscaping Zone 3, Tall Fescue and Wildlife grass mix used in Zones 4,5,6 within three days of final grading for erosion control.
8. Six inches of wood mulch around all trees and shrubs, planting holes to be threetimes rootball diameter.

PLANTING CLUMPS
SOIL TEST LOCATIONS
PONDSCAPING ZONES
MOWING AREAS (3X/YR)

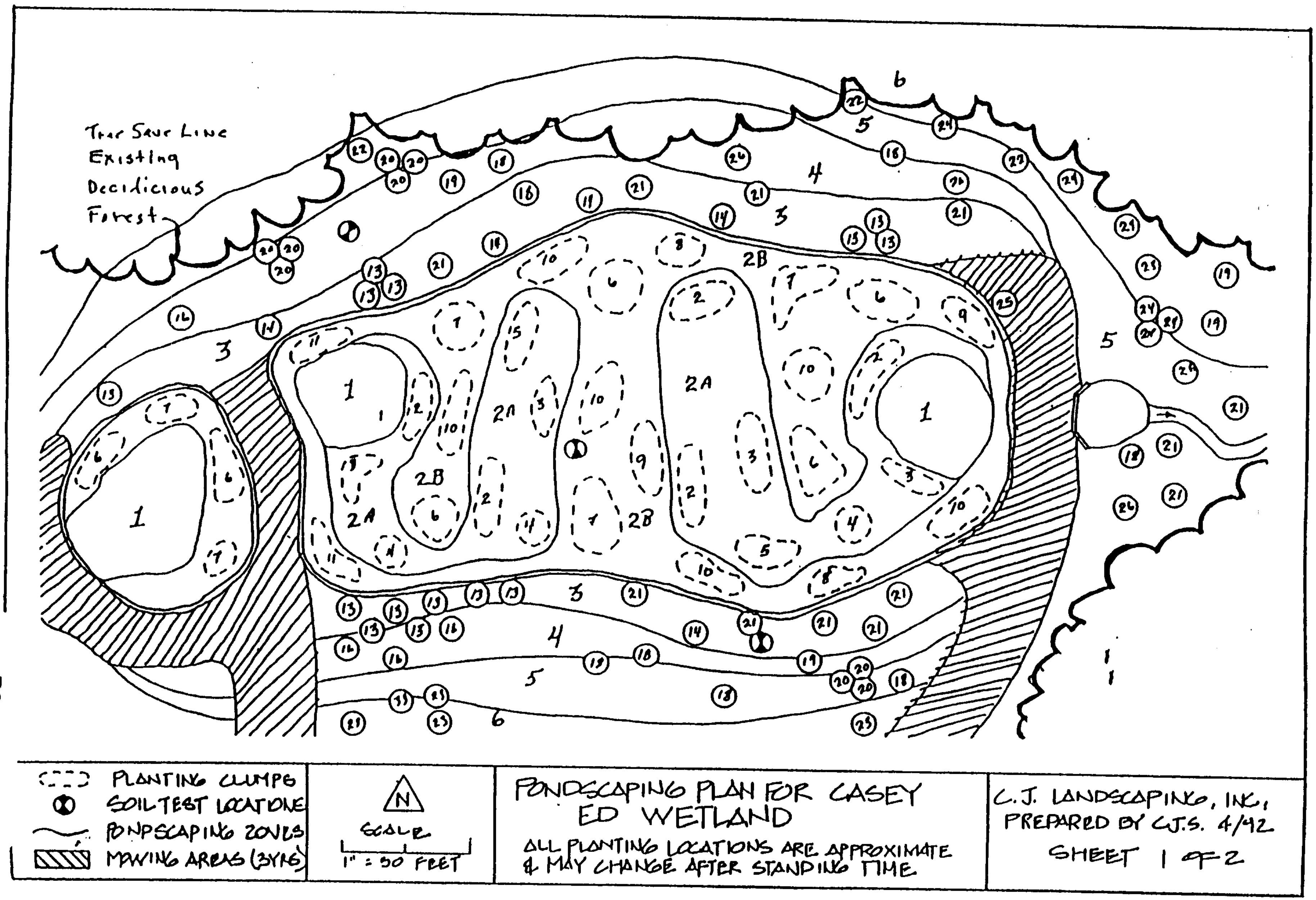
N
SCALE
1" = 50 FEET

PONDSCAPING PLAN FOR CASEY ED WETLAND
ALL PLANTING LOCATIONS ARE APPROXIMATE & MAY CHANGE AFTER STANDING TIME

C.J. LANDSCAPING, INC.
PREPARED BY C.J.S. 4/92
SHEET 2 OF 2

R0020279

Figure 16: Sample Pondscaping Plan



Establishing a Diverse Wetland Plant Community

1. Preparing the Wetland Bed
2. Establishing the Plant Community
   - -planting nursery stock
   - -wetland mulch
   - -broadcasting wetland seeds
   - -allowing volunteer

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Transplanting Wetland Nursery Stock

- Spring planting window
- Plant 5 to 7 species of emergents
- Plant in single-species clumps (18" O.C.)
- Initial plantings: 50% of Surface Area
- Reinforcement plantings: second growing season

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Seedbanks for Wetland Establishment

- Wetland mulch - Upper six inches of wetland soils
- Up to 20 species can emerge from Seedbank
  - composed of native sedges?, rushes, and grasses
- Donor sites are highly restricted
- Spread mulch 3-6 inches in Hi Marsh
- Uncertainty about ultimate community

Center for Watershed Protection

Stormwater Wetland Buffers

- o Minimum 25 Feet from Max WSE
- o Additional 15 Foot Setback to Structures
- o Wider Buffer Helpful for Habitat
- o 75% Buffer Perimeter as Forest

  Preserve Existing Trees, if Practicable

R0020282

Maintenance of the Pondscape

- Reinforcement plantings
- Control of exotic or invasive species
- Harvesting of the wetland
- Reducing mowing of the pondscape
- Intensive maintenance of pondscape (0 to 2 years)

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Preparing the Wetland Bed - Seven Steps

1. Prepare Grading Plan
2. Grade to Interim Elevations
3. Add Topsoil and/or Mulch Amendments
4. Grade to Final Elevations (Micro-T)
5. Allow 6 to 9 Months Standing Time
6. Measure and Stake Planting Depths
7. De-Water Wetland

Center for Watershed Protection

Stormwater Management

Wetland Design Example

For

Extended Detention Wetland

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The Center for Watershed Protection
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Silver Spring, MD 20910

January 1996

R0020284

Wetland Design Example

Design Assumptions

- Wetland example serves same area as pond design example
  - Townhouse development project
  - Located in Mid-Atlantic Piedmont
  - Receiving water is warm-water fishery
  - Low hazard facility
  - 2 and 10 year management
  - soils adequate for wetland pool and embankment
  - No wetlands/forest disturbance
- Water quality volume (WQV) based on 90% rule
- Wetland design example is Design 3: ED Wetland

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R0020285

Wetland Design Example

Design Steps - I

1. Same first 6 as pond design example
   - assemble background information
   - confirm design criteria
   - establish hazard classification
   - conduct site visit
   - perform hydrologic computations
   - determine storage requirements (quantity controls)
2. Calculate target permanent pool volumes and surface areas
3. Perform wetland pond grading
4. Compute provided storage and surface areas

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R0020286

Wetland Design Example

Design Steps - II

5. Perform hydraulic calculations
   - extended detention outlet
   - 2 year storm outlet
   - 10 year storm outlet
   - riser and barrel sizing & capacity
   - emergency spillway
6. Prepare storage-elevation-discharge table
7. Conduct wetland pond routing
8. Perform additional calculations
9. Draw profile and details
10. Pondscaping design

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R0020287

Wetland Design Example

Given: D.A. = 72.4 ac

WQV = 3.77 ac-ft

2 year management volume = 3.20 ac-ft

10 year management volume = 6.18 ac-ft

Allowable release rates:

2 year = 16.0cfs

10 year = 78.4 cfs

Inflow rates:

2 year = 89 cfs

10 year = 212 cfs

100 year = 392 cfs

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R0020288

Wetland Design Example

Surface Area & Storage Requirements - I

Extended Detention:

- 50% of WQV = 1.89 ac-ft
- Maximum depth = 2 ft
- Minimum surface area = 1.89/2 = 0.95 ac-ft

Permanent Pool:

- Target minimum surface area: Between 1% & 2% of watershed area: 72.4(.01) = 0.72 ac
  72.4(.02) = 1.45 AC

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Wetland Design Example

Surface Area & Storage Requirements - II

Target Permanent Pool Depth Zones:

3 Depth zones:	Volume (% of WQV)	Area (% of total)
Deep water	25% - 40%	20% - 30%
High marsh	*5% - 10%	*30% - 40%
Low marsh	*15% - 20%	*30% - 40%

(* Target minimum)

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R0020290

Wetland Design Example

Surface Area & Storage Requirements-III

Permanent Pool Depth Zone Goals:

D.A. = 72.4 ac, WQV = 3.77 ac-ft, ED Vol. = 1.89 ac-ft

3 Depth Zones	Volume (ac-ft)	Area (ac)
High marsh (<6")	.05(3.77) = 0.19 ac-ft	0.38 ac
Low marsh (16" avg.)	.15(3.77) = 0.57 ac-ft	0.42 ac
Deep pool (4' avg.)	.35(3.77) = 1.32 ac-ft	0.33 ac

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R0020291

Wetland Design Example

Wetland Pond Grading

- Storage Provided
  - Permanent pool
  - Stormwater management

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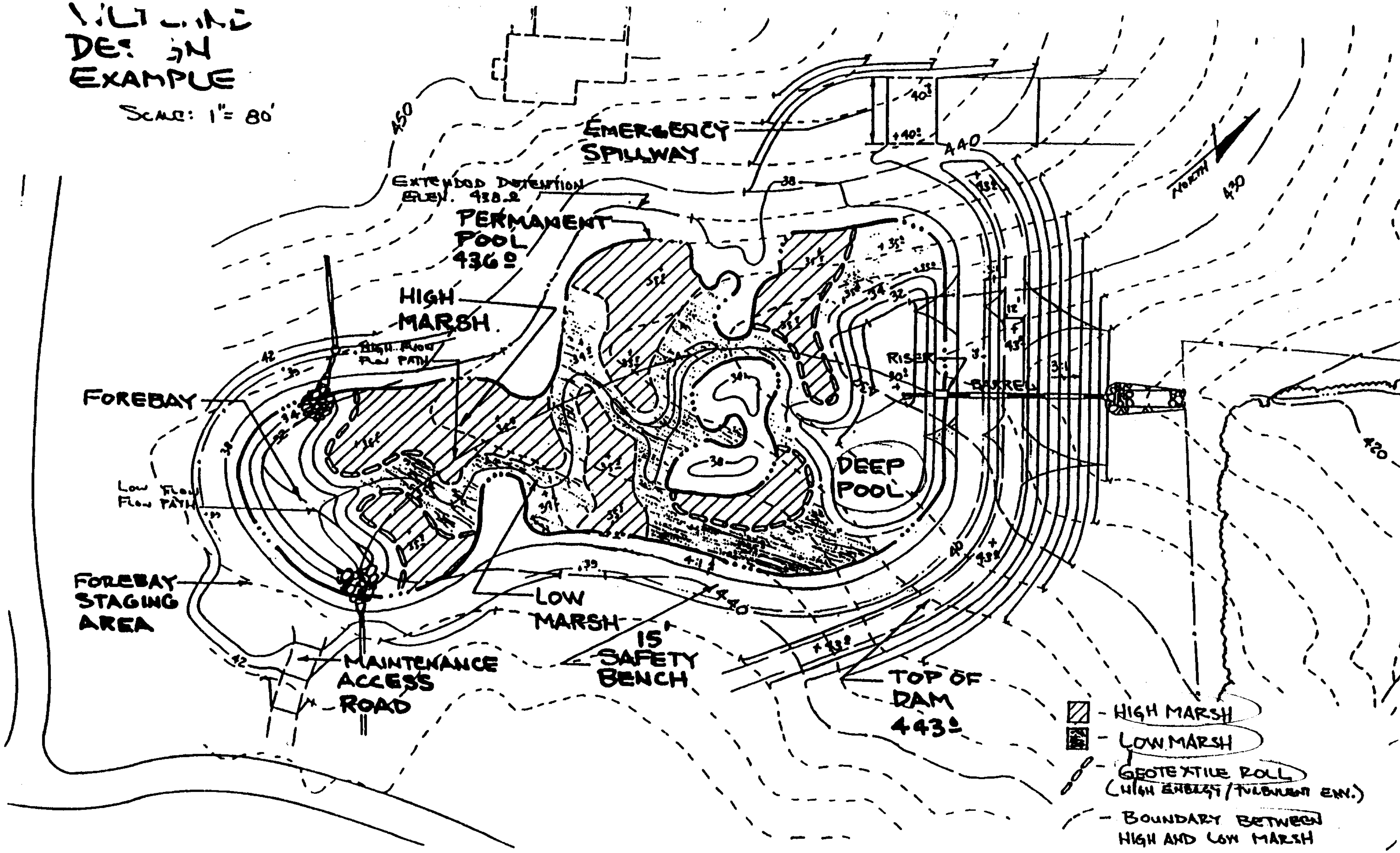
R0020292

WETLAND DESIGN EXAMPLE

SCALE: 1" = 80'



R0020293

Wetland Design Example

Flow Path Analysis

Length to width ratio:

Avg. width = (120+180+50+120)/4 = 137.5 ft

Target dry weather flow path: 3:1

Target wet weather flow path: 2:1

Dry: 2(137.5) = 275 ft Provided: 400 ft

Wet: 3(137.5) = 412 ft Provided: 550 ft

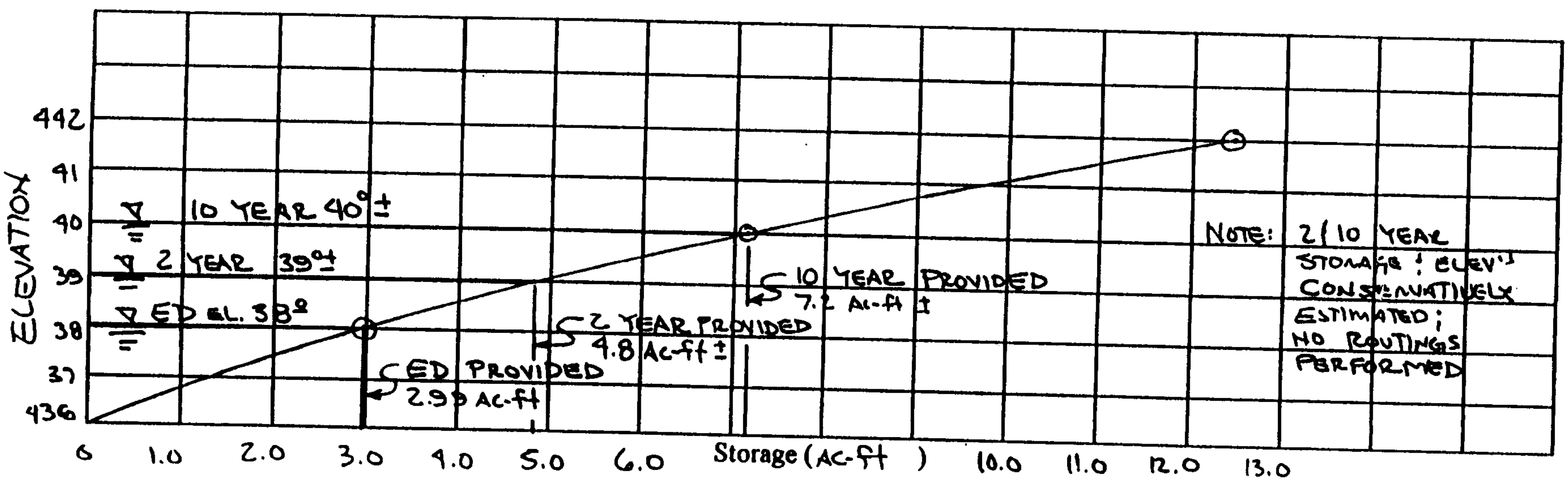
R0020294

Elevation - Storage Data

No routing up to here

Elevation (MSL)	Area (in²)	Area (ft²)	Average Area (ft²)	Depth (ft)	Volume (ft³)	∑ Volume (ft³)	∑ Volume (ac-ft)	∑ Volume above permanent pool (ac-ft)
436	21.44	53,600						
438	30.61	76,525	65,062.5	2	130,125	130,125	2.99	2.99
440	42.21	105,525	91,025	2	182,050	312,175	7.17	7.17
442	50.21	125,525	115,525	2	231,050	543,225	12.47	12.47

ABOVE PERMANENT POOL



ELEVATION - STORAGE DATA AND CURVE

R0020295

Area - Elevation - Storage Data - for Stormwater Wetlands

	Elevation (MSL)	Area (in²)	Area (ft²)	Average Area (ft²)	Depth (ft)	Volume (ft³)	Σ Volume (ft³)	Σ Volume (ac-ft)	Percent of Total Pool Volume (%)	Surface Area of Pool (acres)
	436	21.44	53,600	TOTAL	PERMANENT	POOL	SURFACE	AREA	→	1.23 AC
FOREBAY VOL.	432	1.07	2,675							
	434	1.63	4,078	3,376.5	2	6,753	6,753	0.16		
	436	2.51	6,275	5,176.5	2	10,313	17,066	0.39	20%	.14 AC (11%)
DEEP POOL VOL.	430	0.62	1,550							
	432	1.94	4,850	3,200	2	6,400	6,400	0.15		
	434	3.21	8,025	6,437.5	2	12,875	19,275	0.44		
	436	4.23	10,575	9,300	2	18,600	37,875	0.87	45%	.24 (20%)

Σ FOREBAY + DEEP POOL SA = .38 AC = (31%)

Area - Elevation - Storage Data - for Stormwater Wetlands

	Elevation (MSL)	Area (in²)	Area (ft²)	Average Area (ft²)	Depth (ft)	Volume (ft³)	Σ Volume (ft³)	Σ Volume (ac-ft)	Percent of Total Pool Volume (%)	Surface Area of Pool (acres)
HIGH MARSH	435.5	7.84	19,600		4"(.33')	6,468	6,468	0.15	8%	.45 AC (37%)
LOW MARSH	434.8	6.86	17,150		16"(1.33)	22,867	22,867	0.52	27%	.39 AC (32%)
						TOTAL VOLUME (≥ 1.89 OK)		1.93	100%	

R0020296

Wetland Design Example

Profiles and Details

- Profile through centerline of principal spillway
- Profile through centerline of pond (typical grading)

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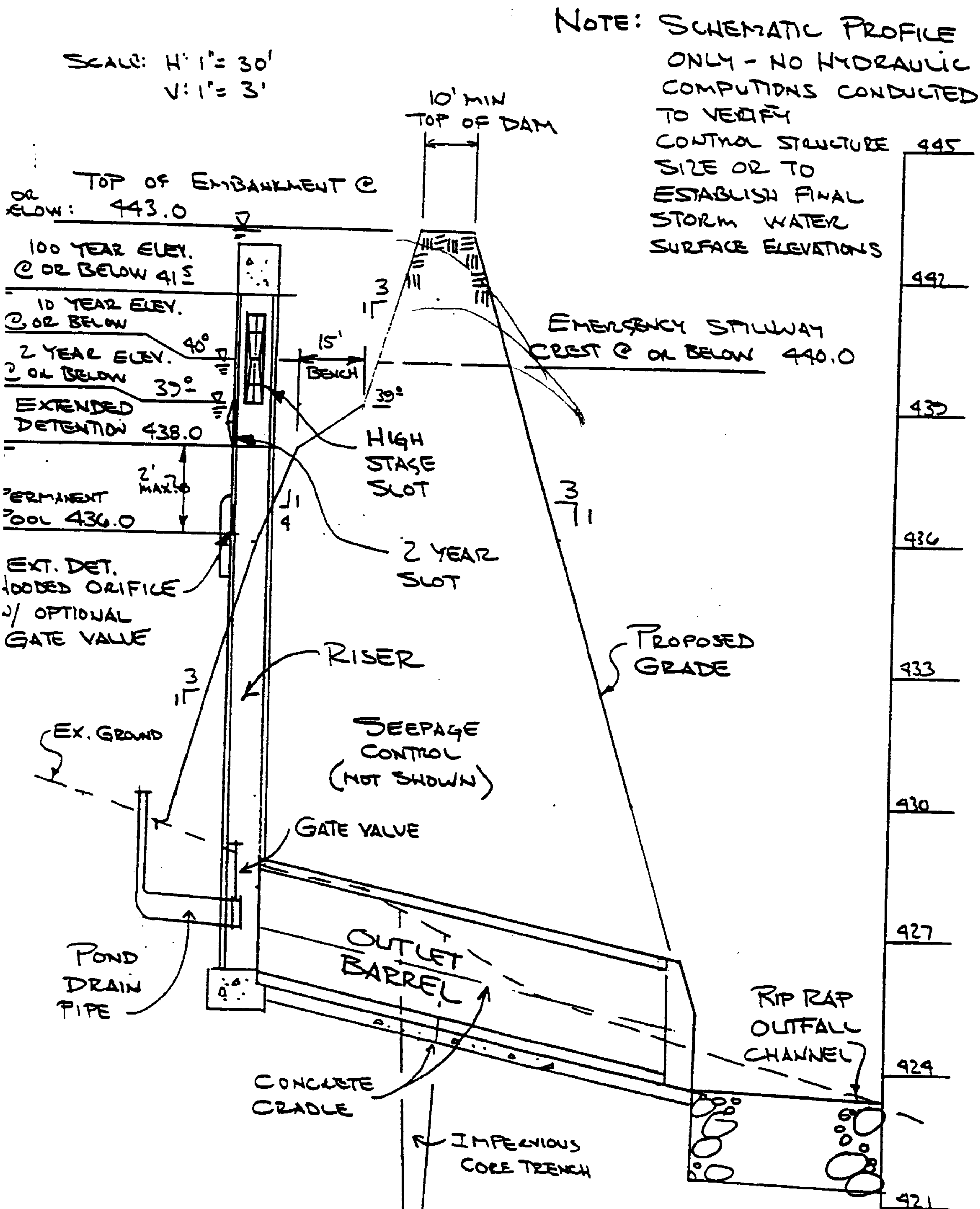
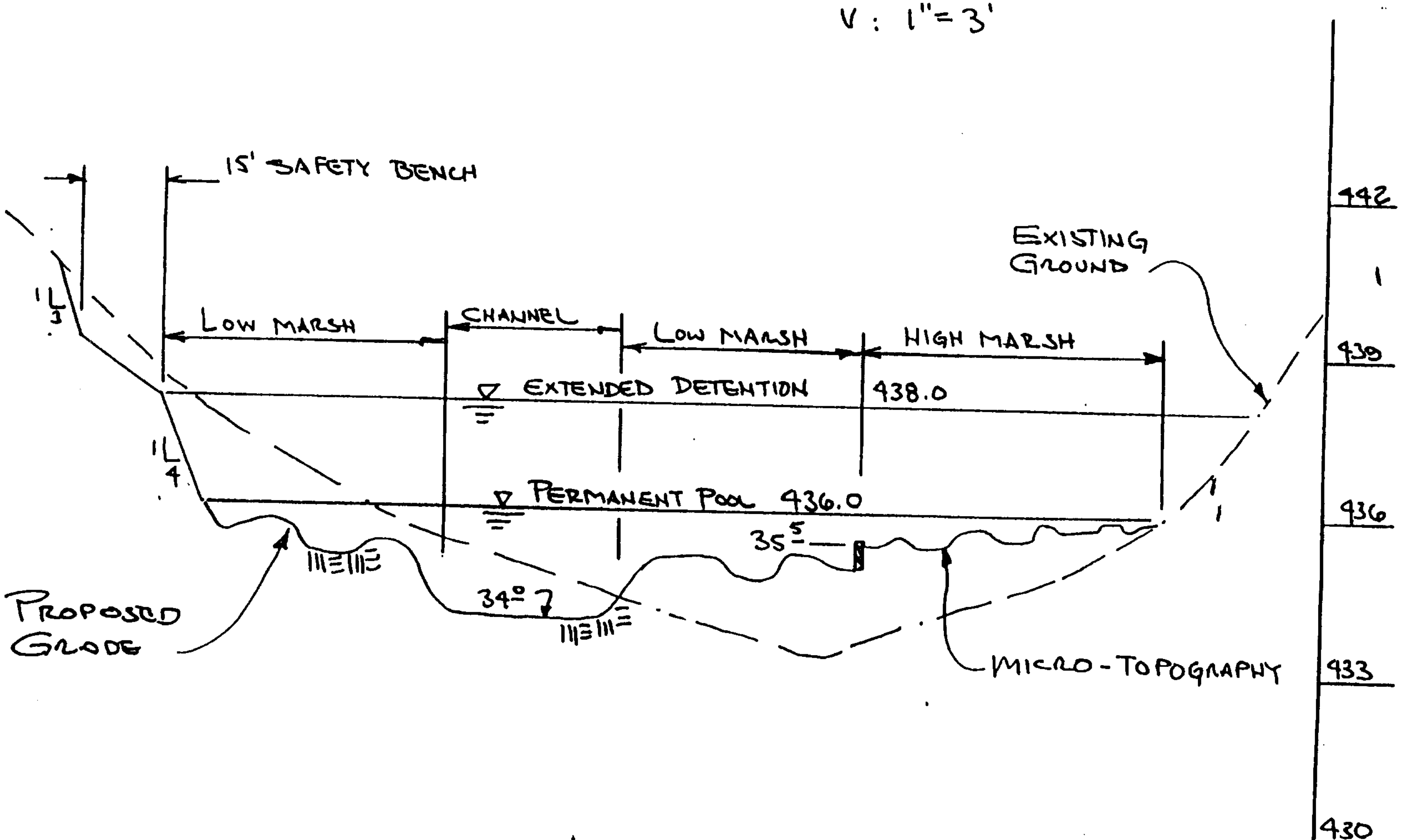
R0020297

PROFILE THROUGH ℄ OF PRINCIPAL SPILLWAY



PROFILE THROUGH CENTER OF POND - TYPICAL GRADING

SCALE: H : 1" = 30'
V : 1" = 3'



R0020299

Wetland Design Example

Pondscaping Design

- Plan view design
- Planting list

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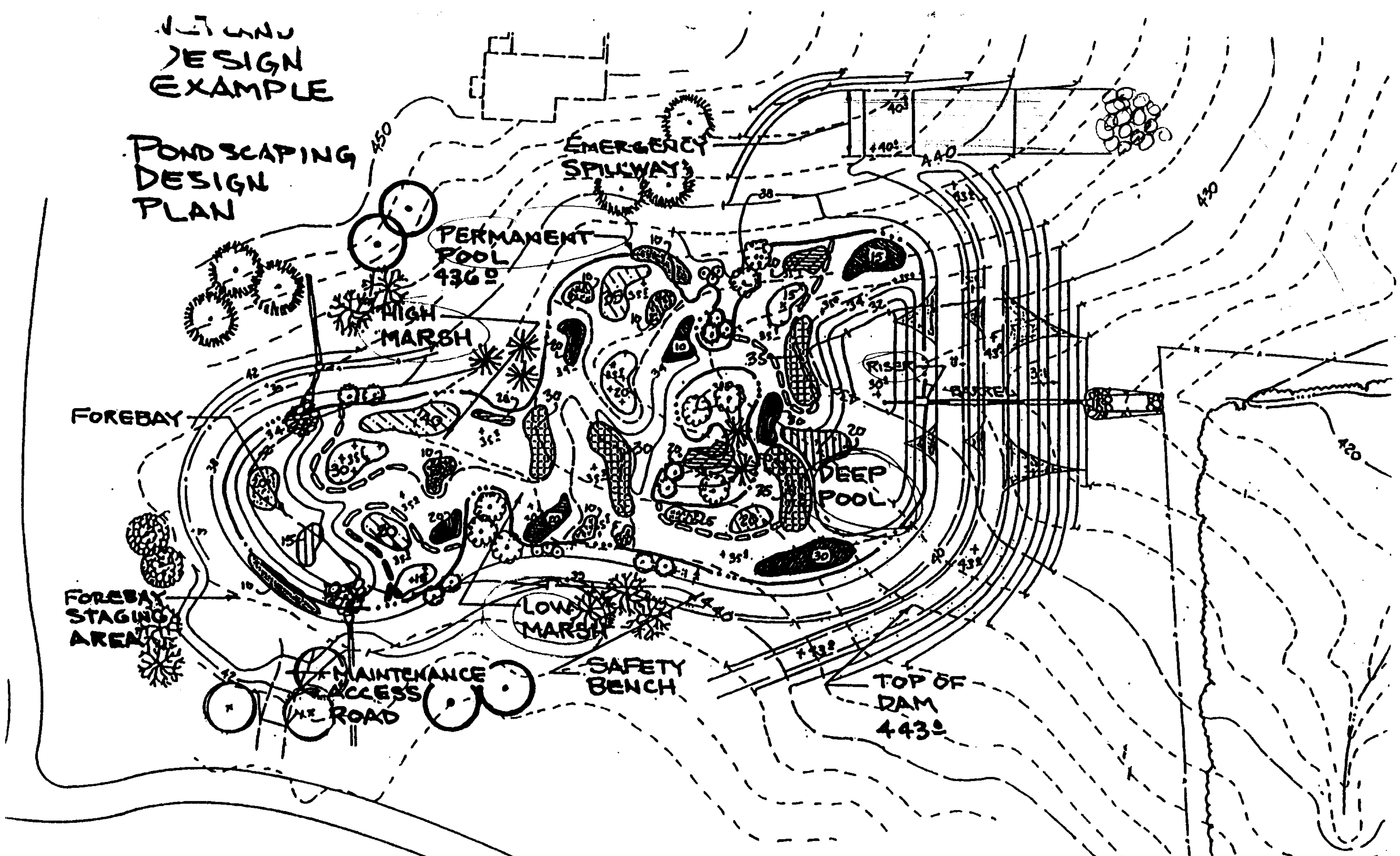
DESIGN
EXAMPLE
PONDSCAPING
DESIGN
PLAN
EMERGENCY
SPILLWAY
PERMANENT
POOL
436.0
HIGH
MARSH
FOREBAY
FOREBAY
STAGING
AREA
RISER
BARREL
DEEP
POOL
LOW
MARSH
SAFETY
BENCH
MAINTENANCE
ACCESS
ROAD
TOP OF
DAM
443.0
450
440
430
420

R0020301

Pondscaping Plant Materials List - I

Deep Pool	QTY	Low Marsh	QTY
Wild Celery	35	Arrow Arum	75
Redhead Grass	20	Duck Potato	70
High Marsh		Pickerelweed*	130
Lizard Tail	80	**Shoreline Fringe**	
Sweet Flag	115	Button Bush	11
Marsh Marigold	25	Softstem Bulrush	20
Common 3-Sq.	60	River Birch	5
Blue Flag	25	Smooth Alder	8
		Swt. Pepperbush	6

* both high and low marsh zones

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R0020302

Pondscaping Plant Materials List - II

Riparian	QTY	Upland	QTY
□ Tall Fescue*		□ Tall Fescue*	
Green Ash	7	Silky Dogwood	2
Sycamore	3	Tulip Poplar	6
□ Wildflower mix**		White Oak	4

*Tall fescue hydroseeded within 3 days of final grading

**Wildflower mix overseeded in tall fescue in selected areas designated in the field

Center for Watershed Protection

Infiltration Practices

I:1 Infiltration Trench: Design Notes

- Fields verification of soil permeability essential
- Helps meet groundwater recharge
- Highly restricted practice
- Longevity is less than 5 years without multiple pretreatment
- Cannot be used if contributing drainage is a hotspot (gasoline outlets)

I-1 Infiltration Trench

DA = < 5 acres

Maintenance = 5.0

Comm. Accept.= 2.0

Cost = 3.5

Treatment

Re_v	x
Cp_v	?
WQ_v	x
Q_{p2}	?

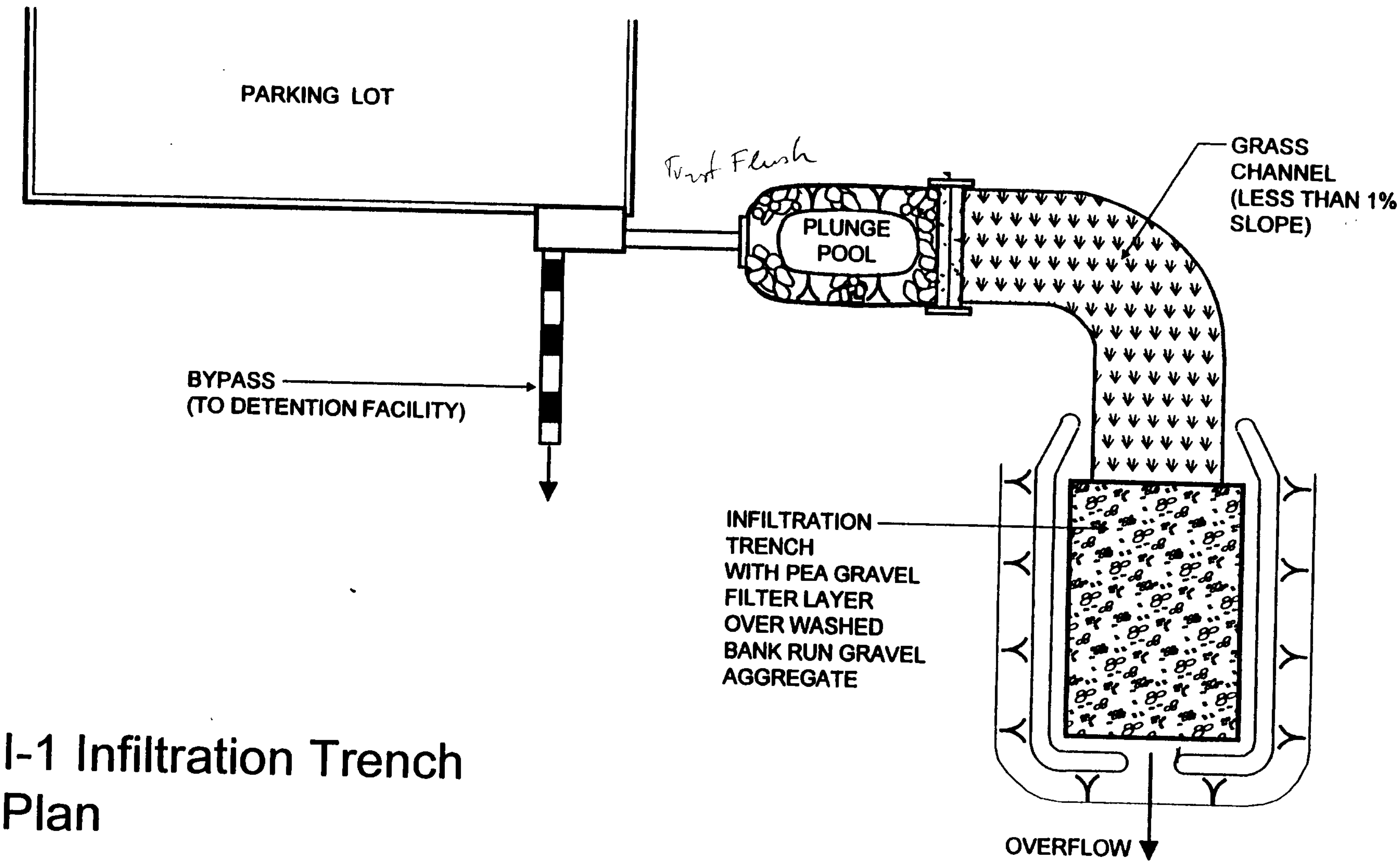
Pollutant Removal

TSS = 90 *

TP = 65 *

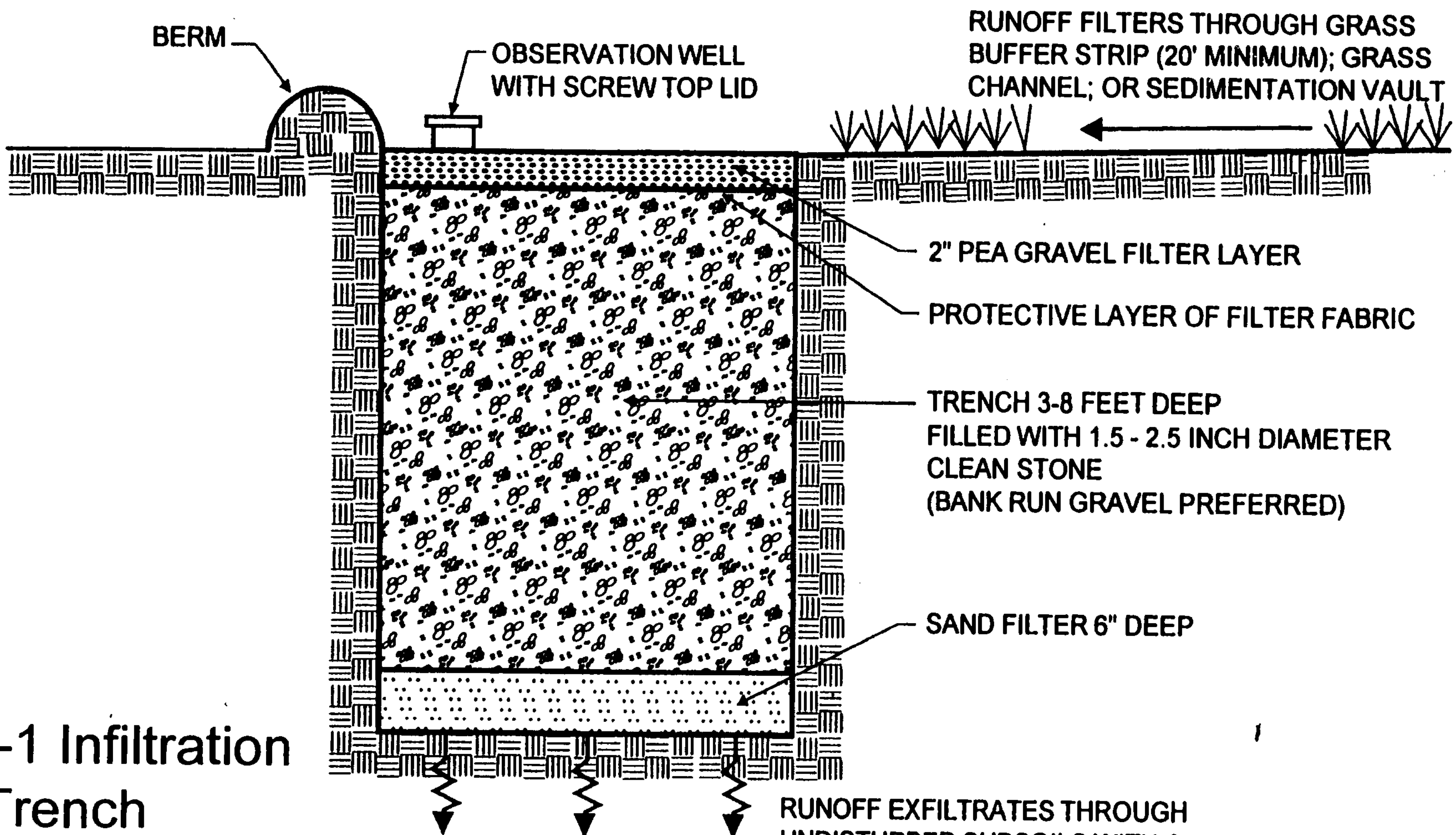
TN = 50 *

* limited pollutant removal data



I-1 Infiltration Trench Plan

R0020307



I-1 Infiltration Trench Profile

R0020308

I:2 Infiltration Basin: Design Notes

- Failure rates of 25 to 100% recorded in the field
- Two cell design, with settling basin
- Surface sand layer or backup underdrain
- Algal growth/organic deposition lead to sealing

R0020309

I-2 Infiltration Basin

DA = < 10 acres

Maintenance = 5.0

Comm. Accept.= 4.0

Cost = 3.0

Treatment

Re_v	x
Cp_v	?
WQ_v	x
Q_{p2}	?

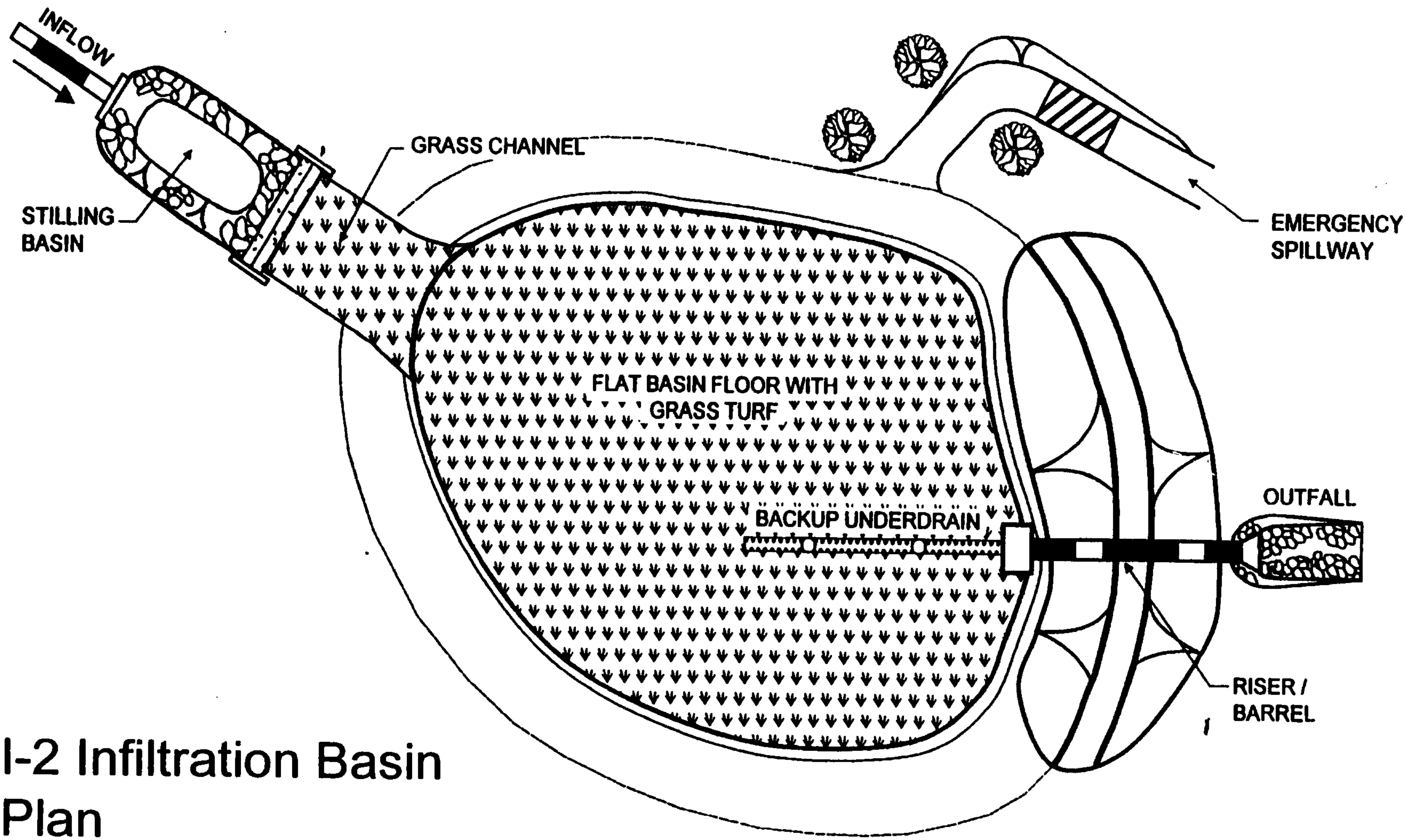
Pollutant Removal

TSS = 90 *

TP = 65 *

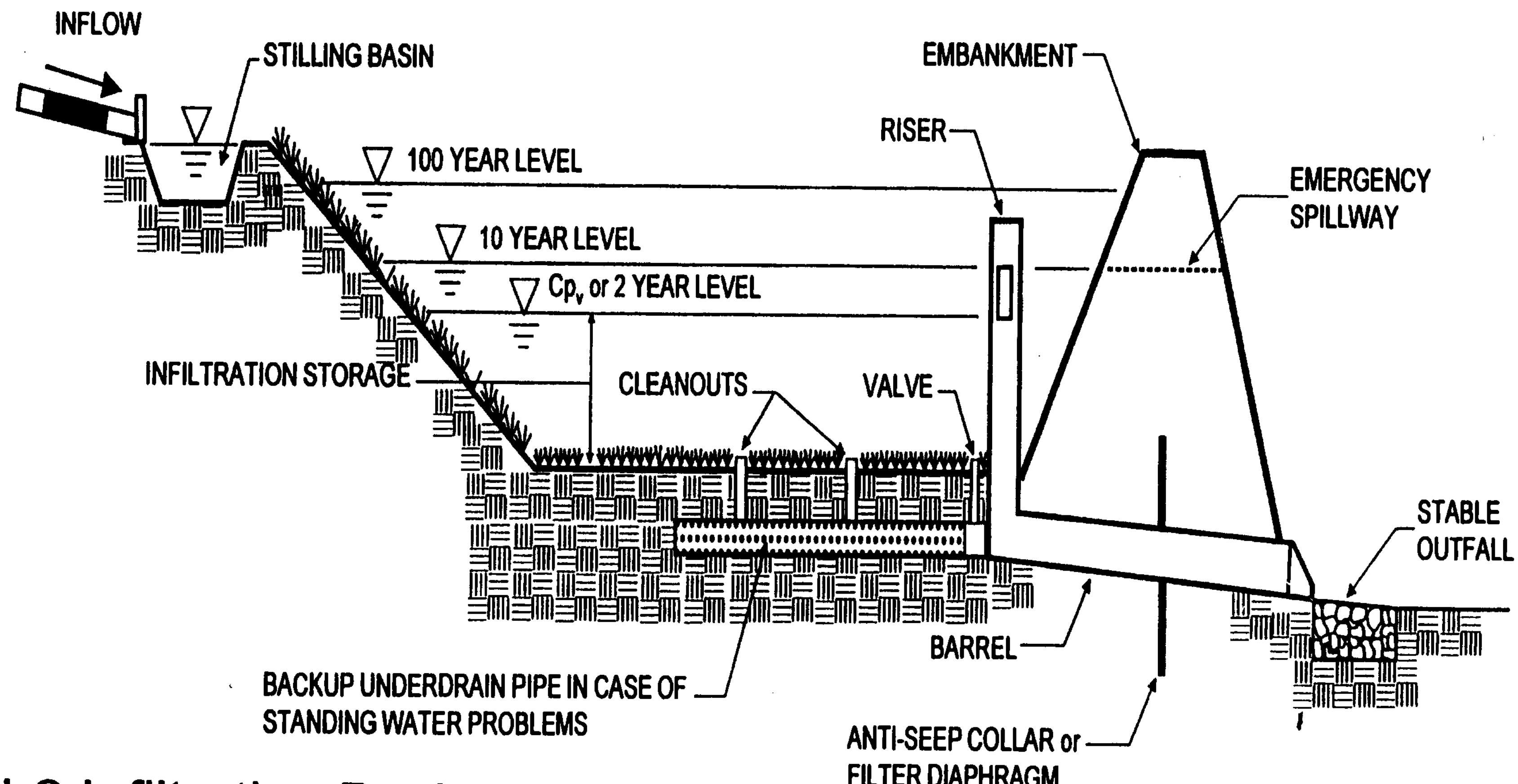
TN = 50 *

* limited pollutant removal data



I-2 Infiltration Basin Plan

R0020311



I-2 Infiltration Basin Profile

R0020312

I:3 Porous Pavement: Design Notes

- Vacuum Sweeping needed
- Construction Stage Sediment Control critical
- Overflow Inlets as backup
- Asphalt, concrete or concrete-grid can be used for inlet
- Wanted: long term, informed owner
- Winter-time plowing/sanding can be a problem

I-3 Porous Pavement

DA = < 5 acres

Comm. Accept. = 1.0

Maintenance = 5.0

Cost = 3.0

Treatment

Re_v	x
Cp_v	?
WQ_v	x
Q_{p2}	?

Pollutant Removal

TSS = 90%

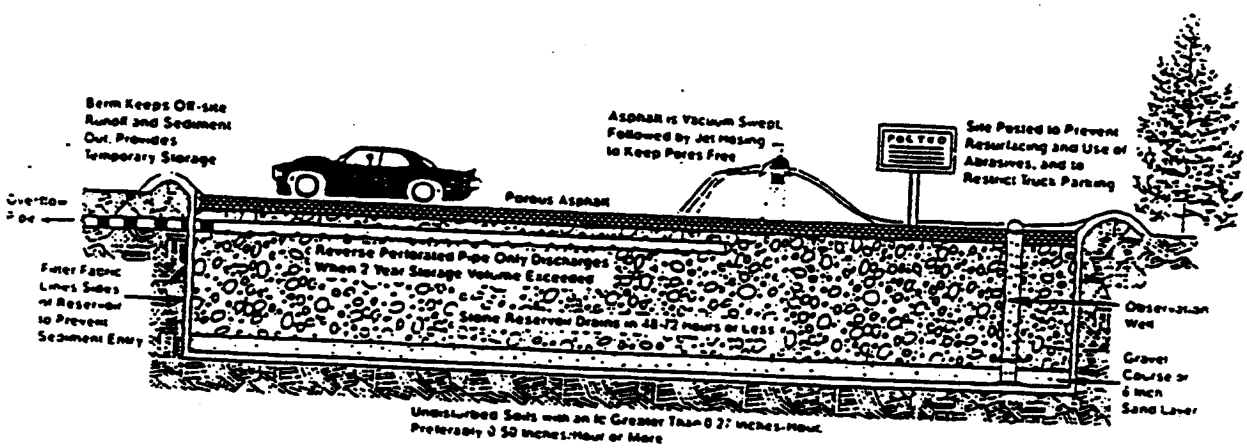
TP = 65%

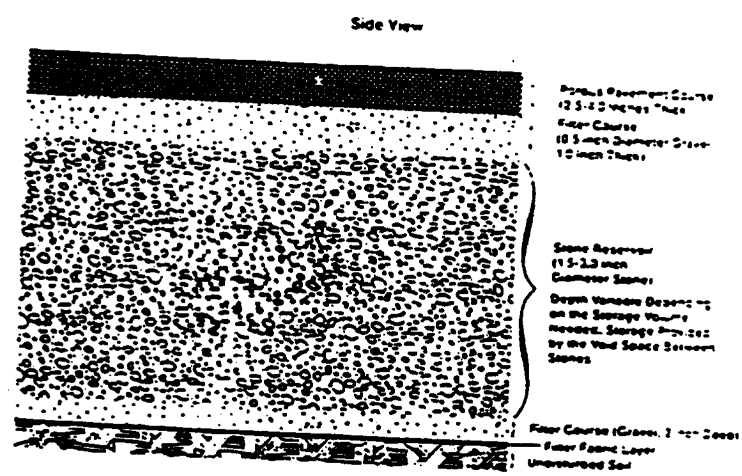
TN = 85%

Definition

Porous pavement is an alternative to conventional pavement whereby runoff is diverted through a porous asphalt layer and into an underground stone reservoir. The stored runoff then gradually infiltrates into the subsoil.

Schematic Design of a Porous Pavement System





Source: Schueler, 1987

Filtering Practices

F-1	Surface Sand Filter
F-2	Underground Sand Filter
F-3	Perimeter Sand Filter
F-4	Organic Filter
F-5	Pocket Sand Filter
F-6	Bioretention Areas

R0020316

F:1 Surface Sand Filter: Design Notes

- Pretreatment essential (dry or wet sedimentation)
- Grass cover crop is an option
- Need maintenance access to filter bed
- Useful to treat hotspot runoff (RGOs)

[RGOs]

R0020317

F-1 Surface Sand Filter

DA = < 10 acres * *may be larger in some instances

Maintenance = 3.5

Comm. Accept.= 2.5

Cost = 4.0

Treatment

Re_v	ex
Cp_v	?
WQ_v	x
Q_{p2}	

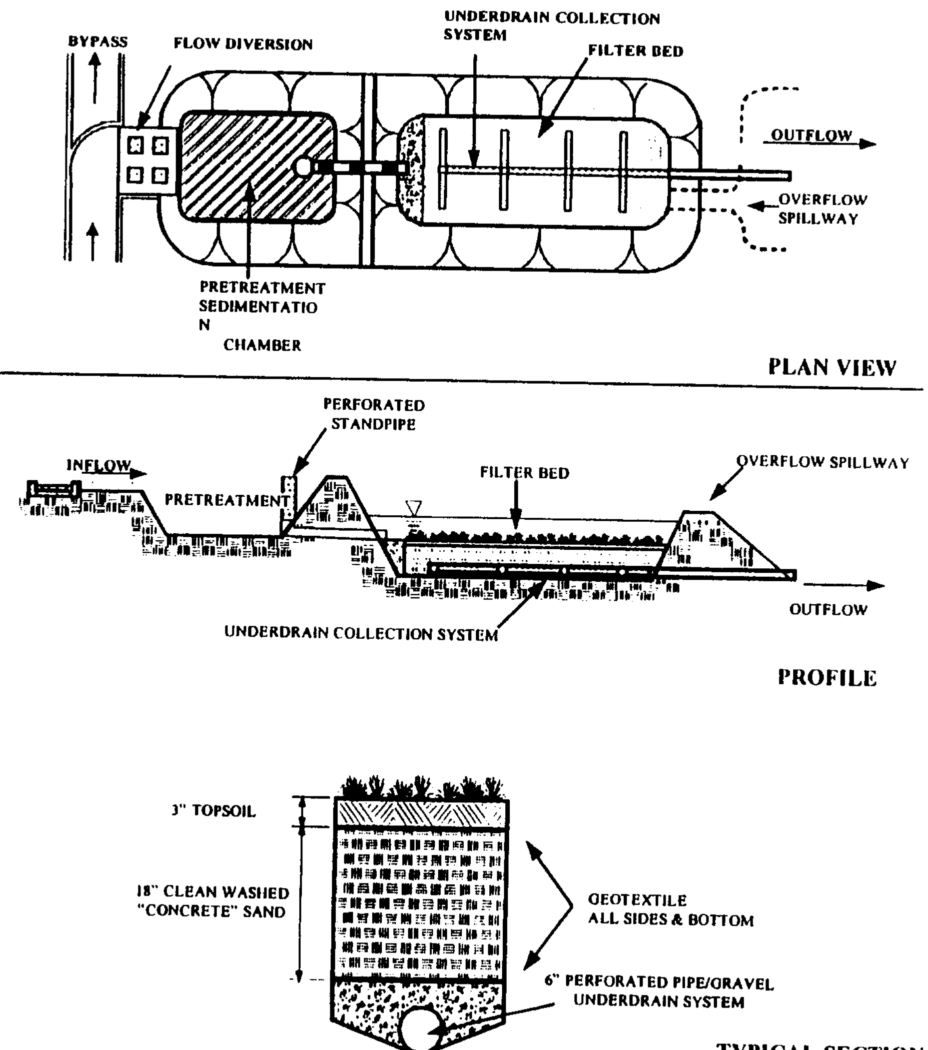
Pollutant Removal

TSS = 85%

TP = 50%

TN = 40%

F-1	**Figure 3.12** Example of Surface Sand Filter	F-1



Surface sand filters can serve the largest drainage area of all the filtering systems.

F:2 Underground Sand Filter: Design Notes

- Useful option in ultra-urban areas
- OSHA confined space
- Saves space, but can be expensive

Try design based on flow!
the footprint may be smaller

F-2 Underground Sand Filter

DA = < 2 acres * | *may be larger in some instances | Comm. Accept.= 1.0

Maintenance = 4.0 | Cost = 4.5

Treatment

Re_v	
Cp_v	
WQ_v	X
Q_{p2}	

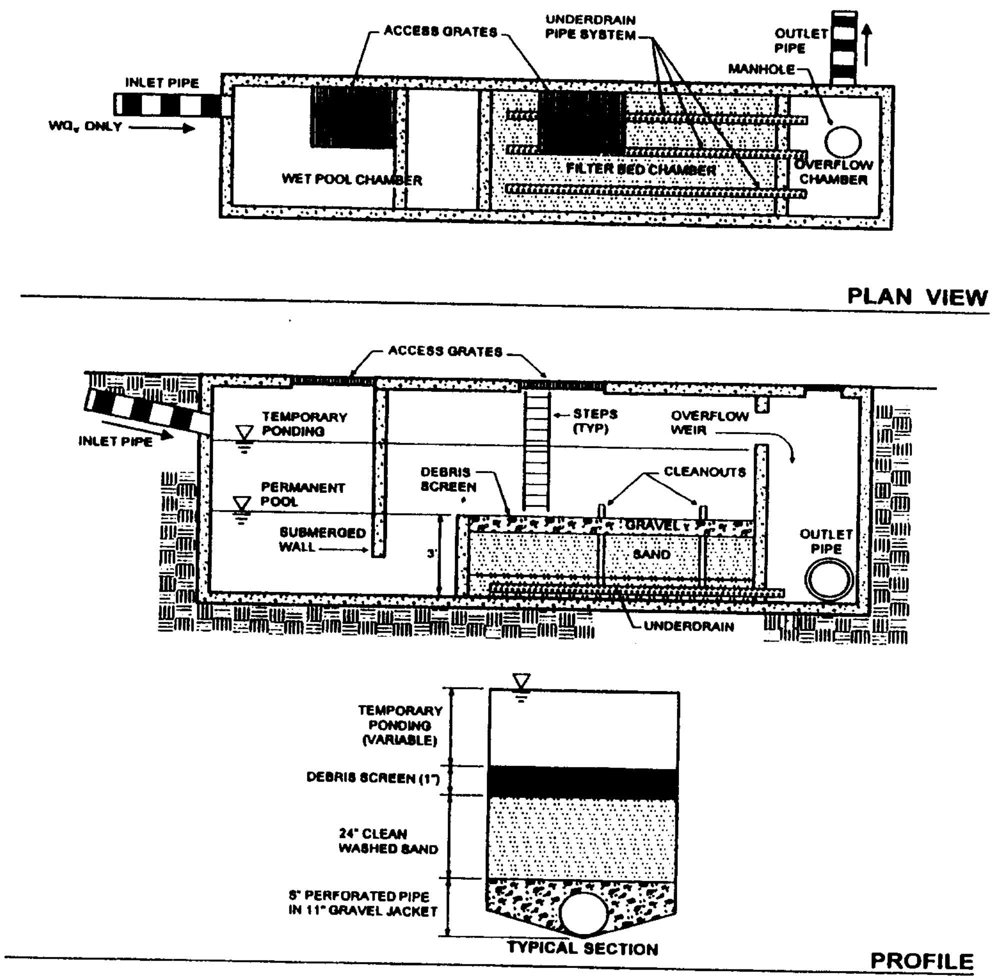
Pollutant Removal

- TSS = 80 *
- TP = 50 *
- TN = 35 *

* limited pollutant removal data

R0020321

F-2	**Figure 3.13** Example of Underground Sand Filter	F-2



The underground sand filter is an option for providing WQ_v where space is limited.

R0020322

F:3 Perimeter Sand Filter: Design Notes

- Useful option for parking lots
- Lowest head requirements of filters
- Lower cost if located so it doesn't bear traffic
- Saves space

gasoline outlets

Alexandria, Virginia design → fiber glass grates for perimeter sand Filter

Recheck WBPA BMP manual for these BMPs

R0020323

F-3 Perimeter Sand Filter

DA = < 2 acres * | *may be larger in some instances | Comm. Accept.= 1.0

Maintenance = 3.5 | Cost = 4.0

Treatment

Re_v	☐
Cp_v	☐
WQ_v	x
Q_{p2}	☐

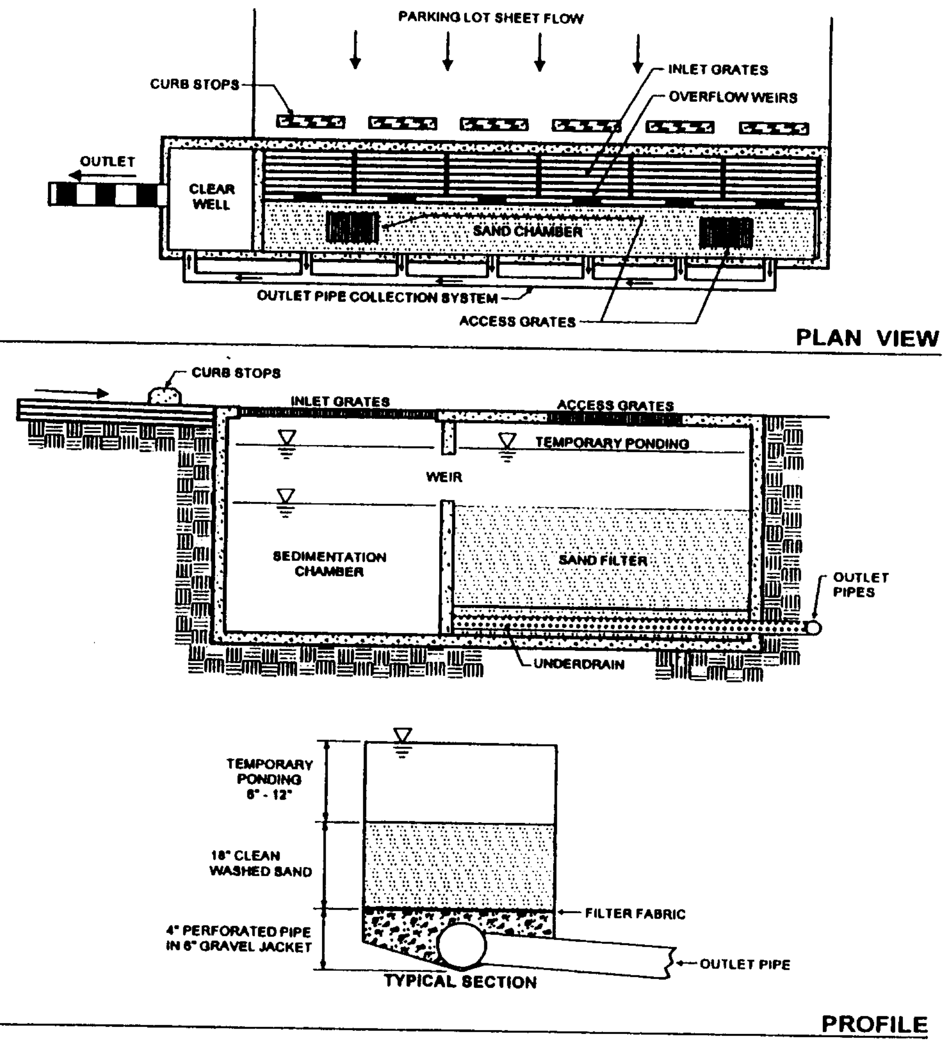
Tiny flow

Pollutant Removal

- TSS = 80%
- TP = 45%
- TN = 45

Figure 3.14 Example of Perimeter Sand Filter

F-3



The perimeter sand filter is most practical for small sites with flat terrain or a high water table.

R0020325

F:4 Organic Filter: Design Notes

- Organic media can include compost or peat
- Use a conservative permeability coefficient
- Replacement of media every 2 to 5 years
- Greater hydrocarbon, metal and bacteria removal

R0020326

F-4 Organic Filter

DA = < 10 acres *

*may be larger in some instances

Comm. Accept.= 2.5

Maintenance = 3.5

Cost = 4.0

Treatment

Re_v	
Cp_v	
WQ_v	X
Q_{p2}	

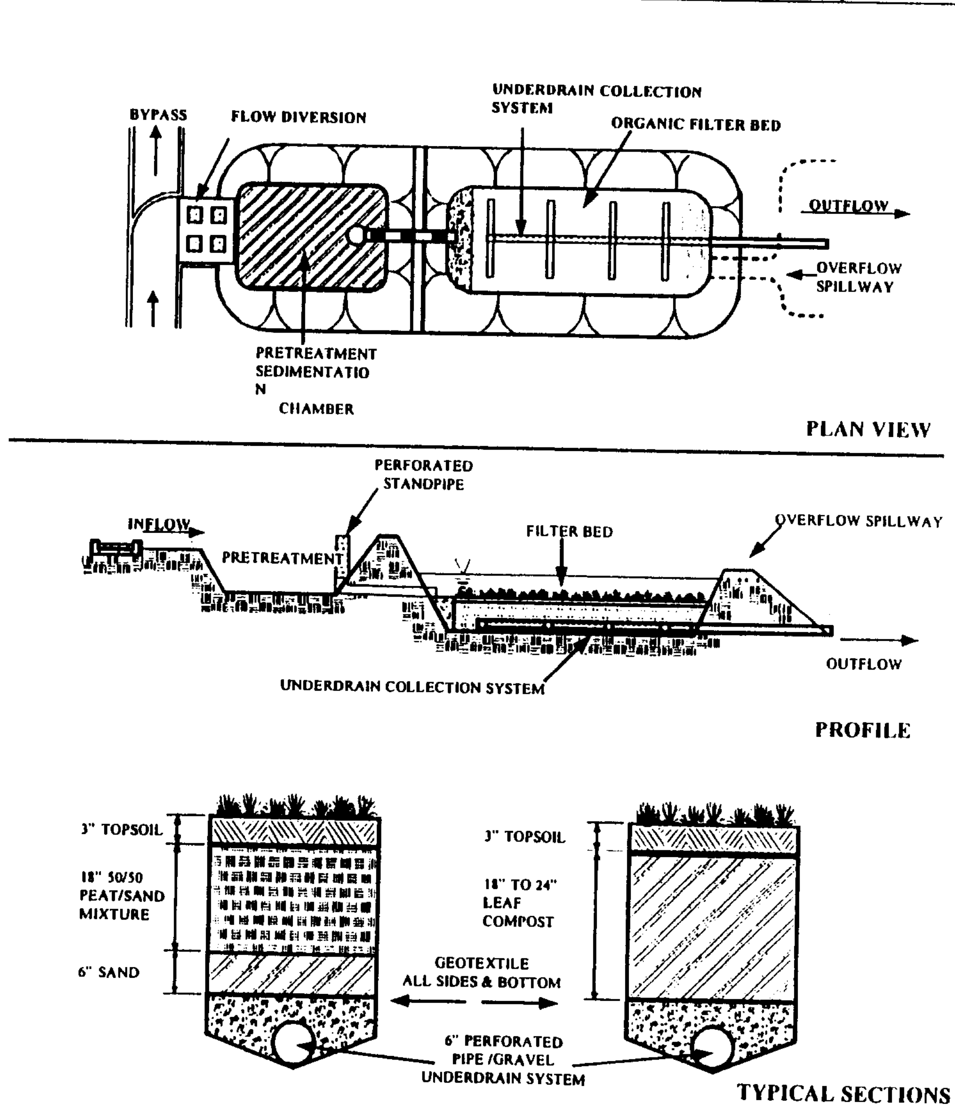
Pollutant Removal

TSS = 80

TP = 45

TN = 50

F-4	**Figure 3.15** Example of Organic Filter	F-4



The organic filter is used when maximum nutrient or trace metal removals are desired.

R0020328

F:5 Pocket Sand Filter: Design Notes

- •Small Area Treatment (<1 acre)
- •Pretreatment essential (dry or wet sedimentation)
- •Grass cover crop is an option
- •Need maintenance access to filter bed
- •Useful to treat hotspot runoff

R0020329

F-5 Pocket Sand Filter

DA = < 2 acres

Comm. Accept.= 2.5

Maintenance = 4.0

Cost = 3.0

Treatment

Re_v	
Cp_v	
WQ_v	x
Q_{p2}	

Pollutant Removal

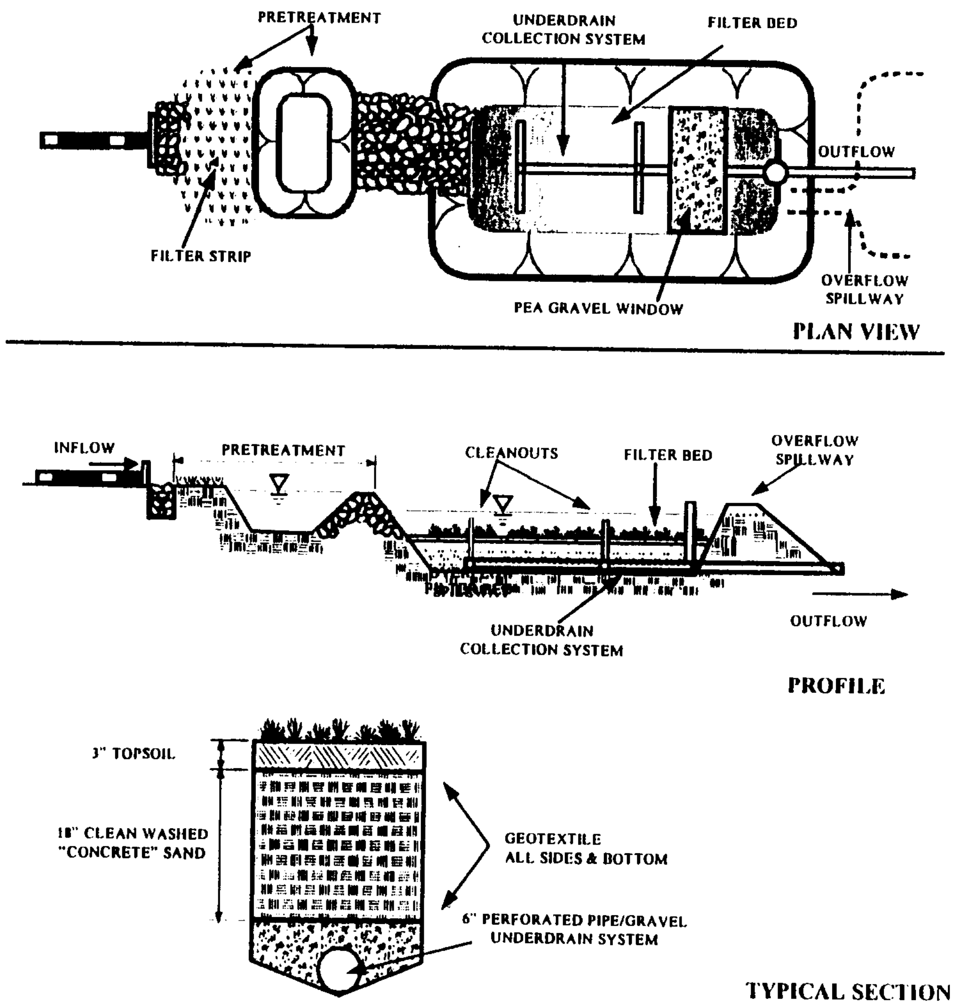
TSS = 80 *

TP = 40 *

TN = 35 *

* limited pollutant removal data

F-5	**Figure 3.16** Example of "Pocket" Sand Filter	F-5



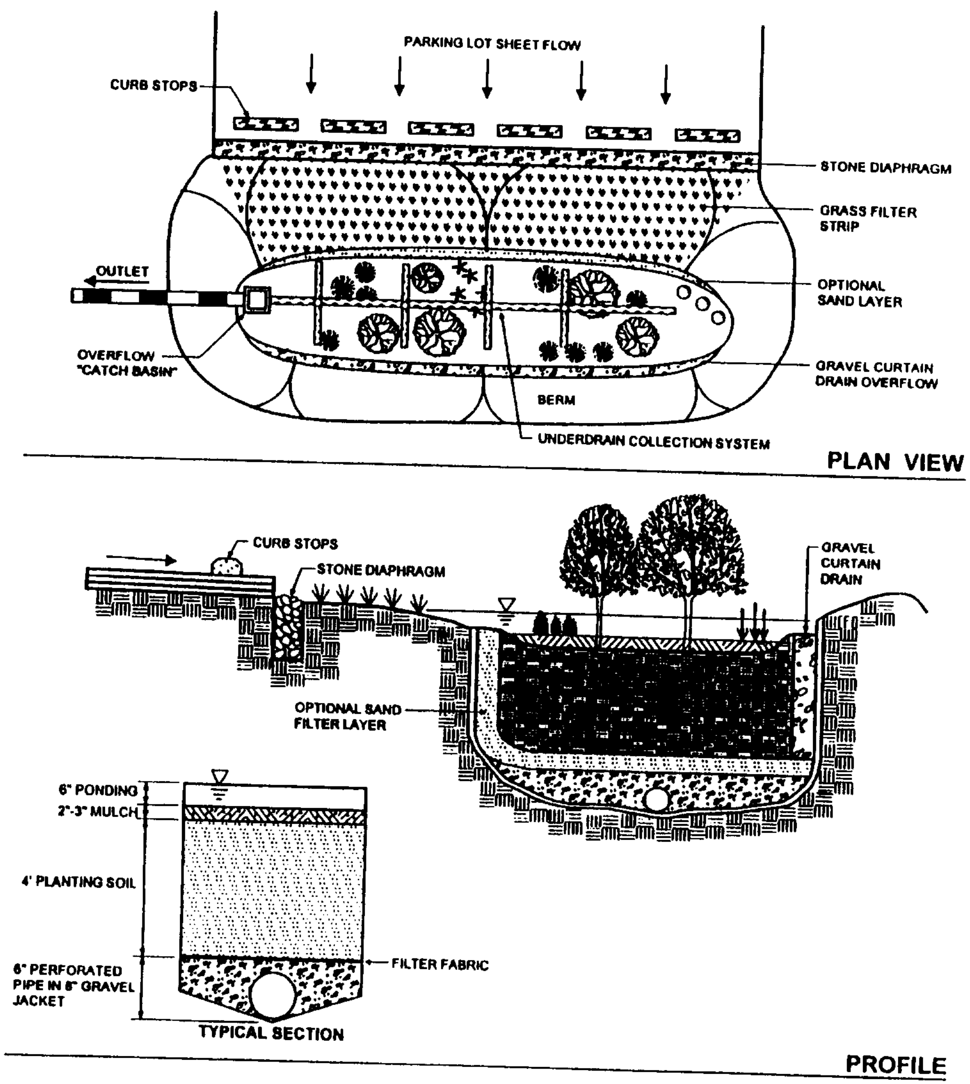
The pocket sand filter is applied to small sites where sediment loads are expected to be moderate to low. The pea gravel windows allow runoff into the filter if the surface becomes clogged.

R0020331

F:6 Bioretention: Design Notes

- Ideal use for small "green spaces"
- Filler employs sand, soil, mulch and grass
- Inlet drop and grading are very important
- Proper landscaping is essential

F-6	Figure 3.17 Example of Bioretention	F-6



Bioretention combines open space with stormwater treatment.

F-6 Bioretention

DA = < 2 acre

Comm. Accept. = 1.5

Maintenance = 2.0

Cost = 2.5

Treatment

Re_v	x
Cp_v	
WQ_v	x
Q_{p2}	

Pollutant Removal

TSS = 80 *

TP = 50 *

TN = 50 *

* limited pollutant removal data

R0020334

PARSONS BRINCKERHOFF COMPUTATION SHEET

Made by EKB

Date 12/2/98

Checked by

Date

Subject LAUREL MARC STATION LOT
SAND FILTER DESIGN

WATER QUALITY VOLUME (WQv):

FROM PROPOSED HYDROLOGY (TR-55)

$A = 2.34$ AC

$A_{imperv.} = 1.821$ AC

$I = 1.821/2340 = 77.8\%$ impervious

$R_v = 0.05 + 0.009(I)$

$= 0.05 + 0.009(77.8) = 0.750$

EASTERN ZONE (1.0" OF RUNOFF)

$$WQ_v = \frac{1.0\, R_v\, A}{12} = \frac{1.0''(0.750)(2.34\text{ ac})}{12''/\text{ft}} = \underline{\underline{0.146 \text{ AC-FT}}}$$

$$= \underline{\underline{6370 \text{ FT}^3}}$$

PRE-TREATMENT (25% WQv) AREA:

$$A_s = \frac{-Q_o \ln(1-E)}{W}$$ Q_o = Q outfall

$Q_o = WQ_v / 24$ hrs

$E = 0.90$

$I > 75\% \Rightarrow W = 0.0033$ fps

$A_s = 0.0081\, WQ_v = 0.0081(6370) = \underline{\underline{52 \text{ FT}^2}}$

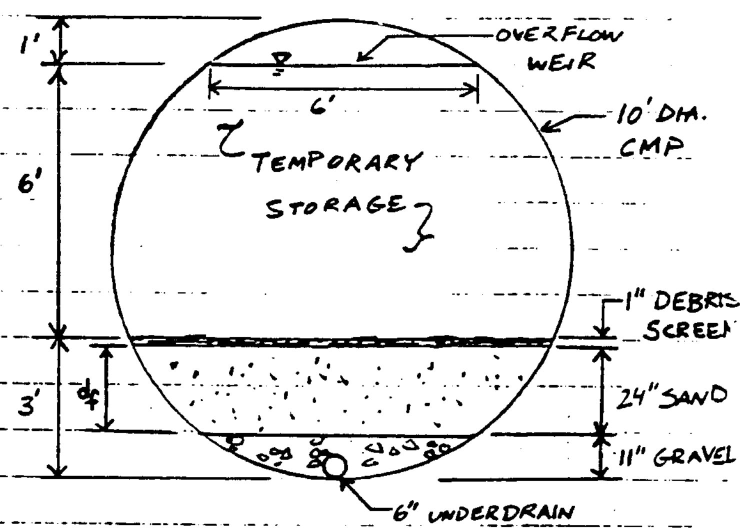
$V_{s_{min}} = 0.25\, WQ_v = 0.25(6370) = \underline{\underline{1593 \text{ FT}^3}}$

R0020335

Subject LAUREL MARC STATION LOT
SAND FILTER DESIGN

SAND FILTER AREA:

$$A_f = \frac{WQ_v * d_f}{k(h_f + d_f)t_f}$$



$WQ_v = 6370\ FT^3$
$d_f = 2.0'$ (24" SAND LAYER)
$h_f = 3.0'$ (6' AVAIL. HEAD × 0.5)
$k = 3.5$ FT/DAY (FOR SAND)
$t_f = 1.0$ DAY (24-HR DRAWDOWN)

$$A_f = \frac{6370 \times 2.0}{3.5(3.0+2.0)1.0} = \underline{\underline{728\ FT^2}}$$

TRY 10' DIA. CMP, 3' DEEP FILTER & DRAINAGE MEDIA,
OVERFLOW WEIR 1.0' FROM CROWN

FROM GEOMETRY (SEE ATTACHED TABLE), TOP WIDTH @
MID POINT OF FILTER SAND, T = 8.0'

$\therefore$ LENGTH REQ'D, $L_f = \frac{A_f}{T} = \frac{728}{8} = 91\ FT$

CALL $L = \underline{95\ FT}$

$V_{min} = 0.75\ WQ_v = \underline{\underline{4778\ FT^3}}$ (ENTIRE STRUCTURE)

PARSONS BRINCKERHOFF COMPUTATION SHEET

Page 3 of 4
Made by EKB
Date 12/2/98
Checked by
Date

Subject: LAUREL MARC STATION LOT
SAND FILTER DESIGN

CHECK VOLUMES:

WITHIN FILTER BED (SAND ONLY) $n=0.40$ FOR SAND

$$V_f = L_f A n = 95'(19.82-4.09)(0.40) = \underline{598\ FT^3}$$

TEMP. STORAGE ABOVE FILTER BED

$$V_{f-temp} = L_f A = 95'(74.45-19.82) = \underline{5190\ FT^3}$$

REMAINING VOLUME (PROVIDE IN SED. CHAMBER)

$$V_s = V_{min} - (V_f + V_{f-temp}) = 4778 - (598+5190) = -1010^{*}$$

* INDICATES THAT 75% OF WQ_V IS PROVIDED IN FILTER ⇒ SIZE SED. BASIN FOR $V_{S_{min}} = 0.25\ WQ_V = 1593$
CROSS-SECTIONAL AREA OF SED. BASIN = 74.45 SF

$$L_s = \frac{1593}{74.45} = 21.4' \quad \text{CALL } 22'$$

$A_s = 52\ FT^2$ IS MET (BY INSPECTION)

CHECK OVERFLOW WEIR SIZE (WQ_V DISCHARGE)

$R_V = 0.750$
$WQ_V = 0.75$ watershed-inches $= Q$
$P = 1.0''$

$$CN = \frac{1000}{10+5P+10Q-10(Q^2+1.25QP)^{1/2}} = 97.5 \quad \text{USE } \underline{\underline{98}} \Rightarrow I_a = 0.041$$

R0020337

$I_a/P = 0.041 \Rightarrow$ USE MIN $= 0.10$ $\Rightarrow q_u = 1010$ csm/in from TR-55
$T_c = 0.10$
$Q_p = q_u A\, WQ_V = 1010\left(\frac{2.34}{640}\right)(0.75) = 2.77$ cfs

contracted weir equation

5' CONTRACTED WEIR @ ... $^{3/2}$ ... $^{1.5}$ 3.19 cfs ✓ OK

Laurel MARC Station Lot
Sand Filter Design - Circular Section Geometry

Diameter D	Depth d	d/D	Top Width T	Theta		Area A
				Radians	Degrees	
10	0	0	0	0	0	0
10	0.5	0.05	4.36	0.90	51.7	1.47
10	1.0	0.10	6.00	1.29	73.7	4.09
10	1.5	0.15	7.14	1.59	91.1	7.39
10	2.0	0.20	8.00	1.85	106.3	11.18
10	2.5	0.25	8.66	2.09	120.0	15.35
10	3.0	0.30	9.17	2.32	132.8	19.82
10	3.5	0.35	9.54	2.53	145.1	24.50
10	4.0	0.40	9.80	2.74	156.9	29.34
10	4.5	0.45	9.95	2.94	168.5	34.28
10	5.0	0.50	10.00	3.14	180.0	39.27
10	5.5	0.55	9.95	2.94	168.5	44.26
10	6.0	0.60	9.80	2.74	156.9	49.20
10	6.5	0.65	9.54	2.53	145.1	54.04
10	7.0	0.70	9.17	2.32	132.8	58.72
10	7.5	0.75	8.66	2.09	120.0	63.19
10	8.0	0.80	8.00	1.85	106.3	67.36
10	8.5	0.85	7.14	1.59	91.1	71.15
10	9.0	0.90	6.00	1.29	73.7	74.45
10	9.5	0.95	4.36	0.90	51.7	77.07
10	10.0	1.00	0	0	0	78.54

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Consulting Engineers

SHEET NO. ______ OF ______
CALCULATED BY BGB DATE 12/2/98
CHECKED BY ______ DATE ______
SCALE ______

Surface Sand Filter Design

A_f = Surface Area of filter bed (ft^2) = $\frac{WQ_v \times d_f}{[K(h_f + d_f)t_f]}$ = 846.0 SF

WQ_v = 5922 cf

d_f = filter bed depth = 1.5'

K = Coeff. of permeability = 3.5 ft/day for sand

h_f = Avg height of water above filter bed = 1.5'

t_f = Design filter bed drain time = 1 day

A_f provided ~ 27'-10" x 31'-2" = 867 SF > 846 SF ∴ O.K.

A_s = Sedimentation basin surface area = (0.066) WQ_v ~ 391 SF
(for I ≤ 75%)

A_s provided = 694 SF > 391 SF ∴ O.K.

V_s = Storage Volume of entire system = 0.75 x WQ_v = 4441.5 CF

V_s provided = 5954 CF > 4441 ∴ O.K.

Open Channel Practices

O-1 Dry Swale
O-2 Wet Swale
O-3 Off-line Bioretention Cells

R0020340

O-1 Dry Swale: Design Notes

- High space requirement
- Swale has made-soil and underdrains to prevent "nuisance water"
- Ideal for roads and residential streets

R0020341

O-1 Dry Swale

DA = < 5 acres * *may be larger in some instances

Maintenance = 2.0

Comm. Accept.= 1.5

Cost = 2.5

Treatment

Re_v	X
Cp_v	
WQ_v	X
Q_{p2}	

Pollutant Removal

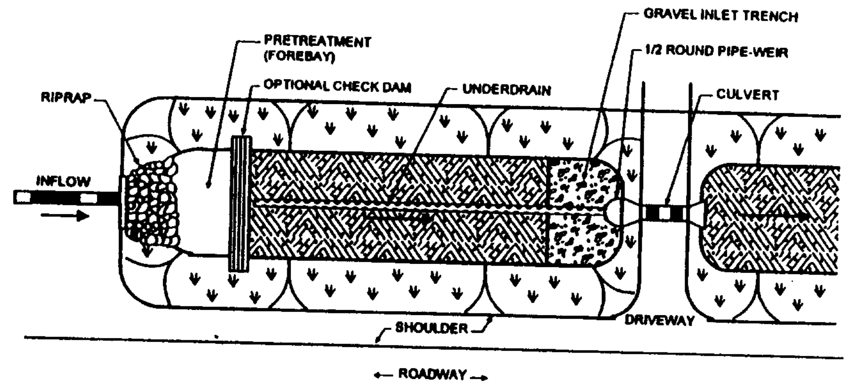
- TSS = 90
- TP = 75
- TN = 90 *

* limited pollutant removal data

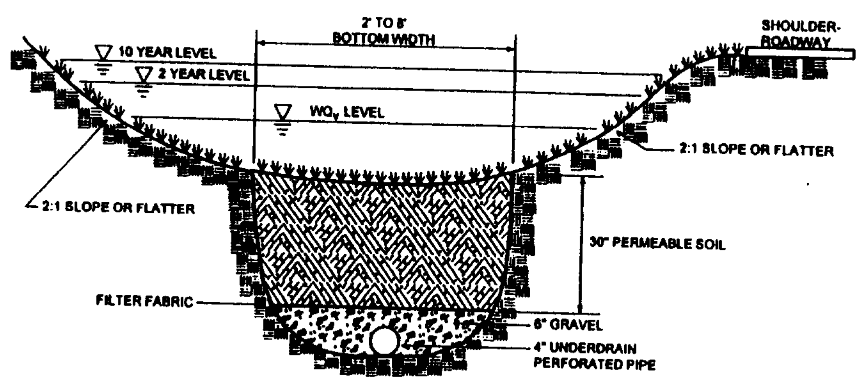
O-2 Wet Swale: Design Notes

- Used when water table is close to surface
- Creates a linear series of wetland cells
- Not recommended for residential areas

O-1	Figure 3.18 Example of Dry Swale	O-1



PLAN VIEW



SECTION

Dry swales are used at low density residential projects or for very small impervious areas.

O-2 Wet Swale

DA = < 5 acres * (*may be larger in some instances)

Maintenance = 2.0

Comm. Accept.= 1.5

Cost = 4.0

Treatment

Re_v	
Cp_v	
WQ_v	x
Q_{p2}	

Pollutant Removal

TSS = 80	TP = 25 *	TN = 40 *

* limited pollutant removal data

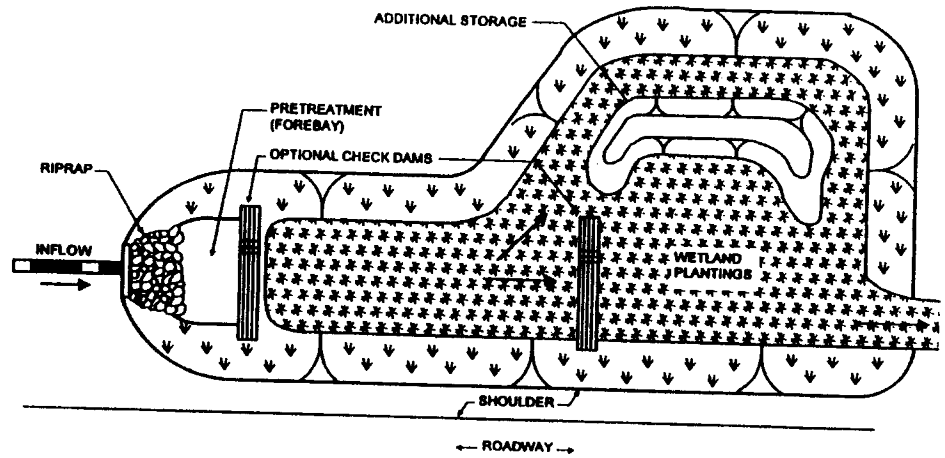
BMPs that do not fully meet WQv

- Water Quality Inlets
- Dry Extended Detention
- Filter Strips
- Grass Channels (biofilter)
- Dry Wells
- Deep Sump Pits

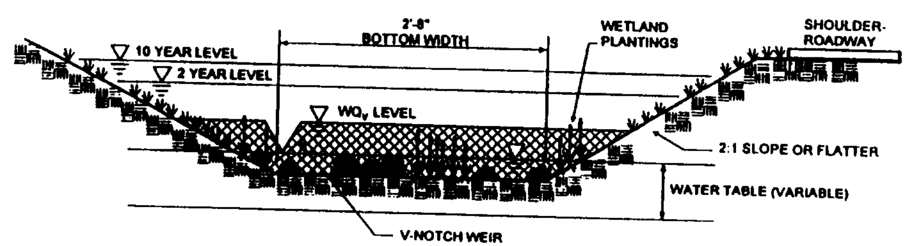
These practices may be combined with other BMPs to provide Rev, pretreatment or WQv requirements

R0020346

O-2	**Figure 3.19** Example of Wet Swale	O-2



PLAN VIEW



PROFILE

Wet swales are ideal for treating highway runoff in low lying or flat terrain areas.

R0020347

BMPs not currently recommended

Conventional Dry Pond
Dry ED Pond
Infiltration Basin
Oil/Grit Separator

R0020348

Ignore this section is Repeated in Section 13 and is in good order

BMP SELECTION AND LOCATION

SELECTING THE RIGHT BMP
BMP SELECTION EXAMPLE

EXCERPT FROM MARYLAND'S DRAFT TECHNICAL SUPPORT DOCUMENT FOR THE STATE BMP MANUAL- CHAPTER 4: A GUIDE TO BMP SELECTION & LOCATION IN THE STATE OF MARYLAND

Repeat in 13

BMP Selection and Location

Six Step Screening Process

1. Watershed Management Objectives
2. Terrain Factors
3. Stormwater Treatment Suitability
4. Physical Feasibility
5. Community and Environmental Benefits
6. Locational/Permitting Factors

Center for Watershed Protection

Step 1. Watershed Management Objective

- Maryland Critical Area (IDA's)
- Coldwater Streams (Maryland Use III and IV)
- Sensitive (Maryland Use I, IV, and Ic less than 15%)
- Wellhead Protection
- Reservoir Protection
- Shellfish/Beach Protection (Maryland Use II)

Center for Watershed Protection

BMP SELECTION MATRIX No. 1:
SPECIAL WATERSHED DESIGN REQUIREMENTS

BMPs	Critical Area	Cold-water	Sensitive	Ground. Protection	Reservoir Protect.	Shellfish Beach
Ponds	Drainage area may limit except for P5. P1 has low removal rate	P2, P3, and P4 restricted, limit ED to 12 hrs offline design shading	Require Control of Cpv, usually 1year 24 ED	May require liner if A soils are present pretreat hotspots 2 to 4 ft SD	Require Cpv Control	Moderate bacteria removal, but design to prevent geese. permanent pool
Wetlands	Drainage area may limit, W-4 excepted	W1, W2 and W3 restricted	Same as above			Provide 48 hr ED for max coliform dieoff
Infiltration	are often infeasible due to soils or water table in tidal area	Useful, if site has right soil	may be difficult to infiltrate the Cpv	SD from wells and water table. No hotspot runoff infiltrate rooftop runoff	SD from bedrock and water table. Pretreat runoff	OK, but a min 4 ft SD is required
Filtering Systems	OK	OK, but evaluate for stream warming	Must be combined another ED basin to provide Cpv	yes, if designed w/ no exfilter	Filtering may be required for pretreat.	mod. to high coliform removal
Open Channels	OK	OK	Must be linked w/ ED basin to provide Cpv	OK, but hotspot runoff must be adequately treated		poor coliform removal for O-2 and O-3

SD = Separation Distance

Step 2. Terrain Factors

- Low Relief
- Karst
- Mountainous

Center for Watershed Protection

BMP SELECTION MATRIX No. 2:
TERRAIN FACTORS

BMPs	Low Relief	Karst	Mountainous
Ponds	Maximum ponding depth of 4 feet	Require poly or clay liner max ponding depth geotechnical tests	Maximum pool depth 8 ft
Wetlands	OK	require polyliner geotechnical testing	Maximum pool depth 8 ft Embankment heights restricted
Infiltration	NOT Recommended. Minimum distance to water table of 2 feet	NOT ALLOWED	Max slope 8% trenches must have flat bottom
Filtering Systems	Several designs limited by low head (F1 and F2)	Use poly-liner or impermeable membrane to seal bottom	OK
Open Channels	Not generally feasible due to low slopes	OK	Often infeasible if slopes are 4% or greater

Note: SD = separation distance to seasonally high water table or bedrock

Step 3. Stormwater Treatment Suitability

- Recharge (Re_v)
- WQ_v
- Cp_v
- Qp
- Ability to accept hotspot runoff

Center for Watershed Protection

R0020354

Step 4. Physical Feasibility

- Soils
- Water Table
- Drainage Area
- Slope
- Head
- Bedrock

Step 5. Other Factors

- Maintenance Burden
- Community Acceptance
- Construction Cost
- Habitat Creation
- Others

Step 6. Locational/Permitting Considerations

- Wetlands
- Streams
- Stream and Shoreline Buffers
- Floodplains
- Forest Conservation Areas
- Steep Slopes
- Existing/Proposed Utilities
- Residential Setbacks

Center for Watershed Protection

BMP Selection Guide

Key feasibility criteria for different BMPs

Feasibility Criteria	Pond Systems	Wetland Systems	Infiltration Systems	Filter Systems
Soils	Most soils	Most soils	> .5 in/hr	All soils
Drainage Area	10-20 ac min	10-20 ac min	2-5 ac max	2-5 ac preferred
Minimum Head	3-6 feet	1-6 feet	2-4 feet	2-5 feet
Space	2-3% of DA	3-5% of DA	2-3% of site	2-6% of site
Cost	Low	Moderate	High	Mod-High
Water Table	No restrictions	No restrictions	2-4 ft above	2 ft above
Cleanout	5-10 years	2-5 years	1-2 years	1-3 years
Quantity Mgmt	Yes	Yes	No	No
Longevity	20-50 years	20-50 years	1-5 years?	5-20 years?

Center for Watershed Protection

BMP Selection Example

Watershed Considerations

(Matrix No. 1)

Cold-water receiving stream

- Ponds: ED with micro-pool, 12 hour detention, off line design, shading, others restricted
- Wetlands: Most are restricted
- Infiltration: OK
- Filters: OK
- Open Channels: OK

BMP SELECTION MATRIX No. 5:
COMMUNITY AND ENVIRONMENTAL FACTORS

GENERAL BMP LIST	Main. Burden	Comm. Accept	Const. Cost	Habitat	Other Factors
P-1 Micropool ED	3.5	4.0	1.0	3.5	trash/debris
P-2 Wet Pond	1.5	1.5	2.0	2.5	High pond premium
P-3 Wet ED Pond	2.0	2.0	2.0	3.0	
P-4 Multiple Pond	2.0	1.5	3.0	1.5	
P-5 Pocket Pond	4.0	3.0	1.5	4.0	drawdowns
W-1 Shallow Marsh	3.5	2.0	3.5	1.5	
W-2 ED Wetland	3.0	2.5	2.5	2.0	Limit ED depth
W-3 Pond/Wetland	2.0	1.5	3.0	1.0	
W-4 Pocket Marsh	4.0	3.0	2.0	3.5	drawdowns
W-5 Gravel Wetland	4.0	4.0	3.0	4.5	Possible odors
I-1 Infil. Trench	5.0	2.0	3.5	5.0	Avoid large stone
I-2 Shallow I-Basin	5.0	4.0	3.0	4.5	Frequent pooling
I-3 Porous Pavement	5.0	1.0	3.0	5.0	
F-1 Surface SF	3.5	2.5	4.0	5.0	Minimize concrete
F-2 Underground SF	4.0	1.0	4.5	5.0	Out of sight
F-3 Perimeter SF	3.5	1.0	4.0	5.0	Traffic bearing
F-4 Organic SF	3.5	2.5	4.0	5.0	Change compost
F-5 Pocket Sand Filter	4.0	2.5	3.0	5.0	
F-6 Bioretention	2.0	1.5	2.5	4.0	Landscaping
O-1 Dry Swale	2.0	1.5	2.5	4.5	
O-2 Wet Swale	2.0	1.5	1.5	4.0	Possible mosquitos
O-3 Bioretention Cell	2.0	1.5	1.5	4.0	

BMP Selection Example

Treatment Suitability

(Matrix No. 3

Recharge and Channel protection controls (Re_v and Cp_v)

- Ponds: limited Re_v, Cp_v OK
- Wetlands: limited Re_v, Cp_v OK
- Infiltration: Re_v good, Cp_v unlikely
- Filters: limited Re_v, no Cp_v
- Bioretention: Re_v good, Cp_v depends
- Open channels: limited Re_v, no Cp_v

BMP Selection Example

- 50 acre single family subdivision
- 15,000 sq ft lot sizes
- Karst topography
- Cold-water receiving stream (Maryland Use IV)
- Drains to headwater stream (approx. 150 acre DA)

BMP Selection Example

Preferred Alternatives

(multiple practices)

- Micro-pool ED for Cp_v & some WQ_v
  - minimizes thermal impacts (provide shading & off line design)
  - provide 12 hr ED for Cp_v
  - drainage area appropriate
  - provides some water quality control
  - provide liner, if necessary
  - appropriate for land use
- Bioretention for Re_v & WQ_v
  - provides recharge
  - provides water quality
  - ok for karst (no infiltration, limited open channel applications)
  - appropriate for land use
  - 5 to 10 locations necessary
  - pretreat with filter strips

R0020363

BMP Selection Example

Terrain Consideration

(Matrix No. 2)

Karst Topography

- Ponds: Poly- or clay liner recommended: (geotech. to confirm)
- Wetlands: same
- Infiltration: Not allowed
- Filters: Liners or concrete shell
- Open channels: OK, but consider increased infiltration (geotech. to confirm)

preclude a BMP. At the end of this step, the designer can screen the BMP options down to a manageable number, and determine if a single BMP or multiple BMP system is needed to meet the four stormwater sizing criteria for the site.

Step No. 4 Physical Feasibility

Are there any physical constraints at the project site that might restrict or preclude the use of a particular BMP? In this step, the designer screens the BMP list using Matrix No. 4 to determine if the soils, water table, drainage area, slope or head conditions present at a particular development site that might limit the use of a BMP. In many cases, the designer can use the matrix to identify geotechnical or other tests to confirm physical feasibility.

Step No. 5 Community and Environmental Benefits/Drawbacks

Do the remaining BMPs have any important community or environmental benefits or drawbacks that would influence the selection process? In this step, a matrix is used to compare the 22 BMPs on the list in regard to maintenance, habitat, community acceptance, cost and other environmental factors

Step No. 6 Locational Considerations

What environmental features must be avoided or considered when locating the BMP system at my development site, so as to fully comply with State and Federal laws and permits? In this step, the designer follows an environmental features checklist that asks whether any of the following are present at the site: wetlands, waters of the US, stream or shoreline buffers, forest conservation areas, etc. Brief guidance is then provided on "fingerprinting techniques" to locate the BMP so as to avoid impacts to sensitive resources. If the BMP is located within sensitive environmental features, a brief summary of State and federal permitting requirements will be provided.

Summary. The six step approach is intended to compactly present comparative information for the 22 BMPs on the list in a condensed format. Some of the comparative information in the matrices reflects our recent interviews with engineers across the State, and general research into the physiographic differences in the State.

The advantage of the six step approach is that it allows manual readers to use whatever matrices they need for design, and also provides a step-wise approach for the novice designer or plan reviewer. A more user-friendly and attractive format will be developed for the final manual.

BMP Selection Example

Physical Feasibility

(Matrix No. 4)

Drainage area

- Ponds: 10-25 acre min. (except pocket)
- Wetlands: 25 acre min. (except pocket)
- Infiltration: 10 ac max.
- Filters: 10 ac max.
- Bioretention: 5-10 ac max.
- Open channels: 5 max.

Shellfish/Bacteria. Watersheds that drain to specific shellfish harvesting areas or public swimming beaches require a higher level of BMP treatment to prevent closings due to bacterial contamination from stormwater runoff. In these watersheds, BMPs are explicitly designed to maximize bacteria removal.

Section 4.0 A Guide to BMP Selection and Location in the State of Maryland

Section 4.1 Introduction

This section outlines a process for selecting the best BMP or group of BMPs at a development site, and provides guidance on factors to consider on where to put the BMP ~~on~~ the site. The process is used to screen the 22 designs on the BMP list that could meet the pollutant removal targets for the WQ_v. The process asks the designer to go through a six step screening process, that progressively examines:

- Watershed Factors
- Terrain Factors
- Stormwater Treatment Suitability
- Physical Feasibility Factors
- Community and Environmental Benefits
- Locational Considerations

More detail on the step-wise screening process is provided below:

Step No. 1 Watershed Factors

Is the project located in a watershed that has special watershed design objectives or constraints that must be met? Matrix No.1 outlines BMP restrictions or additional design requirements that must be considered if the project lies within the Maryland Critical Area, Cold-water watersheds, Sensitive Watersheds, Aquifer Protection Areas, Water Supply Reservoirs, and Shellfish/Beach Protection Zones.

Step No. 2 Terrain Factors

Is the project located in a portion of the State that has particular constraints imposed by local terrain and or underlying geology? Matrix No. 2 details BMP restrictions for karst regions (portions of Carrol, Frederick and Washington Counties) and low relief areas of the lower Eastern Shore.

Step No. 3 Stormwater Treatment Suitability

Can the BMP meet all of my stormwater treatment requirements for my site, or will a combination of BMPs be needed? In this step, the designer can screen the BMP list using Matrix No. 3 to determine if a particular BMP can meet the Re_v, C_{pv} and/or Q_p storage requirements, In addition, this third matrix allows the designer to determine if the BMP is capable of treating hotspot runoff, and provides relative indexes for land consumption and safety risk that might

Each of the 22 BMPs on the list are presumed capable of achieving a long-term removal rate of 80% for total suspended solids, which has been identified as a base criterion for BMP performance under the recently issued CZARA 6217 guidance (see Section 3).

Section 4.3 Terrain Factors

Three key factors to consider are low-relief, karst and mountainous terrain. In the state of Maryland, *Low Relief Areas* can be defined as the Eastern Shore Counties, particularly below Choptank River, while most of the *Karst* and major carbonaceous rock areas are found in portions of Carrol County, Frederick County and Washington County. Mountainous areas are found in the Western part of the State.

BMP SELECTION MATRIX No. 2: TERRAIN FACTORS

BMPs	Low Relief	Karst	Mountainous
Ponds	Maximum ponding depth of 4 feet	Require poly or clay liner max ponding depth geotechnical tests	Maximum pool depth 8 ft
Wetlands	OK	require polyliner geotechnical testing	Maximum pool depth 8 ft Embankment heights restricted
Infiltration	NOT Recommended. Minimum distance to water table of 2 feet	NOT ALLOWED	Max slope 8% trenches must have flat bottom
Filtering Systems	Several designs limited by low head (F1 and F2)	Use poly-liner or impermeable membrane to seal bottom	OK
Open Channels	Not generally feasible due to low slopes	OK	Often infeasible if slopes are 4% or greater

Note: SD = separation distance to seasonally high water table or bedrock

Section 4.2 Watershed Factors

In some cases, higher pollutant removal or environmental performance is needed to fully protect aquatic resources and human health and safety within a particular watershed. Therefore, a shorter list of BMPs may need to be considered for selection within these watersheds or zones. They include:

Maryland Critical Area Intensively Developed Areas (IDAs). BMPs located within the Intensively Developed Area (IDA) of the Maryland Critical Area (a zone extending 1000 feet landward from mean high tide) must demonstrate compliance with the "10% Rule" The rule mandates that post development stormwater phosphorus loads must be reduced to 10% below pre-development loads, using the methodology developed by Herson et al, 1994. Updated estimates of long term keystone pollutant removal rates can be found in Section 3.5.

Coldwater Streams (Maryland Use III). These cold and cool water streams have habitat qualities capable of supporting trout and other sensitive aquatic organisms. Therefore, the design objective is to maintain habitat quality by preventing stream warming, maintaining natural recharge, preventing bank and channel erosion, and preserving the natural riparian corridor. Some BMPs can have adverse downstream impacts on cold-water streams, and their use is highly restricted.

Sensitive Streams (Maryland Use IV, or Impervious Cover less than 15%). These streams also possess high quality warm-water aquatic resources. The design objectives are to maintain habitat quality through the same techniques used for cold-water streams, with the exception that stream warming is not as severe of a design constraint. Designers may need to provide Cp_v to protect stream channels from erosion. These streams are specially designated by local authorities (e.g., Piney Branch Special Protection Area in Montgomery County), or may be designated if a project triggers the 401 or 404 permit process.

Wellhead Protection. Areas that recharge existing public water supply wells present a unique management challenge. The key design constraint is to prevent possible groundwater contamination by preventing infiltration of hotspot runoff. At the same time, recharge of unpolluted stormwater is encouraged to maintain flow in streams and wells during dry weather.

Reservoir Protection. Watersheds that deliver surface runoff to a public water supply reservoir or impoundment are a special concern. Depending on the treatment available at the water intake, it may be necessary to control several pollutants of concern to a higher level, such as bacteria, nutrients, sediment or metals. One particular management concern is enhanced treatment for pollutant hotspots that pose a greater risk to drinking water safety.

BMP Selection Matrix No. 3 STORMWATER TREATMENT SUITABILITY

GENERAL BMP LIST	Rev Ability	Cpv Control	Qp2 Control	safety index	space index	accept hotspot runoff
P-1 Micropool ED	no	yes	yes	1.5	1.5	yes *
P-2 Wet Pond	no	yes	yes	4.0	3.0	yes*
P-3 Wet ED Pond	no	yes	yes	4.5	2.0	yes*
P-4 Multiple Pond	no	yes	yes	4.0	3.5	yes*
P-5 Pocket Pond	no	yes	yes	3.0	1.5	yes*
W-1 Shallow Marsh	no	yes	yes	2.0	5.0	yes*
W-2 ED Wetland	no	yes	yes	2.5	3.0	yes*
W-3 Pond/Wetland	no	yes	yes	3.5	4.0	yes*
W-4 Pocket Marsh	no	yes	depends	2.0	2.5	yes*
W-5 Gravel Wetland	no	yes	depends	1.5	3.0	yes
I-1 Infil. Trench	yes	depends	depends	1.0	2.0	NO
I-2 Shallow I-Basin	yes	depends	depends	1.0	3.5	NO
I-3 Porous Pavement	yes	depends	depends	1.0	1.0	NO
F-1 Surface Sand Filter	no, unless exfilter	depends	no	2.0	2.0	yes **
F-2 Underground SF	no	no	no	3.0	1.0	yes
F-3 Perimeter SF	no	no	no	1.0	1.5	yes
F-4 Organic SF	no	no	no	1.5	2.0	yes**
F-5 Pocket Sand Filter	no, unless exfilter	no	no	1.5	2.0	yes**
F-6 Bioretention	yes	depends	no	1.0	3.5	yes**
O-1 Dry Swale	yes	no	no	1.0	3.0	yes**
O-2 Wet Swale	no	no	no	1.5	3.0	NO
O-3 Off-line Swale	yes	no	no	1.5	3.5	yes **

* only if four foot separation distance is maintained from the floor of the pond to the seasonally high water table (2 feet on Lower Eastern Shore)

** only if bottom of facility is lined with impermeable filter fabric that prevents leachate infiltration

BMP SELECTION MATRIX No. 1: SPECIAL WATERSHED DESIGN REQUIREMENTS

BMPs	Critical Area	Cold-water	Sensitive	Ground Protection	Reservoir Protect	Shellfish Beach
Ponds	Drainage area may limit except for P5. P1 has low removal rate	P2, P3, and P4 restricted, limit ED to 12 hrs offline design shading	Require Control of Cpv, usually 1year 24 ED	May require liner if A soils are present pretreat hotspots 2 to 4 ft SD	Require Cpv Control	Moderate bacteria removal, but design to prevent geese. permanent pool
Wetlands	Drainage area may limit, W-4 excepted	W1, W2 and W3 restricted	Same as above			Provide 48 hr ED for max coliform dieoff
Infiltration	are often infeasible due to soils or water table in tidal area	Useful, if site has right soil	may be difficult to infiltrate the Cpv	SD from wells and water table. No hotspot runoff infiltrate rooftop runoff	SD from bedrock and water table. Pretreat runoff	OK, but a min 4 ft SD is required
Filtering Systems	OK	OK, but evaluate for stream warming	Must be combined another ED basin to provide Cpv	yes, if designed w/ no exfilter	Filtering may be required for pretreat.	mod. to high coliform removal
Open Channels	OK	OK	Must be linked w/ ED basin to provide Cpv	OK, but hotspot runoff must be adequately treated		poor coliform removal for O-2 and O-3

SD = Separation Distance

BMP SELECTION MATRIX No. 4: PHYSICAL FEASIBILITY

GENERAL BMP LIST	SOILS	WATER TABLE	DRAIN AREA (acres)	SLOPE	HEAD	Other
P-1 Micropool ED	A soils may require pond liner B soils may require testing	2 feet If hotspot or aquifer	10 min*	no more than 15%	6 to 8 ft	baseflow bedrock
P-2 Wet Pond			25 min*			
P-3 Wet ED Pond						
P-4 Multiple Pond						
P-5 Pocket Pond	NR	below WT	5 max		4 ft	
W-1 Shallow Marsh	A soils may require liner	2 feet if hotspot or aquifer	25 min	no more than 8%	3 to 5 ft	baseflow bedrock
W-2 ED Wetland						
W-3 Pond/Wetland						
W-4 Pocket Marsh	NR	below WT	5 max		2 to 3 ft	
W-5 Gravel Wetland	NR	2 feet			2 to 4 ft	
I-1 Infil. Trench	Fc > 0.52 inch/hr PT if Fc < 2.00 in/hr	4 feet		flat as possible	1 ft	Bedrock
I-2 Shallow I-Basin			10 max		3 ft	
I-3 Porous Pavement			5 max**		1 ft	
F-1 Surface Sand Filter	NR	2 feet	10 max **	no more than 6%	5 ft	
F-2 Underground SF			2 max **		5 to 7ft	
F-3 Perimeter SF			2 max **		2 to 3 ft	
F-4 Organic SF			5 max**		2 to 4 ft	
F-5 Pocket Sand Filter			2 max **		2 to 5 ft	
F-6 Bioretention	Made Soil				5 ft	
O-1 Dry Swale			5 max	usually 1 to 4% max	3 to 5 ft	
O-2 Wet Swale	NR	below WT	5 max		1 ft	
O-3 Bioretention Cell	Made Soil	2 feet	2 max		1 ft	

Notes: NR = not restricted, WT = water table, PT = pretreatment * unless adequate water balance and anti-clogging device installed ** drainage area can be larger in some instances.

Section 4.4 Stormwater Treatment Suitability

The third matrix examines the capability of each BMP to meet the stormwater treatment sizing criteria outlined in Technical Memo No. 3. Thus, it shows whether a BMP has the:

Ability to Provide Recharge Requirement (Re_v). It should be noted that other practices, not on the BMP list, are capable of meeting the Re_v requirement (e.g. grass channel, filter strip, disconnection of rooftop runoff and other practices outlined in Technical Memo No. 1). Thus, if a BMP on the matrix cannot meet the Re_v requirement, it informs the designer that supplemental recharge practices may be needed in the overall BMP design.

Ability to Provide Channel Protection (Cp_v). The matrix indicates whether the BMP can typically provide the Cp_v that may be needed in some watersheds. The finding that a particular BMP cannot meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one practice may be needed at the site to meet requirements (e.g., a bioretention area and a downstream ED pond).

Ability to Provide Quantity Control (Q_{p2} and/or Q_{10}) The matrix shows whether a BMP can typically meet the over-bank flooding criteria for the site. Again, the finding that a particular BMP cannot meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one practice may be needed at the site to meet requirements (e.g., a bioretention area and a downstream stormwater detention pond)

Safety Index– A comparative rating from 1 to 5 that expresses the potential safety risk of a BMP, The lower score indicates a safe BMP, while a higher score indicates that there may be potential safety risks to children associated with deep pools. The safety factor is included at this stage of the screening process since liability and safety are a paramount concern in many residential settings.

Space Consumption Index. A comparative rating from 1 to 5 that expresses how much space a BMP typically consumes at a site. A lower score indicates that the BMP consumes a relatively small amount of land, whereas a high score indicates the BMP may consume a relatively high fraction of land. Again, this factor is included in this early screening stage since many BMPs are severely constrained by land consumption.

Ability to Accept Hotspot Runoff. This last column examines the capability of a BMP to treat runoff from designated hotspots, as defined in Section 2.7. A BMP may be capable of accepting hotspot runoff, or may have some design restrictions as noted.

BMP SELECTION MATRIX No. 5: COMMUNITY AND ENVIRONMENTAL FACTORS

GENERAL BMP LIST	Main. Burden	Comm. Accept	Const. Cost	Habitat	Other Factors
P-1 Micropool ED	3.5	4.0	1.0	3.5	trash/debris
P-2 Wet Pond	1.5	1.5	2.0	2.5	High pond premium
P-3 Wet ED Pond	2.0	2.0	2.0	3.0	
P-4 Multiple Pond	2.0	1.5	3.0	1.5	
P-5 Pocket Pond	4.0	3.0	1.5	4.0	drawdowns
W-1 Shallow Marsh	3.5	2.0	3.5	1.5	
W-2 ED Wetland	3.0	2.5	2.5	2.0	Limit ED depth
W-3 Pond/Wetland	2.0	1.5	3.0	1.0	
W-4 Pocket Marsh	4.0	3.0	2.0	3.5	drawdowns
W-5 Gravel Wetland	4.0	4.0	3.0	4.5	Possible odors
I-1 Infil. Trench	5.0	2.0	3.5	5.0	Avoid large stone
I-2 Shallow I-Basin	5.0	4.0	3.0	4.5	Frequent pooling
I-3 Porous Pavement	5.0	1.0	3.0	5.0	
F-1 Surface SF	3.5	2.5	4.0	5.0	Minimize concrete
F-2 Underground SF	4.0	1.0	4.5	5.0	Out of sight
F-3 Perimeter SF	3.5	1.0	4.0	5.0	Traffic bearing
F-4 Organic SF	3.5	2.5	4.0	5.0	Change compost
F-5 Pocket Sand Filter	4.0	2.5	3.0	5.0	
F-6 Bioretention	2.0	1.5	2.5	4.0	Landscaping
O-1 Dry Swale	2.0	1.5	2.5	4.5	
O-2 Wet Swale	2.0	1.5	1.5	4.0	Possible mosquitos
O-3 Bioretention Cell	2.0	1.5	1.5	4.0	

Section 4.5 Physical Feasibility

At this point, the designer has whittled down the BMP list to a manageable number and can evaluate the remaining options given the actual physical conditions present on the site. This matrix will ultimately cross-reference the testing protocols needed to confirm physical conditions at the site. The six primary factors are:

Soils. The key evaluation factors are based on an initial investigation of the NRCS hydrologic soils groups at the site, followed by subsequent geotechnical tests to confirm permeability and other factors.

Water Table. Depth to the seasonally high water table from the bottom or floor of the practice

Drainage Area. Indicates the minimum or maximum drainage area that is considered suitable for the practice. If the drainage area present at the site is slightly greater than the maximum allowable drainage area needed for a practice, more than one practice can be installed. The minimum drainage areas indicated for ponds and wetlands should not be considered hard and fast limits, and may be increased or decreased depending on water availability (baseflow or groundwater) or the anti-clogging mechanisms employed.

Slope. This column evaluates the effect of slope on the practice. Specifically, the slope restrictions refer to local slope (how flat the area of practice installation must be) and up-gradient slopes (i.e., how steep can the contributing drainage area or flow length be)

Head. This column provides a typical estimate of the elevation difference needed from the inflow to the outflow to allow for gravity operation within the practice.

Other Factors. This column includes other physical restrictions such as depth to bedrock, proximity to wells and foundations, water balance, etc.

Section 4.6 Community and Environmental Factors

The fifth step involves an assessment of community and environmental factors that the BMP can provide. Again an index approach is used, where the given BMP is ranked from 1 to 5, with the lower score indicating that the practice has either a high benefit (or low drawbacks), and a higher score indicating that the particular practice has a low benefit or a major drawback for that factor.

Maintenance. This column assesses the maintenance burden for the practice, in terms of three criteria: frequency of scheduled maintenance, chronic maintenance problems (such as clogging) and reported failure rates.

Community acceptance. This column assesses community acceptance, as measured by three factors: market and preference surveys, reported nuisance problems, and visual orientation (i.e., is it prominently located or is it in an out of the way or underground location). It should be noted that a low rank may merely indicate the need for a better landscaping plan.

Construction Cost. The BMPs are ranked according to their relative construction cost per impervious acre treated. Please note that these rankings are preliminary, and await completion of the Center's ongoing BMP Cost Study.

Habitat. The BMPs are evaluated on their ability to provide wildlife or wetland habitat, assuming that an effort is made to landscape them appropriately. Objective criteria include: size, water features, wetland features and vegetation coverage in BMP and buffer.

Other Factors. This column indicates other factors that should be considered in BMP selection.

BMP SELECTION AND LOCATION

SELECTING THE RIGHT BMP
BMP SELECTION EXAMPLE

EXCERPT FROM MARYLAND'S DRAFT TECHNICAL SUPPORT DOCUMENT FOR THE STATE BMP MANUAL- CHAPTER 4: A GUIDE TO BMP SELECTION & LOCATION IN THE STATE OF MARYLAND

Section 4.7 Locational Considerations

In the last step, the designer follows a checklist to determine where the selected BMP or BMPs can be located at the site, given the environmental features that are present. The checklist also indicates what, if any, permits must be secured to construct the BMP. The checklist will be modeled after the MDE Stormwater Management Assessment and Flow Chart Documents, already developed by Comstock (1995). Some of the locational factors would include:

Wetlands. Including the limited conditions under which a degraded wetland can be modified to accept stormwater (e.g., retrofits), and forested wetlands, and requirements for State and Federal CWA Sec. 401 and 404 permits.

Streams: Outline the general restrictions for placing ponds and wetlands within waters of the US, and outlining the permit process to follow if they are located in the uppermost 300 feet of a perennial stream. Guidance on dealing with intermittent channels, agricultural drainage, ditches and other situations. Additional guidance on location of detention or Cp_v facilities in and near streams.

Stream and Shoreline Buffers. Restrictions or conditions for locating BMPs within the Critical Area Buffer Zone and local stream buffer zones will be highlighted.

Forest Conservation Area. Discussion of BMP location within the context of the Forest Conservation Act, including prohibition from locating BMPs in Priority 1 Forest Retention Areas, or within 100 feet of specimen trees. Opportunities for reforestation in stormwater buffer areas will be noted.

Steep Slopes: Construction of BMPs are generally restricted on slopes greater than 15%.

Floodplains. BMP restrictions if located within the 100 year floodplain may require approval under the MDE Waterway Construction Regulations (COMAR 26.17.05).

Existing and Proposed Utilities. Restrictions and setbacks from sewer lines, roads, cables and other utilities at the site.

Residential Setbacks. Required setback distances from residential structures.

NOTE: THE CENTER WILL DRAFT THIS SECTION IN THE SUMMER OF 1997 FOR STATE AND LOCAL REVIEW.

BMP Selection and Location

Six Step Screening Process

1. Watershed Management Objectives
2. Terrain Factors
3. Stormwater Treatment Suitability
4. Physical Feasibility
5. Community and Environmental Benefits
6. Locational/Permitting Factors

Step 1. Watershed Management Objective

- Maryland Critical Area (IDA's)
- Coldwater Streams (Maryland Use III and IV)
- Sensitive (Maryland Use I, IV, and Ic less than 15%)
- Wellhead Protection
- Reservoir Protection
- Shellfish/Beach Protection (Maryland Use II)

BMP Selection and Location

Selecting the right BMP
BMP selection example

Excerpt from Maryland's draft technical support document for the state BMP manual- Chapter 4: A guide to BMP selection & Location in the state of Maryland

BMP Selection and Location

Six Step Screening Process

1. Watershed Management Objectives
2. Terrain Factors
3. Stormwater Treatment Suitability
4. Physical Feasibility
5. Community and Environmental Benefits
6. Locational/Permitting Factors

Step 1. Watershed Management Objective

- Maryland Critical Area (IDA's)
- Coldwater Streams (Maryland Use III and IV)
- Sensitive (Maryland Use I, IV, and Ic less than 15%)
- Wellhead Protection
- Reservoir Protection
- Shellfish/Beach Protection (Maryland Use II)

BMP SELECTION MATRIX No. 1:
SPECIAL WATERSHED DESIGN REQUIREMENTS

BMPs	Critical Area	Cold-water	Sensitive	Ground. Protection	Reservoir Protect	Shellfish Beach
Ponds	Drainage area may limit except for P5. P1 has low removal rate	P2, P3, and P4 restricted, limit ED to 12 hrs offline design shading	Require Control of Cpv, usually 1year 24 ED	May require liner if A soils are present pretreat hotspots 2 to 4 ft SD	Require Cpv Control	Moderate bacteria removal, but design to prevent geese. permanent pool
Wetlands	Drainage area may limit, W-4 excepted	W1, W2 and W3 restricted	Same as above			Provide 48 hr ED for max coliform dieoff
Infiltration	are often infeasible due to soils or water table in tidal area	Useful, if site has right soil	may be difficult to infiltrate the Cpv	SD from wells and water table. No hotspot runoff infiltrate rooftop runoff	SD from bedrock and water table. Pretreat runoff	OK, but a min 4 ft SD is required
Filtering Systems	OK	OK, but evaluate for stream warming	Must be combined another ED basin to provide Cpv	yes, if designed w/ no exfilter	Filtering may be required for pretreat.	mod. to high coliform removal
Open Channels	OK	OK	Must be linked w/ ED basin to provide Cpv	OK, but hotspot runoff must be adequately treated		poor coliform removal for O-2 and O-3

SD = Separation Distance

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Step 2. Terrain Factors

- Low Relief
- Karst
- Mountainous

BMP SELECTION MATRIX No. 2:
TERRAIN FACTORS

BMPs	Low Relief	Karst	Mountainous
Ponds	Maximum ponding depth of 4 feet	Require poly or clay liner max ponding depth geotechnical tests	Maximum pool depth 8 ft
Wetlands	OK	require polyliner geotechnical testing	Maximum pool depth 8 ft Embankment heights. restricted
Infiltration	NOT Recommended. Minimum distance to water table of 2 feet	NOT ALLOWED	Max slope 8% trenches must have flat bottom
Filtering Systems	Several designs limited by low head (F1 and F2)	Use poly-liner or impermeable membrane to seal bottom	OK
Open Channels	Not generally feasible due to low slopes	OK	Often infeasible if slopes are 4% or greater

Note: SD = separation distance to seasonally high water table or bedrock

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Step 3. Stormwater Treatment Suitability

- Recharge (Re_v)
- WQ_v
- Cp_v
- Qp
- Ability to accept hotspot runoff

BMP Selection Matrix No. 3
STORMWATER TREATMENT SUITABILITY

GENERAL BMP LIST	Rev Ability	Cpv Control	Qp2 Control	safety index	space index	accept hotspot runoff
P-1 Micropool ED	no	yes	yes	1.5	1.5	yes *
P-2 Wet Pond	no	yes	yes	4.0	3.0	yes*
P-3 Wet ED Pond	no	yes	yes	4.5	2.0	yes*
P-4 Multiple Pond	no	yes	yes	4.0	3.5	yes*
P-5 Pocket Pond	no	yes	yes	3.0	1.5	yes*
W-1 Shallow Marsh	no	yes	yes	2.0	5.0	yes*
W-2 ED Wetland	no	yes	yes	2.5	3.0	yes*
W-3 Pond/Wetland	no	yes	yes	3.5	4.0	yes*
W-4 Pocket Marsh	no	yes	depends	2.0	2.5	yes*
W-5 Gravel Wetland	no	yes	depends	1.5	3.0	yes
I-1 Infil. Trench	yes	depends	depends	1.0	2.0	NO
I-2 Shallow I-Basin	yes	depends	depends	1.0	3.5	NO
I-3 Porous Pavement	yes	depends	depends	1.0	1.0	NO
F-1 Surface Sand Filter	no, unless exfilter	depends	no	2.0	2.0	yes **
F-2 Underground SF	no	no	no	3.0	1.0	yes
F-3 Perimeter SF	no	no	no	1.0	1.5	yes
F-4 Organic SF	no	no	no	1.5	2.0	yes**
F-5 Pocket Sand Filter	no, unless exfilter	no	no	1.5	2.0	yes**
F-6 Bioretention	yes	depends	no	1.0	3.5	yes**
O-1 Dry Swale	yes	no	no	1.0	3.0	yes**
O-2 Wet Swale	no	no	no	1.5	3.0	NO
O-3 Off-line Swale	yes	no	no	1.5	3.5	yes **

* only if four foot separation distance is maintained from the floor of the pond to the seasonally high water table (2 feet on Lower Eastern Shore)
** only if bottom of facility is lined with impermeable filter fabric that prevents leachate infiltration

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Step 4. Physical Feasibility

- Soils
- Water Table
- Drainage Area
- Slope
- Head
- Bedrock

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BMP SELECTION MATRIX No. 4:
PHYSICAL FEASIBILITY

GENERAL BMP LIST	SOILS	WATER TABLE	DRAIN AREA (acres)	SLOPE	HEAD	Other
P-1 Micropool ED	A soils may require pond liner B soils may require testing	2 feet If hotspot or aquifer	10 min*	no more than 15%	6 to 8 ft	baseflo w bedrock
P-2 Wet Pond			25 min*			
P-3 Wet ED Pond						
P-4 Multiple Pond						
P-5 Pocket Pond	NR	below WT	5 max		4 ft	
W-1 Shallow Marsh	A soils may require liner	2 feet if hotspot or aquifer	25 min	no more than 8%	3 to 5 ft	baseflo w bedrock
W-2 ED Wetland						
W-3 Pond/Wetland						
W-4 Pocket Marsh	NR	below WT	5 max		2 to 3 ft	
W-5 Gravel Wetland	NR	2 feet			2 to 4 ft	
I-1 Infil. Trench	Fc > 0.52 inch/hr PT if Fc < 2.00 in/hr	4 feet		flat as possible	1 ft	Bedrock
I-2 Shallow I-Basin			10 max		3 ft	
I-3 Porous Pavement			5 max**		1 ft	
F-1 Surface Sand Filter	NR	2 feet	10 max **	no more than 6%	5 ft	
F-2 Underground SF			2 max **		5 to 7ft	
F-3 Perimeter SF			2 max **		2 to 3 ft	
F-4 Organic SF			5 max**		2 to 4 ft	
F-5 Pocket Sand Filter			2 max **		2 to 5 ft	
F-6 Bioretention	Made Soil				5 ft	
O-1 Dry Swale			5 max	usually 1 to 4% max	3 to 5 ft	
O-2 Wet Swale	NR	below WT	5 max		1 ft	
O-3 Bioretention Cell	Made Soil	2 feet	2 max		1 ft	

Notes: NR= not restricted, WT= water table, PT = pretreatment * unless adequate water balance and anti-clogging device installed ** drainage area can be larger in some instances.

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BMP Selection Guide

Key feasibility criteria for different BMPs

Feasibility Criteria	Pond Systems	Wetland Systems	Infiltration Systems	Filter Systems
Soils	Most soils	Most soils	> .5 in/hr	All soils
Drainage Area	10-20 ac min	10-20 ac min	2-5 ac max	2-5 ac preferred
Minimum Head	3-6 feet	1-6 feet	2-4 feet	2-5 feet
Space	2-3% of DA	3-5% of DA	2-3% of site	2-6% of site
Cost	Low	Moderate	High	Mod-High
Water Table	No restrictions	No restrictions	2-4 ft above	2 ft above
Cleanout	5-10 years	2-5 years	1-2 years	1-3 years
Quantity Mgmt	Yes	Yes	No	No
Longevity	20-50 years	20-50 years	1-5 years?	5-20 years?

Center for Watershed Protection

Step 5. Other Factors

- Maintenance Burden
- Community Acceptance
- Construction Cost
- Habitat Creation
- Others

BMP SELECTION MATRIX No. 5:
COMMUNITY AND ENVIRONMENTAL FACTORS

GENERAL BMP LIST	Main. Burden	Comm. Accept	Const. Cost	Habitat	Other Factors
P-1 Micropool ED	3.5	4.0	1.0	3.5	trash/debris
P-2 Wet Pond	1.5	1.5	2.0	2.5	High pond premium
P-3 Wet ED Pond	2.0	2.0	2.0	3.0	
P-4 Multiple Pond	2.0	1.5	3.0	1.5	
P-5 Pocket Pond	4.0	3.0	1.5	4.0	drawdowns
W-1 Shallow Marsh	3.5	2.0	3.5	1.5	
W-2 ED Wetland	3.0	2.5	2.5	2.0	Limit ED depth
W-3 Pond/Wetland	2.0	1.5	3.0	1.0	
W-4 Pocket Marsh	4.0	3.0	2.0	3.5	drawdowns
W-5 Gravel Wetland	4.0	4.0	3.0	4.5	Possible odors
I-1 Infil. Trench	5.0	2.0	3.5	5.0	Avoid large stone
I-2 Shallow I-Basin	5.0	4.0	3.0	4.5	Frequent pooling
I-3 Porous Pavement	5.0	1.0	3.0	5.0	
F-1 Surface SF	3.5	2.5	4.0	5.0	Minimize concrete
F-2 Underground SF	4.0	1.0	4.5	5.0	Out of sight
F-3 Perimeter SF	3.5	1.0	4.0	5.0	Traffic bearing
F-4 Organic SF	3.5	2.5	4.0	5.0	Change compost
F-5 Pocket Sand Filter	4.0	2.5	3.0	5.0	
F-6 Bioretention	2.0	1.5	2.5	4.0	Landscaping
O-1 Dry Swale	2.0	1.5	2.5	4.5	
O-2 Wet Swale	2.0	1.5	1.5	4.0	Possible mosquitos
O-3 Bioretention Cell	2.0	1.5	1.5	4.0	

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Step 6. Locational/Permitting Considerations

- Wetlands
- Streams
- Stream and Shoreline Buffers
- Floodplains
- Forest Conservation Areas
- Steep Slopes
- Existing/Proposed Utilities
- Residential Setbacks

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BMP Selection Example

- 50 acre single family subdivision
- 15,000 sq ft lot sizes
- Karst topography
- Cold-water receiving stream (Maryland Use IV)
- Drains to headwater stream (approx. 150 acre DA)

R0020394

BMP Selection Example

Watershed Considerations

(Matrix No. 1)

Cold-water receiving stream

- Ponds: ED with micro-pool, 12 hour detention, off line design, shading, others restricted
- Wetlands: Most are restricted
- Infiltration: OK
- Filters: OK
- Open Channels: OK

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BMP Selection Example

Terrain Consideration

(Matrix No. 2)

Karst Topography

- Ponds: Poly- or clay liner recommended: (geotech. to confirm)
- Wetlands: same
- Infiltration: Not allowed
- Filters: Liners or concrete shell
- Open channels: OK, but consider increased infiltration (geotech. to confirm)

R0020396

BMP Selection Example

Treatment Suitability

(Matrix No. 3

Recharge and Channel protection controls (Re_v and Cp_v)

- Ponds: limited Re_v, Cp_v OK
- Wetlands: limited Re_v, Cp_v OK
- Infiltration: Re_v good, Cp_v unlikely
- Filters: limited Re_v, no Cp_v
- Bioretention: Re_v good, Cp_v depends
- Open channels: limited Re_v, no Cp_v

R0020397

BMP Selection Example

Physical Feasibility

(Matrix No. 4)

Drainage area

- Ponds: 10-25 acre min. (except pocket)
- Wetlands: 25 acre min. (except pocket)
- Infiltration: 10 ac max.
- Filters: 10 ac max.
- Bioretention: 5-10 ac max.
- Open channels: 5 max.

R0020398

BMP Selection Example

Preferred Alternatives

(multiple practices)

- Micro-pool ED for Cp_v & some WQ_v
  - minimizes thermal impacts (provide shading & off line design)
  - provide 12 hr ED for Cp_v
  - drainage area appropriate
  - provides some water quality control
  - provide liner, if necessary
  - appropriate for land use
- Bioretention for Re_v & WQ_v
  - provides recharge
  - provides water quality
  - ok for karst (no infiltration, limited open channel applications)
  - appropriate for land use
  - 5 to 10 locations necessary
  - pretreat with filter strips

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Section 4.0 A Guide to BMP Selection and Location in the State of Maryland

Section 4.1 Introduction

This section outlines a process for selecting the best BMP or group of BMPs at a development site, and provides guidance on factors to consider on where to put the BMP on the site. The process is used to screen the 22 designs on the BMP list that could meet the pollutant removal targets for the WQ_v. The process asks the designer to go through a six step screening process, that progressively examines:

- Watershed Factors
- Terrain Factors
- Stormwater Treatment Suitability
- Physical Feasibility Factors
- Community and Environmental Benefits
- Locational Considerations

More detail on the step-wise screening process is provided below:

Step No. 1 Watershed Factors

Is the project located in a watershed that has special watershed design objectives or constraints that must be met? Matrix No.1 outlines BMP restrictions or additional design requirements that must be considered if the project lies within the Maryland Critical Area, Cold-water watersheds, Sensitive Watersheds, Aquifer Protection Areas, Water Supply Reservoirs, and Shellfish/Beach Protection Zones.

Step No. 2 Terrain Factors

Is the project located in a portion of the State that has particular constraints imposed by local terrain and or underlying geology? Matrix No. 2 details BMP restrictions for karst regions (portions of Carrol, Frederick and Washington Counties) and low relief areas of the lower Eastern Shore.

Step No. 3 Stormwater Treatment Suitability

Can the BMP meet all of my stormwater treatment requirements for my site, or will a combination of BMPs be needed? In this step, the designer can screen the BMP list using Matrix No. 3 to determine if a particular BMP can meet the Re_v, C_{pv} and/or Q_p storage requirements, In addition, this third matrix allows the designer to determine if the BMP is capable of treating hotspot runoff, and provides relative indexes for land consumption and safety risk that might

R0020400

preclude a BMP. At the end of this step, the designer can screen the BMP options down to a manageable number, and determine if a single BMP or multiple BMP system is needed to meet the four stormwater sizing criteria for the site.

Step No. 4 Physical Feasibility

Are there any physical constraints at the project site that might restrict or preclude the use of a particular BMP? In this step, the designer screens the BMP list using Matrix No. 4 to determine if the soils, water table, drainage area, slope or head conditions present at a particular development site that might limit the use of a BMP. In many cases, the designer can use the matrix to identify geotechnical or other tests to confirm physical feasibility.

Step No. 5 Community and Environmental Benefits/Drawbacks

Do the remaining BMPs have any important community or environmental benefits or drawbacks that would influence the selection process? In this step, a matrix is used to compare the 22 BMPs on the list in regard to maintenance, habitat, community acceptance, cost and other environmental factors

Step No. 6 Locational Considerations

What environmental features must be avoided or considered when locating the BMP system at my development site, so as to fully comply with State and Federal laws and permits? In this step, the designer follows an environmental features checklist that asks whether any of the following are present at the site: wetlands, waters of the US, stream or shoreline buffers, forest conservation areas, etc. Brief guidance is then provided on "fingerprinting techniques" to locate the BMP so as to avoid impacts to sensitive resources. If the BMP is located within sensitive environmental features, a brief summary of State and federal permitting requirements will be provided.

Summary. The six step approach is intended to compactly present comparative information for the 22 BMPs on the list in a condensed format. Some of the comparative information in the matrices reflects our recent interviews with engineers across the State, and general research into the physiographic differences in the State.

The advantage of the six step approach is that it allows manual readers to use whatever matrices they need for design, and also provides a step-wise approach for the novice designer or plan reviewer. **A more user-friendly and attractive format will be developed for the final manual.**

Section 4.2 Watershed Factors

In some cases, higher pollutant removal or environmental performance is needed to fully protect aquatic resources and human health and safety within a particular watershed. Therefore, a shorter list of BMPs may need to be considered for selection within these watersheds or zones. They include:

Maryland Critical Area Intensively Developed Areas (IDAs). BMPs located within the Intensively Developed Area (IDA) of the Maryland Critical Area (a zone extending 1000 feet landward from mean high tide) must demonstrate compliance with the "10% Rule" The rule mandates that post development stormwater phosphorus loads must be reduced to 10% below pre-development loads, using the methodology developed by Herson et al, 1994. Updated estimates of long term keystone pollutant removal rates can be found in Section 3.5.

Coldwater Streams (Maryland Use III). These cold and cool water streams have habitat qualities capable of supporting trout and other sensitive aquatic organisms. Therefore, the design objective is to maintain habitat quality by preventing stream warming, maintaining natural recharge, preventing bank and channel erosion, and preserving the natural riparian corridor. Some BMPs can have adverse downstream impacts on cold-water streams, and their use is highly restricted.

Sensitive Streams (Maryland Use IV, or Impervious Cover less than 15%). These streams also possess high quality warm-water aquatic resources. The design objectives are to maintain habitat quality through the same techniques used for cold-water streams, with the exception that stream warming is not as severe of a design constraint. Designers may need to provide Cp_v to protect stream channels from erosion. These streams are specially designated by local authorities (e.g., Piney Branch Special Protection Area in Montgomery County), or may be designated if a project triggers the 401 or 404 permit process.

Wellhead Protection. Areas that recharge existing public water supply wells present a unique management challenge. The key design constraint is to prevent possible groundwater contamination by preventing infiltration of hotspot runoff. At the same time, recharge of unpolluted stormwater is encouraged to maintain flow in streams and wells during dry weather.

Reservoir Protection. Watersheds that deliver surface runoff to a public water supply reservoir or impoundment are a special concern. Depending on the treatment available at the water intake, it may be necessary to control several pollutants of concern to a higher level, such as bacteria, nutrients, sediment or metals. One particular management concern is enhanced treatment for pollutant hotspots that pose a greater risk to drinking water safety.

Shellfish/Bacteria. Watersheds that drain to specific shellfish harvesting areas or public swimming beaches require a higher level of BMP treatment to prevent closings due to bacterial contamination from stormwater runoff. In these watersheds, BMPs are explicitly designed to maximize bacteria removal.

BMP SELECTION MATRIX No. 1: SPECIAL WATERSHED DESIGN REQUIREMENTS

BMPs	Critical Area	Cold-water	Sensitive	Ground Protection	Reservoir Protect	Shellfish Beach
Ponds	Drainage area may limit except for P5. P1 has low removal rate	P2, P3, and P4 restricted, limit ED to 12 hrs offline design shading	Require Control of Cpv, usually 1year 24 ED	May require liner if A soils are present pretreat hotspots 2 to 4 ft SD	Require Cpv Control	Moderate bacteria removal, but design to prevent geese. permanent pool
Wetlands	Drainage area may limit, W-4 excepted	W1, W2 and W3 restricted	Same as above			Provide 48 hr ED for max coliform dieoff
Infiltration	are often infeasible due to soils or water table in tidal area	Useful, if site has right soil	may be difficult to infiltrate the Cpv	SD from wells and water table. No hotspot runoff infiltrate rooftop runoff	SD from bedrock and water table. Pretreat runoff	OK, but a min 4 ft SD is required
Filtering Systems	OK	OK, but evaluate for stream warming	Must be combined another ED basin to provide Cpv	yes, if designed w/ no exfilter	Filtering may be required for pretreat.	mod. to high coliform removal
Open Channels	OK	OK	Must be linked w/ ED basin to provide Cpv	OK, but hotspot runoff must be adequately treated		poor coliform removal for O-2 and O-3

SD = Separation Distance

R0020404

Each of the 22 BMPs on the list are presumed capable of achieving a long-term removal rate of 80% for total suspended solids, which has been identified as a base criterion for BMP performance under the recently issued CZARA 6217 guidance (see Section 3).

Section 4.3 Terrain Factors

Three key factors to consider are low-relief, karst and mountainous terrain. In the state of Maryland, *Low Relief Areas* can be defined as the Eastern Shore Counties, particularly below Choptank River, while most of the *Karst* and major carbonaceous rock areas are found in portions of Carrol County, Frederick County and Washington County. Mountainous areas are found in the Western part of the State.

BMP SELECTION MATRIX No. 2: TERRAIN FACTORS

BMPs	Low Relief	Karst	Mountainous
Ponds	Maximum ponding depth of 4 feet	Require poly or clay liner max ponding depth geotechnical tests	Maximum pool depth 8 ft
Wetlands	OK	require polyliner geotechnical testing	Maximum pool depth 8 ft Embankment heights restricted
Infiltration	NOT Recommended. Minimum distance to water table of 2 feet	NOT ALLOWED	Max slope 8% trenches must have flat bottom
Filtering Systems	Several designs limited by low head (F1 and F2)	Use poly-liner or impermeable membrane to seal bottom	OK
Open Channels	Not generally feasible due to low slopes	OK	Often infeasible if slopes are 4% or greater

Note: SD = separation distance to seasonally high water table or bedrock

R0020405

Section 4.4 Stormwater Treatment Suitability

The third matrix examines the capability of each BMP to meet the stormwater treatment sizing criteria outlined in Technical Memo No. 3. Thus, it shows whether a BMP has the:

Ability to Provide Recharge Requirement (Re_v). It should be noted that other practices, not on the BMP list, are capable of meeting the Re_v requirement (e.g. grass channel, filter strip, disconnection of rooftop runoff and other practices outlined in Technical Memo No. 1). Thus, if a BMP on the matrix cannot meet the Re_v requirement, it informs the designer that supplemental recharge practices may be needed in the overall BMP design.

Ability to Provide Channel Protection (Cp_v). The matrix indicates whether the BMP can typically provide the Cp_v that may be needed in some watersheds. The finding that a particular BMP cannot meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one practice may be needed at the site to meet requirements (e.g., a bioretention area and a downstream ED pond).

Ability to Provide Quantity Control (Q_{p2} and/or Q_{p10}) The matrix shows whether a BMP can typically meet the over-bank flooding criteria for the site. Again, the finding that a particular BMP cannot meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one practice may be needed at the site to meet requirements (e.g., a bioretention area and a downstream stormwater detention pond)

Safety Index-- A comparative rating from 1 to 5 that expresses the potential safety risk of a BMP, The lower score indicates a safe BMP, while a higher score indicates that there may be potential safety risks to children associated with deep pools. The safety factor is included at this stage of the screening process since liability and safety are a paramount concern in many residential settings.

Space Consumption Index. A comparative rating from 1 to 5 that expresses how much space a BMP typically consumes at a site. A lower score indicates that the BMP consumes a relatively small amount of land, whereas a high score indicates the BMP may consume a relatively high fraction of land. Again, this factor is included in this early screening stage since many BMPs are severely constrained by land consumption.

Ability to Accept Hotspot Runoff. This last column examines the capability of a BMP to treat runoff from designated hotspots, as defined in Section 2.7. A BMP may be capable of accepting hotspot runoff, or may have some design restrictions as noted.

BMP Selection Matrix No. 3 STORMWATER TREATMENT SUITABILITY

GENERAL BMP LIST	Rev Ability	Cpv Control	Qp2 Control	safety index	space index	accept hotspot runoff
P-1 Micropool ED	no	yes	yes	1.5	1.5	yes *
P-2 Wet Pond	no	yes	yes	4.0	3.0	yes*
P-3 Wet ED Pond	no	yes	yes	4.5	2.0	yes*
P-4 Multiple Pond	no	yes	yes	4.0	3.5	yes*
P-5 Pocket Pond	no	yes	yes	3.0	1.5	yes*
W-1 Shallow Marsh	no	yes	yes	2.0	5.0	yes*
W-2 ED Wetland	no	yes	yes	2.5	3.0	yes*
W-3 Pond/Wetland	no	yes	yes	3.5	4.0	yes*
W-4 Pocket Marsh	no	yes	depends	2.0	2.5	yes*
W-5 Gravel Wetland	no	yes	depends	1.5	3.0	yes
I-1 Infil. Trench	yes	depends	depends	1.0	2.0	NO
I-2 Shallow I-Basin	yes	depends	depends	1.0	3.5	NO
I-3 Porous Pavement	yes	depends	depends	1.0	1.0	NO
F-1 Surface Sand Filter	no, unless exfilter	depends	no	2.0	2.0	yes **
F-2 Underground SF	no	no	no	3.0	1.0	yes
F-3 Perimeter SF	no	no	no	1.0	1.5	yes
F-4 Organic SF	no	no	no	1.5	2.0	yes**
F-5 Pocket Sand Filter	no, unless exfilter	no	no	1.5	2.0	yes**
F-6 Bioretention	yes	depends	no	1.0	3.5	yes**
O-1 Dry Swale	yes	no	no	1.0	3.0	yes**
O-2 Wet Swale	no	no	no	1.5	3.0	NO
O-3 Off-line Swale	yes	no	no	1.5	3.5	yes **

* only if four foot separation distance is maintained from the floor of the pond to the seasonally high water table (2 feet on Lower Eastern Shore)

** only if bottom of facility is lined with impermeable filter fabric that prevents leachate infiltration

R0020407

Section 4.5 Physical Feasibility

At this point, the designer has whittled down the BMP list to a manageable number and can evaluate the remaining options given the actual physical conditions present on the site. This matrix will ultimately cross-reference the testing protocols needed to confirm physical conditions at the site. The six primary factors are:

Soils. The key evaluation factors are based on an initial investigation of the NRCS hydrologic soils groups at the site, followed by subsequent geotechnical tests to confirm permeability and other factors.

Water Table. Depth to the seasonally high water table from the bottom or floor of the practice

Drainage Area. Indicates the minimum or maximum drainage area that is considered suitable for the practice. If the drainage area present at the site is slightly greater than the maximum allowable drainage area needed for a practice, more than one practice can be installed. The minimum drainage areas indicated for ponds and wetlands should not be considered hard and fast limits, and may be increased or decreased depending on water availability (baseflow or groundwater) or the anti-clogging mechanisms employed.

Slope. This column evaluates the effect of slope on the practice. Specifically, the slope restrictions refer to local slope (how flat the area of practice installation must be) and up-gradient slopes (i.e., how steep can the contributing drainage area or flow length be)

Head. This column provides a typical estimate of the elevation difference needed from the inflow to the outflow to allow for gravity operation within the practice.

Other Factors. This column includes other physical restrictions such as depth to bedrock, proximity to wells and foundations, water balance, etc.

BMP SELECTION MATRIX No. 4: PHYSICAL FEASIBILITY

GENERAL BMP LIST	SOILS	WATER TABLE	DRAIN AREA (acres)	SLOPE	HEAD	Other
P-1 Micropool ED	A soils may require pond liner B soils may require testing	2 feet If hotspot or aquifer	10 min*	no more than 15%	6 to 8 ft	baseflow bedrock
P-2 Wet Pond			25 min*			
P-3 Wet ED Pond						
P-4 Multiple Pond						
P-5 Pocket Pond	NR	below WT	5 max		4 ft	
W-1 Shallow Marsh	A soils may require liner	2 feet if hotspot or aquifer	25 min	no more than 8%	3 to 5 ft	baseflow bedrock
W-2 ED Wetland						
W-3 Pond/Wetland						
W-4 Pocket Marsh	NR	below WT	5 max		2 to 3 ft	
W-5 Gravel Wetland	NR	2 feet			2 to 4 ft	
I-1 Infil. Trench	Fc > 0.52 inch/hr PT if Fc < 2.00 in/hr	4 feet		flat as possible	1 ft	Bedrock
I-2 Shallow I-Basin			10 max		3 ft	
I-3 Porous Pavement			5 max**		1 ft	
F-1 Surface Sand Filter	NR	2 feet	10 max **	no more than 6%	5 ft	
F-2 Underground SF			2 max **		5 to 7ft	
F-3 Perimeter SF			2 max **		2 to 3 ft	
F-4 Organic SF			5 max**		2 to 4 ft	
F-5 Pocket Sand Filter			2 max **		2 to 5 ft	
F-6 Bioretention	Made Soil				5 ft	
O-1 Dry Swale			5 max	usually 1 to 4% max	3 to 5 ft	
O-2 Wet Swale	NR	below WT	5 max		1 ft	
O-3 Bioretention Cell	Made Soil	2 feet	2 max		1 ft	

Notes: NR = not restricted, WT = water table, PT = pretreatment * unless adequate water balance and anti-clogging device installed ** drainage area can be larger in some instances.

R0020409

Section 4.6 Community and Environmental Factors

The fifth step involves an assessment of community and environmental factors that the BMP can provide. Again an index approach is used, where the given BMP is ranked from 1 to 5, with the lower score indicating that the practice has either a high benefit (or low drawbacks), and a higher score indicating that the particular practice has a low benefit or a major drawback for that factor.

Maintenance. This column assesses the maintenance burden for the practice, in terms of three criteria: frequency of scheduled maintenance, chronic maintenance problems (such as clogging) and reported failure rates.

Community acceptance. This column assesses community acceptance, as measured by three factors: market and preference surveys, reported nuisance problems, and visual orientation (i.e., is it prominently located or is it in an out of the way or underground location). It should be noted that a low rank may merely indicate the need for a better landscaping plan.

Construction Cost. The BMPs are ranked according to their relative construction cost per impervious acre treated. Please note that these rankings are preliminary, and await completion of the Center's ongoing BMP Cost Study.

Habitat. The BMPs are evaluated on their ability to provide wildlife or wetland habitat, assuming that an effort is made to landscape them appropriately. Objective criteria include: size, water features, wetland features and vegetation coverage in BMP and buffer.

Other Factors. This column indicates other factors that should be considered in BMP selection.

BMP SELECTION MATRIX No. 5: COMMUNITY AND ENVIRONMENTAL FACTORS

GENERAL BMP LIST	Main. Burden	Comm. Accept	Const. Cost	Habitat	Other Factors
P-1 Micropool ED	3.5	4.0	1.0	3.5	trash/debris
P-2 Wet Pond	1.5	1.5	2.0	2.5	High pond premium
P-3 Wet ED Pond	2.0	2.0	2.0	3.0	
P-4 Multiple Pond	2.0	1.5	3.0	1.5	
P-5 Pocket Pond	4.0	3.0	1.5	4.0	drawdowns
W-1 Shallow Marsh	3.5	2.0	3.5	1.5	
W-2 ED Wetland	3.0	2.5	2.5	2.0	Limit ED depth
W-3 Pond/Wetland	2.0	1.5	3.0	1.0	
W-4 Pocket Marsh	4.0	3.0	2.0	3.5	drawdowns
W-5 Gravel Wetland	4.0	4.0	3.0	4.5	Possible odors
I-1 Infil. Trench	5.0	2.0	3.5	5.0	Avoid large stone
I-2 Shallow I-Basin	5.0	4.0	3.0	4.5	Frequent pooling
I-3 Porous Pavement	5.0	1.0	3.0	5.0	
F-1 Surface SF	3.5	2.5	4.0	5.0	Minimize concrete
F-2 Underground SF	4.0	1.0	4.5	5.0	Out of sight
F-3 Perimeter SF	3.5	1.0	4.0	5.0	Traffic bearing
F-4 Organic SF	3.5	2.5	4.0	5.0	Change compost
F-5 Pocket Sand Filter	4.0	2.5	3.0	5.0	
F-6 Bioretention	2.0	1.5	2.5	4.0	Landscaping
O-1 Dry Swale	2.0	1.5	2.5	4.5	
O-2 Wet Swale	2.0	1.5	1.5	4.0	Possible mosquitos
O-3 Bioretention Cell	2.0	1.5	1.5	4.0	

R0020411

Section 4.7 Locational Considerations

In the last step, the designer follows a checklist to determine where the selected BMP or BMPs can be located at the site, given the environmental features that are present. The checklist also indicates what, if any, permits must be secured to construct the BMP. The checklist will be modeled after the MDE Stormwater Management Assessment and Flow Chart Documents, already developed by Comstock (1995). Some of the locational factors would include:

Wetlands. Including the limited conditions under which a degraded wetland can be modified to accept stormwater (e.g., retrofits), and forested wetlands, and requirements for State and Federal CWA Sec. 401 and 404 permits.

Streams: Outline the general restrictions for placing ponds and wetlands within waters of the US, and outlining the permit process to follow if they are located in the uppermost 300 feet of a perennial stream. Guidance on dealing with intermittent channels, agricultural drainage, ditches and other situations. Additional guidance on location of detention or Cp_v facilities in and near streams.

Stream and Shoreline Buffers. Restrictions or conditions for locating BMPs within the Critical Area Buffer Zone and local stream buffer zones will be highlighted.

Forest Conservation Area. Discussion of BMP location within the context of the Forest Conservation Act, including prohibition from locating BMPs in Priority 1 Forest Retention Areas, or within 100 feet of specimen trees. Opportunities for reforestation in stormwater buffer areas will be noted.

Steep Slopes: Construction of BMPs are generally restricted on slopes greater than 15%.

Floodplains. BMP restrictions if located within the 100 year floodplain may require approval under the MDE Waterway Construction Regulations (COMAR 26.17.05).

Existing and Proposed Utilities. Restrictions and setbacks from sewer lines, roads, cables and other utilities at the site.

Residential Setbacks. Required setback distances from residential structures.

NOTE: THE CENTER WILL DRAFT THIS SECTION IN THE SUMMER OF 1997 FOR STATE AND LOCAL REVIEW.

'BMP Selection and Location

Selecting the right BMP
BMP selection example

Excerpt from Maryland's draft technical support document for the state BMP manual- Chapter 4: A guide to BMP selection & Location in the state of Maryland

R0020413

BMP Selection and Location

Six Step Screening Process

1. Watershed Management Objectives
2. Terrain Factors
3. Stormwater Treatment Suitability
4. Physical Feasibility
5. Community and Environmental Benefits
6. Locational/Permitting Factors

Center for Watershed Protection

Step 1. Watershed Management Objective

- Maryland Critical Area (IDA's)
- Coldwater Streams (Maryland Use III and IV)
- Sensitive (Maryland Use I, IV, and Ic less than 15%)
- Wellhead Protection
- Reservoir Protection
- Shellfish/Beach Protection (Maryland Use II)

Center for Watershed Protection

R0020414

BMP SELECTION MATRIX No. 1:
SPECIAL WATERSHED DESIGN REQUIREMENTS

BMPs	Critical Area	Cold-water	Sensitive	Ground Protection	Reservoir Protect	Shellfish Beach
Ponds	Drainage area may limit except for P5. P1 has low removal rate	P2, P3, and P4 restricted, limit ED to 12 hrs offline design shading	Require Control of Cpv, usually 1year 24 ED	May require liner if A soils are present pretreat hotspots 2 to 4 ft SD	Require Cpv Control	Moderate bacteria removal, but design to prevent geese. permanent pool
Wetlands	Drainage area may limit, W-4 excepted	W1, W2 and W3 restricted	Same as above			Provide 48 hr ED for max coliform dieoff
Infiltration	are often infeasible due to soils or water table in tidal area	Useful, if site has right soil	may be difficult to infiltrate the Cpv	SD from wells and water table. No hotspot runoff infiltrate rooftop runoff	SD from bedrock and water table. Pretreat runoff	OK, but a min 4 ft SD is required
Filtering Systems	OK	OK, but evaluate for stream warming	Must be combined another ED basin to provide Cpv	yes, if designed w/ no exfilter	Filtering may be required for pretreat.	mod. to high coliform removal
Open Channels	OK	OK	Must be linked w/ ED basin to provide Cpv	OK, but hotspot runoff must be adequately treated		poor coliform removal for O-2 and O-3

SD = Separation Distance

R0020415

Step 2. Terrain Factors

- Low Relief
- Karst
- Mountainous

Center for Watershed Protection

BMP SELECTION MATRIX No. 2:
TERRAIN FACTORS

BMPs	Low Relief	Karst	Mountainous
Ponds	Maximum ponding depth of 4 feet	Require poly or clay liner max ponding depth geotechnical tests	Maximum pool depth 8 ft
Wetlands	OK	require polyliner geotechnical testing	Maximum pool depth 8 ft Embankment heights. restricted
Infiltration	NOT Recommended. Minimum distance to water table of 2 feet	NOT ALLOWED	Max slope 8% trenches must have flat bottom
Filtering Systems	Several designs limited by low head (F1 and F2)	Use poly-liner or impermeable membrane to seal bottom	OK
Open Channels	Not generally feasible due to low slopes	OK	Often infeasible if slopes are 4% or greater

Note: SD = separation distance to seasonally high water table or bedrock

R0020417

Step 3. Stormwater Treatment Suitability

- Recharge (Re_v)
- WQ_v
- Cp_v
- Qp
- Ability to accept hotspot runoff

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BMP Selection Matrix No. 3

STORMWATER TREATMENT SUITABILITY

GENERAL BMP LIST	Rev Ability	Cpv Control	Qp2 Control	safety index	space index	accept hotspot runoff
P-1 Micropool ED	no	yes	yes	1.5	1.5	yes *
P-2 Wet Pond	no	yes	yes	4.0	3.0	yes*
P-3 Wet ED Pond	no	yes	yes	4.5	2.0	yes*
P-4 Multiple Pond	no	yes	yes	4.0	3.5	yes*
P-5 Pocket Pond	no	yes	yes	3.0	1.5	yes*
W-1 Shallow Marsh	no	yes	yes	2.0	5.0	yes*
W-2 ED Wetland	no	yes	yes	2.5	3.0	yes*
W-3 Pond/Wetland	no	yes	yes	3.5	4.0	yes*
W-4 Pocket Marsh	no	yes	depends	2.0	2.5	yes*
W-5 Gravel Wetland	no	yes	depends	1.5	3.0	yes
I-1 Infil. Trench	yes	depends	depends	1.0	2.0	NO
I-2 Shallow I-Basin	yes	depends	depends	1.0	3.5	NO
I-3 Porous Pavement	yes	depends	depends	1.0	1.0	NO
F-1 Surface Sand Filter	no, unless exfilter	depends	no	2.0	2.0	yes **
F-2 Underground SF	no	no	no	3.0	1.0	yes
F-3 Perimeter SF	no	no	no	1.0	1.5	yes
F-4 Organic SF	no	no	no	1.5	2.0	yes**
F-5 Pocket Sand Filter	no, unless exfilter	no	no	1.5	2.0	yes**
F-6 Bioretention	yes	depends	no	1.0	3.5	yes**
O-1 Dry Swale	yes	no	no	1.0	3.0	yes**
O-2 Wet Swale	no	no	no	1.5	3.0	NO
O-3 Off-line Swale	yes	no	no	1.5	3.5	yes **

* only if four foot separation distance is maintained from the floor of the pond to the seasonally high water table (2 feet on Lower Eastern Shore)

** only if bottom of facility is lined with impermeable filter fabric that prevents leachate infiltration

R0020419

Step 4. Physical Feasibility

- Soils
- Water Table
- Drainage Area
- Slope
- Head
- Bedrock

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R0020420

BMP SELECTION MATRIX No. 4:
PHYSICAL FEASIBILITY

GENERAL BMP LIST	SOILS	WATER TABLE	DRAIN AREA (acres)	SLOPE	HEAD	Other
P-1 Micropool ED	A soils may require pond liner B soils may require testing	2 feet If hotspot or aquifer	10 min*	no more than 15%	6 to 8 ft	baseflo w bedrock
P-2 Wet Pond			25 min*			
P-3 Wet ED Pond						
P-4 Multiple Pond						
P-5 Pocket Pond	NR	below WT	5 max		4 ft	
W-1 Shallow Marsh	A soils may require liner	2 feet if hotspot or aquifer	25 min	no more than 8%	3 to 5 ft	baseflo w bedrock
W-2 ED Wetland						
W-3 Pond/Wetland						
W-4 Pocket Marsh	NR	below WT	5 max		2 to 3 ft	
W-5 Gravel Wetland	NR	2 feet			2 to 4 ft	
I-1 Infil. Trench	Fc > 0.52 inch/hr PT if Fc < 2.00 in/hr	4 feet		flat as possible	1 ft	Bedrock
I-2 Shallow I-Basin			10 max		3 ft	
I-3 Porous Pavement			5 max**		1 ft	
F-1 Surface Sand Filter	NR	2 feet	10 max **	no more than 6%	5 ft	
F-2 Underground SF			2 max **		5 to 7ft	
F-3 Perimeter SF			2 max **		2 to 3 ft	
F-4 Organic SF			5 max**		2 to 4 ft	
F-5 Pocket Sand Filter			2 max **		2 to 5 ft	
F-6 Bioretention	Made Soil				5 ft	
O-1 Dry Swale			5 max	usually 1 to 4% max	3 to 5 ft	
O-2 Wet Swale	NR	below WT	5 max		1 ft	
O-3 Bioretention Cell	Made Soil	2 feet	2 max		1 ft	

Notes: NR= not restricted, WT= water table, PT = pretreatment * unless adequate water balance and anti-clogging device installed ** drainage area can be larger in some instances.

R0020421

BMP Selection Guide

Key feasibility criteria for different BMPs

Feasibility Criteria	Pond Systems	Wetland Systems	Infiltration Systems	Filter Systems
Soils	Most soils	Most soils	> .5 in/hr	All soils
Drainage Area	10-20 ac min	10-20 ac min	2-5 ac max	2-5 ac preferred
Minimum Head	3-6 feet	1-6 feet	2-4 feet	2-5 feet
Space	2-3% of DA	3-5% of DA	2-3% of site	2-6% of site
Cost	Low	Moderate	High	Mod-High
Water Table	No restrictions	No restrictions	2-4 ft above	2 ft above
Cleanout	5-10 years	2-5 years	1-2 years	1-3 years
Quantity Mgmt	Yes	Yes	No	No
Longevity	20-50 years	20-50 years	1-5 years?	5-20 years?

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R0020422

Step 5. Other Factors

- Maintenance Burden
- Community Acceptance
- Construction Cost
- Habitat Creation
- Others

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R0020423

BMP SELECTION MATRIX No. 5:
COMMUNITY AND ENVIRONMENTAL FACTORS

GENERAL BMP LIST	Main. Burden	Comm. Accept	Const. Cost	Habitat	Other Factors
P-1 Micropool ED	3.5	4.0	1.0	3.5	trash/debris
P-2 Wet Pond	1.5	1.5	2.0	2.5	High pond premium
P-3 Wet ED Pond	2.0	2.0	2.0	3.0	
P-4 Multiple Pond	2.0	1.5	3.0	1.5	
P-5 Pocket Pond	4.0	3.0	1.5	4.0	drawdowns
W-1 Shallow Marsh	3.5	2.0	3.5	1.5	
W-2 ED Wetland	3.0	2.5	2.5	2.0	Limit ED depth
W-3 Pond/Wetland	2.0	1.5	3.0	1.0	
W-4 Pocket Marsh	4.0	3.0	2.0	3.5	drawdowns
W-5 Gravel Wetland	4.0	4.0	3.0	4.5	Possible odors
I-1 Infil. Trench	5.0	2.0	3.5	5.0	Avoid large stone
I-2 Shallow I-Basin	5.0	4.0	3.0	4.5	Frequent pooling
I-3 Porous Pavement	5.0	1.0	3.0	5.0	
F-1 Surface SF	3.5	2.5	4.0	5.0	Minimize concrete
F-2 Underground SF	4.0	1.0	4.5	5.0	Out of sight
F-3 Perimeter SF	3.5	1.0	4.0	5.0	Traffic bearing
F-4 Organic SF	3.5	2.5	4.0	5.0	Change compost
F-5 Pocket Sand Filter	4.0	2.5	3.0	5.0	
F-6 Bioretention	2.0	1.5	2.5	4.0	Landscaping
O-1 Dry Swale	2.0	1.5	2.5	4.5	
O-2 Wet Swale	2.0	1.5	1.5	4.0	Possible mosquitos
O-3 Bioretention Cell	2.0	1.5	1.5	4.0	

R0020424

Step 6. Locational/PermittingConsiderations

- Wetlands
- Streams
- Stream and Shoreline Buffers
- Floodplains
- Forest Conservation Areas
- Steep Slopes
- Existing/Proposed Utilities
- Residential Setbacks

Center for Watershed Protection

R0020425

BMP Selection Example

- 50 acre single family subdivision
- 15,000 sq ft lot sizes
- Karst topography
- Cold-water receiving stream (Maryland Use IV)
- Drains to headwater stream (approx. 150 acre DA)

R0020426

BMP Selection Example

Watershed Considerations

(Matrix No. 1)

Cold-water receiving stream

- Ponds: ED with micro-pool, 12 hour detention, off line design, shading, others restricted
- Wetlands: Most are restricted
- Infiltration: OK
- Filters: OK
- Open Channels: OK

R0020427

BMP Selection Example

Terrain Consideration

(Matrix No. 2)

Karst Topography

- Ponds: Poly- or clay liner recommended: (geotech. to confirm)
- Wetlands: same
- Infiltration: Not allowed
- Filters: Liners or concrete shell
- Open channels: OK, but consider increased infiltration (geotech. to confirm)

R0020428

BMP Selection Example

Treatment Suitability

(Matrix No. 3

Recharge and Channel protection controls (Re_v and Cp_v)

- Ponds: limited Re_v, Cp_v OK
- Wetlands: limited Re_v, Cp_v OK
- Infiltration: Re_v good, Cp_v unlikely
- Filters: limited Re_v, no Cp_v
- Bioretention: Re_v good, Cp_v depends
- Open channels: limited Re_v, no Cp_v

R0020429

BMP Selection Example

Physical Feasibility

(Matrix No. 4)

Drainage area

- Ponds: 10-25 acre min. (except pocket)
- Wetlands: 25 acre min. (except pocket)
- Infiltration: 10 ac max.
- Filters: 10 ac max.
- Bioretention: 5-10 ac max.
- Open channels: 5 max.

R0020430

BMP Selection Example

Preferred Alternatives

(multiple practices)

- Micro-pool ED for Cp_v & some WQ_v
  - minimizes thermal impacts (provide shading & off line design)
  - provide 12 hr ED for Cp_v
  - drainage area appropriate
  - provides some water quality control
  - provide liner, if necessary
  - appropriate for land use
- Bioretention for Re_v & WQ_v
  - provides recharge
  - provides water quality
  - ok for karst (no infiltration, limited open channel applications)
  - appropriate for land use
  - 5 to 10 locations necessary
  - pretreat with filter strips

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Section 4.0 A Guide to BMP Selection and Location in the State of Maryland

Section 4.1 Introduction

This section outlines a process for selecting the best BMP or group of BMPs at a development site, and provides guidance on factors to consider on where to put the BMP on the site. The process is used to screen the 22 designs on the BMP list that could meet the pollutant removal targets for the WQ_v. The process asks the designer to go through a six step screening process, that progressively examines:

- Watershed Factors
- Terrain Factors
- Stormwater Treatment Suitability
- Physical Feasibility Factors
- Community and Environmental Benefits
- Locational Considerations

More detail on the step-wise screening process is provided below:

Step No. 1 Watershed Factors

Is the project located in a watershed that has special watershed design objectives or constraints that must be met? Matrix No.1 outlines BMP restrictions or additional design requirements that must be considered if the project lies within the Maryland Critical Area, Cold-water watersheds, Sensitive Watersheds, Aquifer Protection Areas, Water Supply Reservoirs, and Shellfish/Beach Protection Zones.

Step No. 2 Terrain Factors

Is the project located in a portion of the State that has particular constraints imposed by local terrain and or underlying geology? Matrix No. 2 details BMP restrictions for karst regions (portions of Carrol, Frederick and Washington Counties) and low relief areas of the lower Eastern Shore.

Step No. 3 Stormwater Treatment Suitability

Can the BMP meet all of my stormwater treatment requirements for my site, or will a combination of BMPs be needed? In this step, the designer can screen the BMP list using Matrix No. 3 to determine if a particular BMP can meet the Re_v, C_{pv} and/or Q_p storage requirements, In addition, this third matrix allows the designer to determine if the BMP is capable of treating hotspot runoff, and provides relative indexes for land consumption and safety risk that might

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preclude a BMP. At the end of this step, the designer can screen the BMP options down to a manageable number, and determine if a single BMP or multiple BMP system is needed to meet the four stormwater sizing criteria for the site.

Step No. 4 **Physical Feasibility**

Are there any physical constraints at the project site that might restrict or preclude the use of a particular BMP? In this step, the designer screens the BMP list using Matrix No. 4 to determine if the soils, water table, drainage area, slope or head conditions present at a particular development site that might limit the use of a BMP. In many cases, the designer can use the matrix to identify geotechnical or other tests to confirm physical feasibility.

Step No. 5 **Community and Environmental Benefits/Drawbacks**

Do the remaining BMPs have any important community or environmental benefits or drawbacks that would influence the selection process? In this step, a matrix is used to compare the 22 BMPs on the list in regard to maintenance, habitat, community acceptance, cost and other environmental factors

Step No. 6 **Locational Considerations**

What environmental features must be avoided or considered when locating the BMP system at my development site, so as to fully comply with State and Federal laws and permits? In this step, the designer follows an environmental features checklist that asks whether any of the following are present at the site: wetlands, waters of the US, stream or shoreline buffers, forest conservation areas, etc. Brief guidance is then provided on "fingerprinting techniques" to locate the BMP so as to avoid impacts to sensitive resources. If the BMP is located within sensitive environmental features, a brief summary of State and federal permitting requirements will be provided.

Summary. The six step approach is intended to compactly present comparative information for the 22 BMPs on the list in a condensed format. Some of the comparative information in the matrices reflects our recent interviews with engineers across the State, and general research into the physiographic differences in the State.

The advantage of the six step approach is that it allows manual readers to use whatever matrices they need for design, and also provides a step-wise approach for the novice designer or plan reviewer. **A more user-friendly and attractive format will be developed for the final manual.**

Section 4.2 Watershed Factors

In some cases, higher pollutant removal or environmental performance is needed to fully protect aquatic resources and human health and safety within a particular watershed. Therefore, a shorter list of BMPs may need to be considered for selection within these watersheds or zones. They include:

Maryland Critical Area Intensively Developed Areas (IDAs). BMPs located within the Intensively Developed Area (IDA) of the Maryland Critical Area (a zone extending 1000 feet landward from mean high tide) must demonstrate compliance with the "10% Rule" The rule mandates that post development stormwater phosphorus loads must be reduced to 10% below pre-development loads, using the methodology developed by Herson et al, 1994. Updated estimates of long term keystone pollutant removal rates can be found in Section 3.5.

Coldwater Streams (Maryland Use III). These cold and cool water streams have habitat qualities capable of supporting trout and other sensitive aquatic organisms. Therefore, the design objective is to maintain habitat quality by preventing stream warming, maintaining natural recharge, preventing bank and channel erosion, and preserving the natural riparian corridor. Some BMPs can have adverse downstream impacts on cold-water streams, and their use is highly restricted.

Sensitive Streams (Maryland Use IV, or Impervious Cover less than 15%). These streams also possess high quality warm-water aquatic resources. The design objectives are to maintain habitat quality through the same techniques used for cold-water streams, with the exception that stream warming is not as severe of a design constraint. Designers may need to provide Cp_v to protect stream channels from erosion. These streams are specially designated by local authorities (e.g., Piney Branch Special Protection Area in Montgomery County), or may be designated if a project triggers the 401 or 404 permit process.

Wellhead Protection. Areas that recharge existing public water supply wells present a unique management challenge. The key design constraint is to prevent possible groundwater contamination by preventing infiltration of hotspot runoff. At the same time, recharge of unpolluted stormwater is encouraged to maintain flow in streams and wells during dry weather.

Reservoir Protection. Watersheds that deliver surface runoff to a public water supply reservoir or impoundment are a special concern. Depending on the treatment available at the water intake, it may be necessary to control several pollutants of concern to a higher level, such as bacteria, nutrients, sediment or metals. One particular management concern is enhanced treatment for pollutant hotspots that pose a greater risk to drinking water safety.

Shellfish/Bacteria. Watersheds that drain to specific shellfish harvesting areas or public swimming beaches require a higher level of BMP treatment to prevent closings due to bacterial contamination from stormwater runoff. In these watersheds, BMPs are explicitly designed to maximize bacteria removal.

BMP SELECTION MATRIX No. 1: SPECIAL WATERSHED DESIGN REQUIREMENTS

BMPs	Critical Area	Cold-water	Sensitive	Ground Protection	Reservoir Protect	Shellfish Beach
Ponds	Drainage area may limit except for P5. P1 has low removal rate	P2, P3, and P4 restricted, limit ED to 12 hrs offline design shading	Require Control of Cpv, usually 1year 24 ED	May require liner if A soils are present pretreat hotspots 2 to 4 ft SD	Require Cpv Control	Moderate bacteria removal, but design to prevent geese. permanent pool
Wetlands	Drainage area may limit, W-4 excepted	W1, W2 and W3 restricted	Same as above			Provide 48 hr ED for max coliform dieoff
Infiltration	are often infeasible due to soils or water table in tidal area	Useful, if site has right soil	may be difficult to infiltrate the Cpv	SD from wells and water table. No hotspot runoff infiltrate rooftop runoff	SD from bedrock and water table. Pretreat runoff	OK, but a min 4 ft SD is required
Filtering Systems	OK	OK, but evaluate for stream warming	Must be combined another ED basin to provide Cpv	yes, if designed w/ no exfilter	Filtering may be required for pretreat.	mod. to high coliform removal
Open Channels	OK	OK	Must be linked w/ ED basin to provide Cpv	OK, but hotspot runoff must be adequately treated		poor coliform removal for O-2 and O-3

SD = Separation Distance

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Each of the 22 BMPs on the list are presumed capable of achieving a long-term removal rate of 80% for total suspended solids, which has been identified as a base criterion for BMP performance under the recently issued CZARA 6217 guidance (see Section 3).

Section 4.3 Terrain Factors

Three key factors to consider are low-relief, karst and mountainous terrain. In the state of Maryland, *Low Relief Areas* can be defined as the Eastern Shore Counties, particularly below Choptank River, while most of the *Karst* and major carbonaceous rock areas are found in portions of Carrol County, Frederick County and Washington County. Mountainous areas are found in the Western part of the State.

BMP SELECTION MATRIX No. 2: TERRAIN FACTORS

BMPs	Low Relief	Karst	Mountainous
Ponds	Maximum ponding depth of 4 feet	Require poly or clay liner max ponding depth geotechnical tests	Maximum pool depth 8 ft
Wetlands	OK	require polyliner geotechnical testing	Maximum pool depth 8 ft Embankment heights restricted
Infiltration	NOT Recommended. Minimum distance to water table of 2 feet	NOT ALLOWED	Max slope 8% trenches must have flat bottom
Filtering Systems	Several designs limited by low head (F1 and F2)	Use poly-liner or impermeable membrane to seal bottom	OK
Open Channels	Not generally feasible due to low slopes	OK	Often infeasible if slopes are 4% or greater

Note: SD = separation distance to seasonally high water table or bedrock

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Section 4.4 Stormwater Treatment Suitability

The third matrix examines the capability of each BMP to meet the stormwater treatment sizing criteria outlined in Technical Memo No. 3. Thus, it shows whether a BMP has the:

Ability to Provide Recharge Requirement (Re_v). It should be noted that other practices, not on the BMP list, are capable of meeting the Re_v requirement (e.g. grass channel, filter strip, disconnection of rooftop runoff and other practices outlined in Technical Memo No. 1). Thus, if a BMP on the matrix cannot meet the Re_v requirement, it informs the designer that supplemental recharge practices may be needed in the overall BMP design.

Ability to Provide Channel Protection (Cp_v). The matrix indicates whether the BMP can typically provide the Cp_v that may be needed in some watersheds. The finding that a particular BMP cannot meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one practice may be needed at the site to meet requirements (e.g., a bioretention area and a downstream ED pond).

Ability to Provide Quantity Control (Q_{p2} and/or Q_{p10}) The matrix shows whether a BMP can typically meet the over-bank flooding criteria for the site. Again, the finding that a particular BMP cannot meet the requirement does not necessarily mean that it should be eliminated from consideration, but rather is a reminder that more than one practice may be needed at the site to meet requirements (e.g., a bioretention area and a downstream stormwater detention pond)

Safety Index– A comparative rating from 1 to 5 that expresses the potential safety risk of a BMP, The lower score indicates a safe BMP, while a higher score indicates that there may be potential safety risks to children associated with deep pools. The safety factor is included at this stage of the screening process since liability and safety are a paramount concern in many residential settings.

Space Consumption Index. A comparative rating from 1 to 5 that expresses how much space a BMP typically consumes at a site. A lower score indicates that the BMP consumes a relatively small amount of land, whereas a high score indicates the BMP may consume a relatively high fraction of land. Again, this factor is included in this early screening stage since many BMPs are severely constrained by land consumption.

Ability to Accept Hotspot Runoff. This last column examines the capability of a BMP to treat runoff from designated hotspots, as defined in Section 2.7. A BMP may be capable of accepting hotspot runoff, or may have some design restrictions as noted.

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BMP Selection Matrix No. 3 STORMWATER TREATMENT SUITABILITY

GENERAL BMP LIST	Rev Ability	Cpv Control	Qp2 Control	safety index	space index	accept hotspot runoff
P-1 Micropool ED	no	yes	yes	1.5	1.5	yes *
P-2 Wet Pond	no	yes	yes	4.0	3.0	yes*
P-3 Wet ED Pond	no	yes	yes	4.5	2.0	yes*
P-4 Multiple Pond	no	yes	yes	4.0	3.5	yes*
P-5 Pocket Pond	no	yes	yes	3.0	1.5	yes*
W-1 Shallow Marsh	no	yes	yes	2.0	5.0	yes*
W-2 ED Wetland	no	yes	yes	2.5	3.0	yes*
W-3 Pond/Wetland	no	yes	yes	3.5	4.0	yes*
W-4 Pocket Marsh	no	yes	depends	2.0	2.5	yes*
W-5 Gravel Wetland	no	yes	depends	1.5	3.0	yes
I-1 Infil. Trench	yes	depends	depends	1.0	2.0	NO
I-2 Shallow I-Basin	yes	depends	depends	1.0	3.5	NO
I-3 Porous Pavement	yes	depends	depends	1.0	1.0	NO
F-1 Surface Sand Filter	no, unless exfilter	depends	no	2.0	2.0	yes **
F-2 Underground SF	no	no	no	3.0	1.0	yes
F-3 Perimeter SF	no	no	no	1.0	1.5	yes
F-4 Organic SF	no	no	no	1.5	2.0	yes**
F-5 Pocket Sand Filter	no, unless exfilter	no	no	1.5	2.0	yes**
F-6 Bioretention	yes	depends	no	1.0	3.5	yes**
O-1 Dry Swale	yes	no	no	1.0	3.0	yes**
O-2 Wet Swale	no	no	no	1.5	3.0	NO
O-3 Off-line Swale	yes	no	no	1.5	3.5	yes **

* only if four foot separation distance is maintained from the floor of the pond to the seasonally high water table (2 feet on Lower Eastern Shore)
** only if bottom of facility is lined with impermeable filter fabric that prevents leachate infiltration

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Section 4.5 Physical Feasibility

At this point, the designer has whittled down the BMP list to a manageable number and can evaluate the remaining options given the actual physical conditions present on the site. This matrix will ultimately cross-reference the testing protocols needed to confirm physical conditions at the site. The six primary factors are:

Soils. The key evaluation factors are based on an initial investigation of the NRCS hydrologic soils groups at the site, followed by subsequent geotechnical tests to confirm permeability and other factors.

Water Table. Depth to the seasonally high water table from the bottom or floor of the practice

Drainage Area. Indicates the minimum or maximum drainage area that is considered suitable for the practice. If the drainage area present at the site is slightly greater than the maximum allowable drainage area needed for a practice, more than one practice can be installed. The minimum drainage areas indicated for ponds and wetlands should not be considered hard and fast limits, and may be increased or decreased depending on water availability (baseflow or groundwater) or the anti-clogging mechanisms employed.

Slope. This column evaluates the effect of slope on the practice. Specifically, the slope restrictions refer to local slope (how flat the area of practice installation must be) and up-gradient slopes (i.e., how steep can the contributing drainage area or flow length be)

Head. This column provides a typical estimate of the elevation difference needed from the inflow to the outflow to allow for gravity operation within the practice.

Other Factors. This column includes other physical restrictions such as depth to bedrock, proximity to wells and foundations, water balance, etc.

BMP SELECTION MATRIX No. 4: PHYSICAL FEASIBILITY

GENERAL BMP LIST	SOILS	WATER TABLE	DRAIN AREA (acres)	SLOPE	HEAD	Other
P-1 Micropool ED	A soils may require pond liner B soils may require testing	2 feet If hotspot or aquifer	10 min*	no more than 15%	6 to 8 ft	baseflow bedrock
P-2 Wet Pond			25 min*			
P-3 Wet ED Pond						
P-4 Multiple Pond						
P-5 Pocket Pond	NR	below WT	5 max		4 ft	
W-1 Shallow Marsh	A soils may require liner	2 feet if hotspot or aquifer	25 min	no more than 8%	3 to 5 ft	baseflow bedrock
W-2 ED Wetland						
W-3 Pond/Wetland						
W-4 Pocket Marsh	NR	below WT	5 max		2 to 3 ft	
W-5 Gravel Wetland	NR	2 feet			2 to 4 ft	
I-1 Infil. Trench	Fc > 0.52 inch/hr PT if Fc < 2.00 in/hr	4 feet		flat as possible	1 ft	Bedrock
I-2 Shallow I-Basin			10 max		3 ft	
I-3 Porous Pavement			5 max**		1 ft	
F-1 Surface Sand Filter	NR	2 feet	10 max **	no more than 6%	5 ft	
F-2 Underground SF			2 max **		5 to 7ft	
F-3 Perimeter SF			2 max **		2 to 3 ft	
F-4 Organic SF			5 max**		2 to 4 ft	
F-5 Pocket Sand Filter			2 max **		2 to 5 ft	
F-6 Bioretention	Made Soil				5 ft	
O-1 Dry Swale			5 max	usually 1 to 4% max	3 to 5 ft	
O-2 Wet Swale	NR	below WT	5 max		1 ft	
O-3 Bioretention Cell	Made Soil	2 feet	2 max		1 ft	

Notes: NR = not restricted, WT = water table, PT = pretreatment * unless adequate water balance and anti-clogging device installed ** drainage area can be larger in some instances.

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Section 4.6 Community and Environmental Factors

The fifth step involves an assessment of community and environmental factors that the BMP can provide. Again an index approach is used, where the given BMP is ranked from 1 to 5, with the lower score indicating that the practice has either a high benefit (or low drawbacks), and a higher score indicating that the particular practice has a low benefit or a major drawback for that factor.

Maintenance. This column assesses the maintenance burden for the practice, in terms of three criteria: frequency of scheduled maintenance, chronic maintenance problems (such as clogging) and reported failure rates.

Community acceptance. This column assesses community acceptance, as measured by three factors: market and preference surveys, reported nuisance problems, and visual orientation (i.e., is it prominently located or is it in an out of the way or underground location). It should be noted that a low rank may merely indicate the need for a better landscaping plan.

Construction Cost. The BMPs are ranked according to their relative construction cost per impervious acre treated. Please note that these rankings are preliminary, and await completion of the Center's ongoing BMP Cost Study.

Habitat. The BMPs are evaluated on their ability to provide wildlife or wetland habitat, assuming that an effort is made to landscape them appropriately. Objective criteria include: size, water features, wetland features and vegetation coverage in BMP and buffer.

Other Factors. This column indicates other factors that should be considered in BMP selection.

BMP SELECTION MATRIX No. 5: COMMUNITY AND ENVIRONMENTAL FACTORS

GENERAL BMP LIST	Main. Burden	Comm. Accept	Const. Cost	Habitat	Other Factors
P-1 Micropool ED	3.5	4.0	1.0	3.5	trash/debris
P-2 Wet Pond	1.5	1.5	2.0	2.5	High pond premium
P-3 Wet ED Pond	2.0	2.0	2.0	3.0	
P-4 Multiple Pond	2.0	1.5	3.0	1.5	
P-5 Pocket Pond	4.0	3.0	1.5	4.0	drawdowns
W-1 Shallow Marsh	3.5	2.0	3.5	1.5	
W-2 ED Wetland	3.0	2.5	2.5	2.0	Limit ED depth
W-3 Pond/Wetland	2.0	1.5	3.0	1.0	
W-4 Pocket Marsh	4.0	3.0	2.0	3.5	drawdowns
W-5 Gravel Wetland	4.0	4.0	3.0	4.5	Possible odors
I-1 Infil. Trench	5.0	2.0	3.5	5.0	Avoid large stone
I-2 Shallow I-Basin	5.0	4.0	3.0	4.5	Frequent pooling
I-3 Porous Pavement	5.0	1.0	3.0	5.0	
F-1 Surface SF	3.5	2.5	4.0	5.0	Minimize concrete
F-2 Underground SF	4.0	1.0	4.5	5.0	Out of sight
F-3 Perimeter SF	3.5	1.0	4.0	5.0	Traffic bearing
F-4 Organic SF	3.5	2.5	4.0	5.0	Change compost
F-5 Pocket Sand Filter	4.0	2.5	3.0	5.0	
F-6 Bioretention	2.0	1.5	2.5	4.0	Landscaping
O-1 Dry Swale	2.0	1.5	2.5	4.5	
O-2 Wet Swale	2.0	1.5	1.5	4.0	Possible mosquitos
O-3 Bioretention Cell	2.0	1.5	1.5	4.0	

Section 4.7 Locational Considerations

In the last step, the designer follows a checklist to determine where the selected BMP or BMPs can be located at the site, given the environmental features that are present. The checklist also indicates what, if any, permits must be secured to construct the BMP. The checklist will be modeled after the MDE Stormwater Management Assessment and Flow Chart Documents, already developed by Comstock (1995). Some of the locational factors would include:

Wetlands. Including the limited conditions under which a degraded wetland can be modified to accept stormwater (e.g., retrofits), and forested wetlands, and requirements for State and Federal CWA Sec. 401 and 404 permits.

Streams: Outline the general restrictions for placing ponds and wetlands within waters of the US, and outlining the permit process to follow if they are located in the uppermost 300 feet of a perennial stream. Guidance on dealing with intermittent channels, agricultural drainage, ditches and other situations. Additional guidance on location of detention or Cp_v facilities in and near streams.

Stream and Shoreline Buffers. Restrictions or conditions for locating BMPs within the Critical Area Buffer Zone and local stream buffer zones will be highlighted.

Forest Conservation Area. Discussion of BMP location within the context of the Forest Conservation Act, including prohibition from locating BMPs in Priority 1 Forest Retention Areas, or within 100 feet of specimen trees. Opportunities for reforestation in stormwater buffer areas will be noted.

Steep Slopes: Construction of BMPs are generally restricted on slopes greater than 15%.

Floodplains. BMP restrictions if located within the 100 year floodplain may require approval under the MDE Waterway Construction Regulations (COMAR 26.17.05).

Existing and Proposed Utilities. Restrictions and setbacks from sewer lines, roads, cables and other utilities at the site.

Residential Setbacks. Required setback distances from residential structures.

NOTE: THE CENTER WILL DRAFT THIS SECTION IN THE SUMMER OF 1997 FOR STATE AND LOCAL REVIEW.

Draft Data Summary

for the

Construction and Development Industry

United States Environmental Protection Agency
Office of Water
Office of Science and Technology
Engineering and Analysis Division
Washington, DC

February 2001

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Note

Data provided in this report are preliminary and subject to change. EPA may revise this document prior to publication of a proposed Effluent Guidelines rule. Updated versions, if any, will be made available on the EPA website at http://www.epa.gov/OST/guide/construction .

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CONTENTS

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Draft Data Summary for the Construction and Development Industry

Introduction

This document summarizes selected economic data for the construction and development (C&D) industry. EPA is providing preliminary data about the industry as part of its outreach activities in the early stages of rulemaking. These businesses may be covered under a proposed C&D effluent guidelines regulation being developed by the Agency.

EPA chose to develop effluent guidelines for the construction and development industry due to the large impacts some of these activities are causing to receiving waters across the United States. Sediment loadings from construction sites can be orders of magnitude higher than those associated with undisturbed areas. In addition, construction site runoff can contribute high loadings of nutrients and metals to receiving streams and can contribute significantly to receiving water impairments. In addition to contributing pollutants, the increased runoff volumes and flow rates produced following development can cause significant degradation of receiving stream quality. Impacts include stream bed scouring and habitat degradation, shoreline erosion and stream bank widening, loss of fish populations and loss of sensitive aquatic species, increased frequency of downstream flooding and aesthetic degradation. These impacts will be addressed in other documents being prepared by the Agency to support the proposed rule.

The purpose of this document is three-fold:

- Identify the industry sectors that may be covered by the proposed rules
- Quantify the size and magnitude of the potentially covered sectors
- Provide current information about economic conditions in these sectors.

EPA developed the data in this profile from several sources, including the 1997 Census of Construction Industries and the National Association of Home Builders.

1. Industry Definition

The proposed rules may cover establishments within the construction industry (NAICS 23) that disturb the land at construction sites of one acre or more.[1] These land-disturbing activities may include site preparation and site clearing tasks such as tree removal, excavation, blasting, scraping, and grading. Most establishments in NAICS 233 (Building, developing, and general contracting) and

[1] The Bureau of the Census classifies industries according to the North American Industrial Classification System, or NAICS. Under the NAICS, economic activity is first divided into twenty broad 2-digit industry codes. One of these is Construction (NAICS 23). Each 2-digit industry is further subdivided into 3-, 4-, and 5-digit levels.

NAICS 234 (Heavy construction) are likely to engage in such activities on a regular basis. Establishments within selected 5-digit industries that are part of NAICS 235 (Special trade contractors) are also likely to engage in land disturbing activities. The latter include NAICS 23593 (Excavation contractors) and 23594 (Wrecking and demolition contractors). Table 1 identifies the industry sectors that may be covered by the proposed regulations. While the focus of the effluent guidelines rulemaking is on land disturbing activities in the C&D industry, the data sources cited do not separately tabulate these activities.

Table 1. Construction and development industries

233 Building, developing, and general contracting		*234 Heavy Construction (cont.)*	
23311	Land subdivision and development	23491	Water, sewer, and pipeline construction
23321	Single-family housing construction	23492	Power and communication transmission line construction
23322	Multifamily housing construction	23493	Industrial nonbuilding structure construction
23331	Manufacturing and industrial building construction	23499	All other heavy construction
23332	Commercial and institutional building construction		
234 Heavy construction		*235 Special trades contractors*	
23411	Highway and street construction	23593	Excavation contractors
23412	Bridge and tunnel construction	23594	Wrecking and demolition contractors

Source: *North American Industry Classification System - United States*, Office of Management and Budget, 1999.

2. Number of Establishments

In 1997, these industries encompassed 261,614 establishments having at least one paid employee. The National Association of Home Builders estimates that among these establishments are 45,952 building contractors that perform only remodeling work (Ahluwalia and Chapman, 2000). Since most remodeling work does not result in land disturbance, these establishments may not be covered by the proposed regulations. In addition, builders that disturb one acre or less may not be subject to the proposed regulations. EPA believes that the number of such establishments may be substantial but no estimates are available. For purposes of this profile, the number of covered establishments with payroll is approximately 216,000 (i.e., 261,614 minus 45,952). Figure 1 shows the distribution of establishments by industry, as well as changes in the number of establishments between 1992 and 1997. Of note is the increase in the number of establishments in the building, heavy construction, and special trades sectors, but a decline in the land development sector.

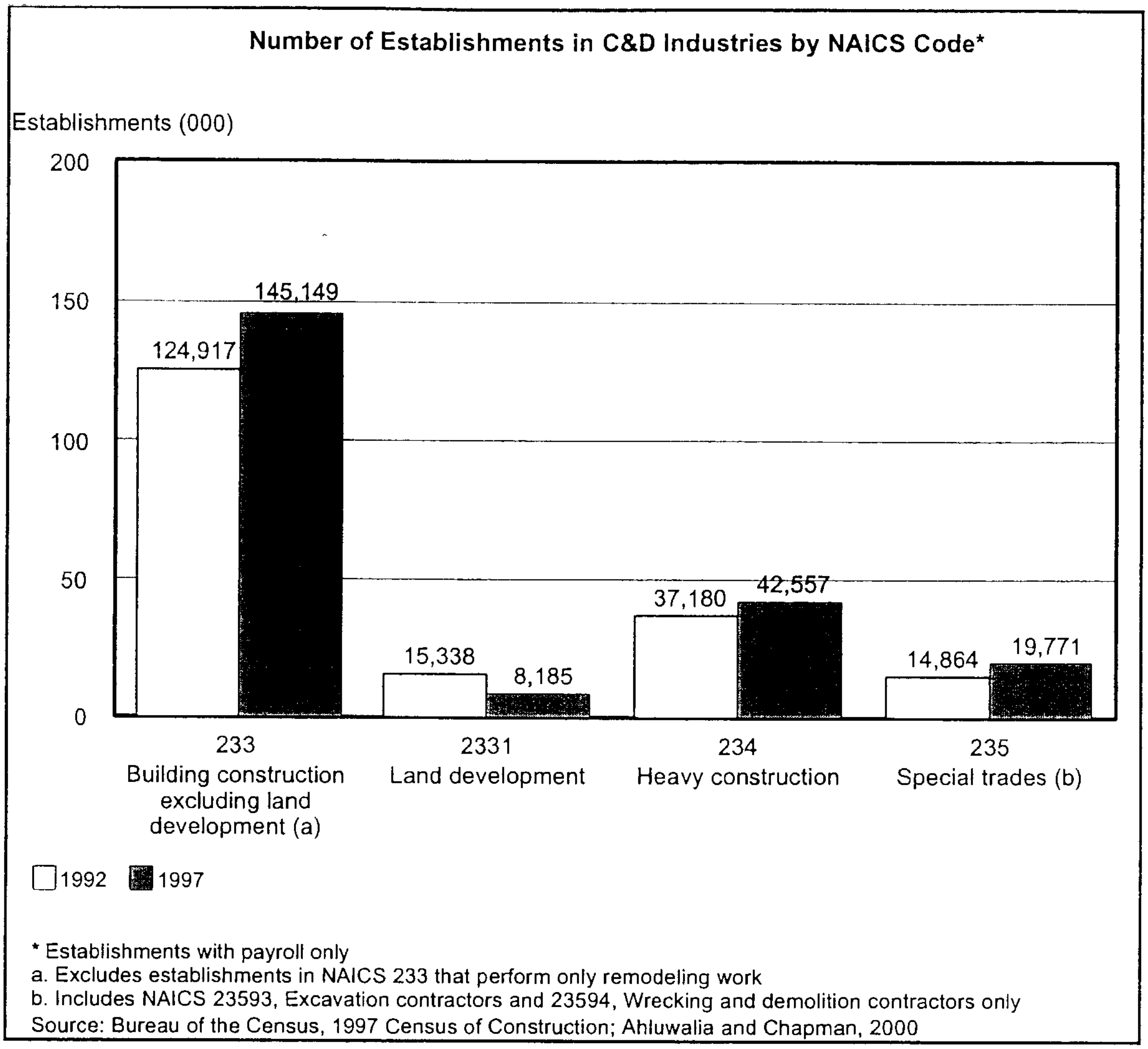


Figure 1. Number of Establishments with payroll in the C&D industries, 1992 and 1997.

In addition to establishments with payroll, Census estimates indicate that at least 448,387 establishments in the C&D industries had no paid employees in 1997.[2] EPA is seeking additional information about these establishments, but believes that many are either inactive or operate on a part-time basis only. Furthermore, a high percentage of those classified in building construction are probably remodelers (Baker, 2001).

[2] The number of non-employer establishments in NAICS 23593 and 23594 was not reported, hence the figure of 448,387 non-employer establishments is an underestimate.

3. Size of Establishments

Figure 2 shows the distribution of establishments by employment size class for 1997. Overall, 67 percent of establishments with payroll in the C&D industries have 4 or fewer employees, 83 percent have 9 or fewer employees, and 92 percent have fewer than 20 employees. Only one percent of C&D establishments with payroll have 100 or more employees. The *average* number of employees per establishment is 6.6 for building construction, 20.1 for heavy construction, and 5.6 for special trades.

From a revenue standpoint, in 1997, 20 percent of establishments with payroll reported annual revenues below $250,000, 35 percent reported revenues below $500,000 and 49 percent reported revenues below $1.0 million. Only 9,118 establishments, representing 3.5 percent of the total, reported annual revenues in excess of $10.0 million.[3]

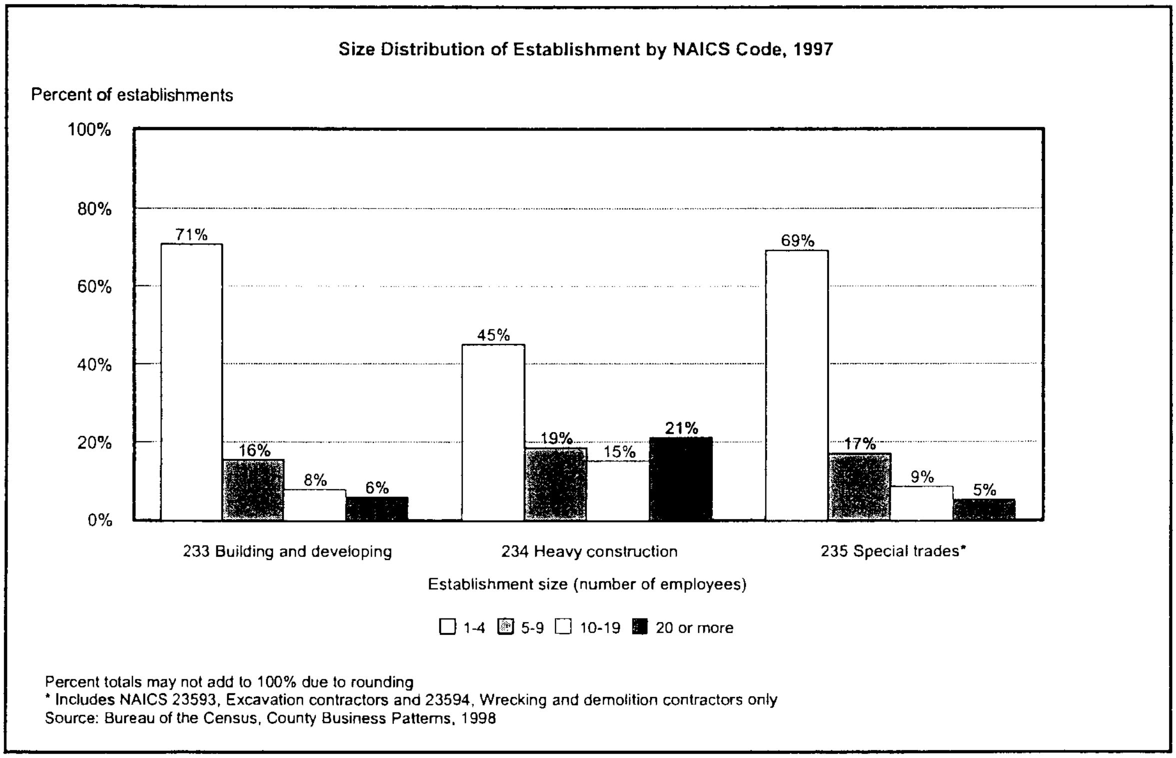
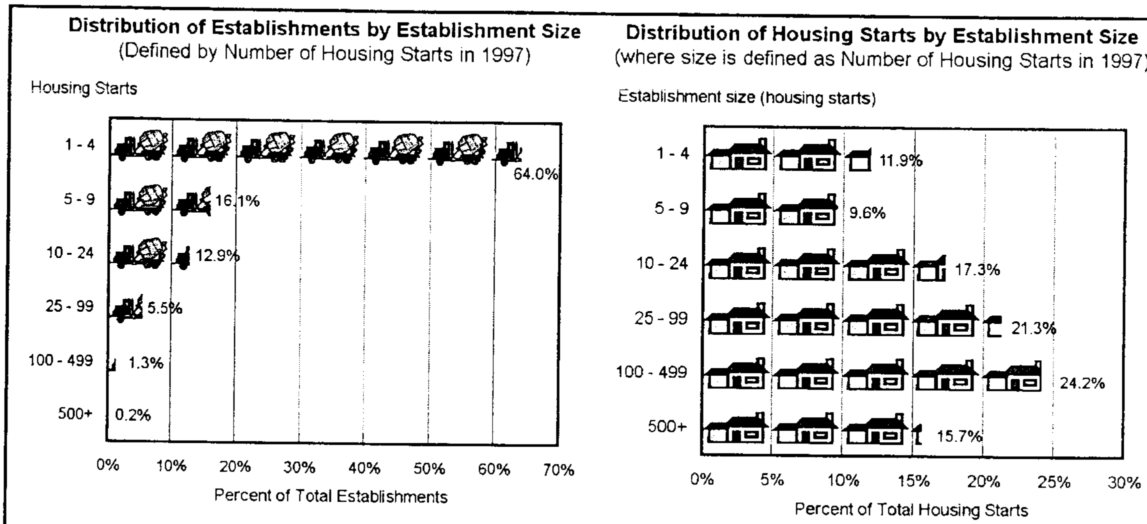


Figure 2. Size distribution of establishments in construction and development industries, 1997.

[3] The Small Business Administration (SBA) has established a small business size standard of $27.5 million for the building construction and heavy construction industries (except NAICS 23311, Land subdivision and development, which has a size standard of $5.0 million), and $11.5 million for special trades contractors. These size standards determine the eligibility of businesses for SBA assistance programs and Federal procurement preferences. In addition, the standards are used to define the number of small businesses affected by regulatory actions under the Small Business Regulatory Enforcement Fairness Act (SBREFA).

Figure 3 and Table 2 provide charts on single family residential construction activity based on the number of new homes started in 1997. A total of 50,661 establishments, representing 64 percent of the total, started constructing between one and four housing units. These units represented 12 percent of the total. Sixteen percent of establishments had between five and nine starts, 13 percent between 10 and 24 starts, and 5.5 percent between 25 and 99 starts. Only 1,200 establishments (1.5 percent of the total) had more than 100 housing starts, but these represented 39.9 percent of all housing units started in 1997.



Explanation:
Read across to compare the population of a particular firm size group to the number of houses produced by that group.
Example:
Firms (establishments) that started 1 to 4 houses in 1997 comprised 64 percent of all firms, and were responsible for 11.9 percent of all houses started in 1997.

Figure 3. Number of establishments in single-family housing construction by number of housing starts, 1997.

Table 2. Number of Housing Starts in 1997	Establishments		Housing Starts	
	Number	Percent	Number	Percent
1-4	50,661	64.0%	102,033	11.9%
5-9	12,708	16.1%	81,900	9.6%
10-24	10,183	12.9%	148,037	17.3%
25-99	4,338	5.5%	182,812	21.3%
100-499	1,060	1.3%	207,687	24.2%
500+	152	0.2%	134,154	15.7%
Total	79,102	100.0%	856,623	100.0%

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4. Geographic Distribution

Figure 4 shows a geographic distribution of establishments by state. The largest distribution of establishments are located in California, New York, Texas, Florida, and Pennsylvania. Combined, these account for approximately 25 percent of all C&D establishments nationwide.

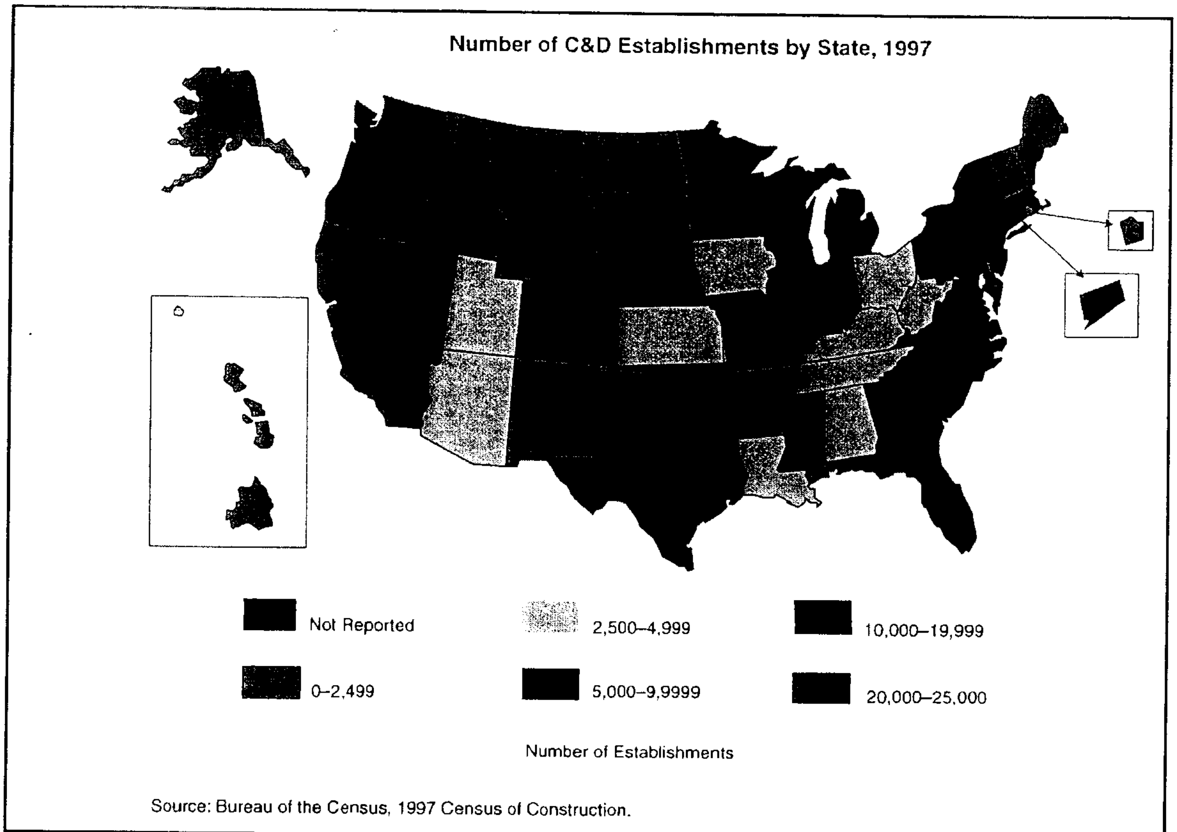

Figure 4. Number of establishments in the C&D industry, by state, 1997.

5. Employment

In 1997, the C&D industries employed 2.4 million workers. As shown in Table 3, land subdividers and developers accounted for 41,827 employees (1.8 percent of the total) while builders and general contractors (the remainder of NAICS 233) accounted for 1.3 million employees, or 55.2 percent of the total. Some 880,400 workers, or 37.3 percent of the total, were employed in heavy construction, and the special trades contractors (excavation contractors and wrecking/demolition contractors) together employed 135,057 (5.7 percent of the total). EPA has not estimated the proportion of these workers that are involved in land disturbing activities.

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Table 3. Employment in the C&D Industries, 1997

NAICS	Description	Employees	Percent of total
233, except 2331	Building, developing, and general contracting, except land development and subdivision	1,301,126	55.2%
2331	Land subdivision and land development	41,827	1.8%
234	Heavy construction	880,400	37.3%
235[a]	Special trade contractors	135,057	5.7%
TOTAL		2,358,410	100.0%

[a] Includes NAICS 23593 (Excavation contractors) and 23594 (Wrecking/demolition contractors)
Source: Bureau of the Census, 1997 Census of Construction.

Construction is a seasonal activity in many parts of the country, and employment data from the industry confirm this trend. Figure 5 shows quarterly employment data for building construction and heavy construction industries in 1997. Overall, employment of construction workers reached its lowest in March at 1.53 million and its highest in August at 1.83 million during that year.

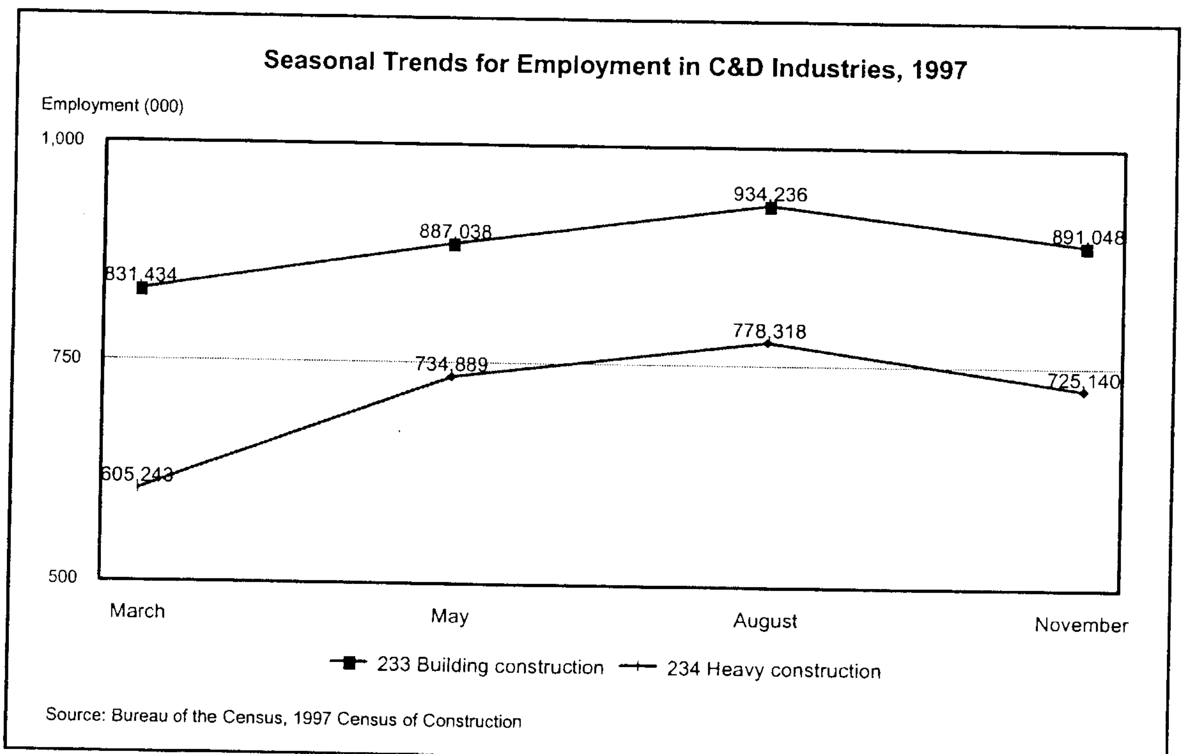

Figure 5. Seasonal trends for employment in the C&D industries, 1997.

6. Payroll and Benefits

In 1997, the total payroll in the C&D industries was $76.8 million. Of this, construction workers earned $48.3 million (62.9 percent) and other workers not directly engaged in construction activity earned $28.5 million (37.1 percent). In addition, the C&D industries incurred $11.2 million in legally required fringe benefit expenditures and $6.5 million in voluntary fringe benefits, for a total of $17.7 million in fringe benefits. This total represents 23.0 percent of the combined payroll for all workers.

7. Revenue Indicators

Table 4 shows revenue indicators for the C&D industries. Overall, the total value of business done in the C&D industries was $534.2 billion in 1997. Builders and developers accounted for $386.9 billion or 72.4 percent of the total in 1997. Revenues of heavy construction contractors were $130.8 billion and represented 24.5 percent of the total, while special trade contractors (excavation contractors and wrecking/demolition contractors) earned $16.5 billion, representing 3.1 percent of total C&D industry revenues. On average, establishments in special trades generate $834,000 in business compared with $1.8 million for land developers, $1.9 million for building construction contractors, and $3.1 million for heavy construction contractors. The value of business done per employee is highest among land developers at $344,514, followed by housing contractors at $286,303, heavy construction contractors at $148,563 and special trades contractors at $122,156.

Table 4. Revenue in the C&D Industries, 1997

NAICS	Description	Value of business done ($millions)[a]	No. of estabs.	Value of business done per estab.	Employees	Value of business done per employee
233, except 2331	Building, developing, and general contracting, except land development and subdivision	$372,516	191,101	$1,949,315	1,301,126	$286,303
2331	Land subdivision and land development	$14,410	8,185	$1,760,538	41,827	$344,514
234	Heavy construction	$130,795	42,557	$3,073,407	880,400	$148,563
235[b]	Special trade contractors	$16,498	19,771	$834,455	135,057	$122,156
TOTAL		$534,219	261,614	$2,042,012	2,358,410	$226,517

[a] Includes value of construction work and other business receipts from 1997.
[b] Includes NAICS 23593 Excavation contractors and 23594 Wrecking and demolition contractors only.
Source: Bureau of the Census, 1997 Census of Construction.

8. Value of Construction Work

Table 5 shows that approximately $845 billion in construction work was completed in the U.S. in 1997. Of this, roughly 80 percent was for building construction and 20 percent was for nonbuilding construction. The building construction component includes residential construction (41 percent of building construction), commercial and industrial construction (40 percent), institutional construction (15 percent), and other (4 percent). The nonbuilding construction component includes highways, streets and related work (29 percent of nonbuilding construction), sewers, water mains and related work (14 percent), power and communication lines and towers (8 percent), bridges, tunnels, and elevated highways (7 percent), and a large number of miscellaneous categories (42 percent).

Table 5. Value of construction work completed, by type of construction (1997 $billions)

Type of Construction	Value of Construction Work	Percent of Total
Building construction	*$667.9*	*79.0%*
Residential	$275.7	32.6%
Single family houses	$238.3	28.2%
Apartment buildings	$35.9	4.2%
Other residential	$1.5	0.2%
Commercial and industrial	$268.3	31.7%
Manufacturing	$84.3	10.0%
Hotels and motels	$17.2	2.0%
Office buildings	$80.6	9.5%
Other commercial	$86.2	10.2%
Institutional	$100.2	11.9%
Religious	$9.4	1.1%
Educational	$46.8	5.5%
Health care	$33.9	4.0%
Public safety	$10.1	1.2%
Farm buildings	$3.5	0.4%
Amusement, social, recreational	$10.4	1.2%
Other building	$9.8	1.2%
Nonbuilding construction	*$169.0*	*20.0%*
Highways, streets and related	$49.3	5.8%
Private driveways and parking areas	$9.8	1.2%
Bridges, tunnels, elevated highways	$12.5	1.5%
Sewers, water mains and related	$23.8	2.8%
Sewage and water treatment plants	$9.7	1.1%
Pipelines and related	$6.4	0.8%
Power and communication lines and towers	$13.1	1.5%
Power plants	$4.5	0.5%
Other	$40.0	4.7%
Construction work, nsk	*$8.7*	*1.0%*
Total*	**$845.5**	**100.0%**

nsk - not specified by kind
*Figures may not add to total due to rounding.
Source: Bureau of the Census, 1997 Census of Construction.

8.1. Value of Construction Work Done, by State

Figure 6 shows the value of construction work done in the C&D industries, by state. On an individual state level, the total value of construction work ranged from $1.4 billion (0.2 percent of the total U.S. value) in the District of Columbia to $93.1 billion (11.0 percent of the U.S. total) in California.

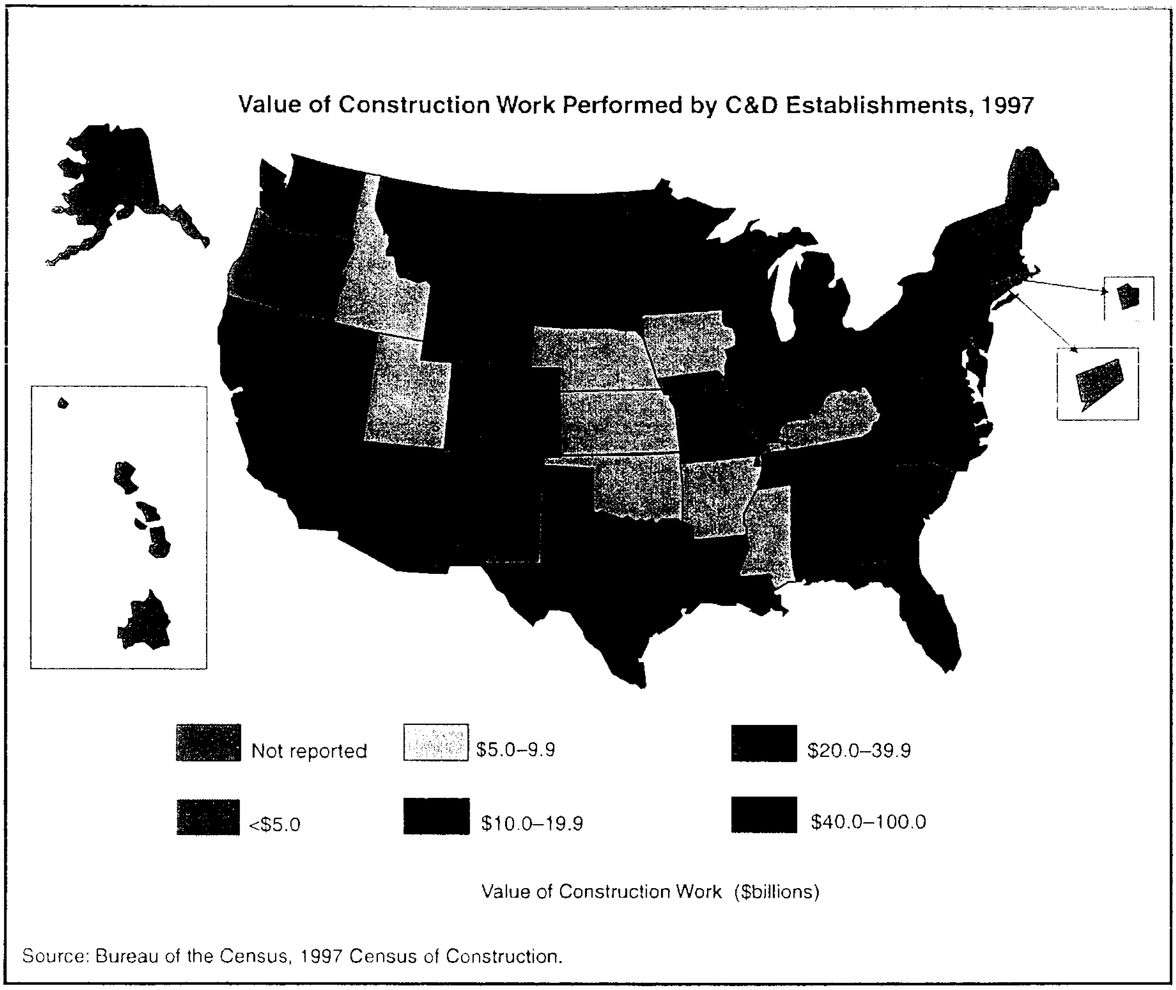

Figure 6. Value of construction work done by state, 1997.

8.2. Value of Construction Work Done, by Type of Ownership

Figure 7 shows the value of construction work, by project ownership. Privately owned projects totaled $501.7 billion in 1997, representing 76.4 percent of the total. Projects owned by State and local governments accounted for $140.8 billion, or 21.4 percent of the total, while Federal government projects totaled $14.1 billion, or 2.1 percent of the total. In general, government projects account for a greater share of heavy construction work, with the Federal government accounting for 6.9 percent and state government accounting for 47.2 percent of the heavy construction total.

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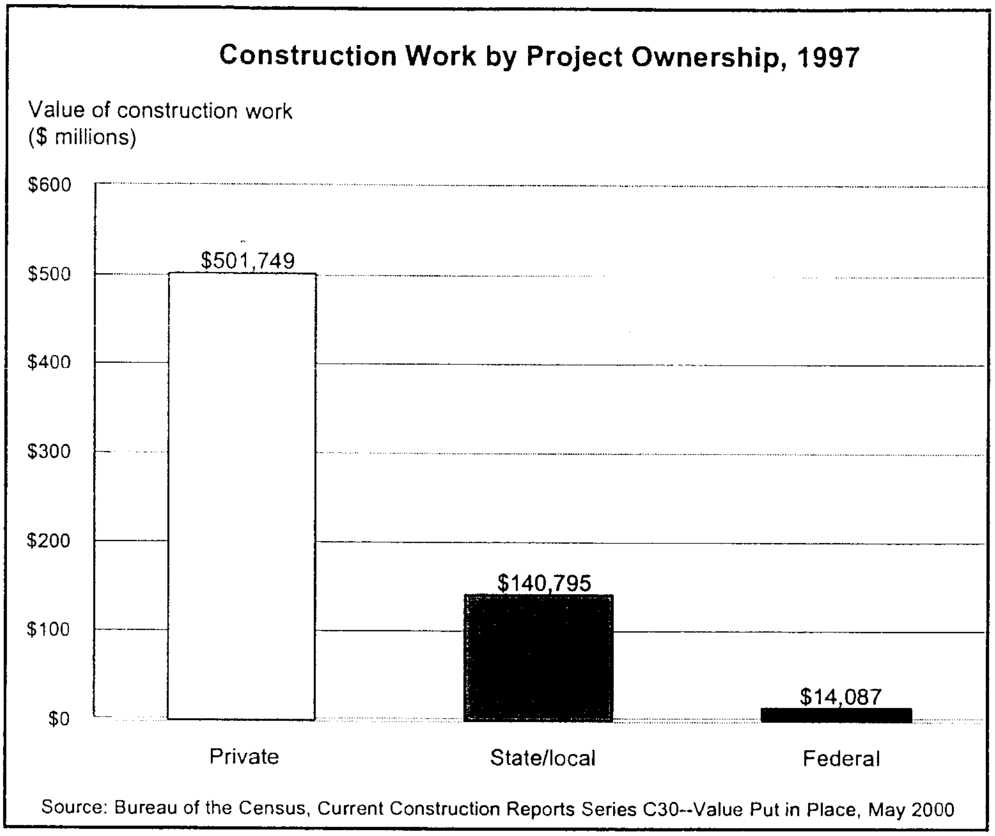

Figure 7. Value of construction work, by project ownership, 1997.

9. Construction Activity Indicators

The primary indicator of construction activity in the U.S. is the number of new housing units authorized for construction. Figure 8 tracks the seasonally adjusted annual number of units authorized on a month-to-month basis. As seen, the number of units authorized shows a steady rise over the recent period. From an average of between 1.3 and 1.5 million units per year over the 1994 to 1997 period, the number rises through the 1998 to 2000 period. The rate appears to have reached a peak in February 2000 when it hit 1.8 million units, and has since fallen steadily back to the 1.5 million units-per-year mark.

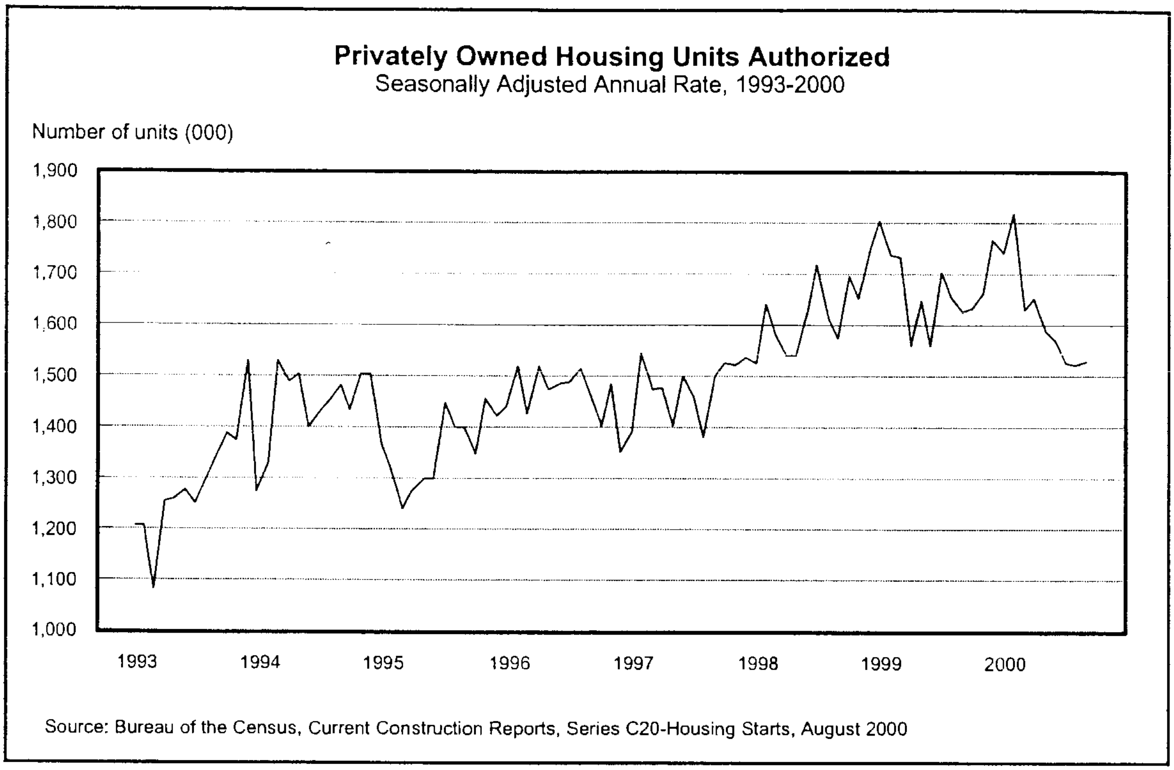

Figure 8. Number of housing units authorized by building permit, 1993 to 2000.

Figure 9 shows actual year-end data on the number of new housing units authorized by building permit in 1997, by state. The states with the greatest number of housing units authorized, and number of units, included Florida (133,990), Texas (125,974), California (109,589), North Carolina (73,015), and Georgia (75,123). States with the fewest housing units authorized, and number of units, included Alaska (2,560), Montana (2,472), Vermont (1,831), Wyoming (1,669), and the District of Columbia (15). The total number of new housing units authorized in 1997 was 1,441,136, with single-family housing units accounting for 1,062,396 or 73.7 percent.

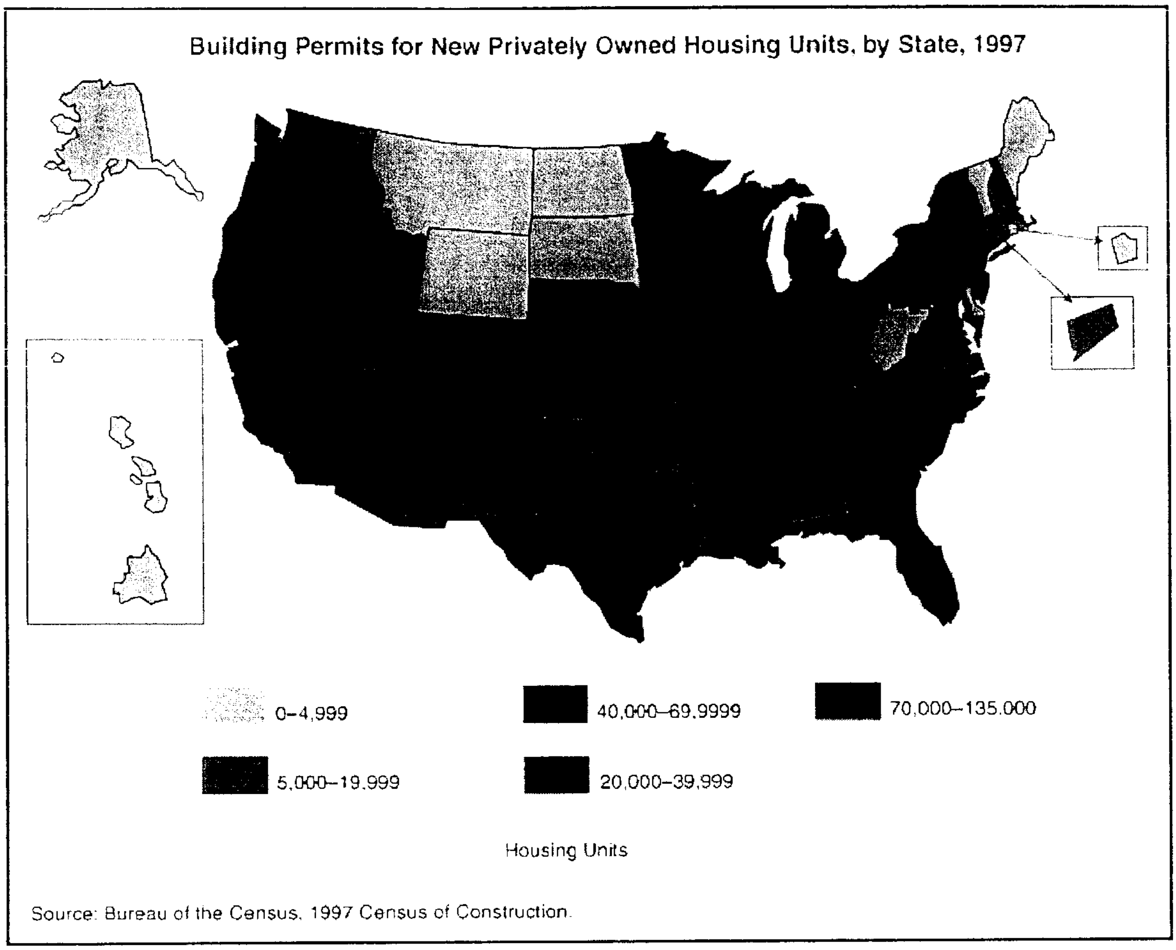

Figure 9. Number of building permits issued, by state, 1997.

Figure 10 demonstrates the annual cycle of building activity, using monthly data on housing units authorized by building permits for 1997. The monthly average for all of 1997 was 120,100 units. This fluctuated from a low of 88,100 units in January to a high of 137,200 units in April.

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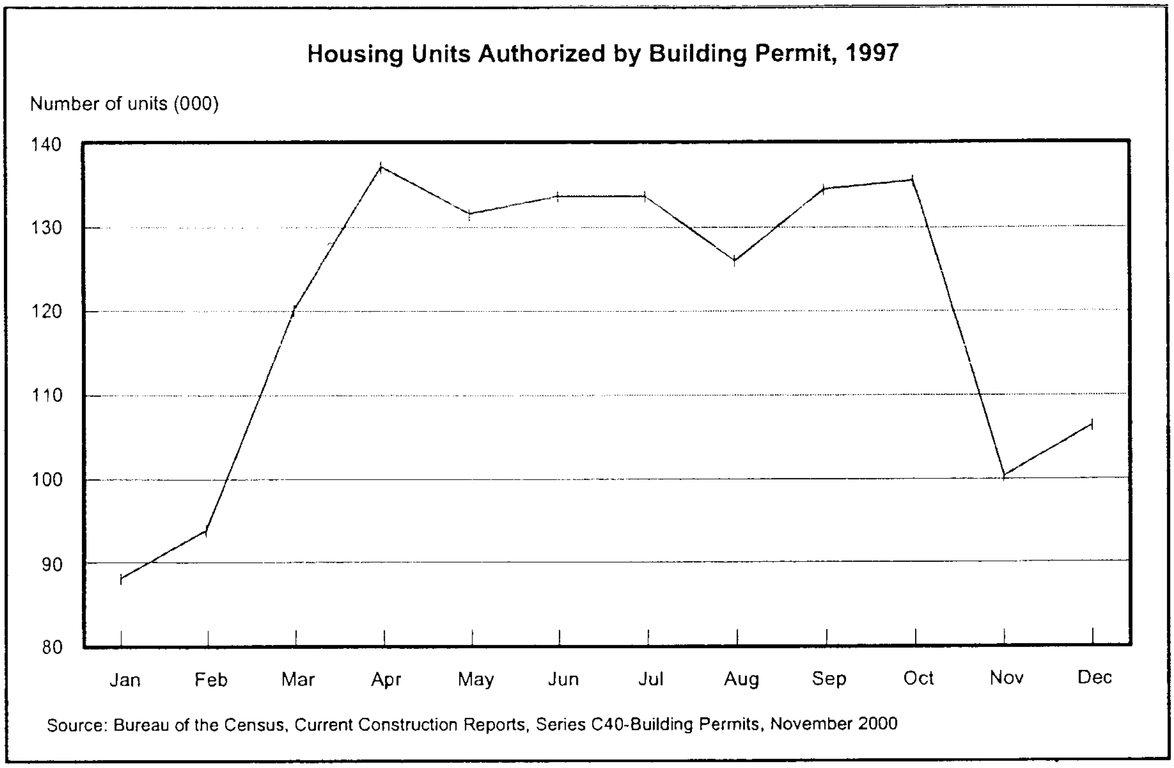

Figure 10. Housing units authorized by building permit, monthly totals, 1997.

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Driveways: Reducing Impacts

Driveways ARE a big deal! They can contribute 15% to the total impervious surface area in a residential subdivision. Research shows that they are also hot spots for pollutant (auto and household hazardous wastes) accumulation too. In addition, moat driveways concentrate runoff and direct it to off-site municipal storm water systems.

Follow the planning guide below for some of the most effective means to reduce impacts fror new driveways. For more information, View NEMO Technical Paper #6 (Adobe Acrobat forma 36k) now or browse the information available in the NEMO Store.

1. Limit the size and number of driveways in your town.
Review your towns zoning and subdivision regulations and road ordinances. Are shared driveways permitted? Allow shared driveways to serve commercial areas and up to four single-family lots. What do your lot setbacks generate? (Photo1) Establish maximum limits on paved driveway lengths. Are driveway standards asking for a minimum width that can be easily exceeded? (Photo 2) Establish *maximum* limits on paved driveway widths. Allow single lane straight drives to be 8' or 9' wide and double lane drives to be 18'. Driveway curb cuts should be limited to one per site.

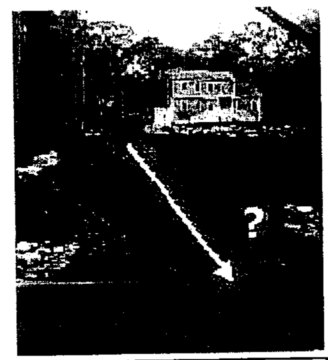

Photo 1

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Middlesex County
Extension Center
1066 Saybrook Road
Box 70
Haddam, CT 06438-0070
860-345-4511
FAX 860-345-3357

2. Reduce their imperviousness

Many local driveway regulations stipulate they be constructed with impervious surfaces. There are numerous porous surfaces that work well on driveways and local regulations should permit their use. Examples of porous driveway surfaces include; porous concrete and asphalt mixtures, paver blocks and brick set in sand, grass pavers, grid pavers, crushed stone and gravel. The key to the use of porous driveway surfaces is the installation of a sub-base specifically designed for the surface material used. The sub base must also be capable of promoting infiltration and runoff cleansing.

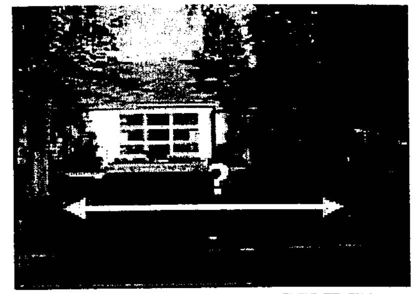

Photo 2

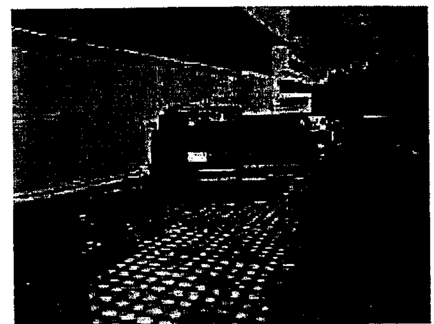

Photo 3 – gravel drive with concrete grid pavers for extra width and emergency vehicle support.

Design shorter and narrower drives. Design wide turnaround areas only where needed. Allow various driveway designs, including ribbon drives that contain less impervious surface than the more common full width, single slab, drive. Where porous driveway surfaces are used, insure that a proper sub base, capable of infiltrating and cleansing storm water runoff is installed

3. Direct runoff to allow for infiltration.

- Design drives to follow contours Do not allow roof gutters and downspouts to drain ov impervious driveways.
- Allow and promote the use of porous driveway surfaces, including; porous asphalt anc concrete mixtures, paver blocks and bricks laid in sand, concrete and grass grid pave crushed stone and gravel.
- Where impervious driveway surfaces are installed they should be crowned and pitche to direct runoff to adjacent porous areas.
- Where impervious driveway surfaces are installed, disrupt their connection to roads, curbs and curtain drains with porous materials in the area where the drive intersects tl road.
- Whatever type of driveway is installed, it should never obstruct existing storm water flows along the road or through drainage facilities.

Got an experience to share? Drop us a note.

Revised: February 09, 2001 .

R0020468

Maintaining Urban Stormwater Facilities
A Guidebook for Common Ownership Communities

Montgomery County Department of Environmental Protection

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David E. Rotolone, Field Program Manager	217-6747
G. Michael McElroy, Stormwater Facility Inspector	217-6336
Montgomery Co. Dept. of Permitting Services	217-6300

Stormwater Related Web Sites

Montgomery Co. Dept. of Environmental Protection
www.co.mo.md.us/dep

Maryland Department of Natural Resources www.dnr.state.md.us

Maryland Department of the Environment www.mde.state.md.us

EPA Office of Watersheds, Oceans and Wetlands
www.epa.gov/owow

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The Montgomery County Department of Environmental Protection would like to thank the Maryland Department of Natural Resources, Chesapeake and Costal Watershed Service for their assistance with the grant and the Montgomery County Department of Permitting Services for their technical review of this manual.

This project was funded in part by the U.S. EPA Section 319 Nonpoint Source Program. Although this project is funded in part by the Environmental Protection Agency, it does not necessarily reflect the opinion or position of the EPA.

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Maintaining Urban Ponds and Other Stormwater Facilities

Urban Stormwater Facilities or Best Management Practices (BMPs), structures for managing stormwater, have become common in Maryland during the past twenty years. These facilities will cease to function as designed if not properly maintained. The purpose of this Guidebook is to describe the four primary types of BMPs found in the County and to outline some basic maintenance tasks that will keep them functioning properly.The audience for this Guidebook is primarily homeowners associations and residential or commercial property managers.

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Introduction

Over the past twenty years, the impacts of watershed urbanization have become apparent in our streams and rivers. Watershed drainage patterns altered by development that had no control for stormwater runoff often resulted in downstream flooding on residential and commercial properties or at road crossings. Uncontrolled stormwater volume increases streambank erosion and produces major detrimental changes in the physical characteristics of receiving streams. Residential, commercial, and industrial land uses result in polluted stormwater runoff, known as non-point source pollution, which can reach streams and rivers unless control mechanisms are in place. Pollutants include sediment, nutrients such as phosphorus and nitrogen, oil and grease, lawn and garden chemicals, heavy metals, and anything else that may wash off from streets and developed properties.

For many years, stormwater management focused on reducing the risks of downstream flooding. During this time, detention basins were frequently used to control quantity impacts by temporarily storing runoff from large storms and then releasing it slowly so that peakflows were reduced. During the mid 1980's, the commonly-used facility designs were modified to reduce pollutants in basin discharges to help protect downstream aquatic life and drinking water quality. These dual purpose (quantity and quality) basins are generally referred to as urban Best Management Practices or BMPs. Federal, state, and local laws and regulations require stormwater management and the control of non-point source pollution. At the local level, these requirements are addressed in Chapter 19 of the Montgomery County Code.

Home Owner Associations and facility managers can perform simple maintenance and contract with knowledgeable consultants for detailed, complex maintenance and repair. The goals of an effective maintenance program would be to prolong the life of stormwater facilities, avert expensive repair costs and prevent adverse downstream impacts.

Under Montgomery County Code and Executive Regulation 5-90, business and homeowners are responsible for routine maintenance and repair of on-site stormwater management facilities. It is the goal of this manual to assist responsible parties in complying with the regulations, to help make stormwater facilities an asset to our communities and to protectlocal streams and the Chesapeake Bay.

This manual is designed to help responsible parties understand basic maintenance needs and associated costs for the facilities being managed. Just as no two natural ponds or lakes are the same, no two urban ponds are the same and therefore maintenance needs will differ from BMP to BMP.

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Types of BMPs

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The following information describes the four most common types of BMPs found in Montgomery County, including Ponds, Infiltration Trenches, Underground Storage Structures, and Oil Grit Separators.

In general, infiltration trenches and oil grit separators manage runoff quality while underground storage structures manage runoff quantity. Stormwater management ponds may be designed to control runoff quantity only or to control both quantity and quality.

Quantity management attempts to prevent downstream flooding and erosion while quality management attempts to control "first flush" effects in which the highest concentration of pollutants are carried during th first stages of runoff from developed sites.

It is not unusual, however, for multiple types of BMPs to be used at one site. For example, a site may includ several oil grit separators at the edge of paved areas to treat the quality of runoff from that area prior to its entering a large detention basin which controls quantity impacts due to runoff from the rest of the site. Owners and operators must therefore conduct a holistic maintenance program which addresses every component in the entire system or the facility will lose its intended capability for quality and/or quantity management.

Storm Water Management Ponds

Dry Ponds

In Montgomery County, most dry ponds provide quantity control through man-made basins which temporarily hold stormwater after a storm. There are a few dry ponds in the County which provide quality control through extended detention of stormwater. Prior to the mid-1980's, dry ponds represented the most common type of stormwater management facility in the County. To meet more recent quality control requirements, dry ponds are built in conjunction with quality control structures such as infiltration trenches. See figure 1.

Wet Ponds

Wet ponds are man-made retention basins which contain permanent pools of water that function much like natural ponds.The wet pond is designed to hold a certain amount of water permanently. Runoff from storm events is stored above the permanent pool with excess water being discharged at a controlled rate via outlet devices similar to those used in dry ponds. Over time, this permanent pool develops into an aquatic ecosystem. See figure 2.

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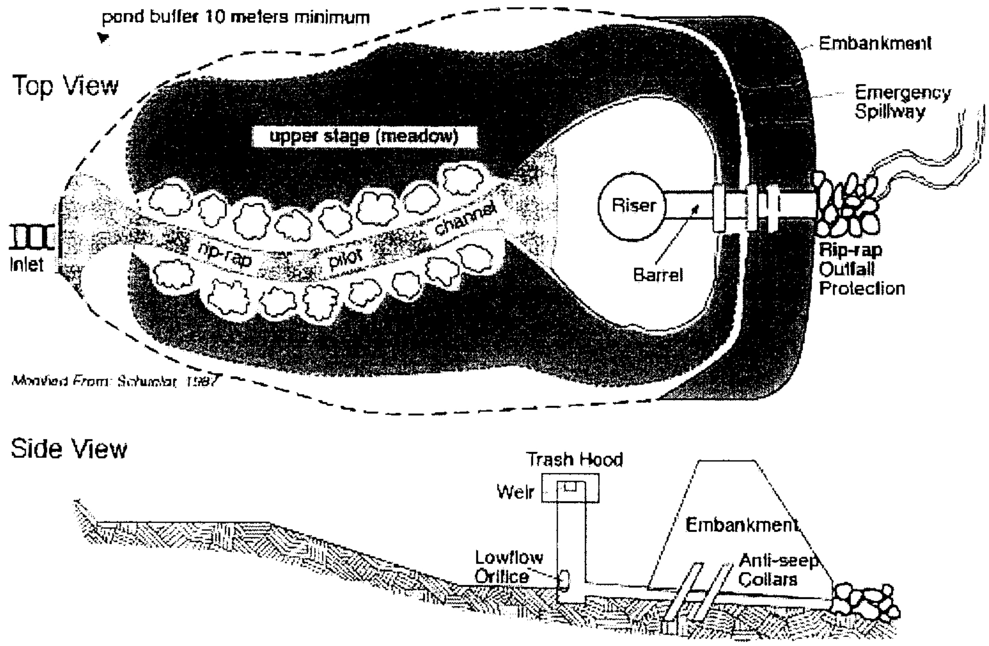


Figure 1. Typical Dry Pond

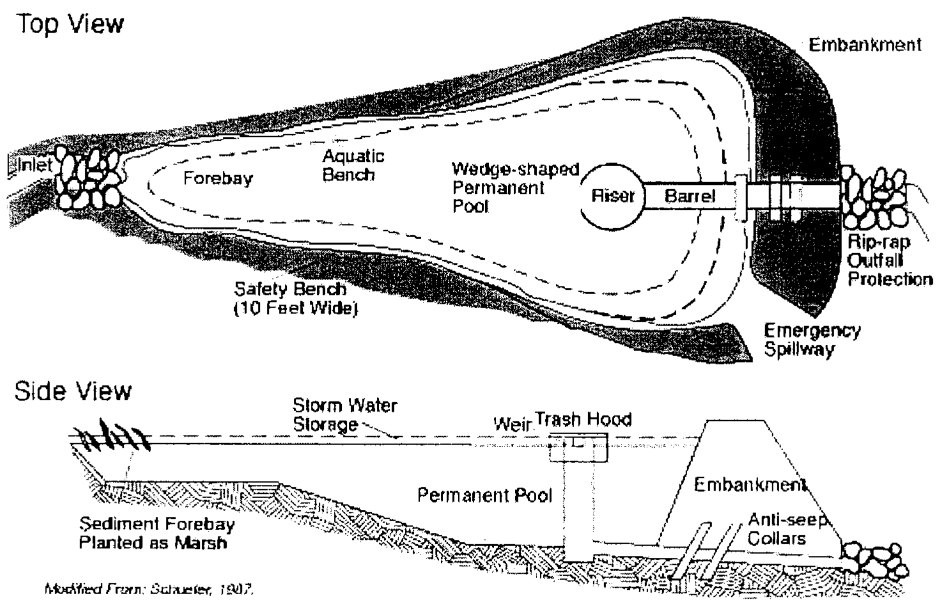
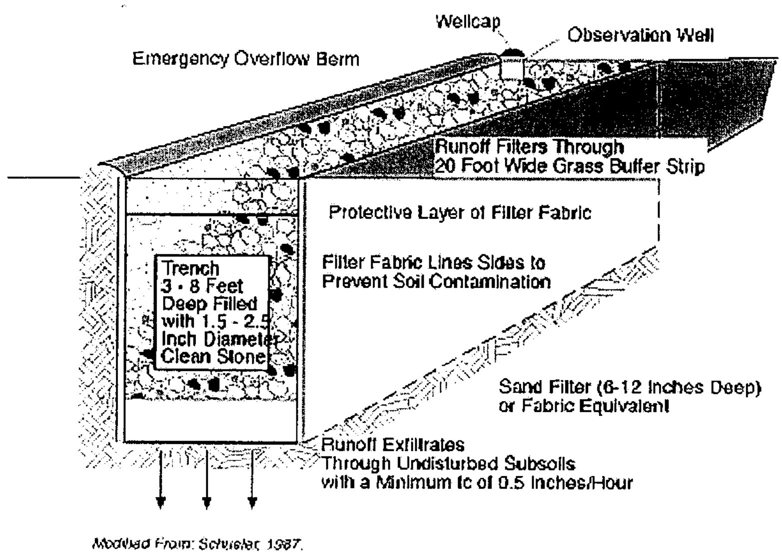


Figure 2. Typical Wet Pond

R0020473

Infiltration Trenches

Infiltration trenches are gravel-filled excavations that temporarily store stormwater and allow it to soak into the soil beneath the trench, filtering out pollutants as the water moves through the soil. In Montgomery County, infiltration trenches are generally used for water quality control only. An example is shown in Figure 3.



The two basic types of infiltration trenches are distinguished by how stormwater enters the facility. Dispersed input facilities allow stormwater to enter the top of the trench as overland runoff. Concentrated input facilities receive stormwater from curb inlets, gutters, and pipes. All underground BMPs are complex in structure and function, and a professional should be consulted to determine a particular facility's maintenance needs.

Figure 3. Typical Infiltration Trench.

R0020474

Oil Grit Separators

Oil Grit separators (also known as water quality inlets) are multiple stage, underground concrete storage structures that are designed to remove hydrocarbons (oil) and particulates (grit) from stormwater. Typically associated with parking lots and other paved areas, these structures are common on commercial sites. These structures require routine removal of the materials accumulated in the storage chambers or their pollutant removal ability will be severely compromised.

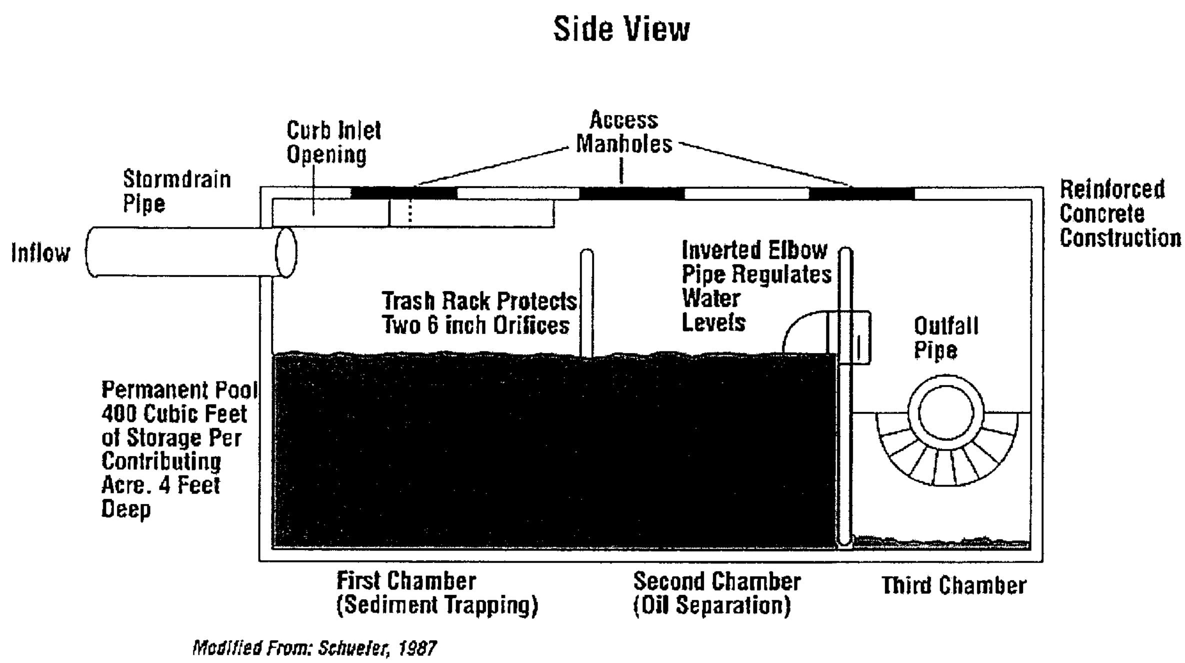


Figure 4. Typical Oil Grit Separator at a Commercial Site

R0020475

Underground Storage Structures

Underground storage structures manage runoff quality similar to ponds. Their advantage is that they do not take up valuable property and are located below parking gargages in large buildings. Specialized certification and training are required for inspecting and maintaining these structures. An example is shown in figure 5.

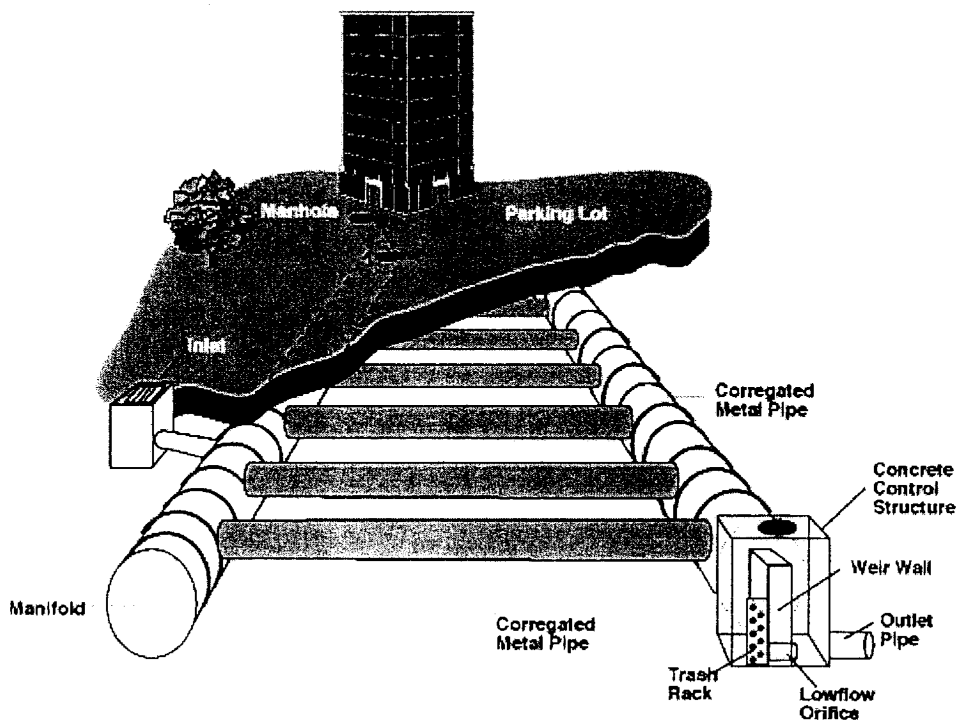


Figure 5. Typical Underground Storage Structure

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Elements of a Maintenance Program

Overview

BMPs cannot perform their two functions, stormwater storage and stormwater quality improvement, unless they are maintained over time. If a facility loses its storage capacity, downstream flooding may occur. There may be no visible indicator, however, if a facility is not removing pollutants like nutrients and heavy metals as originally designed. A consistent maintenance program is the best way to ensure that a BMP will continu to perform its water quality improvement functions.

R0020476

Routine Visual	Non-Routine
Visual Inspection	Bank Stabilization
Vegetation Management	Sediment Removal
Debris/Litter Control	Outlet Structure Maintenance/ Replacement
Maintaining undisturbed areas above infiltrating trenches/basins	Mechanical Components Maintenance (dependenton age of BMP)
Cleaning of Oil/Grit Separators	

Table 1. Components of a Maintenance Program.

This section outlines the maintenance needs for the most common BMPs found in Montgomery County. I is important to note that while general maintenance tasks can be outlined, actual maintenance needs will vary according to specific site conditions.

Table 1 shows the tasks that need to be considered as part of a general maintenance program. Other factors which need to be considered include:

Visibility of the Facility. Community needs and preferences determine to a large extent the type and amount of necessary maintenance for aesthetic purposes.

Landscaping. Maintenance needs vary greatly depending upon the type of vegetation.

Watershed conditions above the facility will largely determine type and amount of sediment and other pollutants that are entering that facility. For example, erosion problems upstream can dramatically increase the amount of sediment entering a basin.

A BMP maintenance program should also consider the following:

Safety. Some tasks can be carried out by non-technical staff or residents quite effectively; however, all programs should carefully ensure the safety of anyone carrying out maintenance tasks, and often a professional should be hired to conduct the work. Confined spaces should never be entered without proper training and permits from occupational and safety regulatory agencies.

Need for professional judgement. Professional judgement should be solicited regularly to ensure that all needs of the facility are met. Even though some maintenance tasks can be routinely performed by non-professionals, there are many problems that are not obvious to the untrained eye.

The County is required to insure that a maintenance inspection of all stormwater management facilities are conducted once every three years.

Financing. A fund should be established to provide for the costs of long-term maintenance needs, such as sediment removal, which can be considerable. (See page 11 for further discussion of estimated costs.)

Routine Maintenance Needs

Inspections

Montgomery County's Stormwater Management Regulations require that the County insure that routine maintenance inspections occur at all privately-owned facilities. The County has developed "checklists" for

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use during routine inspections at facilities. A minimum checklist for ponds is shown in Table 2.

-
- Obstructions of the inlet or outlet devices by trash and debris
- Excessive erosion or sedimentation in the basin
- Cracking or settling of the dam
- Low spots in the bottom of a dry pond
- Deterioration of pipes
- Condition of the emergency spillway
- Stability of the side-slopes
- Upstream and downstream channel conditions
- Signs of vandalism

Table 2. Minimum Inspection Checklist for Ponds.

Infiltration Trenches

Infiltration facilities have been shown to become dysfunctional due to clogging by sediments more frequently than either detention or retention basins. Therefore, it is recommended to inspect these facilities on the order of two to four times a year. The purpose of regular inspection is to determine if the sediment removal structures require routine maintenance. Most infiltration trenches have a grassed and/or gravel filter to remove some sediment before the stormwater enters the trench. Keeping this sediment filter clean is vital to ensuring the long-term performance of the infiltration trench. Although these operations must be undertaken more often than with surface facilities, the costs are significantly less.

The performance of an infiltration trench should be monitored as part of the routine inspection. The observation well installed in most trenches can be used to determine how long it takes the water to infiltrate into the soil after a storm event. This determination can be made in two ways. Several water level readings can be made over a period of days after a large storm. The rate the water level falls can be directly determined by two or more readings. The alternative method is a "one stop" method where a single water level reading is taken and compared to the local rainfall record. Although less accurate than the multiple reading method, the "one stop" method does provide enough information to approximate the emptying time and will identify trenches which are severely clogged.

Debris and Litter Removal

The regular removal of debris and litter provides a variety of benefits as shown in Table 3. Special attention should be given to the removal of floating debris which can clog the outlet device or riser.

- Reduce the chance of clogging in outlet structures, trash rocks, and other facility components
- Prevent possible damage to vegetated areas
- Reduce potential mosquito breeding habitats
- Maintain facility appearance
- Reduce conditions for excessive surface algae

Table 3. Benefits of Regular Debris and Litter Removal

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Mechanical Components Maintenance

Each type of BMP may have mechanical components that need periodic attention to ensure their continued performance. Valves, sluice gates, fence gates, locks and access hatches should be functional at all times. The specific BMP design used will determine how maintenance intensive the facility will be.

Vegetation Management

Vegetative cover filters sediment from runoff as it flows into the BMP and prevents erosion of the banks and in the bottom of the facility. Grass is generally used in and around detention basins and around retention basins and infiltration trenches. There should be at least a 10' buffer strip around ponds and streams which is mowed no more than four times a year.

Mowing requirements can be tailored to the specific needs of a site and the neighboring residents or office building tenants.The grass in a BMP may be hardiest if maintained as an upland meadow, cutting no shorter than 6 to 8 inches. If a more manicured lawn setting is desired, more mowing and special attention to turf health will be needed. Some communities consider the tall wetlands-type vegetation (typically, cattails or rushes) that may spring up in dry ponds as unaesthetic. Some of this vegetation is actually beneficial as it provides water quality benefits and wildlife habitat.

Surrounding vegetation should not be overfertilized or excess nutrients will be washed off into the stormwater management facility and contribute to algae growth problems. Nutrient needs of surrounding vegetation should be evaluated by testing the pH and nutrient content of the soil prior to fertilization. Fertilization of all turf areas should be done in the fall of the year. Local soil conservation service or extension service offices can provide testing as well as interpretation of the results.

Vegetation planted around infiltration trenches, known as a buffer strip, often serves the specific purpose of removing some sediment before the storm water enters the facility. The health of buffer strips should be closely monitored and the turf replaced if necessary. If the buffer strip becomes laden with sediment and is damaged, bare spots will emerge and contribute excessive sediment loads into the trench.

Insect Control

Mosquitoes are not as big a problem as is often perceived and there are proven control strategies that can be used. While ponded water can create mosquito and other insect breeding habitat, it also provides habitat for insect predators to keep the nuisance populations in check.

The best mosquito control technique in retention basins is to prevent stagnant areas from forming in the permanent pool. Prompt removal of floating debris helps to eliminate still or standing surface waters that provide breeding habitat. In larger basins, it may also be possible to maintain stocks of fish which feed on mosquito larvae.

Pond Habitat Maintenance

An important, yet often overlooked aspect of non-routine retention basin maintenance is the need to ensure a healthy aquatic environment. Suitable habitat and a healthy aquatic ecosystem can be ensured with a regular monitoring program and should require little maintenance. For example, a common problem in wet ponds is excessive algae growth (blooms) resulting from excess nutrients in stormwater runoff entering the facility. In many cases, excess nutrients will be taken up by more desirable aquatic and semi-aquatic vegetation encouraged to grow in and around the permanent pool of a retention facility. The presence of submerged and emergent plants will help reduce the amount of algal growth and will provide desirable pond habitat for aquatic and terrestrial creatures. Pond management experts can provide algae management plans that might include aeration fountains, and, in extreme cases, herbicides.

Bank Stabilization

It is very important to ensure the integrity of the banks, slopes, and bottom of a dry pond and the visible banks of a wet pond. A healthy ground cover must be routinely maintained on the embankments and bottoms of basins. Bare areas should be re-seeded and stabilized as quickly as possible to avoid soil erosion and clogging of the facility.

The roots of woody growth, such as young trees and bushes, tend to be destabilizing on embankments. Impoundments over a certain size must comply with state and local dam safety standards. Consistent mowing will control any stray seedlings that take root on an embankment. Woody growth away from the embankment does not generally pose a threat to the stability of the embankment and can play an important role in maintaining a healthy pond ecosystem. Trees and bushes should, however, be planted outside maintenance and access areas.

Beavers have been known to take up residence in facilities with ponded water. These animals can cut down small trees in the BMP area and may cause an increase in the amount of ponding. Should excessive tree damage or ponding be observed, it is suggested that the local Cooperative Extension Services or Maryland Department of Natural Resources be contacted.

Other animals, such as muskrats and groundhogs, may dig out burrows that could deteriorate the structural integrity of an embankment. Muskrats in particular will burrow tunnels up to 6 inches in diameter. Existing burrows should be filled as soon as possible to minimize animal burrowing.

Sediment Removal

Dry and Wet Ponds

Since one of the purposes of BMPs is to remove sediment from stormwater, sediment will accumulate in a BMP and eventually need to be removed. Facilities vary so dramatically that there are no "rules of thumb" to guide responsible parties on the frequency for sediment removal from a surface basin. Upstream conditions, including land use, type of land cover (vegetated vs. paved), and soil types are important factors in determining how rapidly sediment accumulates in a basin. For planning purposes, sediment removal should be considered on intervals shown in Table 4.

POND TYPE	INTERVAL
DRY	2 to 10 years
WET	5 to 20 years

Table 4. Sediment Removal Intervals for Basins

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Sediment removal is usually the largest single cost of maintaining a BMP facility. Responsible parties should therefore plan ahead and set aside the necessary funds in advance. The sediment removed from a basin will need to be disposed. The best solution is to have an on-site area or a site adjacent to the facility, but outside of the floodplain, set aside for the sediment. If such a disposal area is not set aside, transportation and landfill tipping fees can greatly increase the cost. Once the sediment is removed, the bottom of the basin and any disturbed areas need to be immediately stabilized and re-vegetated or the facility will quickly clog and require sediment removal again.

Wet sediment is more difficult and expensive to remove than dry sediment. In some cases the entire facility can be drained and allowed to dry so that heavy equipment can remove sediment from the bottom. In other cases, where this is not practical, it may be necessary to remove sediment from the shoreline or by hydraulic dredging from the surface. This additional cost of sediment removal for a retention facility is partially offset by the longer interval between dredging cycles. Disposal of wet sediment is not allowed in many landfills, so the material often must be dried (dewatered) prior to disposal. This extra step adds to the cost and requires a place where wet material can be temporarily placed to dry.

Infiltration Trenches

If an overflow condition is observed at an infiltration trench, its observation well should be checked to determine the cause.This is especially critical for concentrated input facilities which use sediment traps, because if the sediment trap is full, sediment laden water will be conveyed into the trench. With dispersed input (surface-fed) facilities, a clogged sediment barrier is indicated when water cannot flow into the trench and goes through the overflow channel prematurely. If an infiltration trench is found to stay filled with water after a rain and cause regular overflow, the aggregate stone must be excavated and the facility rebuilt.

The specific sediment removal procedure will depend on the manner in which stormwater enters the facility. Concentrated input facilities will have an in-line filter system or sediment trap. Clean-out procedures are described in the maintenance checklists for those specific facilities. If there is any question on how routine sediment removal is to be performed for a given facility, contact the County for instructions.

For "typical" trenches using dispersed input, routine sediment removal usually means removing the top 6 to 12 inches of

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filter gravel and replacing the filter cloth sediment barrier covering the aggregate reservoir beneath. A layer of clean filter gravel replaces the gravel removed. Any bare spots or damaged areas in the grassfilter strip should be sodded upon completion of the sediment removal procedure.

Who Should Carry Out the Maintenance

In designing a maintenance program, safety, cost and effectiveness of the maintenance activities need to be balanced. Some activities can be cost effectively undertaken by facility owners, if desired. Manageable landscaping tasks, litter removal, and even some mowing, are tasks appropriate for owners to handle themselves.

However, it is usually worth the cost to have a professional do the more difficult work. Mowing and handling a wheelbarrow can be dangerous on the sloping embankments of a detention basin. Filling eroded areas and soil disturbing activities, such as resodding or replanting vegetation, are also items that a professional landscaping firm might best manage. If not performed properly the first time, not only will the effort have been wasted, but damage may be done to the facility by creating excessive erosion. Grading and sediment removal are best left to professional contractors.

In addition, trained personnel will be able to identify potential problems early on when it is most cost-effective to make repairs or alterations. The maintenance needs of BMPs are somewhat site specific and the total costs for conducting needed maintenance will vary greatly. However, it is possible to estimate cost for some general BMP maintenance tasks. The costs for routine and non-routine tasks should be evaluated separately since they vary dramatically.

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Estimating Routine Costs

Routine costs for maintaining a BMP are highly site-specific and dependent on factors like type of development and landscaping on the site. Routine maintenance includes inspections, debris and litter control, mechanical components maintenance, vegetation management, and other routine tasks as determined for the specific facility.

A survey of Washington Metropolitan area lawn and grounds maintenance services showed that grounds keeping maintenance costs ranged between $100 per acre per year for mowing and fertilizing only, to $550 per acre per year for mowing, fertilizing, litter control, resodding and insect control.

Estimating Dredging and Sediment Removal Costs

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Costs for dredging and sediment removal of BMPs are highly site specific and vary greatly depending upon the size and depth of the facility, the volume of sediment trapped in the BMP, ease of access to the BMP, and whether or not on-site disposal of the dredged sediments is possible. In general, both wet and dry pond maintenance costs are similar unless otherwise noted. Table 5 shows the ranges of costs associated with sediment removal for various sized BMPs. The last column is blank and can be used with the data below to estimate the costs of a particular facility.The costs shown here are based on an informal survey of firms that provide such services in Northern Virginia and Montgomery County.

Mobilization and Demobilization

One of the larger fixed costs in dredging a BMP facility is the mobilization and demobilization of the required machinery and personnel. Large wet ponds will often require a waterborne operation during which an excavator or a crane must be mounted to a floating barge and moved into position. The cost associated with such an operation is usually around $30,000.

For dry ponds and smaller wet ponds which can be drained or dredged from shore, a perimeter or dry operation will usually suffice. In this case, a backhoe or crane can scoop out the sediment without a floating barge. The costs of mobilizing and demobilizing for this type of operation will range between $5,000 to $7,000.

Dredging

The costs of physically dredging sediment from a BMP once mobilization has occurred depend on the total volume (in cubic yards) of sediment removed. The cost per cubic yard is largely influenced by the depth of the water and the distance between the excavation area and the "staging area" where sediment is transferred to trucks for removal. A further consideration is whether the equipment can easily access the BMP bottom. Dredging costs range from $6 to $15 per cubic yard.

R0020483

	Surface Area in Acres						ES
	.25	0.5	1	2	10		
Mobilization and Demobilization Low High	5,000 7,000	5,000 7,000	5,000 7,000	5,000 7,000	5,000 7,000		
Dredging (Low ($6/cy) (High ($15/cy)	1,210 3,025	2,420 6,050	4,840 12,100	9,680 24,200	48,400 121,000		
Disposal Onsite ($3/cy) Offsite ($29/cy)	605 5,848	1,210 11,697	2,420 23,303	4,480 46,787	24,200 233,933		
TOTAL							

Table 5. Sample Cost Estimates for Sediment Removal from BMPs

---

The equation shown in Table 6 can be used to estimate the volume of sediment that needs to be removed. The depth of accumulated sediment and the surface area (depends on shape) of the pond must be determined. The surface area in acres is used as an approximation of the area of the bottom of the pond. This figure is multiplied by 43,560 (to convert to square feet) and by the depth of the sediment to be removed. The product is divided by 27 to give the volume of sediment in cubic yards.

-
- surface area (in acres)
- x depth of sediment (in feet)
- x 43,560 = cubic feet/27 = cubic yards

Table 2. Minimum Inspection Checklist for Ponds.

Disposal

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The primary factor in disposal costs is whether an on-site disposal area is available. The largest cost is that of transporting the material, which can be upwards of $40 an hour per truck. Costs may range from $3 per cubic yard, where a single truck is used to dispose of the material on-site, to $29 per cubic yard for a larger site requiring 20 trucks to haul the material to an off-site location.

Total Costs for Dredging and Disposal

By adding the costs of the previous three steps, one can establish a range in which a BMP owner can expect to pay for the non-routine maintenance of a BMP. The estimates shown in Table 5 assume a sediment accumulation of 6 inches. Based on those estimates, total non-routine costs range from $ 6,815 for a small pond of 0.25 acres to $ 384,933 for a larger facility of 10 acres.

Planning Ahead

The costs of maintaining a BMP over the long run can therefore be considerable, particularly when dredging or other non-routine maintenance is needed. To lessen the immediate financial impact of non-routine costs, responsible parties should consider creating a fund for this eventuality. For dry ponds, which need to have sediment removed every 2 to 10 years, 10% to 50% of the anticipated dredging costs should be collected per year. For wet ponds, which need to be dredged every 5 to 20 years, approximately 5% to 20% of the anticipated costs should be accrued per year. The rate of assessment can include anticipated interest over the collection interval.

Recomended Inspection Frequency For Facilities
Ponds - Annually
Oil/Grit Seperator - 6 Months
Infiltration trenches - Annually
Underground Storage Structures - Annually

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Community Involvement

Stormwater facilities, particularly pond BMPs, can provide unique opportunities for fostering stewardship and involvement in community based activities. There are many ongoing school and community-based outreach programs that homeowners' associations can take advantage of which will enhance the BMPs in their communities and make for cleaner local streams and help restore the Chesapeake Bay. A good reference on how individuals can help control pollution is the Baybook: A Guide to Reducing Water Pollutionat Home; copies are available from the Alliance for the Chesapeake Bay in Baltimore.

How does your community affect BMPs?
You and your neighbors can adversely affect the functioning of BMPs by:

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- allowing trash to accumulate in and around BMPs
- dumping grass clippings or leaves on or into BMPs
- using excess or in appropriately applied fertilizers that can then run off into the BMP
- disturbing vegetated areas and leaving bare areas which produce sediment laden runoff to the BMP
- introducing swimming pool discharges or allowing toxic substances (oil or antifreeze, e.g.,) to run off into the BMPs or into stormdrains that lead to BMPs

In most residential areas, the most common type of stormwater control is some form of pond. The following list includes activities that can be organized and performed by homeowners, schools or other volunteer groups to help maintain and improve the pond environment. Some of these activities may need to involve environmental or engineering professionals.

Organizations that assist with some of these projects include Montgomery County Department of Environmental Protection (grasscycling,composting, Stream Teams), Cooperative Extension Office (fertilizer use, planting tips, Master Gardeners), U.S. Fish and Wildlife Annapolis Office-Bayscape Program (native plantings, butterfly gardens), Audubon Naturalist Society (native plantings, workshops on pond ecology). Many private companies focus on proper plantings around ponds and can be found in the phone book under landscaping or gardening.

Some of the best texts available for an HOA or town to use for stormwater facility maintenance are Lake Smarts-The First Lake Maintenance Handbook and Fundamentals of Urban Runoff Management by the Terrene Institute which can be ordered from the Terrene Institute of Washington D.C. by calling (202) 833-8317. It contains field tested, easy and affordable projects to help you clean up, improve, and maintain ponds, such as stormwater ponds.(See Table 7 for community activities to maintain and improve BMPs)

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PROBLEM	EVIDENCE	SOLUTION
Trash accumulation in and around the BMP	Trash and debris settled in basin bottom or floating in wet pond or collected on trash rack	Organize neighborhood trash pickup; contact local school or scout troop and offer prizes for largest item found or most trash collected
Using excess or incorrectly applied fertilizers	Excessive algal growth and fish kills	Find or create a factsheet on proper fertilizer use and distribute it in your neighborhood; encourage your neighbors to closely follow manufacturer's instructions on concentration and application rates for fertilizers and follow recommended application periods (contact the County Cooperative Extension Office)
Oil or other toxic substances	Oily sheen on basin bottom or on surface of pool area; presence of dead fish or other aquatic organisms	Find or create a factsheet on proper disposal of hazardous household waste; encourage your neighbors to follow manufacturer's directions for concentrations and application of pesticides
Bare, exposed areas in or around pond or in areas draining to facility	Water in pond is cloudy	Spread hay on temporarily disturbed areas; reseed and stabilize disturbed areas as soon as possible; organize planting of grass or shrubs in disturbed areas; plant water loving shrubs if disturbed areas are adjacent to pond
Animal activity	Burrows (holes) in pond sides or embankment; small trees cut down around pond or in nearby yards; increase in wet pond area	Coordinate with the County's Cooperative Extension Office

Table 7. Community Activities to Maintain and Improve BMPs

References

Northern Virginia Planning District Commision. *Maintaining BMPs: A Guide Book for Private Owners and Operators in Northern Virginia*

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Schueler, T. R. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*

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Meeting New Requirements for Stormwater Controls in New and Redevelopment Projects

Thursday August 9, 2001
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Friday August 10, 2001
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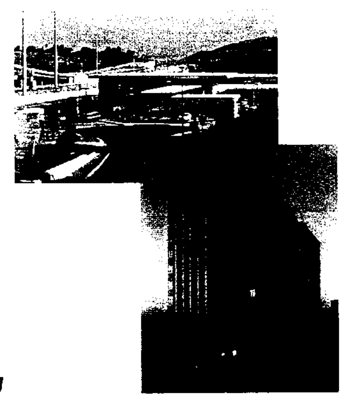

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- Streets & Roadways
- Highways & Bridges
- Light Rail
- Municipal Facilities

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- Wetlands & Coastal Restoration
- Stormwater Management
- Water Quality Assurance
- Flood Control
- Erosion Control BMPs

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Offices:	Irvine, San Diego, Santa Barbara and the Inland Empire

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- ***To be trusted and preferred by our clients***
- ***To be respected and admired by our competition***
- ***To have choice and variety in our work***

Our Goals...

- ***To provide timely and professional services***
- ***To maximize value for our clients***
- ***To deliver on promises and stand behind our work***
- ***To pursue total quality through teamwork, training, commitment and communication***

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Using cutting edge technology while challenging ourselves with dynamic, exciting projects.

Participatory meetings:
Our employees are our most important resource.

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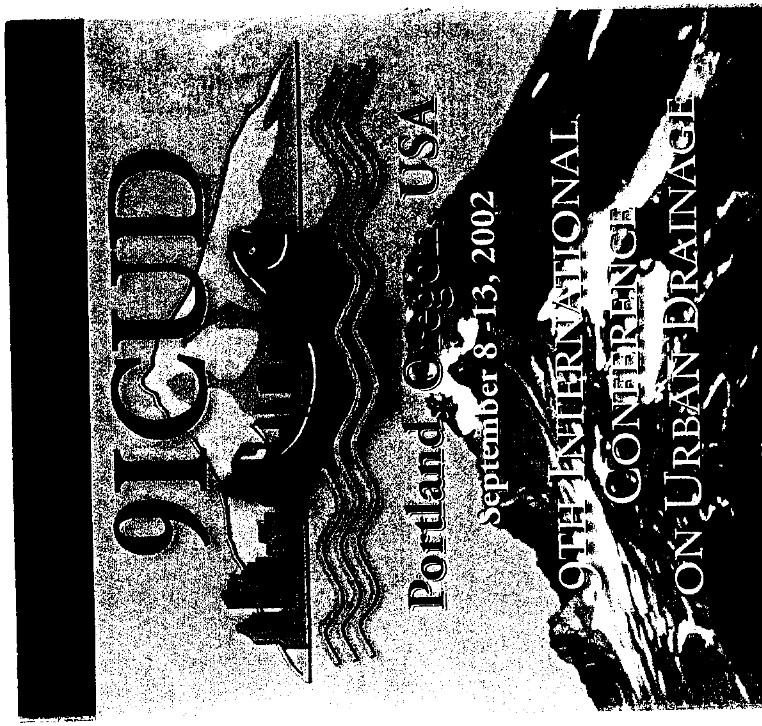

9ICUD

Portland, Oregon USA

September 8-13, 2002

9TH INTERNATIONAL CONFERENCE ON URBAN DRAINAGE

SECOND ANNOUNCEMENT AND CALL FOR ABSTRACTS

Sponsored by:
The Joint Committee on Urban Storm Drainage of the IAHR and IWA
and
The Environmental and Water Resources Institute of the American Society of Civil Engineers

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ASCE American Society of Civil Engineers

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SUBMIT YOUR ABSTRACT TODAY!

Use the reply form inside.

About the Conference

Plan to participate in and attend the ninth triennial International Conference on Urban Storm Drainage — one of the foremost international meetings where engineers, scientists and managers of urban water resources exchange ideas about the urban water environment. The ninth ICUD continues the tradition begun in 1978 in Southampton, UK, exploring state-of-the-art technology and bringing together colleagues from around the world to address critical issues in the practice of urban storm drainage. No other meeting on urban water issues attracts such a diverse group of participants. Don't miss this opportunity to exchange ideas with colleagues and leaders in the field worldwide!

Conference Topics

- Urban hydrologic processes, including precipitation and runoff
- Hydraulics of urban drainage, including combined and separate storm sewer systems
- Highway runoff impacts and management
- Infiltration/inflow and sanitary sewer overflows
- Water quality and environmental issues
- Sediment in sewers
- Sewer system design and rehabilitation
- Impact mitigation and best management practices (BMPs)
- Low impact development techniques

Pictured left, Mount Hood, Mount Hood National Forest

- Monitoring and data collection
- State-of-the-art computer modeling of water quantity and quality in urban areas
- Geographical information systems and decision support systems applications in urban stormwater management
- Receiving water impacts, including effects on migratory fish
- Urban wetlands
- Water reuse
- Real time control
- Integrated stormwater management approaches and stormwater master planning
- Storm system asset management
- Educational initiatives for urban stormwater management
- Urban runoff management and regulatory programs
- Urban streams
- Emerging urban runoff issues of the 21st Century
- Integrated urban water system management
- Other

Conference Format

Proceedings will be prepared in a printed format. Authors are expected to present their papers orally or at poster sessions during the five-day meeting. There will be technical tours and a trade exhibition. All published materials and spoken presentations will be in English.

Key Dates

- **One-page abstract due:** July 31, 2001
- **Author notification:** October 31, 2001
- **Final paper due:** January 31, 2002

Organizing Committee

Dr. Wayne C. Huber (*wayne.huber@orst.edu*) and Mr. Eric W. Strecker (*estrecker@geosyntec.com*) serve as co-chairs for the 9ICUD. Members of the ASCE/EWRI Urban Water Resources Research Council and Portland and regional civil and environmental engineers will lead the conference and serve as its organizing committee, with additional assistance and guidance from the international membership of the IAHR and IWA. The 2002 conference builds on the experience of eight, highly successful past conferences on urban drainage.

Accompanying Persons

Portland, Oregon, ranks 5th in "100 fabulous places to visit in 2001" by Travel & Leisure magazine. While trees and city parks continue to dominate Portland's landscape, trendy restaurants, clothing shops, and art galleries are popping up all over this pedestrian-friendly city, making it one of the world's most interesting destinations.

In addition, the city's nearby ocean beaches, mountains and the high desert of the Pacific Northwest, make it an ideal setting for recreation and touring for the entire family. A selection of activities will be available both during and after the conference. Portland is also an excellent gateway for travel elsewhere in the region.

Trade Exhibition

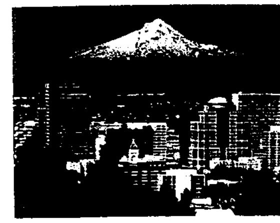
A trade exhibition will run concurrently with the conference. Please contact the conference manager, Ms. Cindy Gold, to reserve a location.

Conference Website

A Web site has been established for up-to-date information about the 9ICUD. The address is:

www.asce.org/conferences/9icud2002

Destination Portland, Oregon, USA



The Pacific Northwest is one of the leaders in efforts to control combined sewer overflows and resolve stormwater management problems — while at the same time addressing special ecological concerns such as endangered salmon populations. As a result, the 9ICUD should receive wide regional as well as international attention. Field trips will take advantage of several large urban water resources construction and planning projects underway in the area, smaller watershed BMP-implementation projects, and a tour of on-site BMPs being employed in the Portland area. Technical tour opportunities will also be available at major dams nearby on the Columbia River.

The greater Portland metropolitan area has a population of approximately 1.6 million and is the third largest city in the Pacific Northwest. The city is situated on the Willamette River near its confluence with the Columbia River, 125 km upstream from the Pacific Ocean. Portland is also just 100 km west of beautiful 3,400-meter Mount Hood, between the Cascade Mountains to the east and the Coast Range to the west, an area boasting every imaginable urban and natural recreational amenity.

Portland's international airport has connections to every part of the world, and public transportation within the city is excellent. The average maximum temperature in September is 24°C, with typically sunny weather. For additional information about the city, visit the Portland Oregon Visitors Association Web site at *www.pova.com*.

The conference will be held at the DoubleTree Hotel at Portland's Lloyd Center. The hotel is near downtown Portland, adjacent to shopping and restaurants, and is served by light rail, city buses and airport vans. More information is available at *www.hilton.com/doubletree/hotels/RLLC-DT*.

Mailing List Reply Form

☐ **YES!** *I'd like to be added to the mailing list! Please send me the full conference program when it becomes available.*

Name ______________________________

Title ______________________________

Organization ______________________________

Address ______________________________

____

____

City ______________________________

State ______________________________

Postal Code ______________________________

Country ______________________________

Phone ______________________________

Fax ______________________________

E-mail ______________________________

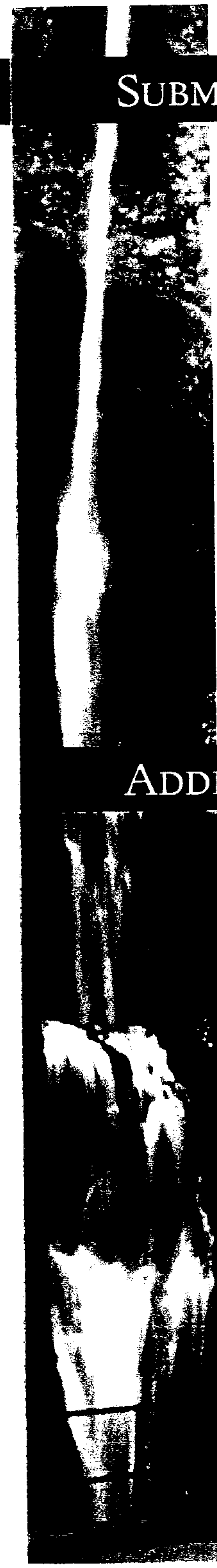
If you have already completed a mailing list reply form, you do not need to do so again.

Mail: ASCE
Conferences Department
1801 Alexander Bell Drive
Reston, VA 20191-4400

Fax: 703/295-6144

Phone: 800/548-ASCE
or 703/295-6197

Email: conf@asce.org



Submission of Abstracts

Electronic submission of abstracts is preferred. Please complete the abstract submittal form on the 9ICUD website:

www.asce.org/conferences/9icud2002

Follow the directions. Abstracts should be no longer than one printed page (A4 or U.S. 8.5 x 11 inches) and include all contact information for the authors, including e-mail addresses. The proposed topic area should be indicated, from the earlier list. Please indicate if you prefer a poster or oral presentation.

Abstracts are due by **July 31, 2001.**

Additional Information

For further information please contact:

Ms. Cindy Gold
Conference Manager

email: cgold@asce.org
Phone: 703/295-6197
Fax: 703/295-6144
Toll-free: 800/548-ASCE

If you are unable to access the Internet, abstracts may be submitted by mail to the following address:

Mr. Eric W. Strecker
GeoSyntec Consultants

333 SW Fifth Avenue, Suite 600
Portland, OR 97204-1743
Phone: 503/222-9518
Fax: 503/242-1416

Pictured left, Multnomah Falls, Columbia Gorge

R0020495

Meeting New Requirements for Stormwater Controls in New and Redevelopment Projects

Thursday August 9, 2001
Berkeley Radisson Marina Hotel
Berkeley, CA

Friday August 10, 2001
Quinlan Community Center
Cupertino, CA

"Meeting New Requirements for Stormwater Controls in New and Redevelopment Projects"

August 9, 2001 Berkeley Revised Agenda **August 10, 2001 Cupertino**

8:30	Registration / Refreshments	
9:00	Welcome / Introduction/Moderator	***August 9, 2001 Berkeley*** *Jim Scanlin*, Alameda Countywide Clean Water Program *Jack Betourne*, Vallejo Sanitation and Flood Control District ***August 10, 2001 Cupertino*** *Jill Bicknell*, Santa Clara Valley Urban Runoff Pollution Prevention Program *Lavenia Millar*, City of Cupertino
9:05	Regulatory Perspective	*Lawrence P. Kolb, Assistant Executive Officer/* *Dale Bowyer, Section Leader* San Francisco Bay Regional Water Quality Control Board
9:20	"Start at the Source" Video	Bay Area Stormwater Management Agencies Association
9:35	**Panel I - Current Efforts to Reduce Impacts of New and Redevelopment** Question and Answer Period	***August 9, 2001 Berkeley*** *Liz Lewis*, Marin County Stormwater Pollution Prevention Program *Ed Boscacci*, BKF Engineers *Kathy Cote*, City of Fremont ***August 10, 2001 Cupertino*** *Pankti Shaw*, City of San Jose *Ed Boscacci*, BKF Engineers *Kathy Cote*, City of Fremont
10:30	BREAK	
10:45	**Panel II -- The Southern California Experience** • Development of the "Standard Urban Stormwater Mitigation Plan" (SUSMP) • Developer's Perspective • Implementation of the SUSMP Requirements in the City of Los Angeles • Engineer's Perspective Question and Answer Period	*Xavier Swamikannu*, Los Angeles Regional Water Quality Control Board *Richard Watson*, Richard Watson & Associates *John Dorsey*, City of Los Angeles *John Olivier*, Fuscoe Engineering

R0020497

12:15	LUNCH	
1:00	**What We Can Expect in the Bay Area**: <u>Regional Board Perspective</u> • SCVURPPP Permit Requirements • Update of *Staff Recommendations* <u>SCVURPPP Perspective</u> • SCVURPPP/BASMAA projects • Implications for Municipalities Question and Answer Period	***August 9, 2001 Berkeley*** *Keith Lichten/Dale Bowyer,* San Francisco Bay Regional Water Quality Control Board *Jill Bicknell,* Santa Clara Valley Urban Runoff Pollution Prevention Program ***August 10, 2001 Cupertino*** *Jan O'Hara/Dale Bowyer,* San Francisco Bay Regional Water Quality Control Board *Jill Bicknell,* Santa Clara Valley Urban Runoff Pollution Prevention Program
2:30	BREAK	
2:45	**Panel III – Applying the New Requirements to Project Designs** Question and Answer Period	*Jeff Endicott,* Camp Dresser and McKee *John Olivier,* Fuscoe Engineering *Eric Strecker*, GeoSyntec Consultants
4:00	ADJOURN	

Sponsored by Bay Area Stormwater Management Agencies

Alameda Countywide Clean Water Program

Contra Costa Clean Water Program

Fairfield-Suisun Urban Runoff Management Program

Marin County Stormwater Pollution Prevention Program

San Mateo Countywide Stormwater Pollution Prevention Program

Santa Clara Valley Urban Runoff Pollution Prevention Program

Vallejo Sanitation and Flood Control District

EOA, Inc.
1410 Jackson Street
Oakland, CA 94612

Meeting New Requirements for Stormwater Controls in New and Redevelopment Projects

R0020499

Are you involved in site design, plan development or review, landscape design, permitting, construction inspection, or other development activities??
If so, this workshop is for you!!

Come learn about:

The proposed new development and redevelopment requirements for municipal storm water discharge permits in the Bay Area;

Proposed design standards for storm water treatment controls at development sites;

Current efforts to reduce impacts of new and redevelopment on water quality;

Experiences of municipal agencies, developers, and engineers in the Los Angeles area in meeting similar requirements;

Case studies of how to apply the new requirements to actual development projects.

A G E N D A

KEY: First speaker(s) in Berkeley
Second speakers(s) in Cupertino
Single speaker at both workshops

8:30 Registration/Refreshments

9:00 Welcome/Introduction

Jim Scanlin, ACCWP

Jill Bicknell, SCVURPPP
Lavenia Millar, City of Cupertino

9:05 Regulatory Perspective

Lawrence P. Kolb, Assistant Executive Officer, RWQCB (invited)

9:20 "Start at the Source" Video

9:35 Panel I - Current Efforts to Reduce Impacts of New and Redevelopment

Liz Lewis, MCSTOPPP
Ed Boscacci, BKF Engineers
Danny Akagi, City of Berkeley

Pankti Shah, City of San Jose
Ed Boscacci, BKF Engineers
Kathy Cote, City of Fremont

10:30 Break

10:45 Panel II - The Southern California Experience

Development of the "Standard Urban Stormwater Mitigation Plan" (SUSMP)

Xavier Swamikannu, L.A. RWQCB

Implementation of the SUSMP Requirements in the City of Los Angeles

Gary Moore, City of Los Angeles

R0020500

Implementation of the SUSMP Requirements in the County of Los Angeles

Phil Doudar, Los Angeles County (invited)

Engineer's Perspective

John Olivier, Fuscoe Engineering

Developer's Perspective

Tim Piasky, Building Industry Assoc.

12:15 Lunch

1:00 What We Can Expect in the Bay Area:

- SCVURPPP Permit Requirements
- Update of Regional Board's Staff Recommendations
- SCVURPPP/BASMAA Projects
- Implications for Municipalities

Keith Lichten, Dale Bowyer, and/or Jan O'Hara, SF RWQCB
Jill Bicknell, SCVURPPP

2:30 Break

2:45 Panel III - Applying the New Requirements to Project Designs

Jeff Endicott, CDM
Eric Strecker, GeoSyntec
John Olivier, Fuscoe Engineering

4:00 Adjourn

Continental breakfast and lunch will be served.

REGISTRATION

Registration is FREE.

But you need to RSVP with the following information to Bonnie Hulkower by Friday, August 3, 2001 at:

Mail: 1410 Jackson Street
Oakland, CA 94612
Phone: (510) 832-2852 ext. 119
Email: bonnie@eoainc.com
Fax: (510) 832-2856

Please complete the following and check off the date that you will attend.

Name __________

Affiliation __________

Address __________

City __________

State and Zip __________

Telephone __________

Fax __________

Workshop Dates and Locations:

☐ Thursday, August 9, 2001
Radisson Hotel Berkeley Marina
200 Marina Blvd., Berkeley, CA

☐ Friday, August 10, 2001
Quinlan Community Center
10185 N. Stelling Road
Cupertino, CA

8:30 a.m. - 4:00 p.m.

Questions? Contact Bonnie at EOA, Inc.

Can't attend? Please pass this brochure on to appropriate staff within your organization.

R0020501

Directions to the
Radisson Hotel Berkeley Marina

From the North
Take I-80 West.
Take the University Ave. exit towards Berkeley.
Keep Right in the fork in the ramp.
Keep Left in the fork in the ramp.
Turn Left onto University Ave.
Turn slight Right onto Marina Blvd.

From the South
Take I-80 East.
Take the University Ave. exit towards Berkeley.
Keep Left at the fork in the ramp.
Turn Left onto University Ave.
Turn slight Right onto Marina Blvd.

Directions to the
Quinlan Community Center (Cupertino)

From the North
Take 101 or 280 South.
Take CA-85 South Ramp toward Cupertino/
Santa Cruz/Gilroy onto CA-85.
Take the Stevens Creek Blvd. exit.
Turn Left onto Stevens Creek Blvd.
Turn Left onto North Stelling Rd.

From the South
Take CA-85 North.
Take Stevens Creek Blvd. exit.
Turn Right onto Stevens Creek Blvd.
Turn Left onto North Stelling Rd.

Take 80 S, get to Left lanes (not carpool) lanes toward S.F. Take the Oakland/San Jose 880 Exit. Take 880 South. In Hayward take the San Mateo Bridge (HWY 92) West. Continue on 92 past 101. Go South on 280

Sponsored by Bay Area Stormwater Management Agencies:

Alameda Countywide Clean Water Program

Contra Costa Clean Water Program

Fairfield-Suisun Urban Runoff Management Program

Marin County Stormwater Pollution Prevention Program

San Mateo Countywide Stormwater Pollution Prevention Program

Santa Clara Valley Urban Runoff Pollution Prevention Program

Vallejo Sanitation and Flood Control District

R0020502

Standard Urban Storm Water Mitigation Plan

Bay Area Storm Water Management Agencies

August 9 and 10, 200
Berkeley and Cupertino

Xavier Swamikannu
CalEPA - California Regional Water Quality Control Board, Los Angeles Region

Regulation of Storm Water

- Clean Water Act Amendments - 1987
- USEPA Phase 1 - Large/ Medium Municipalities and Industrial Permits
- USEPA Phase 2 - Small Municipalities and Construction
- California Implementation - Areawide MS4 Permits; Statewide General Storm Water Permits

Statutory Standard

Standard of Compliance in Statute

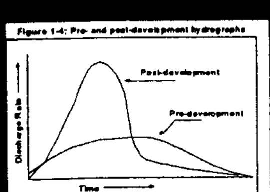
- For MS4 Permits -
  - reduce pollutants to the Maximum Extent Practicable (MEP);
  - meet water quality standards where required by the Permitting Authority

Regulatory Authority

- Regional Board may "require controls to reduce the discharge of pollutants ..and such other provisions ..determines appropriate." [33 U.S.C. 342(p)(3)(B)(iii)]
- EPA's Interim Permitting Policy authorizes "more specific conditions or limitations to be incorporated into storm water permits as necessary and appropriate" [61 Fed. Register 43761]
- Administering agency accorded high degree of deference in areas of law they regulate.

[Chevron v. NRDC (1984) 467 U.S. 837]

Urbanization : Storm Water Problems



- Changes to hydrology
- Changes to water quality
- Ultimate impacts to aquatic life and humans

Standard Urban Storm Water Mitigation Plans

- Definition - Model guidance document for the selection of post-construction BMPs
- Purpose - To ensure that potential adverse water quality impacts are addressed during project planning
- Method - Affirmative review and approval by a municipality of a written plan

Development Categories

SUSMP categories:

- 10 or more home sub-division
- 100,000 square feet commercial development
- stand alone restaurant
- automotive repair
- single family hillside dwelling
- commercial parking lots [5000 sq. ft. or more]
  - » retail gasoline outlets
  - » projects in environmentally sensitive areas

Numerical Storm Water Mitigation Standard

Four different and equivalent volumetric methods to determine BMP sizing criteria (Water Quality Volume - WQV)

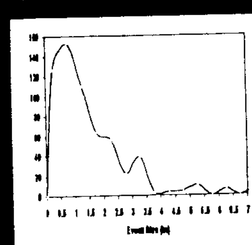
- Maximized volume capture (ASCE Method)
- Percent volume treatment (CA Handbook)
- All events up to 0.75 inch 24-hr precipitation
- Historical record 85th percentile rainfall event

Numerical Storm Water Mitigation Standard

Three different and equivalent flow based methods to determine BMP sizing criteria (Water Quality Flow - WQF)

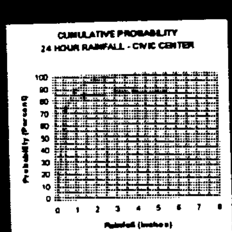
- 0.2 inch per hour or more rainfall intensity
- 2 x the 85th percentile hourly rainfall intensity
- Flow criterion equivalent to the volumetric portion treated

Principle



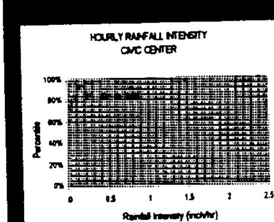
- Largest volumes of runoff are produced by smaller storms
- Criteria promotes BMP application to smaller more frequent storms

Principle



- 85th Percentile 24 hour rainfall event (0 75 inch)
- Representative rainfall station for Los Angeles County
- 100 + Years Records

Principle



- 85th Percentile hourly rainfall intensity (0 08 inch/ hr) x 2
- Margin to account for variability
- 100 + Years Records
- Consider cost benefit
  - 90th = 0.11 in per hr
  - 95th = 0.18 in. per hr
  - 99th = 0.36 in. per hr

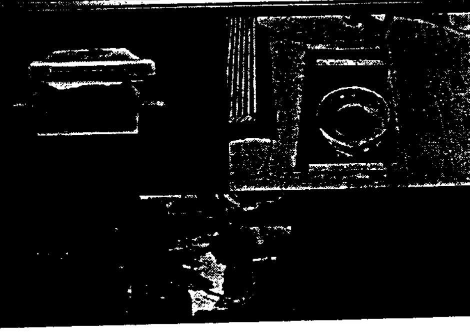
R0020504

Criteria Application

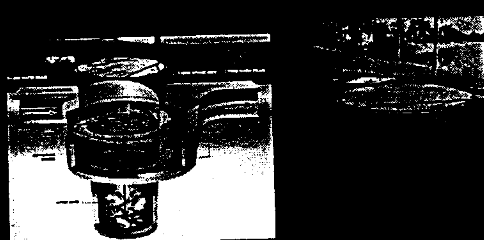
Example - A 100 square feet commercial development

- Select source control and structural BMPs from guidance in SUSMP
- Select a set of "treatment" control BMPs from guidance to remove pollutants in total runoff using WQF or WQV design criteria.
- Size BMPs for respective drainage area
- Submit Plan to municipality for approval.

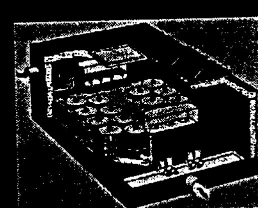
Catch Basin Filter



Full Capture System



Serial Flow Through System



Peak Discharge Flow Criteria

Objective

"Control post-development peak storm water discharge rate to maintain or reduce pre-development peak discharge rate [illegible]"

Peak Discharge Flow Criteria

Examples

- Pennsylvania - detain or infiltrate two year 24 hour storm (2 5 in) on site
- Texas - 24 hour detention storage for 1 year 3 hour frequency event
- Maryland - 12-24 hrs detention storage for one year frequency, and post-development peak discharge not to exceed pre development for 10 year storm frequency
- Washington - post-development discharge to match pre development discharge duration for range 50% of the 2 year peak flow up to 50 year peak flow, and post development discharge rate not to exceed predevelopment discharge rate for 2 year and ten year storms

R0020505

Redevelopment Criteria

- creation or addition or replacement of 5,000 square feet of impervious area or more
- if creation or addition or replacement of impervious surfaces is 50 percent or more of the existing impervious surface area, storm water from the entire site will have to be mitigated, where the original development was not subject to SUSMP requirements.

Next and New

Changes to SUSMP Categories

- All projects (non CEQA included)
- 10 or more home units (replaces sub-divisions)
- Single family hill side developments of 1 acre or more (new threshold)
- Retail gasoline outlets [5,000 sq. ft. and 100 ADT)
- Projects in environmentally sensitive areas (2,500 sq. ft. or more of impervious surface or changes natural condition to 20 percent or more of impervious surface)
- Commercial/ industrial development that disturbs one acre or more [effective March 9, 2003)

Summary

Storm water and urban runoff impair the beneficial uses of receiving waters.

Federal and State Permitting Authorities are moving towards establishing objective criteria for permit compliance.

SUSMPs and BMP water quality design criteria are steps in that direction.

On-line Resources

Web sources

LA Regional Board: www.swrcb.ca.gov/rwqcb4/html/news/news.html

LA County: dpw.co.la.ca.us/epd/

City of LA: www.lacity.org/SAN/swmd/index.htm

R0020506

STANDARD URBAN STORMWATER MITIGATION PLAN:
City of Los Angeles' Approach

John H. Dorsey
Assistant Program Manager

SUSMP BACKGROUND FOR LOS ANGELES

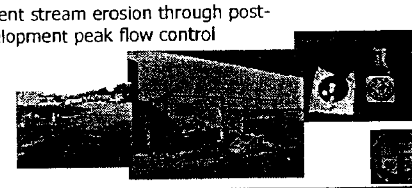
- Adopted by SWRCB on October 5, 2000
- Effective on February 15, 2001

DEVELOPMENT CATEGORIES

- Single-family hillside dwellings
- 100,000 sq ft commercial developments
- Automotive repair shops
- Retail gasoline outlets
- Restaurants
- Home subdivisions with 10 to 99 housing units
- Home subdivisions with 100 or more housing units
- Parking lots (≥5,000 sq ft, or ≥ 25 parking spaces)

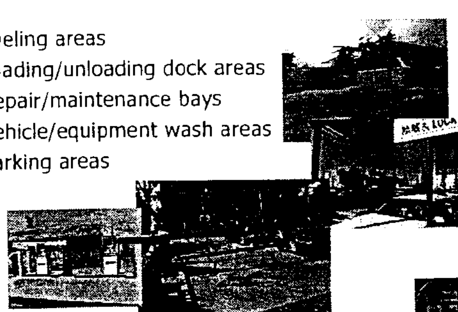
GENERAL REQUIREMENTS

- Conserve natural areas
- Protect slopes and channels
- Provide storm drain stenciling and signage
- Properly design outdoor material storage areas
- Properly design trash storage areas
- Provide for ongoing BMP maintenance
- Prevent stream erosion through post-development peak flow control



SPECIFIC DESIGN REQUIREMENTS

- Fueling areas
- Loading/unloading dock areas
- Repair/maintenance bays
- Vehicle/equipment wash areas
- Parking areas



NUMERICAL DESIGN STANDARDSTO SIZE BMPs

- Flow base methods
  (ex. 0.2 in/hr rainfall intensity)
- Volumetric methods
  (ex. first 0.75 inch of rainfall, 24hr)
- Exclude restaurants & retail gasoline outlets categories

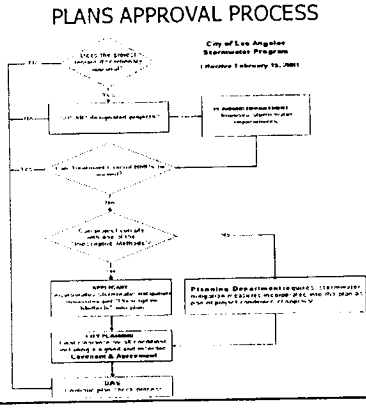
CITY ORDINANCE
No. 173494

- Generic, not detailed
- Refers to handbooks
- Provides Dept of Public Works authority to
  - update handbooks without Council approval
  - grant waivers
  - collect waiver monies
- Gives Public Works' inspectors authority to enter private properties for BMP inspections
- Requires Covenant & Agreement

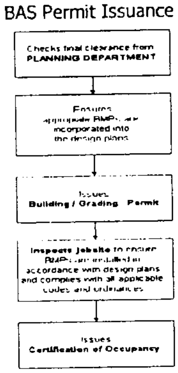
DEPARTMENT RESPONSIBILITIES

- Department of Public Works/Stormwater Management Division (DPW/SMD)
  - developed implementation plan
  - coordinated the implementation
  - acts as technical consultant
- Planning Department -- imposes SUSMP requirements for discretionary projects
- Department of Building and Safety (BAS) -- verifies requirements

PLANS APPROVAL PROCESS



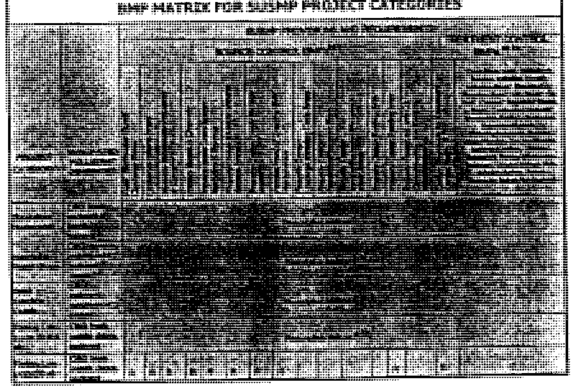
PLANS APPROVAL PROCESS
BAS Permit Issuance



DEVELOPMENT BMP HANDBOOK

- Project Review and Permitting Process
- SUSMP Project Categories and Required Mitigation Measures
- Additional Planning Priority Projects and Recommended Mitigation Measures
- Prescriptive Methods
- BMP Matrixes
- Sample Design Calculations
- Covenant and Agreement Form
- BMP References and Vendor List

TABLE 3-1 FROM HANDBOOK: BMP MATRIX FOR SUSMP PROJECT CATEGORIES



R0020508

TABLE 3-3 FROM HANDBOOK:
BMP MATRIX FOR ADDITIONAL PLANNING PRIORITY PROJECT CATEGORIES

[illegible]	[illegible]

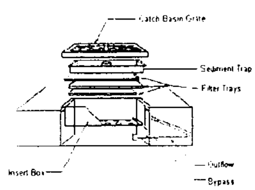
PRESCRIPTIVE METHODS

Definition: Specific stormwater BMPs and requirements designated as standard mitigation measures for certain project categories

- Retail Gasoline Outlets
- Automotive Repair Shops
- Parking Lots (5,000 - 20,000 sq-ft or 25-50 parking spaces)
- Restaurants

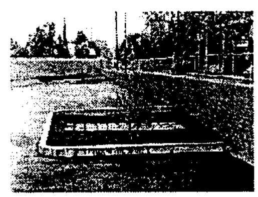
PRESCRIPTIVE METHODS
PARKING LOT BMP EXAMPLES

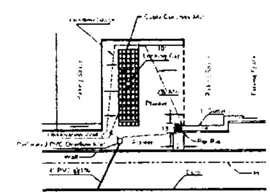
- Catch basin inserts
  - 1 catch basin insert per 5,000 sq-ft area
  - use for areas up to 10,000 sq-ft
  - size of catch basin 24" x 36"
  - minimum depth of catch basin insert shall be 24 inches
  - Aqua-Guard™, Ultra-Urban™, DrainPac™, Enviro-Drain(R)
- Hydrodynamic system
  - use for areas up to 20,000 sq-ft
  - StormCeptor(R) 450i
    4ft ϕ, 5ft-8in depth
    Vortechnics™ 1000
    3.67ft ϕ, 6ft depth
    Jensen(R) Interceptor JPHV-750
    4' x 8'-1" x 6'-3"
    V2B1™ V2-3
    4ft ϕ, 6ft depth



PRESCRIPTIVE METHODS
PARKING LOT BMP EXAMPLES

- Infiltration trench
  - use for areas up to 20,000 sq-ft
  - trench shall be 5'4" wide x 4'6" deep x 15' in length
  - bottom infiltration layer shall be 18" thick & consist of fine sand
  - site consideration to include geology and soil characteristics, presence of water supply wells, groundwater depth





PROGRAM HIGHLIGHTS

- Integration of requirements into existing City process
- Development of prescriptive methods
- Preparation of Development Planning BMP Handbook
- Mitigation of additional priority projects
- Covenant & Agreement for BMPs maintenance

FINAL THOUGHTS

- Developers are willing to work with you to install the required BMPs
- Availability of Handbook at Stormwater Program website (www.lastormwater.org/Pages/partb.htm)
- Anticipate the following 190 development projects will require SUSMP for this year:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

R0020509

Presentation by:
Phil K. Doudar, P.E.
Assistant Division Engineer
Land Development Division
Los Angeles County Department of Public Works
(626)458-4995
pdoudar@dpw.co.la.ca.us

THE LOS ANGELES COUNTY EXPERIENCE

- Los Angeles County principal permittee with 88 co-permittees
- Los Angeles County started the program prior to the RWQCB order
- Have made water quality an element of an integrated watershed management approach
- Contracted with responsive environmental advocacy groups for our outreach efforts
- Developed criteria with input from industry, RWQCB, other agencies, and environmental advocacy groups
- Criteria is continually "refined" to reflect new information, new products, and maintenance issues
- Have an ongoing "BMP" task force
- Pollutants of concern: Trash, O&G, TSS
- Moving towards public maintenance of regional facilities
- Moving towards central units and away from individual filters/inserts
- Experimenting with catch basin excluders
- Moving away from percolation/bio filtration basins
- Subdivisions
  - Part of the conditions of approval
  - Feasibility established at tentative map stage
- Building Permits - Commercial/Industrial
  - Same pollutants of concern
  - Additional pollutants to address case specific
  - SUSMP review is tied to Industrial Waste Permit Review
  - Avoid depressed truck docks and direct connections to storm drains
  - Renewable permits for maintenance accountability
- Did not relax flood control standards
- Did not relax zoning and infrastructure standards
  - Still require garages
  - Did not reduce street widths or eliminate sidewalks

R0020510

MAKING THE RWQCB ORDER WORKABLE

- Private and Public partnership essential
  - You are both regulated
- Identify what is appropriate for the region
  - Geology, hydrology, land use, pollutants of concern
- Balancing the act
  - Make it simple and cost effective
- Maintaining future facilities/ accountability
  - Private, public, volunteers
- Paying for the maintenance
  - Private, public
- Looking ahead
  - More to come
  - Monitoring/sampling
  - TMDL
- Industry
  - Be familiar with the new regulation and simplify it to Do's and Don'ts
  - Train staff to be familiar with basic lingo and the Do's and Don'ts
  - Designate a key person for all SUSMP/SWPPP, and RWQCB contacts
  - Where applicable, make your contractors/subcontractors contractually obligated
  - Keep up - attend workshops and seminars
- Do not lose site of the big picture.
  - The intent is less pollution to receiving waters.

COMMUNICATING WITH THE REGIONAL BOARD

- Be proactive in shaping new regulations
- Stress the uniqueness of the region
  - What is good for Bellflower may not work in San Jose
- Establish credibility on reporting noncompliance
  - Do it before someone else does it
- Record keeping
  - Private – photos, training
  - Public -- statistics

Standard Urban Storm Water Mitigation Plan Requirements: The Southern California Experience

Developers Perspective

Presentation to BASMAA Workshop
by
Richard Watson
Richard Watson & Associates, Inc.
9 August 2001 Berkeley, California
10 August 2001 Cupertino, California

What are SUSMPs?

- SUSMPs are Development Standards.
- SUSMPs define priority projects, include BMP requirements, and generally require application of numeric design criteria.
- SUSMPs target post-development conditions in new development and redevelopment projects.

History of SUSMPs

- Standard Urban Storm Water Mitigation Plans started in Los Angeles.
- The San Diego Regional Board staff (with encouragement) picked them up.
- Included by LARWQCB (under a different name) in the Ventura Permit
- Added to the Long Beach Permit by LARWQCB
- The Santa Clara Valley Permit was delayed and is now being amended to add SUSMPs.

Continued ...

History of SUSMPs
(Continued)

- In the draft CVRWQCB Bakersfield, Modesto, Sacramento, and Stockton Permits
- In the draft SARWQCB Orange County Permit
- Will be included in new SARWQCB Riverside County and San Bernardino County permits
- In the draft Los Angeles Permit
- In new SDRWQCB Orange County Permit
- Will be added to other SFBRWQCB permits

Evolution of SUSMP Content

- Original SUSMPs were developed by permittees as a permit requirement.
- Executive Officer's substitute SUSMPs were very prescriptive.
- Los Angeles SUSMPs were modified by State Board Order 2000-11, which corrected most blatant problems, but retained numeric design criteria.
- San Diego Permit added to Los Angeles permit as modified by SWRCB.

Continued ...

Evolution of SUSMP Content
(Continued)

- April 13 Draft Los Angeles Permit borrowed from San Diego permit and added other onerous requirements.
- June 29 Draft of Los Angeles permit is improved.
- San Diego copermittees finding some elements of their permit are not workable.
- Workshops on both Orange County permits, the Los Angeles permit, and the Santa Clara permit

Typical Priority Projects

- Hillside development > 5,000 sq. ft.
- Home subdivisions > 10 units
- Commercial developments > 100,000 sq. ft.
- Automotive repair shops
- Restaurants
- Parking lots > 5,000 sq. ft.
- Retail gasoline outlets

- Projects adjacent to environmentally sensitive areas
- Streets, roads, highways, freeways

SUSMP Provisions Typically Applicable to All Categories

- Control peak storm water discharge rates
- Conserve natural areas
- Minimize storm water pollutants of concern
- Protect slopes and channels
- Provide storm drain stenciling and signage
- Properly design outdoor material storage areas

Consequences of Not Implementing SUSMPs

Results of LA SUSMP Appeal

- Changes in redevelopment definitions made in-fill projects more feasible.
- "Non-discretionary projects" eliminated
- Retail gasoline stations added to Limited Exclusion
- "Locations within or directly adjacent to or discharging directly to an environmentally sensitive area" eliminated
- Storm water mitigation funding was eliminated.

Continued ...

Results of LA SUSMP Appeal

(Continued)

- Numerical design criteria and procedural arguments were discounted.
- State Board noted that there could be further cost savings for developers if permittees develop a regional solution.
- State Board recommended that the cities and the county, along with other interested agencies, work to develop regional solutions.
- State Board encouraged innovative regional solutions.

The Craig Wilson Memo

- On December 26, 2000, the Chief Council of the SWRCB sent a memo to all RWQCB Executive Officers summarizing State Board Order WQ 2000-11.
- Attempted to make SUSMP order a precedent
- Triggered (or used to justify) a wave of SUSMPs across the State
- Concluded that "the Order finds that the provisions in the SUSMPs as revised by the Order, constitute MEP"

San Diego SUSMP Requirements

- Requires municipalities to assess General Plans (was "revise" in draft) and to modify development approval process
- Requires SUSMPs for new development and significant redevelopment
- Specifies numeric design criteria for post-construction BMPs (added flow-based criteria)
- Expands priority development definition to include streets, highways, and freeways as well as smaller parking lots

Continued ...

San Diego SUSMP Requirements
(Continued)

- Includes a new attempt to define Environmentally Sensitive Areas
- Includes a new attempt to create a waiver provision
- Includes rigid conditions for infiltration and ground water protection
- Requires that pre-development peak storm water runoff discharge rates and velocities be maintained

Draft Los Angeles Permit Requires Expanded SUSMPs

- Adds back what the State Board removed
- Maintains the 0.75 inch volumetric storm event numerical design criterion, but adds a set of flow-based numerical design criteria
- Contains unrealistic implementation schedules for municipal compliance
- Mandates implementation of SUSMP and post-construction requirements on one acre commercial and industrial development projects by March 9, 2003

Draft SARWQCB Orange County Permit

- Less prescriptive than Los Angeles and San Diego permits
- Recognizes significant progress made by permittees during first and second term permits
- Incorporates SUSMPs in a more flexible and realistic manner (incentive and hammer)
- Permittees/Project proponents may propose BMPs based on a watershed approach, establish a storm water pollution fund for such BMPs, or any other innovative and proven alternative to address storm water pollution

SUSMPs in the Draft Orange County Permit

- Requires review of General Plan and CEQA processes and modification of project approval processes, if necessary
- Requires incorporation of SUSMP-related watershed protection principles and policies into General Plan by July 1, 2004
- If stated goals are not properly addressed in WQMP requirements by January 1, 2004, numerical design criteria similar to San Diego's will be required.

Major SUSMP Issues

- Prescriptive Nature
- Discretionary/Ministerial projects
- Significant redevelopment definitions
- Environmentally Sensitive Areas
- Waivers and regional solutions
- Maintenance
- Numeric Sizing Criteria

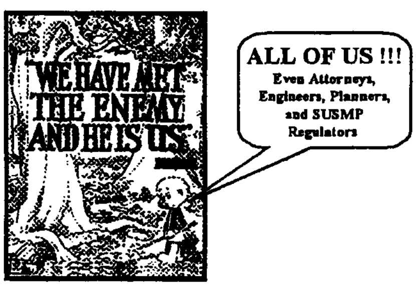
Other Permit Issues

- Micromanagement
- Shifting of inspection responsibilities
- General plan/CEQA checklist requirements
- Peak discharge requirements
- Shifting reliance on CWA and Porter-Cologne
- Lack of economic and housing considerations
- Invitations for third party lawsuits

Emerging Strategy for Regulated Community

- Comply with laws and regulations
- Promote science-based regulation
- Avoid oppressive regulation
- Prepare for potential litigation
- Separate storm water section in CWA

As POGO Said ...



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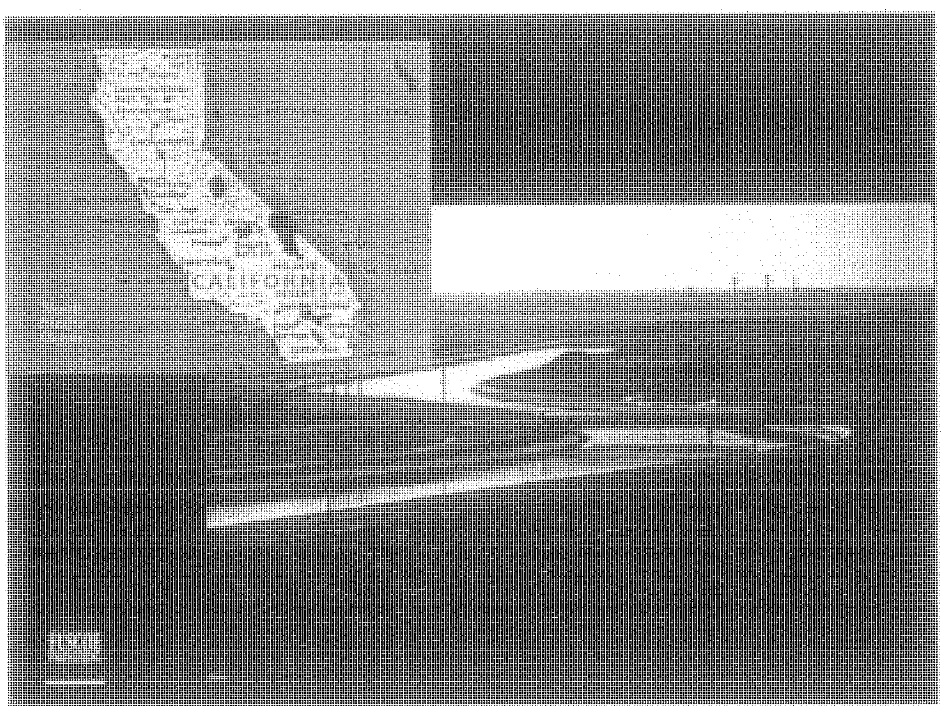
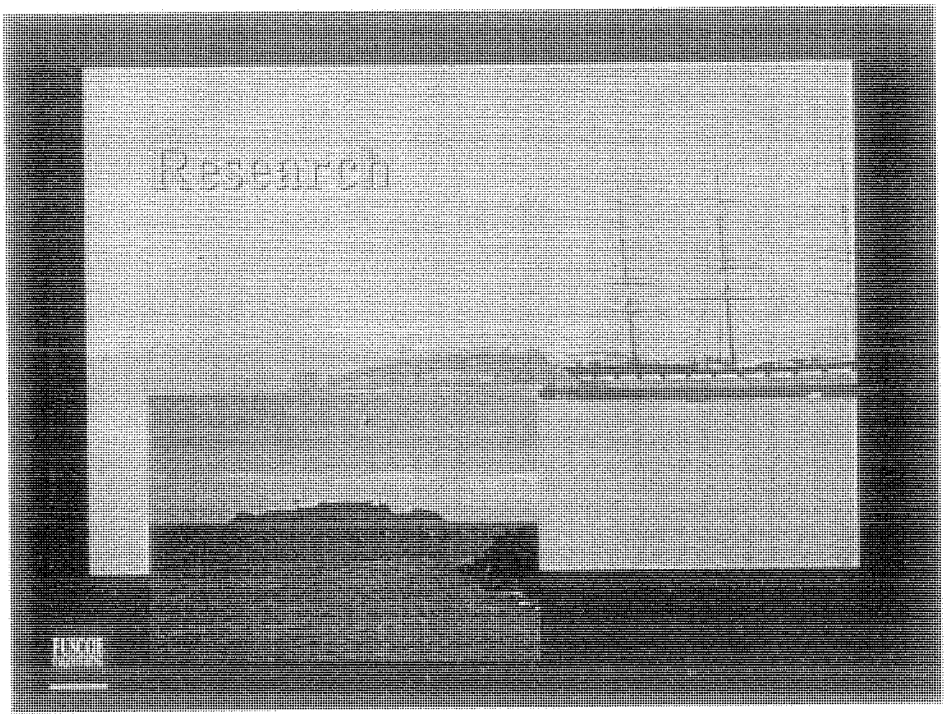
s u s u m p
The Southern
California
Experience
the engineer's
perspective

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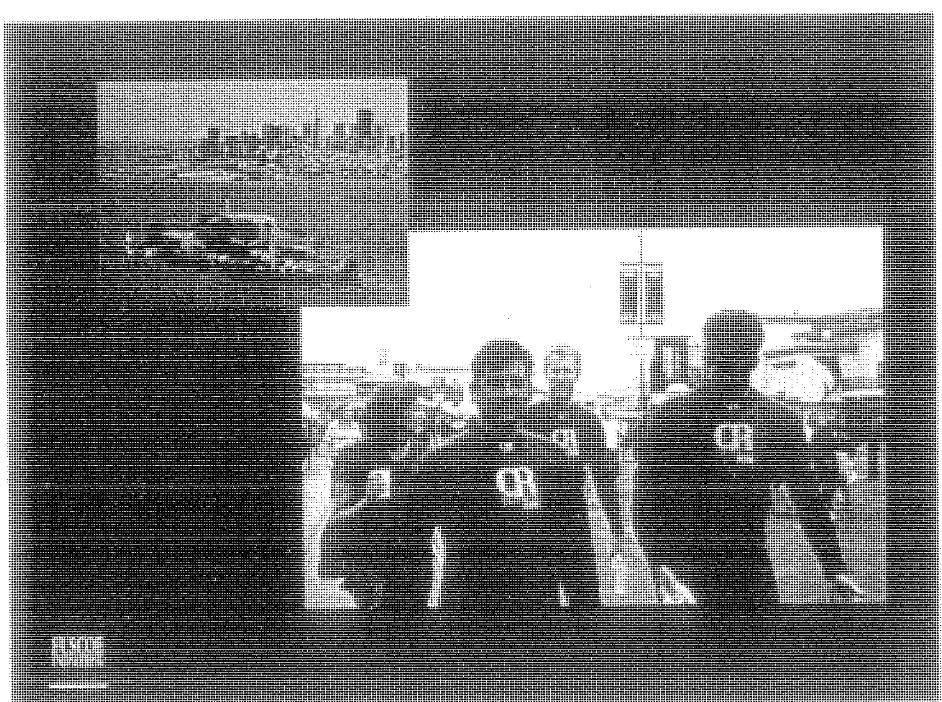
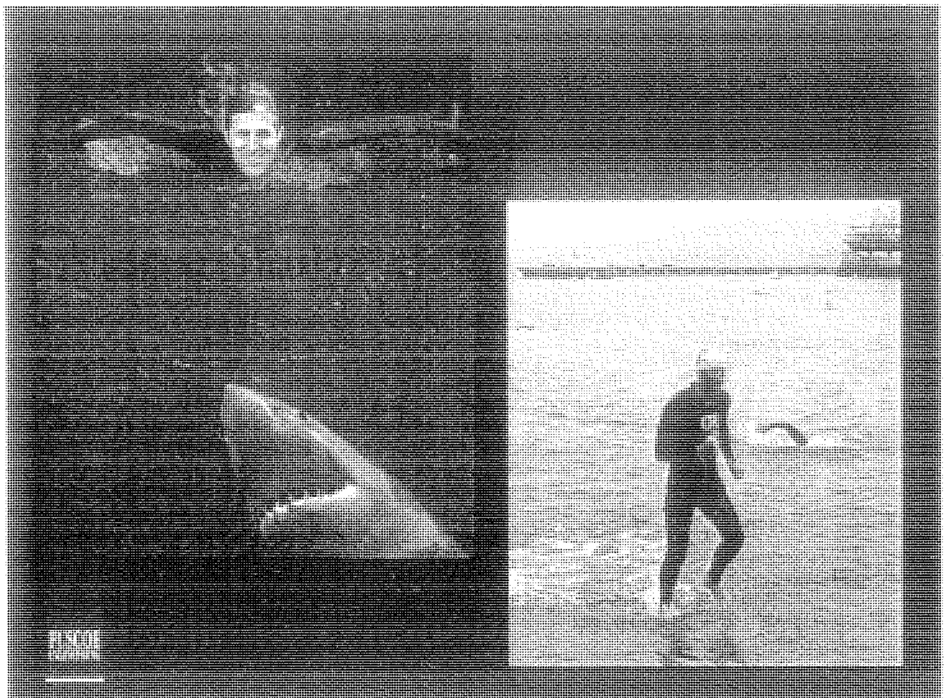


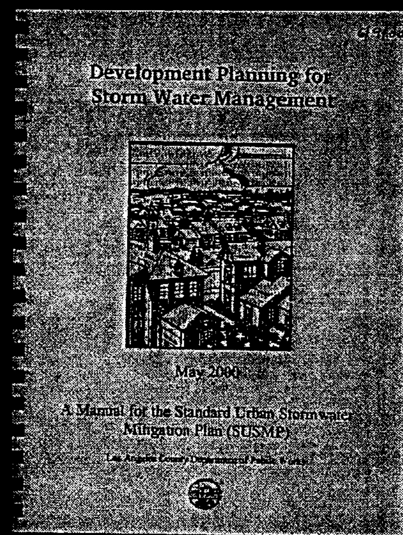


Standard Urban Stormwater Mitigation Plan

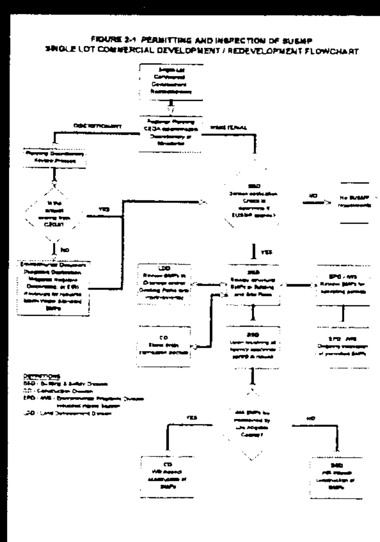
- My Introduction to SUSUMP
- Advantages
- Disadvantages
- Conclusions

Standard Urban Stormwater Mitigation Plan (SUSMP)

"engineers best friend"



FUSCOE ENGINEERING



APPENDIX A **VOLUME & FLOW RATE CALCULATIONS**

TABLE FOR ITERATIONS:

Iteration No.	Initial T_c (min)	I_x (in/hr)	C_P	C_D	C_D*I_x (in/hr)	Calculated T_c (min)	Difference (min)
1	15	0.267	0.1	0.828	0.221076	28.26	13.26
2	28.26	0.198	0.1	0.828	0.163944	33.01	4.75
3	33.01	n/a					
4							
5							
6							
7							
8							
9							
10							

Acceptable T_c value ___30___ minutes

I Calculate the Peak Mitigation Flow Rate
$Q_{PM} = C_D * I_X * A_{Total} * (1.008333\ ft^3\text{-hour / acre-inches-seconds})$

Q_{PM} ___0.89___ cfs

$\boxed{Q_{PM} = 0.89\ cfs}$ ← USE FLOW RATE IN CFS FOR BMP DESIGN IN APPENDIX "B" WHICH REQUIRES "RATE".

$C_D = 0.828$
$I_{30} = 0.193$
$A_{Total} = 5.51$ acres

Use I_{30} since T_c is greater than 30 minutes.

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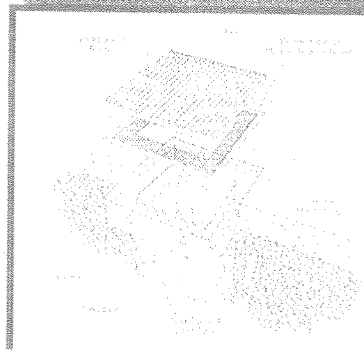
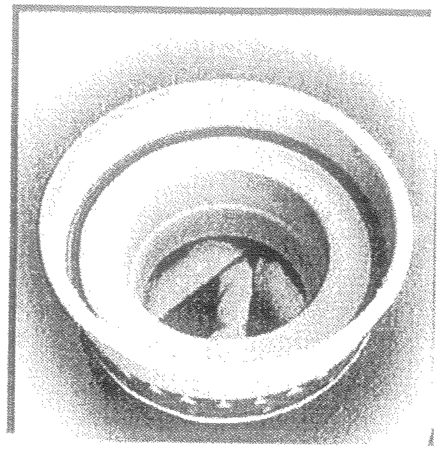
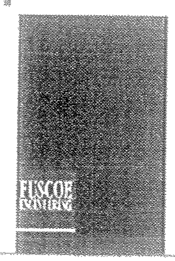
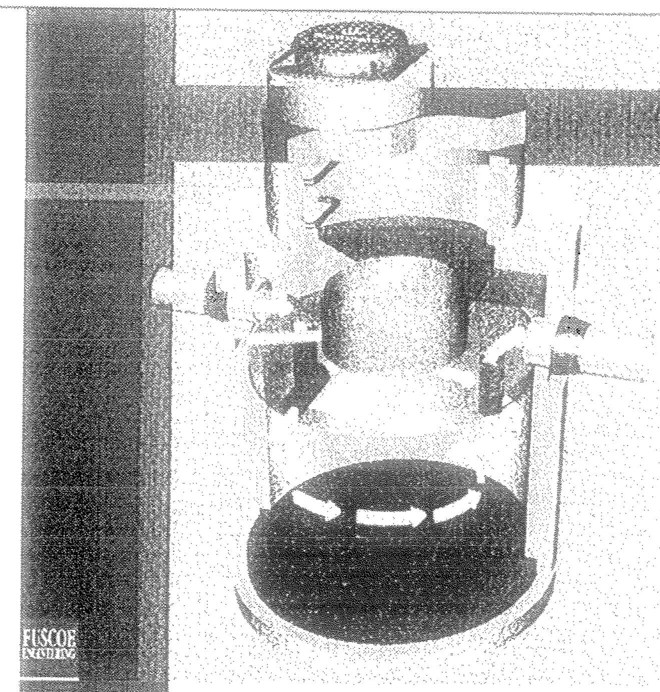
Catch Basin Inserts



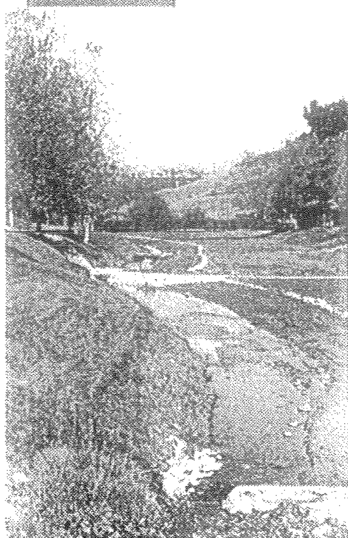


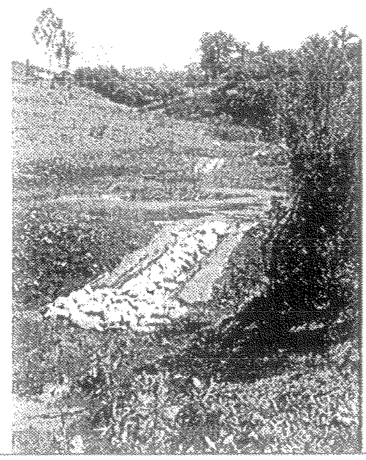


Storm Drain Insert



Constructed Wetland





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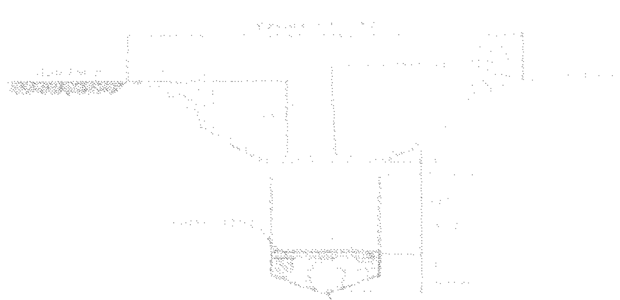
Infiltration Trench



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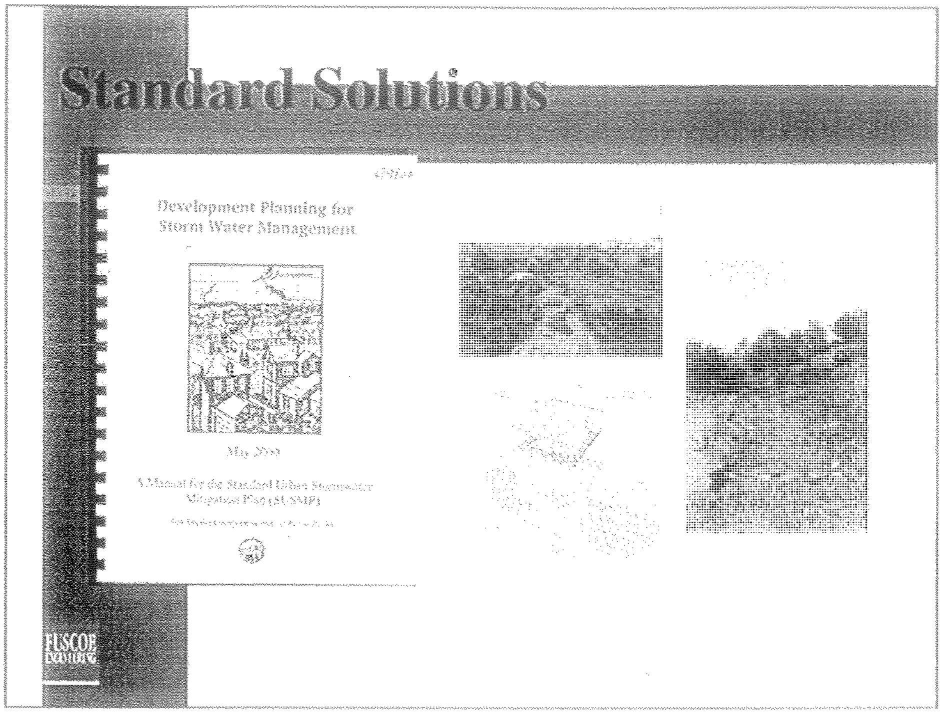
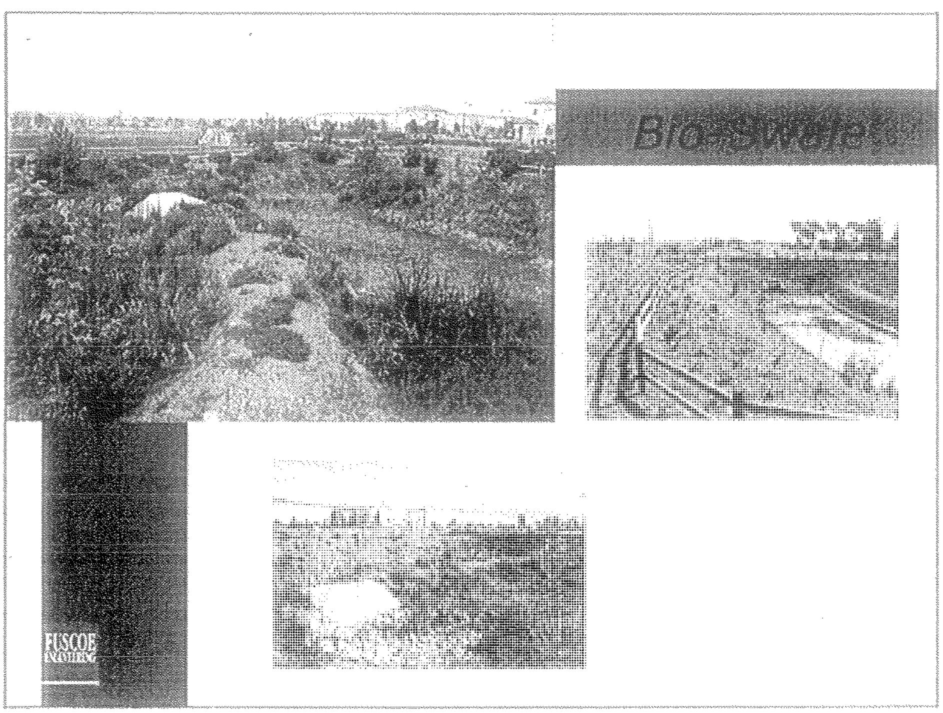

Standard Solutions
Development Planning for
Storm Water Management
FUSCOE


Bio-Swales
FUSCOE

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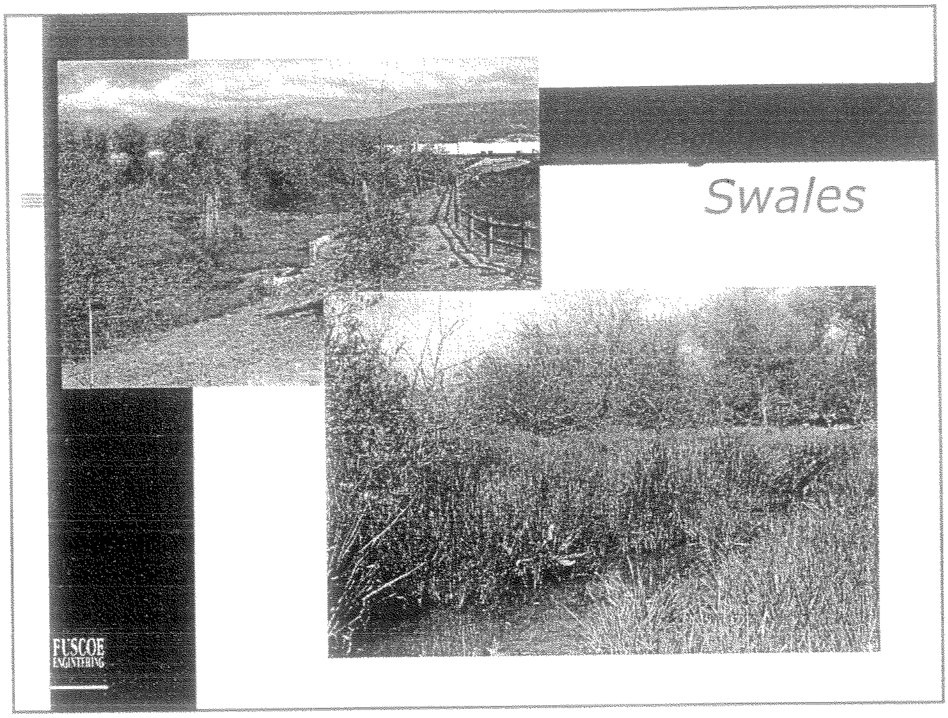
Swales
FUSCOE
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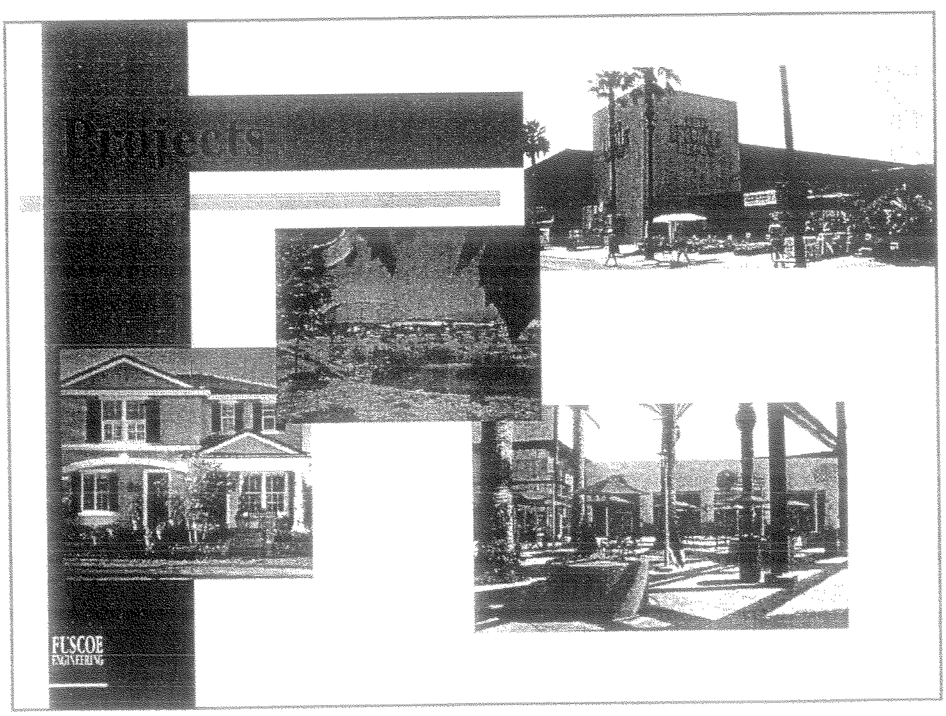
Projects
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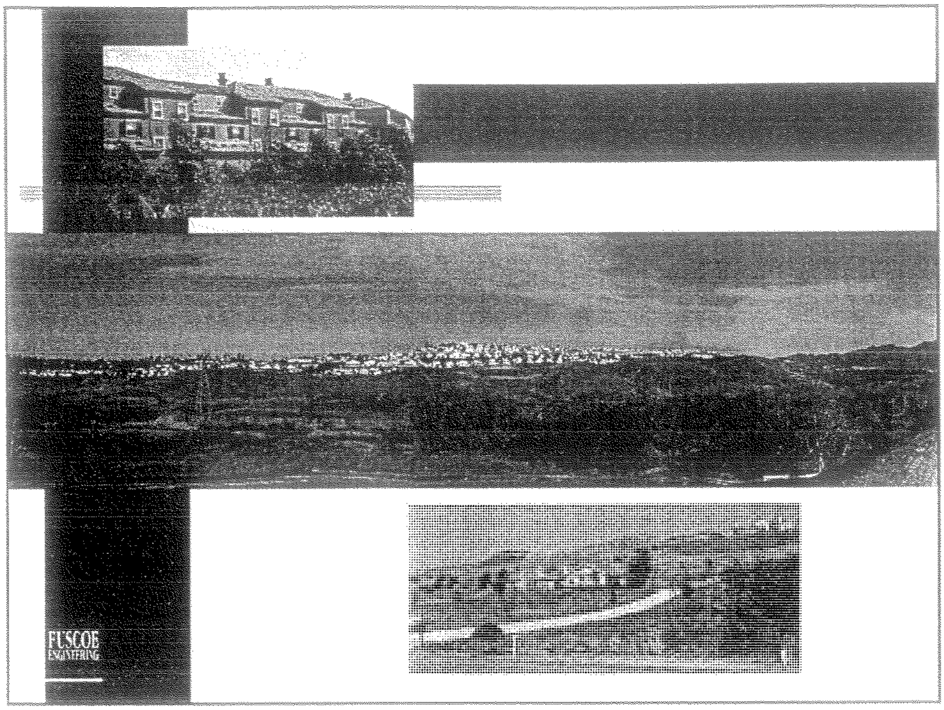
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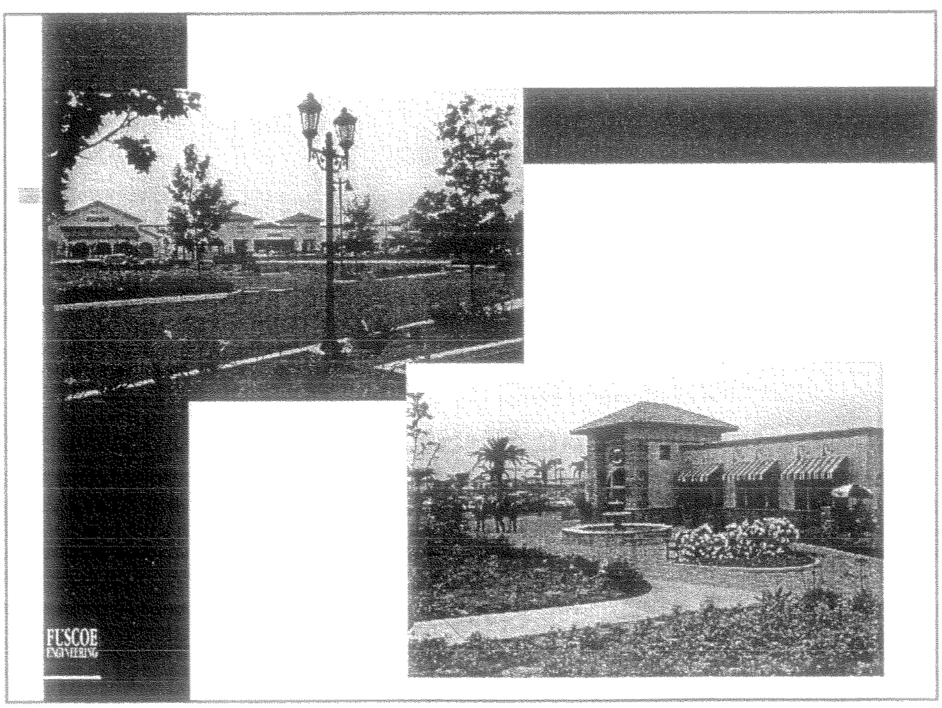
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Advantages

- ...lueprint for ...ompliance
- ...gency personnel ...iven a benchmark ...or checking SUSMP
- ...tandard solutions
- ...treamlined process

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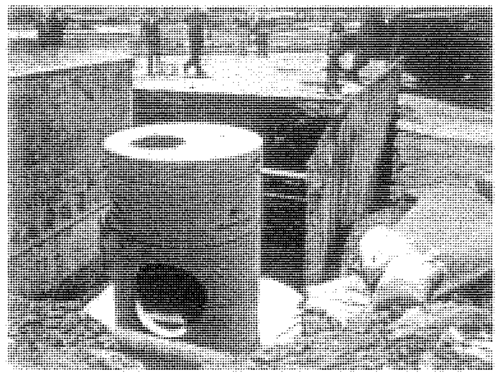
Storm Drain Inserts



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Limitations

- Technical requirements may be too stringent
  - Overkill if only certain constituents need to be addressed

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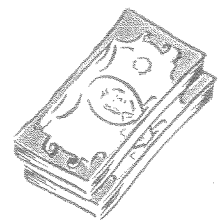
Limitations

- May use more area than otherwise needed
- Costs?



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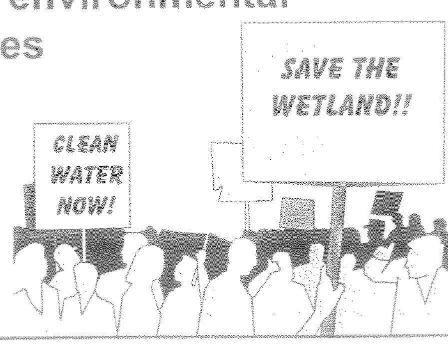
Disadvantages

- Impaired water bodies
- Liability concerns exist
- Political / environmental imperatives

...o little?



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Conclusions

- Great benchmark for comparing and evaluating performance
- Expedites process
- Not a panacea - site needs must be considered

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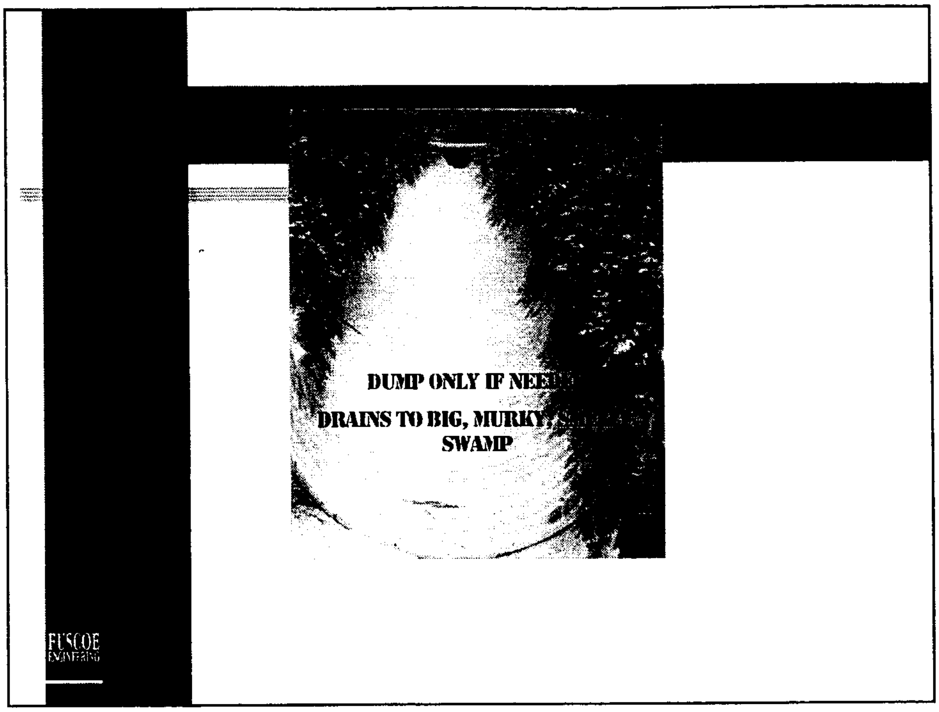
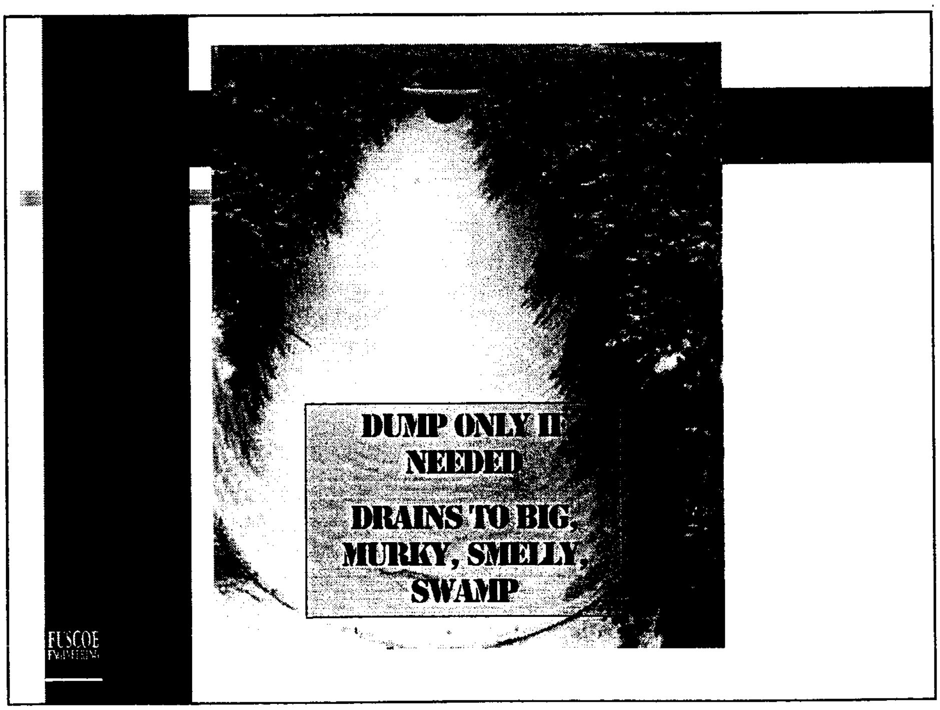

DUMP ONLY IF
DRAINS TO BIG, MURKY,
SWAMP
FUSCOE


DUMP ONLY IF NEEDED
DRAINS TO BIG, MURKY, SMELLY, SWAMP
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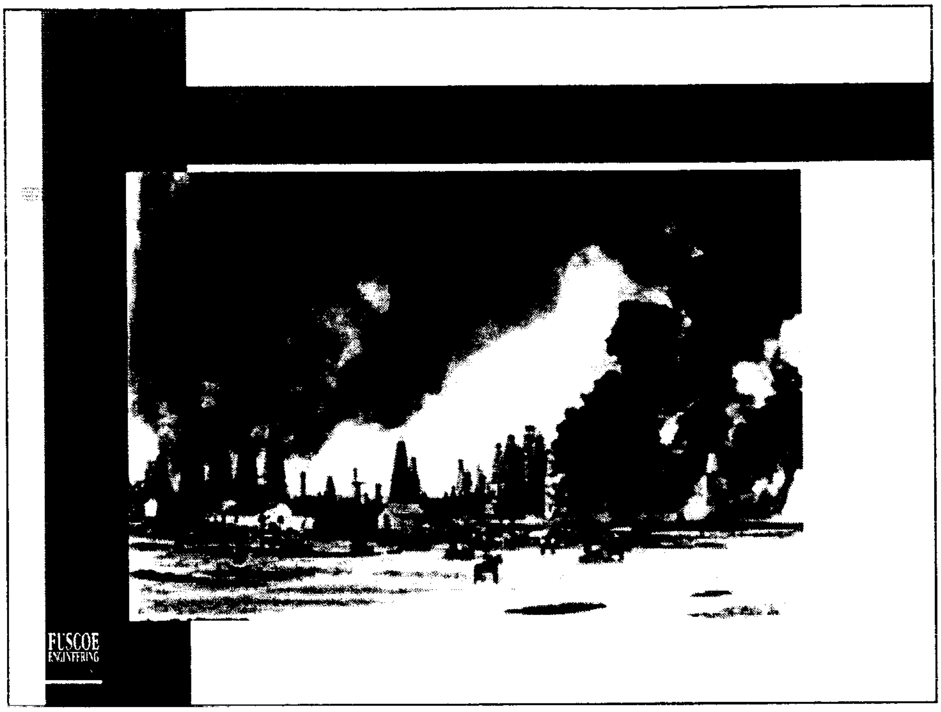
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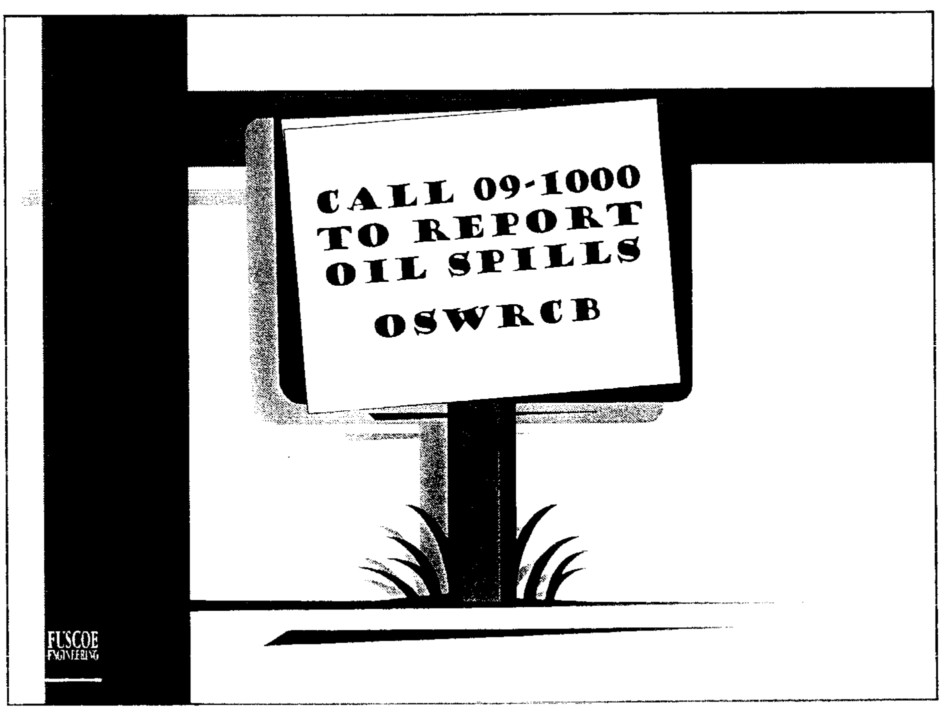
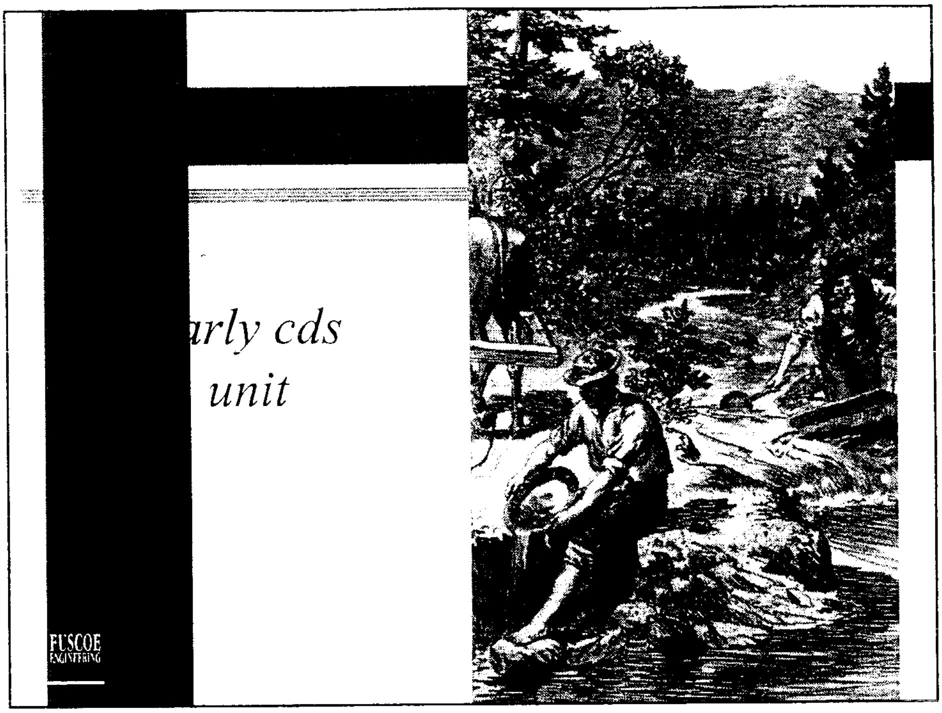

CALL 09-1000
TO REPORT
OIL SPILLS
OSWRCB
FUSCOE
ENGINEERING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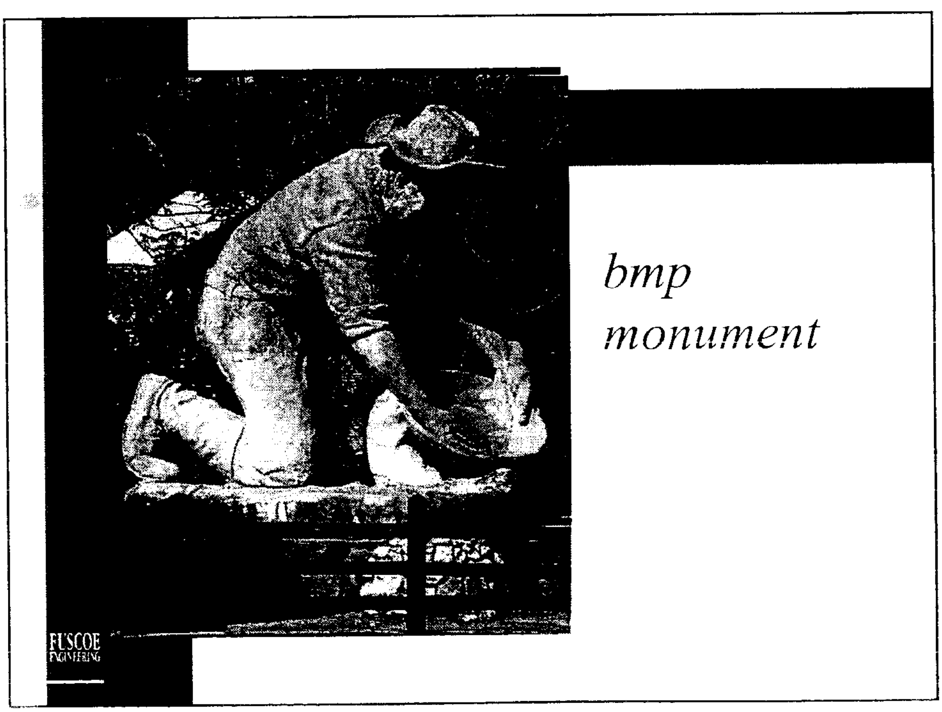
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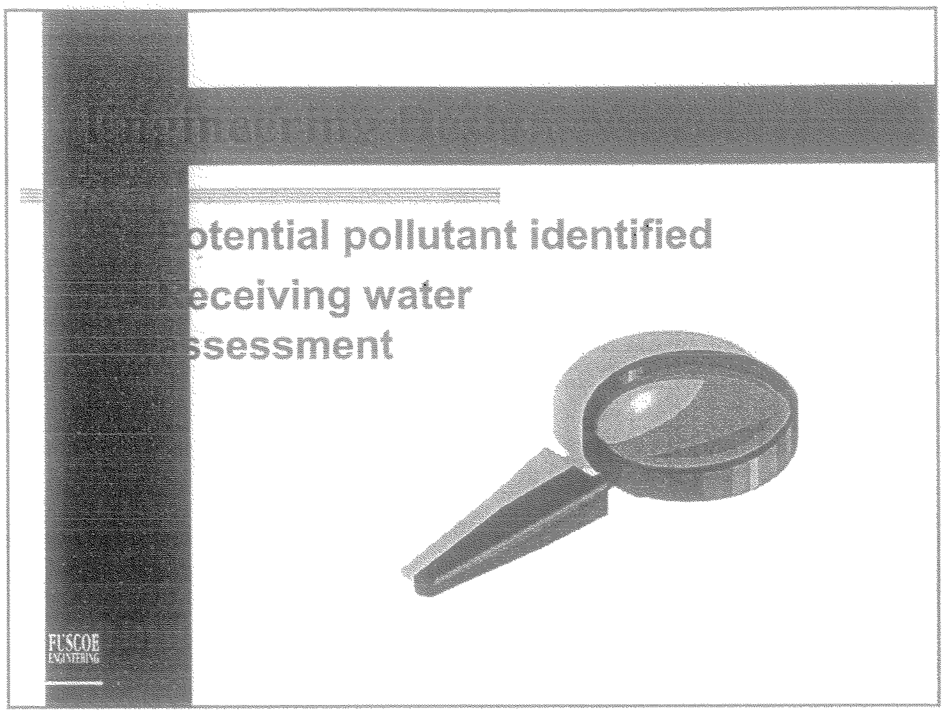
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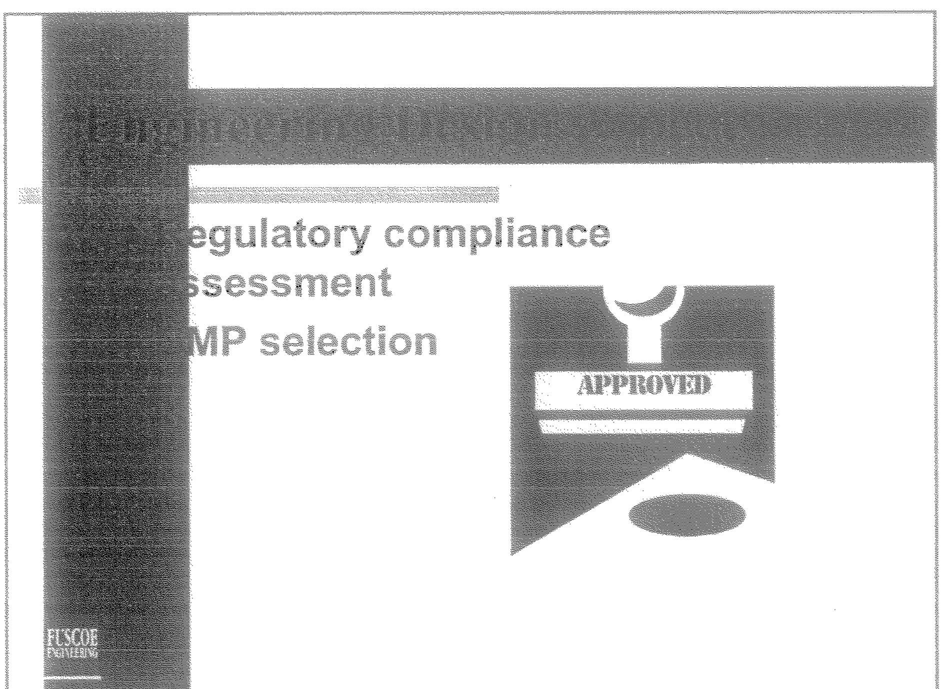
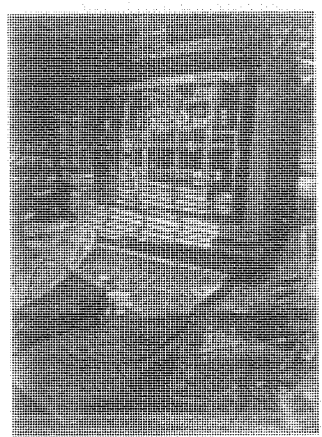
ENGINEERING


egulatory compliance
ssessment
MP selection
APPROVED
FUSCOE
ENGINEERING

Engineering Design

- Numerical sizing
- Design



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Engineering Design

- Construction
- Maintenance
- Monitoring

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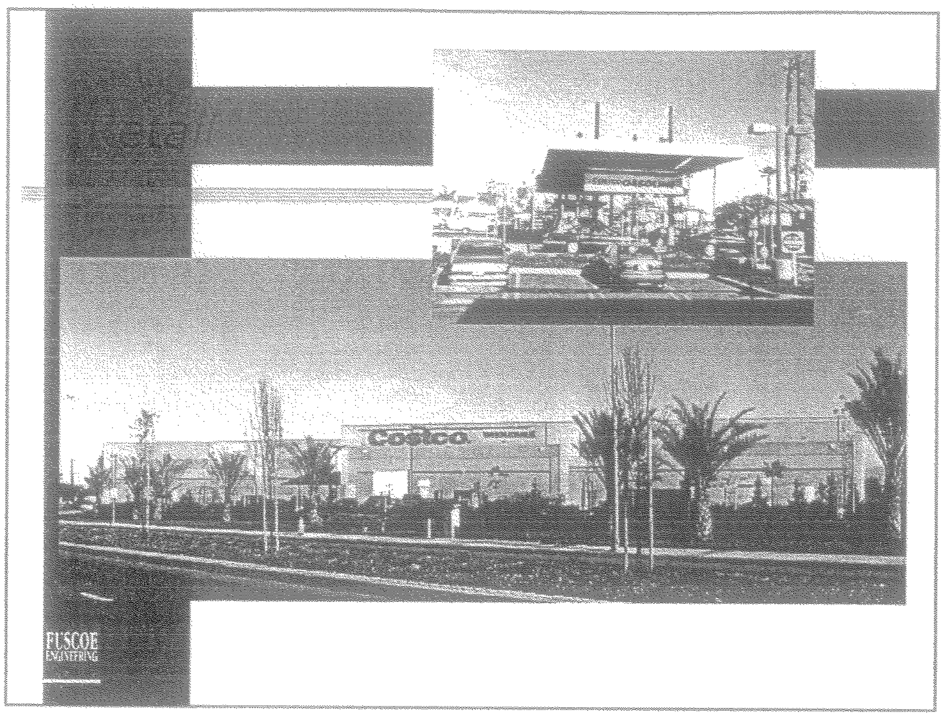
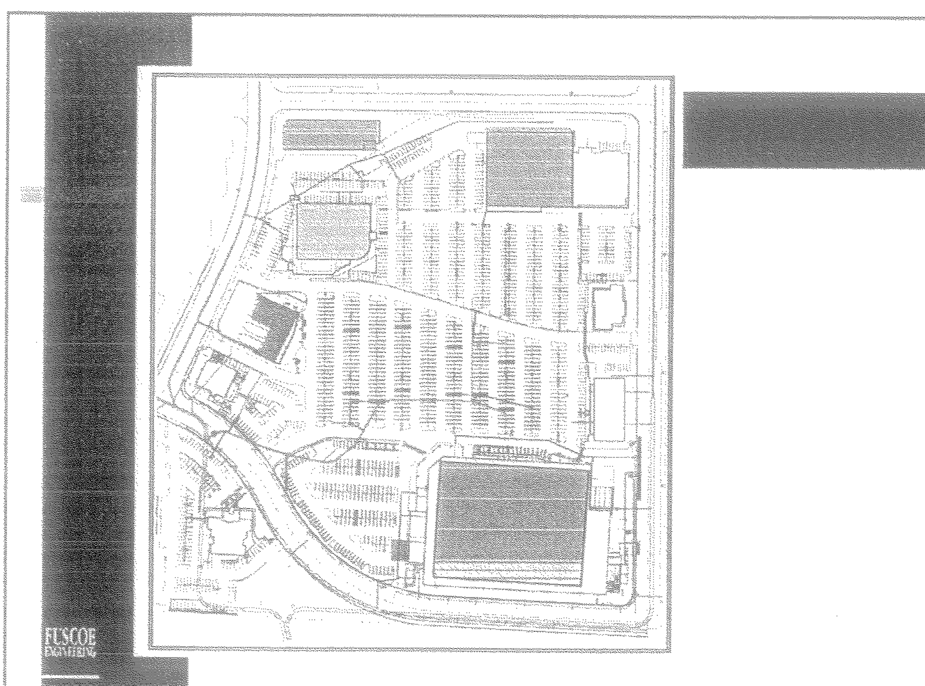

Costco
FUSCOE
ENGINEERING


FUSCOE
ENGINEERING

Standard Solutions

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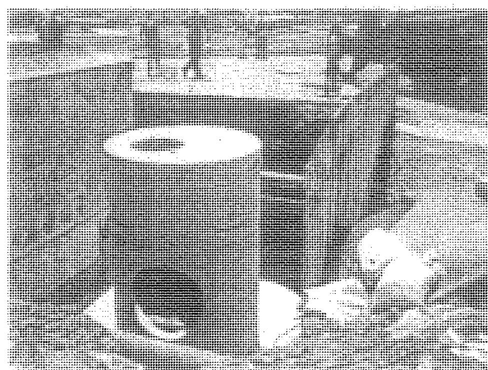
nstallation

$75,000



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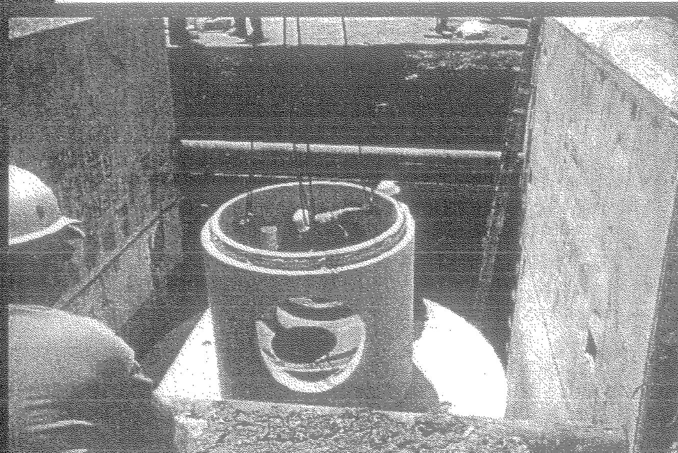


FUSCOE ENGINEERING

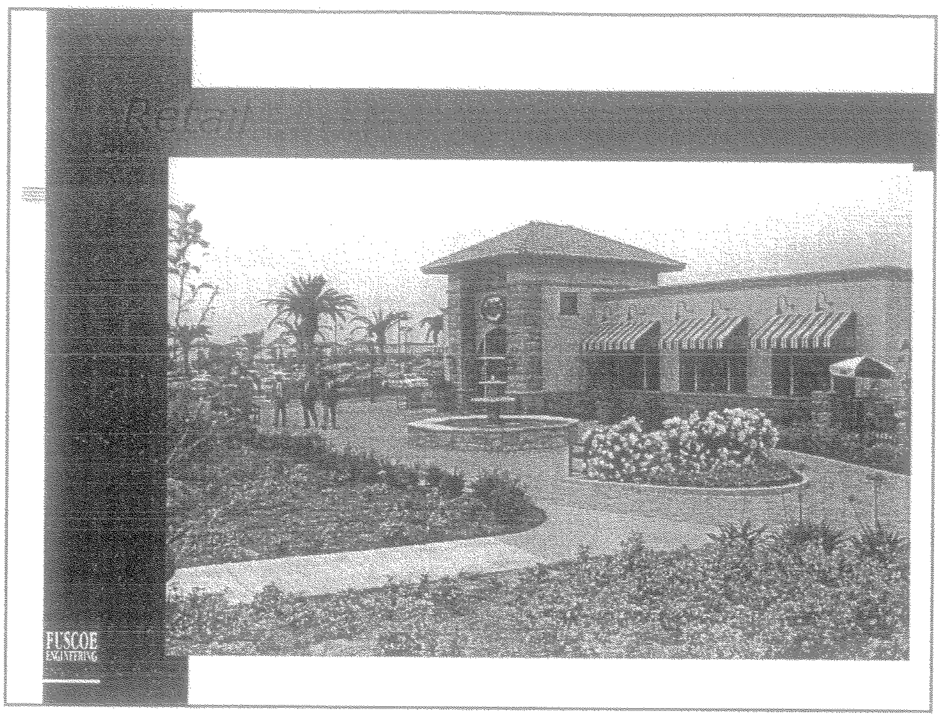
R0020535

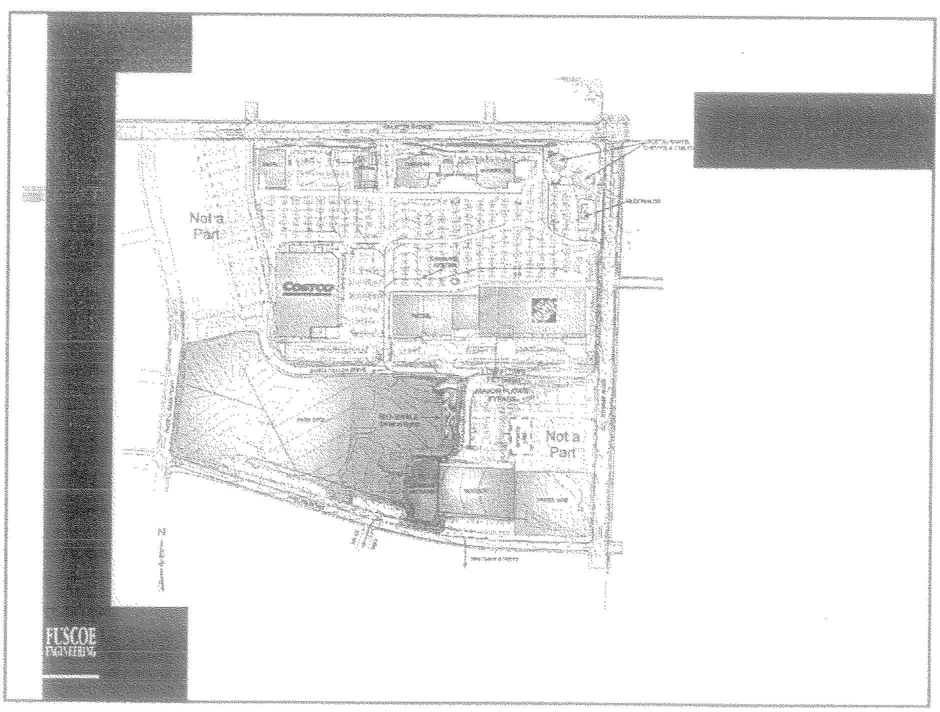
FUSCOE ENGINEERING

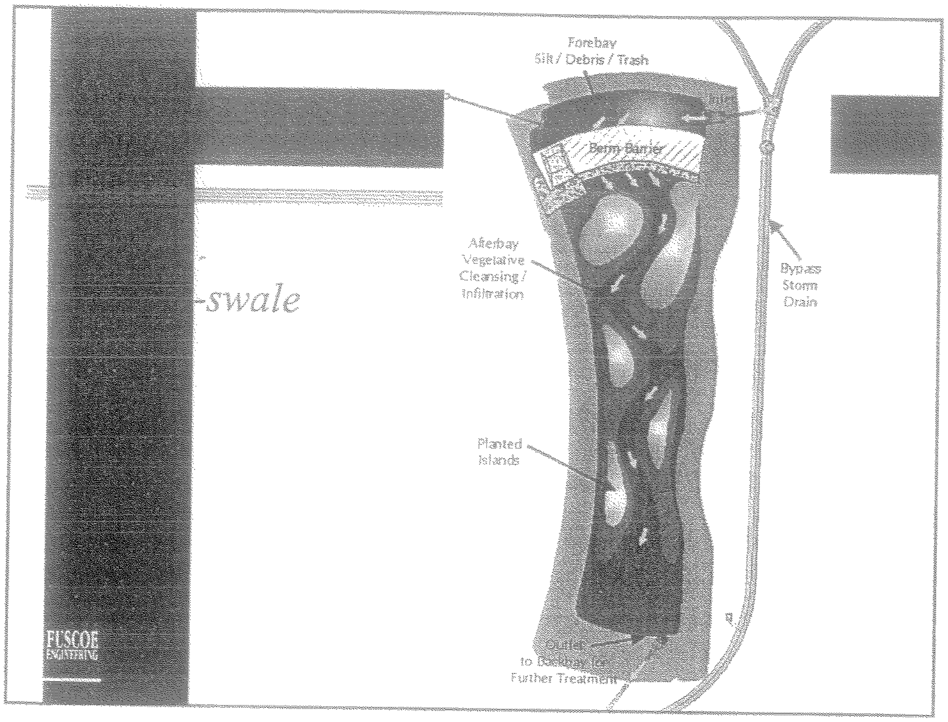
Results

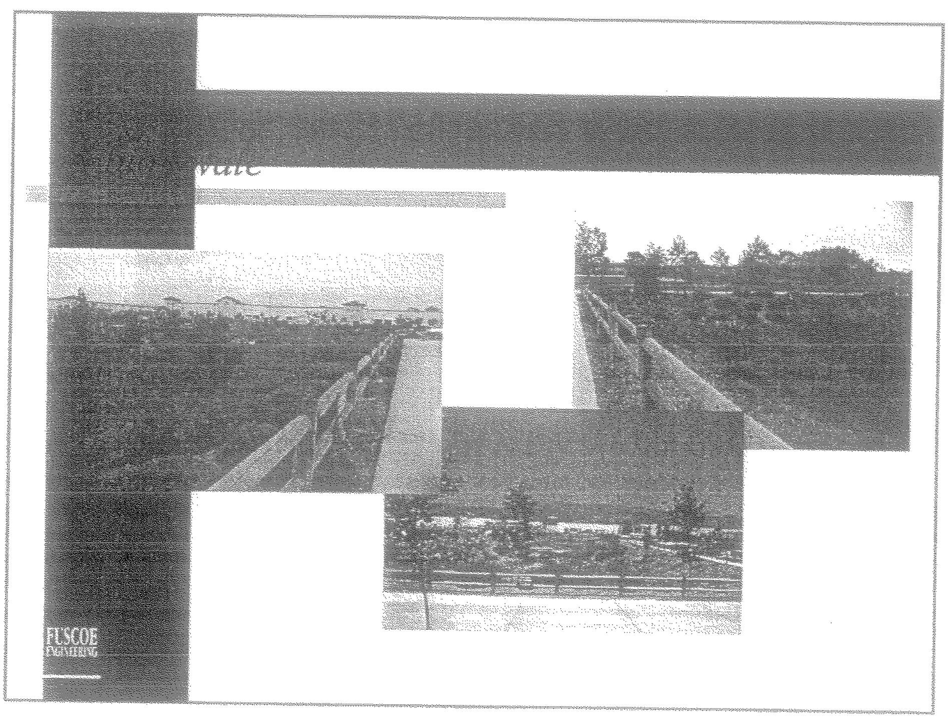
- ...sh, litter, dirt, debris
- ... grease, hydrocarbons
- ...avy metals

FUSCOE ENGINEERING


Retail
FUSCOE
ENGINEERING

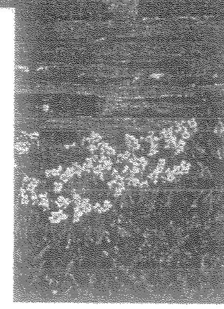

Not a Part
Costco
Not a Part
FUSCOE
ENGINEERING


-swale
Forebay
Silt / Debris / Trash
Berm Barrier
Afterbay
Vegetative
Cleansing /
Infiltration
Bypass
Storm
Drain
Planted
Islands
Outlet
to Backbay for
Further Treatment
FUSCOE
ENGINEERING


FUSCOE
ENGINEERING

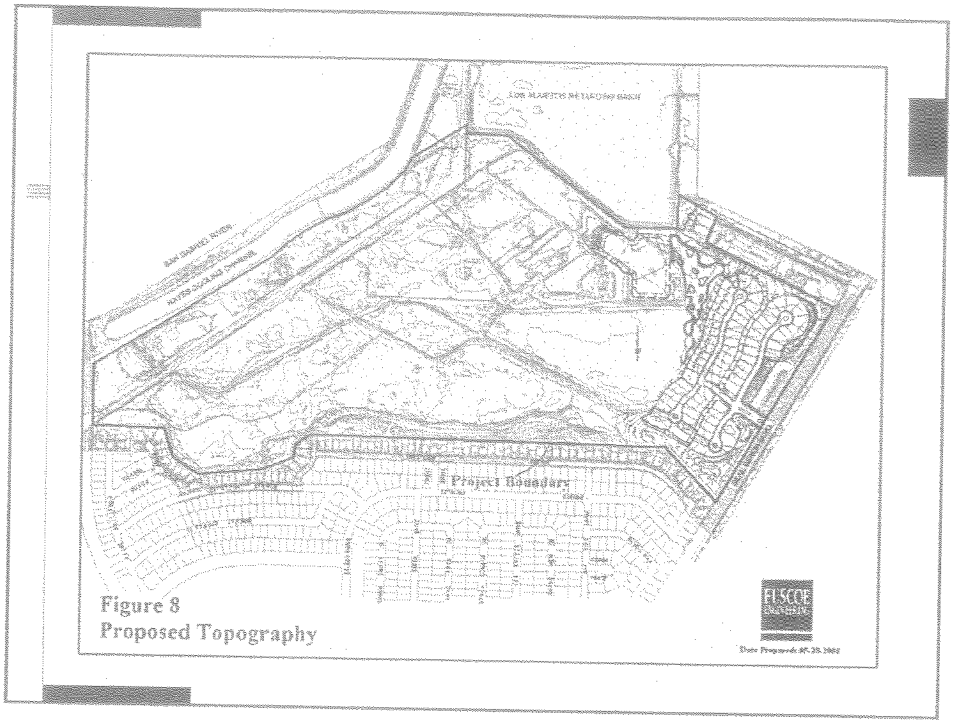
Results

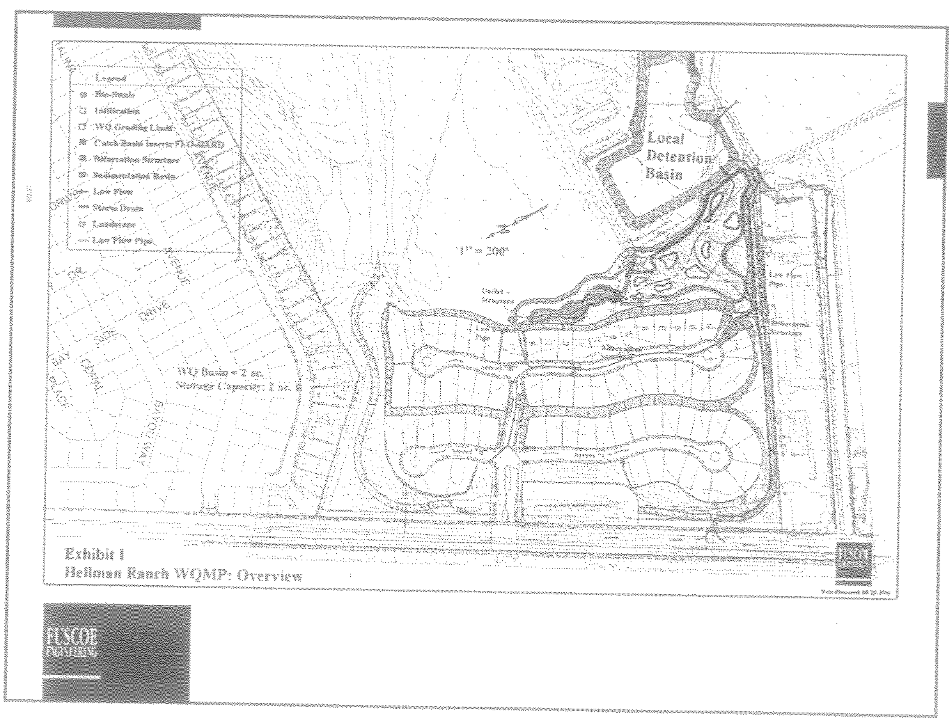
- Trash, litter, dirt, debris
- Oil, grease, hydrocarbons
- Herbicides, pesticides
- Heavy metals, nutrients
- Microbial contaminants



FUSCOE ENGINEERING

FUSCOE ENGINEERING


Project Boundary
Figure 8
Proposed Topography
FUSCOE ENGINEERING


Legend
Bio-Swale
Infiltration
WQ Grading Limit
Catch Basin Insert: FLO-GARD
Diversion Structure
Sedimentation Basin
Low Flow
Storm Drain
Landscape
Low Flow Pipe
Local Detention Basin
1" = 200'
WQ Basin = 2 ac.
Exhibit 1
Hellman Ranch WQMP: Overview
FUSCOE ENGINEERING

Results

- rash, litter, dirt, debris
- il, grease, hydrocarbons
- erbicides, pesticides
- eavy metals, nutrients
- icrobial contaminants

FUSCOE ENGINEERING

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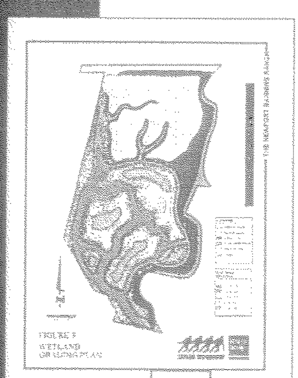
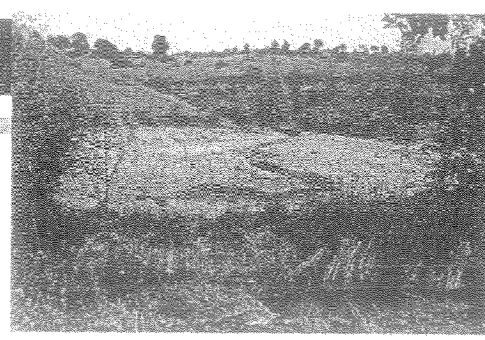
etland





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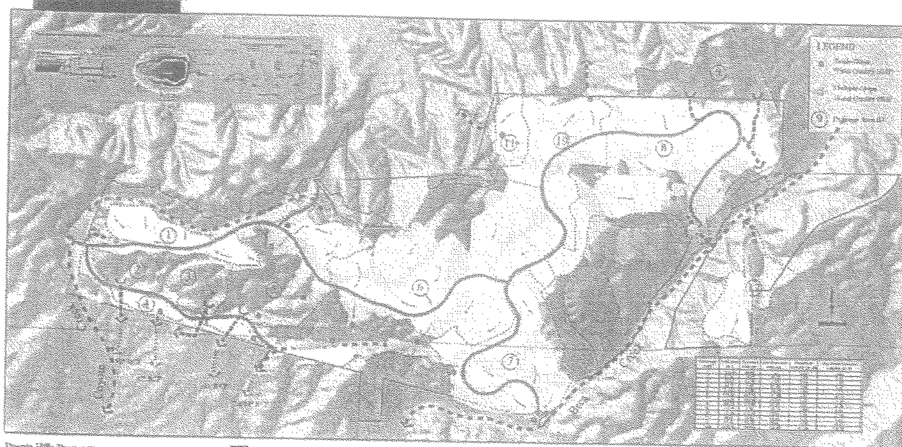

[illegible] Hills Property
Conceptual Storm Runoff Management Plan

FUSCOE
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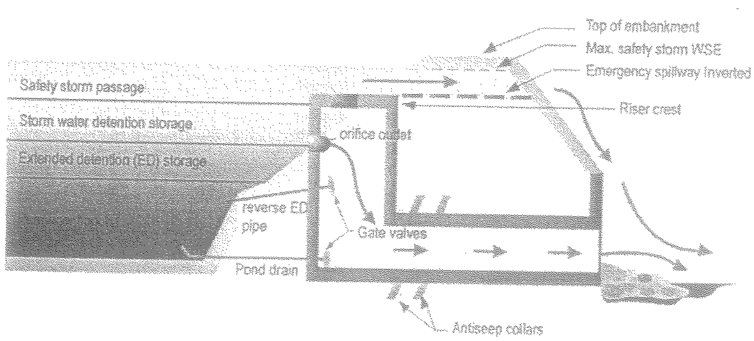
Water Quality Micropool Cross Section View



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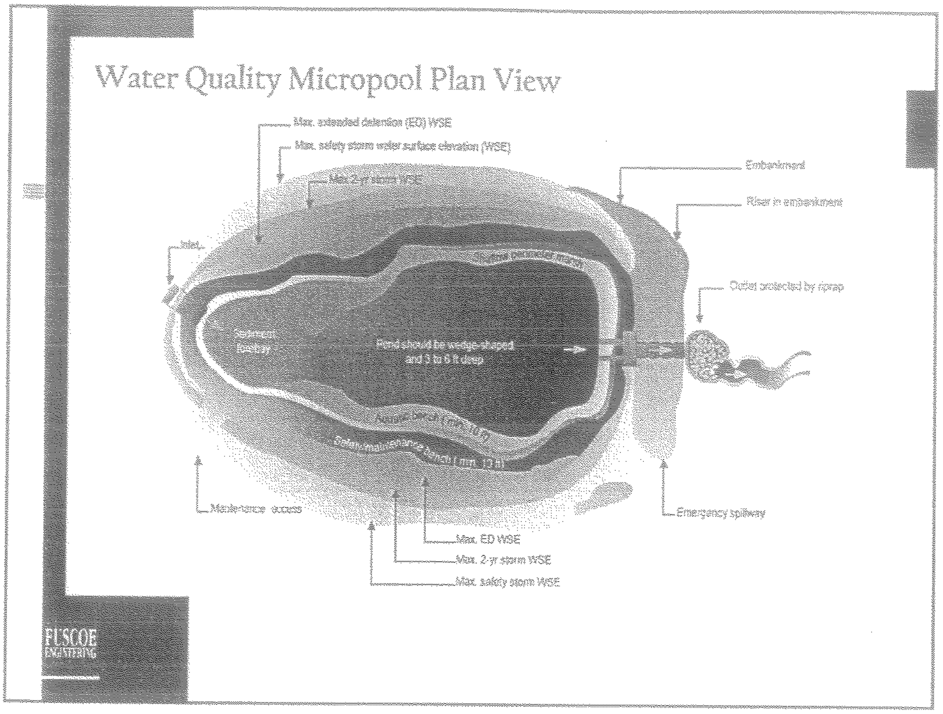
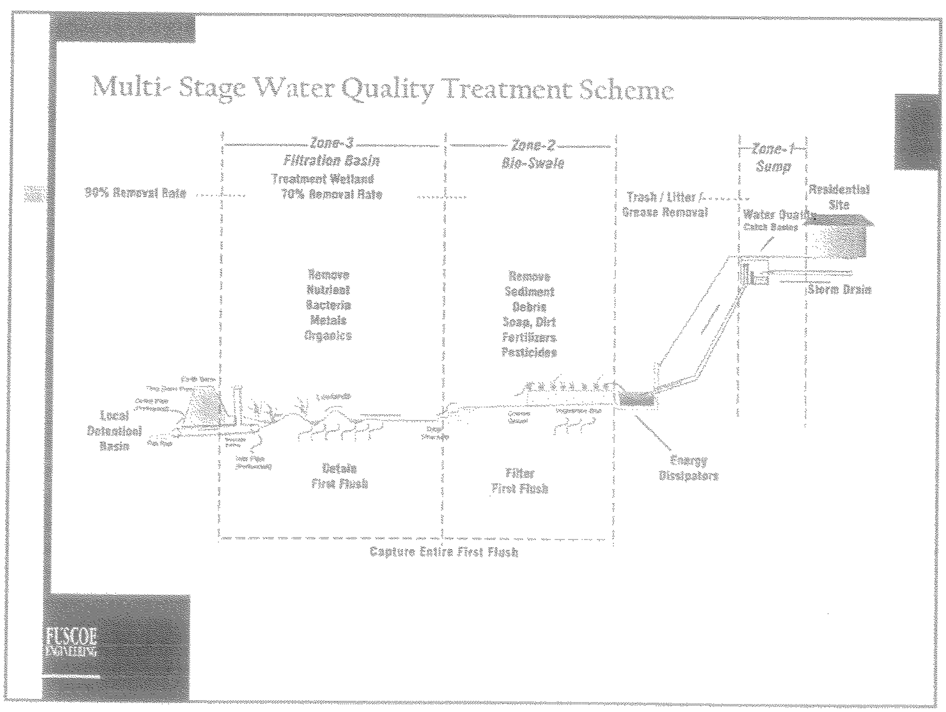
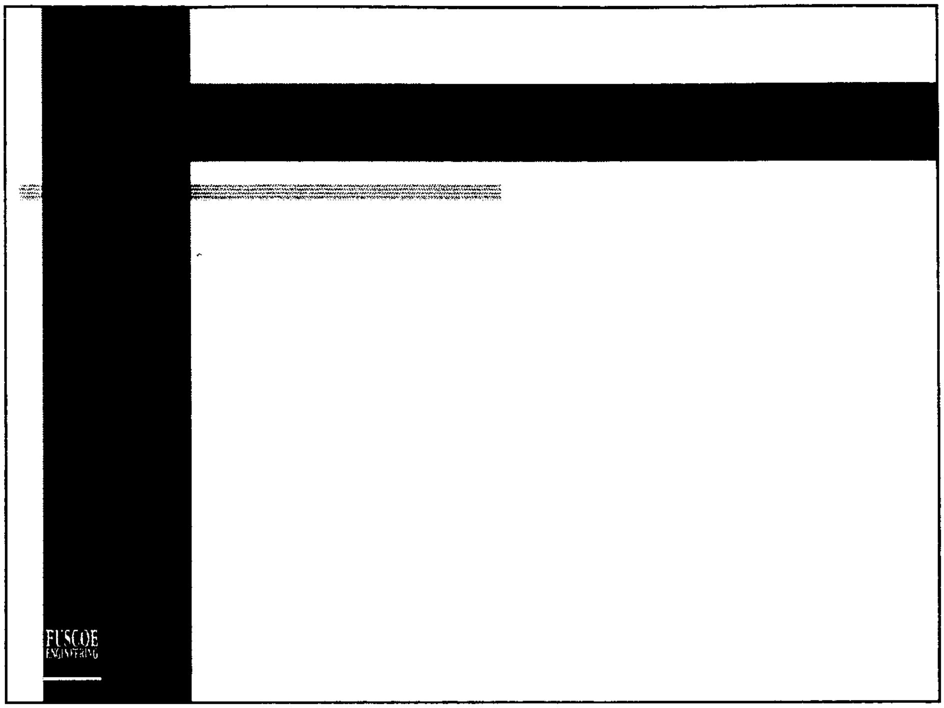

Water Quality Micropool Plan View
Max. extended detention (ED) WSE
Max. safety storm water surface elevation (WSE)
Max 2-yr storm WSE
Embankment
Riser in embankment
Inlet
Outlet protected by riprap
Sediment forebay
Pond should be wedge-shaped and 3 to 6 ft deep
Aquatic bench (min. 10 ft)
Safety/maintenance bench (min. 15 ft)
Maintenance access
Emergency spillway
Max. ED WSE
Max. 2-yr storm WSE
Max. safety storm WSE
FUSCOE ENGINEERING


Multi- Stage Water Quality Treatment Scheme
Zone-3
Filtration Basin
Treatment Wetland
70% Removal Rate
90% Removal Rate
Zone-2
Bio-Swale
Zone-1
Sump
Residential Site
Trash / Litter / Grease Removal
Water Quality Catch Basins
Storm Drain
Remove Nutrient Bacteria Metals Organics
Remove Sediment Debris Soap, Dirt Fertilizers Pesticides
Local Detention Basin
Detain First Flush
Filter First Flush
Energy Dissipators
Capture Entire First Flush
FUSCOE ENGINEERING


FUSCOE
ENGINEERING

TIM PIASKY

Construction Industry Coalition for Water Quality

History of SUSMP

- Seven development categories included in 1996 LA Permit requiring SUSMP development
- Development planning permittee workgroup responsible for developing initial SUSMP
- LA County negotiating planning program with NRDC at same time
- Workgroup submitted SUSMP to regional board that did not include design standard
- LA County agreed to ¾" design standard
- LA regional board added ¾" requirement and ESA and parking lots as priority development categories

SUSMP APPEAL

- Appeal brought by WSPA, BIA and coalition of cities
- Main points argued by BIA and cities were:
  - Administrative procedures
  - Validity of treatment standard
  - Inclusion of ESA and Parking Lots
  - Redevelopment definition
- The inclusion of the original seven development categories was not argued since they were already in Permit

CURRENT SUSMP CONCERNS

- RWQCB's not using existing local science as foundation for policy decisions
  - Water quality monitoring
    - Pollutants of concern
    - Land use
    - BMP effectiveness at addressing pollutants of concern
- Environmentally Sensitive Area (ESA) inclusion
- One size fits all mentality

BIA "CLEAN" WATER PLAN

- C – Create practical regulations and work for good solutions
- L - Lead industry-wide change in approach to water quality
- E - Educate industry on water quality regulation compliance
- A - Advance technological and design innovations
- N - Nurture comprehensive regional solutions

CREATE PRACTICAL REGULATIONS

- Promote and support sound environmental policies
- Participate proactively in water quality regulation process (workshops, hearings, meetings, boards, etc.)
- Provide presentations to interested agencies and groups
- When necessary, challenge unreasonable proposals both legislatively and legally

LEAD INDUSTRY-WIDE CHANGE IN APPROACH TO WATER QUALITY

- Change the way we do business
- Transition builder/contractor philosophy of fighting all water quality regulations to becoming part of the solution

EDUCATE INDUSTRY ON WATER QUALITY

- Increase member education programs on water quality compliance issues
  - Workshops, seminars, trade magazine, newsletters and e-mail updates
  - Provide certification programs
- Involve the broader construction industry (AGC, ECA, SCCA) in our education programs through a coalition approach
- Consumer/public education
  - New homeowner's brochure

ADVANCE TECHNOLOGICAL AND DESIGN INNOVATIONS

- Determine innovative technologies which can be used in building designs
  - Irrigation controllers, building products, etc.
  - Conduct research and monitoring
  - Apply for grants
- Pursue demonstration projects to showcase the use of innovative technologies by the building/construction industries

NURTURE COMPREHENSIVE REGIONAL SOLUTIONS

- Work for inclusion of regional solution option in water quality regulations
- Promote the involvement of other stakeholders in developing regional solutions
- Advantages
  - Creates teamwork "buy-in"
  - Grants may be available to fund capital costs
  - Economies-of-scale provide opportunity to cost effectively address pollutants of concern
  - Ability to establish maintenance districts
  - Large-scale solutions can be planned and modified to address future regulations (i.e. TMDLs)

CONCLUSION

- 2001 and beyond: water quality and supply issues offer many challenges and opportunities
- The building and construction industries will be actively responding to these challenges and searching for opportunities to participate in the movement toward better water quality and supply
- The "CLEAN" water plan is the framework for participating in this movement

Start at the Source

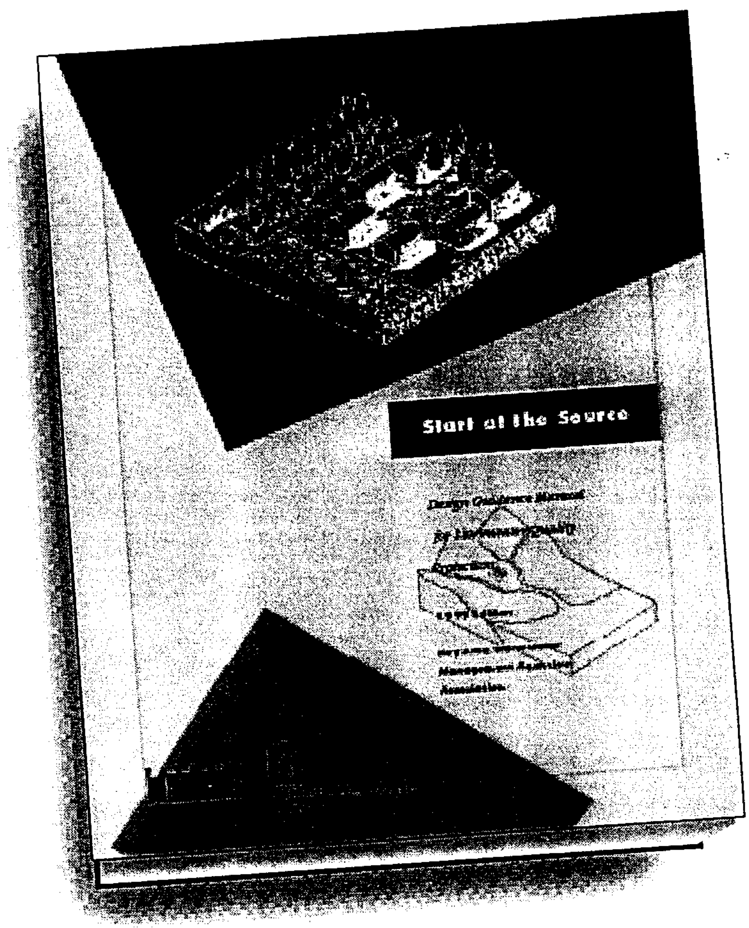
A Design Guidance Manual for Stormwater Quality Protection

by the Bay Area Stormwater Management Agencies Association

BASMAA's second edition of ***Start at the Source*** focuses on the importance of considering stormwater quality in the early stage of planning and designing land development and redevelopment projects.

This current edition has been updated and expanded to include commercial, industrial, and institutional development, as well as a technical section to provide more detailed information on the characteristics, applications, design criteria, maintenance, and economics of the details that are discussed in this document. Examples of case studies, frequently asked questions, and a complete glossary are also included.

This manual was developed under the guidance of a Review Committee comprised of representatives from the public and private sector. The principles and techniques described in this book are valuable and worthwhile to all regulatory agencies, planning and public works departments, developers, builders, engineers, landscape architects, EIR/EIS consultants, and members of the academic community.



Price: $35.00 plus tax, shipping and handling.

For more information or to place your order, please call:

1.510.622.2465

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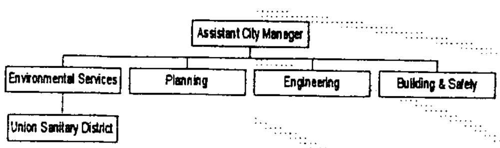
Current Efforts to Reduce Impacts of New and Redevelopment

Kathy Cote
Environmental Services Manager
City of Fremont

City of Fremont

- population 203,413
- 92 square miles
- 1.4 million square feet commercial industrial construction in 2000
- over 1,000 undeveloped acres available for commercial development

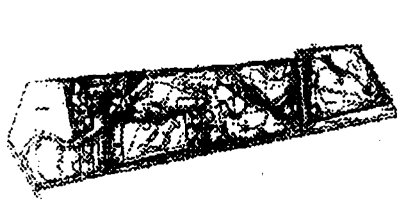
Development and Environmental Services



New Development Examples

- Central Park Golf Course
  - 9 hole executive golf course/driving range
- Jack in the Box
  - fast food restaurant
- Pacific Commons
  - 305 acre office park
  - 8.3 million square feet of office space

Central Park Golf Course



Central Park Golf Course

Conditional Use Permit Requirements

- Dust and Construction Emission Control
  - dust control measures
  - earth moving or travel restrictions
  - soil management provisions
  - roadway & work areas management
- Wetlands
  - wet season survey
  - wetland avoidance or mitigation
  - Streambed Alteration Permit

Central Park Golf Course

Other CUP Requirements

- excavation and grading restrictions
- Notice of Intent requirement
- prerequisite for ground disturbance or grading permit
- erosion control & grading plan

Jack in the Box

CUP Requirements

- Construction/Site Development
  - developer responsibility re: construction BMPs
  - construction mitigation activities
  - storm drain stenciling
  - trash/recycling enclosure
  - outdoor storage requirement

Jack in the Box

CUP Requirements Cont.

- Construction/Site Development (Cont.)
  - structural controls for spill interception, stormwater pretreatment
  - ongoing erosion control
  - drainage study
  - NPDES conformance
  - adequate site drainage

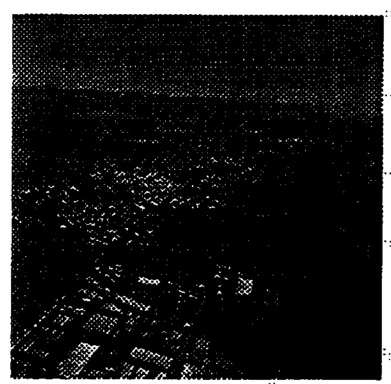
Jack in the Box

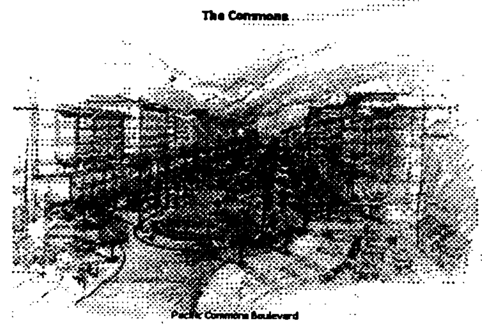
Conditional Use Permit Requirements

- Operational maintenance
  - litter control / sweeping
  - landscaping design and maintenance
  - cleaning facilities and employee training
  - storm water measures and operational BMP's
  - sweeping requirement
  - washwater discharge

Pacific Commons

- 768 total acres
- 305 acre office park
- 391 acres dedicated to Preserve as mitigation
- 49 acre City sports park/stormwater detention basin
- 11 acres for Cushing Parkway and other roads
- 12 acres for N-1 flood control channel

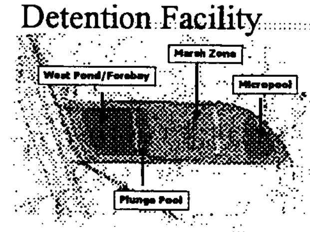




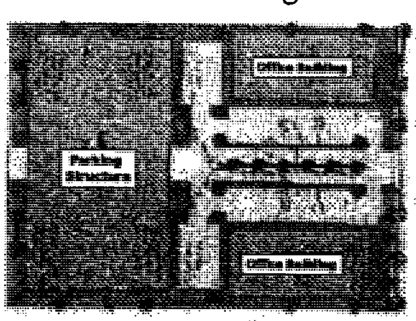
Planned Stormwater Features
for Pacific Commons

- Regional Water Quality Detention Facility
- Vegetated Bioswales
- Depressed Inlets
- Extended Wet Detention Ponds

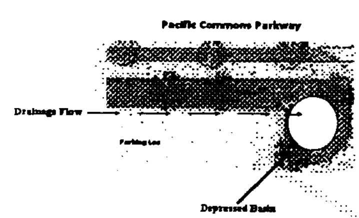
Regional Water Quality Detention Facility



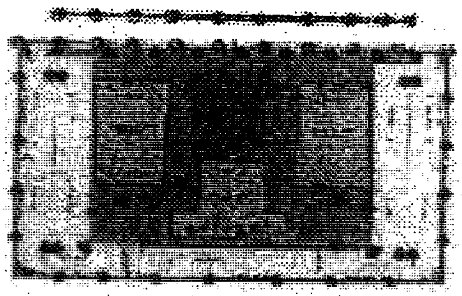
Office Park Design



Depressed Basin



Extended Wet Detention Ponds



Current Efforts to Reduce Impacts of New and Redevelopment in Marin County

Liz Lewis, MCSTOPPP Program Manager

Presentation Overview

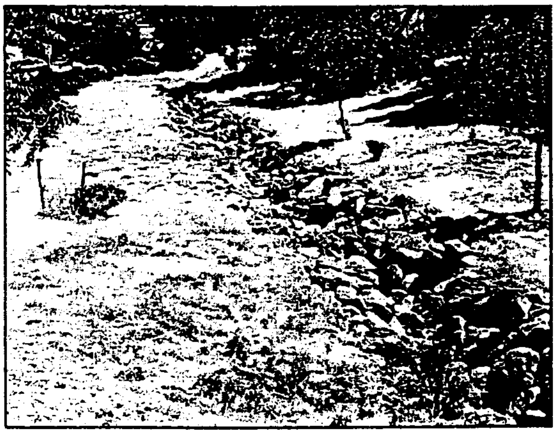
- Program Background
- Stormwater Mgmt Plan- *Action Plan 2005* view @ *www.mcstoppp.org*
- Introduction to Marin County
- Local Measures

Marin County Stormwater Pollution Prevention Program (MCSTOPPP)

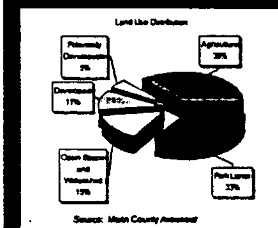
- Drivers
  - *San Francisco Bay Water Quality Control Plan* (*Basin Plan*) required a Baseline Program
    - Good creek habitat within urban setting
    - Concentrated urban corridor which flows to SF Bay
  - Locally popular efforts to preserve and enhance creek and wetland habitat
  - Public Works Directors
  - Phase II permit in 2003

Marin's rural character maximizes infiltration of stormwater

R0020552



Marin Land Use



How Municipalities are Implementing Stormwater Controls

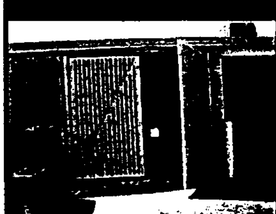
- Interdepartmental Review Teams
- Updating General Plans
- Revising Development Codes

City of San Rafael

Development Coordinating Committee

- Staff from Public Works, Planning, Building Inspection, Fire and Police meet monthly to discuss new development projects
- Public Works recommends appropriate ***Start at the Source*** post-construction controls for every project.

City of San Rafael



City of Novato

- Design Review Committee
  Staff prepares a list of recommended post construction controls and works with applicants to establish conditions.
- Waterway Ordinance-
  - *50 ft laterally outward from top of each bank.*
  - *Can include habitat areas /riparian vegetation.*
  - *Native plants are encouraged*
  - *Non-native, invasive vegetation discouraged*

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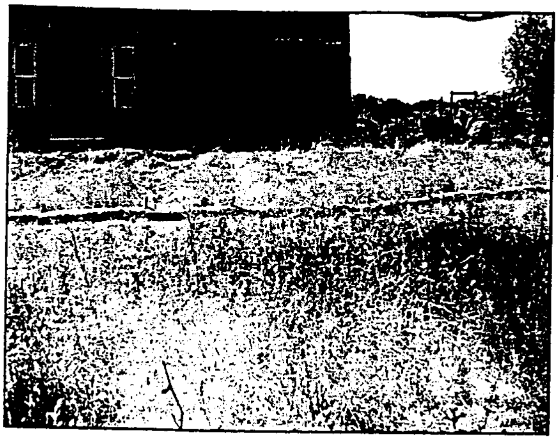


Effects of County Land Use Policies and Management Practices on Salmonids and Their Habitats

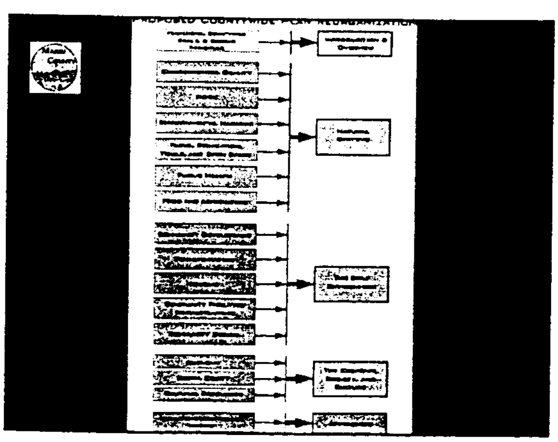
UC Berkeley Extension for *FishNet 4C*
Fishery Network of the Central California Coastal Counties

http://www.co.marin.ca.us/pw/Salmon.cfm

MARIN COUNTY GENERAL PLAN UPDATE

Sustainability as the overarching theme

- Sustainability Guiding Principles
- Calculation of Marin's Ecological Footprint
  www.future-marin.org



For more information…

City of San Rafael
Steve Zeiger @ 415.485.3435, Stormwater Coordinator

City of Novato
Jennifer Barrett @ 415.897.4307, Principal Planner

County of Marin General Plan
Michele Rodriguez @ 415.499.2801
www.future-marin.org

R0020554

Efforts to Reduce Storm Water Impacts of Development

Meeting New Requirements for Storm Water Controls in New and Redevelopment Workshop

Presented By
Pankti Shah

August 10, 2001

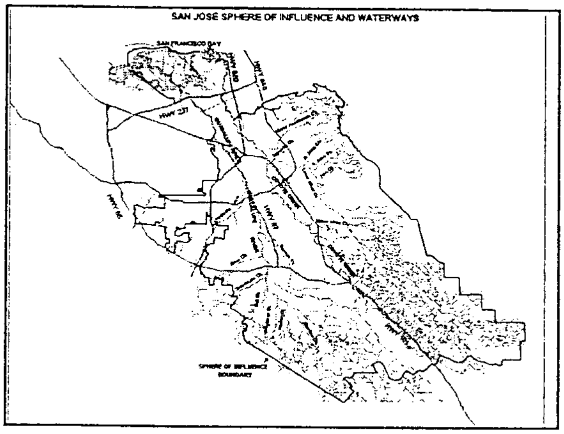
City of San Jose
Department of Planning, Building and Code Enforcement

Control of Pollutants from New Development

- Background
- Local Policies and Planning Tools
- Application of Storm Water Controls
- Educational Resources/References
- Conclusion

Context of San Jose

- San Jose Growth:17 square miles to 136 square miles between 1950-1970 (800%)
- Population Growth: Increased from 95,000 to 446,000 people between 1950-1970 (469%)
- Unplanned expansion resulted in sprawl until the 70's
- Planning policies in 70's began to curb sprawl
- Now: USA is approx. 177 square miles; Sphere of Influence is 104 square miles



Background

- Four main phases of application and management of controls:
  - Planning
  - Design
  - Construction
  - Maintenance
- San Jose is implementing all four phases

Local Policies and Planning Tools

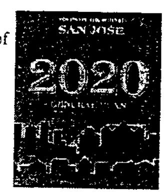
- General Plan Policies
- City Council Policy on Post-Construction Runoff Management
- Guidance Manual on Selection of Stormwater Quality Control Measures
- Riparian Corridor Policy Study
- Riparian Restoration Action Plan
- Zoning Code Provisions

General Plan Policies

- Smart Growth Policies:
  - Higher Density Housing
  - Compact Development near Transit
  - Growth Management
  - Urban Growth Boundary

General Plan Policies

- Water resource policies serve to:
  - regulate development in watershed areas
  - protect groundwater recharge, particularly creeks and riparian corridors
  - establish guidelines to control discharge of storm runoff into storm drains
  - control quantity and improve quality of urban runoff



City Council Policy on Post-Construction Runoff

- Acknowledges NPDES permit requirement to control post-construction runoff
- Establishes framework for incorporating minimum levels of Best Management Practices into new development
- Requires maintenance of all control measures
- Lists various types of land uses and required BMPs

City Council Policy on Post-Construction Runoff

- Example- Auto Wrecking Yards:
  - All new auto wrecking yards or *major expansion* of such uses should include the following:
    - 1) install and maintain a treatment control measure;
    - 2) pave all outside vehicle storage areas;
    - 3) cover fluids drainage areas;
    - 4) pave fluids drainage areas with impermeable materials;

SAN JOSE

City Council Policy on Post-Construction Runoff

- Example- Auto Wrecking Yards:
  - 5) construct a berm around fluids drainage areas and grade the site to prevent water draining toward this working area;
  - 6) remove and store batteries in conformance with the City Fire Code;
  - 7) drain and store fluids in conformance with the City Fire Code; and
  - 8) prepare and execute the spill prevention plan in conformance with the City Fire Code.

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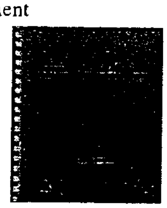
Guidance Manual on the Selection of Stormwater Quality Control Measures

- Summarizes development impacts and pollutants of concern
- Contains guidelines for selecting control measures for major land use development categories
- Recommends treatment measures for various types of development
- Describes BMPs in detail



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RECOMMENDED TREATMENT MEASURES FOR VARIOUS TYPES OF DEVELOPMENT

Type of Development and Impervious Area (acres)	Inlet Filters [1,2]	Porous Pavers	Oil/Sediment Separators [1]	Grassy Swales	Extended Detention (dry) Ponds	Wet Ponds	Filter Strips
Single Family Residential Projects (approx. # of homes)							
< 1 acre (<5 homes)		●					●
1-5 acres (5-30 homes)		●		●			●
> 5 acres (>30 homes)		●		⇨	●	●	●
Commercial/Industrial/... Impervious Area (acres)							
very small (single business)	●	●		●			●
<1.0 acres		●		●			●
1-5 acres		⇨		●			●
> 5 acres		⇨		⇨	●	●	⇨
Other Activities/Sources							
gas stations, equipment fueling facilities [3]			●				
auto wrecking yards [3]	●		●				
limited available space	●	●					

Symbols:
● = appropriate
⇨ = can be used but may require several units or additional measures

Footnotes:
1. Requires additional inspection and/or maintenance following major rainfall events.
2. Cannot be used where vegetation (leaves, grass clippings, pine needles, etc.), trash, debris or coarse sediment occur in the runoff and would cause blockage.
3. See City's Post construction Urban Runoff Management Policy

Note: This table is intended to provide general guidance. Final Selection should carefully consider site specific conditions and appropriateness.

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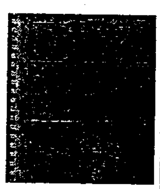
Riparian Corridor Policy Study

- Addresses several issues relating to the identification, management and the protection of riparian resources
- Inventories riparian corridors
- Contains development guidelines



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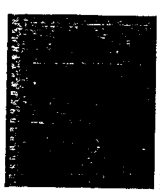
Riparian Corridor Policy Study

- Contains development guidelines:
  - Site Design
  - Building and Fixture Design
  - Landscaping
  - Public Recreation Facilities
  - Fire Management
  - Vegetative Removal
  - Erosion Control, Flood Control, Water Quality and Protection from Construction

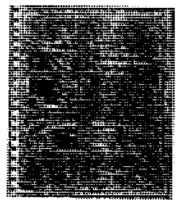


SAN JOSE

R0020559

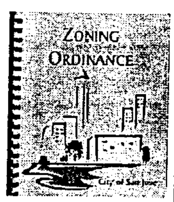
Riparian Restoration Action Plan

- Identifies impacts of past development to restore damaged corridors
- Suggests mitigation measures for new projects
- Provides basis for deciding how and when to restore, and who should be responsible
- Menu of techniques for different circumstances



City of San Jose Zoning Code

- Tool to Implement Planning Policies
- Update Effective February 19, 2001
- Bicycle and Motorcycle Parking Provisions
- Reductions in Minimum Required Parking
- Parking Maximums/Caps Placed
- Includes Storm Water Conditions of Approval

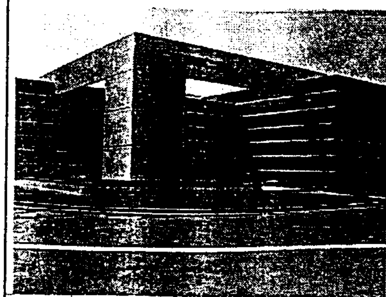


Example of Storm Water Quality Controls

Grassy Swale

- Approx. 30' x 300' swale within setback area
- Ionics Project (at Silver Creek Valley Rd. by Hellyer Av.)
- 66,700 sq. ft. Office/Industrial Use
- Approx. 4.5 acre site

Examples of Storm Water Quality Controls



Brick Pavers

- 2,800 sq. ft. of pavers
- Ionics Project (at Silver Creek Valley Rd. by Hellyer Av.)
- 66,700 sq. ft. Office/Industrial Use
- Approx. 4.5 acre site

Examples of Storm Water Quality Controls

Brick Pavers

- Front entrance driveway area

Educational Resources/References

- Website: www.ci.san-jose.ca.us/planning/sjplan/ ('counter', 'general information', 'Storm Water Management')
- Controlling Storm Water Pollution from Construction Sites (Brochure)
- *Clean Bay Blueprint/Blueprint for a Clean Bay*: handed out and referred to in permit conditions
- In-house training

Conclusion

- Strong policy foundation directs the implementation of storm water controls
- Political will to stand by policies and their implementation
- The policy and implementation tools can be used as a model by community of any size
- Continuously improving tools to implementing storm water controls

SAN JOSE

Challenges to Implementing Post-Construction BMP Measures

Ed Boscacci, Jr. PE
BKF Engineers
Redwood City

Challenges

Close Proximity to Adjacent Projects.

Typically Discharge to Storm Drainage Systems.

Little Room Available for Land Intensive Facilities.

Existing City Drainage Requirements.

Percolation to Shrink/Swell Soils Could Cause Problems.

Site Design Water Quality Measures

- Vegetated Swales
- Infiltration Trenches
- Disconnected Impervious Area
- Storm Water Detention
- Outfall Protection

BIOSWALE

- Summer
  - No Irrigation
- Winter

BIOSWALE

- On-line or Off-line
- Meet Constraints

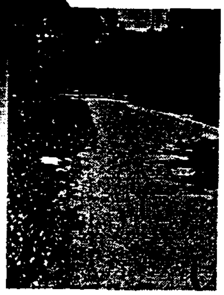
BIOSWALE

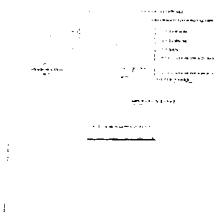
- Flow Enters Swale through Curb Openings

R0020563

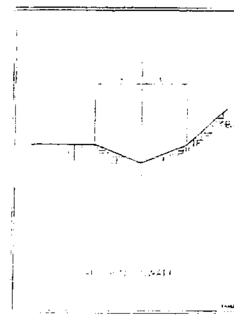
BIOSWALE

- Where Percolation not Allowed
- Near Asphalt
- In Shrink/Swell Soils



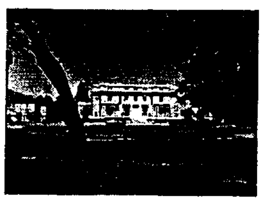


BIOSWALE

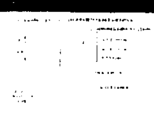


- Plant in Swale
- Analyze Swale for Erosion. Use Geofabric if Erosion Potential.
- Where Percolation Allowed

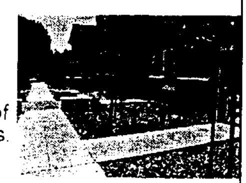
INFILTRATION TRENCH



- Where Percolation Allowed
- Plant in Swale
- Analyze Swale for Erosion. Use Geofabric if Erosion Potential.



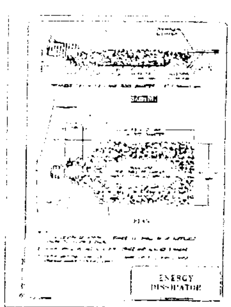
Disconnected Impervious Area



- ed Areas and Roof Landscape Areas.
- Flow Crosses Landscape Area Prior to Discharge to Area Drains
- Cannot be Used near Shrink/Swell Soils.
- Make sure Outlet is Lower than Building and Discharge

Energy Dissipation, Outfalls

- ABAG has Standard Shape, Where Space Available.
- Rock Outfalls Preferred, but Space Intensive.
- Concrete can be more Compact.



Structural Solutions

- Require Maintenance.
- After Solids Settle Out, Heavy Metals may Dissolve and be Discharged in Later Storms.
- Two Common Methods, Filters and Settling Units.

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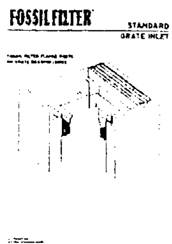
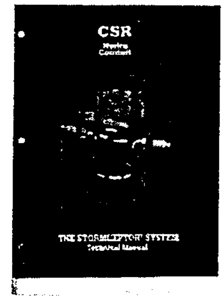
Structural Solutions

- Filtering Unit.

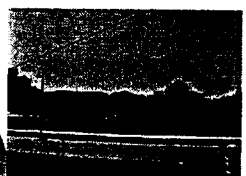


Structural Solutions

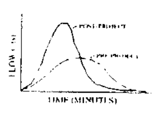
- Settling Unit



Stormwater Detention



- Stormwater Detention Reduces Peak Flows to Downstream System.
- Stormwater Detention Area can be Used for Long-Duration Storage to Provide Water Treatment.



CONCLUSIONS

- Grass Swales
- Infiltration Trenches
- Disconnected Impervious Area
- Covered Trash Area

- Include:

- Treatment Devices
- Street Sweeping
- Landscape Controls
- Where Practical Use:

New & Re-Development Stormwater Permit Amendment

Santa Clara Valley Urban Runoff Pollution Prevention Program Permit*

SF Bay RWQCB Staff
Janet B. O'Hara
Dale C. Bowyer
Keith H. Lichten

*plus RB Staff Recommendations

Municipal Stormwater Permit Components

- Monitoring
- Public Information/Participation
- Municipal Maintenance Activities
- Industrial/Commercial Discharge
- Illicit Discharge
- Construction Activities
- New Development/ Redevelopment
  - Treatment measures
  - Peak runoff changes

Presentation Overview

- Process for Amendment adoption
- New development treatment measures – Brief background
- Permit Amendment – Major issues and proposed revisions

Proposed Amendment Adoption Process

- Last 2 weeks: 2 stakeholder meetings.
- August 15: Revised T.O. and Response to Comments out.
- Five week comment period with more stakeholder meetings
  - Tentative Dates: 8/30/1 & 9/5/1
- October Board action on Final Revised T.O.
- Ample opportunity for further comment on and revision of the T.O.

New Development Treatment Measures – Regulatory Background

- EPA regulations require "a description of planning procedures...to develop, implement and enforce controls to reduce the discharge of pollutants from MS4s which receive discharges from areas of new development and significant redevelopment"
- Best Management Practices implemented to the Maximum Extent Practicable

Where are we now?
How did we get here?

- Bay Area: Existing guidance & implementation.
- What's happening elsewhere?
- Project Examples.

Existing Guidance & Implementation - Bay Area

- 1993: California State BMP Handbooks
- 1994: Regional Board - "Staff Recommendations"
- 1994: Bay Area Preamble to CA State BMP Handbooks
- 1997: BASMAA - "Start at the Source"

Elsewhere -
Other States and Regions Requiring New Dev. Measures

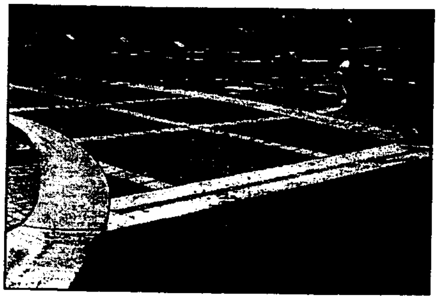
- Washington, Texas, Florida, Virginia, Maryland
- California Region 4 (L.A.), Region 9 (San Diego), Bellflower
- New L.A. Draft Permit

Detention Basin

Vegetated Swale - 1997

Vegetated Swale - 2001

Pervious Pavement



The evolving process

Amendment Goal - Add specific language to existing performance standard

- Include more projects with treatment measures
- Address redevelopment
- Design treatment measures adequately
- Maintain treatment measures
- Address increased peak runoff

New Development / Redevelopment Tentative Order – Major Elements

- Hydraulic sizing criteria for treatment measures
- New development project size
- Significant redevelopment projects
- Exemption for impracticality
- Peak runoff management

Hydraulic Design Criteria for Treatment Measures

- Volume Basis
  - 85^{th} percentile 24 hr Runoff Event
  - Unit Basin Storage Method for 80% Treatment – CA BMP Handbook - 1993
- Flow Basis
  - 2 X 85^{th} percentile of hourly rainfall intensity
  - 0.2 inch per hour intensity
  - 10% of 50 year flow

New Development Project Size

- Group 1 - Commercial, industrial, roads or residential projects of one acre new impervious surface or greater (Significant re-development of same size)
- Group 2 - 5000 ft^2 of new impervious surface creation *Revise to 2004 from 2003*
- Program can propose alternate equivalent approach

Significant Redevelopment Category

- Significant redevelopment emphasized in EPA regulations
- Addition vs. replacement, land disturbance
- Routine pavement and roof replacement, maintenance excluded
- *Interior remodel excluded*
- *50% standard for partial work*

Exemption or Waiver for Impracticality

- Impracticability established, or Regional treatment planned
- Transfer equivalent treatment of water volume or pollutant load basis to near watershed
- *Request Program to Propose Language for Board Approval*

Peak Runoff Change

- New roofs and pavement can increase peak runoff flows and durations
  - Impact example: Damage to downstream structures and habitat through excess erosion & deposition.
- Degree of impact depends on local watershed and stream conditions
- Hydrograph Modification Management Plan development over next 2 years
- ***Interim standard – Revised to limit peak runoff where excessive downstream erosion may occur (L.A. SUSMP Language)***

New Development / Redevelopment Tentative Order – Minor Elements

- Review of site design standards.
- Inclusion in CEQA review, General Plans, etc.
- Source controls.
- Reporting.

Summary

- Process Extended
  - Revised T.O. with response to comments – August 15
  - Revised T.O. will be renoticed for five weeks
  - Revised T.O. can be further revised before October Board Meeting action
- Increased degree of implementation of existing concepts

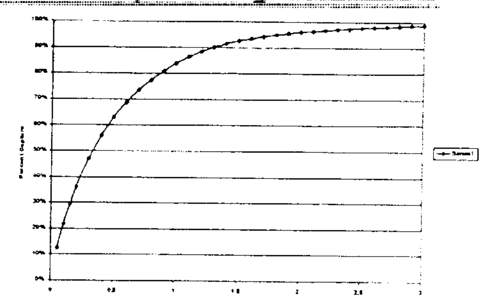
Areas of Revision for New T.O.

- Interim Peak Runoff standard
- Project size categories
- Significant Redevelopment
- Exemption criteria
- Schedule for implementation

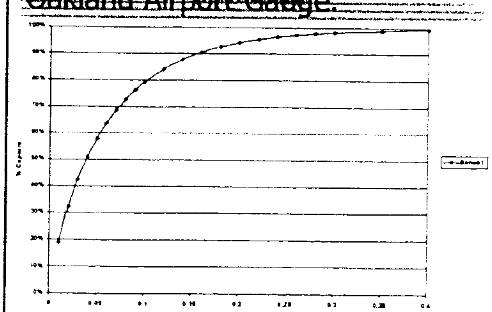
Conclusion

- Ample opportunity for review, discussion, & further changes to the Amendment T.O.
- Consistent approach will follow for other stormwater programs in the Region.
- Back to Water Board in October.

Technical Analysis (Volume): Oakland Airport Gauge:



Technical Analysis (Intensity): Oakland Airport Gauge:



Proposed Permit Requirements for Development Projects: Implications for Municipalities

Jill Bicknell, EOA, Inc.
Assistant Program Manager,
Santa Clara Valley Urban Runoff
Pollution Prevention Program (SCVURPPP)

Overview of Presentation

- Key changes in municipal approvals and responsibilities for development projects (based on May 18th Tentative Order)
- SCVURPPP's approach to implementation of permit requirements
- Expected guidance from SCVURPPP and BASMAA

Key Changes in Development Project Approval Process (May T.O.)

- **Conditions of approval:**
  - Develop additional conditions
  - Include in project requirements
  - Review and condition more projects, down to minimum size threshold

Key Changes in Development Project Approval Process, continued

- **New conditions include:**
  - Site design/landscape measures
  - Source control measures
  - Numeric sizing criteria
  - Peak runoff control measures
  - Pesticide reduction measures
  - Operation & maintenance responsibility

Key Changes in Development Project Approval Process, continued

- **Legal authority** – May need expanded authority to review/require controls at small sites and allow exemptions
- **Environmental reviews** – Must address water quality impacts and mitigation
- **Waiver/Compensation Provision** – Must evaluate/document impracticability & cost
- **Data management** -- More documentation and record keeping required

Key Changes – Ongoing Responsibilities

- **Treatment Controls Operation and Maintenance Verification Program**
  - Establish public/private responsibility
  - Maintain list of properties with controls
  - Conduct inspection and enforcement
- **Management of Compensatory Fees**
  - Accounting and transfer of funds to identified projects

Key Changes -- Implications for Municipalities

- **Major increases in staff time and resources will be needed to:**
  - Review/revise ordinances & procedures
  - Develop new conditions/standards
  - Train planning department staff
  - **Review more projects**

Key Changes -- Implications for Municipalities, cont.

- **Major increases in staff time and resources will also be needed to:**
  - Document site conditions and controls by project
  - Develop and implement O&M verification program
  - Hire and train staff to conduct inspections

Additional Implementation Challenges

- High density, infill, and/or urban redevelopment projects
- Sites with infiltration limitations
- Limiting peak flow discharges to pre-developed conditions
- **Using site design measures to meet numeric sizing criteria**

Additional Implementation Challenges, continued

- Selecting from untested/evolving treatment system technologies
- Selecting controls that cost-effectively reduce pollutants of concern
- Determining equitable and legal ways of collecting mitigation fees
- Meeting permit implementation schedule

SCVURPPP Approach: Update Performance Standards

- Have adequate legal authority
- Provide guidance to developers up front
- Address stormwater quality in CEQA reviews
- *Require developers of significant projects to minimize stormwater quality impacts to MEP, through site planning & permanent controls*

SCVURPPP Approach: Update Performance Standards

- Require coverage under General Permit
- Require effective erosion/sediment controls prior to and during wet season
- *Require O&M methods for permanent BMPs*
- Include control measures in municipal capital improvement projects
- Provide staff training annually

SCVURPPP Approach: Develop Guidance

- Translate numeric sizing criteria to local climate conditions
- Site design measures and design standards
- Source control measures/conditions
- Treatment control selection, design, and maintenance

SCVURPPP Approach: Develop Guidance, continued

- Peak flow limitations (develop Hydromodification Management Plan, protocols and BMPs)
- Pesticide reduction measures/conditions
- Evaluating and documenting impracticability and alternate measures
- Regional approach to guidance

BASMAA Projects (FY 01-02)

- **"Treatment Control Position Paper"**
  - Evaluate cost-effective levels of treatment for various land uses
- **"Using Start at the Source to Comply with Development Standards"**
  - Use site design techniques to comply with flow/volume control standards
- **Workshops**

Using Good Science and Process for BMP Selection and Requirements

Eric Strecker
Portland, OR
GeoSyntec Consultants

Overview of Presentation

- Setting and Implementing Design Standards
- Future Trends
  - The Effectiveness of BMPs
  - BMPs – Emerging Trends
- Project Examples
  - Playa Vista
  - Irvine Company

Effectively Implementing Design Standards

- **Need to target both existing and potential future problems**
- **Dischargers should develop requirements rather than regulators (or if developed, adapt more relevant approaches)**
- **Technical Approaches should be based upon good science and process**

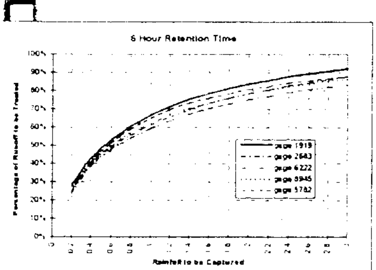
Technical Approaches

- **Setting water quality facility sizing requirements**
  - **Assess rainfall, runoff, and BMP functioning to ascertain what will be achieved**
  - **Volume vs. flow-through BMPs need separate approaches**
  - **Make requirements simple**
  - **Encourage "treatment trains"**
  - **Recognize that standards will need to evolve as we learn more**

City and County of Honolulu-Factors Considered in Selecting Standards

- **Reduce pollutants to "Maximum Extent Practicable"**
- **Pollutants of concern - NPDES Sampling**
- **Water Quality Limited water bodies**
- **Rainfall - Point of diminishing return**
- **Rainfall/runoff/BMP function analysis to ascertain what proposed requirements would achieve for different BMP types**
- **First flush for small sites**
- **We have a lot more to learn about stormwater BMP effectiveness**
- **Hawaii development site conditions**
- **This is an initial start**

Storm Event Rainfall Analysis to Select Storm Sizes for Evaluation for Detention Based BMPs



Honolulu Airport 1919
Kailua Fire 2683
Maunawili 6222
Wahiawa Dam 8945
Makaha Pump 5782

Selected Storm Sizes
1.0 (60 to 67%)
1.4 (67 to 75%)
2.2 (76 to 85%)

R0020578

Example Site Analyses - Simulation of the Results of Requirements Performed

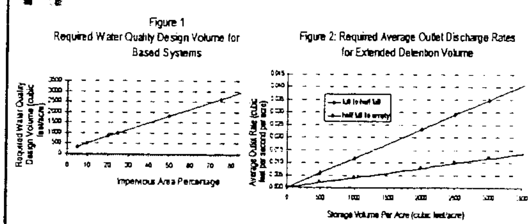
- Selected Actual Site Examples
- Developed Site Re-designs for each sizing requirement
- Predicted Results - Hydrologic, Hydraulic and Pollutant Removal Performance
- Developed Cost Implications/Evaluation
- Assessed Land use/aesthetics

COMPARISON OF ON-SITE WATER QUALITY DESIGN STORMS FOR TYPICAL COMMERCIAL OFFICE BUILDING DEVELOPMENT

Water Quality Design Storm	Water Quality Site Design					Estimated Annual Pollutant Load of Total Suspended Solids (TSS)[2]			Estimated Reduction in Annual Pollutant Load of Total Copper (Cu)
	Potential Water Quality BMP	Estimated Percentage of Annual Runoff Volume Treated		Cost Implications[1]		Site With			
		Rainfall Analysis	SWMM Modeling	Capital	Maintenance	Traditional Site Design	Water Quality Facilities	Percent Reduction	
0.30 in/hr	vegetated swales (2' - 4.5' bottom width)	65%	na	$23,000 Annual Cost	$3,000	710 lbs per year	327 lbs per year	54%	45%
0.40 in/hr	vegetated swales (2' - 6.5' bottom width)	70%	na	$15,000 Annual Cost	$3,000	710 lbs per year	300 lbs per year	58%	50%
0.55 in/hr	vegetated swales (2' - 9' bottom width)	80%	na	$22,000 Annual Cost	$3,000	710 lbs per year	240 lbs per year	66%	56%

NOTES
1. "Cost Implications" based on comparison to construction and maintenance of conventional storm drainage system.
2. Pollutant loads based on stormwater quality data collected on Oahu between 1992 and 1994.
3. Pollutant removal based on performance data reported in Portland Stormwater Quality Facilities Design Guidance Manual.

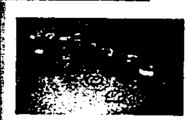
Detention Based Water Quality Control - Design Sizing/Detention Time



Approach -Provided simple charts for sizing of facilities

EPA's and ASCE's Standardized Best Management Practices Data Base -

DETERMINING URBAN STORMWATER BMP EFFECTIVENESS



ASCE UWRRC Team:
Eric W. Strecker and Marcus Quigley
GeoSyntec Consultants;

Ben Urbonas,
Urban Drainage and Flood Control District; and

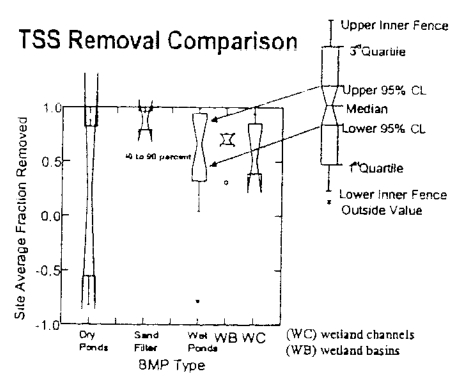
Jonathon Jones and Jane Clary,
Wright Water Engineers

Urban Water Resources Research Council

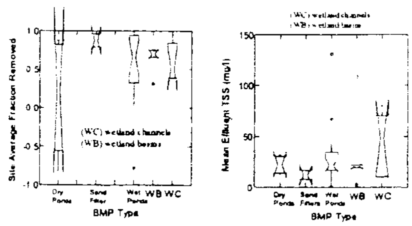
Problem: BMP Studies inconsistencies make it difficult to transfer what is learned to overall knowledge of specific BMP types and factors that affect their effectiveness (examples):

- constituents
- sample collection techniques
- sampling approaches
- data reporting
- effectiveness estimation
- statistical validation of results

TSS Removal Comparison

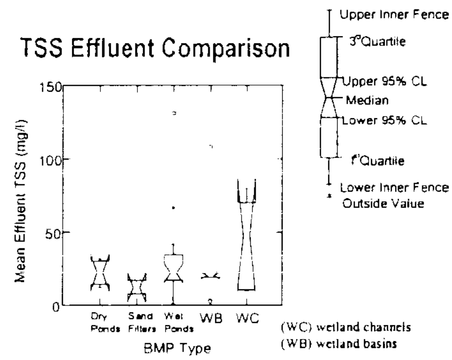


BMP Performance Characterization –Lessons from ASCE Database



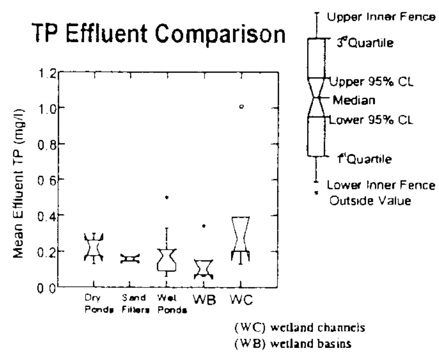
- Percent Removal (-70 to 99% on average) vs. Effluent Quality (Range of 20 to 30 mg/l average TSS) (Note: Only three wetland channels in database)
- So What?
  - BMPs are best described by how much they treat and to what effluent quality.
  - Important for assessing effectiveness for BMP selection (commercial and public domain BMPs)

TSS Effluent Comparison

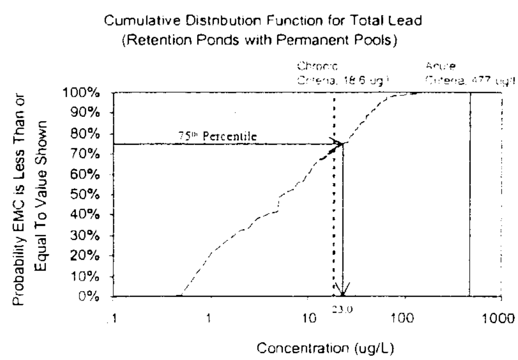


Average effluent of 20 to 40 mg/l common achievement

TP Effluent Comparison



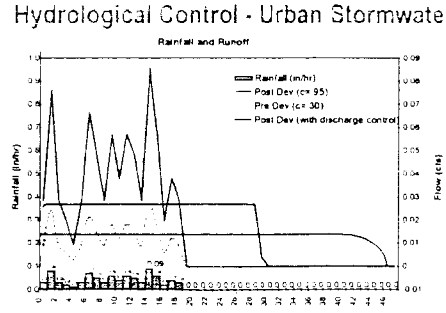
Average effluent of 100 to 200 ug/l common achievement



Effluent CDF Results

	25th Percentile	50th Percentile (median)	75th Percentile	90th Percentile
Total Suspended Solids (mg/l)	6.0	14.6	36.0	79.3
Total Cadmium (ug/l)	0.3	0.7	1.5	200.0
Total Copper (ug/l)	4.0	5.9	10.0	13.4
Lead (ug/l)	2.0	6.0	23.0	44.1
Zinc (ug/l)	12.0	29.0	68.5	153.8

Hydrological Control - Urban Stormwater



Pre=Post peak flows for 1 to 2 year storms is likely to worsen stream impacts!

Addressing Stream Stability by Working with the Stream

Timber Stepdown (front)

Boulder Bed Control Structure (back)

Solving the Problems: BMP Preferences

1. Tied:
   - Hydrological source control
   - Pollution source control
   - On-site "lower impact" stormwater management techniques for treatment and flow control
2. In-stream stabilization measures
3. On-site treatment via end of pipe "structural" facilities
4. Regional water quality/flow management facilities

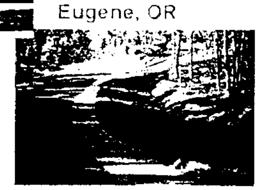
25 – Year Shopping Event Design?

Does the Fire Department Really Need Huge Fire Trucks?

Narrow Streets, No Curb Swale Examples

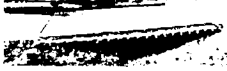
The Woodlands, Texas

Eugene, OR

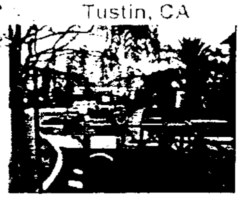


Drainage Swales Within Development

Tustin Ranch, Tustin, CA



Village Homes, Davis, CA



Parking Lot Vegetated Swales

Grass Swale with Trees and a vegetated swale (native plants) with gravel

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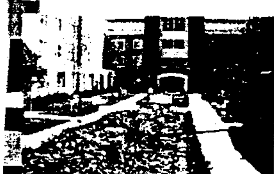
Infiltration Swale

Office Complex Wetland

Apartment Courtyard Biofiltration System



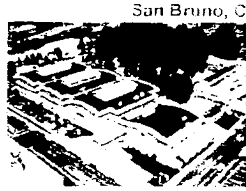
Runoff is directed to center planter and either infiltrates or overflows into small inlets

Roofs – Good Looking?

Vegetated Roofs – Detention and Evapotranspiration

Parking Garage, Oakland, CA

Gap World Headquarters, San Bruno, CA



Traditional vs. Integrated Landscape Stormwater Design Approaches

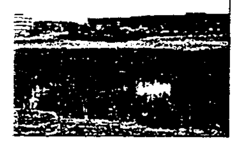
Project	Integrated Approach	Cost: Traditional vs. Integrated Approach	Savings
OMSI (commercial)	"Naturescaped" bioswales in parking lots	$273K vs. $195K	$78,000
Walnut Park Police Station (commercial)	Bioswale and infiltration area in parking lot	$10K vs. $1K	$9,000
Flex Alloy (industrial)	Flow-through grass filters and swale	$[illegible]K vs. $68K	$11,000
[illegible] Village (31-home subdivision, including streets)	Open channel bioswales and soakage trenches	$[illegible]K vs. $58K	$[illegible]

R0020582

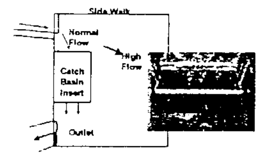
Parking Lot Swales

- Parking Loss Minimized
- Meets Landscaping Requirements
- Can Reduce Costs
- Access Issues
- Look Attractive

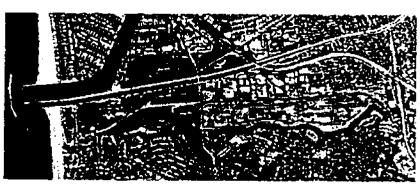
Are All BMPs the Same?



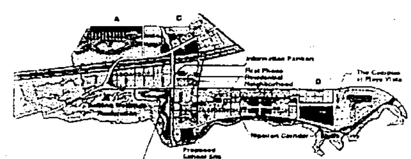
Vs.



Playa Vista – Stormwater Management



Playa Vista's Plan for Ecologically Based Restoration and Development

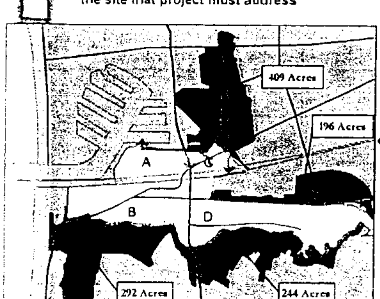


Freshwater Marsh

- The Playa Vista Water Resources Plan was developed to be ecologically driven both internal and external to the project
- One of the first systems in Southern California designed to address water quality from a natural systems perspective
- Is often cited as an example of comprehensive urban water resources management in other Cities (including Portland!)

Playa Vista Water Quality and Quantity "Opportunities"

- Significant off-site flows draining directly onto the site that project must address

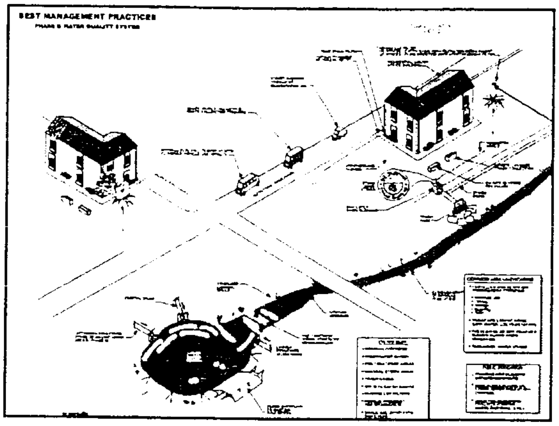


78,000+ acres of greater Los Angeles

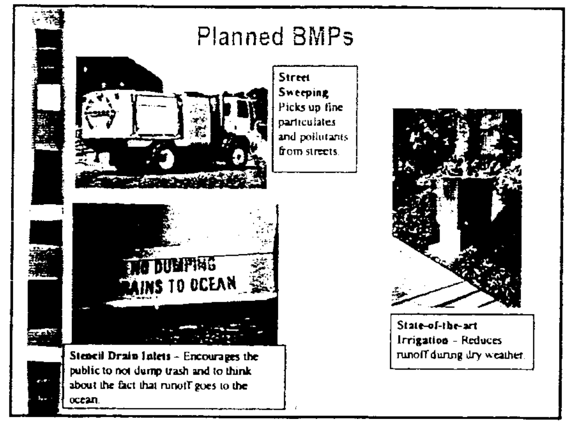
1,087 Acres
A, B, C, & D

Stormwater Management System -Treatment Train BMPs

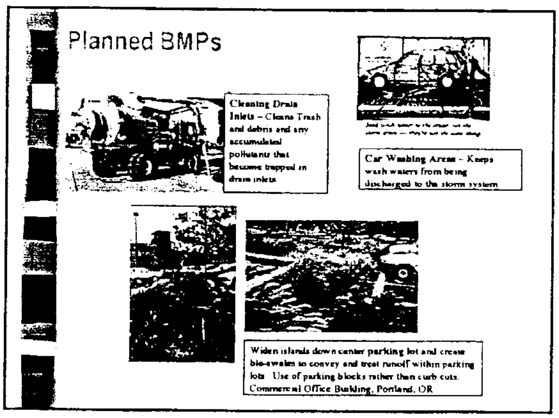
- Community education and amenities
- Off-site BMPs to improve water quality in stormwater that enters project area
- Bio-swales, catch basin inserts and other in-project features in tributary watersheds to minimize runoff amounts and provide primary treatment
- Riparian corridor habitat, water quality, aesthetics
- Water quality wetlands and habitat
- Fresh water flow management



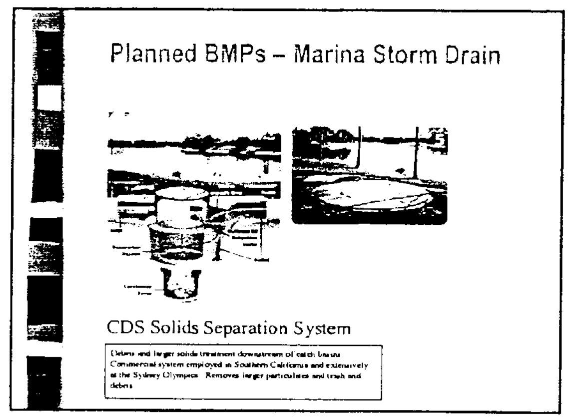
BEST MANAGEMENT PRACTICES



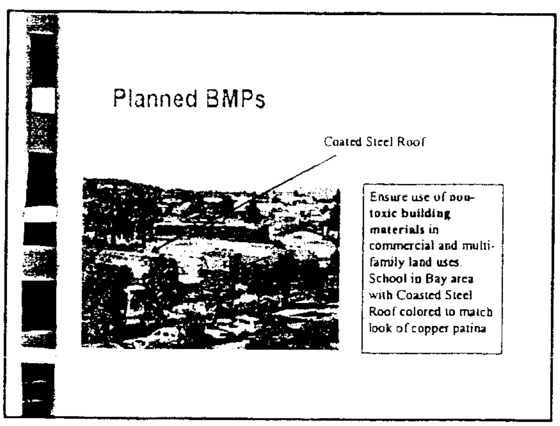
Planned BMPs
Street Sweeping Picks up fine particulates and pollutants from streets.
NO DUMPING
DRAINS TO OCEAN
Stencil Drain Inlets - Encourages the public to not dump trash and to think about the fact that runoff goes to the ocean.
State-of-the-art Irrigation - Reduces runoff during dry weather



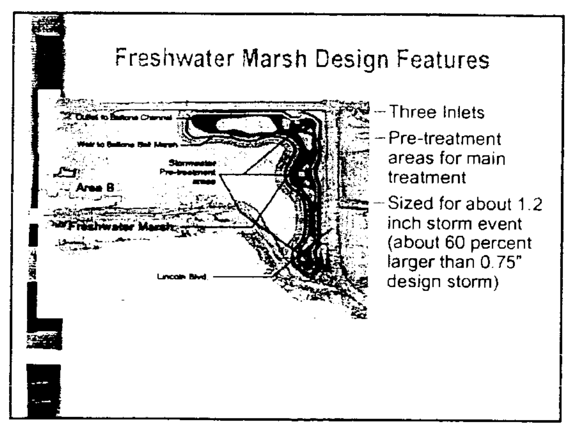
Planned BMPs
Cleaning Drain Inlets – Cleans Trash and debris and any accumulated pollutants that become trapped in drain inlets
Car Washing Areas - Keeps wash waters from being discharged to the storm system
Widen islands down center parking lot and create bio-swales to convey and treat runoff within parking lots. Use of parking blocks rather than curb cuts. Commercial Office Building, Portland, OR



Planned BMPs – Marina Storm Drain
CDS Solids Separation System
Debris and larger solids treatment downstream of catch basins. Commercial system employed in Southern California and extensively at the Sydney Olympics. Removes larger particulates and trash and debris.



Planned BMPs
Coated Steel Roof
Ensure use of non-toxic building materials in commercial and multi-family land uses. School in Bay area with Coasted Steel Roof colored to match look of copper patina



Freshwater Marsh Design Features
Outlet to Ballona Channel
Area B
Stormwater Pre-treatment areas
Freshwater Marsh
Lincoln Blvd
– Three Inlets
– Pre-treatment areas for main treatment
– Sized for about 1.2 inch storm event (about 60 percent larger than 0.75" design storm)

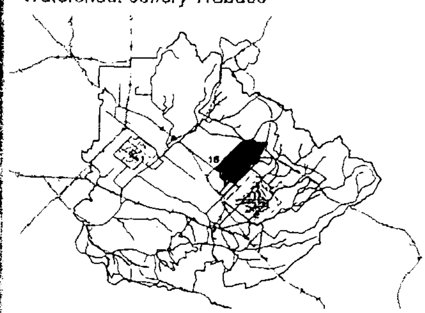
Freshwater Marsh

- Under construction now

Irvine Company Stormwater Management

- Developed a company-wide approach for stormwater management
- Focused on both project and regional solutions
- Selected Natural Treatment Systems options, with other structural approaches as appropriate
- Program includes both regional and on-site solutions to meet water quality goals

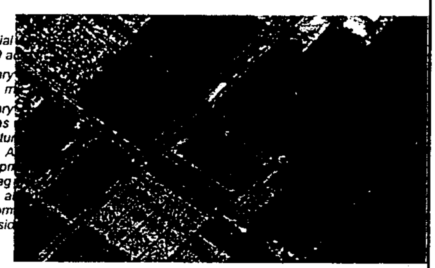
Watershed: Jeffery Trabuco



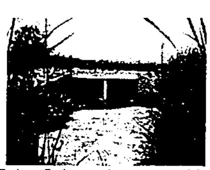
San Diego Creek Watershed

Footprint: Jeffery Trabuco

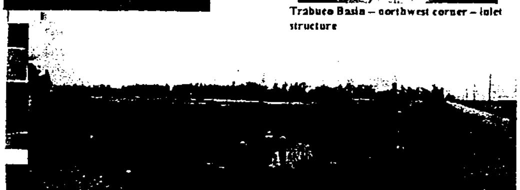
- *Potential 5 to 10 a*
- *Tributary 2.8 sq. m*
- *Tributary includes agricultu urban. A developm some ag remain a with com and resid urban*



Jeffery Trabuco



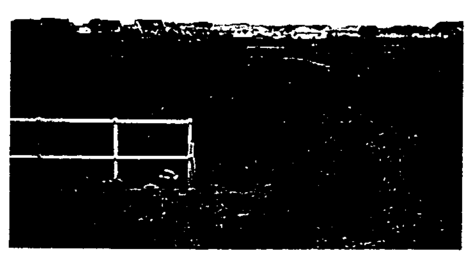
Trabuco Basin – northwest corner – inlet structure



ASCE Database

Online Search of Database

http://www.bmpdatabase.org



Stormwater Controls in New Development Projects

Understanding Numeric BMP Sizing Criteria

Presented by

Jeffrey D. Endicott, P.E.

CDM Camp Dresser & McKee Inc.

Wednesday, August 08, 2001

Presentation Objectives

- Discuss advantages of uniform BMP design criteria – a.k.a. Numeric Sizing Criteria
- Identify areas where BMP design criteria have or will be implemented
- Review BMP design criteria in proposed Santa Clara Valley permit amendment
- Make sense of the proposed BMP design criteria

Advantages of Uniform BMP Design Criteria

- Establishes a basis for compliance
- Provides a measure of equity in BMP implementation
- Allows for consistent evaluation and improvement of
  - Individual BMPs
  - Overall BMP program

CA Migration of BMP Design Criteria – In Place

- Tahoe Basin
- SUSMPs
  - Los Angeles County (Unincorporated)
  - Los Angeles County (Municipalities)
  - City of Long Beach
- Ventura County County-wide Permit
- San Diego County-wide Permit

CA Migration of BMP Design Criteria – Being Considered

- Santa Clara Valley
- L.A. County (Round 2)
- And who knows where else?
  - Orange County Permit, San Diego Regional Board jurisdiction?
  - Others?

Proposed Design Criteria Santa Clara Valley

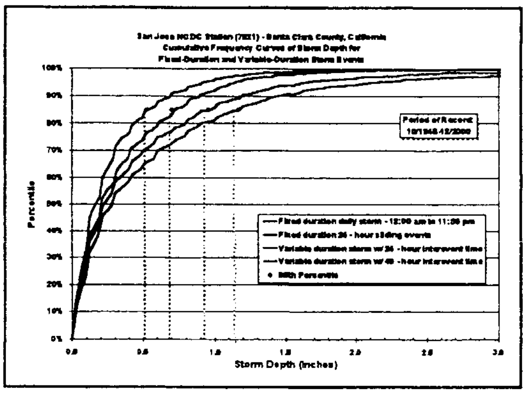
- Volumetric design basis for
  - Detention, Wet and Dry
  - Retention
  - Infiltration
  - Wetlands
- Flow design basis for
  - Biofilters
  - Media filters
- Some BMPs require consideration of both
  - Diversion to off-line detention, retention, etc.

Proposed Design Criteria Santa Clara Valley

- Volumetric Design Basis
  - Each runoff event up to the 85th percentile 24-hour storm runoff event – The URQM Approach
  - Volume of annual runoff to achieve 80 percent capture – The CA BMP Handbook Approach

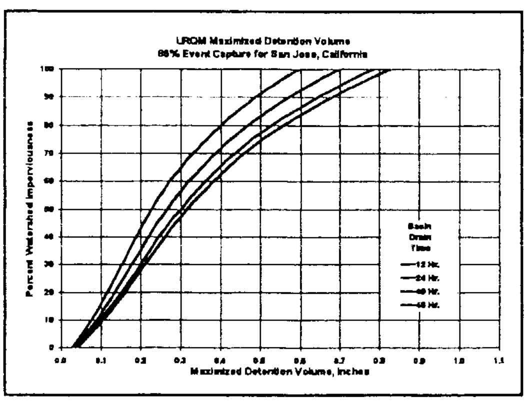
Volumetric Design Basis

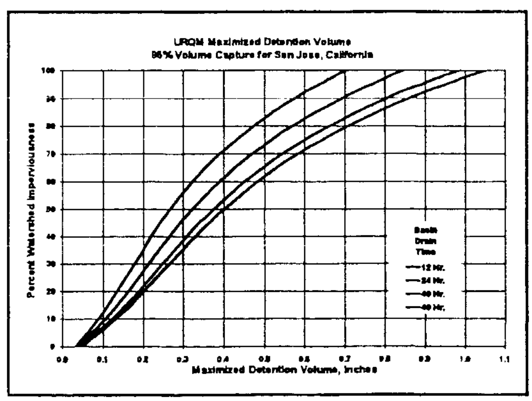
- Current language is ambiguous
  - 24 hr storm Vs 24 hr runoff event?
    - Not part of URQM approach
    - Not recognized by Mother Nature
- Language can be clarified, yielding a sound approach
- CA BMP Handbook Vs URQM
  - Same underlying approach

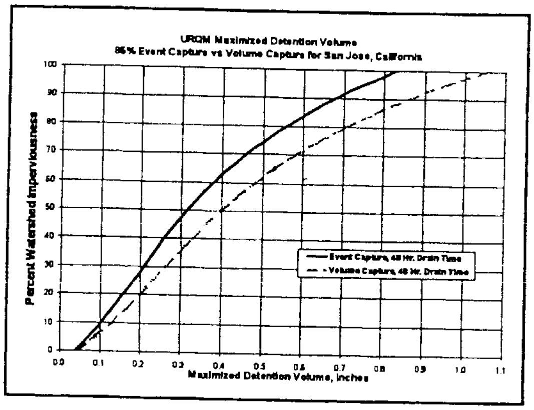


URQM Approach

- Current language allows multiple interpretations

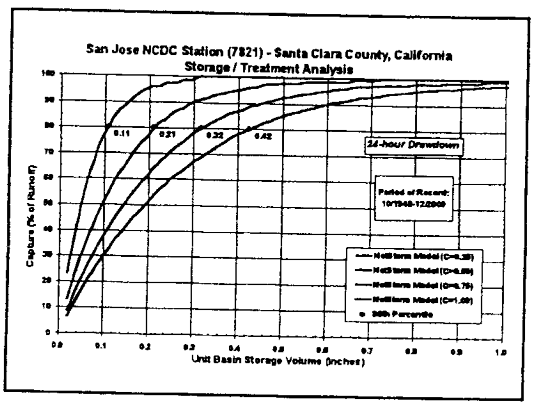


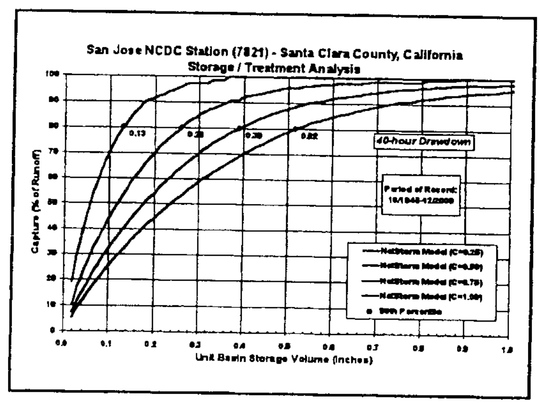




CA BMP Handbook Approach

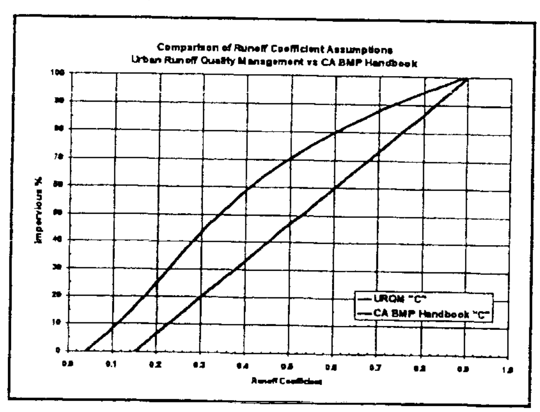
- Current language is sufficiently clear to implement





Important to Keep in Mind

- CA BMP Handbook and URQM use different runoff coefficient assumptions
- Don't co-mingle!



Volume Approach Comparison

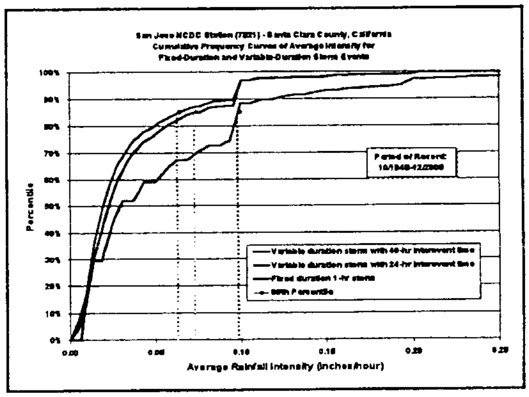
	CA BMP Handbook		URQM		
Impervious Area %	"C"	80% Runoff Volume (inches)	"C"	85% Events Volume (inches)	85% Runoff Volume (inches)
100	[illegible]	0.43	[illegible]	0.70	[illegible]
75	0.71	0.33	0.54	0.42	0.52
50	0.52	0.23	0.36	0.28	0.32
25	0.34	0.11	0.20	0.15	0.19

Proposed Design Criteria Santa Clara Valley

- Flow Design Basis
  - 10% of the 50 yr design flow
    - Straight forward, easy to determine
  - Flow that treats same portion of runoff treated using volumetric standards
    - Difficult to determine, has significant absolute compliance issues - Not Recommended

Proposed Design Criteria Santa Clara Valley

- Flow Design Basis
  - Flow produced by a 0.2 in/hr storm
    - Straight forward, easy to determine
  - Flow produced by 2X the 85th percentile hourly intensity
    - Current language is ambiguous – similar to previous reasons



Flow Approach Comparison

- Intensity approaches
  - Calculated intensities, ~0.06 ~ 0.10 in/hr
  - Doubling yields ~0.12 ~ 0.20 in/hr
  - Doubled figures are similar to the 0.2 in/hr option
  - Doubling intensity for design makes some sense – it factors out numerous "trace" events that do not produce runoff

Summary

- Design criteria
  - Provide equity in BMP implementation
  - Allow long-term assessment
    - BMPs
    - Changes in water quality
- Proposed criteria
  - Generally heading in the right direction
  - Relatively minor changes will make important improvements

R0020589

Summary

- Volumetric design criteria
  - URQM
    - Simple to use
    - Yields somewhat higher volumes for Santa Clara Valley
  - CA BMP Handbook
  - Simple to use once complex hydrologic analysis is completed and curves developed
  - Yields volumes specific to Santa Clara Valley

Summary

- Flow design criteria
  - 10% of Q_{50}
    - Simple to use
    - Yields site-specific results
  - Intensity approach
    - Simple to use
    - ~0.2 in/hr seems to be a reasonable target

Recommended Reading

- Urban Runoff Quality Management (1998) - Water Environment Federation and American Society of Civil Engineers
- California Best Management Practice Handbooks – Municipal (1993) – Camp Dresser & McKee Inc. et al. for the California Stormwater Quality Task Force (Note: the Handbooks are being updated and are scheduled for re-release in July 2002)
- CA BMP Handbook feedback?
  - http://www.stormwatertaskforce.org/

Contact Information

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Marin Countywide Plan Update 2000-2004

Future Marin

Designing a Sustainable County

www.future-marin.org Summer 2001

Hindsite: A Word From the Agency Director...

Dear Marin Community Member,

As we move forward in the new millennium, we welcome your participation in the Countywide Plan Update. We need your ideas to help launch the plan for the 21st century. Your participation will determine the quality of the plan.

Those of us who live or work in Marin County treasure its natural beauty and its emphasis on conservation. We also recognize that housing costs have sky-rocketed and that commuting during rush hour on Highway 101 erodes the quality of our lives.

If you are interested in participating in the planning process, please register on our website (www.future-marin.org) to receive e-mail updates and related information.

Sincerely,

Alex Hinds

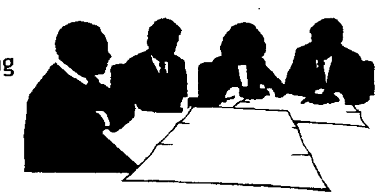
Alex Hinds
Director,
Marin County
Community Development Agency

Marin Countywide Plan (CWP) Update Progress Report

CWP UPDATE FRAMEWORK

Marin's Countywide Plan (CWP) serves as the county's land use and policy blueprint. First adopted in 1973, Marin's plan remains a visionary land use guide. Updated in 1982 and again in 1994, most of the document has withstood the test of time, and its policies continue to reflect widespread community values. Nevertheless, many elements will be updated to address current issues such as traffic congestion, erratic and costly energy supplies, and the need for well-designed and affordable housing. In response to a recommendation of the Marin Economic Commission, the Board of Supervisors in 1999 decided that sustainability would be the overarching theme for the updated plan. See page 4 for the Interim Guiding Principles as prepared by the Sustainability Working Group and staff.

WORKSHOPS



To launch the CWP process, the Community Development Agency held six workshops in various locations throughout Marin beginning in October 2000. About 75 people attended each workshop where they heard presentations and gave input about what they envision for Marin's future. Local and regional experts presented topics addressing planning for sustainable communities such as green business, food and agricultural, social equity, green building, transportation, and economics. Videotapes of the workshops are available through the Marin County Free Library. For availability call the Reference Desk at (415) 499-6058 or visit www.countylibrary.marin.org.

(continued on page 2)

MARIN COUNTY COMMUNITY DEVELOPMENT AGENCY

3501 Civic Center Drive, Room 308 · San Rafael, California 94903 · Phone: (415) 499-6269 · Fax: (415) 499-7880

(continued from page 2)

SUSTAINABILITY WORKING GROUP

The Sustainability Working Group (SWG), the first of four working groups to support the CWP process, met from February through May. Members from different sectors of our community worked with staff to prepare a set of ten sustainability principles to guide the CWP (page 4). SWG members include: Meg Amaral (student liaison), Sue Beittel, Clark Blasdell, Nona Dennis, Nancy Ducos, Jeff Ehlenback, Jim Goodwin, Grace Hughes, Arie Kurtzig, Luke McCann, Charles McGlashan, Linda Novy, Larry Rosenberger, and Sim Van der Ryn. Biographies of members furthur information about the the SWG can be viewed at www.future-marin.org.

The Sustainability Working Group members

WEBSITE

In addition to the workshops and preparation of the guiding principles, several other efforts have begun recently to support the CWP Update process. A logo to help with public awareness and name recognition has been developed for use on all CWP publications. A website (www.future-marin.org) advertises upcoming events, supplements information presented at workshops, provides summaries of workshops, and reports on the working groups including biographies of members and minutes of meetings.

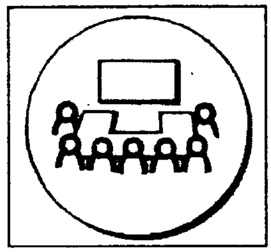
CHILDREN'S ARTWORK KICKOFF

See Marin's Future Through the Eyes of Children

This exhibit of children's artwork looks at Marin's future through the eyes of six to eleven year olds. The Community Development Agency with the help of Art Specialist Barbara Marino gathered input from the very people our long-range plans will most affect - our children. This show of wondrous drawings and accompanying verbatim explanations is part of the Countywide Plan Update process.

This exhibit is on display through August 1, 2001 at the Marin County Civic Center Administrative Wing in the foyer outside of the Board of Supervisors Chambers, 3501 Civic Center Drive, Third Floor, San Rafael.
For more information visit www.future-marin.org or call (415) 499-6269.

WORKING GROUPS



Three working groups are being formed to assist staff in preparing the major sections of the plan: Natural Systems, the Built Environment, and Economy, Equity and Culture. Working groups will begin meeting in late July 2001, and will continue to meet approximately once monthly for the next year to identify trends, challenges, visions and strategies. The product of each working group will then be turned over to a Board-appointed Steering Committee to help blend and balance this input into an integrated and comprehensive plan. A variety of public agencies responsible for transportation, health and human services, and housing twill also assist the working groups by identifying key trends and provide technical information.

No Cost, Easy Energy Conservation Quick Tips

- Turn off anything you're not using: all equipment and appliances, such as lights, TV's, VCRs, computers and monitors.
- Full loads ONLY for dishwasher, clothes washer & dryer. Clean dryer lint trap after each use and line dry clothes whenever possible.
- Water heater: Lower the temperature to 140 degrees (or normal).
- Plan meals so you'll cook and bake several items at once. Preheat as little as possible.
- Turn off lights when they are not needed.
- Air conditioners: Set thermostat at 78 degrees or higher when you're at home, and 85 degrees or higher when you are not home. Inspect filters monthly during operation and clean regularly.
- Heaters: Set at 68 degrees during the day and 55 degrees at night.
- When going on vacation, shut off or turn down automatic appliances, such as your water heater and furnace.

R0020592

Growth and Traffic Congestion in Marin:

Our Solutions Must Match Our Problems

By Dean R. Powell, AICP, Principal Transportation Planner

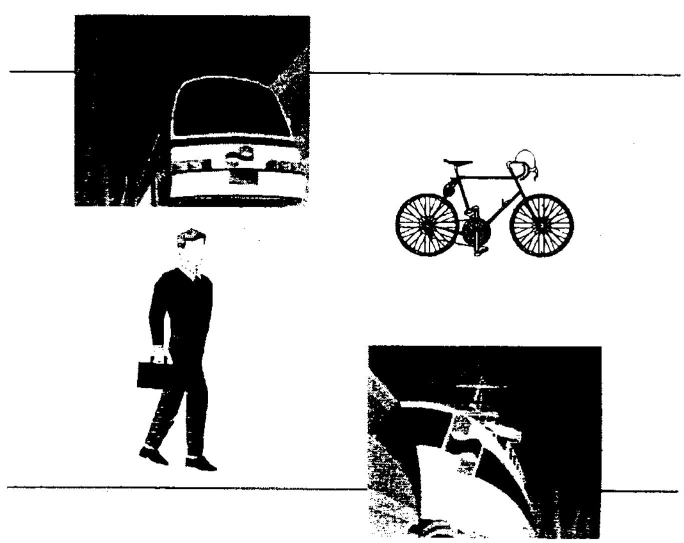
There are many popular myths circulating about the causes of traffic congestion in Marin, such as explosive growth in Sonoma County coupled with jobs in San Francisco, making Highway 101 in Marin a stepping stone for residents to the north. Looking for the true cause of Marin's traffic problems? Try looking into a mirror, if you are a resident of Marin.

Earlier this year the County of Marin and Marin County Congestion Management Agency released a study on growth and traffic congestion in Marin. This cornerstone study is part of a larger, ongoing effort to develop an integrated, multi-modal solution to Marin's traffic congestion by first defining the traffic problems and causes. Multi-modal means various modes of transportation, such as cars, buses, ferries, trains, bicycles, and walking.

The study, which focused on the peak commute hours in the morning and investigated where traffic in Marin comes from and goes to, provided several surprising findings:

- From 1990 to 1998, Marin's population has grown very little, approximately half a percent per year, which is the lowest growth rate in the nine Bay Area counties. The population growth rate is projected to be even less over the next 20 years.
- The number of vehicles registered in Marin has grown almost three times faster (1.4% per year) than the population growth rate over the last 20 years (0.5% per year).
- People are taking more trips per day. As a result, the number of total trips per household has increased by approximately 0.4% per year over the last 10 years. This trend is projected to continue over the next 20 years.
- Over 77% of all daily trips generated in Marin are destined for locations within Marin.
- Over 63% of all daily commute (work) trips generated from all possible sources within and outside Marin are destined for locations within Marin.
- During the morning commute hours, over half (52%) of the trips made from the north that cross the Sonoma/Marin County line via Highway 101 are destined for Marin, about 24% travel through Marin bound for San Francisco, and about 20% travel through Marin bound for the East Bay.
- During the morning commute hours, over three-quarters (76%) of the trips made from the East Bay that cross the Contra Costa/Marin County line via Interstate 580 are destined for Marin and the remaining 24% travel through Marin bound for Sonoma County. Only a negligible percent of these trips are bound for San Francisco.
- Only 8% of the total morning commute hour trips generated from all areas outside of Marin pass through Marin.
- School trips account for 21% of all trips during the morning commute hours.

These findings demonstrate that increased traffic in Marin is primarily due to Marin residents relying more on their private cars, taking more trips per day, commuting within Marin to work, and taking their children to school by private vehicle during the morning commute hours. Our traffic problems are our own. Any solution to traffic congestion in Marin must involve a range of integrated, targeted solutions, such as rail, bus, paratransit, ferry, highway, bike and pedestrian solutions, that respond to these specific problems, which will improve mode choice, manage traffic flow and operations better, and change the behavior of people who rely so much on their private automobile. By improving modal choice and convenience in Marin, mobility will be improved and congestion will be reduced. There is no one solution to Marin's traffic problems.



Marin Countywide Plan Update 2001
Interim Guiding Principles

Preamble

Meeting the needs of the present without compromising the future is the overarching theme of the Marin Countywide Plan. Marin County government is committed to lead by example, support public participation, and work in community partnerships to improve quality of life and use key indicators to measure progress. To design a sustainable future, we will:

Guiding Principles

1. Link equity, economy, and the environment locally, regionally and globally.

We will improve the vitality of our community, economy, and environment. We will seek innovations that provide multiple benefits to Marin County.

Examples of Community Indicators: Social, economic and environmental indicators listed below; GPI (Genuine Progress Indicator: comprehensive, aggregate measure of general well being and sustainability including economic, social and ecological costs).

2. Use finite and renewable resources efficiently and effectively.

We will reduce consumption and reuse and recycle resources. We will reduce waste by optimizing the full life cycle of products and processes.

Examples of Community Indicators: Per capita waste produced and recycled; per capita use of energy, natural gas, and water; ecological footprint (measures per capita consumption of natural resources).

3. Reduce the release of hazardous materials.

We will make continual progress toward eliminating the release of substances that cause damage to living systems. We will strive to prevent environmentally-caused diseases.

Examples of Community Indicators: Water and air quality; measurements of toxic levels; childhood cancer rates.

4. Steward our natural and agricultural assets.

We will continue to protect open space and wilderness, and enhance habitats and bio-diversity. We will protect and support agricultural lands and activities and provide markets for fresh, locally grown food.

Examples of Community Indicators: Acres of wilderness; acres of protected land; level of fish populations; track special status plants and animals; quantity of topsoil; active farmland by crop; productivity of acreage and crop value of agricultural land; acres of organic farmland.

5. Provide efficient and effective transportation.

We will expand our public transportation systems to better connect jobs, housing, schools, shopping and recreational facilities. We will provide affordable and convenient transportation alternatives that reduce our dependence on single occupancy vehicles, conserve resources, improve air quality and reduce traffic congestion.

Examples of Community Indicators: Vehicle miles traveled; bus and ferry ridership and fares; person miles traveled; community walkability; miles and use of bike paths.

6. Supply housing affordable to the full range of our workforce and community.

We will provide and maintain well designed, energy efficient, diverse housing close to job centers, shopping and transportation links. We will pursue innovative opportunities to finance workforce housing, promote infill development and reuse and redevelop underutilized sites.

Examples of Community Indicators: Jobs-housing balance; Housing affordability; Number of new housing units within walking distance to jobs or transit.

7. Foster businesses that provide a balance of economic, environmental and social benefits.

We will retain, expand and attract a diversity of businesses that meet the needs of our residents and strengthen our economic base. We will partner with local employers to address transportation and housing needs.

Examples of Community Indicators: Taxable sales; retention and attraction of targeted businesses; job growth; unemployment rate; number of businesses with environmental management systems; hospitality revenues.

8. Educate and prepare our workforce and residents.

We will make high quality education, workforce preparation and lifelong learning opportunities available to all sectors of our community. We will help all children succeed in schools, participate in civic affairs, acquire and retain well-paying jobs, and achieve economic independence.

Examples of Community Indicators: Education level of Marin residents; per-pupil expenditures; percentage of eligible voters who voted; high school dropout rate; percent of high school graduates going to college or post secondary training.

9. Cultivate ethnic, cultural and socio-economic diversity.

We will honor our past, celebrate our cultural diversity, and respect human dignity. We will build vibrant communities, enact programs to maintain, share and appreciate our cultural differences and similarities.

Examples of Community Indicators: Racial diversity; diversity of community and corporate leadership; number of hate crimes; number and use of cultural resources such as museums and theaters.

10. Support public health, safety, and social justice.

We will live in healthy, safe communities and provide equal access to amenities and services. We will particularly protect and nurture our children, our elders, and the more vulnerable members of our community.

Examples of Community Indicators: Income statistics; health statistics; Percent of uninsured (medical) population; longevity after retirement; volunteerism; crime rate; percent of philanthropic contributions.

> *"Probably the most challenging task facing humanity today is the creation of a shared vision of a sustainable and desirable society, one that can provide permanent prosperity within the biophysical constraints of the real world in a way that is fair and equitable to all of humanity, to other species, and to future generations."*
>
> Robert Costanza

R0020595

Balance in Our Community

By Nancy Rubin, Director of the Marin County Department of Health and Human Services

A doorbell rings, telling a fragile senior that his main meal of the day has arrived. A pregnant woman with diabetes finds out how to maintain her health and that of her unborn baby during her pregnancy. A woman with breast cancer gets counseling and encouragement with the difficult decisions that she faces. A laid off tech worker finds a new job with a local employer who has been looking for well-trained staff. What do these people have in common? They all live in Marin County and they all require and receive valuable services from the County Department of Health and Human Services (H&HS) in order to maintain their life quality, health and independence.

Our agency provides an infrastructure which is sometimes invisible (trauma systems, etc.) but fragile. Our goal at H&HS of providing critical health and social services in Marin County is threatened when we cannot attract and retain staff due to the high cost of housing. It is becoming more and more difficult for job candidates to see Marin County as a viable choice economically and for their personal and family lifestyle satisfaction. Our applicant pool has been reduced by two thirds in the last five years before we even begin to screen for quality. A community cannot thrive without health and social services.

Of the over 2,000 full time employees that work for the County of Marin, the average salary is $54,691. Given the generally accepted standard that no more than one-third of a person's income should go toward housing, that works out to $1,367 a month for housing related expenses, an impossible figure in the local real estate market. As a result, slightly more than 48% of Marin County employees currently live in neighboring counties and commute to work in Marin, adding hours to their days and gridlock to our highways. There is little reason to believe that this trend will reverse itself in the near future without a dramatic shift in public policy.

It is an issue of balance. A vibrant community reflects a diversity in economics, ethnicity and ages. It is supported by the wisdom of seniors, the vitality of families, and the interests of the business community. In Marin County that balance is threatened, creating a level of urgency that can no longer be ignored. All citizens count on the safety net that the County provides and it is up to all of us to make sure that it remains intact.

Marin County is at a crossroad where decisions can still be made to improve the situation if we are willing to see beyond our personal needs in the short run, and commit to providing for all sectors in our community, including those who work to maintain public health and sustainability. It is time to take a serious look at preserving and protecting the workers who are the asset that provides balance and life quality in Marin County. Some communities within the state are exploring subsidized housing for professionals such as teachers, law and fire personnel. A recent article in the Marin Independent Journal outlined the use of recruitment tools like housing loans to lure physicians here. Within the Marin County employment structure we have begun to talk about benefits that will attract workers, such as carpooling, satellite offices, and flexible working conditions, as well as creating affordable housing so that they can live in the community in which they work.

It is time to tell our elected officials that we want affordable housing in our community and that we need to take a look at the kinds of housing projects that are approved. One way to do that is by becoming involved in the update of the County's General Plan Housing Element, a task just getting underway. The process will include an analysis of projected housing needs, as well as a new statement of goals, policies, quantified objectives, and any scheduled programs that will help to preserve, improve and develop housing. This process is being managed by the Marin County Community Development Agency. Additional information about this process and how you can participate in helping to shape Marin's future can obtained by calling the Community Development Agency at (415) 507-2801.

It is a community's responsibility to balance the needs of all of its citizens and one way of doing that is to attract and maintain a vibrant workforce. This is an urgent priority on a business level, on a service level, and on a humane level.

The Year in Review

By Barbara Collins

Barbara Collins is the Affordable Housing Strategist for Marin County. In January 2000, the strategist position was created by the Board of Supervisors and she began work in April 2000. The position coordinates affordable housing efforts among the Marin County Housing Authority, Marin County Department of Health and Human Services and the Marin County Community Development Agency.

In the past year, I have focused my attentions on working with others to determine how we as a community can accommodate the housing needs of our residents and workforce. I am fortunate to be able to work with all the cities, county, and interested groups to help shape the Housing Elements and the Housing Workbook that will help shape how we address this critical need for the next five years.

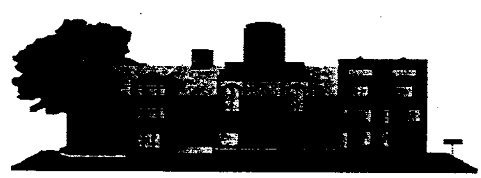
Policy evaluation that addresses unnecessary barriers to developing affordable housing is being conducted and where possible changes are being made in order to increase the number of affordable housing units. It will ultimately be the responsibility of the residents in each jurisdiction to determine what type of housing, for whom, where, and how much housing will be developed in their communities. Although individuals may often appear to be on opposite sides of the issue of affordable housing, in my experience most people share in the desire to solve this challenge.

For example, many housing units are used as income property and are vacant most of the year in the rural communities of West Marin. Existing rental housing is being converted to market-rate rentals and Bed and Breakfast facilities, making it difficult for long time low-income residents to remain. Thus, there is not so much a lack of housing as underutilization of existing units. We have taken steps with the Bolinas Community Land Trust to establish the "Gibson House" project for low income residents.

Financial resources critical to the community are in constant flux and I have worked to increase resources as well as plan for new ways to more effectively use existing resources. Affordable housing development is extremely complicated. It often takes five to ten different sources of financing to develop a project. This requires a great deal of coordination between many different agencies and organizations to achieve the results we want. In the past year, I have worked with several non-profit developers and communities to determine what steps can be taken to gain project support and create ways to address the need for housing.

Employers, including the county, are struggling to recruit and retain employees due to the high cost of housing. Working with other dedicated people, we have been examining ways to bring the community together around this issue to try to develop an effective way for non-profit developers to acquire appropriate sites before they are lost to develop for other purposes. We have also been working on trying to identify a permanent source of revenue to develop affordable housing.

The next year will be extremely exciting for affordable housing. In December 2001, the Housing Element process will be finished and early next year implementation will begin. Everyone will have the opportunity to provide input to the process. I can predict that the open space will remain open and that any housing we build will fit into the existing communities. We will integrate more green building principals into our housing so it uses less energy. Perhaps we can build smaller starter homes, combine more business uses with housing so people don't always have to get in their automobiles to get to work. The possibilities are endless if we use our imagination and work together.



The Marin Community Foundation (MCF) has announced a five year, $10 million commitment to the development, rehabilitation, and construction of affordable housing for low- and moderate-income families in Marin County. The MCF has also provided partial funding for the Affordable Housing Strategist position the County of Marin, the Sustainability Workshops for the CWP Update, and the Housing Element Workbook that will be published in August 2001.

What Is Your Ecological Footprint?

The Ecological Footprint measures people's use of nature. A population's Footprint is the biologically productive area required to produce the resources and to absorb the waste of that population. Since people use resources from all over the world, Footprints add up the extent of these areas, wherever they may be located on the planet.

Footprints can be compared to the biological capacity of a region or the planet. If we are taking more from nature than nature can renew, we erode the very natural capital that current and future generations depend on. This liquidation of our ecological assets is called "overshoot".

Sustainability within this context means achieving satisfying lives for all within the limited capacity of the planet. Tools like the Ecological Footprint track our use of nature, helping us to reduce human pressure on the planet and to move out of overshoot.

THE FOOTPRINT

Redefining Progress has developed a method to calculate the Footprints of cities, towns and regions, using local data on car use, housing, energy consumption, income, and spending on food, goods and services. This makes local Footprints directly comparable to national and global averages.

Take about 5 minutes to calculate your footprint by answering 13 multiple choice questions at www.lead.org/leadnet/footprint.

Community Development Agency Advance Planning Staff

Front row (left to right): Margaret Moster, Dawn Weisz and son Tyler, Michele Rodriquez, Ann Hancock, Barbara Collins, Larisa Roznowski, Alex Hinds.
Back row (left to right): Dan Dawson, Fred Vogler, Link Allen, Robert Taylor, Kristin Drumm.

Further Information

- website: www.future-marin.org
- phone: (415) 499-6269
- email: countywideplan@co.marin.ca.us
- mailing list contact: Sharon Silver phone: (415) 499-7874 or email: ssilver@co.marin.ca.us

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R0020598

STANDARD URBAN STORM WATER MITIGATION PLANS

Abstract

On January 26, 2000, the Regional Board approved a Standard Urban Storm Water Mitigation Plan (SUSMP) for Los Angeles County, which imposes storm water pollution controls on new development and significant redevelopment. The SUSMP incorporates numerical water quality design standards to ensure adequate sizing of treatment control best management practices to reduce pollutants in storm water runoff.

Several cities, the building industry, and a petroleum industry trade-group petitioned the Regional Board's action to the State Water Resources Control Board (State Board). On June 7th and June 8th 2000, the State Board conducted a two-day hearing on the matter in Torrance. In its final decision on the Petition, the State Board upheld the Regional Board action and the SUSMP, although a few subsidiary elements of the SUSMP were set aside for procedural deficiencies or additional technical justification. The Regional Board will review these areas when the Los Angeles County municipal storm water permit is revisited for reissuance in November 2001.

The Regional Board's action to establish numerical design criteria for storm water pollution mitigation was precedent setting in the State. Other Regional Boards are expected to develop similar proposals.

STORMWATER RETENTION BEST MANAGEMENT PRACTICES

"2ND WAVE" BMPS

First wave stormwater management BMPs dealt with preventing the type of pollution that contaminates runoff. These BMPs did not affect the traditional collection and conveyance system of stormwater management. Second wave BMPs involve planning and design that reduce runoff and manage stormwater as a resource.

"AT THE SOURCE" VS "END OF PIPE" SOLUTIONS

Traditional stormwater management involves "end of the pipe" design. In this process, stormwater picks up ever increasing amounts of pollutants, greater volume and speed of flow. This "end of pipe" solution results in large volumes of fast moving, contaminated water being discharged through small channels or pipes into the nearest receiving waters (streams, lakes, or oceans).

"At the source" design strives to allow stormwater to remain onsite by infiltrating permeable surfaces. By treating rain water as a resource and allowing it to infiltrate the soil, it greatly reduces the volume, flow and toxicity of any remaining water that does enter the "end of pipe" system.

CONVEYANCE VS INFILTRATION STRATEGIES

The conveyance approach to stormwater management seeks to "get rid of the water." This system collects and concentrates runoff through a network of impervious gutters, structures, and underground pipes. A conveyance system must be continually increased in size as it reaches its final outfall because of the constant addition of tributary stormdrain systems. Because of its impervious nature, the pollutants in the water it contains become more concentrated. When it reaches its outfall, large volumes of highly polluted water are emptied, untreated into natural water bodies.

The infiltration approach to stormwater management seeks to emulate and preserve the natural hydrologic cycle. This system seeks to move stormwater slowly over large permeable surfaces to allow it to percolate into the ground. These permeable surfaces can double as recreational areas during dry weather. Because these systems allow stormwater to infiltrate the soil, overall runoff volumes are reduced and groundwater supplies are more quickly replenished. The slow, natural infiltration process enables the soil to naturally mitigate many of the pollutants found in stormwater. In addition, as it takes longer for water to enter and make its way through the traditional stormdrain system, it reduces the speed, volume and pollutant load of the remaining water when it reaches the outfall.

THINK SMALL—80% OF RUNOFF COMES FROM SMALL STORMS OF .5" TO 1.25" OF RAIN

Our current stormdrain systems are sized to accommodate the flows from the largest storm cycles. However, 80% of runoff is generated from storms producing only .5" to 1.25" of rain. Infiltration based stormwater systems are ideal for these smaller, more frequent events. Infiltration systems can incorporate overflow design components that direct the flows from the infrequent, larger storm events to the current "end of pipe" system.

SITE DESIGN CONSIDERATIONS

In order to maximize the effectiveness of infiltration type stormwater systems, and to minimize the runoff of rain water, the following site design considerations must be kept in mind.

A. DEFINE DEVELOPMENT ENVELOPE & PROTECTED AREAS — Protect existing site features (trees, creeks, and slopes), keep development compact to minimize environmental impact and reduce costs, and retain desirable landscape features.

B. MINIMIZE DIRECTLY CONNECTED IMPERVIOUS AREAS — Avoid the design of impermeable areas that are directly linked to the stormdrain system. Design impermeable areas to drain to permeable soil, shallow retention basins, or soil depressions that can hold the first 1/3" to 1" of rain.

C. MAXIMIZE PERMEABILITY — Maximize the use of landscaped areas or permeable surfacing materials.

D. MAXIMIZE CHOICES FOR MOBILITY — Incorporate design elements that encourage pedestrian use and support existing mass transit options.

E. USE DRAINAGE AS A DESIGN ELEMENT — Design for the use of water as a site amenity. Properly designed retention or wet ponds can be used as a component of the drainage system while creating a valuable and sought after development amenity.

Stormwater Impact and Regulatory Requirements

The runoff caused by storms is the single largest source of non-point water pollution in the US. Past pollution prevention educational efforts have focused on businesses and the public. While these activities remain important, a new area of stormwater pollution prevention is emerging: designing new developments to allow for the retention and infiltration of stormwater runoff.

The Los Angeles Regional Water Quality Control Board recently passed the Standard Urban Stormwater Management Program (SUSMP) regulation which requires all new developments built in the Los Angeles area to be designed to retain on site the first 3/4" of rain that falls in a 24-hour period.

Through the implementation of some new design approaches and the use, where possible, of permeable paving materials, the quantity of stormwater runoff and its resulting quality can be improved. And the new SUSMP regulations can be met.

Viewing rain water as a resource to be captured and conserved rather than a nuisance to be channeled off site, may require a fundamental change in our thought processes. However, the resulting savings in immediate and long term costs plus the environmental benefit to the Southern California coastal areas is worth the effort.

Information Resources

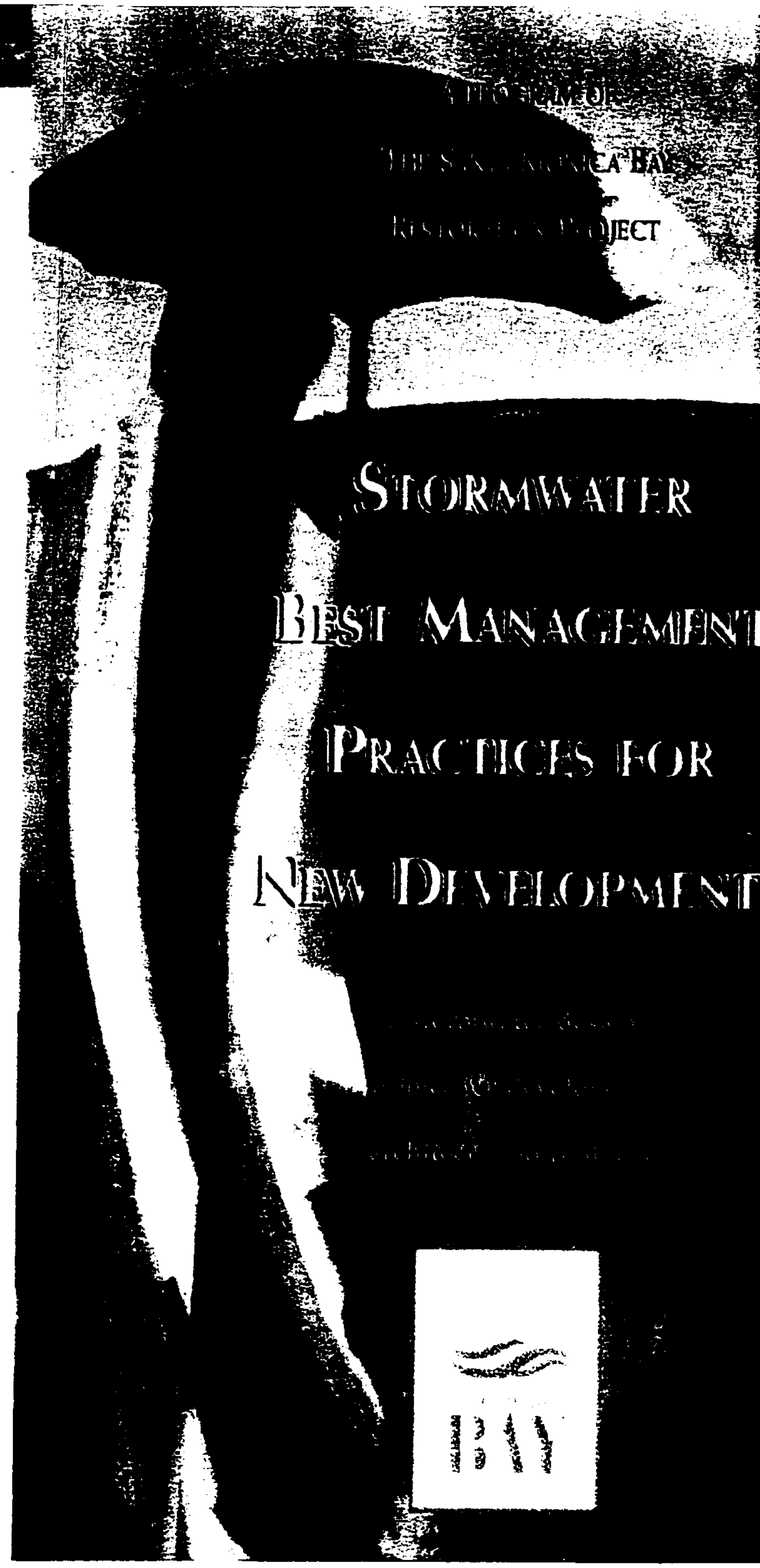
The Santa Monica Bay Restoration Project
(213) 576-6615 / www.smbay.org

Los Angeles Regional Water Quality Control Board
(213) 576-6600 / www.swrcb.ca.gov/rwqcb4

City of Los Angeles Stormwater Program
(800) 974-9794 / www.cityofla.org/SAN/swmd

County of Los Angeles Stormwater Program
(888) CLEANLA / dpw.ca.la.ca.us/epd/#stormwater

Illustrations Courtesy of "Start at the Source"
Bay Area Stormwater Management Agencies Association



Stormwater Design
Best Management Practices for Residential, Commercial, and Industrial Developments

A

[illegible]
to[illegible] stormwater while [illegible] load-bearing surface. While maintaining a surface suitable for walking and driving, permeable pavements contain sufficient void space to allow water to infiltrate into the underlying soil.

Types of Permeable Pavement:

1. Pervious asphalt and concrete.
2. Unit pavers on sand.
3. Granular materials such as gravel, cobbles, and wood mulch.

B

[illegible] impact on stormwater quality. As currently designed most streets are directly connected to an underground conveyance system.

Stormwater quality is improved through the following design options:

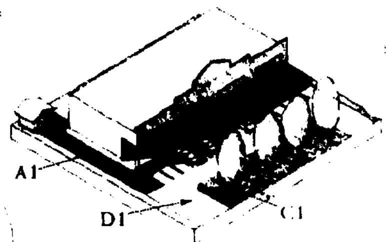
1. Reduced street width.
2. Limited on-street parking.
3. Reduced sidewalk width and placement.
4. Landscaped parkways.
5. Swale drainage systems.
6. Concave medians.
7. Cul-de-sac planting.

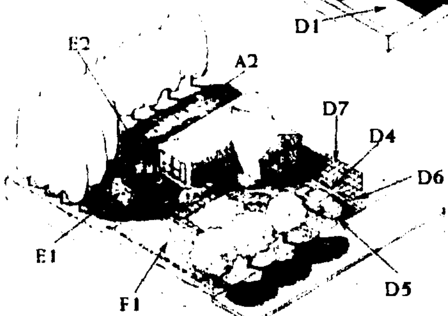
C

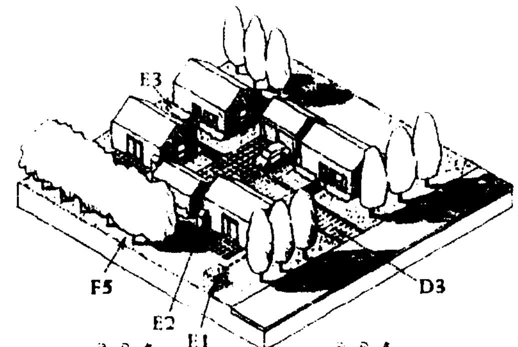
[illegible] (1[illegible]=1 acre). All this paved area has an adverse impact on stormwater.

Ideas to help reduce this stormwater impact include:

1. Hybrid parking lots.
2. Parking groves.
3. Permeable pavement overflow parking.







D

[illegible]

2. [illegible]
3. Unit pavers on sand.
4. Turf block driveways.
5. Paving under wheels only.
6. Flared driveway aprons for 2 or 3 car garages.
7. Temporary RV parking on turf block.

E

[illegible] that can be incorporated into a variety of developments, effectively allow for the retention and infiltration of stormwater.

1. Dry-well.
2. Cistern.
3. Foundation planting.

F

[illegible] infiltration of stormwater [illegible] underlying soils.

1. Concave lawn areas.
2. Vegetated swales.
3. Dry ponds.
4. Wet ponds.
5. Plant selection to maximize infiltration.

G

Manufactured Treatment Devic

Where stormwater cannot be treated by on-site infiltration, devices should be used to clean or filter stormwater before it reaches the existing underground conveyance system.

1. Catch basin or inlet inserts/filters.
2. Oil/Water Separators.
3. Media Filters.

BMPs Design Details Matrix

The matrix summarizes their initial construction cost, maintenance cost, relative effectiveness at meeting stormwater quality goals, and their suitability for use on expansive, clay soils. Conventional approaches are also evaluated for comparison.

[illegible]

R0020602

STANDARD URBAN STORM WATER MITIGATION PLAN

FOR LOS ANGELES COUNTY AND CITIES IN LOS ANGELES COUNTY

Final
Approved – Regional Board Executive Officer
March 8, 2000.

R0020603

STANDARD URBAN STORM WATER MITIGATION PLAN

BACKGROUND

The municipal storm water National Pollutant Discharge Elimination System (NPDES) permit (Los Angeles County Permit) issued to Los Angeles County and 85 cities (Permittees) by the Los Angeles Regional Water Quality Control Board (Regional Board) on July 15, 1996, requires the development and implementation of a program addressing storm water pollution issues in development planning for private projects. The same requirements are applicable to the City of Long Beach under its separate municipal storm water permit (City of Long Beach MS4 Permit), which was issued on June 30, 1999.

The requirement to implement a program for development planning is based on, federal and state statutes including: Section 402 (p) of the Clean Water Act, Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 ("CZARA"), and the California Water Code. The Clean Water Act amendments of 1987 established a framework for regulating storm water discharges from municipal, industrial, and construction activities under the NPDES program. The primary objectives of the municipal storm water program requirements are to:

1. Effectively prohibit non-storm water discharges, and
2. Reduce the discharge of pollutants from storm water conveyance systems to the Maximum Extent Practicable (MEP statutory standard).

The Standard Urban Storm Water Mitigation Plan (SUSMP) was developed as part of the municipal storm water program to address storm water pollution from new Development and Redevelopment by the private sector. This SUSMP contains a list of the minimum required Best Management Practices (BMPs) that must be used for a designated project. Additional BMPs may be required by ordinance or code adopted by the Permittee and applied generally or on a case by case basis. The Permittees are required to adopt the requirements set herein in their own SUSMP. Developers must incorporate appropriate SUSMP requirements into their project plans. Each Permittee will approve the project plan as part of the development plan approval process and prior to issuing building and grading permits for the projects covered by the SUSMP requirements.

All projects that fall into one of seven categories are identified in the Los Angeles County MS4 Permit as requiring SUSMPs. These categories are:

- Single-Family Hillside Residences
- 100,000 Square Foot Commercial Developments
- Automotive Repair Shops
- Retail Gasoline Outlets
- Restaurants
- Home Subdivisions with 10 to 99 housing units
- Home Subdivisions with 100 or more housing units

The Regional Board Executive Officer has designated two additional categories subject to SUSMP requirements for the Los Angeles County MS4 Permit. These categories are:

- Location within or directly adjacent to or discharging directly to an environmentally sensitive area, and
- Parking lots 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to storm water runoff

The City of Long Beach permit requires SUSMP for the following categories only: (i) 10-99 home subdivisions; (ii) 100 or more subdivisions; (iii) 100,000 or more square foot commercial developments; and (iv) Projects located adjacent to or discharging to environmentally sensitive areas. For the remaining five categories, equivalent requirements have been included directly in or are expected to be developed shortly under the City of Long Beach Storm Water Management Plan.

Permittees shall amend codes and promulgate ordinances not later than September 8, 2000, to give legal effect to the SUSMP requirements. The SUSMP requirements for projects identified herein shall take effect not later than October 8, 2000.

DEFINITIONS

"100,000 Square Foot Commercial Development" means any commercial development that creates at least 100,000 square feet of impermeable area, including parking areas."Automotive Repair Shop" means a facility that is categorized in any one of the following Standard Industrial Classification (SIC) codes: 5013, 5014, 5541, 7532-7534, or 7536-7539.

"Best Management Practice (BMP)" means any program, technology, process, siting criteria, operational methods or measures, or engineered systems, which when implemented prevent, control, remove, or reduce pollution.

"Commercial Development" means any development on private land that is not heavy industrial or residential. The category includes, but is not limited to: hospitals, laboratories and other medical facilities, educational institutions, recreational facilities, plant nurseries, multi-apartment buildings, car wash facilities, mini-malls and other business complexes, shopping malls, hotels, office buildings, public warehouses and other light industrial complexes.

"Directly Connected Impervious Area (DCIA)" means the area covered by a building, impermeable pavement, and/ or other impervious surfaces, which drains directly into the storm drain without first flowing across permeable land area (e.g. lawns).

"Discretionary Project" means a project which requires the exercise of judgement or deliberation when the public agency or public body decides to approve or disapprove a particular activity, as distinguished from situations where the public agency or body merely has to determine whether there has been conformity with applicable statutes, ordinances, or regulations.

"Environmentally Sensitive Area" means an area designated as an Area of Special Biological Significance by the State Water Resources Control Board (*Water Quality Control Plan, Los Angeles Region: Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (1994) and amendments) or an area designated as an Area of Ecological Significance by the County of Los *Angeles (Los Angeles County Significant Areas Study, Los Angeles County Department of Regional Planning (1976)* and amendments) or an area designated as a significant natural area by the California Resources Agency. Refer to Table 3 for a listing.

"Greater than (>) 9 unit home subdivision" means any subdivision being developed for 10 or more 10 single-family or multi-family dwelling units.

"Hillside" means property located in an area with known erosive soil conditions, where the development contemplates grading on any natural slope that is twenty-five percent or greater.

"Infiltration" means the downward entry of water into the surface of the soil.

"New Development" means land disturbing activities; structural development, including construction or installation of a building or structure, creation of impervious surfaces; and land subdivision.

"Parking Lot" means land area or facility for the temporary parking or storage of motor vehicles used personally, for business or for commerce with a lot size of 5,000 square feet or more, or with 25 or more parking spaces.

"Redevelopment" means, on an already developed site, the creation or addition of at least 5,000 square feet of impervious surfaces or the creation or addition of fifty percent or more of impervious surfaces or the making of improvements to fifty percent or more of the existing structure. Redevelopment includes, but is not limited to: the expansion of a building footprint or addition or replacement of a structure; structural development including an increase in gross floor area and/ or exterior construction or remodeling; replacement of impervious surface that is not part of a routine maintenance activity; and land disturbing activities related with structural or impervious surfaces.

"Restaurant" means a stand-alone facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption. (SIC code 5812).

"Retail Gasoline Outlet" means any facility engaged in selling gasoline and lubricating oils.

"Source Control BMP" means any schedules of activities, prohibitions of practices, maintenance procedures, managerial practices or operational practices that aim to prevent storm water pollution by reducing the potential for contamination at the source of pollution.

"Storm Event" means a rainfall event that produces more than 0.1 inch of precipitation and that, which is separated from the previous storm event by at least 72 hours of dry weather.

"Structural BMP" means any structural facility designed and constructed to mitigate the adverse impacts of storm water and urban runoff pollution (e.g. canopy, structural enclosure). The category may include both Treatment Control BMPs and Source Control BMPs.

"Treatment" means the application of engineered systems that use physical, chemical, or biological processes to remove pollutants. Such processes include, but are not limited to, filtration, gravity settling, media adsorption, biodegradation, biological uptake, chemical oxidation and UV radiation.

"Treatment Control BMP" means any engineered system designed to remove pollutants by simple gravity settling of particulate pollutants, filtration, biological uptake, media adsorption or any other physical, biological, or chemical process.

CONFLICTS WITH LOCAL PRACTICES

Where provisions of the SUSMP requirements conflict with established local codes, (e.g., specific language of signage used on storm drain stenciling), the Permittee may continue the local practice and modify the SUSMP to be consistent with the code, except that to the extent that the standards in the SUSMP are more stringent than those under local codes, such more stringent standards shall apply.

SUSMP PROVISIONS APPLICABLE TO ALL CATEGORIES

REQUIREMENTS

1. PEAK STORM WATER RUNOFF DISCHARGE RATES

Post-development peak storm water runoff discharge rates shall not exceed the estimated pre-development rate for developments where the increased peak storm water discharge rate will result in increased potential for downstream erosion.

2. CONSERVE NATURAL AREAS

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Concentrate or cluster Development on portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

3. MINIMIZE STORM WATER POLLUTANTS OF CONCERN

Storm water runoff from a site has the potential to contribute oil and grease, suspended solids, metals, gasoline, pesticides, and pathogens to the storm water conveyance system. The development must be designed so as to minimize, to the maximum extent practicable, the introduction of pollutants of concern that may result in significant impacts, generated from site runoff of directly connected impervious areas (DCIA), to the storm water conveyance system as approved by the building official. Pollutants of concern, consist of any pollutants that exhibit one or more of the following characteristics: current loadings or historic deposits of the pollutant are impacting the beneficial uses of a receiving water, elevated levels of the pollutant are found in sediments of a receiving water and/or have the potential to bioaccumulate in organisms therein, or the detectable inputs of the pollutant are at a concentrations or loads considered potentially toxic to humans and/or flora and fauna.

In meeting this specific requirement, "minimization of the pollutants of concern" will require the incorporation of a BMP or combination of BMPs best suited to maximize the reduction of pollutant loadings in that runoff to the Maximum Extent Practicable. Those BMPs best suited for that purpose are those listed in the *California Storm Water Best Management Practices Handbooks*; *Caltrans Storm Water Quality Handbook: Planning and Design Staff Guide*; *Manual for Storm Water Management in Washington State*;

The Maryland Stormwater Design Manual; *Florida Development Manual: A Guide to Sound Land and Water Management*; Denver *Urban Storm Drainage Criteria Manual, Volume 3 – Best Management Practices* and *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* , USEPA Report No. EPA-840-B-92-002, as "likely to have significant impact" beneficial to water quality for targeted pollutants that are of concern at the site in question. However, it is possible that a combination of BMPs not so designated, may in a particular circumstance, be better suited to maximize the reduction of the pollutants.

Examples of BMPs that can be used for minimizing the introduction of pollutants of concern generated from site runoff are identified in Table 2. Any BMP not specifically approved by the Regional Board in Resolution No. 99-03, "Approving Best Management Practices for Municipal Storm Water and Urban Runoff Programs in Los Angeles County", for development planning may be used if they have been recommended in one of the above references.

4. PROTECT SLOPES AND CHANNELS

Project plans must include BMPs consistent with local codes and ordinances and the SUSMP to decrease the potential of slopes and/or channels from eroding and impacting storm water runoff:

- Convey runoff safely from the tops of slopes and stabilize disturbed slopes.
- Utilize natural drainage systems to the maximum extent practicable
- Control or reduce or eliminate flow to natural drainage systems to the maximum extent practicable
- Stabilize permanent channel crossings.
- Vegetate slopes with native or drought tolerant vegetation.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion, with the approval of all agencies with jurisdiction, e.g., the U.S. Army Corps of Engineers and the California Department of Fish and Game

5. PROVIDE STORM DRAIN SYSTEM STENCILING AND SIGNAGE

Storm drain stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets. The stencil contains a brief statement that prohibits the dumping of improper materials into the storm water conveyance system. Graphical icons, either illustrating anti-dumping symbols or images of receiving water fauna, are effective supplements to the anti-dumping message.

- All storm drain inlets and catch basins within the project area must be stenciled with prohibitive language (such as: "NO DUMPING – DRAINS TO OCEAN") and/or graphical icons to discourage illegal dumping.

- Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping, must be posted at public access points along channels and creeks within the project area.
- Legibility of stencils and signs must be maintained.

6. PROPERLY DESIGN OUTDOOR MATERIAL STORAGE AREAS

Outdoor material storage areas refer to storage areas or storage facilities solely for the storage of materials. Improper storage of materials outdoors may provide an opportunity for toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to enter the storm water conveyance system. Where proposed project plans include outdoor areas for storage of materials that may contribute pollutants to the storm water conveyance system, the following Structural or Treatment BMPs are required:

- Materials with the potential to contaminate storm water must be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.
- The storage area must be paved and sufficiently impervious to contain leaks and spills.
- The storage area must have a roof or awning to minimize collection of storm water within the secondary containment area.

7. PROPERLY DESIGN TRASH STORAGE AREAS

A trash storage area refers to an area where a trash receptacle or receptacles are located for use as a repository for solid wastes.

Loose trash and debris can be easily transported by the forces of water or wind into nearby storm drain inlets, channels, and/or creeks. All trash container areas must meet the following Structural or Treatment Control BMP requirements (individual single family residences are exempt from these requirements):

- Trash container areas must have drainage from adjoining roofs and pavement diverted around the area(s).

- Trash container areas must be screened or walled to prevent off-site transport of trash.

8. PROVIDE PROOF OF ONGOING BMP MAINTENANCE

Improper maintenance is one of the most common reasons why water quality controls will not function as designed or which may cause the system to fail entirely. It is important to consider who will be responsible for maintenance of a permanent BMP, and what equipment is required to perform the maintenance properly. As part of project review, if a project applicant has included or is required to include, Structural or Treatment Control BMPs in project plans, the Permittee shall require that the applicant provide verification of maintenance provisions through such means as may be appropriate, including, but not limited to legal agreements, covenants, CEQA mitigation requirements and/or Conditional Use Permits.

For all properties, the verification will include the developer's signed statement, as part of the project application, accepting responsibility for all structural and treatment control BMP maintenance until the time the property is transferred and, where applicable, a signed agreement from the public entity assuming responsibility for Structural or Treatment Control BMP maintenance. The transfer of property to a private or public owner must have conditions requiring the recipient to assume responsibility for maintenance of any Structural or Treatment Control BMP to be included in the sales or lease agreement for that property, and will be the owner's responsibility. The condition of transfer shall include a provision that the property owners conduct maintenance inspection of all Structural or Treatment Control BMPs at least once a year and retain proof of inspection. For residential properties where the Structural or Treatment Control BMPs are located within a common area which will be maintained by a homeowner's association, language regarding the responsibility for maintenance must be included in the projects conditions, covenants and restrictions (CC&Rs). Printed educational materials will be required to accompany the first deed transfer to highlight the existence of the requirement and to provide information on what storm water management facilities are present, signs that maintenance is needed, how the necessary maintenance can be performed, and assistance that the Permittee can provide. The transfer of this information shall also be required with any subsequent sale of the property.

If Structural or Treatment Control BMPs are located within a public area proposed for transfer, they will be the responsibility of the developer until they are accepted for transfer by the County or other appropriate public agency. Structural or Treatment Control BMPs proposed for transfer must meet design standards adopted by the public entity for the BMP installed and should be approved by the County or other appropriate public agency prior to its installation.

9. DESIGN STANDARDS FOR STRUCTURAL OR TREATMENT CONTROL BMPs

Structural or Treatment control BMPs selected for use at any project covered by this

SUSMP shall meet the design standards of this Section unless specifically exempted.

Post-construction Structural or Treatment Control BMPs shall be designed to:

A. mitigate (infiltrate or treat) storm water runoff from either:

1. the 85th percentile 24-hour runoff event determined as the maximized capture storm water volume for the area, from the formula recommended in *Urban Runoff Quality Management, WEF Manual of Practice No. 23/ ASCE Manual of Practice No. 87, (1998)*, or

2. the volume of annual runoff based on unit basin storage water quality volume, to achieve 80 percent or more volume treatment by the method recommended in *California Stormwater Best Management Practices Handbook – Industrial/ Commercial*, (1993), or

3. the volume of runoff produced from a 0.75 inch storm event, prior to its discharge to a storm water conveyance system, or

4. the volume of runoff produced from a historical-record based reference 24-hour rainfall criterion for "treatment" (0.75 inch average for the Los Angeles County area) that achieves approximately the same reduction in pollutant loads achieved by the 85th percentile 24-hour runoff event,

AND

B. control peak flow discharge to provide stream channel and over bank flood protection, based on flow design criteria selected by the local agency.

Limited Exclusion

Restaurants, where the land area for development or redevelopment is less than 5,000 square feet, are excluded from the numerical Structural or Treatment Control BMP design standard requirement only.

10. PROVISIONS APPLICABLE TO INDIVIDUAL PRIORITY PROJECT CATEGORIES

REQUIREMENTS

A. 100,000 SQUARE FOOT COMMERCIAL DEVELOPMENTS

1. PROPERLY DESIGN LOADING/UNLOADING DOCK AREAS

Loading/unloading dock areas have the potential for material spills to be quickly transported to the storm water conveyance system. To minimize this potential, the following design criteria are required:

- Cover loading dock areas or design drainage to minimize run-on and runoff of storm water.
- Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.

2. PROPERLY DESIGN REPAIR/MAINTENANCE BAYS

Oil and grease, solvents, car battery acid, coolant and gasoline from the repair/maintenance bays can negatively impact storm water if allowed to come into contact with storm water runoff. Therefore, design plans for repair bays must include the following:

- Repair/maintenance bays must be indoors or designed in such a way that doesn't allow storm water runon or contact with storm water runoff.
- Design a repair/maintenance bay drainage system to capture all washwater, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.

3. PROPERLY DESIGN VEHICLE/EQUIPMENT WASH AREAS

The activity of vehicle/equipment washing/steam cleaning has the potential to contribute metals, oil and grease, solvents, phosphates, and suspended solids to the storm water conveyance system. Include in the project plans an area for washing/steam cleaning of vehicles and equipment. The area in the site design must be:

- Self-contained and/ or covered, equipped with a clarifier, or other pretreatment facility, and properly connected to a sanitary sewer.

B. RESTAURANTS

1. PROPERLY DESIGN EQUIPMENT/ACCESSORY WASH AREAS

The activity of outdoor equipment/accessory washing/steam cleaning has the potential to contribute metals, oil and grease, solvents, phosphates, and suspended solids to the storm water conveyance system. Include in the project plans an area for the washing/steam cleaning of equipment and accessories. This area must be:

- Self-contained, equipped with a grease trap, and properly connected to a sanitary sewer.
- If the wash area is to be located outdoors, it must be covered, paved, have secondary containment, and be connected to the sanitary sewer.

C. RETAIL GASOLINE OUTLETS

1. PROPERLY DESIGN FUELING AREA

Fueling areas have the potential to contribute oil and grease, solvents, car battery acid, coolant and gasoline to the storm water conveyance system. The project plans must include the following BMPs:

- The fuel dispensing area must be covered with an overhanging roof structure or canopy. The canopy's minimum dimensions must be equal to or greater than the area within the grade break. The canopy must not drain onto the fuel dispensing area, and the canopy downspouts must be routed to prevent drainage across the fueling area.
- The fuel dispensing area must be paved with Portland cement concrete (or equivalent smooth impervious surface), and the use of asphalt concrete shall be prohibited.
- The fuel dispensing area must have a 2% to 4% slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of storm water to the extent practicable.
- At a minimum, the concrete fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.

D. AUTOMOTIVE REPAIR SHOPS

1. PROPERLY DESIGN FUELING AREA

Fueling areas have the potential to contribute oil and grease, solvents, car battery acid, coolant and gasoline to the storm water conveyance system. Therefore, design plans, which include fueling areas, must contain the following:

- The fuel dispensing area should be covered with an overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area.
- The fuel dispensing areas must be paved with Portland cement concrete (or equivalent smooth impervious surface), and the use of asphalt concrete shall be prohibited.
- The fuel dispensing area must have a 2% to 4% slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of storm water.
- At a minimum, the concrete fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.

2. PROPERLY DESIGN REPAIR/MAINTENANCE BAYS

Oil and grease, solvents, car battery acid, coolant and gasoline from the repair/maintenance bays can negatively impact storm water if allowed to come into contact with storm water runoff. Therefore, design plans for repair bays must include the following:

- Repair/maintenance bays must be indoors or designed in such a way that doesn't allow storm water run-on or contact with storm water runoff.
- Design a repair/maintenance bay drainage system to capture all wash-water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.

3. PROPERLY DESIGN VEHICLE/EQUIPMENT WASH AREAS

The activity of vehicle/equipment washing/steam cleaning has the potential to contribute metals, oil and grease, solvents, phosphates, and suspended solids to the storm water conveyance system. Include in the project plans an area for washing/steam cleaning of vehicles and equipment. This area must be:

- Self-contained and/or covered, equipped with a clarifier, or other pretreatment facility, and properly connected to a sanitary sewer or to a permitted disposal facility.

4. PROPERLY DESIGN LOADING/UNLOADING DOCK AREAS

Loading/unloading dock areas have the potential for material spills to be quickly transported to the storm water conveyance system. To minimize this potential, the following design criteria are required:

- Cover loading dock areas or design drainage to minimize run-on and runoff of storm water.
- Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.

E. <u>PARKING LOTS</u>

1. PROPERLY DESIGN PARKING AREA

Parking lots contain pollutants such as heavy metals, oil and grease, and polycyclic aromatic hydrocarbons that are deposited on parking lot surfaces by motor-vehicles. These pollutants are directly transported to surface waters. To minimize the offsite transport of pollutants, the following design criteria are required:

- Reduce impervious land coverage of parking areas
- Infiltrate runoff before it reaches storm drain system.
- Treat runoff before it reaches storm drain system

2. PROPERLY DESIGN TO LIMIT OIL CONTAMINATION AND PERFORM MAINTENANCE

Parking lots may accumulate oil, grease, and water insoluble hydrocarbons from vehicle drippings and engine system leaks.

- Treat to remove oil and petroleum hydrocarbons at parking lots that are heavily used (e.g. fast food outlets, lots with 25 or more parking spaces , sports event parking lots, shopping malls, grocery stores, discount warehouse stores)
- Ensure adequate operation and maintenance of treatment systems particularly sludge and oil removal, and system fouling and plugging prevention control

11. WAIVER

A Permittee may, through adoption of an ordinance or code incorporating the treatment requirements of the SUSMP, provide for a waiver from the requirement if impracticability for a specific property can be established. A waiver of impracticability shall be granted only when all other Structural or Treatment Control BMPs have been considered and rejected as infeasible. Recognized situations of impracticability include, (i) extreme limitations of space for treatment on a redevelopment project, (ii) unfavorable or unstable soil conditions at a site to attempt infiltration, and (iii) risk of ground water contamination because a known unconfined aquifer lies beneath the land surface or an existing or potential underground source of drinking water is less than 10 feet from the soil surface. Any other justification for impracticability must be separately petitioned by the Permittee and submitted to the Regional Board for consideration. The Regional Board may consider approval of the waiver justification or may delegate the authority to approve a class of waiver justifications to the Regional Board Executive Officer. The supplementary waiver justification becomes recognized and effective only after approval by the Regional Board or the Regional Board Executive Officer. A waiver granted by a Permittee to any development or redevelopment project may be revoked by the Regional Board Executive Officer for cause and with proper notice upon petition.

If a waiver is granted for impracticability, the Permittee must require the project proponent to transfer the savings in cost, as determined by the Permittee, to a storm water mitigation fund to be used to promote regional or alternative solutions for storm water pollution in the storm watershed and operated by a public agency or a non-profit entity.

12. LIMITATION ON USE OF INFILTRATION BMPs

Three factors significantly influence the potential for storm water to contaminate ground water. They are (i) pollutant mobility, (ii) pollutant abundance in storm water, (iii) and soluble fraction of pollutant. The risk of contamination of groundwater may be reduced by pretreatment of storm water. A discussion of limitations and guidance for infiltration practices is contained in, *Potential Groundwater Contamination from Intentional and Non-Intentional Stormwater Infiltration, Report No. EPA/600/R-94/051, USEPA (1994).*

In addition, the distance of the groundwater table from the infiltration BMP may also be a factor determining the risk of contamination. A water table distance separation of ten feet depth in California presumptively poses negligible risk for storm water not associated with industrial activity or high vehicular traffic.

Infiltration BMPs are not recommended for areas of industrial activity or areas subject to high vehicular traffic (25,000 or greater average daily traffic (ADT) on main roadway or 15,000 or more ADT on any intersecting roadway) unless appropriate pretreatment is provided to ensure groundwater is protected and the infiltration BMP is not rendered ineffective by overload.

13. ALTERNATIVE CERTIFICATION FOR STORM WATER TREATMENT MITIGATION

In lieu of conducting detailed BMP review to verify Structural or Treatment Control BMPs adequacy, a Permittee may elect to accept a signed certification from a Civil Engineer or a Licensed Architect registered in the State of California, that the plan meets the criteria established herein. The Permittee is encouraged to verify that certifying person(s) have been trained on BMP design for water quality, not more than two years prior to the signature date. Training conducted by an organization with storm water BMP design expertise (e.g., a University, American Society of Civil Engineers, American Society of Landscape Architects, American Public Works Association, or the California Water Environment Association) may be considered qualifying.

14. RESOURCES AND REFERENCE

TABLE 1

SUGGESTED RESOURCES	HOW TO GET A COPY

Start at the Source (1999) by Bay Area Stormwater Management Agencies Association Detailed discussion of permeable pavements and alternative driveway designs presented.	Bay Area Stormwater Management Agencies Association 2101 Webster Street Suite 500 Oakland, CA 510-286-1255
Design of Stormwater Filtering Systems (1996) by Richard A. Claytor and Thomas R. Schuler Presents detailed engineering guidance on ten different storm water-filtering systems.	Center for Watershed Protection 8391 Main Street Ellicott City, MD 21043 410-461-8323
Better Site Design: A Handbook for Changing Development Rules in Your Community (1998) Presents guidance for different model development alternatives.	Center for Watershed Protection 8391 Main Street Ellicott City, MD 21043 410-461-8323
Design Manual for Use of Bioretention in Stormwater Management (1993) Presents guidance for designing bioretention facilities.	Prince George's County Watershed Protection Branch 9400 Peppercorn Place, Suite 600 Landover, MD 20785
Operation, Maintenance and Management of Stormwater Management (1997) Provides a thorough look at stormwater practices including, planning and design considerations, programmatic and regulatory aspects, maintenance considerations, and costs.	Watershed Management Institute, Inc. 410 White Oak Drive Crawfordville, FL 32327 850-926-5310
California Storm Water Best Management Practices Handbooks (1993) for Construction Activity, Municipal, and Industrial/Commercial Presents a description of a large variety of Structural BMPs, Treatment Control, BMPs and Source Control BMPs	Los Angeles County Department of Public Works Cashiers Office 900 S. Fremont Avenue Alhambra, CA 91803 626-458-6959

TABLE 1 (Continued)

SUGGESTED RESOURCES	HOW TO GET A COPY

Second Nature: Adapting LA's Landscape for Sustainable Living (1999) by Tree People Detailed discussion of BMP designs presented to conserve water, improve water quality, and achieve flood protection.	Tree People 12601 Mullholland Drive Beverly Hills, CA 90210 818-753-4600 (?)
Florida Development Manual: A Guide to Sound Land and Water Management (1988) Presents detailed guidance for designing BMPs	Florida Department of the Environment 2600 Blairstone Road, Mail Station 3570 Tallahassee, FL 32399 850-921-9472
Stormwater Management in Washington State (1999) Vols. 1-5 Presents detailed guidance on BMP design for new development and construction.	Department of Printing State of Washington Department of Ecology P.O. Box 798 Olympia, WA 98507-0798 360-407-7529
Maryland Stormwater Design Manual (1999) Presents guidance for designing storm water BMPs	Maryland Department of the Environment 2500 Broening Highway Baltimore, MD 21224 410-631-3000
Texas Nonpoint Source Book – Online Module (1998)www.txnpsbook.org Presents BMP design and guidance information on-line	Texas Statewide Storm Water Quality Task Force North Central Texas Council of Governments 616 Six Flags Drive Arlington, TX 76005 817-695-9150
Urban Storm Drainage, Criteria Manual – Volume 3, Best Management Practices (1999) Presents guidance for designing BMPs	Urban Drainage and Flood Control District 2480 West 26th Avenue, Suite 156-B Denver, CO 80211 303-455-6277
Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (1993) Report No. EPA–840-B-92-002. Provides an overview of, planning and design considerations, programmatic and regulatory aspects, maintenance considerations, and costs.	National Technical Information Service U.S. Department of Commerce Springfield, VA 22161 800-553-6847
National Stormwater Best Management Practices (BMP) Database, Version 1.0 Provides data on performance and evaluation of storm water BMPs	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191 703-296-6000

SUGGESTED RESOURCES	HOW TO GET A COPY
Caltrans Storm Water Quality Handbook: Planning and Design Staff Guide (Best Management Practices Handbooks (1998) Presents guidance for design of storm water BMPs	California Department of Transportation P.O. Box 942874 Sacramento, CA 94274-0001 916-653-2975

TABLE 2

EXAMPLE BEST MANAGEMENT PRACTICES (BMPs)

The following are examples of BMPs that can be used for minimizing the introduction of pollutants of concern that may result in significant impacts, generated from site runoff to the storm water conveyance system. (See Table 1: Suggested Resources for additional sources of information):

- Provide reduced width sidewalks and incorporate landscaped buffer areas between sidewalks and streets. However, sidewalk widths must still comply with regulations for the Americans with Disabilities Act and other life safety requirements.
- Design residential streets for the minimum required pavement widths needed to comply with all zoning and applicable ordinances to support travel lanes; on-street parking; emergency, maintenance, and service vehicle access; sidewalks; and vegetated open channels.
- Comply with all zoning and applicable ordinances to minimize the number of residential street cul-de-sacs and incorporate landscaped areas to reduce their impervious cover. The radius of cul-de-sacs should be the minimum required to accommodate emergency and maintenance vehicles. Alternative turnarounds should be considered.
- Use permeable materials for private sidewalks, driveways, parking lots, or interior roadway surfaces (examples: hybrid lots, parking groves, permeable overflow parking, etc.).
- Use open space development that incorporates smaller lot sizes.
- Reduce building density.
- Comply with all zoning and applicable ordinances to reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.
- Comply with all zoning and applicable ordinances to reduce the overall imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in spillover parking areas.
- Direct rooftop runoff to pervious areas such as yards, open channels, or vegetated areas, and avoid routing rooftop runoff to the roadway or the storm water conveyance system.
- Vegetated swales and strips
- Extended/dry detention basins
- Infiltration basin
- Infiltration trenches
- Wet ponds
- Constructed wetlands
- Oil/Water separators
- Catch basin inserts
- Continuous flow deflection/ separation systems
- Storm drain inserts
- Media filtration
- Bioretention facility
- Dry-wells
- Cisterns
- Foundation planting
- Catch basin screens
- Normal flow storage/ separation systems
- Clarifiers
- Filtration systems
- Primary waste water treatment systems

TABLE 3

HABITAT PROTECTION IN THE LOS ANGELES COUNTY AREA

Agency:
State Water Resources Control Board

Designation:
Areas of Significant Biological Significance (ASBS)

Definition:
Areas designated by the State Water Resources Control Board as requiring protection of species or biological communities to the extent that alteration of natural water quality is undesirable.

Affected Area:
(See Table 1 & Figure 2)

Agency:
Los Angeles County Department of Regional Planning

Designation:
Significant Ecological Areas (SEA)

Definitions:
Significant Ecological Areas (SEAs) are areas that have been identified by the Los Angeles County General Plan as containing unique or unusual species assemblages, or areas of habitat that are rapidly declining in the Los Angeles County. The SEAs were established to protect a special or sometimes unique collection of habitats and species from loss due to encroachment and human disturbances. However, SEAs are not intended to function as isolated preservation areas.

Affected Areas:
(See Table A & Figure 1)

Agency:
California Department of Fish & Game

Designation:
Natural Communities Conservation Plan Region (NCCP)

Definition:
Identifies and provides for the regional or area wide protection and perpetuation of natural wildlife diversity, while allowing compatible and appropriate development and growth. The goal of the program is to protect sufficient resources in regional preserves to assure the survival of the ecosystem and, at the same time, permit compatible uses of less sensitive land.

Affected Area:
(See Table 1 & Figure 3)

TABLE 3 A

HABITAT PROTECTION IN LOS ANGELES COUNTY AREA[1]

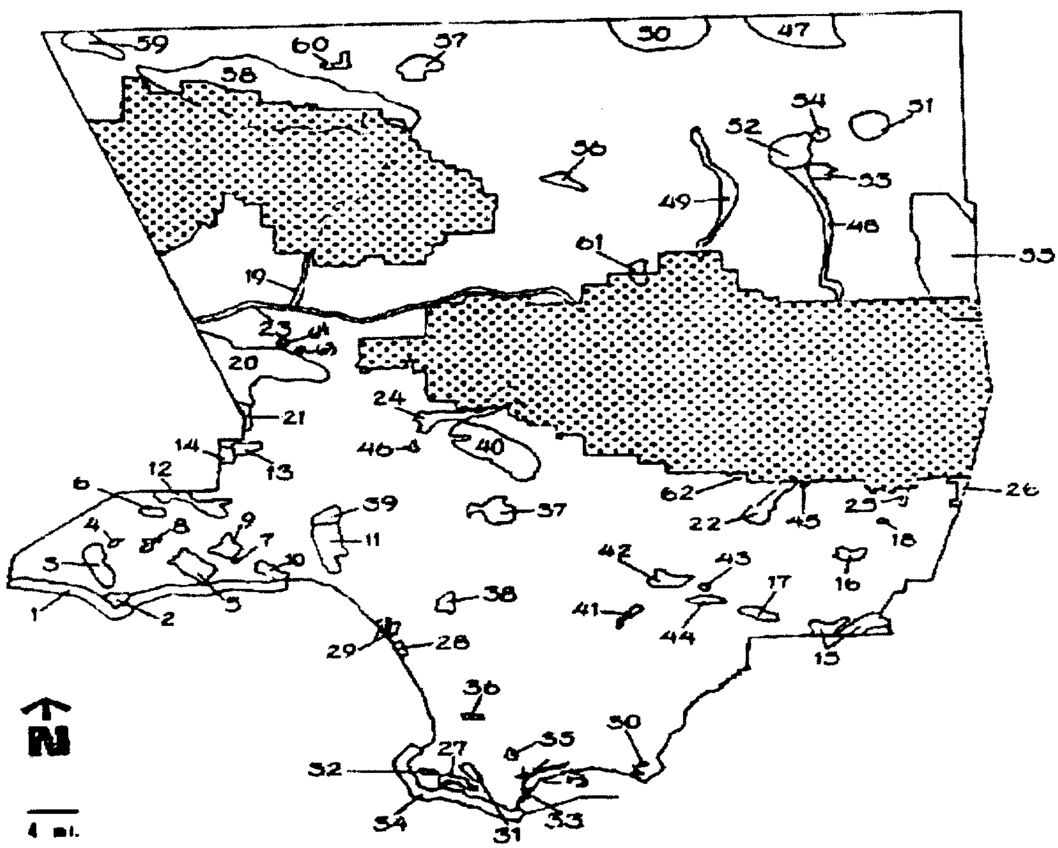
Figure 1	AFFECTED AREA	DESIGNATION	DESIGNATING AGENCY
1.	Malibu Coastline	SEA	LACDRP
2.	Point Dume	SEA	LACDRP
3.	Zuma Canyon	SEA	LACDRP
4.	Upper La Sierra Canyon	SEA	LACDRP
5.	Malibu Canyon and Lagoon	SEA	LACDRP
5.	Malibu Creek State Park Buffer Area	SEA	LACDRP
6.	Las Virgenes	SEA	LACDRP
7.	Hepatic Gulch	SEA	LACDRP
9.	Cold Creek	SEA	LACDRP
10.	Tuna Canyon	SEA	LACDRP
11.	Temescal-Rustic-Sullivan Canyons	SEA	LACDRP
12.	Palo Comado Canyon	SEA	LACDRP
13.	Chatsworth Reservior	SEA	LACDRP
14.	Simi Hills	SEA	LACDRP
15.	Tonner Canyon/Chino Hills	SEA	LACDRP
16.	Buzzard Peak/ San Jose Hills	SEA	LACDRP
17.	Powder Canyon/Punte Hills	SEA	LACDRP
18.	Way Hills	SEA	LACDRP
19.	San Francisquito Canyon	SEA	LACDRP
20.	Santa Susana Mountains	SEA	LACDRP
21.	Santa Susana Pass	SEA	LACDRP
22.	Santa Fe Dam Floodplain	SEA	LACDRP
23.	Santa Clara River	SEA	LACDRP
24.	Tujunga Valley/Hansen Dam	SEA	LACDRP
25.	San Dimas Canyon	SEA	LACDRP
26.	San Antonio Canyon Mouth	SEA	LACDRP
27.	Portuguese Bend Landslide	SEA	LACDRP
28.	El Segundo Dunes	SEA	LACDRP
29.	Ballona Creek	SEA	LACDRP
30.	Alamitos Bay	SEA	LACDRP
31.	Rolling Hills Canyons	SEA	LACDRP
32.	Agua Amarga Canyon	SEA	LACDRP
33.	Terminal Island	SEA	LACDRP
34.	Palos Verdes Peninsula Coastline	SEA	LACDRP
35.	Harbor Lake Regional Park	SEA	LACDRP
36.	Madrona Marsh	SEA	LACDRP
37.	Griffith Park	SEA	LACDRP
39.	Encino Reservoir	SEA	LACDRP
40.	Verdugo Mountains	SEA	LACDRP

1 This list is a compilation of data from the Department of Fish & Game, State Water Resources Control Board, and the Los Angeles County Department of Regional Planning as of February 29, 2000. Areas in this may changes, as area are added or deleted by the designating agencies.

	AFFECTED AREA	DESIGNATION	DESIGNATING AGENCY
42.	Whittier Narrows Dam County Recreation Area	SEA	LACDRP
43.	Rio Hondo College Wildlife Santuary	SEA	LACDRP
44.	Sycamore and Turnbull Canyons	SEA	LACDRP
45.	Dudleya Densiflora Population	SEA	LACDRP
62.	Galium Grande Population	SEA	LACDRP
63.	Lyon Canyon	SEA	LACDRP
64.	Valley Oaks Savannah, Newhall	SEA	LACDRP
Fig.2	Point Dume to Latigo Point	ASBS	SWRCB
Fig.3	Palos Verdes Peninsula	NCCP	DFG

FIGURE 1

SIGNIFICANT ECOLOGICAL AREAS IN LOS ANGELES COUNTY



significant ecological area

national forest

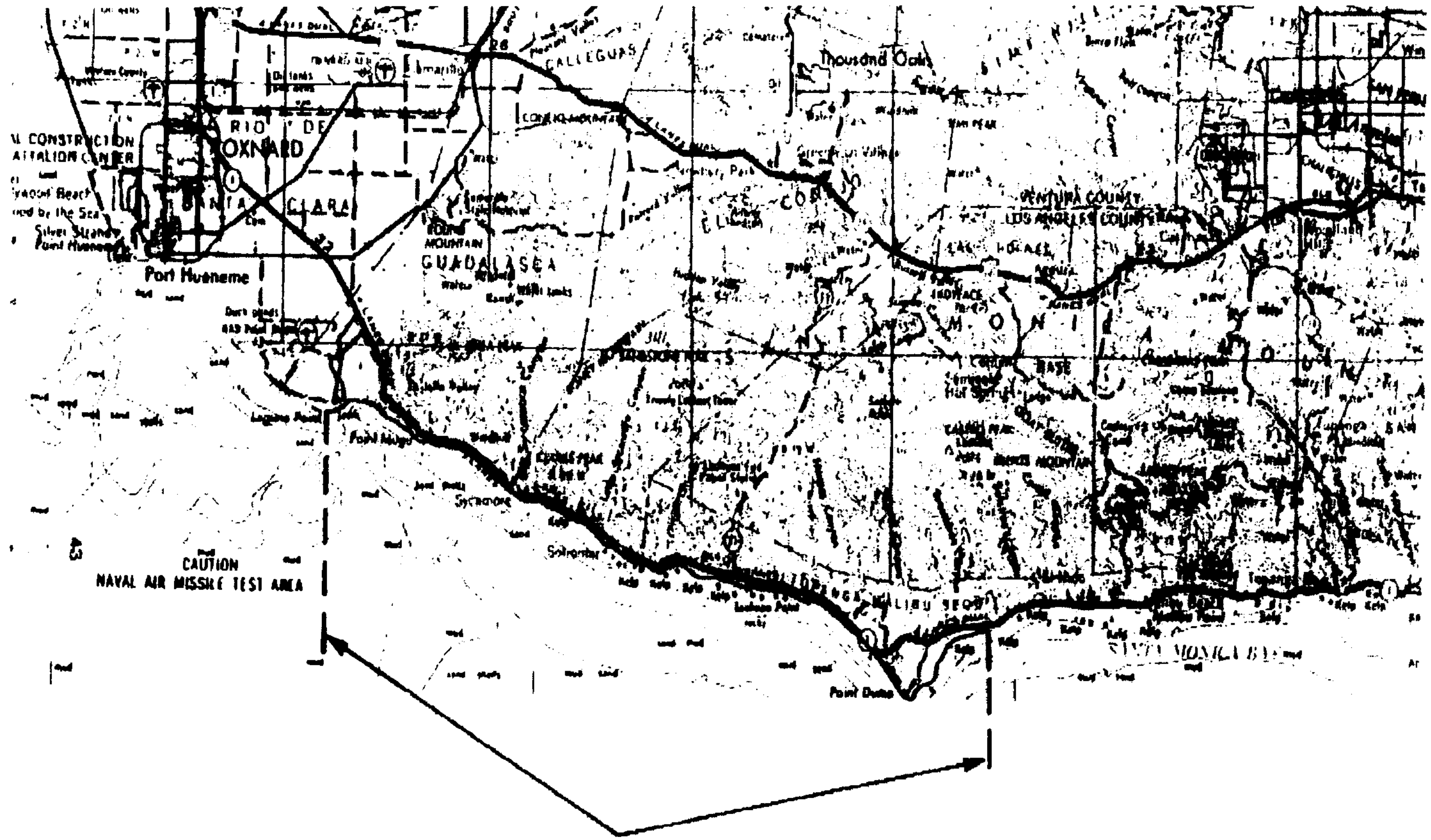


FIGURE 24

POINT MUGU TO LATIGO POINT
AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE

Ref. Maps: USGS Point Mugu, CA
Point Dume, CA

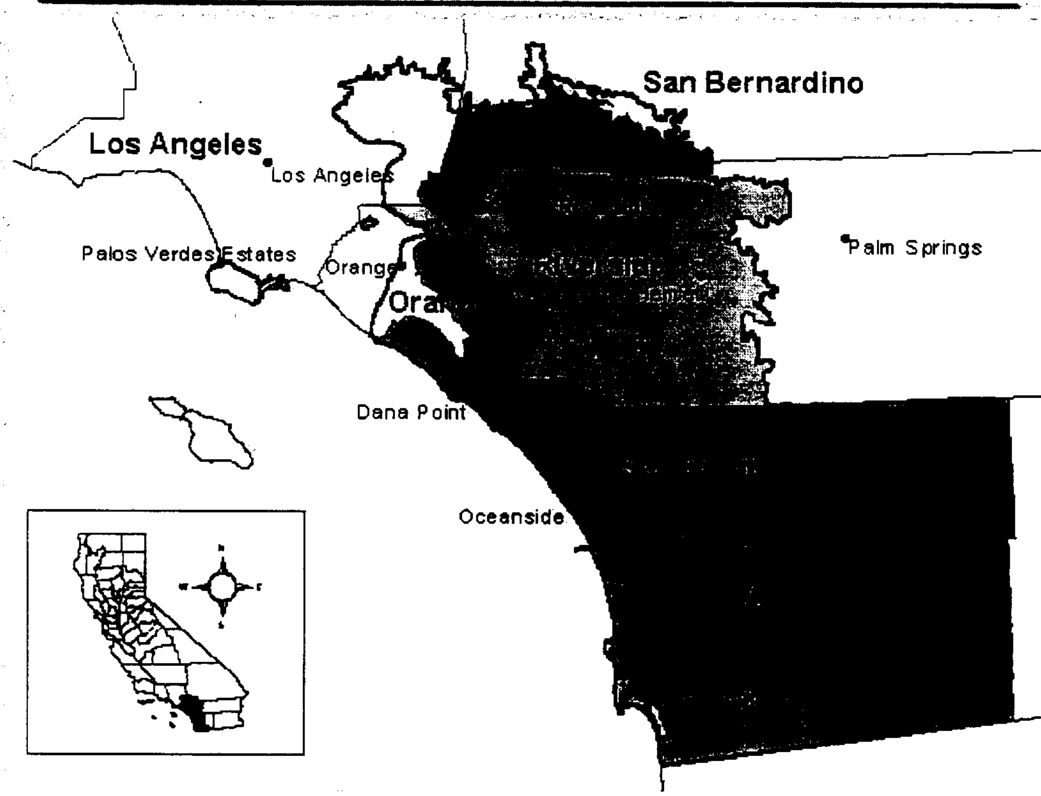
Scale: 1 inch = 4 miles

Seaward boundary is 100-foot isobath or 1000 feet offshore, whichever is more distant.

(For enlarged delineation of boundary lines, SEE FIGURES 24a and 24b)

FIGURE 3

Southern Coastal Sage Scrub NCCP Region



STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

STAFF SUMMARY REPORT (Janet O'Hara)
MEETING DATE: July 18, 2001

ITEM: 11

SUBJECT: **Workshop Regarding Amendment of Santa Clara Municipal Stormwater NPDES Permit Provision on New Development Treatment Measures** – Opening of Public Hearing

CHRONOLOGY: Permit Reissued February 2001

DISCUSSION: The NPDES permit for the Santa Clara Valley Urban Runoff Pollution Prevention Program (Program) was reissued at the February 21, 2001, Board meeting, with the previous permit's new and re-development performance standard, Provision C 3, retained as an enforceable placeholder. Update of Provision C 3 was deferred with the Program Co-permittees' consent at that time. This deferral has allowed time for further meetings and discussions with the Co-permittees and other interested parties, and subsequent circulation on May 18 of the Tentative Order for NPDES Permit Amendment (Appendix A) for a 30-day public comment period.

The Tentative Order is intended to amend the permit to update the new and redevelopment performance standard to more effectively address impacts of new and re-development projects to downstream beneficial uses from both pollutants in stormwater runoff and changes in the amount and timing of stormwater runoff. The Tentative Order is also intended to address the "Cities of Bellflower, et. al." decision by the State Board in October 2000. As such, the Tentative Order would amend the permit to include requirements that certain sizes of new and re-development projects include stormwater treatment measures, that those measures be properly maintained for the life of the project, that they be designed to treat an optimal volume or flow of stormwater runoff from the project site, and that significant changes in the way runoff occurs due to any increase in impervious surface created by the project not adversely erode creekbeds and banks downstream from the project.

The Tentative Order will be revised as appropriate, based on comments received during the workshop and the now-closed public comment period. A revised Tentative Order and a formal

Response to Comments will be distributed prior to the August Board Meeting, when a recommendation will be made for Board action.

RECOMMENDATION: No action is required at this time.

File No. 1538.08 (JBO)

Appendices:

- A: Tentative Order for Permit Amendment and Fact Sheet
- B: Staff Report

APPENDIX A

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

TENTATIVE ORDER
NPDES PERMIT NO. CAS029718

AMENDMENT REVISING PROVISIONS C.3 AND C.14 OF ORDER NO. 01-024 FOR:

SANTA CLARA VALLEY WATER DISTRICT, COUNTY OF SANTA CLARA, CITY OF CAMPBELL, CITY OF CUPERTINO, CITY OF LOS ALTOS, TOWN OF LOS ALTOS HILLS, TOWN OF LOS GATOS, CITY OF MILPITAS, CITY OF MONTE SERENO, CITY OF MOUNTAIN VIEW, CITY OF PALO ALTO, CITY OF SAN JOSE, CITY OF SANTA CLARA, CITY OF SARATOGA, AND CITY OF SUNNYVALE, which have joined together to form the SANTA CLARA VALLEY URBAN RUNOFF POLLUTION PREVENTION PROGRAM

The California Regional Water Quality Control Board, San Francisco Bay Region, hereinafter referred to as the Regional Board, finds that:

<u>**Existing Permit and Amendment of Provisions C.3 and C.14**</u>

1. The Regional Board adopted Order 01-024 reissuing waste discharge requirements under the National Pollutant Discharge Elimination System (NPDES) for the Santa Clara Valley Urban Runoff Pollution Prevention Program for the discharge of stormwater to the South San Francisco Bay and its Tributaries.

2. As outlined in Finding 17 of Order 01-024, Provision C.3 of Order 01-024 is to be revised in response to the "Cities of Bellflower, et. al." decision by the State Water Resources Control Board (State Board Order No. 2000-11). Provision C.14 is hereby revised to extend the permit expiration date by approximately three months, as agreed to by the Dischargers, in order to allow adequate time for implementation of the revised Provision C.3.

3. Order 01-024 recognizes the Santa Clara Valley Urban Runoff Management Plan (Management Plan) as the Dischargers' Comprehensive Control Program and requires implementation of the Management Plan, which describes a framework for management of stormwater discharges. The 1997 Management Plan describes the Program's goals and objectives and contains Performance Standards, which represent the baseline level of effort required of each of the Dischargers. The Management Plan contains Performance Standards for seven different stormwater management activities. The Performance Standard and Supporting Documents for Planning Procedures for new development are contained in Attachment 1.

<u>**Nature of Discharges and Sources of Pollutants**</u>

4. Urban Development Increases Pollutant Load, Volume, and Velocity of Runoff: During urban development two important changes occur. First, natural vegetated pervious ground cover is converted to impervious surfaces such as paved highways, streets, rooftops, and parking lots. Natural vegetated soil can both absorb rainwater and remove pollutants

providing a very effective natural purification process. Because pavement and concrete can neither absorb water nor remove pollutants, the natural purification characteristics of the land are lost. Secondly, urban development creates new pollution sources as human population density increases and brings with it proportionately higher levels of car emissions, car maintenance wastes, municipal sewage, pesticides, household hazardous wastes, pet wastes, trash, etc., which can be washed into the municipal separate storm sewer system (MS4). As a result of these two changes, the runoff leaving the developed urban area is significantly greater in volume, velocity and pollutant load than the pre-development runoff from the same area.

5. Certain pollutants present in storm water and/or urban runoff may be derived from extraneous sources that Dischargers have limited or no direct jurisdiction over. Examples of such pollutants and their respective sources are: PAHs which are products of internal combustion engine operation and other sources; heavy metals, such as copper from brake pad wear and zinc from tire wear; dioxins as products of combustion; mercury resulting from atmospheric deposition; and natural-occurring minerals from local geology. However, Dischargers can implement control measures, or require developers to implement control measures, to reduce entry of these pollutants into storm water and their discharge to receiving waters.

6. These pollutants can have damaging effects on both human health and aquatic ecosystems. In addition, the increased flows and volumes of stormwater discharged from new impervious surfaces resulting from new and redevelopment can significantly impact beneficial uses of aquatic ecosystems due to physical modifications of watercourses, such as bank erosion and widening of channels.

7. Water Quality Degradation Increases with Percent Imperviousness: The increased volume and velocity of runoff from developed urban areas greatly accelerates the erosion of downstream natural channels. Numerous studies have demonstrated a direct correlation between the degree of imperviousness of an area and the degradation of its receiving water quality. Significant declines in the biological integrity and physical habitat of streams and other receiving waters have been found to occur with as little as a 10% conversion from natural to impervious surfaces. (Developments of medium density single family homes range between 25 to 60% impervious).

Implementation

8. The revised Provision C.3 is intended to enhance the Dischargers' existing Performance Standard for new development, through addition of provisions to more effectively incorporate source control measures, site design principles, and structural stormwater treatment controls in new development and redevelopment projects in order to reduce water quality impacts of stormwater runoff for the life of these projects. The consistent application of such measures is intended to greatly reduce the adverse impacts of new and redevelopment on water quality and beneficial uses by reducing stormwater pollutant impacts and increases in peak runoff rate and duration, which can affect the stability of waterbodies, both up and downstream of projects.

9. Because land use planning is where urban development begins, it is the phase in which the greatest and most cost-effective opportunities to protect water quality in new and redevelopment exist. When a Discharger incorporates policies and principles designed to safeguard water resources into the General Plan and development project approval processes, it has taken a far-reaching step towards the preservation of local water resources for future generations.

10. The revised Provision C.3 is written with the assumption that Dischargers are responsible for considering potential stormwater impacts when making planning and land use decisions. Neither Provision C.3 nor any of its requirements are intended to restrict or control local land use decision-making authority.

Public Process

11. The action to modify an NPDES Permit is exempt from the provisions of Chapter 3 (commencing with Section 21100) of Division 13 of the Public Resources Code [California Environmental Quality Act (CEQA)] pursuant to Section 13389 of the California Water Code.

12. The Dischargers and interested agencies and persons have been notified of the Board's intent to modify waste discharge requirements for the existing discharge and have been provided opportunities for public meetings and the opportunity to submit their written views and recommendations.

13. The Regional Board has conducted public meetings to discuss the draft revised Provisions C.3 and C.14.

14. The Board, in a public meeting, heard and considered all comments pertaining to the draft revision of Provisions C.3 and C.14.

IT IS HEREBY ORDERED that the Dischargers, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted hereunder and the provisions of the Clean Water Act as amended and regulations and guidelines adopted hereunder, shall comply with the following:

Provision C.3. New and Redevelopment Performance Standard Enhancement of Order No. 01-024 is hereby revised to read as follows:

The Management Plan contains performance standards and supporting documents to address the post-construction and construction phase impacts of new and redevelopment projects on stormwater quality (Planning Procedures and Construction Inspection Performance Standards). The Dischargers shall continue to implement these performance standards and continuously improve them to the maximum extent practicable in accordance with the following sections.

a. **Performance Standard Implementation:** The Dischargers shall continue to implement and continually improve the following performance standards for planning procedures:

i. Each Discharger shall have adequate legal authority to implement new development control measures as part of its development plan review and approval procedures;

ii. Each Discharger shall provide developers with information and guidance materials on site design guidelines, building permit requirements, and BMPs for stormwater pollution prevention early in the application process, as appropriate for the type of project;

iii. Each Discharger shall require developers of projects that disturb a land area of five acres or more to demonstrate coverage under the State General Construction Activity Stormwater Permit;

iv. Each Discharger shall require developers of projects with potential for significant erosion and planned construction activity during the wet season (as defined by local ordinance) to prepare and implement an effective erosion and/or sediment control plan or similar document prior to the start of the wet season;

v. Each Discharger shall ensure that municipal capital improvement projects include stormwater quality control measures during and after construction, as appropriate for each project, and that contractors comply with stormwater quality control requirements during construction and maintenance activities; and

vi. Each Discharger shall provide training at least annually to its planning, building, and public works staffs on planning procedures, policies, design guidelines, and BMPs for stormwater pollution prevention.

b. **Development Project Approval Process:** Dischargers shall modify their project review processes as needed to incorporate the requirements of Provision C.3. Each Discharger shall include conditions of approval in permits for applicable projects to ensure that pollutant discharges and runoff flows are reduced to the maximum extent practicable

The goal of the conditions of approval should be that pollutant discharges and changes in runoff flows where they can cause damage to downstream waterbodies, are reduced to the maximum extent practicable, and that contributions to exceedance of receiving water quality standards do not occur for the life of the project, through implementation of control measures to the maximum extent practicable. Such conditions shall, at a minimum, address the following goals:

i. Require project proponent to implement site design/landscape characteristics where feasible which maximize infiltration (where appropriate), provide retention, slow runoff, and minimize impervious land coverage, so that post-development pollutant loads from a site have been reduced to the maximum extent practicable; and

ii. For new and redevelopment projects that discharge directly to water bodies listed as impaired by a pollutant(s) pursuant to Clean Water Act Section 303(d), ensure that post-development runoff does not exceed pre-development levels for such pollutant(s), through implementation of the control measures addressed in this provision, to the maximum extent practicable, in conformance with Provision C.1.

c. **New and Redevelopment Project Categories – Size of Projects Addressed by this Provision:** New and redevelopment projects are grouped into two categories, based on project type and size. Stormwater runoff from Group 1 Projects is considered to have greater potential impacts on the beneficial uses of water bodies in the Santa Clara basin; thus, Group 1 Projects are subject to all the requirements of this Provision upon implementation. Group 2 Projects, which at this time are considered to have lesser potential impacts on the beneficial uses of water bodies in the Santa Clara Basin, are exempt from the Numeric Sizing Criteria of Provision C.3.d, Operation and Maintenance requirements of C.3.e, and the Limitation on Increase of Peak Stormwater Runoff Discharge Rates of C.3.f. until July 15, 2003, at which time they will have the same status as Group 1.

   i. **Group 1 Projects:** Group 1 Projects consist of all projects for which a development application has not been deemed complete as of the effective date of Provision C.3.b and which are in the following categories:

   Commercial, industrial, or residential developments that create one acre (43,560 square feet) or more of impervious surface, including roof area, streets and sidewalks. This category includes any development of any type on public or private land, which falls under the planning and building authority of the Dischargers, where one acre or more of impervious surface, collectively over the entire project site, will be created.

   Significant redevelopment projects. This category is defined as the creation or addition or structural replacement or significant reconstruction of at least one acre (43,560 square feet) of impervious surfaces on an already developed site, or significant redevelopment that encompasses one acre of impervious surface, including roof area. Significant redevelopment includes: the expansion of a building footprint and/or floor area, or addition to an existing structure; significant reconstruction of an existing structure; or replacement of a structure. Significant redevelopment also includes replacement of impervious surface that is not part of a routine maintenance activity.

   Redevelopment projects that, when complete, would result in reductions in site imperviousness by twenty percent (20%) or more from the existing site condition are excluded (exempted) from the category of Significant Redevelopment Projects.

   Streets, roads, highways, and freeways that are under the Dischargers' jurisdiction and that create one acre (43,560 square feet) or more of impervious surface. This category includes any paved surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.

   ii. **Group 2 Projects:** Group 2 Projects consist of all other (i.e., not in Group 1) new and significant redevelopment projects that create 5,000 square feet or more of additional impervious surface. Group 2 Projects must be designed and operated to comply with all of Provision C.3 except the Numeric Sizing Criteria of Provision C.3.d, Operation and Maintenance requirements of C.3.e, and the Limitation on Increase of Peak Stormwater Runoff Discharge Rates of C.3.f.

iii. **Alternative Project Size Proposal:** All Dischargers shall review the statistics and pattern of new development and significant redevelopment within their jurisdictions, for all Group 1 and 2 Projects, both in the recent past, and going forward. In the Annual Reports due September 15, 2002, each Discharger shall report a summary of these statistics (numbers, types, and sizes of new and redevelopment projects) showing the ranges of impervious surface creation.

Using this information, each Discharger may propose, for approval by the Executive Officer, an alternative Group 1 Project size, in amount of impervious surface addition, that would encompass approximately 80% of new impervious surface creation in a typical recent year. In the event that a Discharger makes no such proposal, the Group 2 Project definition shall be included in the Group 1 Project definition, making both Group 1 and 2 Projects subject to all the requirements of Provision C.3.

d. **Numeric Sizing Criteria:** All Dischargers shall require that treatment Best Management Practices (BMPs) be implemented at all Group 1 and 2 development projects within their jurisdictions. To ensure their effectiveness, all treatment BMPs for a Group 1 project shall be sized to meet one of the following sizing criteria:

i. **Volume Hydraulic Design Basis:** Treatment BMPs whose primary mode of action depends on volume capacity, such as detention/retention units or infiltration structures, shall be designed to mitigate (infiltrate or treat) stormwater runoff from:

- each runoff event up to and including the 85th percentile 24-hour storm runoff event determined as the maximized capture storm water volume for the area, based on historical rainfall records, from the formula recommended in *Urban Runoff Quality Management, WEF Manual of Practice No. 23/ ASCE Manual of Practice No. 87, (1998)*, or
- the volume of annual runoff based on unit basin storage volume, to achieve 80 percent or more volume treatment by a method such as that recommended in Appendix D of the *California Stormwater Best Management Practices Handbook*, (1993).

ii. **Flow Hydraulic Design Basis:** Treatment BMPs whose primary mode of action depends on flow capacity, such as swales, sand filters, or wetlands, shall be sized to handle:

- 10% of the 50-year design flow rate, or
- a flow that will result in treatment of the same portion of runoff as treated using volumetric standards above, or
- the flow of runoff produced by a rain event equal to at least two times the 85th percentile hourly rainfall intensity for the applicable area, or
- a rain event equal to at least 0.2 inches pr hour intensity.

e. **Operation and Maintenance of Treatment Measures:** The Dischargers shall develop and implement a phased program to verify on a recurring basis that treatment BMPs are adequately operated and maintained. The operation and maintenance (O&M) verification program shall outline the conditions and procedures that will apply when the public agency is responsible and when a private entity is responsible for long-term O&M. At a minimum, the O&M verification program shall include maintenance of a listing of properties (public and private) and responsible operators, a plan for local agency inspection (e.g., random inspection of a subset of the listed properties), inspector training, follow-up procedures, and a commitment to periodic program evaluation. The schedule for phasing in the O&M verification program is based on the type of treatment BMP and is given in Provision C.3.o, Implementation Schedule.

For all properties where a private entity is responsible for O&M, the verification shall include the owner or developer's signed statement, as part of the project application, accepting responsibility for all treatment BMP maintenance until the time the property is transferred and ensuring that the initial and all subsequent transfers of the property to a successor private or public owner will include conditions in the sales or lease agreement requiring the recipient to (1) assume responsibility for inspection and maintenance of all treatment BMPs at least once each year and (2) retain proof of such inspections.

For Group 1 residential properties where a private entity is responsible for O&M, the verification shall include the owner or developer's signed statement, as part of the project application, accepting responsibility for ensuring that printed educational materials accompany the initial and all subsequent deed transfers. The printed materials must:

- provide information on what storm water management facilities are present;
- explain the treatment BMP operation and maintenance requirements;
- clearly illustrate signs that indicate maintenance is needed;
- tell how the necessary maintenance can be performed; and
- indicate what assistance the Discharger can provide.

Where treatment BMPs are located within a common area that will be maintained by a homeowner's association, language regarding the responsibility for maintenance must be included in the project's conditions, covenants and restrictions.

Reporting: The Dischargers shall report on their Treatment BMPs Operation and Maintenance verification programs in each Annual Report. Information to be reported should include the organizational structure of the program, its successes, and any problems along with possible solutions.

f. **Limitation on Increase of Peak Stormwater Runoff Discharge Rates:** New development and redevelopment can impact water quality and beneficial uses of waters by altering a watershed's patterns of runoff and particularly by increasing the rates, durations, and frequencies of peak flows. These impacts can result from individual projects and can occur cumulatively as the result of increasing urbanization of a watershed. It is the goal of this permit requirement to appropriately limit these changes where there is a potential for adverse impacts.

Therefore, post-development peak stormwater runoff discharge rates and durations shall not exceed estimated pre-development rates and durations for new development and/or redevelopment projects, where the increased peak storm water discharge rates and/or durations will result in increased potential for erosion or other adverse impacts to beneficial uses.

This limitation applies to all Group 1 Projects of Provision C.3.c, for all rain events which generate peak or near-peak flow rates and velocities less than or equal to a pre-development rainfall event or events, or within a pre-development rainfall event range, to be determined by the Dischargers. This requirement does not apply to new development and redevelopment projects where the project discharges storm water runoff into creeks or storm drains where the potential for erosion is minimal. Such situations may include discharges into creeks that are concrete-lined or significantly hardened (e.g., with rip-rap, sackrete, etc.) to their outfall in San Francisco Bay, underground storm drains discharging to the Bay, and construction of infill projects in highly developed watersheds, where the potential for single-project and/or cumulative impacts is minimal. Guidelines for identification of such situations shall be included as a part of the Hydromodification Management Plan (HMP) required in this section.

In addition, the HMP may identify conditions under which some increases in runoff may not have a potential for increased erosion or other impacts to beneficial uses. Reduced controls or no controls on peak storm water runoff discharge rates and/or durations may be appropriate in those cases, subject to the conditions in the HMP. In the absence of information demonstrating that changes in post-development runoff discharge rates and durations will not result in increased potential for erosion or other adverse impacts to beneficial uses, it is assumed that such impacts will occur.

The Dischargers shall complete a review of the literature and develop an HMP. The HMP shall include:

- the literature review;
- a protocol to evaluate impacts;
- identification of the rainfall event below which this limitation applies, or range of rainfall events to which this limitation applies;
- a description of how the Dischargers will incorporate this requirement into their local approval processes; and
- guidance on management practices and measures to address identified impacts.

The identified rainfall event or rainfall event range may be different for specific watersheds, streams, or stream reaches. Individual Dischargers may utilize the protocol to determine a site- or area-specific rainfall event standard.

Interim standard: Prior to the Executive Officer's acceptance of the HMP and a proposed standard, post-development peak storm water discharge rates and durations shall not exceed estimated pre-development rates and durations for new development and/or redevelopment projects for discharge from the 2-year storm up to the 10-year, 6-hour storm.

Equivalent limitation of peak flow impacts: The Dischargers may develop an equivalent limitation protocol, as part of the HMP, to address impacts from changes in the volumes, velocities, and durations of peak flows through measures other than control of those volumes and durations. The protocol may allow increases in peak and near-peak flows and durations, subject to the implementation of specified BMPs and land planning practices that take into account expected stream change (e.g., increases in the cross-sectional area of stream channel) resulting from changes in discharge rates and durations.

The evaluation protocols, management measures, and other information in the HMP may include the following measures:

- Evaluation of the cumulative impacts of urbanization of a watershed on storm water discharge and stream morphology in the watershed;
- Evaluation of stream form and condition, including slope, discharge, vegetation, underlying geology, and other information, as appropriate;
- Implementation of measures to minimize impervious surfaces and directly connected impervious area in new development and redevelopment projects;
- Implementation of measures including storm water detention, retention, and infiltration;
- Implementation of land use planning measures (e.g., stream buffers and stream restoration activities, including restoration-in-advance of floodplains, revegetation, etc.) to allow expected changes in stream channel cross sections, stream vegetation, and discharge rates, velocities, and durations without adverse impacts to stream beneficial uses;
- A mechanism for pre- vs. post-project assessment to determine the effectiveness of the HMP and to allow amendment of the HMP, as appropriate; and,
- Other measures, as appropriate.

The HMP shall be completed as follows. All required documents shall be submitted acceptable to the Executive Officer. Development and implementation status shall be reported in the Dischargers' Annual Reports, which shall also provide a summary of projects incorporating measures to address this section, and the measures used.

- No later than March 1, 2002: Submit a detailed workplan and schedule for completion of the literature review, development of a protocol to identify an appropriate limiting storm, development of guidance materials, and other required information;

- No later than September 15, 2002: Submit the required literature review;

- No later than March 1, 2003: Submit a draft HMP, including the analysis that identifies the appropriate limiting storm and the identified limiting storm event(s) or event range(s); and,

- No later than July 15, 2003: Submit and fully implement the HMP, which shall include the requirements of this measure.

g. **Exemption or Waiver Based on Impracticability and Compensatory Mitigation:** A Discharger may, through adoption of an ordinance or code incorporating the treatment requirements of this Provision, or by other formal administrative means, provide for a waiver from the requirement for treatment BMPs if impracticability for a specific project can be established. A waiver of impracticability shall be granted only when all treatment BMPs have been considered and rejected as infeasible. Grounds for impracticability may include: (i) extreme limitations of space for treatment on a redevelopment project, and lack of below surface options, (ii) unfavorable or unstable soil conditions to attempt infiltration, and (iii) risk of ground water contamination because a known unconfined aquifer lies beneath the land surface or an existing or potential underground source of drinking water is less than ten (10) feet from the soil surface. Grounds (ii) and (iii) apply only to infiltration-based treatment measures, which are a subset of the range of treatment measure options, so do not in and of themselves establish impracticality.

The Regional Board may consider amendment of Provision C.3.g submitted by a Discharger to authorize additional grounds of impracticability. The supplementary waiver justification becomes recognized and effective only after approval by the Regional Board or the Executive Officer.

If a Discharger grants a waiver for impracticability, the Discharger must require the project proponent to transfer the savings in cost to a stormwater mitigation project to be used to promote regional or alternative solutions for stormwater pollution in the watershed of the development and operated by a public agency or a non-profit entity. The Discharger shall determine the amount of savings by any method that considers the costs of constructing and maintaining treatment BMPs in similar projects.

Each year, each Discharger shall provide a list of the waivers it granted in its Annual Report. For each project granted a waiver, the following information shall be provided:

- Name and location of the project for which the waiver was granted;
- Project type (e.g., restaurant, residence, shopping center) and size;
- Percent impervious surface in final design;
- Reason for granting the waiver;
- Amount of dollar savings incurred by obtaining the waiver, with brief explanation of calculation method; and
- The stormwater mitigation project to which the savings was transferred.

h. **Alternative Certification of Adherence to Design Criteria for Stormwater Treatment Measures:** In lieu of conducting detailed review to verify the adequacy of measures required pursuant to this Provision C.3.b-C.3.h, a Discharger may elect to accept a signed certification from a Civil Engineer or a Licensed Architect or Landscape Architect registered in the State of California, that the plan meets the criteria established herein. The Discharger should verify that each certifying person has been trained on BMP design for water quality not more than three years prior to the signature date, and that each certifying person understands the groundwater protection principles applicable to the project site (*see Provision C.3.h Limitations on Use of Infiltration Treatment Measures*). Training conducted by an organization with storm water BMP design expertise (e.g., a university, American Society of Civil Engineers, American Society of Landscape Architects, American Public Works Association, or the California Water Environment Association) may be considered qualifying.

i. **Limitations on Use of Infiltration Treatment Measures - Infiltration and Groundwater Protection:** In order to protect groundwater from pollutants that may be present in urban runoff, the Dischargers shall ensure that treatment BMPs that function primarily as infiltration devices (such as infiltration trenches and infiltration basins) meet, at a minimum, the following conditions:[1]

  i. Pollution prevention and source control BMPs shall be implemented at a level appropriate to protect groundwater quality at sites where infiltration devices are to be used.

  ii. Use of infiltration devices shall not cause or contribute to an exceedance of groundwater water quality objectives.

  iii. Infiltration devices shall be adequately maintained to maximize pollutant removal capabilities.

  iv. The vertical distance from the base of any infiltration device to the seasonal high groundwater mark shall be at least 10 feet. Note that some locations within the Dischargers' jurisdiction are characterized by highly porous soils and/or a high groundwater table; in these areas BMP approvals should be subject to a higher level of analysis (e.g., considering the potential for pollutants such as on-site chemical use, the level of pretreatment to be achieved, and similar factors).[2]

  v. Unless stormwater is first pretreated, infiltration devices shall not be recommended for areas of industrial or light industrial activity; areas subject to high vehicular traffic (25,000 or greater average daily traffic on main roadway or 15,000 or more average daily traffic on any intersecting roadway); automotive repair shops; car washes; fleet storage areas (bus, truck, etc.); nurseries; and other high threat to water quality land uses and activities as designated by each Discharger.

  vi. Infiltration devices shall be located a minimum of 100 feet horizontally from any water supply wells.

j. **Site Design Measures Guidance and Standards Development:** Opportunities to address stormwater pollution and hydromodification can be limited by current local design standards and guidance. For example, such standards and guidance may reduce or prohibit opportunities to minimize impervious surfaces, minimize directly connected impervious area, provide for small-scale detention, and implement other management measures. Revision of current standards and guidance can result in a significantly increased ability for project designers to minimize project impacts and can also increase local property values, neighborhood character, and overall quality of life. Further, revision of standards and guidance can allow implementation of site design measures in projects to meet or help meet the numeric sizing criteria in Provision C.3.d and/or the hydromodification limitation in Provision C.3.f.

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[1] These conditions do not apply to structural treatment BMPs which allow incidental infiltration and are not designed to primarily function as infiltration devices (such as grassy swales, detention basins, vegetated buffer strips, constructed wetlands, etc.).

[2] See the June 1999 memo from Dan Cloak and Wendy Edde (SCVURPPP) to Municipal Planning Department Personnel, *Additional Considerations for Incorporating BASMAA's **Start at the Source** Techniques in Development Projects* for further information on the risks to groundwater and steps to take to minimize such risks from infiltration of stormwater runoff.

Therefore, this measure requires that the Dischargers review their applicable local design standards and guidance to identify opportunities to revise those standards, where revision would result in reduced impacts to water quality and beneficial uses of waters, and that identified opportunities for revision be implemented.

The following are examples of areas it may be appropriate to address in the review of design standards and guidance:

- Minimize land disturbance;
- Minimize impervious surfaces (e.g., roadway width, driveway area, and parking lot area), especially directly connected impervious areas;
  - Minimum-impact street design standards for new development and redevelopment, including typical specifications (e.g., neo-traditional street design standards and/or street standards recently revised in other cities, including Portland, Oregon, and Vancouver, British Columbia);
  - Minimum-impact parking lot design standards, including parking space maximization within a given area, use of landscaping as a storm water drainage feature, use of pervious pavements, and parking maxima;
- Clustering of structures and pavement;
- Typical specifications or "acceptable design" guidelines for lot-level design measures, including:
  - Disconnected roof downspouts to splash blocks or "bubble-ups;"
  - Alternate driveway standards (e.g., wheelways, unit pavers, or other pervious pavements);
  - Microdetention, including landscape detention and use of cisterns.
- Preservation of high-quality open space;
- Maintenance and/or restoration of riparian areas and wetlands as project amenities, including establishing vegetated buffer zones to reduce runoff into waterways, allow for stream channel change as a stream's contributing watershed urbanizes, and otherwise mitigate the effects of urban runoff on waters and beneficial uses of waters; and,
- Incorporation of supplemental controls to minimize changes in the volume, flow rate, timing, and duration of runoff, for a given precipitation event or events. These changes include cumulative hydromodification caused by site development. Measures may include landscape-based measures or other features to reduce the velocity of, detain, and/or infiltrate stormwater runoff.

The standards and guidance review shall be completed as follows. All required documents shall be submitted acceptable to the Executive Officer. A summary of review, revision, and implementation status shall be reported in the Dischargers' Annual Reports.

- No later than March 1, 2002: The Dischargers shall submit a detailed workplan and schedule for completion of the review, revision, and implementation of revised standards and guidance;

- No later than September 15, 2003: The Dischargers shall submit a draft document that includes the review and analysis of local standards and guidance, opportunities for revision, and proposed revised standards and guidance;
- No later than September 15, 2004: The Dischargers shall incorporate any revised standards and guidance into their local approval processes and shall be fully implementing the revised standards and guidance.

k. **Source Control Measures Guidance Development:** The Dischargers shall complete a document providing draft conditions of approval for all Dischargers to use and to be incorporated into the enhanced New and Redevelopment Performance Standards. The document shall summarize source control requirements for new and redevelopment projects to limit pollutant generation, discharge, and runoff.

Examples of conditions to be included and areas to be addressed include, but are not limited to:

- Indoor mat/equipment wash racks for restaurants, or covered outdoor wash racks plumbed to the sanitary sewer;
- Covered trash and food compactor enclosures with a sanitary sewer connection for dumpster drips and designed such that run-on to trash enclosure areas is avoided;
- Sanitary sewer drains for swimming pools;
- Sanitary drained outdoor covered wash areas for vehicles, equipment, and accessories;
- Sanitary sewer drain connections to take fire sprinkler test water;
- Storm drain system stenciling;
- Landscaping that minimizes irrigation and runoff, promotes surface infiltration where appropriate, minimizes the use of pesticides and fertilizers, and where feasible removes pollutants from storm water runoff; and,
- Appropriate covers, drains, and storage precautions for outdoor material storage areas, loading docks, repair/maintenance bays, and fueling areas.

The draft conditions of approval document and enhanced Performance Standard shall be submitted by September 15, 2002, acceptable to the Executive Officer. The Dischargers shall have incorporated the conditions of approval document into their local approval processes and shall be fully implementing it by March 1, 2003. Implementation status shall be reported in the Dischargers' Annual Reports, which shall also provide appropriate detail on projects incorporating the required conditions of approval.

l. **Revise General Plans:** At the next scheduled revision of its General Plan or by July 1, 2005, whichever is sooner, each Discharger shall incorporate water quality and watershed protection principles and policies into its General Plan or equivalent plan (e.g., Comprehensive, Master, or Community Plan) as necessary to direct land-use decisions and require implementation of consistent water quality protection measures for all development projects. These principles and policies shall be designed to protect natural water bodies, reduce impervious land coverage, slow runoff, and where feasible, maximize opportunities for infiltration of rainwater into soil. Such water quality and watershed protection principles and policies may include the following, which are offered as examples:

i. Minimize the amount of impervious surfaces and directly connected impervious surfaces in areas of new development and redevelopment and where feasible maximize on-site infiltration of runoff;

ii. Implement pollution prevention methods supplemented by pollutant source controls and treatment. Use small collection strategies located at, or as close as possible to, the source (i.e., the point where water initially meets the ground) to minimize the transport of urban runoff and pollutants offsite and into a Municipal Separate Storm Sewer System;

iii. Preserve, and where possible, create or restore areas that provide important water quality benefits, such as riparian corridors, wetlands, and buffer zones. Encourage land acquisition of such areas;

iv. Limit disturbances of natural water bodies and natural drainage systems caused by development including roads, highways, and bridges;

v. Prior to making land use decisions, utilize methods available to estimate increases in pollutant loads and flows resulting from projected future development. Require incorporation of structural and non-structural BMPs to mitigate the projected increases in pollutant loads and flows;

vi. Avoid development of areas that are particularly susceptible to erosion and sediment loss; or establish development guidance that identifies these areas and protects them from erosion and sediment loss; and

vii. Reduce pollutants associated with vehicles and increasing traffic resulting from development.

m. **Water Quality Review Processes:** When Dischargers conduct environmental review of projects in their jurisdictions, the Dischargers shall conduct evaluations of water quality effects and identification of appropriate mitigation measures. The review shall address increased pollutants and flows from the proposed project through such questions as:

i. Would the proposed project result in an increase in pollutant discharges to receiving waters? Consider water quality parameters such as temperature, dissolved oxygen, turbidity and other typical storm water pollutants (e.g., heavy metals, pathogens, petroleum derivatives, synthetic organics, sediment, nutrients, oxygen-demanding substances, and trash).

ii. Would the proposed project result in significant alteration of receiving water quality during or following construction?

iii. Would the proposed project result in increased impervious surfaces and associated increased runoff?

iv. Would the proposed project create a significant adverse environmental impact to drainage patterns due to changes in runoff flow rates or volumes?

v. Would the proposed project result in increased erosion in its watershed?

vi. Is the project tributary to an already impaired water body, as listed on the Clean Water Act Section 303(d) list? If so, will it result in an increase in any pollutant for which the water body is already impaired?

vii. Would the proposed project have a potentially significant environmental impact on surface water quality, to marine, fresh, or wetland waters?

viii. Would the proposed project have a potentially significant adverse impact on ground water quality?

ix. Will the proposed project cause or contribute to an exceedance of applicable surface or groundwater receiving water quality objectives or degradation of beneficial uses?

x. Will the project impact aquatic, wetland, or riparian habitat?

n. **Reporting, including Pesticide Reduction Measures:** The Dischargers shall demonstrate compliance with Provision C.3 by providing the following information in their Annual Reports for Group 1 and 2 Projects:

- Project name, type of project (using the categories in Provision C.3.c), site acreage or square footage, square footage of new impervious surface.
- Treatment BMPs and numeric sizing criteria used, O&M responsibility mechanism, site design measures used, and source control measures required.
- A summary of the types of pesticide reduction measures required (such as by conditions of approval) for new development and significant redevelopment projects, and the percentage of new development and significant redevelopment projects for which pesticide reduction measures were required. These measures are required under Provision C.9.d.ii, and relate directly to Provision C.3 requirements.
- In the September 2002 Annual Report only: A proposal for enhanced reporting to track the implementation of Provision C.3 requirements. The reporting shall include the above components at a minimum. Enhanced reporting for pesticide reduction measures may also be included.

o. **Implementation Schedule:** The Dischargers shall implement the requirements of this Provision according to the following schedule:

Provision	Action	Implementation Date
C.3.b	Modify development project approval process as needed	July 15, 2002
C.3.c.iii	Report findings of new development and significant redevelopment project numbers, and sizes	September 15, 2002
	Propose an alternative minimum project size proposal	January 15, 2003
	In absence of a proposed alternative minimum project size, Group 2 Projecf definition becomes Group 1 Project definition	July 15, 2003
C.3.e	Implement an O&M verification program for structural in-ground BMPs such as sand filters, filter inlets, detention/ retention basins	July 15, 2002
	Implement an O&M verification program for landscape and all other BMPs, such as vegetated swales, dry or wet ponds	July 15, 2003
	Begin reporting on O&M verification program in Annual Report	September 15, 2003
C.3.f	Submit a detailed workplan and schedule	March 1, 2002
	Submit literature review	September 15, 2002
	Submit draft Hydromodification Management Plan (HMP)	March 1, 2003
	Submit and implement final HMP	July 15, 2003
C.3.g	Report on any waiver(s) granted by the Discharger in Annual Report, due September 15 of each year	Begin the year a waiver is granted
C.3.j	Submit workplan and schedule for completion of review, revision, and implementation of design standards and guidance	March 1, 2002
	Submit draft proposal of revised standards and guidance	September 15, 2003
	Incorporate revisions into local process and fully implement site design standards and guidance	September 15, 2004
C.3.k	Submit draft conditions of approval document for source control measures.	September 15, 2002
	Implement source control measures guidance document	March 1, 2003
C.3.l	Revise General Plans as necessary to direct land-use decisions and require implementation of consistent water quality protection measures for all development projects	July 1, 2005 or at next scheduled revision, whichever is first
C.3.m	Revise Environmental Review Processes	March 1, 2003
C.3.n	Begin reporting Group 1 and 2 Project information in Annual Reports, and propose enhanced reporting method	September 15, 2002

Provision C.14 of Order No. 01-024 is hereby revised to read as follows:

14. This Order expires on June 1, 2006. The Dischargers must file a Report of Waste Discharge in accordance with Title 23, California Code of Regulations, not later than 360 days in advance of such date as application for reissuance of waste discharge requirements.

Fact Sheet

SANTA CLARA VALLEY URBAN RUNOFF POLLUTION PREVENTION PROGRAM
NPDES PERMIT NO. CAS 029718
AMENDMENT OF PROVISIONS C.3 and C.14 OF ORDER NO. 01-024: NEW AND REDEVELOPMENT PERFORMANCE STANDARD ENHANCEMENT

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION
1515 CLAY STREET, 14TH FLOOR
OAKLAND, CA 94612

I. Reason for Amendment of Provision C.3 and Provision C.14

The Santa Clara Valley Water District (hereinafter District), County of Santa Clara, City of Campbell, City of Cupertino, City of Los Altos, Town of Los Altos Hills, Town of Los Gatos, City of Milpitas, City of Monte Sereno, City of Mountain View, City of Palo Alto, City of San Jose, City of Santa Clara, City of Saratoga, and City of Sunnyvale (hereinafter referred to as the Dischargers) have joined together to form the Santa Clara Valley Urban Runoff Pollution Prevention Program (hereinafter referred to as the Program). On February 21, 2001 the California Regional Water Quality Control Board San Francisco Bay Region (hereinafter referred to as the Regional Board) re-issued waste discharge requirements (Order 01-024) under the National Pollutant Discharge Elimination System (NPDES) to the Program to discharge stormwater run off from storm drains and watercourses within the Dischargers' jurisdictions by implementing a Storm Water Management Plan (hereinafter Management Plan).

Prior to the issuance of Order 01-024, the Dischargers gave their written consent to allow Provision C.3, concerning new and redevelopment performance standards, to be considered for amendment to address the "Cities of Bellflower, et. al." decision by the State Board (State Board Order No. 2000-11). The Dischargers also expressed their desire to extend the permit expiration date in Provision C.14 by approximately three months to allow adequate time for implementation of all the permit's Provisions.

A Tentative Order has been prepared which would amend Order No. 01-024. The Regional Board intends to consider adoption of the Tentative Order at a public hearing that will be held on July 18, 2001 at 9:00 AM in the first floor auditorium at the State Building located at 1515 Clay Street in Oakland, CA. The Tentative Order, comments received, and related documents may be inspected and copied at the Regional Board's office. For further information contact Janet O'Hara at (510) 622-5681 or jbo@rb2.swrcb.ca.gov.

II. Discharge Description and Location

The Dischargers each have jurisdiction over and/or maintenance responsibility for their respective municipal separate storm drain systems and/or watercourses in the Santa Clara basin. Discharge consists of the surface runoff generated from various land uses in all the hydrologic sub basins in the basin which discharge into watercourses, which in turn flow into South San Francisco Bay.

The quality and quantity of these discharges varies considerably and is affected by hydrology, geology, land use, season, and sequence and duration of hydrologic event. Pollutants of concern in these discharges are certain heavy metals, excessive sediment production from erosion due to anthropogenic activities, petroleum hydrocarbons from sources such as used motor oil, microbial pathogens of domestic sewage origin from illicit discharges, certain pesticides associated with the risk of acute aquatic toxicity, excessive nutrient loads which may cause or contribute to the depletion of dissolved oxygen and/or toxic concentrations and dissolved ammonia, and other pollutants which may cause aquatic toxicity in the receiving waters.

III. General Rationale

6. Water Quality Control Plan, San Francisco Bay Basin, June 21, 1995 (Basin Plan).

7. The Urban Runoff Management, Comprehensive Control Program section of the Basin Plan requires the Dischargers to address existing water quality problems and prevent new problems associated with urban runoff through the development and implementation of a comprehensive control program focused on reducing current levels of pollutant loading to storm drains to the maximum extent practicable. The Basin Plan comprehensive program requirements are designed to be consistent with federal regulations (40 CFR 122-124) and are implemented through issuance of NPDES permits to owners and operators of storm drain systems. The Dischargers, having jurisdiction over and/or maintenance responsibility for storm drains and water courses within their boundaries, have assumed responsibility for complying with the Basin Plan's requirements. The permit recognizes submittal of the Programs' Urban Runoff Management Plan (Management Plan) as the Dischargers' Comprehensive Control Program and requires implementation of the Management Plan.

   The Management Plan describes a framework for management of stormwater discharges. The 1997 Management Plan describes the Program's goals and objectives and contains Performance Standards, which represent the baseline level of effort required of each of the Dischargers. The Performance Standard and Supporting Documents for Planning Procedures for new development are contained in Attachment 1.

6. The Basin Plan identifies the beneficial uses of waters and establishes water quality objectives necessary to protect these beneficial uses that apply to certain receiving waters within the Dischargers' boundaries. These water quality objectives serve as receiving water limitations for waters that receive discharges of pollutants.

7. Several sections of the Clean Water Act (CWA) and implementing federal regulations pertain to requirements that MS4 dischargers control stormwater discharges from new development and redevelopment:

   8. **CWA 402(p)(3)(B)(ii) – Prohibit Non-Storm Water:** The CWA requires in section 402(p)(3)(B)(ii) that a stormwater program "shall include a requirement to effectively prohibit non-stormwater discharges into the storm sewers."

   9. **CWA 402(p)(3)(B)(iii) – Require Controls:** The CWA requires in section 402(p)(3)(B)(iii) that a stormwater program "shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants."

   10. **40 CFR 122.26(d)(2)(iv)(A)(2) – Enforce Controls on New Development and Significant Redevelopment:** Federal NPDES regulations have required since 1990 that Dischargers utilize "planning procedures including a master plan to develop, implement and enforce controls to reduce the discharge of pollutants from Municipal Separate Storm Sewer Systems (MS4s) which receive discharges from areas of new development and significant redevelopment."

IV. Specific Rationale

Provision C.3 calls for the enhancement of the Dischargers' existing Performance Standard for Planning Procedures (Attachment 1) to address the post-construction and some construction phase impacts of new and redevelopment projects on storm water quality. The Performance Standard enhancement is intended to address impacts of these projects to downstream beneficial uses from both pollutants and changes in amount and timing of storm water runoff, such as increases in peak runoff flow and duration that can cause increased erosion of streams banks and channel.

Provision C.3 calls for enhancement of this existing performance standard to increase the effectiveness of existing implementation, primarily by: (1) setting volume and flow based hydraulic sizing criteria for stormwater treatment measures, (2) setting minimum sizes of new development and redevelopment projects which must employ the treatment measures, (3) creation of a program to assure the adequate operation and maintenance of treatment measures occurs, (4) creation of standards for source control measures (such as covered dumpster areas) and site design measures which can lead to reduced impervious surface for a given equivalent land use, and (5) a requirement that the Dischargers develop a process and criteria to limit changes in the runoff hydrograph for new and redevelopment, where those changes could have a harmful effect on downstream beneficial uses by excessive erosion of the bed and bank of downstream watercourses.

6. **Development Project Approval Process**: Incorporating post-construction Best Management Practices (BMPs) into new development and redevelopment during project planning and approval is an effective means for controlling pollutants in urban runoff. The United States Environmental Protection Agency (US EPA) finds review of development plans during the project approval process necessary, stating: "Proposed stormwater management programs should include planning procedures for both during and after construction to implement control measures to ensure that pollution is reduced to the maximum extent practicable in areas of new development and redevelopment. Design criteria and performance standards may be used to assist in meeting this objective. A municipality should describe how it plans to implement the proposed standards (e.g., through an ordinance requiring approval of storm water management programs, a review and approval process, and adequate enforcement)." For these reasons, the draft revised Provision C.3 includes a requirement for the development project approval process to implement the stormwater management requirements of Provision C.3.

7. **New and Redevelopment Project Categories:** The definition of Group 1 Projects is intended to include an area of additional impervious surface from new and redevelopment that will have a potential to introduce significant additional pollutants to receiving waters and/or cause a significant change in the runoff hydrograph, which has potential to impact downstream watercourse beneficial uses by significant increased erosion of bed and banks of the watercourse. The definition of significant redevelopment is intended to include projects in which the magnitude of the rework of an existing built project is such that the cost of the addition of structural treatment measures, site design measures, and source control measures would be a reasonably small percentage of the overall project cost. In addition, significant redevelopment may include removal and replacement of structures that would present a practical opportunity for overall improvements to the long-term stormwater pollutant runoff condition of the site.

8. **Numeric Sizing Criteria – Volume & Flow Basis:** The American Society of Civil Engineers (ASCE) and the Water Environment Federation (WEF) have recommended a numerical BMP design standard for stormwater that is derived from a mathematical equation to maximize treatment of runoff volume for water quality based on rainfall/ runoff statistics and which is economically sound

(ASCE/ WEF 1998).[1] The maximized treatment volume is cut-off at the point of diminishing returns for rainfall/ runoff frequency. On the basis of this equation the maximized runoff volume for 85 percent treatment of annual runoff volumes in California can range from 0.08 to 0.86 inch depending on the imperviousness of the watershed area and the mean rainfall.[2]

Other methods of establishing numerical BMP design standards include:
(i) Percent treatment of the annual runoff; (ii) Full treatment of runoff from rainfall event equal to or less than a predetermined size; and (iii) Percent reduction in runoff based on a rainfall event of standard size.[3] These numerical design standards have been applied to development planning in Puget Sound, WA; Alexandria, VA; Montgomery County, MD; Denver, CO, Orlando, FL Portland, OR; and Austin, TX. The City of Seattle requires that where new development coverage is 750 square feet or more, storm water detention be provided based on a 25 year storm return frequency and a peak discharge rate not to exceed 0.2 cubic foot per second.[4] Additionally, for projects that add more than 9,000 square feet in developmental coverage, the peak drainage water discharge rate is limited to 0.15 cubic feet per second per acre for a two-year storm. The City of Denver requires new residential, commercial, and industrial developments to capture and treat the 80th percentile runoff event. This capture and proper treatment is estimated to remove 80 to 90 percent of the annual TSS load, which is a surrogate measure for heavy metal and petroleum hydrocarbon pollutants.[5]

Some States have established numerical standards for sizing stormwater treatment BMPs for new development and significant redevelopment. The State of Maryland has established stormwater numerical criteria for water quality of 0.9 to 1 inch and BMP design standards in a unified approach combining water quality, stream erosion potential reduction, groundwater recharge, and flood control objectives.[6] The State of Florida has used numerical criteria to require treatment of storm water from new development since 1982 including BMPs sized for 80 percent (95 percent for impaired waters) reduction in annual total suspended solids load derived from the 90 percent (or greater for impaired waters) annual

[1] In Urban Runoff Quality Management, WEF Manual of Practice No. 23, ASCE Manual and Report on Engineering Practice No. 87. WEF, Alexandria, VA; ASCE, Reston, VA. 259 pp. (1998).

[2] 2 Sizing and Design Criteria for Storm Water Treatment Controls, Presentation to California Storm Water Quality Task Force, November 13, 1998, Sacramento, CA. L.A. Roesner, Camp Dresser McKee.

[3] Sizing and Design Criteria for Stormwater Quality Infrastructure, Presentation at California Regional Water Quality Control Board Workshop on Standard Urban Storm Water Mitigation Plans, August 10, 1999, Alhambra, CA., R.A. Brashear, Camp Dresser McKee.

[4] City of Seattle Municipal Code, Chapter 22.802.015 – Storm water, drainage and erosion control requirements.

[5] Urban Storm Drainage, Criteria Manual – Volume 3, Best Management Practices, Urban Drainage and Flood Control District, Denver, CO (1999). Manual provides detail design criteria for new development for the Denver Metropolitan area.

[6] Maryland Storm Water Design Manual - (Maryland Department of the Environment 2000).. 7 Florida Development Manual: A Guide to sound Land and Water Management (Florida Department of Environmental Protection 19xx). The manual describes structural and non-structural construction and post construction BMPs design criteria.

runoff treatment volume method for water quality.[7] The State of Washington has proposed at least six different approaches of establishing stormwater numerical mitigation criteria for new development that adds 10,000 square feet of impervious surface or more for residential development and 5,000 square feet of impervious surface or more for other types of development.[8] The mitigation criteria options include the 90th percentile 24-hour rainfall event and the six month 24-hour rainfall event.

On a national lèvel, the USEPA is planning to standardize minimum BMP design and performance criteria for stormwater treatment BMPs under Title III of the Clean Water Act and will likely build from the experience of effective state and local programs to establish national criteria.[9] The USEPA, based on the National Urban Runoff Program, supports the first half-inch of rainfall as generating first flush runoff. First flush runoff is associated with the highest pollutant concentrations, and not pollutant load. The USEPA considers the first flush treatment method, the rainfall volume method, and the runoff capture volume method as common approaches for sizing of water quality BMPs.

9. **Operation and Maintenance of Treatment Measures:** All treatment BMPs require some degree of maintenance in order to remain effective for pollutant removal long term. It is the duty of the Dischargers to ensure that adequate and appropriate maintenance and operation occurs, whether the systems are maintained by a public or private entity. This assurance may take the form of an inspection of a random subset of treatment measures in a given year, with effective follow-up.

10. **Limitation on Increase of Peak Storm Water Runoff Discharge Rates:** New development and redevelopment can impact water quality and beneficial uses of waters by altering a watershed's patterns of runoff and particularly by increasing the rates, durations, and frequencies of peak flows. These alterations to runoff patterns, or "hydromodification," result from the addition of impervious surfaces such as rooftops, roads, parking lots, and sidewalks, and the construction of an efficient storm drain system, replacing previously undeveloped land in a watershed. The land use changes associated with urbanization increase the total volume of runoff and increase the speed with which runoff is conveyed to receiving waters.

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[7] Storm Water Management in Washington State Volumes 1 – 5. Public Review Draft (Washington Department of Ecology 1999). The volumes 1,3 and 5 are most relevant to new development standards and cover Hydrologic and Flow Control Designs, Minimum Technical Requirements and Treatment BMPs. The volumes will be adopted as statewide standards in early 2000 after completion of public hearings according to the agency.

[8] Storm Water Management in Washington State Volumes 1 – 5. Public Review Draft (Washington Department of Ecology 1999). The volumes 1,3 and 5 are most relevant to new development standards and cover Hydrologic and Flow Control Designs, Minimum Technical Requirements and Treatment BMPs. The volumes will be adopted as statewide standards in early 2000 after completion of public hearings according to the agency.

[9] Storm Water Phase II Final Rule – 64 Fed. Reg. 68759. See USEPA's discussion on construction and post-construction BMP requirements for Phase II. 3 A Watershed Approach to Urban Runoff: Handbook for Decisionmakers, Terene Institute and USEPA Region 5 (1996). See discussion on sizing rules for water quality purposes, p 36.

Increases in flows from impervious surfaces associated with urbanization can result in:[10]

6. Increases in the number of bankfull events and increased peak flow rates;
7. Sedimentation and increased sediment transport;
8. More frequent flooding;
9. Stream bed scouring and habitat degradation;
10. Stream channel widening and shoreline erosion, including threats to infrastructure (e.g., bridges, utility line crossings, and adjacent roads) and existing structures (e.g., homes, businesses, fences, etc.);
11. Decreased stream baseflow;
12. Aesthetic degradation; and,
13. Changes in stream morphology.

This section requires appropriate control of both changes in peak discharge rates and durations. Efforts to mitigate these impacts in other areas, including Ontario and British Columbia, Canada, and Maryland, initially focused on reducing the increases only in peak flows. However, this approach was often ineffective, and sometimes exacerbated the problems it attempted to solve, by reducing the peak flow, but increasing the duration of erosive flows.[11] To appropriately address hydromodification impacts, it is necessary to address changes to both peak flows and the duration of erosive flows. Thus, this section requires, under certain circumstances, limits on urban runoff flows from new and redevelopment projects. Further, this section recognizes that while the impacts it describes are accepted, the exact runoff control requirements necessary to address those impacts may vary by creek location, condition, and other factors, and therefore requires development of a Hydromodification Management Plan to better address appropriate management of these changes.

6. **Exemption or Waiver Based on Impracticability and Compensatory Mitigation:** In certain circumstances, after all reasonable options have been

[10] Selected references reviewed for this section include:
- , "The Importance of Imperviousness," in *Watershed Protection Techniques* 1(3). p.100-111.
Booth, Derek B., June 1990. "Stream Channel Incision Following Drainage-Basin Urbanization," Paper No. 89098, *Water Resources Bulletin* 26(3), p.407-417.
Brown, Kenneth B., "Housing Density and Urban Land Use as Indicators of Stream Quality," in *Watershed Protection Techniques* 2(4). p.735-739.
Hollis, G.E., 1975. "The Effect of Urbanization on Floods of Different Recurrence Interval," Water Resources Research (1975). p. 431-435.
Klein, Richard D., August 1979. "Urbanization and Stream Quality Impairment," Paper No. 78091, *Water Resources Bulletin* 15(4), p.948-963.
U.S. Environmental Protection Agency, 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. EPA-821-R-99-012. p.4-24 to 4-26.
Washington State Department of Ecology, August 2000. Stormwater Management Manual for Western Washington (Final Draft), Publication 99-11. Volumes 1 and III.

[11] MacRae, C.R., ~1996. "Experience from morphological research on Canadian Streams: Is control of the two-year frequency runoff event the best basis for stream channel protection?"

examined by a project proponent and the Discharger, it may be determined that key aspects of this Provision, primarily structural post-construction, treatment measures designed to operate for the life of the project, are infeasible to integrate into the project. This section allows the Discharger to make this determination under criteria described. It also provides that the Discharger may petition to expand the allowable criteria. If such a determination is made by the Discharger, the project proponent's cost savings, arrived at by comparison to similar projects, must be applied to the removal of stormwater pollutants through treatment measures elsewhere, preferably in the same catchment or watershed.

7. **Alternative Certification of Adherence to Design Criteria for Stormwater Treatment Measures:** This mechanism for review of designs by a competent party is intended to assist Dischargers in the period when they are developing in-house expertise on review of these project elements.

8. **Limitations on Use of Infiltration Treatment Measures - Infiltration and Groundwater Protection:** The use of infiltration, where feasible and safe from the standpoint of structural integrity, must also pose no significant threat to beneficial uses of groundwater.

9. **Site Design Measures Guidance and Standards Development:** The Dischargers have previously participated, through the Bay Area Stormwater Managers Agencies Association, in the preparation of the "Start at the Source" site design guidance. This section seeks to more fully incorporate these site design principles into the Dischargers' local site design guidance and standards.

10. **Source Control Measures Guidance Development:** Many of the Dischargers have already developed planning guidance for this element, but review and augmentation of these efforts is appropriate.

11. **Revise General Plans:** The US EPA finds that the Discharger "must thoroughly describe how the municipality's comprehensive plan is compatible with the storm water regulations" (1992). To achieve this, the Dischargers shall incorporate water quality and watershed protection principles and policies into their General Plans (or equivalent plans). US EPA supports addressing urban runoff problems in General Plans (or equivalent plans) when it states "Runoff problems can be addressed efficiently with sound planning procedures. Master Plans, Comprehensive Plans, and zoning ordinances can promote improved water quality by guiding the growth of a community away from sensitive areas and by restricting certain types of growth (industrial, for example) to areas that can support it without compromising water quality" (2000).

    The principles included in the revised Provision C.3 item 11 incorporate basic measures that have been found to minimize pollutants in urban runoff from new development and redevelopment.

12. **Revise Environmental Review Processes:** Consideration of the effects of new development and redevelopment on water quality during project approval processes will help ensure that potential water quality problems resulting from the development are identified and addressed. The US EPA finds that "Proposed storm water management programs should include planning procedures for both during and after construction to implement control measures to ensure that pollution is reduced to the maximum extent practicable in areas of new development and redevelopment. Design criteria and performance standards may be used to assist in meeting this objective" (1992). The US EPA further finds that "The municipality should consider storm water controls and structural controls in planning, zoning, and site or subdivision plan approval" (1992). Provision C.3 requires the Dischargers' CEQA initial study checklists be revised to include consideration of water quality effects from new development or redevelopment.

13. **Annual Reporting including New Development Pesticide Reduction Measures:** Federal NPDES regulations 40 CFR 122.26(d)(2)(iv) require each Discharger to develop and implement an urban runoff management program. The SFRWQCB must assess the urban runoff management program (URMP) to ensure that it is adequate to prohibit non-storm water discharges and reduce pollutant discharges to and from the MS4 to the maximum extent practicable. In order to assess the urban runoff management program, each Discharger must submit an annual report describing the activities it undertook to meet the requirements of this Provision. The Annual Reports can also be useful tools for the Dischargers. Annual Reports provide a focus to review, update, or revise the URMP on an annual basis. Successful and unsuccessful measures can be identified, helping to focus efforts on areas or issues that provide the greatest results. Areas or issues that have received insufficient efforts can also be identified and improved.

14. **Implementation Schedule:** All of the implementation dates for this provision are presented in this table.

15. **Provision C.14 Expiration Date:** The expiration date is extended by approximately three months to allow adequate time for implementation of the Tentative Order.

V. Written Comments

The formal written comment period for this Tentative Order will close at **5 PM on June 18, 2001**. The Regional Board intends to consider the Tentative Order and any revisions made in response to comments at its July 18, 2001 meeting.

Contact for this Amendment:

Regional Water Quality Control Board

1515 Clay Street, Suite 1400, Oakland, California 94612
ATTN: Janet O'Hara

Or

FAX: (510) 622-5681
e-mail: jbo@rb2.swrcb.ca.gov

APPENDIX B

REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

STAFF REPORT

To: Loretta K. Barsamian
Executive Officer

Date: July 10, 2001

From: Janet O'Hara
Keith H. Lichten
Dale Bowyer
Watershed Management Division

File No. 2182.05 (JBO, KHL, DCB)

SUBJECT: Workshop on Tentative Order Amending the New and Redevelopment Performance Standard in Provision C 3 of the Santa Clara Valley Urban Runoff Pollution Prevention Program NPDES Permit.

Executive Summary

The NPDES permit for the Santa Clara Valley Urban Runoff Pollution Prevention Program (Program) was reissued at the Board's February 2001 meeting, with the previous permit's new and redevelopment performance standard, Provision C 3, retained as an enforceable placeholder. Update of Provision C 3 was deferred with the Program Co-permittees' consent at that time. This deferral has allowed time for further meetings and discussions with the Co-permittees and other interested parties, and subsequent circulation for public comment on May 18, 2001, of the Tentative Order for NPDES Permit Amendment to update Provision C 3 of the Program's permit.

As indicated in Finding 17 of the reissued permit, the Program Co-permittees consented to reopening the permit to address revisions to Provision C 3. As such, the Tentative Order would amend the permit to update the new and redevelopment performance standard to more effectively address impacts of new and re-development projects to downstream beneficial uses from both pollutants in stormwater runoff and sediment erosion in streams caused by changes in the amount and timing of stormwater runoff. The Tentative Order is also intended to address the "Cities of Bellflower, et. al." decision by the State Board in October 2000. The Tentative Order would amend Provision C 3 to include requirements that certain sizes of new and re-development projects include stormwater treatment measures, that those measures be properly maintained for the life of the project, that the measures be designed to treat an optimal volume or flow of stormwater runoff from the project site, and that significant changes in the way runoff occurs due to any increase in impervious surface created by the project not adversely erode creekbeds and banks downstream from the project.

The workshop at the Board's July meeting will allow Board staff to further describe the amendment of Provision C 3 to the Board and interested public, and will open the public hearing on the amendment. Staff intend to revise the Tentative Order as appropriate based on comments received to date and those made in the public hearing, respond to comments made on Provision C 3 in response to the public notices of October 2000 and May 2001, and prepare a Revised Tentative Order for Board consideration at its August 2001 meeting.

Introduction

New and re-development projects present opportunities to efficiently implement measures to reduce the pollutant impacts of stormwater runoff for the life of the newly built projects. Such measures can be and have been completed at a reasonable cost, and can be integrated into the urban and suburban landscape in an aesthetic and unobtrusive manner. The concept of reducing stormwater impacts for the life of a project, including its more technical aspects of design criteria, has been known and widely discussed and implemented for years. The countywide municipal stormwater permitted programs in this Region, including the Program, have worked with Board staff since at least 1993 to develop appropriate technical and conceptual guidance for clean stormwater runoff from new and re-development projects. The challenge remains to ensure consistent and cost-effective implementation of measures that control stormwater pollution and flow to the maximum extent practicable – that is the intent of amending Provision C 3.

We have worked with the Program Co-permittees and other interested parties to develop this amendment through the wide circulation of draft versions of the amendment and through meetings with interested stakeholders on several occasions. While the Co-permittees have stated that the proposed amendment has been improved in some respects as a result of these meetings, the Tentative Order containing the amendment has still drawn significant concern and comment among the Co-permittees and from environmental groups. The Co-permittees' primary comments are that the costs and complexity of implementation will discourage development and redevelopment, the modern life-blood of cities. In addition, the environmental group commenters are not yet satisfied with the Tentative Order; their concerns include that too much time is allowed for implementation of the requirements in the amendment and that the amendment covers fewer types of projects than previous versions, in its first years of implementation. We anticipate further revision of the Tentative Order will help create language that is as clear and workable as possible.

In this report, we summarize the development of the technical and regulatory approaches of addressing the stormwater runoff pollutant impacts of new development, and make it clear that the Co-permittees have been involved in the development and consideration of these approaches for nearly a decade. Besides the years of work in this Region, we mention similar efforts in other California regions and other states in the nation. We discuss the nature of the water quality problem and how the amendment will use the opportunities presented by new development and significant redevelopment to reduce adverse water quality impacts from stormwater runoff. We also describe the major comments received and revisions to the Tentative Order that staff are currently considering to address them.

History and Background of New and Redevelopment Urban Runoff Regulation

In writing the Clean Water Act (CWA), Congress stated, "...the objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (86

Stat. 816 §101). Congress' goal is commonly referred to as making all waters fishable, swimmable, and drinkable.

The CWA initially focused on achieving this objective through control of point sources of polluted water (e.g., oil refineries, sewage treatment plants, and other large wastewater sources). Water quality was significantly improved throughout the 1970s and 1980s by controlling these point source, or "large pipe", discharges. However, large percentages of the nation's waters remained impaired—impairment due primarily to non-point sources, such as urban storm water runoff. As a result, when Congress amended the CWA in 1987, it included a much stronger focus on non-point source pollution, including urban runoff. In fact, urban runoff was declared a "point source" and brought into the federal NPDES permit regulatory sphere. In California, the regional boards are mandated to issue federal NPDES permits. The municipal stormwater programs in this Region, including the sections on new and redevelopment, are a result of the 1987 CWA amendments.

As described below, detailed Best Management Practice (BMP) guidance and design materials for new and redevelopment runoff treatment have been available for a number of years. Since the early 1990s, Board staff, working with the Bay Area urban runoff programs and their consultants, have prepared guidance materials to help address the impacts of new and re-development projects. These guidance materials substantially covered the requirements and issues addressed in the proposed amendment to Provision C 3.

1987

The CWA was amended, with particular focus placed on urban runoff, including runoff from new and redevelopment projects. The 1987 CWA amendments require a municipal stormwater program to "require controls to reduce the discharge of pollutants to the maximum extent practicable (MEP)." [CWA 402(p)(3)(B)(iii)]

Regulations issued by U.S. EPA in 1990 in response to the 1987 CWA amendments require that municipal urban runoff programs include:

- "...[a] description of **planning procedures...to develop, implement and enforce controls** to reduce the discharge of pollutants from municipal separate storm sewers which receive discharges **from areas of new development and significant redevelopment..**" [40 CFR 122.26(d)(2)(iv)(A)(2)] and,

- "...[a] description of **maintenance activities and a maintenance schedule** for structural controls to reduce pollutants (including floatables) in discharges from municipal separate storm sewers." [40 CFR 122.26(d)(2)(iv)(A)(1)]

1993

- U.S. EPA publishes the "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters," a guide that identifies BMPs like those addressed in the present permit, includes information on urban runoff impacts, BMP pollutant removal efficiency, and BMP cost. The Guidance identifies both chemical pollutants and runoff hydrograph changes leading to excess creek erosion as significant urban runoff impacts.

- The State Stormwater Quality Task Force, an association of urban runoff programs in California, publishes the "California Storm Water Best Management Practice Handbooks." These *BMP Handbooks* are funded in part by entities including the Bay Area municipal urban runoff programs, the Santa Clara Valley Water District, and the State Board. The *BMP Handbooks* include:
  - A discussion on the impacts of urban runoff pollutants and erosion caused by changes in runoff associated with development;
  - Detailed information on source control BMPs;
  - Detailed design information for treatment controls like extended detention ponds and vegetated swales; and,
  - Notice that maintenance of controls is "very important."

1994

- Regional Board staff release the "Staff Recommendations for New and Redevelopment Controls for Storm Water Programs." These *Staff Recommendations:*
  - Were prepared through a public stakeholder process that included the Bay Area municipal urban runoff programs and other interested parties, working through the Bay Area Storm Water Management Agencies Association (BASMAA) New Development Subcommittee;
  - Describe the key components that should be included in an effective new and redevelopment performance standard of a municipal storm water management plan;
  - Include components that are included in the proposed amendment to Provision C 3, and form the basis for the Program's new and redevelopment permit standards, including:
    - Use of source controls, site planning and design BMPs, and treatment controls;
    - Use of regional treatment facilities to address treatment more efficiently than on a project-by-project basis;
    - Establishment of an inspection, operation, and maintenance program for BMPs;
    - Minimizing hydromodification resulting from urbanization, and specifically maintaining the pre-development peak flow and average volumes at pre-development levels;
    - Lists of BMPs, including source controls, treatment controls, etc.; and,
    - Incorporation of BMP recommendations by cities into their local planning processes, including addressing impacts in CEQA; and,
  - Specify a recommended schedule for municipalities to update their planning and building ordinances to implement the *Staff Recommendations*.

- The Alameda and Contra Costa Urban Runoff Programs publish the "Final Bay Area Preamble to the California Storm Water Best Management Practice Handbooks and New Development Recommendations." This *Preamble*:
  - Provides a step-by-step procedure for using the Board's *Staff Recommendations* and the state *BMP Handbooks*;
  - Provides straightforward guidance regarding the BMP selection process;

- Defines the applicability of individual BMPs to the Bay Area, and includes some sizing information, including detention basin sizing curves for Alameda and Contra Costa counties, based on local rainfall; and,
- Directs the user to appropriate local agencies for further information.

1995-1997

The Program's NPDES permit, as reissued in 1995, required a Performance Standard for New Development Planning Procedures be developed by September 1, 1996, and submitted to the Executive Officer. The final "model" Performance Standard, dated November 12, 1996, "defined the level of implementation that municipal agencies must attain in order to demonstrate that their land use planning and development plan review and approval processes control stormwater quality impacts to the maximum extent practicable." Using the "model" Performance Standard, each Program Co-permittee developed and certified compliance with its own performance standard by mid-1997. The Performance Standard states that:

- The Co-permittee has adequate legal authority to implement new development control measures as part of its development plan review and approval procedures;
- Developers are provided information on site design guidelines and BMPs for stormwater pollution prevention early in the application process;
- The CEQA and NEPA review processes will address stormwater quality impacts during the life of the project;
- Developers of projects with significant stormwater pollution potential are required to mitigate impacts through proper site planning and design techniques and/or addition of permanent stormwater quality control measures;
- Developers of projects with permanent structural stormwater controls are required by the Co-permittee to establish and provide for operation and maintenance of such controls; and,
- The Co-permittee provides annual training to its planning, building, and public works staffs on planning procedures, design guidelines, and BMPs for stormwater pollution prevention.

Annual Reports prepared by the Co-permittees show that permanent stormwater control measures are implemented at some development projects, indicating at least some acceptance of feasibility. However, the number of new development projects implementing such controls is relatively small overall, and where controls are implemented, often the least effective systems are installed with no serious consideration of treatment capacity and maintenance, and some Co-permittees have required very few projects to implement stormwater control measures.

1997 and 1999

BASMAA publishes "*Start at the Source,*" a site planning and design guidance manual for stormwater quality protection. The manual is developed in a public stakeholder process that includes the local urban runoff programs, Board staff, and other interested parties. The revised 1999 edition includes:

- Detailed information on BMPs, including source controls, site design measures, and treatment controls;
- Information on planning and zoning measures to help address urban runoff impacts;
- A discussion of numerical sizing criteria for treatment controls. The stakeholder group cannot agree on a criterion, so while there is a discussion of the issue, no number or agreed-upon sizing method appears in the published book; and,

- Other information, including a discussion of hydromodification as an impact of urban runoff.

Water Quality Impacts of Urban Runoff from New Development

The water quality impacts of urbanization and stormwater discharges have been summarized by several recent U.S. EPA reports.[1] Urbanization causes changes in hydrology and increases pollutant loads, which adversely impact water quality and impair the beneficial uses of receiving waters. Specifically, urbanization affects stormwater runoff by increasing the following:

- The concentrations and types of pollutants found in stormwater;
- The loads of pollutants carried and their transfer rates into receiving waters; and,
- The volumes and rates of surface runoff.[2]

Nationwide and Bay Area monitoring of stormwater, some of it accomplished through years of effort and expense by Program Co-permittees, has indicated that stormwater contributes to exceedance of state and federal water quality criteria for such pollutants as pathogen indicators (e.g., fecal coliform and streptococcus), heavy metals (e.g., lead, copper, and zinc), and pesticides (e.g., diazinon). Further, stormwater discharges can exhibit both acute and chronic toxicity to aquatic life, and can chronically impair aquatic life. Other impacts include: human health impacts from coming into contact with polluted water while swimming, surfing, or wading, or eating contaminated fish and other seafood; creation of a visual nuisance by trash, oil and grease, and other pollutants accumulating in waters; and smothering of aquatic habitat from the discharge of sediment from construction sites or poorly designed and constructed storm water conveyances.[3]

Increases in population density and imperviousness result in changes to stream hydrology.[4] These changes can result in impacts including:

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[1] *Storm Water Phase II Report to Congress* (USEPA 1995); *Report to Congress on the Phase II Storm Water Regulations* (USEPA 1999); *Coastal Zone Management Measures Guidance* (USEPA 1993);
[2] *Urban Drainage Criteria Manual* (Denver Urban Drainage and Flood Control District 1999), vol. 3.
[3] Summaries of pollutant loading and impact data can be found in, for example, *Fundamentals of Urban Runoff Management: Technical and Institutional Issues*, Horner et al. (1994), Terrene Institute, Washington, D.C.
More detailed local and national data may be found in:
Loads Assessment Summary Report, Alameda Cty. Urban Runoff Clean Water Program (1991), ACFCWD, Hayward;
Water Pollution Aspects of Street Surface Contaminants, USEPA (1972), Doc. No. EPA-R2-72-081;
Water Quality and Biological Effects of Urban Runoff on Coyote Creek, Phase I, USEPA (1980), Doc No. EPA-600/2-80-104; and,
Report to San Francisco District Corps of Engineers on determination of Urban Runoff Water Quality at Castro Valley Creek, Alameda County, California, November 1978-April 1979, Metcalf & Eddy Engineers (1979), Palo Alto.
[4] Examples of changes to hydrology include:
1. Increased peak discharges compared to predevelopment levels;
2. Increased volume of storm water runoff with each storm compared to predevelopment levels;
3. Decreased travel time to reach a receiving water;
4. Increased frequency and severity of floods;
5. Reduced stream low flows due to reduced level of infiltration;
6. Increased runoff velocity during storms due to a combination of effects of higher discharge peaks, rapid time of concentration, and smoother hydraulic surfaces from channelization; and,
7. Decreased infiltration and diminished groundwater recharge.

1. Changes in erosion and sedimentation and increased sediment transport;
2. Increases in the number of stream bankfull flow events and increased peak flow rates;
3. More frequent flooding;
4. Stream bed scouring and habitat degradation;
5. Stream channel widening and shoreline erosion, including threats to infrastructure (e.g., bridges, utility line crossings, and adjacent roads) and existing structures (e.g., homes, businesses, fences, etc.);
6. Decreased stream base flow during dry weather;
7. Aesthetic degradation; and,
8. Changes in stream morphology.

The measures proposed in the Tentative Order can be expected to reduce the discharge of pollutants to waters of the State. Water bodies within Santa Clara County or to which Santa Clara County is tributary are listed as impaired for pollutants on the CWA Section 303(d) list. Impairing pollutants include those for which urban runoff is a significant contributor, including sediment, copper, nickel, PCBs and diazinon. Total maximum daily load (TMDL) estimates are being prepared for listed pollutants and water bodies, and the measures required in this Tentative Order will be significant measures to manage loadings to waters, when waste load allocations are developed to implement the TMDLs.

In summary, urban runoff has been identified as a significant contributor to degradation of beneficial uses and water quality criteria exceedance. The measures proposed in this Tentative Order will help reduce detrimental impacts to waters of the State caused by urban runoff from new development and significant redevelopment projects.

<u>Implementation in Other California Regions and Other States</u>

A number of municipalities across the country are presently implementing the BMPs, planning practices, and other practices similar to those proposed by the Tentative Order. In addition, projects with measures for site design, source control, or treatment control, and/or limitations on changes in the runoff hydrograph, like those included in the Tentative Order, have been constructed throughout the Bay Area and in at least 25 states.[5] Letters from programs in Maryland, Florida, and Washington, written to the Los Angeles Regional Board staff during the development of the Los Angeles Standard Urban Stormwater Mitigation Plans (L.A. SUSMP), and discussing implementation of numerical standards in those states, are attached (see Attachment A).

Outside of California, numerical design standards similar in approach to those in the Tentative Order apply to development projects in, among other places:

- Puget Sound, Washington
- Alexandria, Virginia

[5] "*Stormwater Strategies: Community Responses to Runoff Pollution*," Natural Resources Defense Council (May 1999), National Storm Water BMP Database, ASCE/USEPA (revised 2000). Projects recently permitted by the Board, including residential projects such as the Gale Ranch project in Contra Costa County and the Blue Rock Country Club in Alameda County, and commercial/industrial projects such as Catellus' Pacific Commons project in Fremont and Pacific Shores in Redwood City, include such measures.

- Montgomery County, Maryland
- Denver, Colorado
- Orlando, Florida, and
- Austin, Texas.

Examples of implementation include:

- **State of Florida:** Since 1979, Florida has used numerical sizing criteria (the method for specifying the runoff rate used to design the proper-sized BMP) for stormwater BMPs, including BMPs sized to treat 90 percent or greater of average annual runoff with the goal of reducing the total suspended solids loadings to waters by 80 percent (95 percent for impaired waters).
- **State of Maryland:** Since 1982, Maryland has required treatment of 0.9 – 1.0 inch of rainfall runoff for water quality, and included BMP design standards in a unified approach combining water quality, stream erosion potential reduction, groundwater recharge, and flood management.
- **State of Washington, Puget Sound catchment:** Since 1992, Washington has required use of numerical sizing criteria for stormwater BMPs and hydromodification impacts. The criteria are presently being revised and, when released this summer, are expected to become more stringent, and to apply to the entirety of western Washington.[6] The 1992 standards, while allowing for differing approaches, required use of numerical hydraulic design standards for new development and redevelopment projects of 5,000 square feet or larger. Sizing options included the 90th percentile 24-hour rainfall event and the six-month, 24-hour rainfall event.[7]
- **Seattle, Washington:** Where new development coverage is 750 square feet or more, stormwater detention must be provided based on a 25-year storm and a peak discharge rate not to exceed 0.2 cubic feet per second per acre. For projects that add more than 9,000 square feet in development coverage, the peak drainage discharge rate is limited to 0.15 cubic feet per second per acre for a 2-year storm.
- **Denver, Colorado:** New residential, commercial, and industrial projects greater than one acre must capture and treat the 80th percentile runoff event.[8] This capture and proper treatment are estimated to remove 80 – 90 percent of the annual total suspended solids (TSS) load. TSS is viewed as a surrogate measure for heavy metal and petroleum hydrocarbon pollutants.

The L.A. SUSMP was affirmed by the State Board in the precedential "Cities of Bellflower, et. al." appeal decision (State Board Order 2000-011). Following this decision, other California stormwater permits, e.g., the County of Ventura, the City of Long Beach, and the City and County of San Diego, contain similar provisions appropriate for local conditions. In addition, draft tentative orders for Municipal Stormwater Permits containing similar provisions are out for public comment for Orange County, and for the reissuance of the L.A. County permit. The L.A. County draft tentative order for permit reissuance, and other adopted orders summarized in Attachment B, include some more comprehensive elements than the first L.A. SUSMP.

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[6] *"FINAL DRAFT – Stormwater Management Manual for Western Washington, Volume I, Minimum Technical Requirements,"* Washington State Department of Ecology (August 1999, as revised January 2001).
[7] "Stormwater Program Guidance Manual for the Puget Sound Basin," Washington State Department of Ecology (July 1992) (Vol. 1, Appendix A).
[8] "Stormwater Quality Control Plans: An Information Guide," Denver Department of Public Works (2000).

In summary, numerical design capacity standards and other BMPs similar to those in the Tentative Order are being successfully implemented in a number of jurisdictions inside and outside of our State.

Key Components of the Tentative Order for NPDES Permit Amendment Revising Provision C 3, including a discussion of Major Comments and Potential Tentative Order Revisions

Major Stakeholder Comments on the Tentative Order

Comments were received from 39 entities during the May 18 through June 18, 2001, public comment period, including fifteen entities representing the Co-permittees, two environmental advocacy groups, fifteen representatives of industry, five other Bay Area public entities, and two consulting firms. Through the stakeholder process and from the comments received, staff has attempted to incorporate in this report discussion, in advance of formal response to comments and revision of the Tentative Order, some of the major issues stated in those comments, and recommended or potential revisions of the Tentative Order which may be made in response to some of the major comments. The most frequent comments could be grouped under the following subjects:

- Project size categories and definition of significant redevelopment
- Cost of implementation
- Implementation schedule
- Limitations in changes to runoff peak flow and duration
- Linkage between Tentative Order requirements and water quality benefits. (This topic is addressed in previous sections of this Staff Report.)

New Development and Redevelopment Project Size Categories

The Tentative Order describes the categories of new and redevelopment projects that would be subject to the new requirements at the proposed date of implementation, July 15, 2002. The Co-permittees expressed concern that implementing numerically sized treatment BMPs for small projects would initially be difficult, because of a lack of design resources and consulting help needed for smaller projects. As a result of this discussion, we included a phased approach, based on project size, to implementing the numerical sizing criteria, so that experience could be gained with larger projects before implementing stormwater BMPs at smaller projects. The larger projects, referred to as Group 1, consist of all new projects that create one acre (43,560 square feet) or more of impervious area including roof area, and all significant redevelopment projects that encompass the same area of impervious surface. For this category, stormwater treatment BMPs must be required during the development approval process by July 15, 2002.

The smaller projects, referred to as Group 2, range from one acre down to 5000 square feet of impervious area for new development and significant redevelopment projects. Initially, this group would be subject to all requirements of the amended Provision C 3 *except* the numeric sizing criteria, the operation and maintenance verification, and the limitations on hydrograph change. Then, in July, 2003, Group 2 merges with Group 1, becoming subject to all the requirements of Provision C 3. Provision C 3 does not apply to any project below these sizes.

The Co-permittees can propose an alternate minimum size for Group 2, which includes 80% of new impervious surface built within a typical year, in order to tailor the requirements to the sizes of new development in their municipalities.

The size categories in the Tentative Order differ from those in the precedential L.A. SUSMP Order. The L.A. SUSMP contains more specific categories that are artifacts of a previous permit. Projects included in the L.A. SUSMP are commercial developments of 100,000 ft^2 or greater; 10 unit or more residential developments; 5000 ft^2 or 25 space parking lots; single family homes on hillsides; and restaurants and automotive facilities of 5000 ft^2 or greater. However, L.A. SUSMP project sizes are being revised downward. The new draft tentative order to reissue the L.A. permit includes one-acre sites by March 2003. The current L.A. SUSMP project categories cover fewer new development projects than would be covered by those specified in our Tentative Order.

The Program has commented that the L.A. SUSMP categories are preferable to the currently proposed categories. However, WaterKeepers has commented that the phasing approach represents a significant reduction of implementation of the requirements from previous drafts of the amendment, and the Group 2 projects should be included immediately upon implementation of this Tentative Order, particularly given the delay in updating Provision C 3.

Significant Redevelopment Definition

The proposed requirements apply to new development projects and to projects that meet the specifications for "significant redevelopment." The definition of significant redevelopment, which involves enough capital investment and physical change in an existing developed site so that stormwater treatment improvements would be a reasonable requirement, has been difficult to specify. Co-permittees are concerned that urban redevelopment is not impeded by permit requirements. We share the Co-permittees' concern that redevelopment limited to simple maintenance of structures and pavement should not be included. All parties are interested in ensuring that these requirements have at least a neutral or positive effect on the sprawl versus smart growth/urban infill dynamic.

The Program has commented that it prefers the L.A. SUSMP redevelopment definition, that we consider very similar to our own. In addition, we anticipate revising the Tentative Order to clarify that strictly interior remodels are excluded.

Numeric Sizing Criteria – Volume and Flow

The Tentative Order includes several equivalent methods to determine the optimum volume or flow rate of stormwater to be treated by stormwater BMPs. This volume or flow rate is used to design proper-sized treatment controls. The volume or flow rate is calculated using local rainfall data and the runoff characteristics of an individual development site. Numeric sizing methods are intended to assist in the design of stormwater treatment controls by answering the question: "How much stormwater treatment capacity is enough?" In so doing, they provide a level of predictability needed by the builders and engineers tasked to incorporate these controls into their projects. The numeric sizing criteria do not appear to be controversial. Throughout the stakeholder process, there has been very little comment focused on the numeric sizing criteria.

The sizing calculations are based on the concept of optimal treatment capacity. With these methods, the capacity of the treatment devices is as large as it can be before additional capacity is more expensive than is reasonable. The table and discussion in Attachment C describe this point in more detail.

The approach in the Tentative Order does not specify use of a particular type of treatment control system or physical principle. For example, the use of infiltration measures, detention basins, and/or grassy swales is not required. Rather, the approach directs the appropriate design capacity or hydraulic sizing of whichever treatment control or controls are selected by a builder. The builder then applies a sizing method from the appropriate category (e.g., volume-based for detention basins, flow-based for grassy swales, etc.) to the project.

The options will result in treatment of about 80-90% of average annual runoff from a site. This volume has been determined based on analyses of rainfall patterns to maximize the amount of runoff treated while minimizing total cost per amount of runoff treated.[9] Under the proposed criteria, 80-90% of average annual runoff is treated without the substantial increase in size and cost of treatment controls that would be necessary to treat the largest storms that comprise the remaining 10 – 20% of average runoff.

The American Society of Civil Engineers (ASCE) and the Water Environment Federation (WEF) have recommended a numerical BMP design standard for storm water. Their recommended standard is derived from a mathematical equation to maximize treatment of runoff volume for water quality based on rainfall/runoff statistics and is economically sound (ASCE/WEF 1998).[10] The standard is based on analyses of hourly rainfall data in cities across the United States, including San Francisco, and is reflected in the criteria listed in the proposed amendment.

In summary, the listed numerical criteria provide an important even playing field for those who will design and build these treatment systems. These technical approaches have been calculated to provide the most treatment for the least cost.

Operation and Maintenance

In order for the installed treatment systems to function adequately, appropriate long-term operation and maintenance must occur. For some of the treatment approaches based on landscape

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[9] Analysis of 13 years of daily rainfall data for Palo Alto and Livermore found that about 90% of average annual runoff-generating precipitation was in storms of 1.2 inches in depth or less. On average, only about one storm per year was more than 1.2 inches in depth. Thus, sizing controls to treat the largest storm events would result in a significant increase in cost without a concomitant increase in pollutant removal. *Adapting Engineered Vegetated Swales to the San Francisco Bay Area's Mediterranean Climate: Law, Design, and Pollutant Removal Effectiveness. Master's Thesis.* Keith Lichten, University of California, Berkeley (1997).

[10] In Urban Runoff Quality Management, WEF Manual of Practice No. 23, ASCE Manual and Report on Engineering Practice No. 87. WEF, Alexandria, VA; ASCE, Reston, VA (1998).

elements, such as vegetated swales and detention basins, maintenance can be relatively simple. For many of the measures that are more mechanical and exist in below ground vaults, inspection and maintenance can become more resource intensive. Lack of timely maintenance of such measures may result in greater water quality impacts than if the measures were never installed.

The Co-permittees are reluctant to take on new municipal maintenance burdens. However, in some instances, no private entity will be available to assume maintenance responsibility. The language in the Tentative Order follows an approach very similar to that used in the L.A. SUSMP Order, with some improvements. The approach for operation and maintenance assurance in the Tentative Order also gives the Co-permittees responsibility for an effective inspection program, checking a subset of installed systems each year, with follow up and enforcement, if necessary, to assure adequate results. Such an approach is similar to that currently required for the construction and industrial/commercial components of the Program's permit.

The Co-permittees have expressed reluctance to approach this issue using the L.A. SUSMP approach, which directs the creation of deed restrictions and CCRs in property transfers to require appropriate maintenance, because it may be difficult to apply these deed restriction on small, ministerial projects, which do not receive much city review. ***The Tentative Order may be revised to exempt these smaller projects from the deed restriction requirement.***

Economics of Implementing the Tentative Order's Requirements

Among the greatest concerns stakeholders have about the Tentative Order is its potential costs. However, source control, site design, and treatment control BMP requirements for new development offer a cost-effective strategy to reduce urban runoff pollutant loads to surface waters. Studies on the economic impacts of watershed protection indicate that stormwater quality management has a positive or at least neutral economic effect while reducing stormwater pollutant impacts to the quality of surface waters.[11]

Costs of implementation of the Tentative Order requirements are expected to fall in the range of 1 – 2% of overall project costs for new or significant redevelopment. This percentage will vary depending on project type, site design constraints, and the extent to which the Tentative Order's requirements are combined with other parts of a project, such as required landscaping. A simplified example cost estimate is provided in Attachment D.

Innovative project designs that utilize site design and treatment control requirements to reduce other costs—for example, draining stormwater in surface swales rather than excavating for and building an underground storm drain system—may even have lower costs than a so-called "standard" development. Village Homes, constructed in the mid-1970s in Davis, California, is an example of a single-family residential subdivision project that saved money by constructing surface swales and detention basins instead of underground storm drains. Village Homes' use of those

[11] *The Economics of Watershed Protection*, Tom Schueler (1999), Center for Watershed Protection, Endicott, Maryland. The article summarizes nationwide studies to support the statement that watershed planning and stormwater management provide positive economic benefits.
Economic Benefits of Runoff Controls, USEPA (1995), Doc. No. EPA 841-S-95-002, discusses the economic benefits of including stormwater treatment wetlands and wet ponds in projects.

measures also resulted in improved flood control, higher property values, and increased quality of life as compared to similarly situated single-family subdivisions.

Some Co-permittees have asserted that the Tentative Order will lead to costs of as much as 10% of the new and redevelopment capital expense. ***While staff does not agree that costs will be so high, part of this high cost estimate may be based on an interpretation of the interim limitation on changes to the runoff hydrograph from new development. Staff anticipates modifying this limitation to conform to L.A. SUSMP in the Revised Tentative Order. Please see the section below on limitations of hydrograph change.***

Stakeholders also assert that the Tentative Order could have a detrimental effect on downtown urban redevelopment projects, infill, low-cost housing, and "smart growth" initiatives. However, as shown in the Davis, California, example above, and in much of the literature quoted in earlier sections of this Staff Report, the requirements of the Tentative Order are compatible with smart growth concepts and are likely to have positive effects on flood control and property values.

We recognize that Co-permittees may incur some additional staffing costs, depending on their current level of implementation of the existing performance standard. Most will need to augment their existing development review processes, and there will be some initial guidance development and training costs. Information provided in their Annual Reports shows that few Co-permittees consistently require new developments to implement storm water treatment BMPs, despite existing permit requirements.

Based on the results of the Survey of Southern California Stormwater Programs[12], some permitted entities have used existing staff to fulfill requirements, while others have added staff. The Tentative Order includes a measure to reduce cities' potential need for additional staff to review project designs to ensure compliance with the amendment's requirements. Specifically, it allows "alternative certification" of compliance. That is, rather than completing review in-house, cities may defer technical review to a third party, and accept a signed certification from an appropriately trained and licensed professional that a project design meets the established requirements.

The Co-permittees have asked that the "exemption or waiver based on impractibility" process, with compensatory mitigation, such as regional treatment facilities, be made more available than currently written at C 3 g. For very difficult, high-density developments, with high cost of treatment, some additional waiver criteria may be appropriate, and may reduce some "worst case" costs.

The revision of the Tentative Order with the addition of a waiver provision that allows off-site storm water treatment under certain specific conditions, should ease potential conflicts between the requirements of the Tentative Order and in-fill or redevelopment, and may also address some difficult cost issues.

<u>Implementation Schedule</u>

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[12] Letter from Donald P. Freitas, Program Manager, Contra Costa Clean Water Program, to Loretta Barsamian, Executive Officer; Appendix A of the letter: Survey of Southern California Stormwater Programs, June 18, 2001.

The Co-permittees comment that the amount of time allowed to implement requirements is too short in general, and does not recognize the many time consuming steps, including often lengthy internal review, public participation, CEQA, and other statutory processes that may be required to implement the Tentative Order requirements. However, WaterKeepers comments that too much time will pass before implementation occurs.

More time is provided for implementation in this Tentative Order than in previous drafts, and nearly a year has transpired since the update of the new and redevelopment performance standard was first raised in the permit reissuance process. While it appears that much of the concern about the need for a longer implementation schedule is related to the time needed to adopt ordinances to establish the agencies' legal authority to implement the measures, much of that legal authority should already have been secured in ordinances adopted in response to their existing permit and performance standards. Co-permittees certified as early as November 1996 that they have legal authority to implement new development control measures as part of their development plan review and approval processes.

The schedule in the Tentative Order allows more time for the tasks that are difficult to complete. For example, a two-year period is provided to complete the Hydromodification Management Plan to minimize changes to the hydrograph of local creeks and rivers where erosion impacts can occur. Three years is given to fully implement site design standards and guidance, and two years are allowed before the smaller projects defined under Group 2 are included under the broader requirements for Group 1.

The L.A. SUSMP Order allowed six months for any necessary ordinance modifications, with one additional month to implement requirements. Our Tentative Order allows one year to implement similar requirements. Los Angeles Regional Board staff reports that the municipalities did have adequate time to accomplish the required work. Indeed, survey results provided with stakeholder comments describe that the City of Los Angeles, Los Angeles County, San Diego County and the City of San Diego did not require extra time to fulfill requirements[13]. Los Angeles Co-permittees, who completed all necessary ordinance revisions in six months, did not require CEQA. In many cases, unlike the Program Co-permittees, the Los Angeles Co-permittees had never previously established ordinances for broad implementation of their stormwater pollution control programs.

Many of the requirements in the Tentative Order are similar to requirements and performance standards based on the Program's 1995 permit. In addition to certifying that they have had adequate legal authority to implement new development control measures, the Co-permittees, to some extent, have also required developers of projects with significant stormwater pollution potential to mitigate impacts through proper site planning and design techniques and/or addition of permanent stormwater quality control measures. The existing performance standard also states that Co-permittees will require developers of projects with permanent structural stormwater controls to provide for operation and maintenance of such controls. It further requires annual training to planning, building, and public works staffs on planning procedures, design guidelines, and BMPs for stormwater pollution prevention. While already required, this is a set of tasks that the Co-

[13] Letter from Donald P. Freitas, Program Manager, Contra Costa Clean Water Program, to Loretta Barsamian, Executive Officer; Appendix A: Survey of Southern California Stormwater Programs, June 18, 2001.

permittees comment will now take time and resources to accomplish, as these tasks apparently have not yet been fully implemented.

Regarding requests for additional time to study the impacts of development on local creeks and rivers, the large body of studies quoted in previous sections of this Staff Report provide adequate support that development has detrimental impacts on beneficial uses and water quality, and that the approach which is already a part of the Program's Stormwater Management Plan and existing permit will reduce those impacts.

Regarding requests for more time to comment on the Tentative Order, Board staff believes the stakeholder process, while not perfect, has been adequate. The public dialogue concerning the new development provisions began in 1999 with the NPDES permit reapplication process. A summary of the steps in the public process is included as Attachment E.

An option for consideration is extension by one year of the date when smaller Group 2 projects would be subject to the stricter requirements of Group 1, from the current July 15, 2003 until July 15, 2004. In addition, we will clarify the language on which projects in the plan approval pipeline are subject to implementation. We will also examine whether, upon adequate proof of need, extra time for CEQA review and adoption of ordinance enhancement should be added.

<u>Limitation on Change in Runoff Peak Flow, and Duration of High Energy Flows</u>

Many comments were received on this provision, which limits changes in the peak rate and duration of high energy, scouring flows in runoff from new development. Changes in the peak rate and duration of flows have been shown to cause erosion damage to streams. The language initially used for this provision was not clear enough, and caused serious concern among the Co-permittees.

We currently anticipate revising the Tentative Order so that the interim standard of this provision is very similar to the L.A. SUSMP peak runoff discharge limitation, which is less stringent than the current language that requires no change in peak or duration of runoff after development.

The present standard requires strict controls on increases to peak flows and durations for a certain range of storms for new and redevelopment projects, while a more comprehensive approach to appropriately deal with this impact of new development is required to be developed over two years. This approach is termed the "Hydromodification Management Plan" (HMP) in the Tentative Order.

The impacts of peak flow and duration increases have long been recognized. This provision requires, in part, development of HMPs. A significant advantage of developing these plans, as opposed to specifying a single countywide standard, is that municipalities can look at site- and creek-specific conditions to determine the flexibility in how much flows can change without significant impacts *to their waterbodies*. In addition, the HMP process will determine where it makes sense to impose stormwater flow BMPs, because many creeks in the County have been so hardened by previous flood control work that significant changes due to upstream projects will have little or no impact on sediment erosion. Staff believes there will be significant flexibility, which will be identified as the HMPs are developed. Meanwhile, the interim approach will be revised to be more flexible.

Summary of Other Tentative Order Items

The tentative order includes a variety of measures intended to assist implementation of the amendment's requirements by revising Co-permittees' project planning and approval processes. These measures include development of source control BMP guidance, revising general plans, ensuring that urban runoff water quality impacts are appropriately addressed in environmental review processes such as CEQA, and reviewing and revising local site design standards and guidance to help address urban runoff impacts.

Some of these measures, such as the source control BMP guidance, have already been developed by Bay Area urban runoff programs. Others will require a more detailed review of existing city policies. The amendment includes guidance for each of these areas, to help direct the Co-permittees in completing them. The guidance provides suggestions of areas to address and questions to consider when completing the reviews and revisions. The guidance items listed in the tentative order (e.g., examples of particular source controls, questions that could be incorporated into a city's environmental review process, etc.) are not required, but are strongly recommended as starting points for the review process. Staff anticipates that the Co-permittees will be able to use work that has been completed by other Bay Area stormwater programs, and, further, that the Program may work together with other stormwater programs to address these issues. This would help to reduce the amount of work needed to complete these reviews.

Summary and Conclusions

The Tentative Order is the result of many hours of discussion and consideration with Co-permittees and other interested parties, and is largely patterned on the Orders adopted in other regions of California, and guidance created with the Co-permittees' involvement over the last two 5-year permit cycles. Staff recognize that some careful revision of the Tentative Order will be necessary prior to final Board consideration, and we have attempted to present some recommendations and options for such revisions in this report. Future generations will inherit the built environment we create today, including both its positive and negative aspects. There is much we can do, working together, to reduce the impacts to our waters from necessary development.

ATTACHMENT A

Correspondence From Maryland, Florida And Washington States Regarding Their Implementation Of Numeric Design Criteria For Urban Stormwater Runoff

MDE
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Parris N. Glendening
Governor

MDE
MARYLAND DEPARTMENT
OF THE ENVIRONMENT
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Nonpoint Source [redacted] Program
(410) 631-3543

Brian Clever

May 31, 2000

RECEIVED
00 JUN -5 PM 1:23
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD LOS ANGELES REGION

Ms. Elizabeth M. Jennings, Esq.
Office of Chief Counsel
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

And,

Mr. Xavier Swamikannu
Storm Water Program
California Regional Water Quality Control Board – LA Region
320 W. 4th Street, Suite 200
Los Angeles, CA 90013

Dear Ms. Jennings and Mr. Swamikannu:

Enclosed are several items that may help you understand the goals attributed to Maryland's stormwater management program. The Maryland Department of the Environment is nearing 20 years worth of experience in administering an urban runoff program. Some basic tenets of the program and the successes and failures are described in the three reports provided.

Additionally, a brief background summary is provided in order to explain the transition we are making from current requirements to those proposed in the "2000 Maryland Stormwater Design Manual." This summary also helped to better answer the design and performance standards questions that you posed regarding stormwater management in our State. We hope this material will be of some use to you.

If you have any questions or need any more information, please call me at 410-631-3543.

Sincerely,

Brian S. Clevenger

Brian S. Clevenger
Water Management Administration

w\Enclosures

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MARYLAND'S STORMWATER MANAGEMENT PROGRAM
SUMMARY

Introduction

The State of Maryland has recently completed the development of the "*2000 Maryland Stormwater Design Manual*" (Manual). This document took nearly 5 years to compose and is intended to improve the State's stormwater management program that has been in existence since 1982. The Maryland Department of the Environment, Water Management Administration (MDE/WMA) provides here a synopsis of Maryland's program's evolution over the last 18 years. This summary will provide the perspective needed to answer questions regarding programmatic goals, performance standards, and strengths and weaknesses. Apologies for the lack of brevity.

Background

Maryland's stormwater management program was a logical progression from its erosion and sediment control efforts. The Attorney General of the State declared "sediment" a pollutant in 1969. The next year a statute was passed that required sediment control practices to be implemented for any earth disturbing activities over 5,000 square feet. Maryland's erosion and sediment control program was implemented statewide by local government beginning in 1970.

The next step from controlling runoff from grading and construction would obviously be controlling runoff after development has been completed. This progression then, is stormwater management. Recognizing that urban runoff was a contributing factor to water quality degradation, the Maryland legislature passed the Stormwater Management Act in 1982. This law, and commensurate regulations adopted the following year, sought to ensure that pre-development runoff characteristics were maintained after development.

During the mid 1980s when Maryland's program was first conceived and implemented, the prevailing attitude was that if peak discharge increases caused by urbanization were controlled, the receiving waters would be protected from excess volume, increased velocities, channel erosion, sedimentation, flooding, etc. Therefore, Maryland's program was, and is currently, based on this flood control perspective. Current State regulations require that all new development project designs include provisions for reducing peak discharge increases for the 2 and 10 year frequency storm events back to pre-development conditions. Clearly, this requires a best management practice (BMP) approach and typically, the BMP of choice is a pond.

Because of the prevailing attitudes regarding how best to control stormwater (e.g., flood management), very little specific design criteria were included in Maryland's stormwater management program. The approach taken, and the one we work under currently, was a "preferred practices" list. State regulations require that infiltration be considered first and, if not feasible, the designer would then progress through a list of BMPs each with lesser water quality efficiency than the one previous. In latter years, rules-of-thumb for water quality design were implemented sporadically throughout the State (e.g., one half inch times total site imperviousness). However, Maryland still operates under its original design criteria (e.g., 2 and 10 year management and the preferred practices list).

Chesapeake Bay Protection and Environmental Awareness

Given the above historical explanation, several points need to be made that will provide other factors affecting program implementation and help explain why a major change of philosophy has been contemplated with the Manual. First, it cannot be overemphasized how much Chesapeake Bay restoration efforts play on bringing to the forefront environmental concerns, especially those related to water quality. Chesapeake Bay garners much attention in the State, region, and, arguably, the world for protection and restoration. This was the case in 1983 when the Six Bay states and Washington, D.C signed the original "Chesapeake Bay Agreement." Therefore, the protection of this valuable resource was very much a factor for implementing an urban runoff program.

Another factor contributing to Maryland's stormwater management program development was the groundswell of environmental awareness caused primarily by nutrient enrichment of the Chesapeake Bay. Nutrient reduction goals, wetland protection, and sediment control all served as catalysts for grass roots organizations to bring to light the importance of environmental issues. This public and sometimes political support cannot be overlooked.

Technical Program Improvements Needed

Finally, because of over 12 years of program oversight and experience, changes with our program were clearly needed in the mid 1990s. Some issues have been mentioned above (e.g., no specific water quality design standards; too much flood control emphasis). However, explaining a couple of technical issues related to our program will address questions regarding stormwater management program goals and specific issues such as redevelopment.

As originally conceived, the State program makes no mention of where new development takes place. Nor does it specify what land use types are affected. If 5,000 square feet of earth is disturbed with new development, you must address stormwater runoff. This would presumably include redevelopment or in-fill situations. However, as with most regulatory programs, Maryland's stormwater regulations contain exemptions and allow for waivers provided certain conditions are met. Since 1982, certain projects have been waived depending on hydrological circumstances. Three major waiver categories have been allowed and these demonstrate the flood management program emphasis on which the program was founded. These categories are:

1) Less than a ten percent increase in the pre-development 2 year storm event,
2) Direct discharges to tidewater, and
3) Projects completely surrounded by an existing storm drain system of sufficient capacity to convey the increase in discharge caused by the new development.

The emphasis on peak management and flood control is quite obvious. It was MDE's want to change this emphasis when regulatory changes were proposed and the Manual was conceived in

1995. Beginning with the Manual's composition, the issue of stormwater control for redevelopment projects was debated vigorously.

The above waiver provisions that local jurisdictions applied to certain "new development" caused most redevelopment and in-fill work to avoid BMP implementation. A fast food restaurant built in the corner of a shopping mall parking lot would surely not change hydrologic characteristics, especially peak discharge. Additionally, this and similar urban "redevelopment" would most likely be surrounded by an existing storm drain system of adequate capacity. Therefore, most redevelopment is waived under Maryland's original and current stormwater regulations. This was an additional reason why MDE felt improvements were warranted.

__Summary__

Under increased environmental awareness caused by Chesapeake Bay protection concerns, Maryland instituted a stormwater management program that emphasized peak flood management for new development projects disturbing 5,000 square feet of earth. Relatively little specific water quality control design criteria were included in original regulations as a "preferred practices" list was used. With an obvious flood control emphasis, most redevelopment projects were waived because pre-development hydrologic conditions remained after construction completion.

With over 12 years of program implementation experience, a recognition that improved water quality management was needed, and a need to eliminate many waivers of stormwater management requirements for such things as redevelopment, MDE developed the "*2000 Maryland Stormwater Design Manual*." This document, along with major regulatory modifications, is intended to address many of Maryland's stormwater management program weaknesses. When adopted later this year, major improvement to controlling urban runoff is expected.

POLICY STATEMENT ON CONTROLS AND REQUIREMENTS FOR NEW DEVELOPMENT AND REDEVELOPMENT IN THE STATE OF MARYLAND

i) Why did your state elect to have requirements on new development and redevelopment?

In 1982, restoration and protection of Chesapeake Bay was one of the most important factors contributing to the development of Maryland's stormwater management program. Heightened environmental awareness and a recognition that urban runoff contributed to water quality degradation combined to produce a program that emphasized peak flood control. Because of this emphasis on peak management, typical redevelopment projects were often waived from stormwater controls.

To address various program shortcomings, MDE development the "*2000 Maryland Stormwater Design Manual*" (Manual). This document is intended to provide better water quality control, an area not specifically addressed currently. Relative to redevelopment, the choice to impose requirements was based primarily on "everyone contributes runoff, everyone ought contribute management." However, a balance between management contributions for environmental purposes, and, practical requirements that make economic sense must be struck. Everyone should contribute management. However, conventional BMPs (e.g., ponds) are not feasible in major metropolitan areas where land values prevent typical management strategies. Flexibility is key.

ii) Does your state have design standards and performance standards for treatment control BMPs for new development/redevelopment?

Currently, there are no performance standards for BMPs only design standards. Maryland requires that BMPs be designed to maintain pre-development peak discharges for the 2 and 10 year storm events in most of the State.

Maryland's proposed Manual contains both design standards and performance standards. A suite of design volumes has been developed to address recharge (Re_v), water quality (WQ_v), channel protection (Cp_v), and overbank flood protection (Q_p). All of these volumes need to be included in new development designs. Additionally, BMP performance standards are implicit in Maryland's proposed Manual. Based on pollutant removal efficiency studies, all BMPs in the Manual have been equated in terms of efficiency. If a BMP is designed according to the criteria specified in the Manual, an 80% total suspended solids (TSS) and a 40% total phosphorus (P) reduction will both be realized. In fact, this 80:40 criteria is used to judge whether new technology is allowed to be used to address the required suite of volumes above. If the proverbial "new mousetrap" can meet 80% TSS and 40% P removal, it can be used as a stand alone BMP.

iii) Do you have thresholds for new development and or redevelopment (impervious area; size; etc.) for requirements to apply?

If a project disturbs 5,000 square feet of earth in Maryland, the site design must address stormwater management.

iv) What development categories do the requirements apply to [i.e. commercial; parking lots; residential, etc.]?

There are no specific development categories. If you disturb 5,000 square feet with any new development, you automatically are included. State regulations, however, do "exempt" agricultural land management activities.

v) How long have such requirements been in place? Are they statewide or region specific?

Stormwater management has been on the books since 1982. This is a statewide program that does have design variations based on hydrologic areas of the State (e.g., no 10 year management requirements in the Coastal Plain on our "Eastern Shore."

vi) Have the design standards and performance standards unduly burdened cities and builders with unsupportable costs? Has compliance been difficult? Has change been for the better or have you seen none? Any noticeable improvements in water quality?

All of these questions have been, are, and will not doubt continue to be debated. Volumes could be written to explain perspectives for burdens, costs, compliance, or noticeable improvements. To avoid this, some very random thoughts about these issues.

Generally, the answer to all of these questions could be "it depends on whom you ask" or "it depends on where you ask it." Maryland has three distinct geographic areas. These are a "Western" section; a central, "Urban" area; and our "Eastern Shore." The Urban area houses most of the State's population; can be defined in terms of the corridor between Washington, D.C., Baltimore, and toward Philadelphia, PA; and, not coincidentally, contains the most sophisticated stormwater programs in our State. It is not uncommon for a central Maryland county to have 8 or 10 plan reviewers and as many field staff dedicated solely to stormwater functions. The burden on these places currently is minimal.

As you travel west or east from this Urban region, the stormwater programs locally tend to become more burdensome. There is less sophistication technically, less resources, and obviously less compliance. In Western Maryland and on our Eastern Shore, localities may only have a single staff person to perform both review and inspection. The burden associated with changing to the proposed Manual in these regions will increase dramatically. However, again, it depends on whom you ask.

Environmental groups have told us we are not doing enough and have actually demanded "zero discharge" from new development. Developers and builders believe we are making them do too much now and are severely questioning our proposed changes and the Manual requirements. Frankly, and with tongue only partially in cheek, we believe we are close to where we need to be with the Manual because we have aggravated an equal number of people on both sides of this regulatory fence.

Some really random thoughts:

- In the beginning of the program (circa 1982), the design standards were very burdensome. Localities had to hire staff and purchase vehicles and equipment. Developers endured the added cost of BMP construction.
- Currently, stormwater management on both sides is a routine part of the development process.
- Compliance varies with the level of resources and the distance from Urban Maryland as described above. One difficulty we do have is the interpretation of the same requirement differently from locality to locality.
- We have seen only modest water quality improvement. This is expected to change dramatically with our Manual.

vii) Typically, what is your estimate of the range in additional cost (in percent of project cost) that the requirements have imposed on builders?

Obviously, this depends on that real estate saying "location, location, location." However, currently, stormwater management for 2 and 10 year control ranges from 0% to 20%. We have proposed to make optional the control of the 10 year storm. Because "lots are money" and "more stormwater means less lots," costs are anticipated to decrease about 20% of current costs without 10 year management. Costs will increase commensurately with 10 year management under the Manual.

viii) How have municipalities ensured that the post construction BMPs O & M has been provided and/or BMPs are properly maintained?

Operation and Maintenance Agreements are required as a condition of plan approval and permit issuance. Localities are required by State regulation to inspect and cause to be maintained BMPs every three years. Some jurisdictions assume ownership of BMPs. This is best for ensuring future maintenance. Other localities require private ownership, which makes it difficult for requiring maintenance due to the limited resources of entities such as homeowners' associations.

ix) What are the policy goals that the standards are intended to achieve (reverse impairment; hold the line; etc.)?

Basically, the best way to describe our proposed program's goal is to minimize damage caused by urban runoff. For us, this boils down to basic hydrology. When you change natural conditions to developed conditions, bad things happen to water quality. We also know that all soils have some recharge value, sustained bankfull discharges create severe channel erosion, and minimizing impervious surfaces is the best way to mimic pre-development hydrology. Therefore, we are hoping to change how development occurs. Hopefully, we can incorporate water management early in the site design process rather than having a BMP placed at the bottom discharge point of a site as an afterthought.

Individual volume goals and design criteria:

1) Recharge (Re_v) – mimic existing annual groundwater recharge rates.
2) Water quality volume (WQ_v) – 80% TSS removal (a Coastal Zone Management Act requirement), 40% P removal (a Chesapeake Bay Program goal), and treatment of 90% of the average annual rainfall.
3) Channel protection volume (Cp_v) – the 2 year storm control policy has actually created more channel erosion in some cases. This method sustains bankfull discharges over a longer period of time. Therefore, more frequent storm event control is essential. We are choosing the 1 year storm using extended detention. This is delaying the 1 year storm's inflow hydrograph by 24 hours.
4) Overbank flood protection (Q_p) – 10 year storm control is optional provided no additional downstream flooding occurs.

5) Redevelopment – the goal is to reduce by 20% the total site imperviousness. If not feasible, BMPs elsewhere in the watershed, stream restoration, fees paid are all acceptable but subject to local approval.

Department of Environmental Protection

Jeb Bush
Governor

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David B. Struhs
Secretary

May 31, 2000

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State Water Resources Board
P.O. Box 100
Sacramento, California 95812-0100

Mr. Xavier Swamikannu
Stormwater Program
Water Quality Control Board
320 W. 4th Street, Suite 200
Los Angeles, California 90013

Dear Ms. Jennings and Mr. Swamikannu:

This letter is sent in response to the email that I received from Mr. Swamikannu on May 19 requesting information about the State of Florida's stormwater treatment requirements. Where appropriate I also have included information that may be helpful about stormwater treatment programs in other states. This information was collected and published in the books *Institutional Aspects of Urban Runoff Programs: A Guide for Program Development* and *Implementation and Operation, Maintenance, and Management of Stormwater Management Systems.* I also have enclosed a paper that I use in teaching stormwater classes that I think will be helpful.

You specifically requested a response to the following questions:

1. Why did your state elect to have requirements on new development and redevelopment?

Studies conducted in the mid to late 1970s as part of the Section 208 Areawide Water Quality Management Program demonstrated that stormwater was a significant source of water pollution, especially from urban development. These studies also demonstrated that it was much easier and cheaper to prevent stormwater pollution using BMPs than to restore degrade water bodies and retrofit already developed areas. Accordingly, given the rapid urban growth Florida was experiencing in the late 1970s and the project growth in the 1980s, the Department of Environmental Protection determined that stormwater was a pollution source that needed treating. Consequently, the Environmental Regulation Commission adopted an interim stormwater rule requiring treatment in 1979 until further studies could be done on BMP effectiveness. On February 1, 1982, the final state stormwater rule was adopted requiring all new development and redevelopment activities to treat their runoff.

Today, six states in the country (Florida, Maryland, Delaware, Virginia, South Carolina, and Massachusetts) have adopted laws or rules that require the treatment of runoff from new developments. In addition, there are numerous regional (i.e., Puget Sound) and local governments that have implemented requirements for stormwater treatment.

2. **Does your state have design standards and performance standards for treatment control BMPs for new development/ redevelopment?**

Under the Federal Clean Water Act, water pollution control programs can be either water quality effluent based or technology based. Every stormwater treatment program in the United States is a technology based program. The key components of a technology based program are a performance standard (desired level of stormwater treatment) and design criteria for BMPs that assure they will provide that level of treatment. To develop design criteria, a number of analyses must be conducted including rainfall characteristics (annual volume, number of storms, interevent time, etc), runoff characteristics (i.e., stormwater volume, pollutant loadings, drainage area), whether BMPs are on-line or off-line, and BMP effectiveness.

Like all stormwater treatment programs in the United States, Florida's performance standard for stormwater treatment is to reduce the average annual loading of TSS by 80% (note that this is postdevelopment loading, so even with treatment, pollutant loads almost always increase). We adopted design criteria for various stormwater treatment BMPs (ie, retention, wet detention, detention with filtration) in our first rule. These criteria have been revised periodically as we gained additional information to assure that they meet the desired level of treatment. I have included a copy of Rule 40C-42 from the St. Johns River Water Management District which is the most current of our state stormwater rules with respect to design criteria. Also please remember that, during construction, erosion and sediment control BMPs must be used to retain sediment on site.

3. **Do you have thresholds for new development and or redevelopment (impervious area; size etc) for requirements to apply.**

The threshold varies depending on the stormwater/environmental resource permitting rule. Florida's stormwater program is cooperatively implemented by DEP and our regional water management districts. Therefore, we have five sets of rules in the state. The typical threshold is the creation of 4000 square feet of impervious area.

4. **What development categories do the requirements apply to [i.e. commercial; parking lots; residential etc]?**

Our rule applies to all urban development (and many agricultural activities as well).

5. **How long have such requirements been in place. Are they statewide or region specific?**

As previously stated, the statewide stormwater rule was first adopted in 1979 with a revised comprehensive rule in place on February 1, 1982. Florida's stormwater program is cooperatively implemented by DEP and our regional water management districts. Therefore, we have five sets of rules in the state. The WMD rules combine stormwater quantity, stormwater quality, and wetlands protection into a single permit called an environmental resource permit.

6. **Have the design standards and performance standards unduly burdened cities and builders with unsupportable costs? Has compliance been difficult? Has change been for the better or have you seen none. Any noticeable improvements in water quality?**

Complying with Florida's stormwater rule is a way of life that does not impose unduly burdens on local governments or the private sector. It also has provided many jobs for the engineering profession. The only part of compliance that is difficult is assuring long term operation and maintenance of the stormwater BMPs. They need to be inspected at least annually. Unfortunately, the public sector will never have enough inspectors which is why Delaware and Florida have implemented training and certification programs for inspectors. We have no doubts that the implementation of Florida's stormwater treatment program has greatly reduced the effects of growth in Florida on water quality and is a major reason why the state has so few truly impaired waters. We also have seen improvements in water quality as a result of retrofitting older stormwater drainage systems.

7. **Typically, what is your estimate of the range in additional cost (in percent of project cost) that the requirements have imposed on builders.**

This question is very site specific since the major cost is the land cost and that varies with every site. We estimate that complying with our stormwater rules requires about 5-10 percent of the land area of a development, although much of this is related to flood protection.

8. **How have municipalities ensured that the post construction BMPs O & M has been provided and/or BMPs are properly maintained.**

As part of our permitting process, the developer must identify the responsible maintenance entity. Typically, this is a homeowner or property owners association for residential development or the property owner for commercial development. The DEP and WMDs require recertification that the stormwater system is functioning on a regular basis (every 1 to 2 years). Additionally, since stormwater systems are part of the local infrastructure, many local governments conduct inspections annually and several have implemented stormwater operating permit systems that require annual inspections. Some of the 100+ local stormwater utilities in the state provide credits for functioning onsite stormwater systems providing an economic incentive to land owners to maintain their stormwater systems.

9. What are the policy goals that the standards are intended to achieve [reverse impairment; hold the line etc.]

Florida statutes and rules establishes the goals for the state's stormwater management program. These include:

- Effective stormwater management for existing and new systems to protect, preserve and restore the functions of natural systems and the beneficial uses of waters;
- Preventing stormwater problems from new land use changes and restoring degraded water bodies by reducing the pollution contributions from older stormwater systems;
- Preserving freshwater resources by encouraging stormwater infiltration and reuse;
- Trying to assure that the stormwater peak discharge rate, volume and pollutant loading are no greater after a site is developed than before; and
- Eliminating the discharge of inadequately managed stormwater into waters and to minimize other adverse impacts on natural systems, property and the health, safety and welfare caused by improperly managed stormwater.

9. Also discuss standards and requirements in other states that you are familiar with because of you special role and expertise.

As previously stated, nearly all of the stormwater treatment programs in the United States are similar. All of the above information for 32 stormwater programs around the country are summarized in books *Institutional Aspects of Urban Runoff Programs: A Guide for Program Development.*

I hope that this information is helpful. It is truly unfortunate that the development industry is still denying that urban runoff is a major source of degradation of our aquatic ecosystems. However, don't be discouraged. When we first adopted our rule, we went through 29 official rule drafts and over 100 TAC meetings before the final rule was adopted. Given the knowledge about stormwater pollution and the effects of urbanization on aquatic ecosystems, it should be much easier to fight any challenges that arise. Please let me know if I can be of further assistance.

Sincerely,

Eric H. Livingston

Eric H. Livingston
Chief
Bureau of Watershed Management

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD LOS ANGELES REGION

May 25, 2000

Xavier Swamikannu
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Elizabeth Jennings, Esq.
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Mr. Swamikannu and Ms. Jennings:

This is in response to Mr. Swamikannu's e-mail correspondence to me dated May 19, 2000. In that correspondence, Mr. Swamikannu asked for responses to nine questions. Enclosure #1 provides responses from Ann Wessel and me to those questions. Ms. Wessel and I work on stormwater management issues for the Washington Department of Ecology (Ecology) in the Program Development Services Section of the Water Quality Program.

Because our time is limited, we have not elaborated in detail but have tried to give you enough information to satisfy your needs. In addition, I have enclosed a summary of the thresholds and minimum requirements for new development and redevelopment (Enclosure #2) from Ecology's 1992 *Stormwater Management Manual for the Puget Sound Basin*. I have also referenced other documents that are available to you, if you prefer.

Finally, Mr. Swamikannu should have received a draft of Volume 1 of the 1999 Dept. of Ecology Stormwater Manual for Washington State as an attachment to an e-mail message. Please note that the draft has no legal standing, as it has not been formally promulgated by the state. It could significantly change prior to its publication.

If you need a clarification of these responses or any additional information, please feel welcome to contact us. You have my e-mail address. My telephone number is 360/407-6438. Ann Wessel's e-mail address is awes461@ecy.wa.gov; her telephone number is 360/407-6457.

Sincerely,

Ed O'Brien

Ed O'Brien, P.E.
Program Development Services Section
Water Quality Program

EO:pc
2 Enclosures

cc: Ann Wessel

R0020687

Enclosure #1

Response to Questions Posed by Xavier Swamikannu

1) Why did your state elect to have requirements on new development and redevelopment?

Response:

The state first became involved in developing requirements for new development and redevelopment as a result of the 1987 Puget Sound Water Quality Management Plan (The Plan). The Plan was developed as a comprehensive conservation and management plan under section 320 of the federal Clean Water Act. The Plan recognized that urban stormwater was a major contributor to the degradation of Puget Sound water and sediments, and its biological health. Consequently, The Plan specified a number of "program elements," or actions, to manage urban stormwater. One of the actions called for the Washington Department of Ecology (Ecology) to develop a manual to be used by local jurisdictions in stormwater management.

The Plan requires the manual to include: BMP's for controlling erosion from construction sites; hydrologic analysis procedures, including selection of design storms and runoff estimates; design, operation and maintenance standards for public and private structural facilities; and techniques for reducing or eliminating pollutants in runoff from problem land uses.

Subsequently, Ecology published its first *Stormwater Management Manual for the Puget Sound Basin* in February 1992. The Plan requires local governments to adopt requirements that are substantially equivalent to those in Ecology's manual.

In 1995, Ecology issued its first NPDES municipal stormwater permits. Because the permittees were all in the Puget Sound Basin, and so were already required by The Plan to have a "Comprehensive Stormwater Management Program," including a manual equivalent to Ecology's, Ecology issued permits that required permittees to develop and implement (Special Condition S.7.B.8.a.):

> A program to control runoff from new development, redevelopment and construction sites that discharge to the municipal separate storm sewers owned or operated by the permittee. The program must include: ordinances, minimum requirements, and best management practices (BMP's) equivalent to those found in Volumes I-IV of Ecology's Stormwater Management Manual for the Puget Sound Basin (1992 edition, and as amended by its replacement), permits, inspections, and enforcement capability. The program must also include a process to make available copies of the "Notice of Intent for Construction Activity" and/or copies of the "Notice of Intent for Industrial Activity" to representatives of proposed new development and redevelopment."

2) Does your state have design standards and performance standards for treatment control BMPs for new development/redevelopment?

Response:

A) 1992 Stormwater Manual
Washington State has design standards in its stormwater manual that are applicable to the Puget Sound Basin

and NPDES Phase I municipal permittees. The standards are not adopted into a state regulation. They are required by the Puget Sound Plan and by NPDES Phase I municipal stormwater permits.

The treatment design standard is the following:

> All projects shall provide treatment of stormwater. Treatment BMP's shall be sized to capture and treat the water quality design storm, defined as the 6-month, 24-hour return period storm. The first priority for treatment shall be to infiltrate as much as possible of the water quality design storm, only if site conditions are appropriate and ground water quality will not be impaired. Direct discharge of untreated stormwater to ground water is prohibited. All treatment BMP's shall be selected, designed, and maintained according to an approved manual.
>
> Stormwater treatment BMP's shall not be built within a natural vegetated buffer, except for necessary conveyance systems as approved by the local government. An adopted and implemented basin plan (Minimum Requirement #9) may be used to develop runoff treatment requirements that are tailored to a specific basin.

The following statements are offered for clarification:

The manual allows residential roof runoff to be infiltrated without having received treatment.

For most areas of the Puget Sound Basin, the 6-month, 24-hour storm is greater than the 90th percentile, 24-hour rainfall amount.

Volume I of the manual provides a BMP selection process to determine which BMP is most appropriate for the development site. Volume II of the manual specifies hydrologic procedures for determining the runoff flow rates and volumes for the water quality design storm. Volume III specifies design criteria for each treatment BMP listed in the manual.

B) The Draft 1999 Stormwater Manual

The draft of the 1999 manual lists the same water quality design storm as described in the 1992 manual. However, the draft also includes a list of options for defining a new water quality design storm event and asks for recommendations. Volume I of the draft manual is available upon request.

The 1999 draft also distinguishes between pollution-generating surfaces and non-pollution generating surfaces. Runoff from non-pollution generating surfaces does not have to receive treatment if it is discharged without mixing with runoff from pollution-generating surfaces. The draft manual includes definitions for pollution-generating impervious surfaces and pollution-generating pervious surfaces. Non-pollution generating surfaces would include: residential roofs, commercial roofs that do not accumulate pollutants from vents and fugitive emissions, isolated bicycle lanes, other ground surfaces that are not subject to vehicular use.

The draft manual also suggests that Ecology establish performance criteria for treatment BMP's. A performance criterion for basic water quality treatment BMP's is likely to be established in the manual. The criterion is likely to be a specified percent removal of total suspended solids given certain conditions (e.g., influent TSS, flow rate or volume). The criterion will likely not be used to determine site-by-site compliance, but will be used as the standard against which to judge whether new BMP designs will be accepted for use in new and redevelopments.

The draft 1999 also includes:

- A proposal to have discharges into receiving waters that have a phosphorus related water quality problem, to use treatment BMP's that are more able to remove phosphorus.
- A proposal to have discharges from high volume traffic intersections (25,000/15,000 ADT) and "high use sites" (Average daily trips of 15 vehicles per parking space per day; or, commerical or industrial sites subject to petroleum storage and transfer in excess of 1,500 gallons/year; or, commercial/industrial sites subject to use, storage or maintenance of a fleet of 25 or more diesel vehicles that are over 10 tons gross weight) to use an oil removal BMP in addition to applying a "basic" or "enhanced" treatment BMP.
- A proposal to require "enhanced" treatment BMP's for discharges that are likely to violate water quality standards, despite the application of a "basic" treatment BMP, because of a lack of available dilution in the receiving water. The pollutants in question are dissolved copper, zinc, and lead.

3) Do you have thresholds for new development and or redevelopment (impervious area; size, etc) for requirements to apply?

Response:

A) 1992 Stormwater Manual
We have established thresholds that determine the set of requirements that apply to projects. I will fax a summary of the thresholds and corresponding minimum requirements. In brief:

Large Parcels:
Projects that disturb 1 acre or more of land have to meet all eleven of the Large Parcel Minimum Requirements.

Medium Parcels:
Development that disturbs less than 1 acre of land but adds or creates 5,000 ft2 or more of impervious surface, are subject to Large Parcel Minimum Requirements #2 through #11, and the Small Parcel Minimum Requirements for erosion control.

Small Parcels:
Construction of an individual single family residence or duplex; or, construction that adds or creates less than 5,000 ft2 of impervious area and disturbs less than 1 acre are only subject to the small parcel minimum requirements.

Redevelopment projects have some additional thresholds. I will fax a summary of the redevelopment requirement also.

B) The Draft 1999 Stormwater Manual
The draft 1999 manual has similar requirements to the 1992 manual, but there are some significant proposed changes:

- Single family residential projects could be subject to large parcel requirements if they exceed certain thresholds.

- The Small Parcel Requirements may be expanded to include onsite design requirements to maximize infiltration and flow dispersion and treatment without construction of structural facilities.

- All projects, regardless of size, will have to comply with all of the erosion and sediment control requirements or explain why a requirement is not necessary for the site (e.g., no silt fence around a site that is flat or is a closed depression).

- The Large Parcel Requirements allow use of Small Site Requirements for small isolated drainage areas of larger projects.

- The proposed Redevelopment thresholds are significantly changed. They are:

  All redevelopment projects in which the total of *new plus replaced* impervious surfaces is 5,000 square feet or more must comply with Large Parcel Minimum Requirements #1 and #3 for the project site.

  Redevelopment projects that add 5,000 square feet or more of *new* impervious surface must comply with all the Large Parcel Minimum Requirements for the new impervious surfaces. If the runoff quantity from the new surfaces is not separated from runoff from other surfaces prior to treatment or flow control, the stormwater facilities must be sized for the entire flow. Alternatively, the local government may allow the Large Parcel Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site.

  All redevelopment projects in which the total of new plus replaced impervious surfaces is 5,000 square feet or more, and whose valuation of proposed improvements – including interior improvements - exceeds 50% of the assessed value of the existing site improvements shall comply with all the Large Parcel Minimum Requirements for the entire site.

  Local governments may exempt redevelopment projects from compliance with Large Parcel Minimum Requirements #4, #5, and/or #6 if they have adopted a plan that fulfills those requirements in regional facilities that will discharge to the same receiving water, AND if they have an implementation plan and a schedule for construction of those facilities. Redevelopment projects for public roads may be exempted from meeting Large Parcel Minimum Requirements #4, #5, and/or #6 for the entire site (i.e., the exemption does not extend to new surfaces that add impervious area) if there is an adopted Capital Improvement Program for retrofitting existing road surfaces.

4) What development categories do the requirements apply to (i.e., commercial; parking lots; residential, etc.)?

Response:

Washington's requirements for water quality treatment and flow control apply to impervious surface and to land disturbance (clearing and grading) regardless of the type of land use. Generally, the source control requirements specified in our Volume IV of the manual apply only to commercial and industrial operations.

5) How long have such requirements been in place? Are they statewide or region-specific?

Response:

In 1992 we adopted the Stormwater Management Manual for the Puget Sound Basin. The manual was guidance for the approximately 115 municipalities in the Puget Sound Basin that are required to adopt either the Ecology manual or a manual containing substantially equivalent technical standards. The requirement to adopt the manual was contained in a statute establishing the Puget Sound Water Quality Authority, and development of the Puget Sound Plan. The statute stated that local governments "*must evaluate, and incorporate as applicable, <u>subject to the availability of appropriated funds or other funding sources</u>, the provisions of the plan, including any guidelines, standards and timetables contained in the plan.*" The deadline in the plan for adopting the manual was 1994, however, given the weak statutory requirement and lack of consequences for failing to adopt a manual, few municipalities met the deadline. Regardless, many municipalities began amending and adopting ordinances to incorporate at least part of the requirements, and stormwater controls for new development are accepted practice.

Outside of Puget Sound, the 1992 Stormwater Management Manual was applied as best available science in permitting decisions made by Ecology and other State Agencies.

In 1995 we issued our first municipal stormwater NPDES permits covering the five largest municipalities and Washington State Department of Transportation (WSDOT). This permit established a requirement for adoption and implementation of technical standards and BMPs equivalent to those in the Ecology manual during the term of the permit.

We are currently updating the Ecology manual, and expanding it to a statewide manual. As soon as possible after completion of the new manual, we will reissue the municipal stormwater permit requiring updating of local ordinances and manuals. When we issue phase 2 permits we will also require adoption of the new manual.

6) Have the design standards and performance standards unduly burdened cities and builders with unsupportable costs? Has compliance been difficult? Has change been for the better or have you seen none? Any noticeable improvements in water quality?

Response:

There are substantial costs to implementing stormwater controls for new development and redevelopment, but they are incremental to existing development and permit review costs. The single largest cost driver for developers is land value, so vaults and other underground BMPs tend to prevail in the downtown core areas. Local governments struggle with adequate enforcement, but seem to manage costs through combinations of general fund, permit fee, and stormwater utility revenues. Given the pace of development in Puget Sound, even in the municipalities where stormwater controls for new development are more stringent than what is in the Ecology manual, stormwater controls have not proven to be an obstacle to development.

As for noticeable improvements in water quality, we have not been monitoring to specifically address this question. We are in the process now of developing monitoring requirements for the next permit term that will address the question of effectiveness of programs to control both quantity and quality of runoff from new development. We have anecdotal evidence of reduced sediment loads from erosion and sediment control programs at construction sites (our requirements go beyond the federal 5-acre minimum to require erosion control for all land disturbing activities). Also, data on sediment contamination in urban bays is showing some improvement that could be attributed to stormwater controls.

7) Typically, what is your estimate of the range in additional cost (in percent of project cost) that the requirements have imposed on builders?

Response:

A) 1992 Stormwater Manual
We have not run cost estimates as a percentage of construction. We developed cost estimates for compliance with our 1992 manual using three different types of development (residential, small and large commercial), and assuming infiltration was possible and not possible. For each instance, we developed cost estimates for erosion and sediment control during construction, for the permanent water quality treatment and flow control facilities, and for operation and maintenance.

Ecology did not consider the costs as unreasonable. Let me know if you want a copy of the cost analyses.

One of our Phase I NPDES municipal permittees developed a cost factor for determining whether it was reasonable to make a redevelopment site retrofit treatment BMP's to the entire site (even though only part of the site may be redeveloped). If the treatment BMP retrofit would increase total project costs by 10% or more, the county would allow a reduction in the area being treated in order to stay below the 10% threshold. But in any case, the runoff from the redeveloping portion of the site has to receive treatment. The state accepted this redevelopment requirement.

B) The Draft 1999 Stormwater Manual
We have not done cost estimates on our proposed treatment, flow control, source control, and other minimum requirements. Where those requirements do not substantially change from our 1992 manual, we do not think it is necessary to re-justify them. Through the previous cost analyses and because they have been implemented for eight years throughout Puget Sound, they are considered reasonable requirements.

We have two areas in which our updated requirements could impose significant new costs: 1) the proposed flow duration standard for discharges to streams; and 2) the possible requirement for BMP's to remove significant amounts of dissolved metals in discharges to small receiving waters. We intend to develop costs for these instances. However, costs may not be a factor in these decisions. Both of these proposed requirements are water-quality based. That is, they will be required in those situations where they are determined necessary to maintain beneficial uses and not violate water quality standards. Water-quality based requirements are not subject to cost reasonableness analyses. In addition, both of these requirements are already in effect in significant areas of King County (i.e., the Seattle metropolitan area) for almost two years. The application of these requirements to ongoing development projects could also speak to their cost reasonableness.

8) How have municipalities ensured that the post-construction BMP's operation and maintenance has been provided and/or BMP's are properly maintained?

Response:

The municipal stormwater NPDES permit requires adoption of an ordinance that requires maintenance of privately owned stormwater facilities that discharge into municipal separate storm sewers (ms4) owned or operated by the permittee. The permit also requires the permittee to inspect facilities draining to the ms4 for proper operation and maintenance, and to have enforcement capability.

9) What are the policy goals that the standards are intended to achieve (reverse impairment; hold the line, etc)?

Response:
The goal of the technical standards for new development is to hold the line. The goal of the standards applied to redevelopment is to begin to reverse impairment.

ATTACHMENT B

Comparison of Tentative Order to Other California Municipal Stormwater Permit Requirements

	SCVURPPP	L.A. SUSMP, Long Beach, Ventura	New L.A. permit	San Diego County
Approach	Implement requirements	Develop SUSMPs	Implement requirements	Develop SUSMPs
Project Sizes	Redevelopment: creation or addition of one acre (43,560 sq.ft.) or more impervious surface or redevelopment that encompasses one acre of impervious surface • Every new development that creates one acre impervious surface Streets, roads that create one acre impervious surface Alternate size or 5000+ sq.ft. goes into effect July 2003	Redevelopment: 5000+ sq.ft. new impervious surface or 50% more impervious surface or making improvements to 50%+ of existing structure • 100,000+ sq.ft. industrial commercial development • 100+ home subdivision • 10-99 home subdivision • auto service facilities • retail gasoline outlets • restaurants 5000+ sq.ft. • parking lots 5000+ sq.ft. or 25+ spaces • hillside single dwelling	Redevelopment: Same as L.A. SUSMP • 100,000+ sq.ft. industrial commercial development • Any housing development 1+ acre in size • auto facilities 5000+ sq.ft. • retail gasoline 5000+ sq.ft. with 100+ avg. daily traffic • restaurants 5000+ sq.ft. • parking lots 5000+ sq.ft. with 25+ spaces • hillside single dwelling 1+ acre in size • environ'ly sensitive areas: 2500+ sq.ft OR 10% new impervious surface One acre sites by March 2003 (coincides w/EPA Phase II rule)	Redevelopment: Same as L.A. SUSMP *Total* project size, impervious or not: • 100,000+ sq.ft. industrial commercial development • 100+ home subdivision • 10-99 home subdivision • auto service facilities • retail gasoline outlets • restaurants 5000+ sq.ft. • parking lots 5000+ sq.ft. or 15+ spaces • hillside devel. 5000+ sq.ft. • environ'ly sensitive areas: 2500+ sq.ft OR 10% new impervious surface Streets, roads, etc, no sq.ft given
Numeric Sizing Design Basis	Volume and flow options	L.A. SUSMP used volume only, left flow up to local agencies Ventura & Long Beach gave volume and flow options	Volume and flow options	Volume and flow options

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	SCVURPPP	L.A. SUSMP, Long Beach, Ventura	New L.A. permit	San Diego County
O&M requirements	Require adequate O&M by public entity OR condition in sales agreement OR CCRs OR other legally enforceable agreement	Developer must verify maintenance through appropriate means, such as legal agreements, CCRs, CEQA mitigation, &/or Conditional Use Permits	Require adequate O&M by public entity OR condition in sales agreement OR CCRs OR other legally enforceable agreement	Dischargers shall implement schedule of maintenance at all trt BMPs, include inspection & cleaning between May 1 & Sept 30 each year
Peak Runoff Limitation	Post-devel. peak & near-peak discharge rates & durations shall not exceed estimated pre-devel rates & durations where erosion or other adverse impacts could occur Requires Hydromod Mngt Plan that ID's the applicable rainfall event & includes guidance to address impacts Allows equiv. limitation protocol to address impacts thru other measures, such a land planning	none	Permittees establish numerical criteria to control post-development peak runoff rates in natural drainage systems to maintain or reduce pre-development peak discharge rates to prevent down-stream erosion. Lists the drainages.	The SUSMP shall require BMPs that maintain pre-devel peak stormwater runoff rates and velocities (one of a list of things BMPs must do)
Schedule	one yr to modify conditions of approval process; begin requiring treatment BMPs & begin O&M CEQA – 20 months 2 yrs-submit HMP & begin limiting peak runoff Revise Gen'l Plan – 4 yrs. 22 mo.-add source control guidance (i.e. plumb swim pools to sewer) to project review processes 3 yrs-add site design guidance (like Start @ Source) to project review processes	6 months to adopt any needed ordinances, then 30 days to implement them	one yr to adopt Model SUSMPs; adopt local SUSMPs 180 days more; begin requiring trt BMPs upon adoption CEQA - one yr. O&M - 180 days Revise Gen'l Plan - one yr.	one yr to adopt Model SUSMPs; adopt local SUSMPs 180 days more;

ATTACHMENT C

STORMWATER TREATMENT BEST MANAGEMENT PRACTICES

Numerical Sizing Criteria for Development Planning

Sample Calculations

Sample calculations for using the numerical sizing criteria under consideration by the Board were performed for a hypothetical commercial development. The case examples illustrate that the three different numerical sizing criteria for calculating best management practice (BMP) sizing dimensions produce values that are within 10 - 15 percent of one another, when local rainfall data are used.

Requirement: capture of 85th percentile rainfall event
Project: Light industrial warehouse/office with parking lot (assume the site is entirely impervious)
Project site size: 240,000 sq. ft = 5.51 acres

Treatment BMP: 48-hour Detention Basin: Sample calculation demonstrates the water quality treatment volume required to size a detention basin using (a) the maximized water quality treatment volume method; (b) the 85th percentile rainfall event treatment volume for the site using local rainfall data; and (c) the 90 percent annual runoff volume capture method.

(a) Maximized Water Quality Treatment Method – WEF Manual of Practice #23 (Chap 5)

Maximized Detention Volume, $P_o = a\,C\,P_6$ [WEF, p.175]

For 85th percentile event capture for 24 hours

Regression constant, a = 1.963 [WEF, Tbl 5.4, p.177]
Mean Storm Depth, P_6 = 0.64 in. [WEF, Fig 5.3, p.176]
(Note: Local precipitation record can be used to calculate more accurate P_6 for the site)
Runoff Coefficient, C = 0.9 [Dunne, p.300]
(Assume the entire site is paved)

⇨ P_o = 1.963 x 0.9 x 0.64 = 1.13 inch
⇨ Required storage volume = P_o x area of site
⇨ = (1.13 in/12) x 240,000 sq. ft.
⇨ 22,600 cu. ft.

Basin Size ~ 55'L x 40'W x 10.3'D

(b) Using treatment volume from all events up to and including 1.1" rainfall (85% treatment based on local rainfall data)

P_o = 1.1 in.

⇨ Required storage volume = (1.1 in/12) x 240,000 sq. ft
⇨ 22,000 cu. ft

Basin Size ~ 55'L x 40'W x 10'D

(c) California Stormwater Handbook

90 percent annual runoff volume capture for 40 hours [Indus. Handbook, p. D1]

Unit basin storage volume = 0.060 ac-ft/ac [Indus. Handbook, p. D9]

⇨ Required storage volume = Unit basin storage x area of site
⇨ = 0.060 ac-ft/ac x 5.51 ac
⇨ = 0.331 ac-ft
⇨ = 14,400 cu. ft

Basin Size ~ 36'L x 40'W x 10'D
(Note: This calculation was performed using available data from the Oakland Airport rather than the Palo Alto data used in example (b). The Oakland data appears to significantly understate the need for storage, and this example demonstrates the importance of using local rainfall data in stormwater calculations).

References

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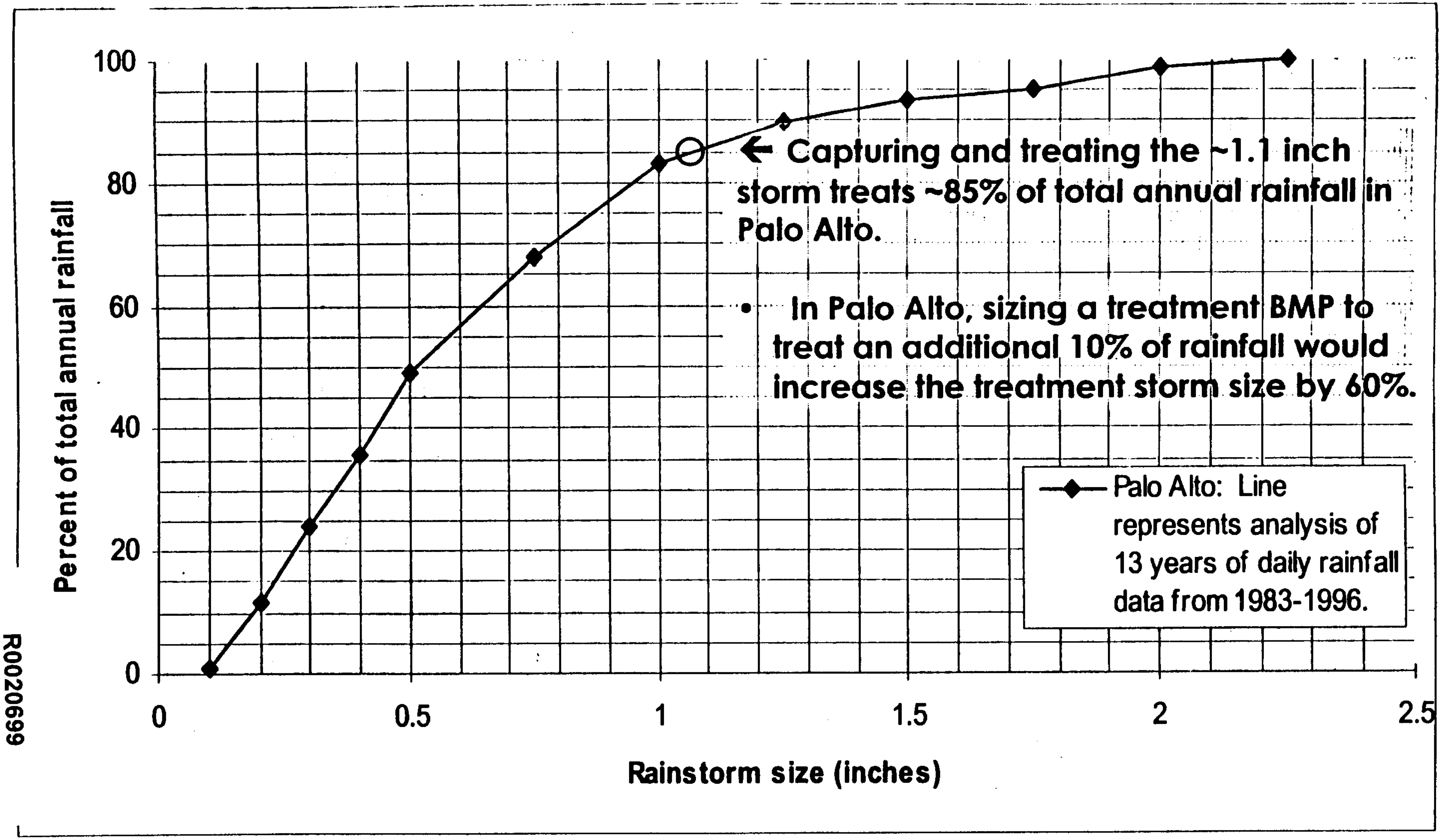

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Technical Concept

- **Over a year, the largest volumes of runoff are produced by smaller storms**
- **Using the Tentative Order sizing criteria, BMPs would be sized, using local rainfall data, to treat these smaller, more frequent storms.**

ATTACHMENT D

STORMWATER TREATMENT BEST MANAGEMENT PRACTICES

Numerical Sizing Criteria for Development Planning

BMP Cost Estimates

A cost estimate has been developed for post-construction BMPs for a commercial development project using the numerical sizing criteria under consideration by the Board. The cost estimate calculations are based on cost estimates developed by the Los Angeles Regional Board Water Quality Control Board and City of Los Angeles staff. Staff realizes costs in the Los Angeles Region will not be identical to those in the San Francisco Bay Region. However, the cost estimates should be similar, providing adequate information for analysis at the planning level.

The cost estimate is conservative and designed to maximize the cost of the BMP relative to overall project costs (see *Note*, below). The estimate indicates that the capital and maintenance costs associated with a treatment BMP sized to meet the numerical sizing criteria are reasonable and amount to about 1.1 percent of the project cost. The total cost of the project was estimated to be $6.5 million and includes the land acquisition for a 5.5 acre site, engineering and design, any clean-ups, construction, permits, etc.

A single estimate has been prepared for a 48-hour detention basin. Because of the land area and excavation they require, detention basins are usually viewed as the most costly treatment control BMP in terms of up-front capital investment. Other BMPs, such as vegetated swales or in-ground treatment controls, would be expected to have a lower capital cost. The operation and maintenance costs for BMPs vary depending on BMP, and could be relatively higher or lower than those shown here. For example, vegetated swales are usually placed into a site's landscape area, and are often maintained as landscaping would be (e.g., regularly mowed). Thus, while there is a cost that can be attributed to the swale, the presence of the swale does not necessarily incur an increased maintenance cost for the project compared to not having it there.

Note: A land cost of $1.1 million per acre was used in this calculation. This is an estimated land cost based on anecdotal discussions with local developers. However, even a significantly increased land cost would not change the results of the calculation. This is because BMP costs are calculated relative to the overall project costs. If estimated land costs were to almost triple, for example, to $3 million per acre ($75 per square foot), the cost of the detention basin as a percentage of project costs would actually fall, to less than 1 percent.

The below example is simplified. It likely understates project costs by estimating total project costs other than land (e.g., design, permitting, construction, local fees, etc.) at about $500,000. "Other project costs" are likely significantly above that amount, perhaps by more than an order of magnitude (i.e., for a total of at least $5.5 million). Detention basin costs have also been simplified. For example, costs including planting, orifice design, etc., have not been included. However, based on construction costs of $25,000 –50,000 per acre for constructed wetlands with similar features (excavation, planting, installed tide gates, etc.), the overall conclusion of the example remains the same—that BMP costs relative to overall project costs are around 1-2% or less. In general, the example has been estimated conservatively to attempt to maximize the costs of the BMP as a percentage of the overall project costs.

Case Example 1 – 48-hour Detention Basin

Excavation and haul away - $22 per cubic yard [1]

⇨ Warehouse Project: 22,600 cubic foot = 837 cu. yd = $18,414

Land Cost - $25 per square foot (~$1.1 million per acre) [2]

⇨ Warehouse Project: 55' x 40' = 2200 sq. ft = $55,000

Maintenance cost – 1 clean out per year

Event mean TSS concentration for Commercial Area = 91 mg/L [3]

Total rainfall volume captured by basin ~ 85% of 13.2 in. per year
= (11.22 in./12) x 240,000 square feet
= 224,400 cubic feet of water
= 6,350,000 L

TSS collected = 80% (91 mg/L x 6,350,000) = 463 kg/yr
If sediment density = 1.5 tons/ cu. yd, total TSS removed = 0.31 cu. yd/yr
⇨ Clean Out Cost: 1 cu. yd / 3 years = $99/3 yrs = $33 / yr

Total Capital Cost = $73,414
Annual Maintenance = $ 33
About 1.1% of total project cost.

ATTACHMENT E

AMENDMENT OF THE NEW DEVELOPMENT PROVISION: STAKEHOLDER PROCESS

1999-2000: Discussions and submittals from Co-permittees regarding reissuance of the entire municipal storm water NPDES permit, including new development provisions as well as all other permit provisions

Oct. 13 - Nov. 13 2001: Formal public comment period on the Tentative Order for the entire NPDES permit reissuance. Comments were received from Co-permittees, environmental advocacy groups, and industry, and included comments on new development provisions.

Nov. 7, 2000: Held a stakeholder meeting during the formal public comment period to discuss permit issues. Significant comments remained on the new development provisions.

Dec. 13, 2000: Held a stakeholder meeting on the new development provision only. Regional Board staff and stakeholders agreed that the new development provision needed further work, while the remainder of the permit should be reissued. Co-permittees gave their permission to reopen the storm water permit after its reissuance for purposes of adopting a revised new development provision.

Jan. 10, 2001: Held a stakeholder meeting to discuss the new development provisions. Regional Board staff considered comments from this and previous meetings to draft new language.

Feb. 21, 2001: Santa Clara Basin municipal storm water NPDES permit is reissued.

Early May, 2001: Draft new development provisions issued for discussion with stakeholders.

May 14, 2001: Held a stakeholder meeting on the new development provisions. Verbal comments from the meeting and written comments received after the meeting were used to make additional changes in the provisions.

May 18-June 18, 2001: Formal public comment period for the Tentative Order containing the new development provisions.

June 5, 2001: Held final stakeholder meeting on the new development provisions to discuss the changes made following the meeting in May.

STORMWATER RESEARCH NEEDS IN SOUTHERN CALIFORNIA:

2001-2005 Research Agenda

Brock Bernstein and Kenneth Schiff

November 29, 2001

R0020703

Acknowledgements

This document represents a remarkable first step towards regional cooperation in stormwater science and management for southern California. The culmination of this research agenda was, for the most part, a voluntary activity initiated by both stormwater management agencies and regulators in a spirit of mutual collaboration.

The authors wish to thank the workshop panelists who gave freely of their time and talents. The wonderful mix of local and national experts across a wide variety of disciplines and backgrounds provided a unique opportunity for us.

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Introduction

Watersheds in southern California are among the most modified systems in the world (Brownlie and Taylor 1981). Stormwater conveyance systems have been built primarily to reduce flooding, but the infrastructure has not designed to improve water quality. Water quality issues are compounded by the high degree of urbanization of watersheds in southern California. More than 17 million people inhabit the six coastal counties of southern California making it among the most densely populated coastal region in the country (Culliton et al. 1990). The large degree of urbanization, coupled with infrequent rainfall that enables build-up of non-point sources of pollutants, results in sporadic but tremendous loads to receiving waters. Current estimates of pollutant mass emissions for the southern California region indicate loads to the coastal ocean from stormwater discharges rival, and often exceed, those from point sources (Schiff et al. 2001). Based upon the increasing population of southern California and the lack of storm water quality infrastructure, it is likely that stormwater loads will continue to increase.

There is some evidence that stormwater discharges impact receiving water quality. For example, regional monitoring of southern California beaches has shown that shorelines which receive dry weather flows are 10 times more likely to exceed water contact standards than those that are distant from storm drains (Noble et al. 2000). Moreover, more than 60% of the shoreline exceeds water contact standards following wet weather events. This has led to the permanent posting of warning signs near drain outlets and blanket warnings against body contact recreation at any beach for 72 hr following rain events. In addition, large loadings of nutrients have been measured from urban creeks and these have ultimately contributed to the over-enrichment of estuaries at the mouths of urban watersheds, as indicated in part by large blooms of macroalgae. As another example, storm drain discharges have been shown to be toxic to marine and freshwater organisms and this toxicity persists over large areas as discharge plumes spread through coastal receiving waters. After these plumes settle to the bottom of the ocean, the pollutants have been measured in nearshore sediments. Where these sediments must be dredged to maintain navigable harbors or marinas, the associated contamination increases the cost of dredging by orders of magnitude.

Although pollutant loads from stormwater are as large as those from municipal wastewater discharges (POTWs, or publicly owned treatment works), there has been no long-term and sophisticated effort, as there has been for POTWs, to reduce these loads. A primary reason for this lack of coordinated effort is the absence of an equivalent base of scientific knowledge on which to base sound management decisions. For example, knowledge about reference, or expected, conditions is insufficient to enable managers to identify when impacts occur, which beneficial uses are most severely impaired, or clarify target endpoints for remediation. Similarly, we are often unable to differentiate between natural (e.g., storms) and anthropogenic (e.g., contamination, flow modification) impacts on biological communities. Moreover, when water quality impacts from specific constituents do occur, we are too often incapable of identifying, targeting, and reducing their specific contributions.

In parallel with the relatively poor level of scientific understanding of stormwater impacts, there is a lack of technical knowledge on how best to control stormwater discharges. Technical data gaps include source identification in urban watersheds where many small, diffuse sources may commingle. Further, assessments of the most effective and efficient treatment or management strategies for resolving stormwater impairments are typically absent or not well validated. For example, there is a lack of substantive and long-term data about how well best management practices (BMPs) work, which ones work best under a range of conditions, or which BMPs are most appropriate in specific applications for improving receiving water quality.

Finally, available stormwater management tools are typically inadequate to deal with existing needs for proper stewardship and decision making. The tools that do exist are often inadequate because they are either not specific enough (i.e., are based on inappropriate point source analogs) or have not been developed or tested in southern California. For example, managers do not have a tool for assessing the health of physical habitats and biological communities in freshwater environments. Although this tool has been effective at addressing physical and water quality impacts elsewhere around the nation, it has not been developed or applied successfully in southern California. An index or metric of physical and/or biological health would be an invaluable tool for environmental decision making.

Despite such information gaps, management actions (from both the regulated and regulator communities) are being mandated by regulatory frameworks such as National Pollutant Discharge Elimination System (NPDES) Permit requirements and Total Maximum Daily Loads (TMDLs). In the absence of adequate information about stormwater impacts, regulatory requirements derived through such frameworks are likely to be questioned from a variety of perspectives and may not achieve their intended benefits.

Formation of the Stormwater Monitoring Coalition

As a result of the increasing regulatory focus and the lack of scientific knowledge base, both stormwater regulators and municipal stormwater management agencies throughout southern California have developed a collaborative working relationship. The goal of the relationship is to develop the technical information necessary to better understand stormwater mechanisms and impacts, and then develop the tools that will effectively and efficiently improve stormwater decision making. As individuals and agency representatives, there was early recognition that these issues are most often not localized, but oftentimes cross watershed and jurisdictional boundaries. The relationship culminated in a formal letter of agreement signed by all of the Phase I municipal stormwater NPDES lead permittees and the NPDES regulatory agencies in southern California to create the Stormwater Monitoring Coalition (SMC) (Appendix 1).

The SMC member agencies have developed a clear vision of regional cooperation. The vision includes combining resources to cost effectively address the data gaps. The vision includes improved effectiveness of existing monitoring programs by promoting standardization and coordination and reducing duplication of effort across individual programs. In addition, this will lead to improving the basic infrastructure for exchanging, combining, and analyzing data from across the region. The multi-agency collaboration hopes to trade off redundant or ineffective monitoring program elements in order to allocate resources to the research projects necessary for improving stormwater management. The findings from these applied research projects can then be easily and quickly integrated into the existing stormwater management programs.

Once the agreement to work collaboratively was signed, the next step was to determine which research projects should be undertaken. The SMC developed a three step process to identify these projects. The process included: (1) creation of a white paper outlining the technical issues and management questions of interest; (2) conduct a workshop to develop an agenda of research projects using experts in a variety of scientific disciplines; and (3) establish a five-year research plan to implement based upon the workshop proceedings. This document represents step three in the process. The white paper and workshop details can be found in appendices to this document.

Research Themes

The experts who participated in the research agenda workshop generated more than 50 project ideas in less than four hours. This plethora of ideas were combined, clarified, and prioritized over the next day ultimately leading to 15 research projects. Each project was then developed in terms of a problem statement, desired outcome (products), tasks, schedule, and necessary resources (expertise, costs, and potential collaborators).

The 15 research projects developed by the workshop experts naturally fell into one of three categories. These categories included: (1) developing a regional stormwater monitoring infrastructure; (2) improving the fundamental understanding of stormwater mechanisms and process; and (3) identifying stormwater impacts in receiving waters. Monitoring infrastructure includes projects that find ways to integrate, standardize or maintain comparability among programs throughout southern California. These projects include mining existing data, sampling and analysis, data management and sharing, and testing BMPs.

Research projects that improve our fundamental understanding of stormwater mechanisms and processes begin with creating a conceptual model of our existing understanding of these processes. This will help us to identify our knowledge gaps. *A priori* we expect that there will be at least three gaps in the conceptual model. These include an evaluation of reference condition, an evaluation of beneficial uses, and identifying relative contributions of nonpoint sources to stormwater discharges.

Identifying stormwater impacts in receiving waters is the research theme with the greatest number of projects, reflecting how little we know about this subject. Five research projects are geared specifically towards developing tools for assessing conditions in receiving waters. These tools include freshwater bioassessments, toxicity testing, faster and more specific methods for identifying microbial contamination, and identifying indicators of impacts resulting from increased peak flows.

Although the projects are written as individual projects, many of the projects are inter-related. The final chapter of this document provides an overview of these relationships showing where the results from one project may feed into another project.

Developing a Stormwater Monitoring Infrastructure

The following four projects focus on improving the basic knowledge and tools available for addressing questions on a regional scale. They are intended to increase the efficiency of monitoring and improve data integration and interpretation.

Project 1. Integrate and evaluate available data

To date, historical stormwater monitoring data have not been used to their full potential, with the result that important questions at both the local and regional scale have not been addressed and significant opportunities for improving the effectiveness and efficiency of monitoring have not been taken advantage of. This project will address these issues by identifying, integrating, and evaluating available monitoring data from the region. This project would depend to some extent on the regional data infrastructure (Project 3) and would contribute to the definition of regional reference conditions (Project 6) and assessing beneficial uses (Project 7).

Problem statement

While stormwater monitoring programs in southern California have collected large amounts of data, there has been no systematic effort to integrate and analyze these data from a regional perspective. An estimated 1,700 wet weather site-events have been monitored by southern California monitoring programs between 1992 and 1999, which are more than most nationwide data sets. In addition, analysis efforts carried out by individual stormwater programs have not examined a consistent set of questions across the region. As a result, there is little information about the following questions, among others:

- what is the spatial extent of stormwater monitoring?
- what percentage of the total estimated flow of stormwater is monitored on an annual basis?
- what kinds of data types are being sampled throughout the region, and to what extent?
- what is the regional distribution and variability among runoff coefficients from specific land uses?
- what is the regional distribution and variability in contaminant loadings from specific land uses?
- what is the regional distribution and variability in impacts on receiving waters?
- are there specific watersheds or sources that contribute disproportionately to mass emissions on a regional basis?

Thus, available data have not been fully utilized, on a regional basis, to characterize monitoring effort, identify significant sources, describe impacts on receiving waters, and improve the effectiveness and efficiency of monitoring efforts by, for example, removing redundancies among programs.

Desired outcome

This project would take advantage of available monitoring data to help lay the groundwork for important aspects of a regional stormwater monitoring program. It will fully describe monitoring efforts in terms of the parameters sampled and their spatial and temporal coverage. By integrating available information on sources and impacts, it will also take the first steps toward a regional assessment of impacts and beneficial uses (Project 7) and toward a regional definition of background or reference conditions (Project 6). Together, these results will help improve the effectiveness and efficiency of monitoring, on both the local and the regional levels, focus management attention on areas and problems of greater significance, and improve understanding of where and how impacts on receiving waters occur.

Tasks

The major challenges facing this project involve collecting and integrating available data and defining and agreeing on key questions and the analysis approaches appropriate for addressing them.

This project would collaborate with or make use of information from other ongoing or planned studies. For example, the Contaminated Sediment Task Force in Los Angeles has already allocated funds for an analysis of contaminant sources in stormwater to the sediments in Marina del Rey and Los Angeles/Long Beach Harbors. In addition, SCCWRP has committed to a regional analysis of stormwater monitoring data from industrial discharges. Finally, SCCWRP has already compiled a portion of the regional stormwater monitoring data that would be needed for this project and this experience could provide a firm basis for planning and costing out the remainder of the data collection and integration effort. Datasets produced in this project would be formatted to the standards developed in Project 3 and would become part of the regional data infrastructure developed in that same project.

The specific tasks involved in this project include:

- identify existing relevant data
- develop list of specific questions and analyses needed to answer them
- develop a formal data management and analysis plan
- acquire or otherwise confirm access to needed data
- perform quality and consistency checks on data
- standardize and/or normalize data as needed
- conduct analyses
- prepare report(s).

This is a low risk / high benefit project. The probability of success is high because techniques for data integration, synthesis, and analysis are well established. The benefits are likely to be substantial because region-wide analyses have not been performed in the past. In such a situation, the marginal benefit of initial investments in synthesis and analysis are typically very high.

Schedule

This project could begin immediately and could be completed within 12 months.

Resources

Needed expertise includes data managers and data analysts with direct experience with a range of environmental data types. Expected costs are in the range of $100,000 to $250,000. Examples of similar projects include the regional assessments performed as part of the Bight '98 project and watershed assessments performed at a variety of locations throughout the country. Potential partners include the Contaminated Sediments Task Force in Los Angeles and an analogous effort being conducted by San Diego County.

Project 2. Standardize sampling and analysis protocols

At present, the wide array of monitoring approaches used throughout southern California makes it difficult to readily compare findings across stormwater programs and address questions of regional importance. This project would address this problem by developing a standardized set of monitoring protocols for use throughout the region, guided in part by insights gained from Project 1's regional assessment. Senate Bill 72 (SB72) has allocated funds that could support this effort.

Problem statement

Monitoring programs throughout southern California often approach the same question in different ways, sample different sets of parameters, and use a range of field and laboratory methods to collect and analyze samples. This inconsistency makes it difficult, if not impossible, to address questions on a broader spatial scale, to compare monitoring results across programs, and to improve efficiency by taking advantage of opportunities for exchanging data and coordinating monitoring responsibilities across the region.

There are several significant issues involved in any attempt to establish regional standards. Standardization can be approached at four distinct levels. The highest level involves the issue of what to monitor (e.g., should loads be monitored?). The next level involves the approach to use once a decision has been made to monitor a particular parameter (e.g., should time weighted or flow weighted sampling be used?). The third level is procedural and focuses on what specific instrumentation and/or techniques to apply (e.g., should the Mark IV or Mark V Tricorder be used?). Finally, the lowest level of detail involves sampling design issues (e.g., how many samples should be collected? How long should monitoring continue for?). In addition, any attempt at regional standardization must balance the benefits of standardization against the costs in lost flexibility at the local level. Finally, robust sampling approaches for many stormwater related issues have not yet been fully developed, making it difficult to readily select a common standard.

Despite the fact that these issues are often difficult to resolve, the benefits of appropriate regional standardization have been amply demonstrated in numerous instances around the country and in many different types of programs.

Desired outcome

This project would produce a regionally consistent set of standardized monitoring protocols. These would provide the technical basis for addressing questions of regional importance while at the same time maintaining local flexibility where it is essential. Standardization efforts could move in succession through each of the four levels identified above.

Tasks

The major challenges facing this project involve obtaining agreement among a diverse set of participants on, first, the set of priorities for standardization and, second, the standards themselves. The multiyear efforts involved in standardizing monitoring protocols for the marine coastal environment in southern California provide a useful template for this project.

This project could make use of efforts elsewhere in the country to develop uniform approaches to stormwater monitoring. However, the unique features of climate and geography in southern California often make it difficult to apply such approaches directly and without modification. The specific tasks involved in this project include:

- identify a list of management and technical questions that require regionally standardized data to answer
- review and compare relevant monitoring protocols from southern California and from other areas
- determine which protocols can be applied regionally in southern California
- determine which management questions and/or technical issues require further methods development
- develop detailed recommendations to guide implementation by appropriate working groups
- develop regional field operations manual
- conduct laboratory intercalibrations for bacteria, metals, nutrients, and organics.

This is a low to medium risk / high benefit project. The potential risks stem, not from technical problems, but from institutional issues that may make it difficult to achieve regional consensus about sampling methods. However, the potential benefits, in terms of improved efficiency and coordination, along with the ability to integrate data from across the entire region, are large.

Schedule

This project could begin immediately and be completed in 12 months.

Resources

Needed expertise includes a facilitator and in-kind time of one field operations staff person from each participating agency, as well as in-kind time of agency staff knowledgeable about chemical analyses. Expected costs are in the range of $50,000 to $150,000 to produce the field operations manual and another $100,000 to $500,000 to complete the laboratory intercalibrations for chemical analyses. Intercalibrations for bacteria, metals, and nutrients are relatively inexpensive compared to those for organics. Where in the range the costs actually fall depends largely on the constituents chosen. The Bight project undertook similar standardization efforts and these costs are based on that experience. Besides the stormwater agencies in the region, potential partners include the USGS, the SWQTF, and WERF.

Project 3. Develop a regional data infrastructure

The lack of a common data infrastructure in the region makes it extremely difficult to combine data from different programs to assess impacts and problems, quantify trends, evaluate the effectiveness of different solutions, and establish reference conditions on a regional scale. As a result of this situation, it is impossible both to make the best use of available historical data and to realistically consider developing a coordinated regional monitoring program that reduces duplication of effort. This project addresses this problem by creating a set of agreements and standards that will streamline data integration, along with a distributed data management system that will expedite finding and acquiring needed data.

Problem statement

At present, scientists and managers do not have the ability to examine data from across the region to search for patterns or trends, compare impacts and BMP effectiveness across locations, assess local conditions against regional background or reference conditions, or ensure regionally consistent quality control of raw and processed data. In addition, the inability to combine and integrate data from throughout the region leads to duplication of effort and other inefficiencies in individual monitoring programs. Thus, because there is no central data clearing house or network, based on common standards, to make data readily and broadly available, stormwater monitoring and research are less cost effective than they otherwise could be.

Desired outcome

Ultimately, this project would produce a distributed online system, with a centralized catalogue to facilitate search and retrieval, which would provide a wide range of users access to stormwater data from throughout the region. The system could be developed in stages, as follows:

- a simple catalogue of datasets, their locations, and descriptions
- a catalogue with search functions and links to permit users to access and/or retrieve specific datasets
- the addition of data summaries, analysis results, and other data products
- the implementation of regional data quality control and formatting standards to aid data integration
- the addition of modeling, mapping, and other analysis tools to support regional investigations.

Tasks

The major challenges involved in addressing this problem include deciding what data types the system should accommodate, what design the system should be based on, what specific needs it should focus on, and establishing the necessary agreement and coordination among participants. However, the availability of modern distributed database technology will help any such effort avoid the problems inherent in older, centralized systems such as STORET and ODES.

In addition, there are several examples of the successful development of regional information management systems that can provide guidance for this effort, including efforts by the Chesapeake Bay Program and the Gulf Ecosystem Monitoring Program in Alaska. The steps involved are relatively generic and include the following:

- identify data users (e.g., managers, regulators, environmental interests), how they use data now, and how they would like to use the data if they were more readily accessible
- reach agreement on users' needs and desires
- identify existing data generators and the nature of their data
- define an appropriate architecture that describes core functions and how they will be fulfilled
- develop a working prototype, including the user interface, as a focus for more obtaining more detailed user input and defining the system more clearly
- finalize the system design
- select hardware and software components to support the system design
- determine housing and administration needs and how these will be met
- implement system
- maintain and enhance the system over time.

While the development steps are relatively clear, there will nevertheless be significant challenges to be met. These will be primarily institutional, not technical, and will involve issues of funding, coordination, standard setting, access to data that is considered proprietary to some extent, and making provision for orphan datasets.

This is a low risk / high benefit project. The probability of success is high because of the lessons provided by other similar effort and the benefits to be obtained from wider access to regionally standardized data are substantial.

Schedule

With adequate funding, this project could be completed in two to three years. Major milestones include:

- system design
- final cost estimate and funding decision
- completion of the prototype
- implementation
- ongoing maintenance and enhancements.

The only significant rate limiting factors would be the availability of funding and speed with which the participants reach agreement on the system's major design features.

Resources

Needed expertise includes specialists in data management, database design, system architecture, and distributed networks. Expected costs are in the range of $50,000 to $150,000 to establish a data sharing format and an online catalog of existing datasets. This would require no new hardware or software. Developing the full distributed system that permits users to remotely access data over the Internet could cost between $1,000,000 and $1,500,000 and would require new hardware and software. The recent effort to standardize data sharing protocols for regional participants in ocean monitoring in southern California is a good model for the first phase of this project, while the two larger systems mentioned in the Tasks section are models for the second phase. Potential partners are other agencies with needs to acquire and integrate data from a range of sources in order to perform larger-scale analyses and assessments. These may include the SWRCB, Caltrans, and the U.S. EPA, among others.

Project 4. Measure BMP effectiveness

At present, the lack of reliable information on the performance of a range of BMPs hampers decision making about how best to invest available resources to reduce loads. This project would address this problem by systematically evaluating stormwater BMPs using a standardized, regional protocol.

Problem statement

Best management practices (BMPs) are being applied without the benefit of systematic and neutral evaluations of their effectiveness in reducing loads. Available studies of whether BMPs meet manufacturers' claims are often not performed by neutral third parties and are difficult to compare because of inconsistencies in their methods, settings, and timeframes. In addition, the absence of a coordinated regional evaluation strategy means that individual stormwater programs engage in studies that, from a regional perspective, are inefficient and insufficiently comparable. The need for systematic, neutral, and regionally coordinated evaluations is pressing because the ongoing implementation of TMDLs for stormwater contaminants is raising both the regulatory and economic stakes involved in reducing loads and their impacts. Many proposed BMPs (e.g., large settling basins, treatment plants) are expensive and smaller-scale ones are often ineffective (e.g., storm drain filters). As a result of the lack of reliable evaluation studies, decisions involving substantial investments of time, effort, and money are being made based on incomplete and/or faulty information.

Desired outcome

This project will produce a regionally consistent, standardized framework for evaluating stormwater BMPs and will apply this to a priority set of BMPs. The evaluation will focus not only on the performance of individual, or stand-alone, BMPs but also on how alternative networks of BMPS (e.g., fewer, larger BMPs vs. more, smaller BMPs) perform. The project will also take advantage of efficiencies to be gained from using the entire region as a study area.

Tasks

The major challenge involved in this project will be designing a series of evaluation studies that address decision makers' current and future information needs. In addition to examining the performance of individual BMPs, the project should also consider the performance of alternative combinations of BMPs configured in networks relevant to circumstances in southern California.

This project should take advantage of, and integrate if possible, ongoing BMP evaluation efforts by academic researchers and individual stormwater programs. Specific tasks involved in this project include:

- define key management questions
- define primary technical questions and issues
- identify priority list of BMPs
- describe possible alternative BMP networks for evaluation
- incorporate and/or coordinate with ongoing studies
- develop detailed study designs
- develop and/or adapt hydrological and water quality network models as needed
- implement studies of individual BMPs
- implement studies of prototype alternative networks
- apply results to ongoing decision making.

This is a medium risk / high benefit project. The probability of success at the site-specific scale is good because techniques for evaluating the performance of some individual BMPs are relatively well developed. At the larger spatial scale of BMP networks, new modeling approaches may have to be developed or adapted from other applications. Because of the potential aggregate cost of stormwater BMPs in southern California, the potential benefits from improving the effectiveness of this investment are extremely high.

Schedule

This project could begin immediately. Its duration will depend on the number and complexity of BMPs selected for study.

Resources

Needed expertise includes in-kind time of decision makers and of agency staff with direct experience in implementing BMPs, as well as additional expertise in engineering, hydrology, modeling, and statistics. Expected costs are in the range of $50,000 to $150,000 to identify decision makers' priorities and develop the assessment design and $200,000 to $500,000 for the network modeling, depending on the size and complexity of networks considered. Costs for evaluating individual BMPs are difficult to estimate at this time because they are dependent on the number and types of BMPs considered and on the constituents measured. Potential partners include stormwater agencies that are currently implementing BMPs, Caltrans, the Building Industry Association, and XXX (underwriter).

Improving Fundamental Understanding of Stormwater Mechanisms and Processes

The following four projects focus on filling crucial gaps in the understanding of basic mechanisms and processes in the stormwater system. They are intended to bolster the conceptual and empirical foundation for developing improved indicators, assessing conditions, and better targeting management strategies where opportunities are greatest.

Project 5. Develop a systemwide conceptual model

Stormwater management and monitoring efforts in southern California are often planned and undertaken on a case by case basis, without the benefit of a comprehensive regional framework that describes the generation, transport, and fate of contaminants in both wet and dry weather, as well as the operation of important causes of disturbance such as increased flow. This project would address this problem by creating a regional conceptual model of the processes linking sources of impact and endpoints of concern to managers and the public. This model would lay important groundwork for all the subsequent projects in this research plan.

Problem Statement

The stormwater system is a complex combination of natural processes and engineered components, all characterized by poorly understood interactions and a high degree of variability. A basic conceptual model is widely accepted – rainfall causes runoff that mobilizes a variety of contaminants as well as sediment and these cause physical, chemical, and biological impacts in receiving waters. However, the details of the mechanisms and processes that control each step in this causal chain are poorly understood. In addition, currently used conceptual models do not adequately represent the ocean and there are serious knowledge gaps in conceptual models of biological processes.

As a result, it is often difficult to choose appropriate indicators, i.e., where along the causal chain to gather information. It is also difficult to decide where the best leverage points for management action might be, that is, where to intervene to improve conditions and how to determine if such interventions are working as intended. This requires enough knowledge about the system's behavior to make reasonably accurate predictions about what will happen under a range of different conditions. At present, the lack of such knowledge is a serious impediment to the development, implementation, and evaluation of improved management and monitoring strategies.

Desired outcome

This project would produce a conceptual model of stormwater processes that included both wet and dry weather; the full geographical range of the hydrological system (from headwaters to the ocean); and all key system components including hydrology, aerial deposition, chemistry, biology, and human land use decisions. This model would begin as a qualitative summary of knowledge, with quantitative aspects (up to and including mathematical models) where knowledge is more advanced. Its ability to identify linkages between different parts of the system would provide the basis for prioritizing and coordinating management, research, and monitoring on a common set of problems. The ultimate product could range from a linked set of flow charts and system diagrams to a computerized decision support tool.

Tasks

There are two major challenges involved in this project. The first will be the collection and integration of available knowledge about the complete stormwater system in southern California. The second will be the development of a conceptual framework that adequately prioritizes and structures this knowledge.

Major tasks in this project include the following:

- identify all potential processes
- prioritize important pathways

- summarize existing knowledge
- evaluate the need for analytical, quantitative and predictive capability to 'reverse engineer' the impacts to the sources to resolve causation from correlation. For example:
  - attributing the cause of eutrophication to sources (e.g. land use) to receiving waters,
  - identifying locations for monitoring and testing to confirm or refute sources,
  - prioritizing sources on the basis of relative contributions to receiving water impacts to help separate biological impacts from physical and chemical impacts.
- develop framework conceptual model
- flesh out the conceptual model as needed with existing information
- develop an approach to applying the conceptual model to the decision support needs of managers and to structuring the research and monitoring agenda.

This is a low risk / high reward project. There is substantial knowledge available about many aspects of the stormwater system and conceptual modeling techniques are well established. The presence of a systemwide conceptual model will improve a wide range of research, monitoring, and management efforts, in part by providing a systematic and widely accepted framework for planning and decision making.

Schedule
This project could begin immediately and could be completed in 6 – 12 months.

Resources
Needed expertise includes modeling, hydrology, ecology, chemistry, engineering, and systems analysis. Expected costs are in the range of $100,000 to $250,000, with the exact amount depending on the degree of sophistication of the product (e.g., flow charts vs. a computerized decision support tool). Potential partners are stormwater agencies in the region and other agencies responsible for carrying out region-wide assessments of water-related issues.

Project 6. Determine appropriate reference conditions

Assessing impacts, setting management targets, and measuring progress toward these all require clear definitions of reference conditions in order to be maximally effective. While some reference conditions are, in effect, defined by regulatory water quality criteria, there are significant gaps in the systemwide identification of reference conditions throughout the region. This project would address this problem through a comprehensive effort to establish a regionally consistent set of reference definitions for physical, chemical, and biological components of the environment. This effort would depend to some extent on the conceptual model developed in Project 5 and would integrate closely with the following project to stratify beneficial use definitions (Project 7), as well as with all of the indicator research projects described below (Projects 10 – 12).

Problem statement

Quantifying impacts on beneficial uses and tracking progress in improving these requires a definition of reference conditions. These can be numerical regulatory criteria, a description of the natural or unimpacted condition, or a more abstract definition of what might be theoretically possible at a particular site. Whatever form they take, definitions of reference conditions are essential for providing needed context to monitoring and management. Despite the use of numerical water quality criteria, the overall definition of reference conditions in southern California is spotty. Numerical criteria, by themselves, do not take into account broader system hydrology and network linkages. In addition, there is no common agreement about reference for biological conditions or for important physical disturbances such as flow and structural modifications. Nor is there an explicit understanding of how water quality, physical disturbances, and biological processes should be related in a more comprehensive definition of reference conditions.

Desired outcome

This project would produce a regional description of reference conditions that includes water quality, physical processes, biology, and human uses such as recreation and water supply. It would describe functional links between these to ensure that management focuses as much on the functionality of the entire system as on its individual parts. Reference conditions would be defined quantitatively wherever possible and qualitatively where this is not possible.

Tasks

The major challenges involved in this project are the collection and organization of a wide array of data types from across the region, followed by analyses needed to develop appropriate reference frameworks for a variety of habitats. Two recent efforts in the region provide insight into the kinds of analyses that may be required. The Benthic Response Index (BRI) defines a reference condition for marine infaunal communities and a method for measuring how far any particular site is from reference. It is based on regional analyses of data from sites along the entire gradient of conditions from undisturbed to highly impacted. In the second example, the development of the iron normalization technique for sediment samples provided a quantitative method for measuring the increase of metals concentrations above the natural background. Iron normalization essentially calibrates each sample with respect to reference conditions.

Major tasks in this project involve the following:

- examine and evaluate the relevance to southern California of methodologies developed elsewhere
- tailor these methodologies to southern California as appropriate
- use existing data and region-wide data collection, as needed, to identify reference locations and broadly characterize reference conditions for a variety of habitats and environmental components
- define potential indicators for each habitat and/or component, including multivariate indicators that include physical, chemical, and biological features
- analyze indicators in terms of spatial and temporal pattern and resolution
- refine list of potential indicators
- apply metrics (quantitative or qualitative) from Project 7 that define a measurable gradient from reference to highly impacted conditions

- conduct additional field surveys as needed to further refine indicators and/or identify and evaluate new ones
- field test indicators in ongoing monitoring programs.

This project will use the tools developed in Project 1 (Evaluate Available Data) and Project 3 (Develop Regional Data Infrastructure) to improve the efficiency of the characterization and analysis steps. In addition, the conceptual model developed in Project 5 will help ensure that the initial characterization of reference conditions captures important functional relationships. This project will also of necessity be closely integrated with all the indicator projects (Projects 10 – 12) described below. The regional survey that is an integral part of this task will, in an iterative fashion, both depend on and help to define appropriate indicators that can capture the full range of conditions from reference to severely impacted. Finally, the definitions of reference conditions will provide the basis for the next project, which aims to stratify the degree of relative attainment of beneficial uses with respect to reference conditions.

This is a medium risk / high benefit project. The level of risk and difficulty will be low for some environmental components that have been well studied and higher for others that have been less well studied. The benefits to monitoring and management from a regionally consistent definition of reference conditions are substantial.

Schedule

This project could begin immediately and be completed in 5 years.

Resources

Needed expertise includes hydrology, geomorphology, ecology, water quality, and study design. Expected costs are in the range of $XXX to $XXXX, per site, inclusive of project planning, data management, and laboratory and data analysis costs. The total number of sites that might be required is in the range of XXX to XXX. Examples of similar projects include the Bight Project, U.S. EPA's EMAP, and the California Department of Fish and Game's effort to develop bioassessment protocols. Potential partners include U.S. EPA's EMAP, the Statewide Ambient Monitoring Program, the California Department of Fish and Game, and the offshore marine regional monitoring consortium, which is increasingly interested in linkages between land and ocean in the coastal zone.

Project 7. Stratify beneficial uses

The protection of beneficial uses is the fundamental motivation for stormwater monitoring and management. Despite existing frameworks for defining such uses and determining where they have been degraded, there is no regionally consistent system for quantifying how far a particular situation is from reference conditions or how it relates to conditions at other sites. This project addresses this problem by developing a regional scheme for stratifying beneficial use conditions in terms of a set of benchmarks that describe how far from reference a particular site is.

Problem statement

The assessment of receiving water conditions is fundamental to the regulation, management, and mitigation of stormwater impacts. While there are frameworks for this assessment in the Basin Plans and Section 305b of the Clean Water Act, the lack of regionally based reference conditions (see Project 6) and of more sophisticated indicators of both water quality and ecosystem condition (see Projects 10 – 12) has made such assessment more difficult. In addition, there is no regionally consistent definition of benchmarks along the gradient from extremely degraded to reference conditions. Without such benchmarks, it is not possible to quantify just how far from reference conditions a particular location is, to then describe and compare the status of beneficial uses across the region, and to more efficiently manage the application of BMPs. For example, the U.S. EPA's Rouge River Wet Weather Demonstration Project developed quantitative benchmarks for five indicators of river quality (dissolved oxygen, flow, bacteria, Index of Biotic Integrity, and habitat) and used these to rate the status of key beneficial uses along different segments of the river.

Desired outcome

This project will produce a region-wide system for quantifying the status of key beneficial uses and relating their status to a set of benchmarks that rate their relative distance from ideal or reference conditions. This system will then be integrated with existing monitoring and assessment programs in order to begin producing regionally consistent information on the status of beneficial uses. The system could be developed to the point where metrics are converted to colors that visually indicate the status of beneficial uses on maps.

Tasks

The major challenges involved in this task are related to producing a consistent regional framework for inventorying beneficial uses, developing improved indicators of their status (Projects 10 – 12, 15), and achieving region-wide agreement on a set of benchmarks of status.

The major tasks in this project involve the following:

- develop inventory and framework for existing designated uses
- assess stratification schemes used elsewhere
- review range of conditions in southern California (Project 1)
- relate current conditions to regional reference conditions established in Project 6
- develop prototype stratification scheme, with benchmarks
- apply to selected water bodies as test cases using relevant indicators, including those developed in Projects 10 – 12 and 15
- refine stratification scheme as needed
- integrate stratification scheme into ongoing monitoring and assessment programs.

This is a medium risk / high benefit project. The successful development of stratification schemes elsewhere should provide a useful model for a similar effort in southern California. However, the actual benchmarks developed elsewhere will not necessarily be applicable in southern California because of significant differences in rainfall, flow regimes, and habitats. In addition, this project depends on the successful completion of other research projects (Projects 1, 6, 10 – 12, and 15). Despite these risks, the benefits of a regionally consistent set of strata and benchmarks for evaluating the status of beneficial uses will pay substantial dividends in management's ability to inform the public about the condition of beneficial uses and to prioritize monitoring and mitigation efforts.

Schedule

This project must await the completion of the region-wide assessment in Project 1 but could begin before the completion of Projects 6, 10 – 12, and 15. The first two tasks could be completed in six months and the remainder in an additional 12 months, assuming results from other projects are readily available, as shown in the task list above.

Resources

Needed expertise includes data analysts and GIS support, in-kind participation of managers and technical staff from participating agencies, and a facilitator. Expected costs are in the range of $50,000 to $75,000 for a test case and an additional $150,000 to apply the stratification scheme to the entire region. Examples of similar projects include the Bight Project's development of the Benthic Response Index and U.S. EPA's Rouge River Wet Weather Demonstration Project. Potential partners include both regulatory and stormwater management agencies in the region.

Project 8. Identify relative contributions of nonpoint sources to urban runoff loads

Stormwater monitoring and management has focused on a subset of sources that are either presumed to contribute the most to overall loads or are the most tractable to address. What has been missing to date is a comprehensive assessment of the relative contributions to total runoff loads of the full range of potential sources. These include the urban land uses traditionally monitored, as well as aerial deposition, agricultural runoff, and forestry activities. This project addresses this problem in two steps. First, it will use available information to prepare an assessment of how much individual sources may be contributing to overall runoff loads. Using this assessment, it will then design a regional nonpoint source monitoring program to fill data gaps and monitor trends over time.

Problem Statement

With minor exceptions, urban stormwater monitoring and assessment in southern California measures the concentration and loads of a suite of contaminants to receiving waters, along with the contribution to these loads from a range of land uses. As management moves from an earlier emphasis on characterization to a greater concern with reducing impacts (with TMDLs as a primary tool), it will become increasingly important to quantify the contributions to runoff loads of the full range of potential sources. While treated discharges are relatively well characterized, there remain gaps in our understanding of runoff from nonpoint sources. Thus, there is no monitoring program in southern California that looks at all nonpoint sources and quantifies loads and impacts related to these.

Desired Outcome

This project would produce a design for a regional nonpoint source monitoring program that addresses the full range of potential nonpoint sources. This design would be based in part on a best estimate, using currently available data, of the relative contribution to urban runoff loads of these nonpoint sources. This would necessarily use information developed in Project 1 (Integrate Available Data) and Project 5 (Develop Conceptual Model). Data from such a monitoring program would allow stormwater and wastewater managers and regulatory agencies to carry out improved water quality assessments, develop more appropriate TMDLs, and better prioritize pollution prevention efforts.

Tasks

The major challenges involved in this project are the integration of existing data (see Projects 1 and 3) and the development of robust sampling designs for all relevant nonpoint sources, especially those that are not part of traditional stormwater monitoring programs. Further, special attention must be given to developing an approach to sampling on private agricultural lands.

Major tasks involved in this project include:

- identify significant known and potential nonpoint sources (overlap with Project 5, Develop Conceptual Model)
- acquire and integrate available data on these sources (overlap with Projects 1, Integrate Available Data, and 3, Develop Regional Data Infrastructure)
- using available data, estimate relative contribution of significant sources at several spatial scales (overlap with Project 1)
- develop framework of regional nonpoint monitoring design, taking account of the requirements of loading models
- identify relevant monitoring approaches to accomplish the design
- organize information on existing monitoring efforts that could constitute portions of the regional design
- develop detailed program design, including sampling methods and spatial and temporal replication.

These tasks should be carried out in coordination with, or at least with full knowledge of, related efforts by the State Board's SWAMP, U.S. EPA's EMAP, and others to assess loadings and effects.

This is a low risk / high reward project. The monitoring and modeling involved will use readily available techniques. A more complete picture of how all nonpoint sources contribute to regional loadings will greatly assist decision making about how to best allocate monitoring and source reduction efforts.

Schedule

This project could begin as soon as input from the other research projects is available and could be completed in one year.

Resources

Needed expertise includes in-kind support from participating agencies' staff, statisticians, interdisciplinary scientists, air deposition and agricultural runoff specialists, and a facilitator/project manager. Expected costs are in the range of $75,000 to $125,000.

Projects Related to Identifying Receiving Water Impacts

The following seven projects focus on enhancing the tools available for identifying and quantifying stormwater impacts on receiving waters. They are intended to increase the breadth, specificity, and timeliness of methods currently in use and to bring new methods to the level of development where they can be used routinely.

Project 9. Identify the causes of impacts in receiving waters

While there is information available on impacts in receiving waters, monitoring studies, with few exceptions, have yet to identify the specific causes of such impacts. This is because the upstream tracking and identification of sources can be difficult and the causal mechanisms by which sources lead to impacts are not always clearly understood. This project will address this problem by performing detailed field studies to link impacts and sources in one or more pilot watersheds.

Problem Statement

Past stormwater monitoring has successfully identified important sources of contamination and disturbance, although there are some data gaps and remaining questions about the relative contribution of different sources (see Project 8, Identify Relative Contributions). At the "downstream" end of the system, monitoring has also documented specific impacts, such as elevated levels of contaminants in water and sediment, instream toxicity, habitat damage, and eutrophication. What is missing in most cases, however, is accurate knowledge about which sources are related to which impacts and the specific mechanisms causing these impacts. For example, the sources of persistently elevated levels of bacteria in Aliso Creek in Orange County and of organophosphate pesticides in Chollas Creek in San Diego County have been clearly identified.

Desired outcome

This project would produce a catalogue of important impacts in receiving waters, along with the specific kinds of sources that cause each. It would identify the mechanisms that link impacts and sources, as well as procedures for establishing causation from correlative monitoring data.

Tasks

The major challenges involved in this project are identifying and then documenting the particular intermediate mechanisms that lead from sources to impacts. While the systemwide conceptual model (Project 5) will provide a starting point, this project will depend on field investigations to validate presumed relationships and search for currently undefined causal linkages. An additional challenge may involve unraveling the relative contribution of multiple sources to cumulative impacts. This project will also depend on the results of the regional synthesis of existing data (Project 1), as well as improved indicators from Projects 11 (Toxicity Testing), 13 (Microbial Source Tracking), and 15 (Peak Flow).

Major tasks involved in this project include:

- develop list of impacts
- develop list of candidate causes
- develop hypotheses for investigating correlation and causality between them
- assess information available to test specific mechanisms
- identify additional information needed to validate causal relationships
- select pilot watershed(s) suitable for field studies, i.e., where clear impacts exist and upstream tracking of sources is feasible
- design and implement a research plan to test hypothesized mechanisms. This might involve using relatively inexpensive screening techniques throughout the watershed(s), followed by more sophisticated tools focused on specific problem areas.
- update conceptual model with new understanding.

This is a medium to high risk / high benefit project. Assuming that results from Projects 11 (Toxicity Testing) and 13 (Microbial Source Tracking) are available, it should be relatively straightforward to identify the sources of most impacts. Cumulative impacts may present more problems. However, the benefits of an improved ability to reliably link impacts and sources will pay important dividends for source reduction programs.

Schedule

This project could begin when needed information from other projects is available and could be completed in two to five years.

Resources

Needed expertise includes in-kind participation from agency managers who are knowledgeable about the pilot watershed(s) and can help provide needed access for sampling, as well as a hydrologist, scientists skilled in relevant impact identification techniques (e.g., microbiology, toxicity, chemistry), field staff, laboratory facilities, data analysts, GIS support, and data managers. Expected costs are in the range of $250,000 for a single watershed and a single constituent and would scale up from there depending on the number of watersheds and constituents. Similar projects have been conducted elsewhere in the country focusing on individual constituents of concern, such as bacteria. Potential partners include local agencies and the Los Angeles Contaminated Sediment Task Force.

Project 10. Develop bioassessment indicators and protocols

The ultimate concern for both managers and the public is not the levels of contaminants in a waterbody but the status of beneficial uses and trends in these over time. However, indicators do not yet exist for those beneficial uses that are related to ecological conditions. This project would address this problem by developing a regionally consistent set of bioassessment indicators and protocols for a range of important habitat types and ecological assemblages in southern California.

Problem statement

Stormwater monitoring and management have focused primarily on the measurement of levels of contamination and other water quality conditions. However, a focus on contamination and its direct effects can miss other significant sources of impact and do not capture the ecological impacts of stormwater. Adequate or excellent water quality can coexist with serious impairments to biological conditions. Increased flow volume and velocity change sediment budgets, erode banks and streambeds, and damage instream habitat. Channelization removes riparian vegetation and increases water temperatures, creating a lethal barrier to fish migration. Maintenance practices designed to preserve channels' ability to convey stormwater efficiently also remove instream habitat for fish and invertebrates. Development that spreads to the very edge of creeks, streams, and other waterbodies can remove important riparian habitat and damage or destroy a waterbody's ability to respond to natural perturbations by expanding/contracting its extent or changing course.

Bioassessment methods, as developed by U.S. EPA, the U.S. Forest Service, and the California Department of Fish and Game, among others, provide a means of reflecting overall ecosystem health, as well as measuring the status of specific biological conditions, independent of a focus on chemical contamination. Such bioassessment methods can integrate both episodic and long-term exposure to perturbation and can also be used in concert with chemical and other monitoring, as a screening tool, to focus attention on areas of particular concern. While these methods can help to rank sites in relative terms, incomplete understanding of relationships between stressors and biological indicators, along with the lack of accepted biocriteria for assessment, make it impossible to say with any certainty (except in more extreme situations) whether conditions meet minimum levels of acceptability.

Desired outcome

This project would produce a set of regionally standardized bioassessment protocols for macroinvertebrates, fish, algae, and macrophyte assemblages in fresh waters of southern California. The protocols will define procedures for routinely measuring and interpreting appropriate indicators of ecosystem health. In combination with the regional reference framework (Project 6) and the stratification of beneficial uses (Project 7), these protocols would help determine whether and to what degree a system is being ecologically degraded by stormwater inputs.

Tasks

The major challenges involved in this project are those related to identifying sensitive measures of biological response for each assemblage and then developing appropriate indicators that capture that response. Bioassessment protocols are currently under development for fresh waters in southern California, primarily by the California Department of Fish and Game and U. S. EPA's EMAP. These efforts will provide an important framework for this project and mean that, for many habitat types, new techniques will not be needed.

Major tasks in this project will include:

- evaluate existing efforts being conducted by U.S. EPA EMAP, California Department of Fish and Game, U.S. Geological Survey, U.S. Forest Service, and others
- define the degree to which each effort is applicable to specific habitats in southern California
- define baseline and reference conditions of each habitat, including defining subhabitats as needed, within the framework established in Project 6 (Determine Reference Conditions)
- test candidate methods and prospective indicators

- determine biological response signatures of indicator organisms to stormwater. This may require integrating information from toxicity testing. Simultaneously, measure potential physical and chemical confounding factors and the relationship of habitat type to ecosystem health.
- validate the protocols.
- develop QA/QC procedures.

This is a low risk / high benefit project. The fact that current research on bioassessment protocols is underway in southern California, combined with relevant knowledge from similar successful efforts elsewhere in the country, increase the likelihood of success. The benefits of an improved ability to relate stormwater to ecological conditions would be substantial.

Schedule

Each habitat type may have a different schedule, depending on the availability of existing methods and associated data. The project should begin with freshwater systems, on the following schedule:

- Year 1 – literature search on potential indicators and methods; evaluate and select candidate protocols; exploratory analyses on available data to assess stormwater effects (may be a pilot study in one or more test areas)
- Year 2 – prepare study design for additional data collection (e.g., quantify spatial and temporal patterns and variability); field test protocols and indicators; identify indicators' response signatures
- Year 3 – validate procedures and indicators; conduct peer review; report results; identify strengths, weaknesses, recommendations

Resources

Needed expertise includes bioassessment in freshwater systems, indicator and protocol development for biological assemblages, familiarity with methods used in other key programs, field sampling, data analysis, and data management. Expected costs are in the range of $400,000 per year for three years, of which $150,000 would be required for filling data gaps. Similar projects have been carried out at several places throughout the country, most notably in Ohio under the auspices of U. S. EPA. Potential partners are the California Department of Fish and Game, U. S. EPA's EMAP, California State Water Resources Control Board (SWAMP), and volunteer monitoring networks such as those supported by Heal the Bay and the Stream Team in San Diego.

Project 11. Develop improved toxicity testing procedures

Despite their wide use, significant limitations constrain the application and interpretation of toxicity tests. There remain unresolved questions about the choice of indicator organisms, the interpretation of test results, and the identification of sources of toxicity with TIEs. This project will address these problems by developing and field testing a set of improved toxicity testing and TIE protocols.

Problem statement

Toxicity tests are widely used to measure stormwater impacts directly, especially where information on individual chemical contaminants is inconclusive or incomplete. However, there are several important unresolved issues with toxicity testing, including selecting appropriate test organisms, interpreting conflicting and variable test results, and better defining and expanding the scope of toxicity evaluations (TIE). Because of these shortcomings, current toxicity testing procedures are often limited to use in specific environments and their results are often not well integrated into a complete understanding of the ecosystem. In addition, integrating toxicity tests into a regional reference framework (see Project 6) would improve the assessment of stormwater impacts.

Desired outcome

This project will evaluate available methods of toxicity testing (including TIEs), identify the method(s) most applicable in specific types of systems (estuarine, marine, freshwater), and propose improvements to existing methods where needed.

Tasks

The major challenges involved in this project relate to the complex responses of test organisms and the complex chemical characteristics of toxic compounds, both singly and in combination.

This project will utilize results of Project 6 (Determine Reference Conditions) and Project 7 (Stratify Beneficial Uses) to help define the range of conditions toxicity testing should address. Major tasks in this project will include:

- establish prioritized list of problems and issues with toxicity testing approaches currently used in southern California
- develop set of criteria for ideal toxicity tests, e.g., ability to define spatial extent of toxicity, measure spatial and temporal variability of toxicity in relation to hydrology
- evaluate existing toxicity testing protocols in relation to problems and issues
- define areas where further research and development are most needed
- design needed laboratory studies
- design and implement field case studies (see detail below) focused on key habitats
- improve and/or develop ancillary TIE procedures
- develop regional toxicity testing protocols based on field test results and incorporating EPA standards.

Field tests for improved methods could follow the following format:

1. Identify a receiving water of interest
2. Design case study
   - 2.1. consider temporal variability (intra- and inter-storm)
   - 2.2. consider spatial variability
3. Conduct toxicity tests along gradient of exposure
4. Assess results along gradient relative to predefined criteria
   - 4.1. Relative sensitivity (stormwater, ambient water, and reference toxicants)
   - 4.2. Control response / reference site response
   - 4.3. Correlations with contaminants
   - 4.4. Correlations with bioassessment metrics (macroinvertebrates, phytoplankton, fish)
   - 4.5. Correlations with chemical and physical factors, and possible confounding factors
   - 4.6. Use in TIEs
   - 4.7. Ecological relevance

5. Conduct dose-response experiments with key indigenous species identified in bioassessment
6. Conduct in-situ tests to assess ecological linkages, temporal variability in response signal, and response to simultaneous multiple stressors
7. Identify causes of toxicity.

This is a low to medium risk / high benefit project. The responses of different test organisms to the suite of stormwater contaminants are complex and it may be difficult to make clear-cut decisions about which test organisms are the most appropriate in different circumstances. Similarly, the chemistry of toxic compounds is also complex, complicating the development of enhanced TIE procedures. However, if these difficulties can be overcome, the ability to more precisely quantify the level of toxicity and to link it to one or more specific contaminants would substantially improve monitoring and source tracking efforts.

Schedule

This project could begin immediately and be completed in three to five years, assuming results from Projects 6 and 7 were available as needed. Tasks preparatory to the field studies would take six to 12 months. Tasks 1 – 3 in the field tests could be completed in the second year, tasks 4 and 7 in the third year, and tasks 5 – 7 in the fourth year. Writing a protocols and standards document would take up the fifth year.

Resources

Needed expertise includes toxicity specialists, chemists, field teams, specialized laboratories, and in-kind support from agencies for field collection. Expected costs would be $300,000 to $350,000 at a minimum and could be as high as $1 million, depending on the number of sites and test organisms, and on the number and complexity of toxicants of concern. Potential partners include regional stormwater and regulatory agencies, academic researchers, and SCCWRP.

Project 12. Develop rapid response indicator(s) for microbial contamination

The absence of a real-time ability to detect microbial contamination in receiving waters prevents managers in some cases from reliably closing recreational waters when they are contaminated, but also causes a loss in economic revenue when sites are not reopened for public use as quickly as possible. This project addresses this problem by developing improved indicators that would quickly (within two hours) provide reliable measures of the presence of pathogens of concern.

Problem statement

The rapid detection of fecal contamination in receiving waters would improve public health managers' ability to protect the health of those using receiving waters for recreation. This is important in southern California, where beach visitation in the millions coincides with the large-scale stormwater inputs that can carry a variety of human pathogens into waters designated for recreational use. However, current methods for fecal indicator bacteria have a lag time of 24 – 48 hours, which means that it is impossible to provide real-time information to the public about the relative risk of water contact recreation. This not only makes it impossible in some instances to reliably close or post recreational sites when they are contaminated, but also causes a loss in economic revenue when sites are not reopened for public use as quickly as they might be. In addition to their lack of timeliness, current indicators are not necessarily reliable indicators either of animal and/or human waste products or of the presence of pathogens that may cause illness in humans. Improved indicators would provide a speedier and more reliable link to human health risk and do a better job of identifying sewage sources.

Desired outcome

This project would develop a rapid pathogen screening tool that would provide a result within two hours of sampling and would be applicable in marine, brackish, and freshwater environments. This rapid detection method would be accurate, reliable, require little technical training, and might include viruses, bacteria, protozoans, and chemical indicators of sewage (e.g., caffeine). Optimally, the method could be used either in the lab or in the field to provide a quick determination of whether the stormwater from a particular storm event presents a hazard to public health.

Tasks

The major challenge involved in this project is the development of methods that can directly detect pathogens themselves or reliable indicators of their presence. This may require a shift away from standard culture approaches and toward more modern techniques such as biosensors or DNA probes.

The major tasks involved in this project include:

- establish criteria for ideal indicator(s)
- evaluate the full range of existing technologies
- identify directly applicable technologies (if any)
- define development and testing procedure for directly applicable technologies
- carry out further development on directly applicable technologies as needed
- define and conduct needed research if no directly applicable technologies exist
- evaluate new technologies in system(s) of interest, including receiving waters, sources
- refine methods, to improve measurement capabilities and definition of endpoints
- integrate with current epidemiology studies to evaluate how new methods relate to actual human health risk
- conduct further testing and validation
- develop protocols for routine use.

This is a high risk / high benefit project. There are no off-the-shelf technologies that are directly applicable to this problem and also ready for routine use. The direct detection of pathogens, as opposed to indirect indicators such as fecal coliforms, has proved difficulty, and the two-hour goal is a challenging one. However, the ability to reliably and quickly measure the presence of pathogens of relevant to human health concerns would provide substantial economic benefits because it would dramatically improve managers' ability to target closures where they are actually needed.

Schedule

This project could begin immediately and would take five years to complete, as follows:

- Year 1 – identify and select methods to be evaluated
- Year 2 – evaluate methods with regard to rapidity, sensitivity, and specificity. If technology is not available, develop new methods that meet above requirements.
- Year 3 – refine evaluated methods to optimize their capabilities with regard to measuring appropriate analytes in water environments or continue development of new methods.
- Year 4 – use method to measure water quality during the conduct of an epidemiology study. Analyze epidemiology study data to determine how well water quality data relates to health data.
- Year 5 – verify that the method works under a broad range of conditions and develop QA/QC protocols for routine use.

Resources

Needed expertise includes bacteriologists and epidemiologists, as well as in-kind support from regional agencies for field sampling. Expected costs are in the range of $300,000 to $500,000, assuming that the project can collaborate with at least one epidemiology study planned in the region. Potential partners include SCCWRP, U. S. EPA, the California State Water Resources Control Board, county health departments, and the NPDES ocean dischargers who conduct beach monitoring.

Project 13. Develop microbial source tracking protocol

At present, it is not possible to accurately and quickly identify the sources of microbial contamination in stormwater. This prevents the timely application of source controls and results in costs due to closures and other impacts on receiving waters. This project will address this problem by developing standard protocols for tracking the specific sources of contamination in local watersheds.

Problem statement

Fecal contamination in stormwater can derive from agricultural activities, livestock, wastewater, urban runoff, leaking septic systems, and soils, among others. The ability to determine which sources are most important in any particular situation can not only provide a basis for cost-effective source reduction efforts, but can also help determine relative public health risk associated with poor water quality in receiving waters. In addition, successful source tracking techniques are vital to implementing coliform TMDLs, because partitioning of fecal contamination will permit waste load allocation of tributaries or upstream sources in a watershed. However, current approaches to partitioning fecal sources are not successful due to the inability to reliably differentiate among the several possible sources of contamination. In addition, current approaches do not provide results in a timely manner. As a result, it is nearly impossible to follow a "hot spot" or contaminated parcel of water upstream.

Desired outcome

This project would develop standardized protocols for microbial source tracking that will allow stormwater managers to quickly identify the relative contribution of different sources of fecal contamination in any particular situation. The method developed will be accurate and reliable, capable of consistently providing correct classification of sources of fecal contamination, and should be applicable for use in different water body types (i.e., marine, brackish, and freshwater). This project will also provide guidance on the use of this method, including implementation, interpretation of results, its degree of geographic specificity (i.e., whether it is equally applicable in watersheds of different types). The research project would also identify strengths and limitations of the method developed, especially in the context of other available methods, and make suggestions for improved applicability in other systems.

Tasks

The major challenges involved in this project are related to the difficulty in establishing a broadly usable database of microbial fingerprints. Currently used microbial source tracking techniques depend on the development of a watershed-specific database of genetic fingerprints of existing sources of fecal contamination. For example, if the watershed is dominated by residential homes and ranches, and contains very little area where wildlife reside, a typical database might be created that is based upon fingerprints of collected fecal samples from horses, cows, dogs, cats, and humans. Not only are the necessary databases for different systems inherently different, but microbial populations can also vary within individual populations within a system and among systems. Given this, it is often difficult or impossible to use an available database from one watershed for identifying sources of fecal contamination in another watershed. Developing these libraries, or databases, can be time consuming and tedious, especially because the size of the database required increases exponentially with the size of the watershed. This is because scat samples must be collected from a representative portion of the animal and human populations in the watershed. Therefore, this project will identify the technique(s) that are most appropriate for the southern California region, test them in one or more pilot watersheds, and develop standardized protocols for their application throughout the region.

Major tasks in this project include:

- identify possible methods (e.g. ribotyping, Terminal Restriction Fragment Length Polymorphism, antibiotic resistance patterns, nutrition patterns, coliphage serotyping and genotyping, virus detection, Pulse field gel electrophoresis, Rep-PCR, Quantitative PCR)
- evaluate alternative methods in terms of applicability to southern California watersheds and the balance between statistical rigor, cost, and size of watershed
- develop a standardized protocol and relevant databases, with attention to the size of database necessary for statistical rigor and accurately classifying sources

- develop tracking strategy, assessing both top down (evaluate relative contribution of known sources) and bottom up (tracking upstream from a contaminated waterbody or end of a pipe) approaches for use in different situations, and defining the other types of data that should be collected (e.g., flow, pH, salinity, TSS, nutrients)
- test and validate methods both in the laboratory and in the field
- develop QA/QC protocols for routine use.

This is a medium risk / high benefit project. Even given the limitations described above, currently available techniques have been used successfully to identify and mitigate sources of fecal contamination. These methods will undoubtedly improve with time and the likelihood of success is high, given time and funding enough to develop needed databases. As long as the source tracking goal is a general differentiation between sources, for example, differentiating between human and animal fecal contamination, or livestock and dog fecal contamination, available methods provide a suitably high level of correct source classification. However, in a watershed with many confounding factors, and high variability in sources and stormwater inputs, a relatively quick and clear differentiation between sources may not be possible with genetic tracking alone. Despite this, the benefits heavily outweigh the risks because the method will be useful in the large majority of situations, thus greatly improving the efficiency of source tracking and mitigation efforts.

Schedule

This project could be accomplished in three to four years, depending upon the complexity and size of the pilot watersheds. The following milestones could be used to track progress:

- Milestone 1: Identify and evaluate methods. This can be accomplished in six months, given a group that is already familiar with microbial source tracking techniques. First, the available methods must be narrowed to those that are applicable to the system. Second, many small projects using some of these methods have already been undertaken in southern California, so methods that are in existing use should be actively identified and evaluated.
- Milestone 2: Once a method or set of methods is identified that will work for a given system or watershed, it will take approximately 6 months to 1 year to develop a suitable database of existing possible sources, collect scat samples with representative viral or bacterial populations, and design a tracking strategy suitable for the particular watershed of interest. Other important components of this will be to successfully GIS map the system, identify all tributaries and inputs, study hydrological characteristics, and create a conceptual model of the system.
- Milestone 3: Implement microbial source tracking strategy and sampling. This will take approximately 1 year. Microbial source tracking samples will be taken given the tracking strategy outlined, in addition characteristics of the water body of interest will be incorporated to better understand the entire system, namely nutrients, flow, TSS, temperature, pH, etc.
- Milestone 4: Statistical analysis, and data reporting, and data visualization will be followed by transfer of knowledge to parties responsible for decision making and future legislative action. This will take approximately 6 months to 1 year.

Resources

Needed expertise includes microbiologists, molecular biologists, hydrological engineers, statisticians, and data managers. Specialized equipment specific to microbial techniques will also be necessary. Some of the techniques available (e.g., antibiotic resistance) require less large equipment. However, any laboratory using these approaches will need to be outfitted with a laminar flow hood, centrifuges, filter apparatus, incubators, water baths, and other equipment. Other larger cost items that may be needed include hybridization ovens, quantitative PCR machines, gel electrophoresis equipment, power supplies, among others. Expected costs are in the range of $200,000 to $800,000 for pilot studies in one or two smaller watersheds with one or two dominant sources each. The wide range of costs reflects in part the differences among the methods that might be used. Similar projects have been conducted at several places throughout the country. Potential partners include SCCWRP, U. S. EPA, the California State Water Resources Control Board, county health departments, and the NPDES ocean dischargers who conduct beach monitoring.

Project 14. Evaluate BMP effects on receiving water impacts

The large regional investment in BMPs has been based on the assumption that BMPs, by reducing loads of various kinds, will ultimately result in significant improvements in the condition of receiving waters. This assumption has not been systematically and rigorously tested and the ongoing implementation of TMDLs is raising the level of risk associated with the attendant increased investment in BMPs. This project addresses this problem by developing a method, based on conceptual and numerical modeling and on field monitoring, to evaluate the degree to which BMPs actually improve receiving water conditions.

Problem statement

As Projects 9 – 13 (which focus on developing a variety of improved indicators) make clear, our current understanding of causal linkages between a variety of sources and impacts is limited. Such limitations extend to our understanding of linkages between BMPs and their potential reductions of impacts in receiving waters. It is possible to measure the immediate effect of a BMP in terms of reductions in loading of contaminants at a particular point in the drainage system (see Project 4, Measure BMP Effectiveness). However, it is much more difficult to estimate the cumulative effect of a network of BMPs on loadings in an entire watershed and even more difficult to determine if such reductions have improved conditions in the receiving waters. Thus, stormwater programs have made significant commitments to activities such as street sweeping and catch basin cleaning, but there have as yet been no rigorous studies of whether these and other actions actually improve water quality.

Desired outcome

This project will produce a method for determining whether and to what extent BMPs improve conditions in their ultimate receiving waters. This will be extremely valuable in deciding which BMPs to use to achieve the goals of the TMDLs being implemented in the region.

Tasks

The major challenges involved in this project are related to understanding the causal relationships among the different components of the stormwater system. Thus, answering the question whether BMPs have improved receiving water conditions depends on the results of several other projects in this research program. It will require a comprehensive framework that describes the operation of the hydrological system and how sources create impacts (Project 5, Conceptual Model), an estimate of the relative contribution of different kinds of sources to regional loadings (Project 8, Relative Contribution of Nonpoint Sources), improved knowledge about the causes of specific impacts (Project 9, Identify Causes of Impacts), and better indicators of ecological condition (Project 10, Develop Bioassessment Indicators). It will also require improved estimates about the ability of individual BMPs to reduce loads of contaminants in their immediate receiving waters (Project 4, Measure BMP Effectiveness).

Because of the large variability in ambient conditions, and length of time needed to detect changes in these, this project should consider focusing on small pilot watersheds that can be easily manipulated and monitored.

The major tasks involved in this project include:

- enhance the systemwide conceptual model to include specific BMPs and their links to potential receiving water improvements
- select and prioritize BMP / receiving water relationships to examine
- identify one or more pilot watersheds for study
- conduct numerical modeling of the cumulative effects of BMP network(s) to guide design of the field study
- design field study, based on BACI (before-after-control-impact) design if possible
- begin monitoring
- implement BMPs, if necessary
- complete monitoring.

This is a high risk / high reward project. It depends on the successful completion of a number of other research projects. In addition, such an evaluation of BMPs effects on ultimate receiving water conditions has not previously been carried out and there is therefore no prior body of experience to draw on. However, the potential benefits of this project are substantial. Large investments in BMPs have been made and even larger ones are being contemplated in order to meet the requirements of TMDLs. It is therefore crucially important to better understand whether BMPs will produce hoped-for improvements in receiving water conditions.

Schedule

The initial steps of this project through development of the field study design will take at least one year. Monitoring both before and after the implementation of specific BMPs could require an additional five to ten years, depending on the kinds of receiving water conditions targeted. In addition, results can be achieved more quickly for constituents with short residence times (e.g., diazinon, TSS) or that can be more readily controlled. Monitoring would have to continue for a longer period to detect changes related to constituents with reservoirs in the system (e.g., nutrients, metals, bioaccumulative compounds).

Resources

Needed expertise includes in-kind support from stormwater agencies for BMP implementation and field monitoring, as well as engineers, statisticians, hydrologists, scientists knowledgeable in the specific constituents and impacts of concern, data analysts, and data managers. The initial steps of this project through development of the field study design could require up to $1 million. Expected costs for monitoring are in the range of $250,000 - $500,000 per year for ten years. It is not possible at present to scope the BMP implementation and it would be prudent to link monitoring to implementation that is already planned. Potential partners include Caltrans, the State Water Resources Control Board, Water Environment Research Foundation, BMP manufacturers, and stormwater agencies throughout the region, particularly the agency in whose jurisdiction the study will be done.

Project 15. Develop improved indicators of peak flow impacts

Land use changes that increase impervious area lead to increased flows. While this increases the flood potential during major storms, it also increases flows during periods of low to moderate rainfall. These increased flows can cause downstream impacts on water quality and habitat through increased erosion and sedimentation. However, there are no well-established relationships between various levels of increased flow and downstream impacts. This project addresses this problem through an integrated modeling, experimental, and monitoring program in pilot watersheds.

Problem statement

Land development and consequent increases in impervious area increase runoff volumes and peak flows and can lead to downstream erosion and flooding. Traditionally, concerns about increased peak flows have focused on the 50 – 100 year storm event and the potential for destructive flooding. A variety of methods have therefore been developed to shave, retard, and/or channel peak flows and reduce flooding potential. However, development changes the hydrograph and increases runoff volume and velocity even for much smaller flows. Concern is therefore growing that such smaller changes, when they occur on a persistent basis, can create more subtle yet long-term and potentially important impacts on water quality and habitat and the beneficial uses related to them. Such impacts would occur primarily through changes in water quality and through sediment movement and redeposition and streambed scouring. Despite these concerns, there are no regulatory criteria that establish limits on increases in peak flow, nor is there sufficient knowledge about peak flow impacts on which to base such criteria.

Desired outcome

This project would produce indicators that quantitatively link a range of downstream impacts, primarily those related to stream bank and stream bed erosion, to increased peak flows due to land development and increases in impervious area. These indicators could help provide the basis for eventually establishing regulatory criteria for peak flows from smaller and more frequent storms.

Tasks

The major challenges involved in this project stem from the relative lack of quantitative information in the region about the effects of sustained increases in peak flows. Information available from other regions is only partly applicable because of the semi-arid nature of the southern California environment and the highly episodic nature of flows. This project will necessarily depend on the results of several other projects in this research program. It will require a comprehensive framework that describes the operation of the hydrological system and how increased flows might create impacts (Project 5, Conceptual Model), an assessment of historic and current conditions (Project 1, Integrate Available Data), an estimate of the relative contribution of different kinds of sources to regional loadings (Project 8, Relative Contribution of Nonpoint Sources), improved knowledge about the causes of specific impacts (Project 9, Identify Causes of Impacts), and better indicators of ecological condition (Project 10, Develop Bioassessment Indicators).

The major tasks involved in this project include:

- refine or expand the portion of the conceptual model dealing with peak flows
- analyze available data to build a picture of likely changes over time due to increased peak flows
- select pilot watersheds
- design field and modeling study to quantify changes in peak flows and relate these to impacts
- implement field study, including manipulative experiments involving, for example, controlled increases in flow
- develop recommendations for establishing management or regulatory criteria related to peak flows.

This is a medium to high risk / high benefit project. The highly variable nature of rainfall and flows in southern California makes it extremely difficult, in a short period of time, to develop reliable relationships between peak flows and downstream impacts. In addition, the lack of prior attention to this issue means that historical data are not likely to provide a useful database for establishing such relationships.

Schedule

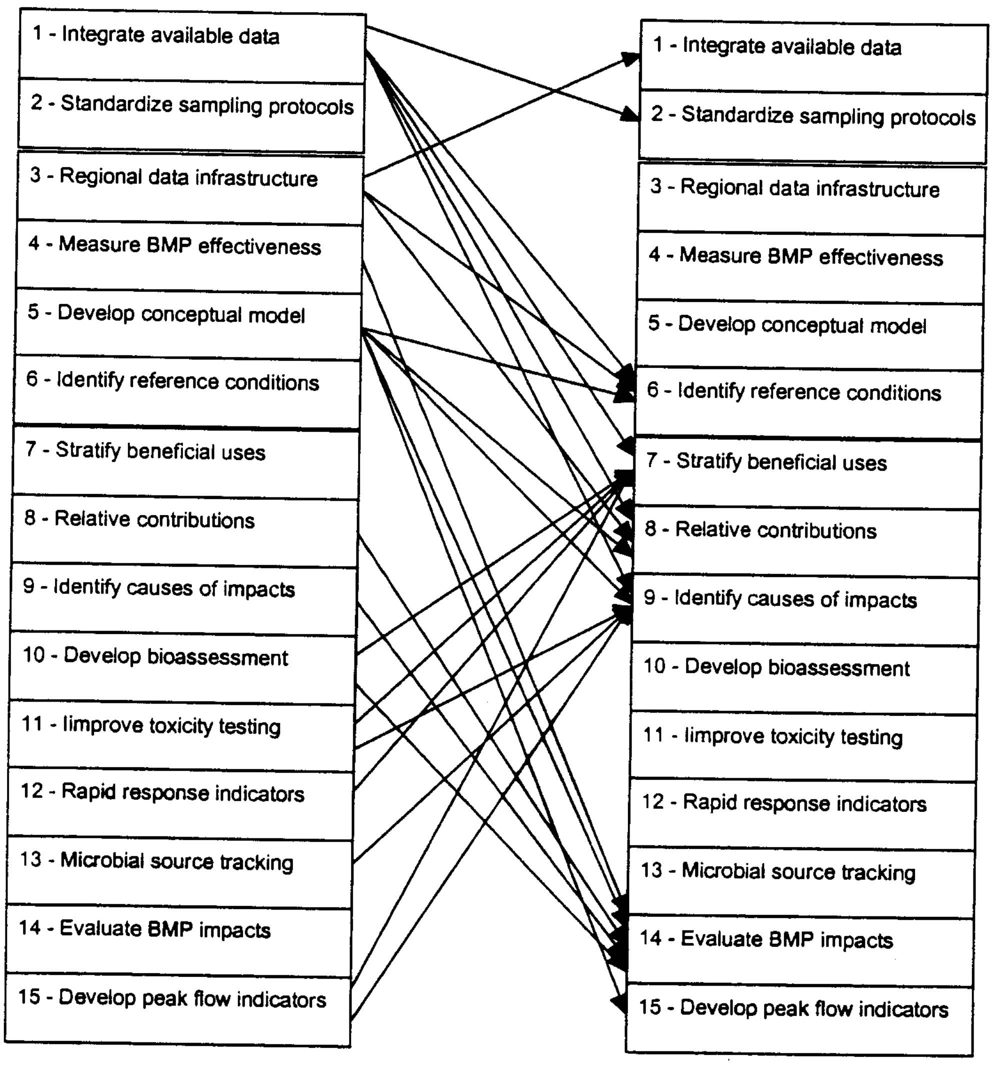
This project could begin in concert with development of the conceptual model in Project 5 and could produce results within three years.

Resources

Needed expertise includes in-kind support from agencies with field monitoring staff, as well as hydrologists, engineers, and modelers. Expected costs for gaging stations, field manipulations, and monitoring range from $75,000 to $250,000 per year, depending on the number of sites and the complexity of field experiments. Modeling would require an additional $200,000. Potential partners include the State Water Resources Control Board, regional stormwater agencies, SCCWRP, the U. S. Army Corps of Engineers, and the U. S. Geological Survey.

Research Plan Overview

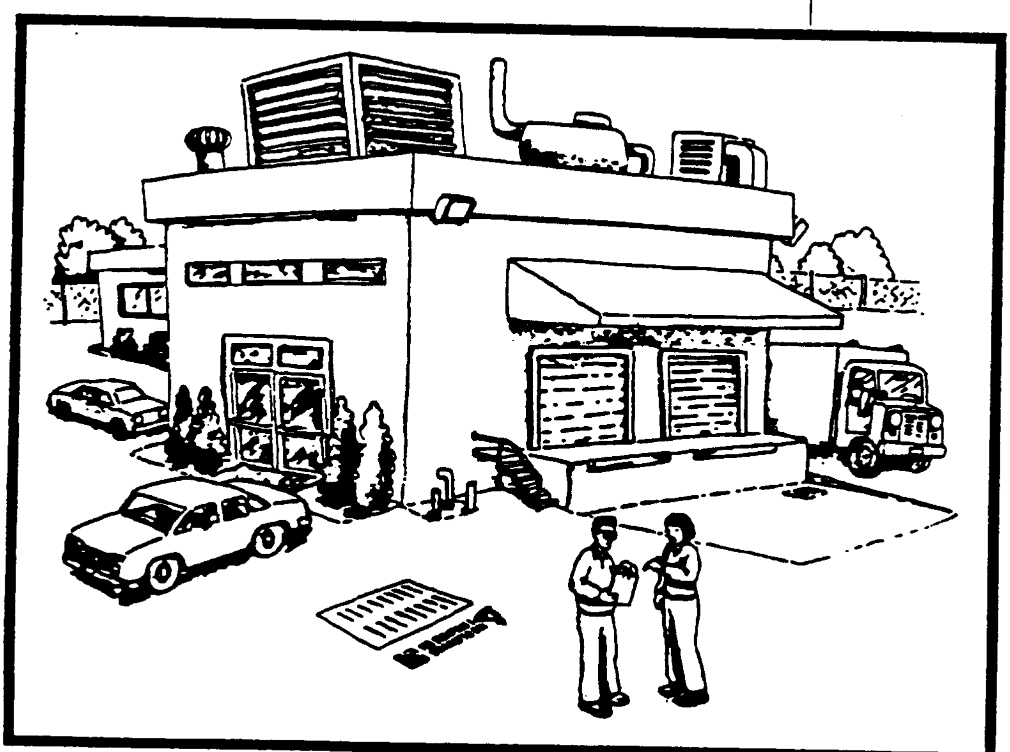
The preceding sections describe 15 distinct research projects that address key gaps in the knowledge base and the monitoring and management tools needed to adequately address stormwater impacts in southern California. While they are presented individually, they have two important features, as a group, that are important to emphasize. First, as the individual descriptions make clear, many of the projects are directly related, with some depending on the output of other projects for their success. The following figure illustrates the major groupings and relationships among the 15 projects. The projects on the left with several arrows emanating from them are projects that should be attempted first. These include integrating available data, creating a regional data infrastructure, developing a conceptual model, and developing or improving assessment tools for identifying receiving water impacts. Similalry, there are projects on the left with several arrows pointing towards them that should be left until the initial work is completed. These include stratifying beneficial uses, identifying causes of impacts, and evaluating the effect of BMPs on receiving wate quality. Ultimately, the interconnectedness among projects demonstrates that the workshop panelists have devised not just a list of individual wish-list projects, but a comprehensive research program.



Second, they lay the necessary groundwork for a comprehensive and region-wide stormwater monitoring program that focuses on high-priority problems and takes advantage of opportunities for regional coordination. In this sense, the information and tools the research program produces will not only improve individual stormwater programs, but will improve all of the stormwater programs in the region. The research projects will identify where there is uneven levels of effort and help to bring parity to monitoring programs throughout southern California. They will identify enhance the efficiency of individual programs and regional programs by ensuring comparability and quality. Finally, the research projects will improve effectiveness by identifying areas where all agencies can use commonly generated information thereby reducing redundancies or repetitive effort.

Finally, the workshop experts set an expectation that the research plan will eventually lead to a model stormwater monitoring program at the end of five years. The expectation included at least three levels of monitoring effort including: (1) an ongoing regional monitoring program where agencies interact at large spatial scales; (2) local monitoring focused on their individual discharges of concern; and (3) an ongoing research component consisting of specific projects, not unlike those described herein, where there is a defined beginning, middle and end, whose results feed directly back into the monitoring and management deciosn-making framework.

Best Management Practices for Industrial Storm Water Pollution Control



Alameda County
Urban Runoff
Clean Water Program
A Consortium of Local Agencies

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Contents

INTRODUCTION:
Storm Water Pollution Control for Industrial Facilities

Storm water pollution is the major source of contamination affecting local creeks and the San Francisco Bay. Storm drains carry excess water from streets, urban centers, industrial sites, and open spaces. In Alameda County, contamination of storm water is largely due to urban runoff pollution, which occurs when contaminants from industrial, commercial, and residental areas are picked up by runoff water and carried into the storm drain. In Alameda County alone, more than 85 billion gallons of untreated water and debris pass through the storm drain systems each year and flow into the bay.

Industrial operations constitute only partly responsible for urban runoff pollution, but they are known to be a source of heavy metals, oily wastes, and other contaminants. Manufacturing, shipping, and storage operations that are exposed to storm water runoff are common contributors to storm water pollution.

Federal and state storm water regulations now require most industrial facilities to take steps to prevent such contamination. Your facility might need to be covered by the Regional Board's October 1992 Industrial Storm Water General Permit. If so, you must prepare a Storm Water Pollution Prevention Plan (SWPP) that incorporates a variety of Best Management Practices (BMPs) like the ones described in this manual. If your facility is not covered by the General Permit, you might still need to implement BMPs to comply with local pollution prevention requirements.

Unlike some pollution problems, storm water pollution cannot be covered by a single set of rules that applies to all industrial facilities. Regulated industrial facilities in Alameda County range from manufacturing facilities that occupy several square miles to storefront distributors. As a result, plants can have very different storm water quantities, flow patterns, and potential pollutants. Even different facilities within the same general industry might have to adopt different approaches to the prevention of storm water pollution.

The BMPs in this manual are recommended by the Alameda County Urban Runoff Clean Water Program to help you:

- *Prevent storm water pollution;*
- *Protect water quality in local creeks, groundwater basin and the bay; and*
- *Comply with storm water regulations.*

This manual is intended to help you identify and implement the BMPs that are necessary and economically feasible for your facility to prevent storm water pollution. The BMPs include both operating practices and structural controls designed to reduce the amount of pollutants entering the storm drain system. You will need to evaluate which apply to your facility and implement them as necessary. Specific regulations can vary from one municipality to another, so you should become familiar with local storm water ordinances in the communities in which you do business.

This manual consists of two parts. The recommended BMPs in Part 1 are basic everyday operational practices that can be very effective in preventing pollution and reducing potential pollutants at the source, with relatively minimal structural or equipment requirements.

In many industrial facilities, storm water pollution can be prevented with common-sense precautions and modest changes in routine operations or maintenance practices. The numbered sections are keyed to industrial operations that are common to many kinds of facility. For some industrial facilities, these practices alone might be sufficient to control storm water pollution.

In other cases, it will be necessary to establish new practices or build physical controls to prevent storm water pollution. Part 2 of this manual consists of "advanced management practices." The advanced BMPs require more costly or more intensive efforts to address pollutants that are not adequately controlled by the simpler operational BMPs.

PART 1

Recommended BMPs for Storm Water Pollution Prevention

Part 1 of this manual contains BMPs that are recommended to control storm water pollution from particular industrial activities. It is divided into numbered sections, describing activities common to many kinds of industrial facilities, and it contains BMPs tailored to each kind of industrial activity or operation.

The recommended BMPs are to be implemented on an ongoing basis for the indefinite future. Operators of commercial and industrial facilities in Alameda County should implement these BMPs or similar controls wherever they would be effective in preventing pollutants at the site from entering storm water runoff.

PREVENT WATER FROM CONTACTING WORKING AREAS.

Shipping areas, outdoor equipment, material storage areas, vehicle maintenance spaces, and working areas of all sorts are subject to contamination by raw material, process liquids, grease, oily wastes, heavy metals, and miscellaneous potential pollutants. If you prevent storm water, wash water, or water from other sources from contacting areas exposed to pollutants, you won't discharge pollutants into your storm drains. Following are measures you should take to prevent water from contacting exposed areas:

- Keep rainfall from directly contacting working areas by installing roofs or moving industrial operations indoors where possible.
- Prevent storm water *runoff* from flowing across industrial areas by using properly designed berms or grading.
- Avoid practices in which you use water that later enters the storm drains — for instance, washing in outdoor areas. Most of those practices, including many that were acceptable in the past, are now considered to be "illicit discharges" of nonstorm water to the storm drain.

KEEP POLLUTANTS OFF SURFACES THAT COME INTO CONTACT WITH WATER.

Evaluate your site carefully to identify all areas that are contacted by storm water, wash water, or other water that is discharged into the storm drain. Then take special care to keep pollutants off those surfaces. That means controlling minor leaks and spills you might otherwise overlook, and taking a close look at your operating routines and equipment to determine whether any substances are unnecessarily exposed to storm water.

MANAGE STORM WATER BEFORE IT IS DISCHARGED INTO THE STORM DRAIN.

If you cannot avoid adding pollutants to storm water, you might have to remove them before they are discharged. Storm water control regulations, and this manual, consider treatment to be a last resort and emphasize source control options, because they are usually less costly, and more effective in the long run. In this manual, treatment measures appear only under Advanced Management Practices.

1 TRAINING AND EDUCATION FOR EMPLOYEES AND CUSTOMERS

Successful storm water pollution control relies mostly on the proper training and education of employees. Many of the recommended BMPs in this part of the manual identify specific training needs for employees who conduct the activities.

Train employees in the BMPs, because an employee's mistake can lead to a costly pollution incident. Assign experienced workers to train new employees. Review procedures as a group at least once a year.

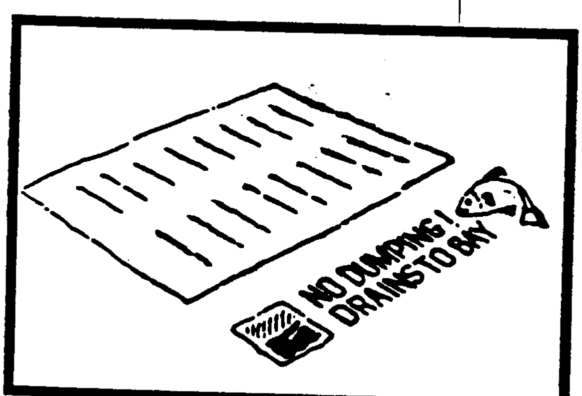
Periodically check employees' work practices to be sure the BMPs are implemented properly. Post informational signs, such as proper equipment washing procedures, at designated washing areas, and "Close the cover" signs at dumpsters and other storage areas. Stencil "NO DUMPING! — DRAINS TO BAY" messages at storm drains. (Stencils might be available from the Clean Water Program.)

Provide general information as well, because employees often respond best if they understand *why* they are being asked to conduct a new procedure. Employees' suggestions in return can help identify cost-effective storm water controls for your facility.

If you subcontract for small construction jobs or other work on your premises, include BMPs as conditions when writing contracts. Provide contractors with proper disposal options for wastes. Monitor contractors to be sure they comply with your BMPs.

If you serve customers at your facility, be aware of customer activities on-site. If they dispose of material improperly, *you* will be responsible for the violation. Ask your customers not to discard liquids into your trash cans or storm drains. If you have persistent problems, you might need to monitor your customers more carefully at trash cans, storm drains, and other potential disposal areas, on your property.

Let your customers know how you are minimizing wastes and recycling fluids to show that you are a "good neighbor," and encourage your customers to do the same. Showing clients what you are doing to protect the Bay is good public relations. Some businesses make the customer aware of their environmental requirements by including a modest environmental compliance fee, itemized on customers' billing statements, to cover handling and disposal costs for hazardous material.



Label storm drain inlets, so that employees do not dispose of waste there.

2 ELIMINATING IMPROPER DISCHARGES INTO STORM DRAINS

Local ordinances generally prohibit discharging *anything but storm water* into the storm drains. There are many ways in which nonstorm water from industrial plants can enter the storm drainage system. In most cases, those discharges are now illegal, even though they might have been permissible in the past. Industrial process water, building wastewater, and water from other sources are prohibited, with a few exceptions described in Table 1. Inspect your facility and yard to be sure no unauthorized discharges enter your storm drains.

Unauthorized discharges take two forms:

Illicit connections are improper permanent connections that allow wastewater to enter storm drains. Connections that allow sanitary or process wastewater to enter the storm drain are prohibited, including all storm drain connections from indoor drains or sinks. More information on identifying and removing illicit connections is available from your sanitary sewer district or municipality.

An illicit discharge is any nonstorm water discharged into the storm drainage system. Pollutants can be introduced into storm drains inadvertently by routine practices that discharge water outdoors or by routinely discharging wastes, wash water, and other material into storm drains, catch basins, and other conveyance facilities either on your property or in the street. A large part of this improper discharge results from employees' lack of understanding, coupled with a lack of readily available proper routes for the discharge.

You need to make a long-term ongoing effort to assure that no illegal discharges will occur. That requires continuing observation to identify potential sources of intentional or

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TABLE 1. PREFERRED DISPOSAL OPTIONS FOR WATER DISCHARGES			
WATER SOURCE	**PREFERRED DISPOSAL OPTION**	**RESTRICTIONS OR PERMIT NEEDED**	**POSSIBLE OPTIONS FOR REUSE OR RECYCLING**
Industrial process	**Sanitary sewer whenever possible**	**POTW permit**	**Reuse in-plant wastewater**
Noncontact cooling water	**On-site reuse**		**Reuse in closed-loop cooling system** ***(cooling tower)***
• Uncontaminated*	• Storm drain if reuse is impossible	• Storm water NPDES permit	
• Contaminated	• Sanitary sewer	• POTW permit	• Treat and reuse
Industrial cooling equipment condensation		**Storm water NPDES permit**	**Hold and apply to landscape**
• Uncontaminated*	• Storm drain	• Must be tested and shown to be uncontaminated.	
• Contaminated	• Sanitary sewer	• POTW permit	
Building air conditioner condensation	**Storm drain (if city allows)**	**Some localities require discharge to POTW with permit**	
Building air conditioner coolant			**Reuse in-plant whenever possible**
• Uncontaminated*	• Storm drain	• Storm water NPDES permit	
• Contaminated	• Sanitary sewer	• POTW permit	
Storm water in outdoor secondary containment			
• Uncontaminated*	• Storm drain	• Test to determine contamination.	• Pump and apply to landscaping. (See Section 5)
• Contaminated	• Sanitary sewer	• POTW permit	
Storm water from outdoor material storage			
• Covered	• No discharge	• Zero contact with storm water.	
• Open	• Storm drain	• Water quality inlet or similar treatment. (See Section 20) Storm water NPDES permit	
Roof drain water	**Storm drain if no pollutants**	**Roof vents may be source of pollutants. See BAAQMD air emissions regulations and Section 4.**	
Industrial equipment wash water	**Sanitary sewer**	**POTW permit**	**Reuse in-plant whenever possible**
Vehicle maintenance wash water	**Sanitary sewer**	**POTW permit**	**Capture and reuse for washing**
Vehicle one-time wash water	**Storm drain (See Section 7)**	**Water only (no soap or solvents)**	**Minimize water; prevent flow across paved area**
Wash water from paved walkways in commercial and business districts	**Storm drain**	**Sweep sidewalks before washing. No cleaning chemicals may be used.**	**Minimize water use and direct to landscape.****
Commercial building exterior wash water	**Storm drain**	**Filter before it enters catch basin**	**Minimize water use and direct to landscape****
Landscape irrigation	**Storm drain**		**Minimize water so none runs off****
Potable water and potable line flushing	**Storm drain**	**Must be dechlorinated*****	
Fire-fighting flows	**Storm drain**	**Block downstream channels to detain for testing as hazardous waste**	

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inadvertent improper discharges. Discontinue or reroute the water from those activities. Measures to help prevent illegal discharges include:

- Providing well-marked proper disposal or collection methods for wastewater wherever you frequently use wash water, discharge cooling water, or produce a liquid waste that might otherwise reach the storm drain.
- Employee training that especially emphasizes proper disposal of nonstorm water (see Section 1). Educate employees to understand that storm drains connect directly to streams and the bay without treatment.
- Labeling all storm drain inlets and catch basins "NO DUMPING! — DRAINS TO BAY," so that employees will know which inlets are part of the storm drain system.
- Periodically inspecting and maintaining storm drain inlets. Clean out catch basins so that accumulated pollutants do not wash down the storm drains.

Source: Storm Water Industrial General Permit for the Santa Clara Valley, Regional Water Quality Control Board/S.F. Bay Region, January 1992.
POTW (Publicly Owned Treatment Works) permit: Permit to pretreat and discharge is required from your wastewater authority.
BAAQMD: Bay Area Air Quality Management District.
* Biocides, corrosion inhibitors, or other additives are contaminants from a storm water point of view.
** Must comply with local water use restrictions during drought conditions.
*** Potable water, swimming pool water, and other chlorinated sources must be dechlorinated by aeration, retention, or chemical additives to a "no measurable chlorine" standard before reaching receiving water. If the water is not dechlorinated, it must be discharged to the sanitary sewer under a POTW permit.

Table 1 identifies some common sources in industrial plants of water that can enter storm drains. For each source, the table lists the preferred disposal option. For water that is allowable for discharge into the storm drain, Table 1 lists conditions or restrictions placed on the discharge.

Following are conditions or restrictions placed on a few categories of special interest:

- **Cooling tower condensate** for industrial process water must be discharged into the sanitary sewer. Permits are required.
- **Internal coolant** for refrigeration or building air conditioning must not be discharged into storm drains.
- **Building air conditioner condensate** may be discharged into the storm drain *only* if it is not treated with algae inhibitors, corrosion, control chemicals, or other additives.

Wipe up spills immediately with shop rags.

3 SPILL PREVENTION, CONTROL, AND CLEANUP

Small spills can have cumulative effects that add up to a significant source of potential pollutants in your storm water discharge. The best approach by far is to prevent spills and leaks. Maintain a regular inspection and repair schedule, and correct potential spill situations. Some prevention techniques are described in Sections 4, 5, and 6.

When a spill does occur, quick and effective response is the best way to prevent pollutants from reaching storm water. Prepare a set of well-defined procedures for responding to a spill of any liquids in an area that might be exposed to storm water. The procedures can be specific for your facility. They should take into consideration all circumstances, from small and minor releases that can be easily handled to a large emergency spill, and they should identify whom to call to respond to the situation before it gets out of hand. Train employees in the procedures (Section 1).

The basic procedures should emphasize that spills be cleaned up promptly and not allowed to evaporate. Otherwise, pollutants remain on the pavement and might be washed to the storm drains with the next rain, or they remain in the soil and become a possible groundwater pollutant. If the spill is on an unpaved surface, determine whether you need to remove the contaminated soil to prevent it from becoming a source of future storm water pollutants.

Also the standard procedures should specify cleaning up leaks, drips and other spills without water whenever possible. Do not use a hose or wet mop to clean up a spill area. Hosing might remove the spill from the immediate area, but does not keep the pollutant out of the environment. On the contrary, it

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adds to the volume of the spill and spreads the spilled material around a larger area.

If you handle hazardous material, spill prevention and response procedures are described in your hazardous material management plan filed with your fire department or other hazardous material ("HazMat") authority (see Section 6). If a spill occurs, notify the authorities as required in your emergency response plan. Contain and collect the spilled substance, then dispose of the substances and any contaminated soil in compliance with hazardous materials regulations.

Small spills are those which can be wiped up with a shop rag. Do not put wet rags in the dumpster with the shop trash. Store them in a covered rag bin of the kind used at auto service stations. Avoid paper towels. You can avoid making this a waste stream by sending used rags to a professional cleaning service. (You must inform your cleaning service of what the shop rags have been used for.) Do not saturate rags with gasoline, solvents, or other volatile liquids.

Medium sized spills are too large to wipe up with a rag and require more attention. Contain and soak up the liquid, using dry absorbent material, such as vermiculite, specially prepared sawdust, or cat litter. Absorbent "snakes" may be used as temporary booms to contain and soak up the liquid. Sweep up the used absorbent material and snakes, and dispose of them appropriately, with the shop trash if nonhazardous, with the hazardous wastes if necessary. Another convenient option is to use a wet/dry shop vacuum cleaner to collect spills and dispose of the liquid with your liquid or hazardous wastes. *Do not* use vacuums for gasoline, solvents, or other volatile fluids because the enclosed vacuum could become an explosion hazard.

Larger spills must be contained then cleaned up. For spills of food waste or other nonhazardous liquid, take steps to contain and clean up the liquid and minimize the wash water used in cleanup. Shut off or plug storm drain inlets or sewer inlets where the spill can enter. If necessary, keep temporary plugs on hand to fit your inlets and train employees regarding when and how to use them. For hazardous material spills, implement your emergency procedures and alert your HazMat authority.

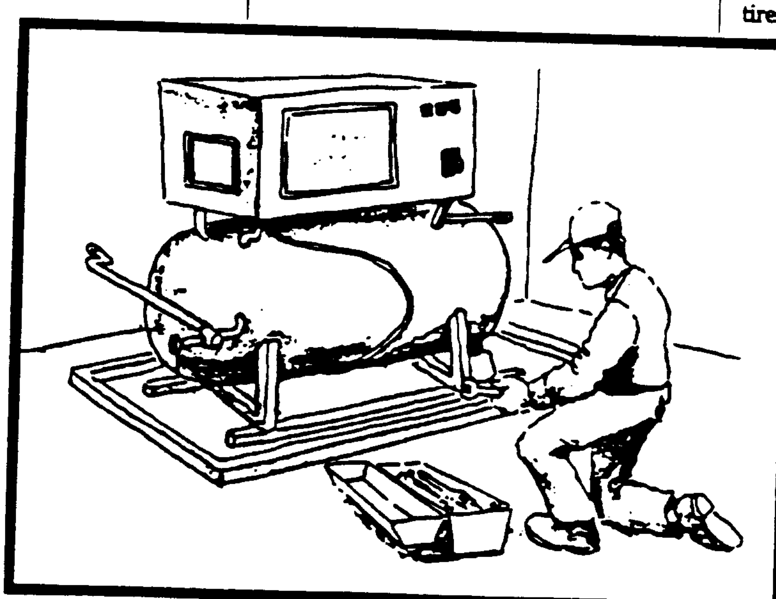
4 OUTDOOR EQUIPMENT OPERATIONS AND MAINTENANCE

Storm water from your site can accumulate pollutants by exposure to numerous small leaks, spills, and other discharges from outdoor equipment. Large equipment might require specially designed structural or advanced BMPs to reduce the potential for storm water to contact pollutants. Ordinary precautions, such as those described below, might suffice for smaller equipment.

As a first step, identify all equipment at your site that might be exposed to storm water or could discharge potential pollutants that could be exposed to storm water. Identify the kinds of pollutants each piece of equipment might generate—lubricants, coolants, and other leaks or discharges.

Be creative and thorough in developing your list. The inventory should include rooftop cooling towers or air conditioners; rooftop air vents for industrial equipment; outdoor air compressors and other service equipment; indoor wet processes where leaks or discharges might reach outdoor areas; and material transfer areas, such as loading areas where forklifts or trucks can carry pollutants outdoors on their tires.

Keep drip pans under outdoor equipment to contain drips and leaks, especially during maintenance.



Using the equipment inventory, assign an employee to inspect each piece of equipment on a regular basis to see that it is functioning properly. The employee might be the person responsible for operating the equipment if it is used regularly, or a maintenance staff member for equipment on the roof or in seldom-seen places. Inspect for leaks, malfunctions, and staining on and around the equipment and other evidence of leaks and discharges. Assign to the inspecting person responsibility for reporting a spill.

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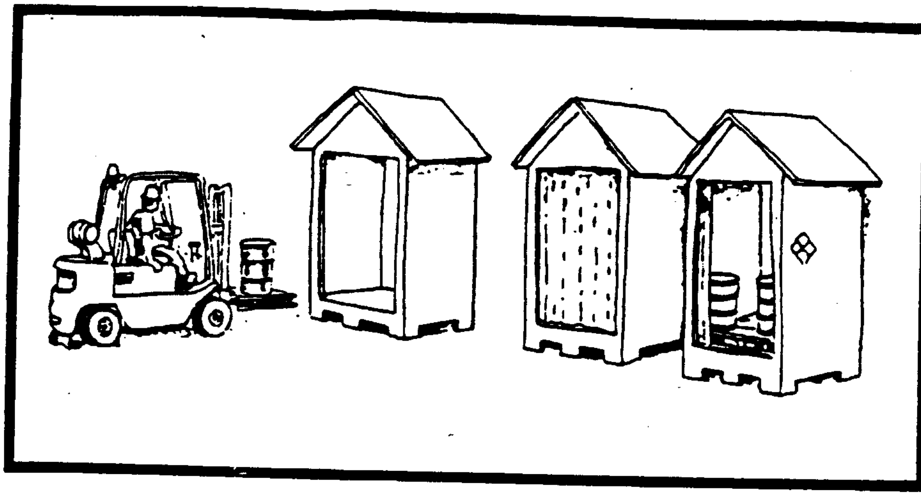

A "Doghouse" shed is one way to keep storm water away from barrels and materials kept outdoors, and at the same time it provides spill control.

Develop a routine for taking actions on the report—cleaning up the spill and repairing the leak to prevent future spills.

Where possible, take the next step toward full pollution prevention and make modifications to prevent storm water from contacting the equipment or its discharges. Place equipment on an impermeable surface, or install a drip pan beneath potential leak points. To minimize the amount of rainwater that contacts the equipment, you might construct a simple roof and install a berm to prevent run-on and runoff. If the equipment requires a "wet" process—that is, if operation inevitably releases wash water or process liquids—place it on a paved surface and install a connection to the sanitary sewer. Check with your municipality or wastewater authority to identify appropriate permits.

Air compressors and other equipment sometimes produce small quantities of automatic blowdown water, which usually contains lubricating oil or other potential pollutants. The water may not be discharged into the storm drain. Connect the blowdown to the sanitary sewer with proper approval. Or if the compressor has a frequent small bleed, place a drip pan or catchment to collect the water—do not let it soak into unpaved surfaces or run off paved surfaces.

Condensate on exterior surfaces of compressors, building cooling equipment, and other machinery may be directed to the storm drain system or, preferably, to a landscaped area.

5 OUTDOOR MATERIALS STORAGE AND HANDLING

If you handle **bulk solid material** outdoors, keep them covered in appropriate containments and protected from storm water. Apply this policy to raw material, products, by-products, and construction materials or supplies.

Store the material in one of these ways:

- The preferred method is storage on a paved surface, with a roof or covering, so that no direct rainfall contacts them, and with appropriate berms or mounding to prevent run-on of storm water. Roofs are recommended by most municipalities for new facilities.
- Where a roof is not feasible, place the material on a paved surface and cover it with plastic sheeting or tarp secured with weighted tires or sand bags. If possible, choose a mounded or bermed area that will prevent run-on of storm water through the material.

Parking lots or other surfaces near bulk material storage facilities should be swept periodically to remove fines that wash out of the material and would otherwise wash away with storm water. Larger bulk material storage facilities need more extensive structural controls for the specific facility and material.

Hazardous material must be stored in accordance with federal, state, and local HazMat requirements. The requirements are generally more than adequate to prevent storm water pollution—for instance, a HazMat secondary containment might have no drain.

If you store **liquid containers**, implement a plan and a design to control unexpected leaks and spills so that the liquid does not reach storm drains or surfaces that will be exposed to storm water. If you store hazardous material, the spill prevention plans required by your HazMat authority are adequate to ensure storm water protection. Nonhazardous material storage should also incorporate spill control designs and procedures.

Select a storage method appropriate for the type of material. Keep liquid tanks in a designated area on a paved impermeable surface and within a berm or other secondary containment. Inspect containers regularly for damage or leaks, as described in Section 4. Clean up any leaks or spills immediately (using dry methods described in Section 3), and repair the leaks promptly.

For smaller storage tanks, storage in roofed areas can prevent all contact with storm water (in combination with well-designed spill control procedures). A possible option is the "doghouse" design used by some firms (see illustration). The roof and flooring prevent contact with direct rain or run-on storm water. Contact your local HazMat and fire authorities for specific requirements.

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Storm water often accumulates in **secondary containment areas**. If this water is contaminated, it may not be discharged into the storm drain system.

You might wish to roof the containment to avoid this problem. If that is not possible, the liquids that accumulate in the containment *might*, with approval, be acceptable for discharge into the sanitary sewer. However, the area itself should have no direct connection, in case of spills. One common solution is a portable pumping system that can be moved to accommodate separate containment structures on your site. The equipment can pump water into a truck or portable temporary holding tank. The water then can be tested and disposed of according to whether any pollutants are present. Following are some disposal options:

- If the water meets criteria for hazardous waste, employ a certified hazardous waste hauler for disposal at a permitted hazardous waste facility.
- If it has constituents similar to process wastewater for which your on-site wastewater pretreatment facilities are designed, pretreat the water and discharge into the sanitary sewer.
- If it meets standards for your industrial discharge permit, discharge it into the sanitary sewer without pretreatment (if permitted by your wastewater authority).
- Reuse it on your site in an appropriate manner as industrial process water, equipment wash water, steam cleaning makeup, or another use where the water will eventually be discharged as industrial or sanitary wastewater. You might have to invest in a truck or plumbing to convey the water to its reuse location.
- If it is free of hazardous constituents, use it on your facility grounds for landscape watering. Do not apply the water to landscaping if hazardous pollutants are present—even if not concentrated enough to be hazardous waste—because the pollutants might accumulate in the soil or vegetation and eventually create a health hazard.

6 WASTE HANDLING AND DISPOSAL

Table 2 summarizes the preferred storage and disposal practices for some common industrial facility wastes. For many wastes, reusing or recycling is the most cost effective means to prevent potential pollution. Fluids that you hold for recycling are special categories of hazardous waste. You may store them on your site only for short periods in accordance with hazardous waste requirements, but they may be transported under somewhat less stringent requirements than other hazardous wastes. Many recycling services have special variances or permits, which reduce your paperwork requirements and allow shipping at reduced cost.

Keep general shop trash in a dumpster with the lid closed. Put the dumpster in a paved area, not on unpaved soil or your lawn. Keep the area clean by picking up dropped trash and sweeping the area regularly (perhaps once a week), but do not use a hose to clean up—keep water off the area. Nearly all dumpsters and trash compactors leak; keep liquid wastes out of them, and keep them closed to keep out storm water.

If you cannot prevent leakage from trash containers, install a roof or lean-to that keeps direct rainfall off them, and place asphalt curbing or berms around the dumpster to contain the leaks. (Check with your local agencies, and comply with fire codes and building permits.)

If you store **scrap metal** or other such material outdoors, keep it under a roof, cover, or tarpaulin. Keep scrap, parts or other used metals indoors. Oils and other potential pollutants can wash off long after you think the parts have been washed clean. Collect waste metal, such as used parts and metal lathe filings, for delivery to a scrap metal dealer.

If you store **empty drums** outdoors, do not hold them longer than necessary. Ship them to a drum reconditioner or another facility. Before shipping:

- Drain them completely to avoid spills.
- Seal them properly so that they are watertight, to keep storm water from entering; otherwise the water would become a process wastewater, and could not be dumped into the storm drain.

Store and handle **hazardous wastes** properly. Hazardous material or waste is not a storm water problem if they are handled in accord with state and federal regulations, and the requirements of your local HazMat control authority.

Keep hazardous waste and material indoors or under cover in a locked area, to keep nighttime trespassers away from them. Store them before disposal in special hazardous waste containers or in closed drums within a secondary containment that is approved by your HazMat authority.

In some cities of Alameda County, the municipal fire department is the HazMat authority that controls hazardous material storage, handling, and response. Other locales contract with the County Health Department. For information about handling solid wastes that might be controlled under hazardous waste regulations, contact the County's Environmental Health Department or Cal-EPA's Toxic Substances Control Division. (See the back cover for a list of regulatory agencies.)

Empty containers, such as storage barrels, oil cans, paint buckets, and aerosol cans are hazardous wastes if they once held hazardous material. You may not discard these with the regular trash. They must be stored properly so that they do not leak outdoors. Some drum suppliers accept empty drums for reuse under less stringent hazardous material recycling regulations.

TABLE 2. PREFERRED WASTE HANDLING & DISPOSAL METHODS

		RECOMMENDED STORAGE	PREFERRED DISPOSAL	HAZARDOUS WASTE?
General Plant Wastes	• Used parts—clean metal scrap	• Bin (covered or indoors)	• Scrap collector	No
	• Used oily parts—contaminated	• Drum	• Hazardous waste hauler	**Yes**
	• Metal shavings	• Bin (covered or indoors)	• Scrap collector	No
	• Used rags	• Rag bin with lid	• Rag laundry	***Possibly***
	• Soiled cleanup absorbent	• Drum	• Hazardous waste hauler	**Yes**
	• Coolant from air conditioner or refrigeration equipment	• Recycling machine	• Reuse in-house (HVAC service company)	No
Liquid Wastes	• Paints*	• Original container, with lid	• Hazardous waste hauler	**Yes**
	• Waste lubricating oil	• Drum (segregated)	• Oil recycler	*Special***
	• Solvents, thinners, and miscellaneous fluids*	• Tank ("hot" waste) *Segregate different fluids to make recycling possible*	• Solvent recycler (where possible) or waste hauler	***Possibly***
Liquid Containers	• Empty drums	• Indoors or under cover	• Drum reconditioner	
	• Empty cans, bottles, aerosol cans, etc.	• Drum	• Municipal trash or hazardous waste hauler	***Possibly***
Vehicle Wastes	• Waste motor oil	• Drum (segregated)	• Recycler	*Special***
	• Brake fluid, gear oil, hydraulic fluids, etc.*	• Bottle or tank ("hot" waste)		**Yes**
	• Antifreeze	• Tank (segregated)		*Special***
	• Batteries	• Open rack	• Battery supplier	*Special***
	• Tires	• Covered or indoors	• Tire hauler	No
	• Oil filters	• Drum (drain first)	• Oil recycler	*Special**

*Unused pure product may sometimes be returned to the vendor rather than disposed of as waste.

**Recyclable under special hazardous-materials restrictions.

Vehicle maintenance waste material often deserves special attention. Waste oil, antifreeze, spent solvents, and some other liquids can be recycled. Spent batteries may not be discarded with trash, but must be either disposed of as hazardous waste or returned for reclamation and reuse to the dealer from whom you purchased them. Guidance on handling vehicle wastes can be found in the Automotive Industries BMP manual which is available from your municipality.

7 EQUIPMENT WASHING AND STEAM CLEANING

Wash water for industrial equipment in most cases must be discharged as process wastewater into the sanitary sewer, and it is not allowed in storm drains. To clean dirty and/or greasy field equipment or trucks, you must install equipment to capture and pretreat the wash water for discharge into the sanitary sewer as industrial process waste. It may be less costly in the long run to locate a commercial car wash that has all the appropriate equipment and municipal permits, and to contract with them for washing services offsite.

If you wash vehicles or equipment on your site, you may do so only in a designated area, which must be designed and equipped as follows:

- Pave the area.
- Mark the area clearly as a wash area, and be sure all employees know that they may wash in this area only. Post instructional signs that prohibit changing vehicle oil, washing with solvents, and other such activities.
- Install sumps or drain lines to collect wash water for treatment and discharge into the sanitary sewer; reuse (for repeated washings); or recycle (for use elsewhere on-site).

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- If the equipment is a continuing source of grease or heavy dirt, cover the area to prevent contact with rain water when not in use.
- Grade or berm the area to prevent storm water from running onto it.
- Wash inside a building designed for maintenance or equipment storage if possible. Ensure that all drains connect to the sanitary sewers.

Steam cleaning should be done on your site *only* if you are equipped to capture all the water and other wastes. All the washing requirements above apply to steam cleaning as well. Steam cleaning wash water is not allowed in storm drains unless you have a permit from your wastewater authority. Permit requirements include pretreatment with equipment such as an oil/water separator, which might have to be a hazardous waste unit. If you steam clean, do it indoors or in a specially prepared outdoor working area where you collect the wash water and treat it for discharge.

Storm water runoff from industrial roofs, trucks, parking lots, and yards flows into storm drains and directly into streams and the Bay. It never receives treatment that would remove pollutants.

8

TRUCKING AND SHIPPING/ RECEIVING

Truck loading and unloading are potential sources of pollutants when rainfall and run-on contact spilled raw material, dust, and motor fluids that accumulate in this heavy traffic area.

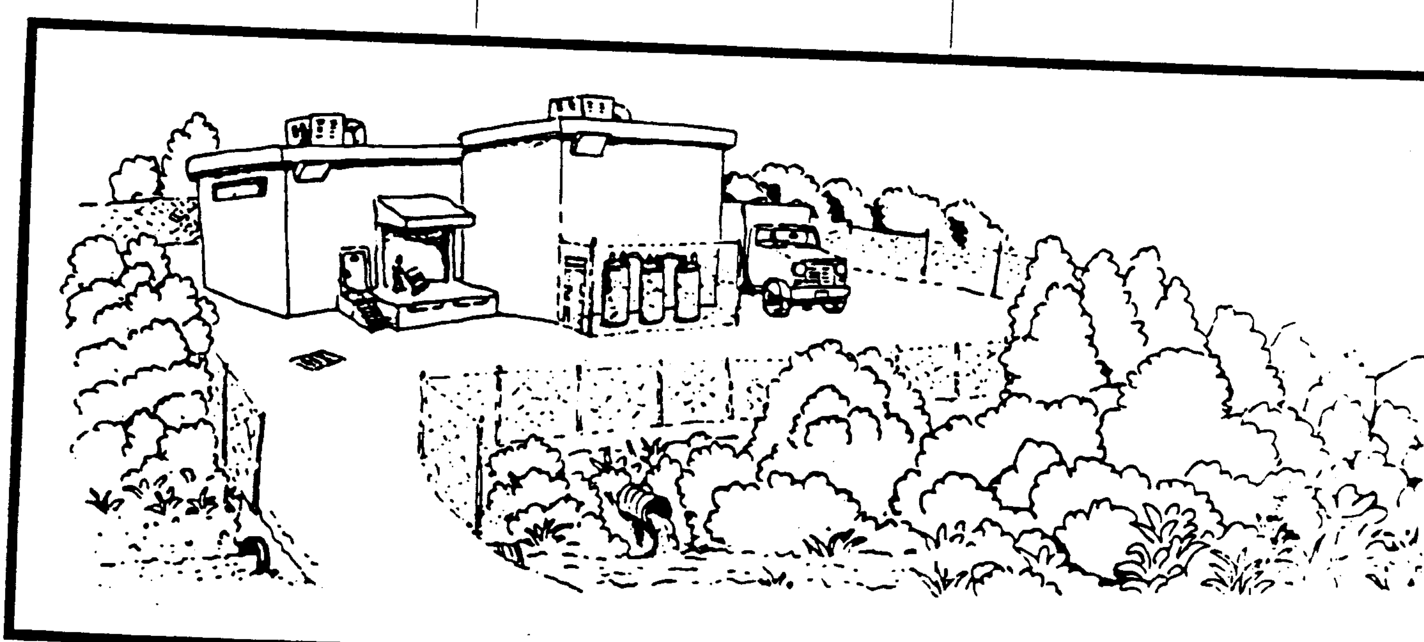
Load and unload raw material, products, and other material only at designated loading areas. In that way, you can isolate the potential source in areas that you can control, instead of in unspecified areas throughout your site. The best areas from a storm water point of view are indoor bays. For facilities that must use an outdoor loading dock, some operational BMPs and simple design features can control storm water pollution:

- Cover the loading dock area with a roof overhang, or use a door skirt that snugly fits both the building door and the truck door.
- Install curbs or berms around the loading area to prevent storm water from running onto it and any spilled material from running off it.
- Instruct the person who accepts the shipment, the truck driver, or someone else to check under the truck for leaked motor fluids, spilled matter, debris, and other foreign material.
- Develop a procedure requiring a maintenance crew to clean up spilled material promptly.

If you load or unload liquids, you need further operational precautions, and the loading dock should have additional design features. If you handle hazardous material, all the features you need are probably in place as part of a spill control and response plan. If they are not, you should select structural BMPs like those described in Section 13.

Parking lots and access roads are sources of potential pollutants from the trucks themselves and from possible spills or leaks of the material being transported. If you are regrading roads and parking lots, or if you transport materials that you expect to be significant sources of potential storm water pollutants, follow the structural BMPs recommended in Section 16. For existing facilities, especially smaller parking lots and short driveways where no hazardous material are transported, you can effectively prevent storm water pollution by implementing routine maintenance activities, such as:

- Regular visual inspection of your access roads and parking lots to identify and clean up spills.
- Removal of debris as soon as operations permit.



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Conduct street sweeping style cleanups periodically to remove loose debris, small amounts of spilled raw material, road dust, and other potential pollutants:

- Smaller spaces can easily be swept by hand.
- Do not hose off paved surfaces.
- For larger spaces, use a vacuum truck or mechanical sweeper (one that collects solids, not just brushes them aside). Whenever possible, do not use a wet washing street sweeper unless you can collect the polluted wash water.
- Private companies can perform the work on a contract basis so that you need not purchase the truck.

During the dry weather season, the appropriate frequency of sweeping for your facility depends on how heavily the road is used and the kinds of material you transport. Following are signs that you need to sweep more frequently:

- Your trucks commonly spill or drip bulk material.
- Debris or other material accumulates on the access roads. The correct frequency is one that prevents unwanted material from accumulating.

During the wet weather season, emphasize sweeping at times that will best prevent storm water from contacting potential pollutants:

- Clean the area once thoroughly before the wet weather season begins.
- After that, you may stay close to your dry season needs for debris removal, but add an additional thorough cleaning before a major rainfall (when half an inch or more is forecast).

Dispose of the cleaned-up material with your regular facility trash if there is no hazardous material. If you suspect it is hazardous — if you handle hazardous material, or if you know of a significant motor oil leak, for example — you should test the material or dispose of it with your facility's hazardous waste. You could face substantial penalties if you improperly dispose of hazardous waste.

If you **park trucks or heavy equipment** on-site, inspect the parking area for leaks of oil and motor fluids and design a procedure to report them, clean them up, and repair the leaking vehicle. Following are some practical techniques:

- Design consistent parking spots for each vehicle, so that if a leak is indicated on the ground the truck can be identified and repaired.
- Designate a person to be responsible for checking under a vehicle for leaks or spills. If you employ drivers, the driver could have the responsibility as part of a vehicle check conducted before driving.
  - Clean up spills promptly, using dry cleanup procedures described in Section 3. Conduct the preferred cleanup procedures for unpaved, as well as paved, areas.
  - Develop a reasonable procedure for identifying, reporting, repairing, and cleaning up leaking motor fluids and spilled material. Make sure employees are fully trained in the procedures and know who is responsible for checking each truck, who should be notified if there is a problem, and who should respond.

9 MAINTENANCE OF FLEET VEHICLES

The Automotive BMP manual prepared by the Alameda County Urban Runoff Clean Water Program addresses automotive and vehicle repair facilities. You should implement the BMPs in that manual if vehicle maintenance is a potentially significant source of pollutants on your site. Sections 9 and 10 of this manual summarize some of the appropriate BMPs for fleet maintenance at an industrial facility.

Whenever possible, perform vehicle maintenance in an indoor garage, not in outdoor parking areas. If you change oil and do other routine engine work outdoors, you should create a designated area for vehicle maintenance. Keep the area clean, as if it were part of your shop floor, and use dry cleanup practices. The area should incorporate some specific design features, such as those described in Sections 14 and 15. Some operational methods also can be successful in preventing storm water pollution at vehicle maintenance areas. A few suggestions:

- Keep equipment clean; do not allow buildup of grease and oil, which will wash away when the equipment is exposed to rain.
- If you work on vehicles outdoors, keep drip pans or containers under the vehicles at all times while you work on them — leaks and spills can occur unexpectedly. Place drip pans under vehicles as soon as you detect a leak.
- Drain fluids from any retired vehicles kept on-site for scrap or parts. Out-of-service vehicles you intend to restore and vehicles being held for resale should be checked periodically for leakage.

R0020753

- Do not change motor oil or perform vehicle or equipment maintenance in the parking lot or storage yard; use the vehicle maintenance area. Do not allow customers or employees to change their personal vehicles' oil in your vehicle service areas.

Vehicle parking or storage yards need to be operated with similar precautions:

- Inspect equipment in the yard for fluid leaks regularly — perhaps with a walk-by inspection for ground staining every day, and a closer visual inspection once a week.
- Keep the equipment yard clean and clear of debris, using dry sweeping methods described in Section 8. Do not hose off the area or wash with water, because any runoff becomes an illegal discharge into the storm drain.
- Maintain the yard's storm drain inlet(s) with special care. Clean them on a regular schedule and also after large storms. Pay attention to the kinds of potential pollutants that accumulate, so that you can identify the sources and take measures to control the sources.

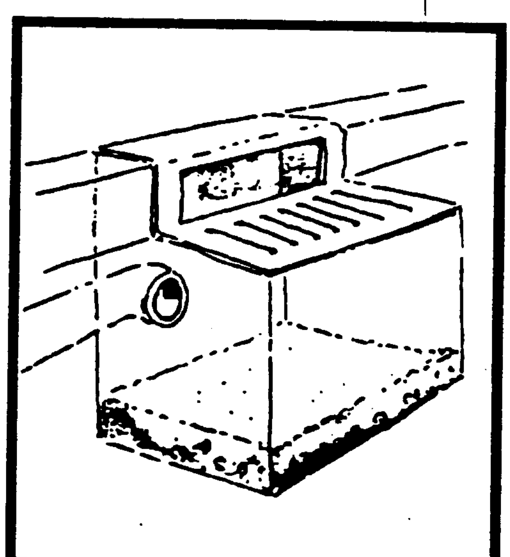
10 FUELING FLEET VEHICLES AND EQUIPMENT

If you have a vehicle fueling area, it should be designed and operated to minimize the contact of spilled fuel and leaked fluids with rain water. This section describes general principles, but simple operational controls might not be adequate for an industrial fueling facility. You might have to redesign your fueling area or install structural controls. Section 14 describes some general design approaches that can be useful in your eventual complete Storm Water Pollution Prevention Plan. Following are steps you can take for proper operation of a fueling area:

- Use a paved area or provide a concrete slab for the fueling area — never locate the area on open ground. Concrete is preferred because fuel and oils cause asphalt to deteriorate.
- Clean up gasoline overflows and spills, using dry methods described in Section 3. Do not allow spills to run off or evaporate, and do not flush the spill away with a hose. Spread absorbent material, sweep it up with a broom, and dispose of it as hazardous waste.
- Post signs that instruct pump operators not to "top off" or overfill gas tanks. Keep dry cleanup material in the fueling area, and instruct employees in the dry cleanup methods described in Section 3. Assign someone the responsibility of checking the area every day for gasoline, motor oil, or other fluids that have leaked.
- When you do routine cleaning, use a damp cloth on the pumps and a damp mop on the pavement, instead of spraying with a hose, to minimize the flow of cleaning water to the sump.

The main concept is to respond properly to fluid leaks in this spill-prone area. Even very small spills, when they happen every day, add up to a lot of fuel in the drainage system. This is an improper discharge that is illegal under the General Permit. Small spills do not present a problem if the fueling area is designed to handle spills — that is, if no storm water contacts it, and if it drains to a sump. But if the area drains to a valved-off storm drain or sewer connection, it must be pumped out before the valve may be opened during a rainfall.

A permit from the HazMat Authority is required for fuel tanks, including temporary ones. The authority will specify design features, such as the size of containments. Keep temporary fuel tanks in a bermed area that has an impervious lining, such as concrete or heavy-gauge plastic.



A catch basin helps keep debris and sediments out of the storm drain, but must be cleaned out periodically.

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11 BUILDING AND GROUNDS MAINTENANCE

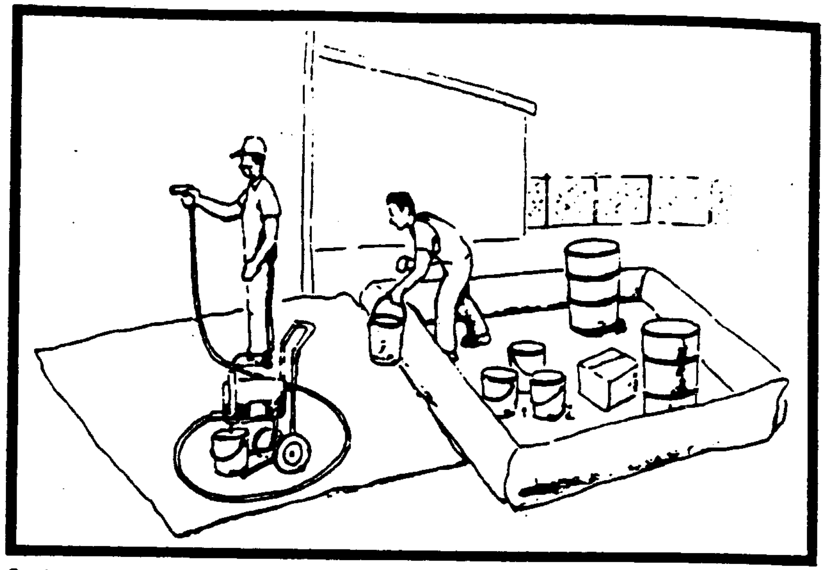
Building maintenance and general outdoor cleanup should be based on the same principles as parking lot cleanup and spill prevention: clean up without water, whenever possible, by sweeping or wiping; wash with as little water as possible; prevent and clean up spills; and clean up debris and solids, so that they do not reach the storm drains.

Maintain the storm water conveyance system on your property. The "conveyance system" might be as simple as roof downspouts and a gutter in your driveway or might be an extensive system of inlets, ditches, drainage channels, and underground lines. Keep all parts of the system clear of debris to avoid blockage that can cause storm water to back up. Remove from the system any spilled or leaked material that can be transported by storm water.

Clean the storm drain inlets to remove sediment and debris at least twice a year — late in the dry weather season before the first storm, and after the first major storm of the wet weather season. After each large storm, inspect the inlet; remove debris; and determine whether you need to remove sediment or do other maintenance.

The storm drain inlet might have a catch basin—a below-grade chamber where the storm drain pipe connects. Catch basins are intended to collect debris and sediment to prevent clogging the lines. Therefore the catch basins themselves must be cleaned out periodically to prevent flooding. If you clean catch basins annually, shortly before the wet weather season, you can keep them flowing freely and remove leaves, sediment, and other material that would otherwise be washed down the storm drain. Do not flush the catch basin with water; use a shovel or vacuum device to remove the material.

Other useful design features, such as vegetated ditches and water quality improvement inlets, are described in Sections 19, 20, and 21 as advanced BMPs.



Outdoor painting requires practices to prevent paint and dust from becoming storm water pollutants.

12 BUILDING REPAIR, REMODELING, AND CONSTRUCTION

This section describes some relatively simple BMPs that apply to minor building repairs, remodeling, and minor construction projects that involve "industrial activity exposed to storm water."

Large-scale projects, such as construction of new facilities, are covered under a separate General Permit for construction. They require more extensive storm water pollution prevention measures than described here. A manual developed by the state is available through the Clean Water Program. (See the back cover of this manual.)

The same practices are *recommended* for construction activities on industrial sites. Before you begin a construction or repair project, review the Construction BMP Manual to identify and implement the appropriate practices. If those BMPs do not apply, or are unduly elaborate for a simple construction activity that will be completed in a short time, consider the BMPs described in this section.

Store building materials under cover or in contained areas, using BMPs discussed in Section 5. For outdoor storage at a construction site, select a pollution prevention method such as:

- Putting an impermeable tarp over piles of wood, gravel or other material. Do not wait for forecasts of rain — do this every day, to avoid being caught unawares. Also it will keep material from blowing off the pile and contributing pollutants to runoff later.
- Keeping the working area clean every day for the same reason. Sweep up wood splinters, paint chips, and other residue every day, as well as thoroughly cleaning up at the end of the project.

Painting requires some basic procedures:

- Before you scrape to remove old paint, spread a ground cloth or tarpaulin to collect dust and paint chips. If the paint contains lead or tributyl tin, dispose of the paint chips as hazardous waste.
- Use impermeable ground cloths, such as plastic sheeting, while you paint. Place in-use paint buckets in a pan or on plastic sheets.

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- At the end of the work day, store paint buckets and barrels of material away from contact with storm water.
- Treat a paint spill as a chemical spill. Capture it before it flows to the storm drain, and clean it up promptly using dry methods.

During painting cleanup, the following are important procedures:

- If you use water-based paint, clean brushes and equipment in a sink connected to the sanitary sewer.
- Clean up oil-based paint where you can collect the waste paint and solvents for handling as small-quantity hazardous waste — do not pour it into the sink or a storm drain.
- Keep leftover paint, solvents, and other supplies for a later use, or deliver them to a solvent recycler with other plant wastes when you ship a batch.
- Handle empty paint cans and other containers as described in Section 6. Containers might be small-quantity hazardous waste. Latex paint cans are not hazardous waste if the paint is dry.

Do not fall back on old cleanup practices from days when storm water pollution was not known to be a problem. Do not pour leftover paint down the storm drain or onto the ground. Do not clean brushes into the storm drain or pour buckets of cleanup water into the drain, or wash spilled paint down the storm drain with a hose. Those practices are now categorized as "illegal dumping." Do not wipe brushes onto old newspapers or pour leftover paint supplies into newspapers and discard the paper in the trash.

Spray painting requires a few extra precautions:

- Use temporary scaffolding to hang drop cloths or draperies to shield you from the wind and to collect overspray.
- Arrange the draperies to minimize the spreading of windblown materials.
- Be aware of air-quality restrictions on spray paints that use volatile chemicals. Consider a water-based spray paint for better air quality compliance.

Sand blasting can be controlled to keep particles off paved surfaces and out of storm drains. Ask your municipality whether building and construction codes place requirements on the size and type of blasting medium that is allowed. More complete instructions are available in the Construction BMP manual for full-sized jobs, but some basics should be applied for smaller projects as well:

- Place a tarpaulin or ground cloth beneath your work to capture the blasting medium and particles from the surface being cleaned.
- Hang tarps or drop cloths to enclose the area, using temporary scaffolding if necessary. Arrange the drop cloths to protect the work area from wind and to capture airborne particles.
- Curtail operations on a windy day.
- Clean up frequently; collect dust and particles from the drop cloths before you produce a pile that is too large to handle easily.

Wood preservatives, pavement seal coating, and other outdoor surface treatments commonly contain metals, pesticides, solvents, or polymers that are hazardous materials. Handle and dispose of them properly in the following ways:

- Apply only as much of the chemical as the wood can absorb or as needed to cover the paved area.
- Soak up excess chemicals with absorbent material or rags, instead of allowing them to flow to the storm drains or soak into the soil.
- If the chemicals spill, clean them up promptly using dry techniques (See Section 3).
- When sealing a sidewalk, prevent the sealant from reaching the gutters or drains.
- When treating a roof with wood preservative or sealant, line the gutters with rags. Dispose of the rags properly—with your hazardous waste if the substances you are using are hazardous.
- If you clean a roof or sidewalk before applying preservative, sweep thoroughly to remove loose particles, then wash with water if necessary.
- Collect wash water from down spouts or drains where possible, and remove particles.
- Avoid applying surface treatment chemicals during the wet weather season.

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Advanced BMPs and Structural Controls

Some industrial operations and plant situations require more extensive measures to control storm water pollution. Depending on your facility, and your success at eliminating potential sources of storm water pollution, your long-term implementation plan might need to contain some advanced BMPs. The BMPs include structural controls — storm water management measures that require the construction of new facilities or installation of new equipment.

You will need to evaluate your own plant to determine which BMPs are applicable to your operations and which combination will be most effective at controlling the storm water pollutants that might run off from your site. You could find that you have a choice in selecting structural BMPs. Evaluate and select controls that are adequate and most cost-effective for your site.

The BMP descriptions in this section are not complete design standards, but describe the principles you need to consider in identifying and controlling storm water pollution. Design standards, performance specifications, and further discussion of the design and application of structural and treatment BMPs are contained in the State BMP Manual (available from the Clean Water Program).

Advanced pollution control practices take a number of forms, and might include solutions that are not listed here. If you conduct activities that are unavoidably exposed to storm water, you will need to develop more intensive source control and storm water management BMPs.

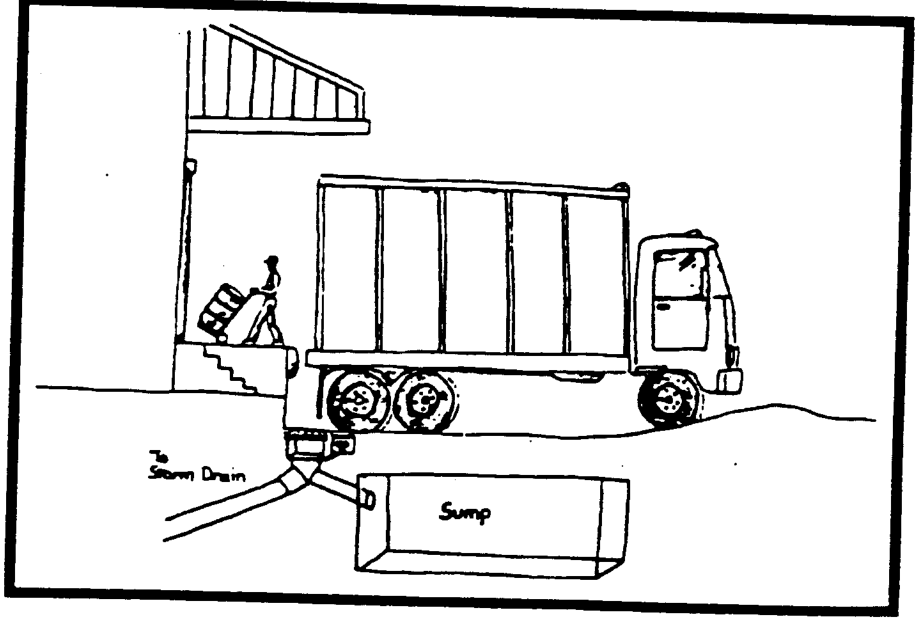
If you are renovating your shop or building a new facility, you should consider installing some of these structural controls. For example, if you regrade an equipment parking area, you should consider storm water design criteria. If you put off implementing the measures, more stringent requirements in the future could oblige you to retrofit the new or upgraded facility, which could be more costly than if you include the work in the construction or renovation.

13 LOADING DOCK DESIGN FEATURES

Loading docks sometimes require more intensive pollution controls than the operational BMPs described in Section 8. That is especially true of areas where you load or unload liquids in containers. Bulk liquid transfers are a more intensive industrial operation that require specific control designs, and are not addressed in this manual.

Additional features of a properly designed loading dock including grading the loading area so that it is sloped or recessed to direct flow toward an inlet with a shutoff valve or toward a dead-end sump. Make sure the inlet includes a sump with enough capacity to hold a spill while the valve is closed. Keep the valve closed at all times, except when you need to release storm water or other liquids that are acceptable for discharge.

A dead-end sump provides secure spill control, but any accumulated liquids need to be pumped out, tested, and properly disposed. Use berms or slopes to prevent run-on so storm water is not added to waste in the sump.



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Preferably, the inlet should connect to a sanitary sewer instead of a storm drain. Check with your wastewater treatment authority for permit requirements. Consider completely preventing contact with storm water by using a roof and berms, as described in Section 8. This will avoid both washing potential pollutants into the drain and discharging clean storm water into the sanitary sewer.

If the inlet connects to a *storm drain*, accumulated liquid must be tested and found to contain no pollutants before the valve may be opened for discharge. If the liquid does contain pollutants, you must pump it from the sump and discharge it into your sanitary sewer, providing that the wastewater treatment authority agrees to accept it. (See the recommendation below.)

If the inlet connects to a *sanitary sewer*, accumulated liquid must be tested and found to be within the parameters specified in your wastewater discharge permit before the valve may be opened for discharge. If you cannot discharge into the sanitary sewer, you need to convey the liquid to a hazardous waste disposal facility.

14

EQUIPMENT YARD DESIGN FEATURES

Parking and storage yards for large vehicles and heavy equipment generally require site-specific structural and operational controls. Follow the operational BMPs for vehicles recommended in Sections 7, 8, 9, and 10. Also assess your equipment yard to determine if there are possible sources of pollutants, and install appropriate controls to keep potential pollutants out of the storm water. Following are some measures that might be included in the design:

- Grade the area to slope toward a longitudinal drain, or install curbs to direct all storm water to a storm drain in the yard. If your yard is not too large and is properly designed, it should drain to a single storm drain. Even a small yard should include a storm drain on your property and not rely on a city-operating drain in the street.
- If you determine that the equipment yard is a significant source of oily material in your storm water, consider fitting the inlet(s) with a sand filter (see Section 20) or removing oily pollutants (see Section 21).

Segregate the area where you service vehicles, and install special structural controls:

- If possible, perform all work indoors, or construct a roof over the specified area. That will require a building permit and compliance with appropriate fire codes.
- Pave the surface with concrete, not asphalt. Vehicle fluids can dissolve asphalt or be absorbed into the blacktop and released later.
- Drain the surface to a single drain, preferably one connected to a sanitary sewer. The drain will require an oil/water separator or oil/grease trap, and must be approved by your wastewater treatment authority.
- Grade the working area to be higher than the parking lot, or surround it with a berm, to prevent storm water run-on.
- Construct a special area in which to segregate your "dirtiest" equipment (roof tar equipment, asphalt paving equipment, etc.) Handle its discharges, leaks, and runoff separately. This approach could save you from the need to treat all the runoff from the equipment yard.

15 FLEET OR EQUIPMENT FUELING AREA DESIGN FEATURES

If your facility's vehicle fueling area is one of the significant sources you identify in your SWPP Plan, you might need more intensive BMPs than the operational efforts described in Section 10. Following are some design features to consider:

- Cover the fueling area to prevent rain from falling directly on the area. Install a roof over the fueling island, the area where vehicles park while fueling, and as much of the approach as practical. Leaked engine fluids and spilled fuel inevitably accumulate on the pavement in those heavy traffic areas.
- Storm drain and sewer inlets that drain the fueling area must be equipped with shutoff valves to keep fuel out of the drain in the event of a spill from the pumps. The valves should be kept closed at all times except during a rainfall.
- Curtail fueling activities when the valves must be open, or use extra precautions to capture any spilled fuel, such as a large drip pan under the vehicle.

A number of different approaches can serve as effective drainage design. The fueling area must be separated from the rest of the yard, both to contain any fuel spill and to prevent storm water from running onto the area. Select or adapt one of the following schemes:

- Grade the fueling area to be "mounded" or elevated. The Automotive Industries BMP manual includes a suggested mounded grading scheme.
- Install around the area berms that are high enough to redirect water from a large storm.
- Grade the entire fueling area to drain to a single inlet. You can accomplish this with longitudinal drains at the perimeter along the "downhill" side of the fueling area, or with a depression in the middle of the fueling area. Either way, be sure to design the grading to avoid run-on.
- Install at the inlet a sump from which you will pump any accumulated liquids. The sump or connection should be operated as suggested for a loading dock area in Section 13.

16 ACCESS ROADS AND RAIL CORRIDORS

Access roads and rail corridors can be significant sources of pollutants. In the General Permit, access roads and rail corridors are defined as "industrial activities exposed to storm water," which you must include when identifying potential sources and selecting BMPs for your SWPP Plan.

Maintenance and operational BMPs for access roads are the same as those described for vehicle access and parking areas under Section 9. Some structural BMPs are described below.

Proper drainage design is a good place to start. Generally, this means that the roads should be crowned and sloped outward and that storm water should not be allowed to drain across the road but be carried in ditches or culverts alongside the road. Grass lining the roadside ditches, can be an effective way to remove storm water pollutants — see Section 20. Maintain the ditch to make sure it does not clog or fill with sediments and cause storm water to overflow. Plant vegetation by the roadside to control erosion and promote rainwater infiltration.

If your site includes railroad access, preservatives on wooden railroad ties can become important pollutants. Use a less-toxic preservative. Avoid organic toxics, such as creosote and pentachlorophenol. Or use concrete ties or other nonwood ties.

Control spills and dust from railroad unloading. If your rail line delivers or picks up liquids in bulk or in containers, you might have to add spill control loading docks with shutoff valves. (See Section 3 for spill controls, and Section 13 for loading dock design features.) If parked railroad cars drip, install a drip pan at the loading dock between the rails.

17 ON-SITE STORM WATER MANAGEMENT

Some industrial facilities will have potential pollutants exposed to storm water even after implementing source control measures like the operational BMPs described in the first part of the manual and the structural source controls discussed in this part. Further structural controls can be used to manage the storm water itself, either to control the flow of the runoff (described in Section 19), to remove some of the pollutants in passive devices (Section 20), or to remove pollutants using specially designed equipment (Section 21).

The best way to avoid the need for storm water management or treatment is to use source controls, most likely in combination. The right combination for your facility will probably include conscientious implementation of BMPs such as those recommended in Sections 1 through 12 of this manual, attention to the sources of waste at your facility, and careful reduction of process wastes.

If you need to manage storm water on-site, the most important consideration is to minimize the quantity of storm water that contacts potential pollutants. For example, keep the area of industrial activities as small as possible, separate the area from parking lots to prevent run-on, and roof or enclose the area if possible.

Design your storm water conveyance system to *isolate* the areas where storm water contacts potential pollutants, and convey water from those areas separately from water that runs off of "clean" and nonindustrial parts of the site. That will allow you to control storm water with smaller and less costly hydraulic or water quality controls. Or, if you plan to discharge to your wastewater treatment authority (see Section 18), reducing the volume will reduce the discharge cost and increase the willingness of your wastewater authority to accept the discharge.

18 REDIRECT STORM WATER DISCHARGE FROM STORM DRAIN INTO SANITARY SEWER

If source control BMPs are not adequate to prevent discharging pollutants in storm water from your facility, you might have to cease discharging storm water that contacts those pollutants. One way to avoid discharging potential pollutants with storm water is to isolate runoff from that part of your facility where the pollutants are contacted and discharge the storm water into the sanitary sewer instead of a storm drain.

Installation of new connections and new piping can be quite costly, and the necessary permits could be a barrier. Also, a permit from your local wastewater authority will be required. The permit will specify the volume of water you may discharge, the kind of pretreatment equipment you might need to install and operate, and requirements for monitoring your discharge.

Redirecting discharge to the sanitary sewer might not be allowed in all localities — some wastewater authorities have sections in their local ordinances that prohibit the discharge of storm water into the sanitary sewer. Requirements might differ from one municipality to another, so contact the authority that serves your area for information. (See the list on the back cover.)

As a rule, your wastewater treatment authority would prefer to minimize the volume of storm water that passes through the treatment system. You should reduce the quantity of storm water you redirect, using techniques like those described in Section 17.

The wastewater authority might require temporary storage of your storm water on-site, to avoid overloading its facilities during a storm. Your authority is more likely to accept discharge of storm water that has contacted pollutants if you can store it temporarily and deliver it *after* the high flows from a storm.

19 STORM WATER MANAGEMENT: HYDRAULIC CONTROLS

Hydraulic controls are intended to control the *quantity* of storm water discharge, but can be useful for water *quality* as well by removing potential pollutants from storm water. BMPs of this type are widely used to control erosion of hillsides and to remove sediments from storm water runoff. Also hydraulic control BMPs can help to remove oils and heavy metals that adsorb to sediment particles in storm water.

Design standards and operating information for hydraulic controls are available in a number of reference works. Design specifications for hydraulic controls are addressed in the State Industrial BMP manual. Many local and regional regulations that target erosion control provide specifications for hydraulic BMPs.

Hydraulic controls are designed for one of two purposes. One category controls the **rate of peak flow**, slowing the flow of water at the height of the storm to reduce its potential for carrying away soils and other contaminants. The other type reduces **volume** of runoff, generally by causing some storm water to *infiltrate* (or soak into the soil) instead of running off into storm drains, streets, or streams. Some approaches control both peak rate and volume.

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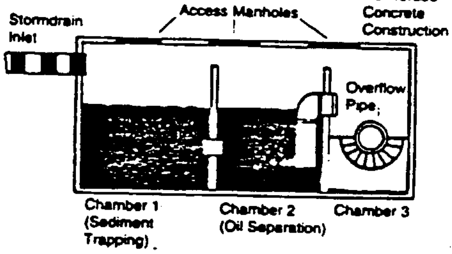
Hydraulic controls for a site are most effective if the overall site design is considered. The first step generally is to modify the site layout to increase the water-permeable surface, thereby increasing infiltration and reducing runoff volume. If greater flow control is needed, the second step might be to strategically place *infiltration trenches* to intercept runoff and promote infiltration. (Infiltration is not permitted in some areas — see Section 20.) For large quantities of flow, on-site ponds can be designed either to slow the peak flow of storm water or to hold water on-site until it infiltrates or evaporates. They are known as *detention ponds* or *retention ponds*. A variation is the *storm water wetland*, which similarly controls flow while wetland vegetation helps remove pollutants.



An API separator is only partly effective in removing oily wastes, but is more effective than an ordinary catch basin in removing sediments.

20

STORM WATER MANAGEMENT: WATER QUALITY CONTROLS

A number of specific storm water management controls are better suited to water-quality control than hydraulic control. These features might be added to various parts of the storm water conveyance system on an industrial site to help control potential pollutants in the storm water before it leaves the site. They are, for the most part, passive design features instead of treatment devices in the usual sense. Information in existing references gives design parameters for those water-quality controls, so this section merely summarizes a few types of controls.

A simple technique is a **vegetated swale or channel**, a ditch that carries storm water in which plants are permitted to grow. The plants provide some peak flow control by slowing the water. They also remove some pollutants by encouraging the deposit of sediments and minor oily wastes. This control can be retrofitted to some existing storm water conveyance ditches simply by allowing grasses to grow, if it does not interfere with storm water drainage and cause water to back up onto the site.

A **water quality inlet** is a simple multi-purpose device. A storm drain inlet is fitted with an enlarged catch basin or grit chamber where solids and sediments settle out of the water. A baffle restricts the flow of surface-floating oil, which can be removed by hand later. Floatable debris also collects at the baffle. This type of inlet has, in the past, been used to help remove oily wastes, but is of limited effectiveness. Section 21 describes the inlet further, including maintenance requirements.

A **sand filter inlet** is a storm drain inlet that contains sand or another filter medium. The sand removes particulates and oily wastes from storm water as it enters the storm drain. An extension of the same concept is a **sand filter**, where storm water quality can be improved before discharge. Sand filters appear to be particularly effective if used in combination with detention or retention ponds because they divert the first-flush of runoff (often carrying the most pollutants) to the filter and route the remainder of the water to the pond.

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STORM WATER MANAGEMENT: REMOVING OILY POLLUTANTS

A simple technique for removing oils and grease from storm water uses **oil-absorbent materials** (or oleophilic materials), such as the booms used to contain oil spills. The absorbent material preferentially absorbs oil and does not fill with water, so it can be used on storm water with small concentrations of oily materials.

Some facilities that have a storm water conveyance ditch where water flows throughout the rainy season have found it convenient to install a permanent floating boom to control an occasional light surface sheen. When the boom is spent, it is full of oil and is visibly heavier, floating lower in the water. The booms are inexpensive enough to be easily replaced whenever the absorbent is saturated. Disposal is more costly, since they might be hazardous waste, unless an oil recycler can accept the material.

Oil/water separators comprise a broad category of devices that are intended to remove oily constituents. There are many varieties of oil/water separators, and the term is not used in the same way by all equipment vendors or design specifications.

For most applications, oil/water separators are *not recommended* as a storm water management strategy. Source control BMPs are strongly preferred. Oil/water separators are fairly costly, and most designs do not operate well at the low concentrations commonly present in storm water. A sand filter inlet is typically more effective, and less costly, for the small quantities and low concentrations of oils in routine storm water runoff — that is, runoff that has not directly contacted oily industrial activities.

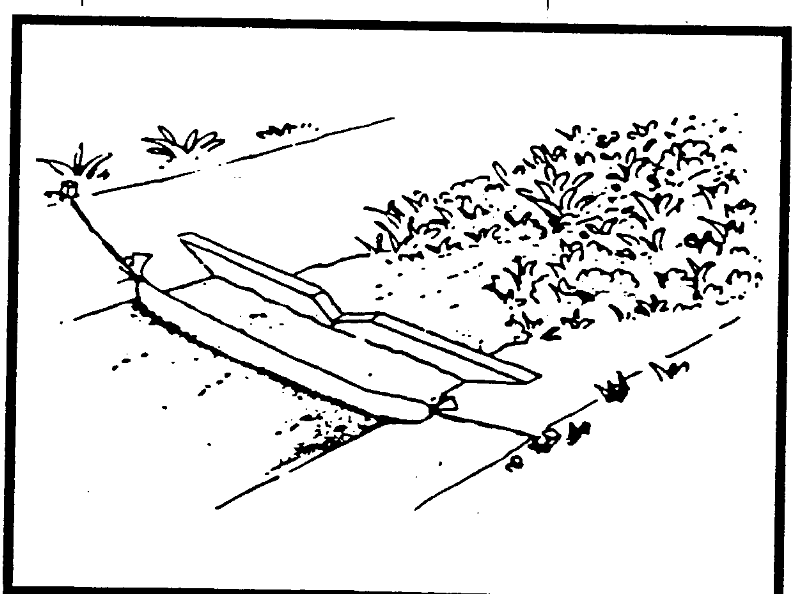
Separators can be useful in limited applications, such as for retrofitting to temporarily help a facility comply while it installs more effective source control BMPs. Another use is in spill control sumps, upstream of a treatment process. The advanced designs are sometimes used as treatment devices, discharging into a sanitary sewer storm water that contacts industrial activities in isolated areas where contact cannot be avoided.

The API (American Petroleum Institute) oil/water separator is a simple design. It is sometimes called an "oil and grease trap," to distinguish it from a true oil/water separator used for industrial wastewater. An API separator usually is a long basin with multiple chambers or vaults, typically installed below grade. It can be fitted to storm drains or storm water inlets in a variety of configurations — the water-quality inlet described in Section 20 is one form. The intent is to slow water and stratify the flow so that oil rises. The floating oil is then retained by one or more baffles in the chambers.

An API separator removes the bulk of floating oily wastes, especially if the oil is not well mixed but floats on top of the water. However, it is not very efficient, so storm water can still be polluted unacceptably even after it flows through the inlet. The separator works by concentrating oily wastes within the chamber, so some of the collected wastes are inevitably carried away during heavy storms. It can be made somewhat more effective at oil removal if it includes pads or pillows of oleophilic material at the water surface level.

If you install an API separator, *it must be maintained* regularly. It requires a standing pool of water, which should be pumped out periodically and replaced with clean water. To clean, remove oil floating on the standing pool and greasy matter collected at the baffle. Some commercial oil recyclers accept this material for recycling; otherwise, it must be handled as hazardous waste. If you install oil-absorbent pillows, they must be closely monitored and replaced when they are saturated, and must be disposed of either as hazardous waste or sent to a recycler. If the inlet includes a sediment trap, as in the water-quality inlet shown in Section 20, remove solids with a shovel between storms.

Develop a regular cleaning schedule. For inlets that don't carry much flow, three cleanings a year are sufficient—once before the rainy reason (mid-September) to remove materials that have accumulated; once after the first major storm; and then at the end of the rainy season to prevent slow loss or



Oil-absorbent berms can remove oily sheen from storm water. Vegetation in an open ditch can slow the flow, helping sediments settle.

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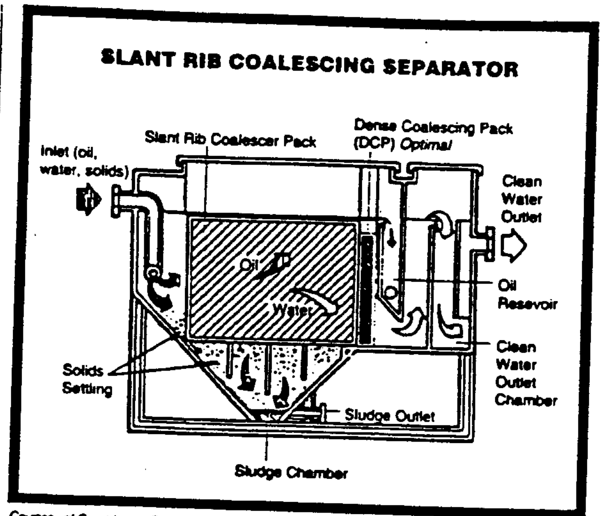
evaporation of the collected oily wastes. If storm water flow is greater, the API separator might have to be cleaned monthly or periodically between storms. As another guideline, clean the separator before three inches of oil accumulate in the entry chamber.

The CPI, or coalescing plate interceptor oil/water separator, is a more advanced design. It is commonly used for treatment of oil-bearing industrial wastewater, but is less often cost-effective for storm water. The CPI separator generally achieves greater removal efficiency than an API type, but is more costly to purchase and operate. A CPI separator can attain a high removal efficiency and accommodate a fairly high flow rate, but at ever-increasing capital costs for the equipment because of the addition of more separator plates. Cost-effectiveness is generally optimal for relatively high concentrations of oil at low and constant flow rates.

A few design features can improve the effectiveness of an oil/water separator. Pollution removal is most effective if the concentration is high when the storm water enters the unit. Avoid diluting the water to be treated with water from other parts of the site where it does not contact the potential pollutants, both to save on the capital investment and to increase treatment effectiveness. For industrial process applications, an evaporator can be used to reduce the volume of water treated.



Courtesy of Great Lakes Environmental, Inc.

A CPI separator can be very effective in removing oil, but requires upstream sediment control and can be costly to maintain.

An oil/water separator works best if sediment is not present in the water — limit the water to be treated to isolated areas free of mud and soils if possible. Efficiency is highest with a fairly steady flow, so you might require upstream detention. Also, do not site the separator downstream of a pump, because the pump mixes the oil and water and partially emulsifies the oil, with the result that separators are less effective.

Storm water treatment generally is *not recommended* as a BMP. The State or your local wastewater authority might consider as treatment some of the devices described in Section 21, but that could open the door to some burdensome regulatory restrictions and permit requirements.

For most industrial facilities, the best advice about on-site storm water treatment is to avoid it, for a number of reasons. Most of the available treatment equipment is costly to purchase and to obtain permits for. Operational costs can also be significant — you must monitor the equipment to ensure continued effectiveness, and you might need to prepare and submit chemical analyses to demonstrate compliance.

The most troublesome permit procedures are for hazardous materials. Before installing any treatment equipment, determine whether your wastewater is hazardous. Cal-EPA/Toxics or the County Environmental Health Department will describe the necessary testing and approval procedures. If the wastewater that would enter the pretreatment equipment is considered to be hazardous you must obtain a permit from Cal-EPA/Toxics to operate a hazardous waste treatment facility. At present this might be true even for a simple water-quality inlet. If you determine that the waste stream is not hazardous, and do not apply for a hazardous waste treatment permit, keep your testing documentation on hand to show regulators.

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Pollution Control Agencies and Sources of Information

STATE OF CALIFORNIA

For information on the State's General Industrial Storm Water Permit contact:

Regional Water Quality Control Board
(510) 286-1255

State Water Resources Control Board
(916) 657-1110

For information on waste minimization and hazardous waste management technology contact:

Alternative Technology Division
(916) 324-1807

744 P Street
P.O. Box 942732
Sacramento, CA 94234-7320

Documents available from Alternative Technology:

- California Waste Exchange: A Newsletter/Catalog
- Fact Sheet: Waste Reduction for Automotive Repair Shops
- Hazardous Waste Reduction for Automotive Repair Shops:
  - Part 1: Checklist
  - Part 2: Assessment Manual
- List of CA Licensed Hazardous Waste Haulers

COUNTY OF ALAMEDA

For information on hazardous waste compliance, waste minimization, and disposal contact:

Alameda County Environmental Services
Hazardous Materials Division
(510) 271-4320

ASSOCIATION OF BAY AREA GOVERNMENTS

P.O. Box 2050
Oakland, CA 94604-2050
(510) 464-7900

Documents available from ABAG:

- Manual of Standards for Erosion & Sediment Control Measures

SANITARY WASTEWATER AUTHORITIES

Dublin San Ramon Services District
Industrial Waste Inspector
(510) 846-4565

East Bay Municipal Utility District
(510) 287-1627

City of Hayward Water Pollution Source Control
(510) 293-5269

City of Livermore Source Control Program
(510) 373-5230

Oro Loma Sanitary District
(510) 276-4700 ext. 149

City of San Leandro
Environmental Compliance Divsion
(510) 577-3436

Union Sanitary District
Environment Compliance Section
(510) 790-0100

For more information on the urban runoff pollution control program in your area, contact:

City of Alameda
(510) 748-4623

City of Albany
(510) 528-5772

City of Berkeley
(510) 644-6540

Castro Valley
(510) 670-5543

City of Dublin
(510) 833-6630

City of Emeryville
(510) 596-4306

City of Fremont
(510) 494-4700

City of Hayward
(510) 293-5269

City of Livermore
(510) 373-5230

City of Newark
(510) 790-7270

City of Oakland
(510) 238-6600

City of Piedmont
(510) 420-3050

City of Pleasanton
(510) 484-8063

City of San Leandro
(510) 577-3434

San Lorenzo
(510) 670-5543

City of Union City
(510) 471-3232 ext. 369

Unincorporated Alameda County
(510) 670-5543

Or call the Alameda County Urban Runoff Clean Water Program: (510) 670-5543

Alameda County
Urban Runoff
Clean Water Program
A Consortium of Local Agencies

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Article #22

Inventory of Ocean Monitoring in the Southern California Bight

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Valerie Raco-Rands

ABSTRACT

Monitoring of the ocean environment in southern California has been conducted by a diverse array of public and private organizations with different motivations, working on a variety of spatial and temporal scales. To create a basis from which to integrate information from these diverse programs, we conducted an inventory of ocean monitoring activities in the Southern California Bight to address the following questions: (1) How many dollars are being expended annually on marine monitoring programs? (2) Which organizations are conducting the most monitoring effort? and (3) How are resources allocated among the different types of monitoring programs? This inventory focused on existing programs, or expected to be in existence, for at least 10 years and that were active at any time between 1994 and 1997. For each program identified for inclusion in this study, information was collected on the number of sites, sampling intensity, parameters measured, and methods used. Levels of effort were translated into cost estimates based upon a market survey of local consulting firms. One hundred and fourteen marine monitoring programs, conducted by 65 organizations and costing $31 million annually, were identified. Most of the effort (81 programs, 65% of samples, 70% of costs) was expended by ocean dischargers as part of their compliance with National Pollutant Discharge Elimination System (NPDES) permit requirements. Federal programs (11 programs, 25% of samples, 10% of total expenditures) expended more than state or local government programs. More than one-quarter of monitoring expenditures were conducted to measure concentrations and mass of effluent inputs to the ocean. The largest effort expended on receiving water monitoring was for measuring bacteria, followed by sediments, fish/shellfish, water quality, and intertidal habitats.

INTRODUCTION

Monitoring provides the foundation upon which managers base their decisions about the marine environment (NRC 1990a). Effluent monitoring is used to evaluate potential effects on the marine environment, with discharge concentrations compared to the water quality thresholds that trigger impacts to human health or aquatic life. Mass emission estimates are also derived from effluent monitoring to determine the largest contributors of contaminants to the marine habitat. Ambient monitoring is used to define the magnitude or extent of ecological impacts, such as habitat degradation or impairments to natural biotic communities. Additionally, each of these monitoring types are used to evaluate trends, allowing managers to assess whether environmental conditions are declining or whether previous management actions have been effective in improving conditions.

Numerous organizations conduct monitoring, but often on different spatial and temporal scales. State and federal government programs typically monitor environmental conditions to assess the overall health of large regions. In contrast, most municipal and industrial dischargers monitor to understand the effects their individual facility has on the local environment. Universities often monitor for yet a third goal, to understand the temporal cycles of natural phenomenon, such as oceanographic temperature or biological recruitment processes. These different types of monitoring programs are rarely coordinated.

Several national reviews of monitoring activities in the United States have called for the integration of monitoring programs to enhance their cost effectiveness (NRC 1990a; NSTC 1995, 1997). The first step in coordinating programs is to inventory the existing effort and identify areas that can achieve synergy through combined resources or shared data. The National Science and Technology Council (NSTC 1997) conducted such an inventory for that purpose, but it was limited to the effort expended by federal programs. An inventory that incorporates federal, state, local university, and private programs has not been conducted previously.

The Southern California Bight (SCB), a 500 km section of coastline from Point Conception, California, to the United States-Mexico international border, has one of highest coastal population densities in the country, and also has numerous coastal monitoring programs to assess the effects of this large population. The NRC (1990b) evaluated the monitoring programs being conducted in this area and found that few groups collaborated to enhance the effectiveness of their individual program, nor were data routinely shared among programs. The investigators found that, as a result, environmental managers were unable to develop an integrated assessment of the health of the southern California marine ecosystem or to produce the integrated information required to make informed decisions.

In this article, we present an inventory of monitoring activities in the SCB and address the following questions: (1) How many dollars are being spent annually on marine monitoring programs? (2) Which organizations are conducting the most monitoring effort? and (3) How are resources allocated among the different types of monitoring programs? The objective of this inventory and assessment is to quantify and define the monitoring programs of multiple organizations so that the information generated by each can be integrated into a sustainable monitoring program that is needed by local, regional, and national-level environmental managers.

METHODS

The inventory focused on long-term monitoring programs that met all of the following criteria: (1) programs that had been in existence (or expected to be in existence) for at least 10 years, (2) programs that collected samples at any time between 1994 and 1997, and (3) programs with data or reports that were publicly accessible. In addition, only those monitoring efforts within a selected program that were conducted in the following geographical areas were included in the inventory: (1) south of Pt. Conception, California, and north of the U.S./Mexico international border; and (2) no farther inland than the head of tide and no farther offshore than the continental shelf (ca. 200 m depth).

Both effluent and receiving water monitoring programs were included in the inventory. Effluent monitoring included quantity and quality measures of discharges from municipal wastewater, industrial wastewater, power generating station wastewater, and municipal stormwater. Receiving water monitoring elements included water quality (primarily nutrients and plankton), physical water column structure (primarily conductivity temperature depth [CTD] casts), bacteria, sediments (chemistry and biota), rocky subtidal biota and kelp beds, intertidal habitats, and fish/shellfish programs (fish assemblage and bioaccumulation). Bird, mammal, and wetland monitoring programs were not included.

For each program, the number of stations sampled, frequency of sampling, number of replicates, analytical parameters and media, sampling methods, and analytical methods were documented. Information about discharger monitoring programs was obtained from the Regional Water Quality Control Board that issued the permit to the permittee, or from the permittee directly. Information about other programs was gathered through the examination of data sets and/or project reports, and was often augmented with interviews of the project managers.

Each program was classified according to whether it was conducted by a federal agency, state agency, local agency, university, or private sector or non-profit environmental organization. Some programs were difficult to categorize, particularly when a government agency funded the effort and a university or private contractor conducted the work. In these cases, the effort was classified based upon which organization was the final repository for the data obtained from the program.

Program effort was translated into annual cost estimates by multiplying the number of samples of each type by their unit cost for sample collection and analysis. Unit costs were obtained as the median value of at least three price quotes for each parameter obtained from local contractors. The field/laboratory costs were then doubled to account for program planning, database activities, data analysis, and report preparation. This approach compared costs across organizations and considered the large discrepancies in the ways that different organizations, particularly public organizations, accounted for their costs. For programs in which the number of sites, number of replicates, or frequency of sampling were not evenly distributed over multiple years, the effort expended in the years between 1994 and 1997 was averaged to obtain a representative single-year estimate. To assess the accuracy of the study methods, these cost estimates were compared with a few public agencies that use private contractors to implement their programs. In each case, the study cost estimate was within +/- 20% of the actual costs.

RESULTS

The study identified 114 marine monitoring programs conducted by 65 organizations in the SCB. These numbers included 81 programs conducted by ocean dischargers as part of their NPDES permit requirements, 11 federal programs, 4 state programs, 5 local government programs, 12 university programs, and 1 private program. These programs collect 244,917 samples annually (Table 1). More than 65% of these samples were collected by NPDES permittees while nearly 25% of the samples were collected by federal programs. State, local, university, and private programs combined collected 10% of the samples.

The largest number of samples (36%) was collected to assess bacteria concentrations, particularly along the shoreline (Table 1). Effluent (26%) and kelp bed/rocky subtidal (22%) samples were the next most frequent measurement types surveyed. None of the remaining types of monitoring programs accounted for as much as 5% of the total sampling effort.

There was an estimated $31.3 million spent annually on monitoring in the SCB (Table 2). The differences in cost among program types were even more disproportionate than differences in sampling effort. Nearly 70% of the cumulative annual budget allotted for monitoring was expended by NPDES permittees. Federal agencies contributed 10% and universities contributed 6% of the cumulative annual budget. Local and state governmental agencies combined spent less than 6% of the estimated total SCB monitoring budget.

Although NPDES programs spent the most money on monitoring in the SCB, large differences were found in expenditures between the different types of NPDES programs (Table 3). For example, $17.1 million was spent on monitoring by publicly owned treatment works (POTWs), with 60% of these monies spent by the four largest POTWs. Thermal dischargers were the only other group that accounted for more than 10% of the NPDES monitoring expenditures.

The amount of money expended on monitoring in the SCB differed among monitoring types (Table 2). The most money (28%) was spent on monitoring effluent. The second and third largest expenditures were for bacteria (24%) and sediment chemistry and infauna (13%) monitoring, respectively. Fish and shellfish monitoring accounted for 12% of the annual monitoring expenditures. All other monitoring types accounted for $\leq$ 6% of the annual budget.

Monitoring agencies invested their dollars differently among monitoring types (Table 2). For example, NPDES programs, which expended an estimated $24 million annually, invested most of their funds in monitoring effluents, bacteria, and sediments (37, 27, and 16% of total NPDES expenditures, respectively). The federal government, which expended \$3.1 million annually, invested most of its funds in monitoring water quality, intertidal habitats, and kelp bed/rocky subtidal habitats (40, 23, and 22% of total federal expenditures, respectively). Universities and state governmental agencies invested the bulk (69%) of their combined \$1.2 million in fish and shellfish monitoring. Local government invested the majority (78%) of their \$0.6 million in bacteria monitoring.

DISCUSSION

Although the amount of marine monitoring conducted in southern California is large, the estimates should be placed in perspective. Southern California is the most densely populated coastal area in the country, with 17 million people living within 50 miles of the ocean; thus, the \$31 million annual monitoring expenditures estimated in the present study equates to less than \$2 per person/year. Moreover, the annual estimate of monitoring costs is small in context of the operating budgets of the dischargers and of the regulatory agencies that oversee the dischargers. The annual operating budget of wastewater dischargers alone in southern California exceeds \$1 billion.

The amount of ocean monitoring conducted in the SCB was split almost equally between two types of endpoints: public health and ecological health. However, the expenditures were not evenly apportioned among the indicators for these endpoints. For example, approximately four times more money was spent to address the management question, "Is it safe to swim?" compared to the management question, "Is it safe to eat the seafood?" Similarly, the money allocated to addressing the management question, "Is the ecosystem adequately protected?" was not evenly distributed among habitats or indicators. More than five times the expenditures were spent addressing contaminant levels in sediment compared toeutrophication measures in the water column. Perhaps this level of expenditure is appropriate in the SCB, where historical deposits of threatening pollutants are a greater risk to ecosystem integrity than plankton blooms (Schiff 2000, Conversi and McGowan 1994).

Most of the monitoring in the SCB was conducted by dischargers as requirements of their NPDES permits, but not all dischargers shared equally in the monitoring activity. The POTWs incurred nearly 80% of the ocean monitoring costs expended by NPDES permittees. This finding is consistent with the historical pattern of discharge, in which sewage treatment plants discharged 90% of mass emissions (Raco-Rands 1999). However, increased treatment, pretreatment, reclamation, and source control have considerably reduced the mass emissions from POTWs over the last three decades. Currently, stormwater mass emissions are larger than the mass emissions from POTWs for many constituents (Schiff et *al.* 1999). Despite this trend, NPDES permittees for urban stormwater discharges conducted little or no ocean monitoring for either public health or ecosystem impacts.

In its review of federal programs, the National Science and Technology Council (NSTC 1995) found that more than \$200 million is spent annually on marine monitoring and research nationally. In contrast, we found that federal programs spent only an estimated \$3.1 million annually on monitoring in the SCB. This low percentage partially reflects our definition of monitoring, which included only sustained programs and precluded many shorter term research activities included in the NSTC estimate. Still, federal expenditures in the SCB were small in comparison to the economic and environmental importance of the southern California coast; 25% of the U.S. population living within 50 miles of the coast resides in southern California (Culliton *et al.* 1990) and more than 50% of the beachgoer-days in the country take place in this area (Schiff *et al.* 2000). Some of this disparity may reflect differences in national versus regional priorities. For example, recent national ecosystem initiatives at the federal level focus on harmful algal blooms (Turgeon *et al.* 1998) and coral reefs, which are not important issues along the southern California coast. In contrast, federal agencies do not participate in bacteria monitoring, which is a high priority at the local level.

The much larger investment of resources in marine monitoring by local agencies suggests the desirability for federal programs to leverage their effort through integration with local programs, a strategy endorsed by the federal Clean Water Action Plan (Coastal Research and Monitoring Strategy Workgroup 2000). In some cases, this goal can be accomplished through cost sharing, although the exchange of funds is not the only means of integration. For example, the National Oceanic and Atmospheric Administration's (NOAA's) Status and Trends Program has developed a national laboratory intercalibration program that has enhanced consistency in sediment and fish tissue chemistry measurements (Cantillo and Lauenstein 1993). The Environmental Protection Agency's (EPA's) Environmental Monitoring and Assessment Program has provided assistance in developing local sampling designs that can be integrated with its national design (Stevens 1997). Neither of these efforts requires a great degree of coordination, but both approaches facilitate integration of data sets for larger scale assessments.

The most significant barrier to the integration of federal and local programs is the difference in their overall missions; local programs are typically conducted on a smaller spatial scale to address site-specific issues. However, significant precedents have been established that could break down this barrier as federal compliance programs are increasingly being redirected towards regional assessment. For example, funding for the Chesapeake Bay Benthic Monitoring Program in Maryland is derived from the integration of the federal baywide program with a state program to monitor the effects of power plants. Another example is the Southern California Bight 1998 Regional Monitoring Program, in which 62 organizations pooled their efforts to achieve a $7 million regional assessment of fish, sediment, and water quality, funded almost entirely through redirection of local compliance monitoring (Hashimoto and Weisberg 1998). Moreover, almost all compliance monitoring programs measure trends at unimpacted reference sites for comparison with potentially impacted sites. Some of the most comprehensive long-term data records in this country, such as those for Hudson River fisheries (Barnthouse *et al.* 1988) and California continental shelf benthos (Zmarzly *et al.* 1994, Stull 1995) have resulted from the integration of such compliance-based programs.

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TABLE 1. Number of annual samples collected by the various types of monitoring agencies in the Southern California Bight.

	Bacteria	CTD	Effluent	Eutrophication	Fish and Shellfish	Intake Screen	Intertidal	Kelp Beds/ Rocky Subtidal	Sediments	Water Quality	Total
Federal Government		36			4,296		1,696	53,728		205	59,961
Local Government	15,136	216		228	14				328	864	16,786
NPDES	71,895	3,367	62,744	2,808	3,714	84	48	382	7,059	8,831	160,933
Private Party								360			360
State Government					2,134				13	768	2,915
University	40	32		1,468	1,556		516	18		332	3,962
Total	87,071	3,651	62,744	4,504	11,714	84	2,260	54,488	7,400	11,000	244,917

CTD = Conductivity temperature depth.
NPDES = National Pollutant Discharge Elimination System.

TABLE 2. Estimated annual costs for monitoring by the various types of agencies in the Southern California Bight.

	Cost($1,000s)										
	Bacteria	CTD	Effluent	Eutrophication	Fish and Shellfish	Intake Screen	Intertidal	Kelp Beds/ Rocky Subtidal	Sediments	Water Quality	Total
Federal Government		9			444		718	694	34	1,248	3,148
Local Government	995	63		49	17				85	65	1,274
NPDES	6,415	958	8,828	570	1,724	147	24	876	3,962	530	24,034
Private Party								394			394
State Government					505			19	7	15	547
University	4	8		277	1,183		291	106		13	1,883
Total	7,415	1,038	8,828	896	3,873	147	1,033	2,089	4,089	1,872	31,279

TABLE 3. Cost of effluent and receiving water monitoring for various National Pollutant Discharge Elimination System (NPDES) permittees in the Southern California Bight.

	Cost ($1,000)		
	Effluent	Receiving Water	Total
Power Generating Stations	1,913	1,331	3,244
Industrials	586	157	743
Large POTWs	1,605	8,618	10,223
Platforms	278	0	278
Ship and Boatyards	290	800	1,090
Small POTWs	3,052	3,850	6,902
Stormwater	1,398	156	1,554
Total	9,122	14,912	24,034

NAHB Storm Water & Urban Runoff Seminars

Guide for Builders & Developers

Seminar Sponsor
National Association of Home Builders

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New York State Builders Association
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Southern California Building Industry Association
Home Builders Association of Metropolitan Portland, OR

Seminars made possible by a grant from the U.S. Environmental Protection Agency's Coastal Nonpoint Source Program and cooperation from the National Association of Home Builders Research Center.

A Service of NAHB

National Association of Home Builders
State, Local & Regulatory Affairs Division
1201 15th Street NW
Washington, DC 20005-2800
800/368-5242, ext. 582
FAX 202/822-8873

R0020777

What is Low Impact Development (LID)?

Ever wish you could simultaneously lower your site infrastructure costs, protect the environment, and increase your project's marketability? With LID techniques, you can. LID is an ecologically friendly approach to site development and storm water management that aims to mitigate development impacts to land, water, and air. The approach emphasizes the integration of site design and planning techniques that conserve the natural systems and hydrologic functions of a site.

Residential Lot with Bioretention

Somerset Development
Prince George's County, MD

LID Benefits

In addition to the practice just making good sense, LID techniques can offer many benefits to a variety of stakeholders.

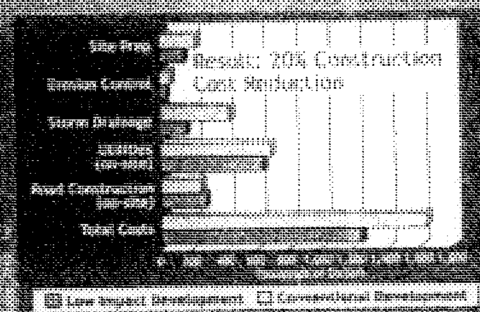
Developers
- Reduce land clearing and grading costs
- Potentially reduce infrastructure costs (streets, curbs, gutters, sidewalks)
- Reduce storm water management costs
- Potentially reduce impact fees and increase lot yield
- Increase lot and community marketability

Municipalities
- Protect regional flora and fauna
- Balance growth needs with environmental protection
- Reduces municipal infrastructure and utility maintenance costs (streets, curbs, gutters, sidewalks, storm sewer)
- Increase collaborative public/private partnerships

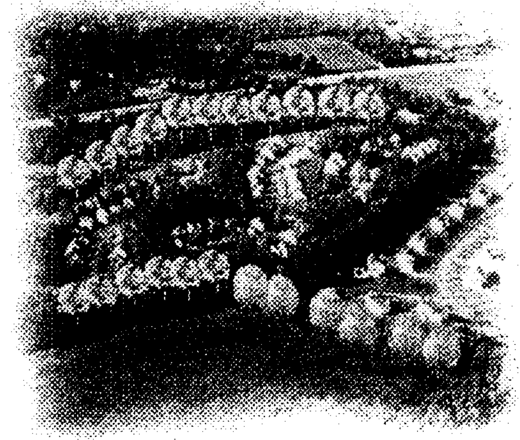
Environment
- Preserve integrity of ecological and biological systems
- Protect site and regional water quality by reducing sediment, nutrient, and toxic loads to water bodies
- Reduce impacts to local terrestrial and aquatic plants and animals
- Preserve trees and natural vegetation

Cover Photo: R. Arnold

Case Study



For More Information



Builder's Guide to Low Impact Development

Would you be interested in saving upwards of $70,000* per mile in street infrastructure costs by eliminating one lane of on-street parking on residential streets?

Did you know that communities designed to maximize open space and preserve mature vegetation are highly marketable and command higher lot prices?

Are you aware that most homeowners perceive Low Impact Development practices, such as bioretention, as favorable since such practices are viewed as additional builder landscaping?

Did you know that by reducing impervious surfaces, disconnecting runoff pathways, and using on-site infiltration techniques, you can reduce or eliminate the need for costly storm water ponds?

LID Site Planning and Design Concepts

Successful LID projects simultaneously reduce land development and infrastructure costs while protecting a property's natural resources and functions. During the development process, the designer, developer, and reviewing agency should work together to identify solutions that integrate the following concepts:

- Preserve Open Space and Minimize Land Disturbance;
- Protect and Incorporate Natural Systems (wetlands, stream/wildlife corridors, mature forests) as Design Elements;
- Utilize Neo-Traditional Street and Lot Layouts and Designs; and
- Decentralize and Micromanage Storm Water at its Source Using LID Storm Water Management Practices.

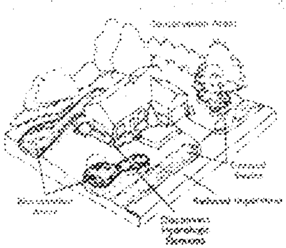
LID and Storm Water Management

LID aims to mimic natural hydrology and processes by using small-scale, decentralized practices that infiltrate, evaporate, and transpire rainwater. Specifically, LID aims to:

- Minimize impervious surfaces;
- Disconnect hydrologic elements (roofs, downspouts, parking areas);
- Maintain/increase flow paths and times; and
- Utilize decentralized treatment practices.

Bioretention Areas
Storm water directed to these shallow topographic depressions in the landscape is filtered, stored, and infiltrated into the ground using specialized vegetation and engineered soils.

Grassed Swales
Water moving through these systems is slowed, filtered, and percolated into the ground. These systems can act as low cost alternatives to curbs, gutters, and pipes.



Source: Low Impact Development Center

LID Lot Level Source Controls

R0020779

Preserve Open Space and Minimize Land Disturbance

Community Open Space

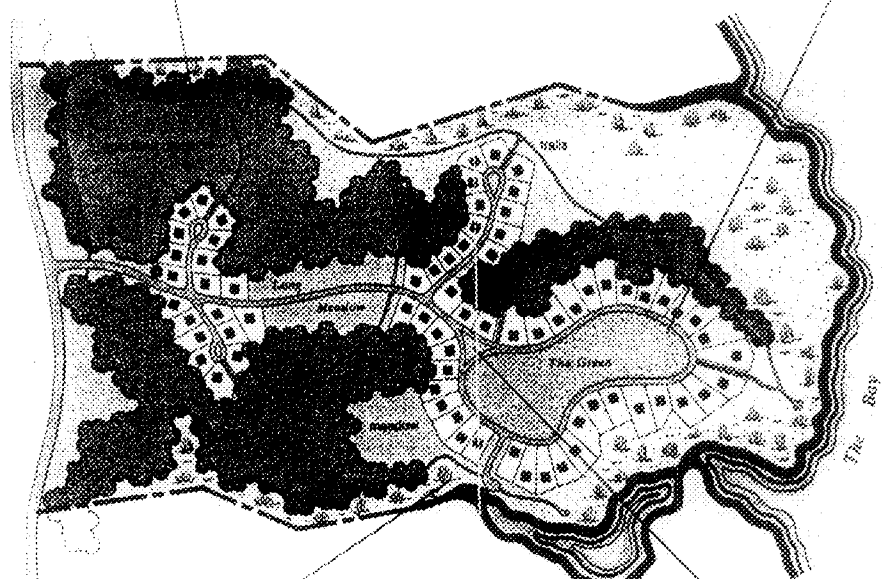
Bielinski Homes
Waukesha, WI

Decentralize and Micromanage Storm Water at its Source using LID Storm Water Management Practices

Source: Low Impact Development Center

Grassed Swales

Somerset Development
Prince George's County, MD



From Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks, by Randall G. Arendt. Copyright (C) 1996 by Island Press. Reprinted by permission of Island Press, Washington, D.C. and Covelo, CA.

Protect and Incorporate Natural Systems as Design Elements

Source: Applied Ecological Services, Inc.

Wetland System

Prairie Crossing
Grayslake, IL

Utilize Neo-Traditional Street and Lot Layouts and Designs

What is Low Impact Development (LID)?

LID is an ecologically friendly approach to site development and storm water management that aims to mitigate development impacts to land, water, and air. The approach emphasizes the integration of site design and planning techniques that conserve natural systems and hydrologic functions on a site. The practice has been successfully integrated into many municipal development codes and storm water management ordinances throughout the United States. Specifically, LID aims to:

- Preserve Open Space and Minimize Land Disturbance;
- Protect Natural Systems and Processes (drainage ways, vegetation, soils, sensitive areas);
- Reexamine the Use and Sizing of Traditional Site Infrastructure (lots, streets, curbs, gutters, sidewalks) and Customize Site Design to Each Site;
- Incorporate Natural Site Elements (wetlands, stream corridors, mature forests) as Design Elements; and
- Decentralize and Micromanage Storm Water at its Source.

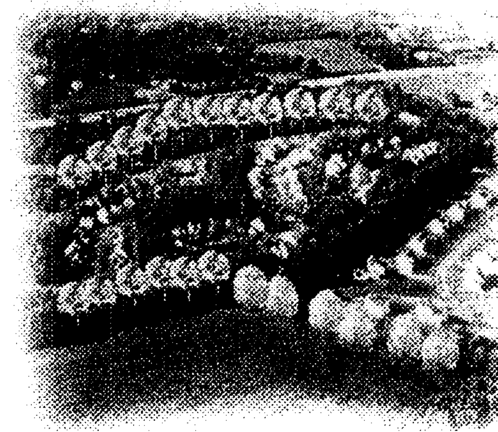
Courtyard with Bioretention Areas

Buckman Heights Community
Portland, OR

Cover Photo: R. Arendt

Questions and Answers

For More Information



Municipal Guide to Low Impact Development

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Grassed Swale and Narrow Street
Montgomery County, MD

Bioretention with Native Vegetation
Prairie Crossing, Grayslake, IL

LID Benefits

In addition to the practice just making good sense, low impact development techniques can offer many benefits to a variety of stakeholders.

Municipalities
- Protect regional flora and fauna
- Balance growth needs with environmental protection
- Reduce municipal infrastructure and utility maintenance costs (streets, curbs, gutters, sidewalks, storm sewer)
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Environment
- Preserve integrity of ecological and biological systems
- Protect site and regional water quality by reducing sediment, nutrient, and toxic loads to water bodies
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- Preserve trees and natural vegetation

Case Study

Somerset is an 80-acre development in Prince George's County, Maryland consisting of 199 homes on 10,000-square-foot lots. During its creation, the developer used LID practices to reduce the storm water management burden. By using LID, the developer:

- Eliminated the need for storm water ponds by using bioretention techniques saving approximately $300,000;
- Gained six additional lots and their associated revenues; and
- Reduced finished lot cost by approximately $4,000.

Lot with Bioretention

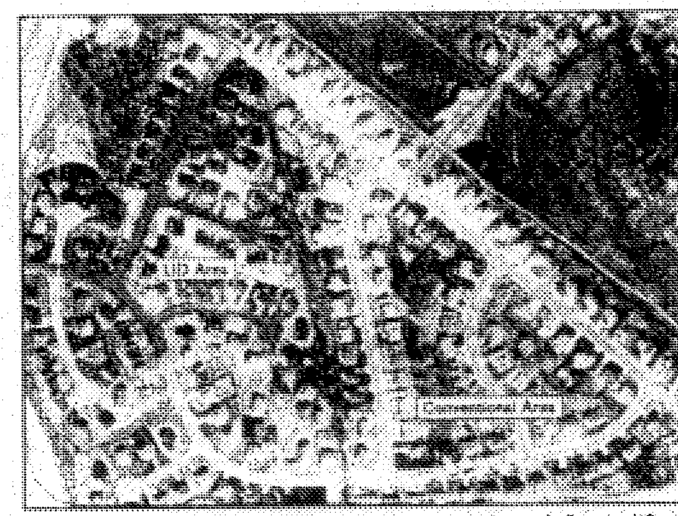
Grassed Swale and Street without Curb and Gutter

Bioretention Area and Open Space

Photos: Low Impact Development Center

[illegible]	[illegible]	[illegible]
Engineering Redesign	0	$110,000
Land Reclamation (6 lots x $40,000 Net)	0	<$240,000>
Total Costs	$2,457,843	$1,541,461
Total Costs (-Land Reclamation + Redesign Costs)	$2,457,843	$1,671,461
[illegible]		

Cost Comparison: Conventional Design vs. Bioretention



Aerial View of Somerset Development Site Plan, Prince George's County, MD

This is one in a series of pamphlets describing storm drain protection measures. Other pamphlets include:

Auto Maintenance & Car Care

Fresh Concrete & Mortar Application

General Construction & Site Supervision

Heavy Equipment & Earthmoving Activities

Home Repair & Remodeling

Horse Owners & Equine Industry

Landscaping, Gardening & Pest Control

Painting

Swimming Pool, Jacuzzi & Fountain Maintenance

Roadwork & Paving

For more information about storm drain protection or additional pamphlets, call:

STORMWATER MANAGEMENT DIVISION

1 (800) 974-9794
Bureau of Engineering
Department of Public Works
City of Los Angeles

Printed on Recycled Paper 5/96

Stormwater Best Management Practices (BMPs)

Food Service Industry

Safe Environmental Habits and Procedures for:

Bakeries
Food Producers & Distributors
Grocery Stores
Restaurants

Stormwater Management Division — Department of Public Works

R0020782

Ocean Pollution Prevention It's Up to *Us*

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Because the system contains no filters, it now serves the *unintended* function of carrying urban pollution straight to the ocean.

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Rain, industrial and household water mixed with urban pollutants creates stormwater pollution. The pollutants include: oil and other automotive fluids, paint and construction debris, yard and pet wastes, pesticides and litter.

Urban runoff pollution flows to the ocean through the storm drain system–1,500 miles of pipes that take water and debris straight from Los Angeles streets to the ocean. Each day, 100 million gallons of polluted urban runoff enter the ocean untreated, leaving toxic chemicals in our surf and over 4,300 *tons* of trash on our beaches annually.

Urban runoff pollution contaminates the ocean, closes beaches, harms aquatic life and increases the risk of inland flooding by clogging gutters and catch basins.

These Best Management Practices (BMPs) will ensure a cleaner ocean and city.

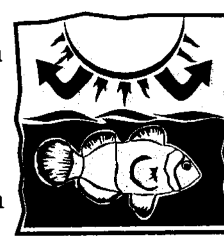
Food Industry Problems

The by-products of food-related businesses can harm the ocean and sea life if they enter the storm drain system.

Food businesses can cause harm by putting food waste in leaky dumpsters, not cleaning up outdoor food or chemical spills, or by washing outdoor spills into the storm drain system.

Other routine activities such as cleaning oily vents and operating and maintaining delivery trucks are sources of pollution, unless proper precautions are taken. When it rains, motor oil that has dripped onto parking lots from business and customer vehicles is washed into the ocean via the storm drain system.

Oil and grease can clog fish gills and block oxygen from entering the water. Also, toxics found in oven and floor cleaners can, in high concentrations, harm aquatic life.



Solutions

Best Management Practices that include the proper handling, storage and disposal of materials can prevent pollutants from entering the ocean through the storm drain system.

❶ Minimize Wastes

Use non-disposable products. Serve food on ceramic dishware rather than paper, plastic or styrofoam and use cloth napkins rather than paper ones. If you must use disposable products, use paper instead of styrofoam.

Buy the least toxic products available.

- Look for "non-toxic," "non-petroleum based," "free of ammonia, phosphates, dye or perfume," or "readily biodegradable" on the label.
- Avoid chlorinated compounds, petroleum distillates, phenols and formaldehyde.
- Use water-based products.
- Look for and use "recycled" and "recyclable" containers.

❷ Keep Work Sites Clean

Cover, repair or replace leaky dumpsters and compactors, and/or drain the pavement beneath them to the sewer. Rain can wash oil, grease and substances into storm drains.

Wash greasy equipment such as vents and vehicles in designated wash areas with an appropriate oil/water separator before storing outside. Ensure that designated wash areas are properly connected to the sewer system.

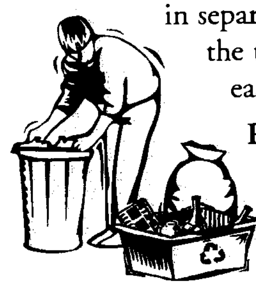
❸ Recycle Wastes

Purchase recycled products. By doing so, you help ensure a use for recyclable materials.

Recycle the following materials:

- Food waste (non-greasy, non-animal food waste can be composted)
- Paper and cardboard
- Glass, aluminum and tin containers
- Pallets and drums
- Oil and grease

Separate wastes. Keep your recyclable wastes in separate containers according to the type of material. They are easier to recycle if separated.



Recycle oil and grease wastes. Never dump them down storm drains or on the ground. Look in the yellow pages for "Renderers" or call one of the disposal numbers listed in this pamphlet.

❹ Toxic Disposal

Toxic waste includes used cleaners, rags (soaked with solvents, floor cleaners and detergents) and automotive products (such as anti freeze, brake fluid, radiator flush and used batteries).

For disposal information call: (213) 237-1209.

5 Employee & Client Education

Employees can help prevent pollution when you include water quality training in employee orientation and reviews. Promote these Best Management Practices (BMPs):

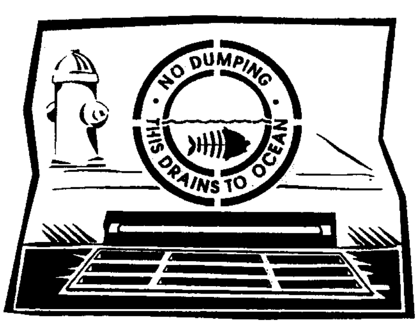
Storage containers should be regularly inspected and kept in good condition.

- Place materials inside rigid, durable, water-tight and rodent-proof containers with tight fitting covers.
- Store materials inside a building or build a covered area that is paved and designed to prevent runoff from entering storm drains.
- Place plastic sheeting over materials or containers and secure the cover with ties and weighted objects. (Not appropriate for storing liquids.)

Post BMPs where employees and customers can see them. Showing customers you protect the ocean is good public relations.

Explain BMPs to other food businesses through your merchant associations or chambers of commerce.

Raise both employee and customer awareness by stenciling storm drains near the workplace with the City's stencil:



Spill Response Agencies

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

City of Los Angeles
Police Department, Hazardous Materials Unit
(213) 237-2793 or (213) 485-4011

Los Angeles Fire Department
Health/Hazardous Materials Program
City: (213) 485-6185 County: (213) 890-4045

Recycling & Hazardous Waste Disposal

City of Los Angeles
Hazardous and Toxic Materials Office
(213) 237-1209

City of Los Angeles
Integrated Solid Waste Management Office
(213) 237-1444

Los Angeles County
Department of Public Works
Recycling & Household Hazardous Waste Hotline
1 (800) 552-5218

To Report Illegal Dumping

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

Los Angeles County
Department of Public Works
1 (800) 303-0003

To Report a Clogged Catch Basin

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

Los Angeles County
Department of Public Works
(818) 458-HELP

This is one in a series of pamphlets describing storm drain protection measures. Other pamphlets include:

Food Service Industry

Fresh Concrete & Mortar Application

General Construction & Site Supervision

Heavy Equipment & Earthmoving Activities

Home Repair & Remodeling

Horse Owners & Equine Industry

Landscaping, Gardening & Pest Control

Painting

Swimming Pool, Jacuzzi & Fountain Maintenance

Roadwork & Paving

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STORMWATER MANAGEMENT DIVISION

1 (800) 974-9794
Bureau of Engineering
Department of Public Works
City of Los Angeles

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Stormwater Best Management Practices (BMPs)

Automotive Maintenance & Car Care

Safe Environmental Habits and Procedures for:

Auto Body Shops
Auto Repair Shops
Car Dealerships
Gas Stations
Mobile Fleet Managers
Mobile Fleet Washing Businesses

Stormwater Management Division Department of Public Works

R0020786

Ocean Pollution Prevention
It's Up to *Us*

Los Angeles has two drainage systems–the sewers and the ***storm drains.*** The storm drain system was designed to prevent flooding by carrying excess rainwater away from city streets out to the ocean.

Because the system contains no filters, it now serves the *unintended* function of carrying urban pollution straight to the ocean.

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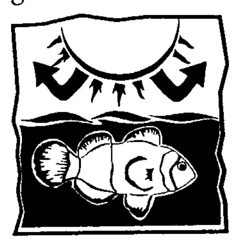
Urban runoff pollution contaminates the ocean, closes beaches, harms aquatic life and increases the risk of inland flooding by clogging gutters and catch basins.

These Best Management Practices (BMPs) will ensure a cleaner ocean and city.

Car Maintenance Problems

Many common car maintenance routines contribute to ocean pollution. Washing the car or pouring used motor oil into a gutter or storm drain pollutes the ocean.

Water runoff from streets, parking lots and driveways picks up oil and grease dripped from cars, asbestos worn from brake linings, zinc from tires and organic compounds and metals from spilled fuels. These chemicals drain into the ocean, harming sea life.



Oil and grease, for example, clog fish gills and block oxygen from entering the water. If oxygen levels in the water become too low, aquatic animals die.

Solutions

❶ Cleaning Work Sites

Do not hose down your shop floor. It is best to sweep regularly. For information about proper disposal of industrial waste, call the

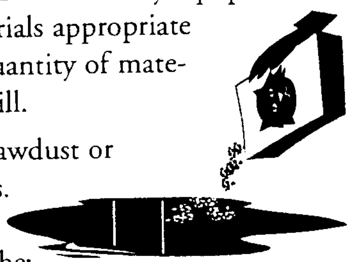
City of Los Angeles
Integrated Solid
Waste Management Office
(213) 237-1444

Use **non-toxic cleaning products.** Baking soda paste works well on battery heads, cable clamps and chrome; mix the soda with a mild, biodegradable dishwashing soap to clean wheels and tires; for windows, mix white vinegar or lemon juice with water.

R0020787

❷ Spills

Prepare and use easy to find spill containment and cleanup kits. Include safety equipment and cleanup materials appropriate to the type and quantity of materials that could spill.



Pour kitty litter, sawdust or cornmeal on spills. For disposal instructions, call the:

City of Los Angeles
Hazardous and Toxic Materials Office
(213) 237-1209

❸ Fluids

Your customer's regular car maintenance prevents fluids from leaking onto streets and washing into storm drains. It is also good for business.

Change fluids carefully. Use a drip pan to avoid spills.

Prevent fluid leaks from stored vehicles. Drain fluids such as unused gas, transmission and hydraulic oil, brake and radiator fluid from vehicles or parts kept in storage.

Implement simple work practices to reduce the chance of spills. Use a funnel when pouring liquids (like lubricants or motor oil) and place a tray underneath to catch spills. Place drip pans under the spouts of liquid storage containers. Clean up spills immediately.

❹ Washing Vehicles

Prevent oil and grease, suspended solids and toxics from washing into storm drains:

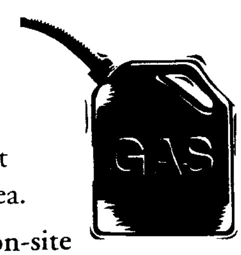
Designate a washing site where water drains to the sewer system. The area must be paved and well marked as a wash area. Post signs prohibiting oil changes and washing with solvents. Train all employees to use the designated area.

Wash vehicles with biodegradable, phosphate-free detergent. Use a bucket (not a running hose) to wash and rinse vehicles. This conserves water and minimizes urban runoff.

❺ Fueling Vehicles

Gas and diesel spills are common when fueling vehicles. To minimize pollution:

Design fueling areas so that all spills are contained and runoff cannot carry spills into storm drains. Spills should be directed to a containment area that allows for proper treatment and disposal.



Cover the fueling area to keep rain from washing away spilled materials. Extend the cover several feet beyond the containment area.

Keep absorbent materials on-site to allow prompt cleanup of all spills.

Post signs instructing people not to overfill gas tanks. Overfilling causes spills and vents gas fumes to the air.

> L.A.M.C. 64.30.B.1(a)— *prohibits the discharge of gasoline...hydrocarbons...kerosene...benzene...etc. to Publicly Owned Treatment Works (P.O.T.W.).*

❻ Recycle

Recycle what you must:

Division 20 of the Health and Safety Code requires motor oil recycling.
Section 66822 of the California Code requires lead acid battery recycling.

Recycle what you can:

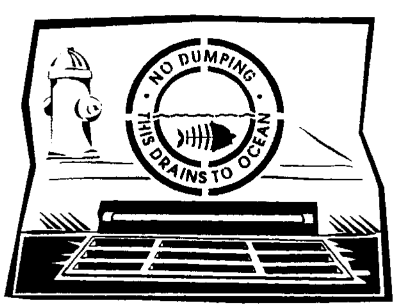
- Metal scraps
- Used tires, paper and cardboard
- Container glass, aluminum, and tin
- Water-based paints

Call the referral numbers in this pamphlet for information.

❼ Employee & Customer Education

Educate your employees. Include water quality training in new employee orientations and conduct annual review sessions.

Educate your customers. Raise employee and customer awareness by stenciling storm drains near the work place with the City's stencil:



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Home Repair & Remodeling

Horse Owners & Equine Industry

Landscaping, Gardening & Pest Control

Painting

Swimming Pool, Jacuzzi & Fountain Maintenance

Roadwork & Paving

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STORMWATER MANAGEMENT DIVISION

1 (800) 974-9794
Bureau of Engineering
Department of Public Works
City of Los Angeles

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Stormwater Best Management Practices (BMPs)

Heavy Equipment & Earthmoving Activities

Safe Environmental Habits and Procedures for:

Bulldozer, Backhoe & Gardening Machine Operators

Developers

Dump Truck Drivers

General Contractors

Home Builders

Site Supervisors

Stormwater Management Division Department of Public Works

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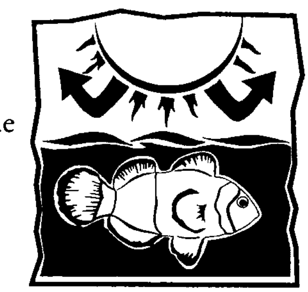
Heavy Equipment Operation Problems

Soil excavation and grading operations often contribute to urban runoff pollution. By loosening large amounts of soil and sediment, earthmoving activities can cause sediment to flow into gutters, storm drains and the ocean.



Sediment is the most common pollutant washed from work sites, creating multiple problems once it enters the ocean. Sediment clogs the gills of fish, blocks light transmission and increases ocean water temperature, all of which harm sea life, disturbing the food chain upon which both fish and people depend.

Sediment also carries with it other work-site pollutants such as pesticides, cleaning solvents, cement wash, asphalt and car fluids like motor oil, grease and fuel. Thus, poorly maintained vehicles and heavy equipment leaking fuel and oil at the construction site also contribute to ocean pollution.

Solutions

Best Management Practices that include the proper handling, storage and disposal of materials can prevent pollutants from entering the ocean through the storm drain system.

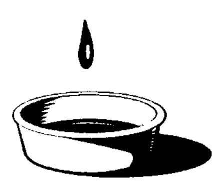
❶ General Business Practices

- Schedule excavation and grading work for dry weather.
- **Use as little water as possible** for dust control.

❷ Vehicle & Equipment Maintenance

- Maintain all vehicles and heavy equipment. **Inspect frequently for leaks.**
- Conduct all vehicle/equipment maintenance and refueling at one location—**away from storm drains.**

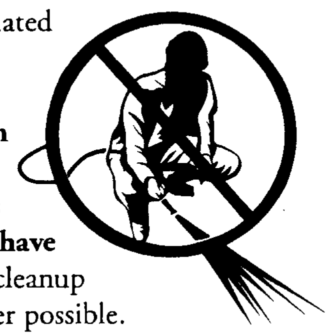
- Perform major maintenance, repair jobs and vehicle/equipment washing off-site.
- Use gravel approaches where truck traffic is frequent to reduce soil compaction and limit the tracking of sediment into streets.
- **Use drip pans or drop cloths to catch drips and spills,** if you drain and replace motor oil, radiator coolant or other fluids on-site. Collect all used fluids, store in separate containers and recycle whenever possible.



- Do not use diesel oil to lubricate equipment or parts.

❸ Cleaning Up

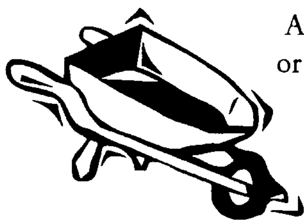
- Sweep up dry spilled materials immediately. Never attempt to bury them or "wash them away" with water.
- Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
- **Report significant spills to the appropriate spill response agencies immediately.** Use the telephone numbers provided on the back of this pamphlet.
- **Clean up leaks, drips and other spills immediately.** This will prevent contaminated soil or residue on paved surfaces.
- **Never hose down "dirty" pavement or surfaces where materials have spilled.** Use dry cleanup methods whenever possible.



❹ Employee & Client Education

Educate your employees. Include water quality training in new employee orientations and conduct annual review sessions.
Educate your customers. Raise employee and customer awareness by stenciling storm drains near the work place with the City's stencil:

❺ Erosion Prevention



After clearing, grading or excavating, exposed soil poses a clear and immediate danger of stormwater pollution.

Re-vegetation (permanent or temporary) is an excellent form of erosion control for any site.

- Avoid excavation and grading activities during wet weather.
- Construct diversion dikes to channel runoff around the site. Line channels with grass or roughened pavement to reduce runoff velocity.
- Cover stockpiles and excavated soil with secured tarps or plastic sheeting.
- Remove existing vegetation only when absolutely necessary. Large projects should be conducted in phases.

- Consider planting temporary vegetation for erosion control on slopes or where construction is not immediately planned.
- Plant permanent vegetation as soon as possible, once excavation and grading activities are complete.

Spill Response Agencies

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

City of Los Angeles
Police Department, Hazardous Materials Unit
(213) 237-2793 or (213) 485-4011

Los Angeles Fire Department
Health/Hazardous Materials Program
City: (213) 485-6185 County: (213) 890-4045

Recycling & Hazardous Waste Disposal

City of Los Angeles
Hazardous and Toxic Materials Office
(213) 237-1209

City of Los Angeles
Integrated Solid Waste Management Office
(213) 237-1444

Los Angeles County
Department of Public Works
Recycling & Household Hazardous Waste Hotline
1 (800) 552-5218

To Report Illegal Dumping

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

Los Angeles County
Department of Public Works
1 (800) 303-0003

To Report a Clogged Catch Basin

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

Los Angeles County
Department of Public Works
(818) 458-HELP

This is one in a series of pamphlets describing storm drain protection measures.
Other pamphlets include:

Automotive Maintenance & Car Care

Food Service Industry

Fresh Concrete & Mortar Application

Heavy Equipment & Earthmoving Activities

Home Repair & Remodeling

Horse Owners & Equine Industry

Landscaping, Gardening & Pest Control

Painting

Swimming Pool, Jacuzzi & Fountain Maintenance

Roadwork & Paving

For more information about storm drain protection or additional pamphlets, call:

STORMWATER MANAGEMENT DIVISION

1 (800) 974-9794
Bureau of Engineering
Department of Public Works
City of Los Angeles

Printed on Recycled Paper 7/95

Stormwater Best Management Practices (BMPs)

General Construction & Site Supervision

Safe Environmental Habits and Procedures for:

General Contractors
Construction Inspectors
Home Builders
Developers
Masons & Bricklayers
Patio Construction Workers
Sidewalk Construction Crews

Stormwater Management Division — Department of Public Work

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Ocean Pollution Prevention It's Up to *Us*

Los Angeles has two drainage systems—the sewers and the ***storm drains.*** The storm drain system was designed to prevent flooding by carrying excess rainwater away from city streets out to the ocean.

Because the system contains no filters, it now serves the ***unintended*** function of carrying urban pollution straight to the ocean.

This pamphlet tells you how to prevent ocean pollution from "stormwater" or "urban runoff."

Rain, industrial and household water mixed with urban pollutants creates stormwater pollution. The pollutants include: oil and other automotive fluids, paint and construction debris, yard and pet wastes, pesticides and litter.

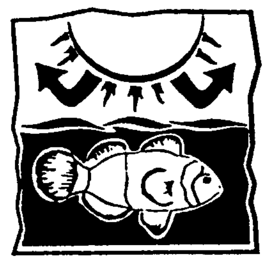
Urban runoff pollution flows to the ocean through the storm drain system—1,500 miles of pipes that take water and debris straight from Los Angeles streets to the ocean. Each day, 100 million gallons of polluted urban runoff enter the ocean untreated, leaving toxic chemicals in our surf and over 4,300 *tons* of trash on our beaches annually.

Urban runoff pollution contaminates the ocean, closes beaches, harms aquatic life and increases the risk of inland flooding by clogging gutters and catch basins.

These Best Management Practices (BMPs) will ensure a cleaner ocean and city.

General Construction Problems

Construction sites are common sources of urban runoff pollution. Materials and wastes blown or washed into a street, gutter or storm drain flow directly to the ocean. Sediment is the most common pollutant washed from work sites, creating multiple problems once it enters the ocean.



Sediment clogs the gills of fish, blocks light transmission and increases ocean water temperature, all of which harm aquatic creatures and disturb the food chain upon which both fish and people depend.

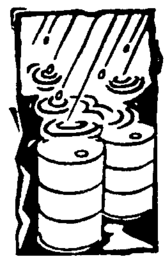
Sediment also carries with it other work site pollutants such as pesticides, cleaning solvents, cement wash, asphalt and car fluids like motor oil, grease and fuel. Thus, poorly maintained vehicles and heavy equipment leaking fuel and oil on the construction site also contribute to ocean pollution.

As a contractor, site supervisor, owner or operator of a site, you may be held responsible for the environmental damage caused by your subcontractors or employees.

Solutions

Best Management Practices such as handling, storing and disposing of materials properly can prevent pollutants from entering storm drains.

❶ General Business Practices

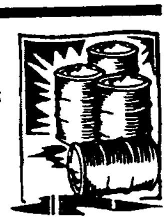


- **Keep pollutants off exposed surfaces.** Place trash cans and recycling receptacles around the site.
- **Cover and maintain dumpsters.** Check frequently for leaks. Place dumpsters under a roof or cover with tarps or plastic sheeting.

Never clean a dumpster by hosing it down on-site!

- **Keep materials out of the rain.** Cover exposed piles of soil or construction materials with plastic sheeting or temporary roofs.
- **Designate one area** for auto parking, vehicle refueling and routine equipment maintenance. The designated area should be well away from gutters or storm drains. Make all major repairs off-site.
- **Make sure portable toilets are in good working order.** Check frequently for leaks.
- **Use as little water as possible** for dust control.

❷ Cleaning Up

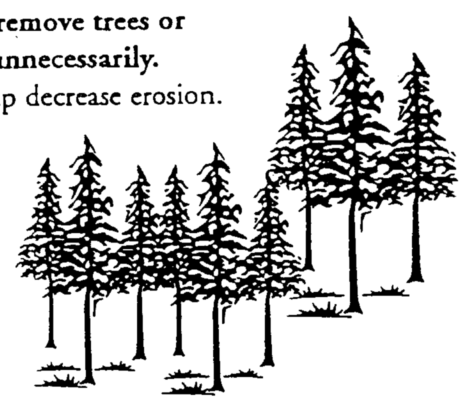


- **Clean up leaks, drips and other spills immediately.** This will prevent contaminated soil or residue on paved surfaces.
- **Never hose down "dirty" pavement or surfaces where materials have spilled.** Use dry cleanup methods whenever possible.

❸ Advanced Planning to Prevent Pollution

An erosion control program, worked out before construction begins, prevents or minimizes most erosion and sedimentation problems.

- **Train your employees and subcontractors.** Make these pamphlets available to everyone working on site. Inform subcontractors about the stormwater requirements and their own responsibilities.
- **Schedule excavation and grading activities** for dry weather periods.
- **Control surface runoff to reduce erosion,** especially during excavation. Use drainage ditches to divert water flow.
- **Use gravel approaches to reduce soil compaction** and limit the tracking of sediments into streets, where truck traffic is frequent.
- **Prevent erosion by planting** fast-growing annual and perennial grasses. These will shield and bind the soil.
- **Do not remove trees or shrubs unnecessarily.** They help decrease erosion.



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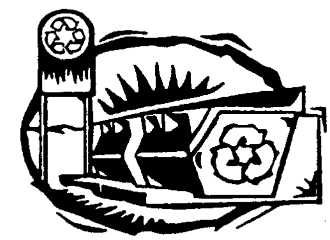
4 Handling Materials & Wastes

?ractice Source Reduction - minimize waste vhen ordering materials. Order only the ımounts needed to complete the job.

Jse recycled and recyclable materials whenver possible.



Vever bury waste naterials or leave 1em in the street. ispose of all aste properly.

Aany construction materials, including solvents, water-based paints, vehicle fluids, broken asphalt and concrete, wood, and cleared vegetation can be recycled. Non-recyclable materials must be taken to an appropriate landfill or disposed of is hazardous waste. For disposal information, call the numbers listed in this pamphlet.

5 Disposal Options

Jse a crushing company to recycle cement, phalt and porcelain rather than taking them a landfill. For a listing of companies that ept these materials, call the:

City of Los Angeles
Department of Public Works
1 (800) 974-9794

Spill Response Agencies

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Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

City of Los Angeles
Police Department, Hazardous Materials Unit
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Los Angeles Fire Department
Health/Hazardous Materials Program
City: (213) 485-6185 County: (213) 890-4045

Recycling & Hazardous Waste Disposal

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Hazardous and Toxic Materials Office
(213) 237-1209

City of Los Angeles
Integrated Solid Waste Management Office
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Los Angeles County
Department of Public Works
Recycling & Household Hazardous Waste Hotline
1 (800) 552-5218

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Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

Los Angeles County
Department of Public Works
1 (800) 303-0003

To Report a Clogged Catch Basin

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

Los Angeles County
Department of Public Works
(818) 458-HELP

This is one in a series of pamphlets describing storm drain protection measures.
Other pamphlets include:

Automotive Maintenance & Car Care

Food Service Industry

Fresh Concrete & Mortar Application

General Construction & Site Supervision

Heavy Equipment & Earthmoving Activities

Home Repair & Remodeling

Horse Owners & Equine Industry

Landscaping, Gardening & Pest Control

Painting

Swimming Pool, Jacuzzi & Fountain Maintenance

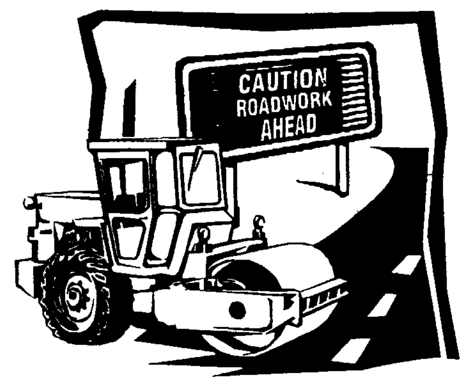
For more information about storm drain protection or additional pamphlets, call:

STORMWATER MANAGEMENT DIVISION

1 (800) 974-9794
Bureau of Engineering
Department of Public Works
City of Los Angeles

Printed on Recycled Paper 5/96

Stormwater Best Management Practices (BMPs)



Roadwork & Paving

Safe Environmental Habits and Procedures for:

Construction Inspectors

Driveway/Sidewalk/Parking Lot/ Road Construction Crews

Equipment Operators

General Contractors

Seal Coat Contractors

Stormwater Management Division Department of Public Works

Ocean Pollution Prevention It's Up to *Us*

Los Angeles has two drainage systems–the sewers and the ***storm drains.*** The storm drain system was designed to prevent flooding by carrying excess rainwater away from city streets out to the ocean.

Because the system contains no filters, it now serves the *unintended* function of carrying urban pollution straight to the ocean.

This pamphlet tells you how to prevent ocean pollution from "stormwater" or "urban runoff."

Rain, industrial and household water mixed with urban pollutants creates stormwater pollution. The pollutants include: oil and other automotive fluids, paint and construction debris, yard and pet wastes, pesticides and litter.

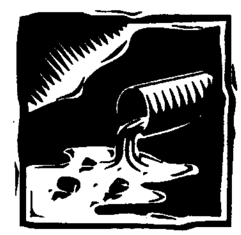
Urban runoff pollution flows to the ocean through the storm drain system–1,500 miles of pipes that take water and debris straight from Los Angeles streets to the ocean. Each day, 100 million gallons of polluted urban runoff enter the ocean untreated, leaving toxic chemicals in our surf and over 4,300 *tons* of trash on our beaches annually.

Urban runoff pollution contaminates the ocean, closes beaches, harms aquatic life and increases the risk of inland flooding by clogging gutters and catch basins.

These Best Management Practices (BMPs) will ensure a cleaner ocean and city.

Roadwork & Paving Problems

Road paving, surfacing and pavement removal activities contribute to urban runoff pollution because they take place right in the street, where urban runoff contamination can result from asphalt, saw-cut slurry or excavated material.



Rain or runoff can carry these toxic substances to the ocean through the storm drain system, posing a hazard to human and sea life.

Extra planning is required to store and dispose of materials properly and guard against stormwater and ocean pollution. As a contractor, site supervisor, owner or operator of a site, *you may be held responsible for the environmental damage caused by your subcontractors or employees.*

Solutions

❶ General Business Practices

- Keep materials out of the rain. Store them under cover, with temporary roofs or plastic sheets, protected from rainfall, runoff and the wind.
- Schedule excavation and grading work for dry weather.
- Develop and implement erosion and sediment control plans for embankments.
- Recycle used oil, concrete, and broken asphalt.

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❷ Equipment Maintenance

- Maintain all vehicles and heavy equipment. Inspect frequently for leaks.
- Conduct all vehicle/equipment maintenance and refueling at one location—**away from storm drains.**

- Perform major equipment/vehicle repairs and washings off-site.
- Do not use diesel oil to lubricate equipment or parts.

❸ During Construction

- Cover catch basins and maintenance holes when applying seal coat, slurry seal or fog seal.
- Use check dams, ditches or berms to divert runoff around excavations.
- Never wash excess materials from exposed aggregate concrete or similar treatments into a street, gutter or storm drain. Collect and recycle, or dispose to a dirt area.
- Collect and recycle excess abrasive gravel or sand. Call the **Integrated Solid Waste Management Office to order a Construction and Demolition Waste Recycling Guide, (213) 237-1444.**
- Avoid over-application by water trucks for dust control.

❹ Asphalt & Concrete Removal

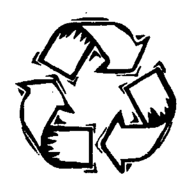
- After breaking up paving, be sure to remove all chunks and pieces. Recycle them at a crushing company. Use the referral numbers listed below.
- Dispose of small amounts of dry concrete in the trash.

- Make sure broken pavement does not come in contact with rainfall or runoff.
- Shovel or vacuum saw-cut slurry and remove from the site. For disposal information contact the Hazardous and Toxic Materials Office at 213-237-1209
- Cover or barricade storm drain openings during saw-cutting.

❺ Asphalt & Concrete Disposal

Use a crushing company to recycle cement, asphalt and porcelain rather than taking them to a landfill. For a listing of companies that accept these materials, call the:

City of Los Angeles
Department of Public Works
1 (800) 974-9794



❻ Spills

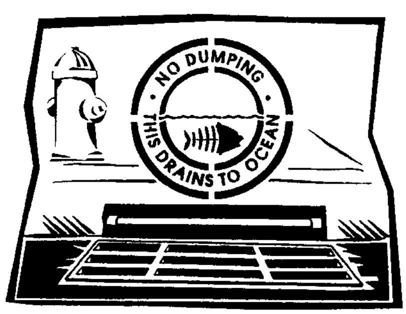
- Never hose down dirty pavement or surfaces. Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags), or dig up and remove contaminated soil. For disposal information contact the Hazardous and Toxic Materials Office at (213) 237-1209.

- Catch drips from pavers with drip pans or absorbent material (cloth, rags, etc.) placed under machine when not in use.

❼ Employee & Customer Education

Educate your employees. Include water quality training in new employee orientations and conduct annual review sessions.

Educate your customers. Raise employee and customer awareness by stenciling storm drains near the work place with the City's stencil:



Spill Response Agencies

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

City of Los Angeles
Police Department, Hazardous Materials Unit
(213) 237-2793 or (213) 485-4011

Los Angeles Fire Department
Health/Hazardous Materials Program
City: (213) 485-6185 County: (213) 890-4045

Recycling & Hazardous Waste Disposal

City of Los Angeles
Hazardous and Toxic Materials Office
(213) 237-1209

City of Los Angeles
Integrated Solid Waste Management Office
(213) 237-1444

Los Angeles County
Department of Public Works
Recycling & Household Hazardous Waste Hotline
1 (800) 552-5218

To Report Illegal Dumping

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

Los Angeles County
Department of Public Works
1 (800) 303-0003

To Report a Clogged Catch Basin

City of Los Angeles
Department of Public Works, Bureau of Engineering
Stormwater Management Division
1 (800) 974-9794

Los Angeles County
Department of Public Works
(818) 458-HELP

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Automotive Maintenance & Car Care

Food Service Industry

General Construction & Site Supervision

Heavy Equipment & Earthmoving Activities

Home Repair & Remodeling

Horse Owners & Equine Industry

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Swimming Pool, Jacuzzi & Fountain Maintenance

Roadwork & Paving

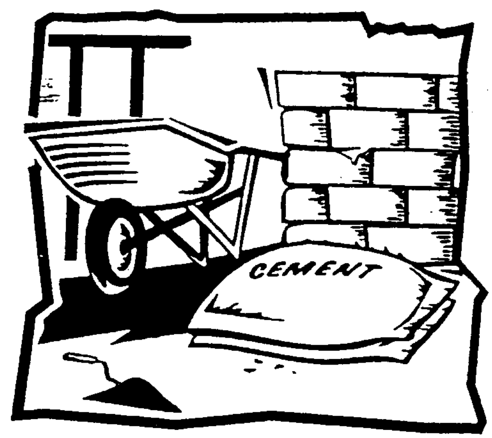
For more information about storm drain protection or additional pamphlets, call:

STORMWATER MANAGEMENT DIVISION

1 (800) 974-9794
Bureau of Engineering
Department of Public Works
City of Los Angeles

Printed on Recycled Paper 7/95

Stormwater Best Management Practices (BMPs)



Fresh Concrete & Mortar Application

Safe Environmental Habits and Procedures for:

Masons and Bricklayers
Sidewalk Construction Crews
Patio Construction Workers
Construction Inspectors
Home Builders
Developers
Do-It-Yourselfers

Stormwater Management Division Department of Public Works

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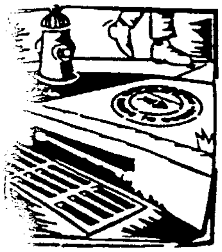
Ocean Pollution Prevention It's Up to *Us*



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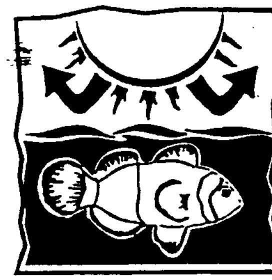
These Best Management Practices (BMPs) will nsure a cleaner ocean and city.

Concrete & Mortar Application Problems

Fresh concrete and mortar activities are frequent sources of urban runoff pollution. Materials and wastes blown or washed into a street, gutter or storm drain have a direct impact on the ocean.



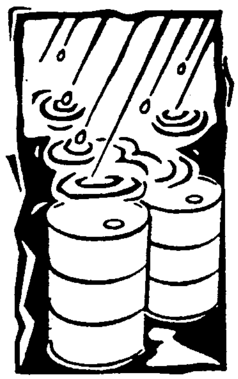
Sediment is the most common pollutant washed from work sites, creating multiple problems once it enters the ocean. Sediment clogs the gills of fish, blocks light transmission and increases ocean water temperature, all of which harm sea life, disrupting the food chain upon which both fish and people depend.

Sediment also carries with it other work site pollutants such as cement wash, gravel, asphalt, pesticides, cleaning solvents, motor oil, grease and fuel. Thus, poorly maintained equipment and vehicles leaking fuel and oil at the work site contribute to ocean pollution.

Solutions

Best Management Practices such as handling, storing and disposing of materials properly can prevent pollutants from entering storm drains.

❶ General Business Practices



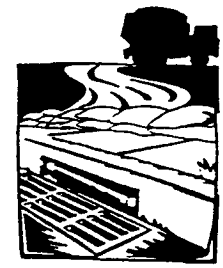
- Schedule projects for dry weather periods.
- **Keep materials out of the rain.** Store both dry and wet materials under cover, protected from rainfall and runoff. Also, protect dry materials from the wind.
- Secure open bags of cement to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall and runoff.

❷ Cleaning Up

- When cleaning up after driveway or sidewalk construction, wash concrete dust onto dirt areas, not down the driveway or into the street or storm drain.
- Wash out concrete mixers and equipment only in designated wash-out areas, where the water flows into containment ponds or onto dirt.

- Recycle cement wash water by pumping it back into cement mixers for reuse.
- Never dispose of cement washout into driveways, streets, gutters, storm drains or drainage ditches.

❸ During Construction



- Place erosion controls (i.e. berms or temporary vegetation) down slope to capture runoff carrying mortar or cement before it reaches the storm drain.
- Do not order or mix up more fresh concrete or cement than you will use.
- Set up and operate small mixers on tarps or heavy drop cloths.
- When breaking up paving (cement or asphalt), be sure to pick up all the pieces. Recycle them at a crushing company. Use the referral numbers listed in this pamphlet.

- Dispose of small amounts of excess dry concrete, grout and mortar in the trash.
- **Never bury waste material.** Recycle or dispose of it as hazardous waste material. For disposal information contact the:

City of Los Angeles
Hazardous and Toxic Materials Office
at (213)-237-1209

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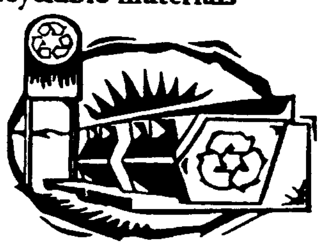
4 Handling Materials & Wastes

Practice Source Reduction - minimize waste when ordering materials. Order only the amounts needed to complete the job.

Use recycled and recyclable materials whenever possible.



Recycle broken asphalt, concrete, wood and cleared vegetation. Non-recyclable materials must be taken to an appropriate landfill or disposed of as hazardous waste. For disposal information, call the numbers listed on the back of this pamphlet.

5 Disposal Options

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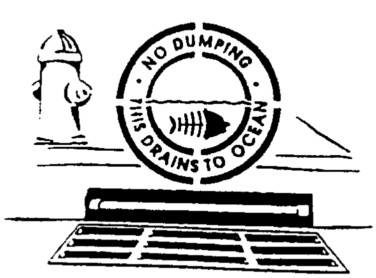
Department of Public Works
1 (800) 974-9794



Spill Response Agencies

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Los Angeles County
Department of Public Works
(818) 458-HELP

Best Management Practices

Metal Grinding & Polishing

Keep a bin under your lathe or grinder to capture metal filings. Send uncontaminated filings to a scrap metal recycler for reclamation.

Tenga un recipiente debajo de su maquina de tornear o molinero para colectar rellenos de metal. Mande rellenos no contaminados a un centro de reciclaje de metales para reciclar.

Preventing Leaks and Spills

Place drip pans underneath to capture fluids. Use absorbent cleaning agents instead of water to clean work areas.

Utilice graseras o cazuelas para capturar liquidos de aceite. Selle o quite desaguaderos del piso para prevenir descargo accidental. Use limpiadores absorbentes en lugar de agua para limpiar áreas del trabajo.

Proper Storage of Hazardous Waste

Keep your liquid wastes segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover or inside to prevent contamination by rainwater.

Mantenga sus desechos de liquido separados. Si no estan mezclados, varios liquidos pueden ser reciclados por compañias que especializan en desechos tóxicos. Guarde y cubra todos los materiales dentro de un lugar para prevenir la contaminacion de la agua de la lluvia.

Cleaning Up Spills Immediately

Follow your hazardous materials response plan, as filed with your local fire department or other hazardous materials authority. Be sure that all employees are aware of the plan and are capable of implementing each phase of the plan. Use dry methods for spill cleanup (sweeping, absorbent materials, etc.)

Siga su plan responsivo de materiales tóxicos, como clasificado con su departamento de bomberos local o con la autoridad de materiales tóxicos. Asegure que todos los empleados estén informados y capaz de aplicar cada fase del plan. Use métodos secos para limpiar derramamientos (barriendo, materiales absorbentes, etc.)

Cleaning Auto Parts

Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks, and drain boards so that fluids are directed back into the sink or the fluid holding tank.

Limpie partes de auto con un cepillo de alambre o use un limpiador de hornos en vez de usar limpiadores de liquido. Arregle las graseras, perchas para secar y tablas de escurrir para que los liquidos sean dirigidos al sumidero o tanque de guardar liquidos.

Proper Disposal of Hazardous Waste

Recycle solvents, oil and used filters, anti-freeze, batteries, lubricants, and metal filings collected from grinding/polishing auto parts. Contact a licensed hazardous waste hauler to dispose of saturated absorbents.

Recicle solventes, aceite de motor usado, filtros de aceite usados, anticongelante, baterias, lubricantes, y rellenos de metal colectados por medio del moliendo y pulimentando partes de auto. Llame a un colector de desechos toxicos para disponer de absorbentes saturados.

(800) 974-9794

PROJECT Pollution PREVENTION

R0020806

(CO-99-2) County Population Estimates for July 1, 1999 and Population Change for April
(includes revised April 1, 1990 Population Estimates Base)

Source: Population Estimates Program, Population Division, U.S. Census Bureau, Washin
Contact: Statistical Information Staff, Population Division, U.S. Census Bureau (301-

Internet Release Date: March 9, 2000

FIPS State/County Code and Area Name	7/1/99 Estimate	4/1/90 Population Estimates Base	Numeric Population Change 1990-99	Perce Populati Chan 1990-
06 California........................	33,145,121	29,811,427	3,333,694	11
06001 Alameda County, CA................	1,415,582	1,304,347	111,235	8
06003 Alpine County, CA.................	1,161	1,113	48	4
06005 Amador County, CA.................	34,153	30,039	4,114	13
06007 Butte County, CA..................	195,220	182,120	13,100	7
06009 Calaveras County, CA..............	40,051	31,998	8,053	25
06011 Colusa County, CA.................	18,844	16,275	2,569	15
06013 Contra Costa County, CA...........	933,141	803,731	129,410	16
06015 Del Norte County, CA..............	26,477	23,460	3,017	12
06017 El Dorado County, CA..............	161,358	125,995	35,363	28
06019 Fresno County, CA.................	763,069	667,479	95,590	14
06021 Glenn County, CA..................	26,328	24,798	1,530	6
06023 Humboldt County, CA...............	121,358	119,118	2,240	1
06025 Imperial County, CA...............	145,287	109,303	35,984	32
06027 Inyo County, CA...................	17,958	18,281	-323	-1
06029 Kern County, CA...................	642,495	544,981	97,514	17
06031 Kings County, CA..................	123,241	101,469	21,772	21
06033 Lake County, CA...................	55,405	50,631	4,774	9
06035 Lassen County, CA.................	33,028	27,598	5,430	19
[redacted]				
06039 Madera County, CA.................	116,760	88,090	28,670	32
06041 Marin County, CA..................	236,768	230,096	6,672	2
06043 Mariposa County, CA...............	15,605	14,302	1,303	9
06045 Mendocino County, CA..............	84,085	80,345	3,740	4
06047 Merced County, CA.................	200,746	178,403	22,343	12
06049 Modoc County, CA..................	9,210	9,678	-468	-4
06051 Mono County, CA...................	10,512	9,956	556	5
06053 Monterey County, CA...............	371,756	355,660	16,096	4
06055 Napa County, CA...................	120,962	110,765	10,197	9
06057 Nevada County, CA.................	92,014	78,510	13,504	17
06059 Orange County, CA.................	2,760,948	2,410,668	350,280	14
06061 Placer County, CA.................	239,485	172,796	66,689	38
06063 Plumas County, CA.................	20,370	19,739	631	3
06065 Riverside County, CA..............	1,530,653	1,170,413	360,240	30
06067 Sacramento County, CA.............	1,184,586	1,066,789	117,797	11
06069 San Benito County, CA.............	51,276	36,697	14,579	39
06071 San Bernardino County, CA.........	1,669,934	1,418,380	251,554	17
06073 San Diego County, CA..............	2,820,844	2,498,016	322,828	12
06075 San Francisco County, CA..........	746,777	723,959	22,818	3
06077 San Joaquin County, CA............	563,183	480,628	82,555	17
06079 San Luis Obispo County, CA........	236,953	217,162	19,791	9
06081 San Mateo County, CA..............	702,102	649,623	52,479	8
06083 Santa Barbara County, CA..........	391,071	369,608	21,463	5
06085 Santa Clara County, CA............	1,647,419	1,497,577	149,842	10
06087 Santa Cruz County, CA.............	245,201	229,734	15,467	6
06089 Shasta County, CA.................	164,530	147,036	17,494	11
06091 Sierra County, CA.................	3,334	3,318	16	0
06093 Siskiyou County, CA...............	43,570	43,531	39	0
06095 Solano County, CA.................	385,723	339,469	46,254	13

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06097	Sonoma County, CA..................	439,970	388,222	51,748	13
06099	Stanislaus County, CA..............	436,790	370,522	66,268	17
06101	Sutter County, CA..................	78,423	64,409	14,014	21
06103	Tehama County, CA..................	54,012	49,625	4,387	8
06105	Trinity County, CA.................	12,927	13,063	-136	-1
06107	Tulare County, CA..................	358,470	311,932	46,538	14
06109	Tuolumne County, CA................	53,764	48,456	5,308	11
06111	Ventura County, CA.................	745,063	669,016	76,047	11
06113	Yolo County, CA....................	155,573	141,212	14,361	10
06115	Yuba County, CA....................	59,607	58,234	1,373	2

R0020808

U.S. Census Bureau

State and County QuickFacts

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Los Angeles County, California

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USA QuickFacts

1990 8.9

Follow the ? link for definition and source information.

People QuickFacts	Los Angeles County	California
? Population, 2000	9,519,338	33,871,648
? Population, percent change, 1990 to 2000	7.4%	13.6%
? White persons, percent, 2000 (a)	48.7%	59.5%
? Black or African American persons, percent, 2000 (a)	9.8%	6.7%
? American Indian and Alaska Native persons, percent, 2000 (a)	0.8%	1.0%
? Asian persons, percent, 2000 (a)	11.9%	10.9%
? Native Hawaiian and Other Pacific Islander, percent, 2000 (a)	0.3%	0.3%
? Persons reporting some other race, percent, 2000 (a)	23.5%	16.8%
? Persons reporting two or more races, percent, 2000	4.9%	4.7%
? Persons under 18 years old, percent, 2000	28.0%	27.3%
? Persons of Hispanic or Latino origin, percent, 2000 (b)	44.6%	32.4%
? High school graduates, persons 25 years and over, 1990	3,838,409	14,244,971
? College graduates, persons 25 years and over, 1990	1,223,442	4,366,674
? Homeownership rate, 1990	48.2%	55.6%
? Single family homes, number 1990	1,745,663	6,930,949
? Households, 1990	2,994,343	10,399,700
? Persons per household, 1990	2.90	2.79
? Family households, 1990	2,036,104	7,218,877
? Median household money income, 1997 model-based estimate	$36,441	$39,595
? Persons below poverty, percent, 1997 model-based estimate	20.5%	16.0%
? Children below poverty, percent, 1997 model-based estimate	30.5%	24.6%

Business QuickFacts	Los Angeles County	California
? Private nonfarm establishments with paid employees, 1998	219,933	773,925
? Private nonfarm employment, 1998	3,693,537	12,026,989
? Private nonfarm employment, percent change 1990-1998	-4.0%	6.3%
? Nonemployer establishments, 1997	590,246	1,936,556
? Manufacturers shipments, 1997 ($1000)	106,706,380	379,612,443
? Retail sales, 1997 ($1000)	69,534,164	263,118,346
? Retail sales per capita, 1997	$7,619	$8,167
? Minority-owned firms, 1992	230,025	541,414
? Women-owned firms, 1992	232,723	801,487
? Housing units authorized by building permits, 1999	14,060	138,039
? Federal funds and grants, 1999 ($1000)	43,465,603	166,049,702
? Local government employment - full-time equivalent, 1997	341,941	1,194,169

Geography QuickFacts	Los Angeles County	California
? Land area, 2000 (square miles)	4,061	155,959
? Persons per square mile, 2000	2,344.1	217.2
? Metropolitan Area	Los Angeles-Long Beach, CA PMSA	

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

FN: Footnote on this item for this area in place of data
NA: Not available
D: Suppressed to avoid disclosure of confidential information
X: Not applicable
S: Suppressed; does not meet publication standards
Z: Value greater than zero but less than half unit of measure shown

Data Quality Statement

What do you think of our new QuickFacts? Send comments to quickfacts@lists.census.gov

Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, 2000 Census of Population and Housing, 1990 Census of Population and Housing, Small Area Income and Poverty Estimates, County Business Patterns, 1997 Economic Census, Minority- and Women-Owned Business, Building Permits, Consolidated Federal Funds Report, 1997 Census of Governments

Last Revised: Wednesday, 09-May-2001 12:19:00 EDT

ANNOUNCEMENT

NPDES–DEVELOPMENT PLANNING FOR STORMWATER MANAGEMENT

On July 15, 1996, the Regional Water Quality Control Board (RWQCB), Los Angeles Region, adopted Order No. 96-054 ("Permit"). Under the Permit, the County of Los Angeles is designated as the Principal Permittee and the 85 incorporated cities as co-Permittees. In February 2000, the RWQCB adopted a Resolution that established Standard Urban Stormwater Mitigation Plan (SUSMP) criteria for priority projects for the Permittees described in Part A and Part B of the attached table.

The primary objectives are to:

- Effectively prohibit non-stormwater discharges, and
- Reduce the discharge of pollutants from stormwater conveyance systems to the maximum extent practicable

The Los Angeles County Department of Public Works (DPW) is responsible for the implementation of SUSMP requirements in the County unincorporated areas (excluding the Antelope Valley area) and all County-owned facilities. Development and redevelopment projects falling into either Parts A or B of the attached table will be required to obtain SUSMP approvals. Details of facilities and measures that mitigate impacts to water quality must be shown on improvement plans and reviewed as part of those plans.

Information regarding the preparation of SUSMP is available on our website (*link to* SUSMP Plan on www.888CleanLA.com).

SUSMP pertaining to new subdivisions will be reviewed by DPW's Land Development Division. Please call Steve Burger at (626) 458-4943 with any questions (Monday through Thursday).

SUSMP for single-lot developments will be reviewed by DPW's Building and Safety Division. Please contact Mitch Miller at (626) 458-6390 with any questions pertaining to these developments (Monday through Thursday).

In addition, SUSMP for non-residential projects will be reviewed by DPW's Environmental Programs Division. Related questions should be directed to the Industrial Waste Unit of Environmental Programs Division at (626) 458-3517 (Monday through Thursday).

Attachment: SUSMP Project Types, Characteristics and Activities, Parts A and B.

SUSMP Project Types, Characteristics, and Activities
Part A. Type of Proposed Project:
A 10+ home subdivision
A 100,000+ square-foot commercial development[1, 2]
An automotive repair shop (SIC codes 5013, 5014, 5541, 7532-7534, and 7536-7539)[3]
A retail gasoline outlet
A restaurant (SIC code 5812)[4]
A hillside-located single-family dewelling[5]
Parking lots 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to stormwater runoff
Location within or directly adjacent to or discharging directly to an environmentally sensitive area

Part B. Project Characteristics or Activities:
Automotive or Equipment Repair and/or Maintenance
Automotive or Equipment Washing or Cleaning Area(s)
Gas Station or Fuel Dispensing
Outdoor Material or Waste Handling or Storage
Chemical handling and/or storage of petroleum products, paints, solvents, concrete, or hazardous waste?
Outdoor Equipment or Product Fabrication including welding; cutting; sawing; metal fabrication; assembly; application of paints, coatings, or finishes; pre-cast concrete fabrication, etc.
Outdoor Areas for Equipment or Machinery Repair and/or Maintenance
Dry Cleaning Factory
Food Service
Food Processing Plant
Animal Slaughtering
Animal Confinement, Pet Care Facilities, Stables, Kennels, etc.
10 or More Dwelling Units
Hillside Location[5]

[1] "100,000 Square Foot Commercial Development" means any commercial development that creates at least 100,000 square feet of impermeable area, including parking areas.

[2] "Commercial Development" means any development on private land that is not heavy industrial or residential. The category includes, but is not limited to: hospitals, laboratories and other medical facilities, educational institutions, recreational facilities, plant nurseries, multi-apartment buildings, car was facilities, mini-malls and other business complexes, shopping malls, hotels, office buildings, and public warehouses and other light industrial complexes.

[3] "Automotive Repair Shop" means a facility that is categorized in any one of the following Standard Industrial Classification (SIC) codes: 5013, 5014, 5541, 7532-7534, or 7536-7539.

[4] "Restaurant" means a stand-alone facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812).

[5] "Hillside" means property located in an area with known erosivesoil conditions, where the development contemplates grading on any natural slope that is 25 percent or greater.