State of California
Regional Water Quality Control Board
North Coast Region

Mona S. Dougherty
May 22, 2008

EXECUTIVE OFFICER'S SUMMARY REPORT
8:30 a.m., Thursday, June 12, 2008
Regional Water Board Hearing Room
5550 Skylane Boulevard, Ste. A
Santa Rosa, California

ITEM: 12

SUBJECT: Storm Water Program Workshop

DISCUSSION

The state and regional water quality control boards are responsible for implementing storm water permitting requirements in the federal Clean Water Act. Individual and general storm water permits are issued under the authority of the National Pollutant Discharge Elimination System (NPDES) program. The storm water permit program contains three types of permits – industrial storm water, construction storm water and municipal storm water. This workshop is intended to provide a background of the storm water permit program, focusing mainly on the municipal storm water permit for the Santa Rosa and Sonoma County area.

On June 26, 2003, the Regional Water Board adopted a municipal storm water NPDES permit (Permit) for discharges from the City of Santa Rosa, Sonoma County and the Sonoma County Water Agency's municipal separate storm sewer systems (MS4s). In the Permit, the three entities cooperate as co-Permittees, each responsible for their individual storm drain system and discharges into these systems. The Permit is scheduled for a renewal adoption hearing on September 11, 2008.

In preparation for the adoption hearing and to solicit stakeholder comments, staff will present information on the storm water program to the Regional Water Board and the public at this workshop. The Permittees, interested agencies and the public will have the opportunity to present information as well.

The following attachments provide background information that will be discussed at the workshop.

Attachment 1:	Protecting Water Quality from Urban Runoff
Attachment 2:	EPA featured story: Stormwater Runoff
Attachment 3:	Introduction to the California Stormwater Quality Association Construction BMP Handbook
Attachment 4:	Introduction to the California Stormwater Quality Association Industrial and Commercial BMP Handbook

Attachment 5:	Introduction to the California Stormwater Quality Association Municipal BMP Handbook
Attachment 6:	EPA Small MS4 Stormwater Program Overview (Storm water municipal program for communities in urbanized areas with a population smaller than 100,000, known as Phase II)
Attachment 7:	Introduction to the California Stormwater Quality Association New Development and Redevelopment BMP Handbook
Attachment 8:	State Water Resources Control Board Resolution No. 2008-0030 Requiring Sustainable Water Resources Management
Attachment 9:	December 26, 2000 letter from the Office of the Chief Counsel discussing the State Water Board's precedential decision concerning the use of Standard Urban Storm Water Mitigation Plans
Attachment 10:	EPA brochure: Incorporating Environmentally Sensitive Development into Municipal Stormwater Programs
Attachment 11:	EPA Managing Wet Weather with Green Infrastructure March 2008 Newsletter
Attachment 12:	EPA Stakeholder Statement of Support for Green Infrastructure
Attachment 13:	Storm Water Links

PRELIMINARY STAFF RECOMMENDATION:

No action is recommended at this time. This is an informational item.

Attachment 1:
Protecting Water Quality from Urban Runoff

EPA United States Environmental Protection Agency

EPA 841-F-03-003

Protecting Water Quality *from* URBAN RUNOFF

Clean Water Is Everybody's Business

In urban and suburban areas, much of the land surface is covered by buildings and pavement, which do not allow rain and snowmelt to soak into the ground. Instead, most developed areas rely on storm drains to carry large amounts of runoff from roofs and paved areas to nearby waterways. The stormwater runoff carries pollutants such as oil, dirt, chemicals, and lawn fertilizers directly to streams and rivers, where they seriously harm water quality. To protect surface water quality and groundwater resources, development should be designed and built to minimize increases in runoff.

The most recent National Water Quality Inventory reports that runoff from urbanized areas is the leading source of water quality impairments to surveyed estuaries and the third-largest source of impairments to surveyed lakes.

Did you know that because of impervious surfaces like pavement and rooftops, a typical city block generates more than 5 times more runoff than a woodland area of the same size?

How Urbanized Areas Affect Water Quality

Increased Runoff

The porous and varied terrain of natural landscapes like forests, wetlands, and grasslands traps rainwater and snowmelt and allows them to filter slowly into the ground. In contrast, impervious (nonporous) surfaces like roads, parking lots, and rooftops prevent rain and snowmelt from infiltrating, or soaking, into the ground. Most of the rainfall and snowmelt remains above the surface, where it runs off rapidly in unnaturally large amounts.

Storm sewer systems concentrate runoff into smooth, straight conduits. This runoff gathers speed and erosional power as it travels underground. When this runoff leaves the storm drains and empties into a stream, its excessive volume and power blast out streambanks, damaging streamside vegetation and wiping out aquatic habitat. These increased storm flows carry sediment loads from construction sites and other denuded surfaces and eroded streambanks. They often carry higher water temperatures from streets, roof tops, and parking lots, which are harmful to the health and reproduction of aquatic life.

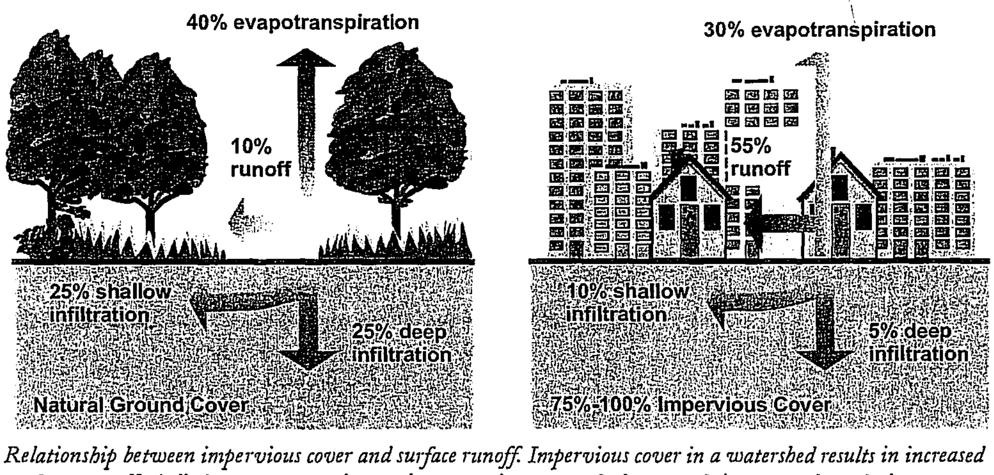
The loss of infiltration from urbanization may also cause profound groundwater changes. Although urbanization leads to great increases in flooding during and immediately after wet weather, in many instances it results in lower stream flows during dry weather. Many native fish and other aquatic life cannot survive when these conditions prevail.

Increased Pollutant Loads

Urbanization increases the variety and amount of pollutants carried into streams, rivers, and lakes. The pollutants include:

- Sediment
- Oil, grease, and toxic chemicals from motor vehicles
- Pesticides and nutrients from lawns and gardens
- Viruses, bacteria, and nutrients from pet waste and failing septic systems
- Road salts
- Heavy metals from roof shingles, motor vehicles, and other sources
- Thermal pollution from dark impervious surfaces such as streets and rooftops

These pollutants can harm fish and wildlife populations, kill native vegetation, foul drinking water supplies, and make recreational areas unsafe and unpleasant.



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

Managing Urban Runoff

What Homeowners Can Do

To decrease polluted runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns. Homeowners can use fertilizers sparingly and sweep driveways, sidewalks, and roads instead of using a hose. Instead of disposing of yard waste, they can use the materials to start a compost pile. And homeowners can learn to use Integrated Pest Management (IPM) to reduce dependence on harmful pesticides.

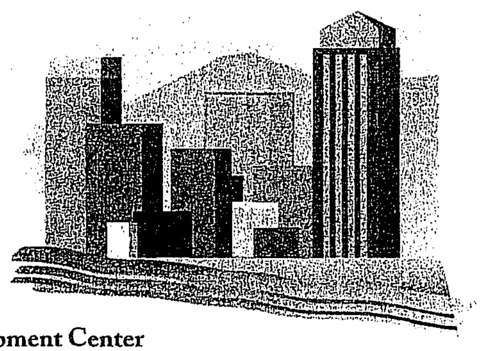
In addition, households can prevent polluted runoff by picking up after pets and using, storing, and disposing of chemicals properly. Drivers should check their cars for leaks and recycle their motor oil and antifreeze when these fluids are changed. Drivers can also avoid impacts from car wash runoff (e.g., detergents, grime, etc.) by using car wash facilities that do not generate runoff. Households served by septic systems should have them professionally inspected and pumped every 3 to 5 years. They should also practice water conservation measures to extend the life of their septic systems.

Controlling Impacts from New Development

Developers and city planners should attempt to control the volume of runoff from new development by using low impact development, structural controls, and pollution prevention strategies. Low impact development includes measures that conserve natural areas (particularly sensitive hydrologic areas like riparian buffers and infiltrable soils); reduce development impacts; and reduce site runoff rates by maximizing surface roughness, infiltration opportunities, and flow paths.

Controlling Impacts from Existing Development

Controlling runoff from existing urban areas is often more costly than controlling runoff from new developments. Economic efficiencies are often realized through approaches that target "hot spots" of runoff pollution or have multiple benefits, such as high-efficiency street sweeping (which addresses aesthetics, road safety, and water quality). Urban planners and others responsible for managing urban and suburban areas can first identify and implement pollution prevention strategies and examine source control opportunities. They should seek out priority pollutant reduction opportunities, then protect natural areas that help control runoff, and finally begin ecological restoration and retrofit activities to clean up degraded water bodies. Local governments are encouraged to take lead roles in public education efforts through public signage, storm drain marking, pollution prevention outreach campaigns, and partnerships with citizen groups and businesses. Citizens can help prioritize the clean-up strategies, volunteer to become involved in restoration efforts, and mark storm drains with approved "don't dump" messages.



Related Publications

Turn Your Home into a Stormwater Pollution Solution!
www.epa.gov/nps

This web site links to an EPA homeowner's guide to healthy habits for clean water that provides tips for better vehicle and garage care, lawn and garden techniques, home improvement, pet care, and more.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas
www.epa.gov/owow/nps/urbanmm

This technical guidance and reference document is useful to local, state, and tribal managers in implementing management programs for polluted runoff. Contains information on the best available, economically achievable means of reducing pollution of surface waters and groundwater from urban areas.

Onsite Wastewater Treatment System Resources
www.epa.gov/owm/onsite

This web site contains the latest brochures and other resources from EPA for managing onsite wastewater treatment systems (OWTS) such as conventional septic systems and alternative decentralized systems. These resources provide basic information to help individual homeowners, as well as detailed, up-to-date technical guidance of interest to local and state health departments.

Low Impact Development Center
www.lowimpactdevelopment.org

This center provides information on protecting the environment and water resources through integrated site design techniques that are intended to replicate preexisting hydrologic site conditions.

Stormwater Manager's Resource Center (SMRC)
www.stormwatercenter.net

Created and maintained by the Center for Watershed Protection, this resource center is designed specifically for stormwater practitioners, local government officials, and others that need technical assistance on stormwater management issues.

Strategies: Community Responses to Runoff Pollution
www.nrdc.org/water/pollution/storm/stoinx.asp

The Natural Resources Defense Council developed this interactive web document to explore some of the most effective strategies that communities are using around the nation to control urban runoff pollution. The document is also available in print form and as an interactive CD-ROM.

For More Information

U.S. Environmental Protection Agency
Nonpoint Source Control Branch (4503T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
www.epa.gov/nps

February 2003

Attachment 2:
EPA featured story: Stormwater Runoff

Featured Story: Stormwater Runoff

Here's how you can prevent chemicals, garbage and other debris from winding up on the local beach

Have you ever wondered where the oil goes that makes driving so dangerous after the first rainfall? Or what happens to the detergent that runs down the driveway when you wash your car? The used oil, as well as detergents, dirty water and soaps from washing your car, are carried through city drains into the nearest lake, stream, bay or ocean.

Illegal Disposal Down a Storm Drain

Anything dumped or dropped on the ground or in the gutter can end up in the nearest body of water. Stormwater pollution results from materials and chemicals washed into the storm drains from streets, gutters, neighborhoods, industrial sites, parking lots and construction sites. This type of pollution is significant because, unlike the water that goes down a sink or toilet in your home, stormwater is untreated and flows directly to a lake, river, or the ocean.

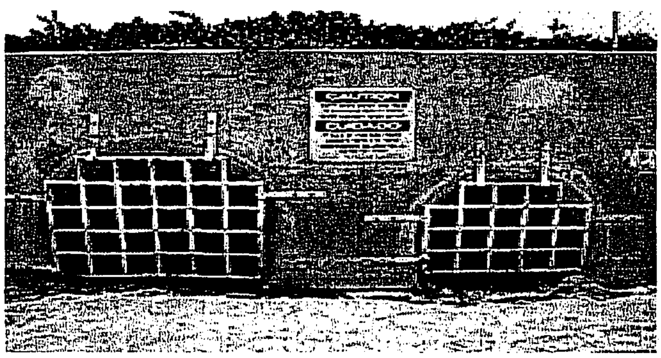
Clogged storm drain photo courtesy of the City of Palo Alto, CA.

Stormwater systems were originally intended to route rainwater quickly off the streets during a heavy storm. Unfortunately, these systems can carry pollutants such as pesticides, bacteria and chemicals through city streets and straight to our waters. Stormwater pollution can include chemicals, fast food wrappers, cigarette butts, Styrofoam cups, sewage overflow, cooking oil, bacteria from pet waste, used motor oil, fertilizers, paint and construction debris.

Used oil from a single oil change can pollute up to one million gallons of freshwater. Improper disposal of used oil, which includes oil leaking from cars, contributes significantly to stormwater pollution. The EPA estimates that American households generate 193 million gallons of used oil every year, and improperly dump the equivalent of 17 Exxon Valdez oil spills every year.

And household cleaners can hurt the environment as well, if not disposed of properly. One ounce of household bleach requires 312,000 ounces of water to be safe for fish. Even biodegradable soaps can pose problems for aquatic life — in order for one ounce of biodegradable detergent to be safe for fish, it needs to be diluted by almost 20,000 ounces of water.

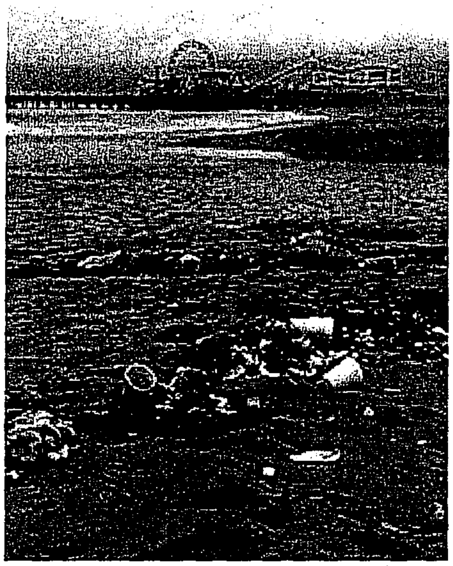
Why is stormwater pollution so bad?



Stormwater outlet onto an ocean beach

As polluted water makes its way to the oceans, water quality can be affected, which often results in the closing of local beaches due to unhealthy water conditions. Stormwater carries disease-causing bacteria and viruses. Swimming in polluted waters can make you sick. A study in Santa Monica Bay showed that people who swim in front of flowing storm drains are 50 percent more likely to develop certain symptoms than those who swim 400 yards from the same drain. Illnesses generally associated with swimming in water contaminated with urban runoff include earaches, sinus problems, diarrhea, fever and rashes. Polluted stormwater can also hurt aquatic life. Cigarette butts, the number one most littered item in America, have been found in the stomachs of fish, birds, whales and other marine creatures that mistake them for food. The plastic loops that hold six-packs of beer or soda together can strangle seabirds.

What can I do to prevent stormwater pollution?



Pico Kenter stormdrain in Santa Monica, CA Photo by Haan-Fawn Chau

The EPA controls storm water pollution at industries and construction sites by inspecting sites and enforcing the agency's requirements. However, a significant amount of storm water pollution is caused by everyday human activities that are not regulated by the EPA – washing and maintaining cars, littering, watering lawns, etc. There are many simple, basic steps people can do each day to prevent storm water pollution:

- Don't dump waste into storm drains
- Keep yard clippings out of the street
- Dispose of household chemicals properly by following the directions on the package or by calling the local public works department for proper disposal guidelines
- Clean up oil spills and fix leaking automobiles
- Use drip pans to catch engine oil and other pollutants while repairing cars
- Recycle used motor oil
- Sweep driveways clean instead of hosing them down
- Water your lawn by hand, or adjusted sprinklers to avoid over-watering. If any water flows off your lawn, you're using too much water.
- Wash your car at a commercial car wash, or at least wash your car on an unpaved surface so the excess water can be absorbed by the ground.
- Drain swimming pools and spas into a sanitary sewer outlet, never into a street. Check first with your local wastewater treatment plant before disposing of anything in the sewer.

Attachment 3:
Introduction to the California Stormwater Quality Association Construction BMP Handbook

Section 1
Introduction

Stormwater runoff is part of the natural hydrologic process. However, human activities such as urbanization and construction can impact stormwater runoff. Construction activities can alter natural drainage patterns and affect runoff water quality, adding pollutants to rivers, lakes, and streams as well as coastal bays and estuaries, and ultimately, the ocean. Urban runoff is a significant source of water pollution, causing possible declines in fisheries, restrictions on swimming, and limiting our ability to enjoy many of the other benefits that water resources provide (USEPA, 1992). Urban runoff in this context includes all flows discharged from urban land uses into stormwater conveyance systems and receiving waters and includes both dry weather non-stormwater sources (e.g., runoff from landscape irrigation, etc.) and wet weather stormwater runoff. In this handbook, urban runoff and stormwater runoff are used interchangeably.

For many years, the effort to control the discharge of stormwater focused on quantity (e.g., drainage, flood control) and, to a limited extent, on quality of the stormwater (e.g., sediment and erosion control). However, in recent years awareness of the need to improve water quality has increased. With this awareness federal, state, and local programs have been established to pursue the ultimate goal of reducing pollutants contained in stormwater discharges to our waterways. The emphasis of these programs is to promote the concept and the practice of preventing pollution at the source, before it can cause environmental problems (USEPA, 1992). However, where further controls are needed, treatment of polluted runoff may be required.

1.1 Handbook Purpose and Scope

The purpose of this handbook is to provide general guidance for selecting and implementing Best Management Practices (BMPs) that will eliminate or reduce the discharge of pollutants from construction sites to waters of the state. This handbook also provides guidance on developing and implementing Stormwater Pollution Prevention Plans (SWPPPs) that document the selection and implementation of BMPs for a particular construction project.

This handbook provides the framework for an informed selection of BMPs, and developments and implementation of a site-specific SWPPP. However, due to the diversity in climate, receiving waters, construction site conditions, and local requirements across California, this handbook does not dictate the use of specific BMPs and therefore cannot guarantee compliance with NPDES permit requirements or local requirements specific to the user's site.

1.1.1 Users of the Handbook

This handbook provides guidance suitable for use by a wide range of individuals involved in construction site water pollution control. Each user of the handbook is responsible for working within their capabilities obtained through training and experience, and for seeking the advice and consultation of appropriate experts at all times

The target audience for this handbook includes: developers, including their planners and engineers; contractors, including their engineers, estimators, superintendents, foremen, tradesmen, and subcontractors; municipal agencies, including their engineers, municipal inspectors, building inspectors, permit counter staff, code enforcement officers, and construction staff; Regulatory agencies, including permit staff and enforcement staff, and the general public with an interest in stormwater pollution control.

1.1.2 Organization of the Handbook

The handbook is organized to assist the user in developing and implementing a stormwater program for construction sites to reduce potential impacts of both stormwater and non-stormwater discharges on receiving waters. The handbook consists of the following sections:

California Stormwater BMP Handbook - Construction

Section 1
Introduction
This section provides a general review of the sources and impacts of construction activity stormwater discharges and provides an overview of the federal, state, and local programs regulating stormwater discharges.

Section 2
Stormwater Pollution Prevention Planning for Construction
This section describes how to prepare and implement a SWPPP for a construction project. It covers minimum requirements, construction activity assessment, BMP selection, and stormwater control planning. A SWPPP template is provided to facilitate SWPPP development and review by providing easy data entry and consistency in SWPPP documents.

Section 3
Erosion and Sediment Control BMPs
This Section provides an overview of BMPs for erosion, sediment, wind, and tracking control.

Section 4
Non-Stormwater Management and Materials Management BMPs
This Section provides an overview of BMPs for non-stormwater management and materials management including waste materials and material stockpiles.

Section 5
Glossary and List of Acronyms
This section identifies terms and abbreviations used in the handbooks.

Appendix A
General Permit
This Appendix contains a copy of the construction General Permit for application to most construction activities in the state.

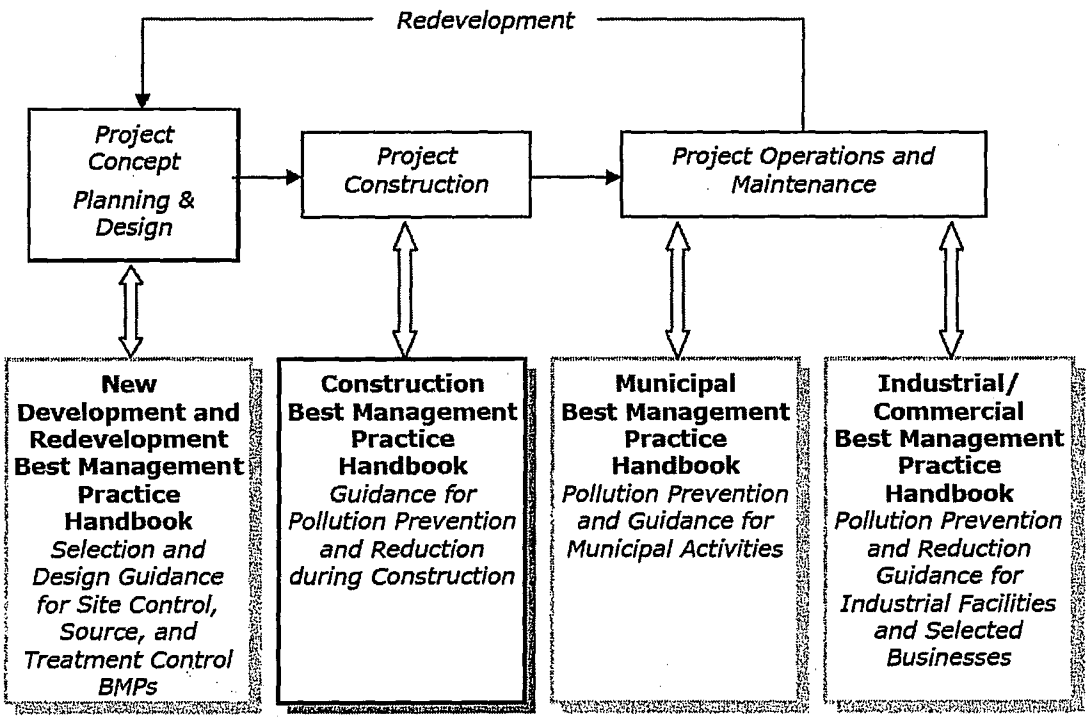
Appendix B
SWPPP Template
This Appendix provides the SWPPP Template that was developed as an assistance tool for SWPPP preparation and review. The template contains elements required by the General Permit.

Appendix C
Construction Storm Water Sampling and Analysis Guidance Document
This Appendix contains a copy of the California Stormwater Quality Task Force's Construction Storm Water Sampling and Analysis Guidance Document

1.1.3 Relationship to other Handbooks

This handbook is one of four handbooks that have been developed by the California Stormwater Quality Association (CASQA) to address BMP selection. Collectively, the four handbooks address BMP selection throughout the life of a project – from planning and design – through construction – and into operation and maintenance. Individually, each handbook is geared to a specific target audience during one stage of the life of a project. This handbook, the Construction Handbook, addresses selection and implementation of BMPs to eliminate or to reduce the discharge of pollutants associated with construction activity.

Project Lifecycle



For a comprehensive understanding of stormwater pollution control throughout the life cycle of a project, it is recommended that the reader obtain and become familiar with all four handbooks. Typically, municipal stormwater program managers, regulators, environmental organizations, and stormwater quality professionals will have an interest in all four handbooks. For a focused understanding of stormwater pollution control during a single phase of the project life cycle, a reader may obtain, and become familiar with, the handbook associated with the appropriate phase. Typically, contractors, construction inspectors, industrial site operators, commercial site operators, some regulators and some municipal staff may have an interest in a single handbook.

1.2 Construction Sites and their Impacts on Water Quality

1.2.1 Pollutants Associated with Construction Activities

Stormwater runoff naturally contains numerous constituents. However, urbanized and urban activities such as construction increase constituent concentrations to levels that impact water quality. Pollutants associated with stormwater include sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, pesticides, gross pollutants (floatables), and miscellaneous waste Some constituents can also affect the pH of stormwater. Stormwater runoff can also be highly attractive to vector organisms, particularly mosquitoes, which can impact public health and become a legal liability. Stormwater pollutants are described in Table 1-1.

Excessive erosion and sedimentation are perhaps the most visible water quality impacts due to construction activities. Other less visible impacts are associated with off-site discharge of pollutants such as metals, nutrients, soil additives, pesticides, construction chemicals, and other construction waste. The magnitude of stormwater impacts depends on construction activities, climatic conditions, and site conditions. Development of a comprehensive SWPPP requires a basic understanding of the impacts, pollutant sources and other contributing factors, as well as BMPs to eliminate or reduce these impacts.

Table 1-1 Pollutant Impacts on Water Quality

Sediment	Sediment is a common component of stormwater, and can be a pollutant. Sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, and fish) by interfering with photosynthesis, respiration, growth, reproduction, and oxygen exchange in water bodies. Sediment can transport other pollutants that are attached to it including nutrients, trace metals, and hydrocarbons. Sediment is the primary component of total suspended solids (TSS), a common water quality analytical parameter.
Nutrients	Nutrients including nitrogen and phosphorous are the major plant nutrients used for fertilizing landscapes, and are often found in stormwater. These nutrients can result in excessive or accelerated growth of vegetation, such as algae, resulting in impaired use of water in lakes and other sources of water supply. For example, nutrients have led to a loss of water clarity in Lake Tahoe. In addition, un-ionized ammonia (one of the nitrogen forms) can be toxic to fish.
Bacteria and viruses	Bacteria and viruses are common contaminants of stormwater. For separate storm drain systems, sources of these contaminants include animal excrement and sanitary sewer overflow. High levels of indicator bacteria in stormwater have led to the closure of beaches, lakes, and rivers to contact recreation such as swimming.
Oil and Grease	Oil and grease includes a wide array of hydrocarbon compounds, some of which are toxic to aquatic organisms at low concentrations. Sources of oil and grease include leakage, spills, cleaning and sloughing associated with vehicle and equipment engines and suspensions, leaking and breaks in hydraulic systems, restaurants and waste oil disposal.
Metals	Metals including lead, zinc, cadmium, copper, chromium, and nickel are commonly found in stormwater. Many of the artificial surfaces of the urban environment (e.g., galvanized metal, paint, automobiles, or preserved wood) contain metals, which enter stormwater as the surfaces corrode, flake, dissolve, decay, or leach. Over half the trace metal load carried in stormwater is associated with sediments. Metals are of concern because they are toxic to aquatic organisms, can bioaccumulate (accumulate to toxic levels in aquatic animals such as fish), and have the potential to contaminate drinking water supplies.
Organics	Organics may be found in stormwater in low concentrations. Often synthetic organic compounds (adhesives, cleaners, sealants, solvents, etc.) are widely applied and may be improperly stored and disposed. In addition, deliberate dumping of these chemicals into storm drains and inlets causes environmental harm to waterways.
Pesticides	Pesticides (including herbicides, fungicides, rodenticides, and insecticides) have been repeatedly detected in stormwater at toxic levels, even when pesticides have been applied in accordance with label instructions. As pesticide use has increased, so too have concerns about adverse effects of pesticides on the environment and human health. Accumulation of these compounds in simple aquatic organisms, such as plankton, provides an avenue for biomagnification through the food web, potentially resulting in elevated levels of toxins in organisms that feed on them, such as fish and birds.
Gross Pollutants	Gross Pollutants (trash, debris, and floatables) may include heavy metals, pesticides, and bacteria in stormwater. Typically resulting from an urban environment, industrial sites and construction sites, trash and floatables may create an aesthetic "eye sore" in waterways. Gross pollutants also include plant debris (such as leaves and lawn-clippings from landscape maintenance), animal excrement, street litter, and other organic matter. Such substances may harbor bacteria, viruses, vectors, and depress the dissolved oxygen levels in streams, lakes, and estuaries sometimes causing fish kills.
Vector Production	Vector production (e.g., mosquitoes, flies, and rodents) is frequently associated with sheltered habitats and standing water. Unless designed and maintained properly, standing water may occur in treatment control BMPs for 72 hours or more, thus providing a source for vector habitat and reproduction (Metzger, 2002).

1.2.2 Erosion and Sedimentation

Soil erosion is the process by which soil particles are removed from the land surface by wind, water, or gravity. Most natural erosion occurs at slow rates; however, the rate of erosion increases when land is cleared or altered and left unprotected. Construction sites, if unprotected, can erode at rates in excess of one hundred times the natural background rate of erosion.

Sediment resulting from excessive erosion is a pollutant. Sedimentation is defined as the settling out of particles transported by water. Sedimentation occurs when the velocity of water is slowed sufficiently allow suspended soil particles to settle. Larger particles, such as gravel and sand, settle more rapidly than fine particles such as silt and clay. Effective sediment control begins with proper erosion control, which minimizes the availability of particles for settling downstream.

Erosion from Rainfall Impact

The impact of raindrops on bare soil can cause erosion. On undisturbed soil protected by vegetation or other cover, the erosion is minimal. Construction activities increase the amount of exposed and disturbed soil, which increases erosion potential from rainfall.

Sheet Erosion

After rainfall strikes the ground, it flows in a thin layer for a short distance. The distance of sheet flow depends on slope, soil roughness, type of vegetative cover, and rainfall intensity. Erosion due to sheet flow on undisturbed soils is minimal and greater on soils disturbed by construction. However, sheet flows are capable of transporting soil particles dislodged by the impact of raindrops onto bare soil, and thus cannot be ignored.

Rill and Gully Erosion

As runoff accumulates, it concentrates in rivulets that cut grooves (rills) into the soil surface. Rills generally run parallel to one another and to the slope of the soil surface. If left unchecked, several rills may join together to form a gully. Rills are small enough to be stepped across, whereas a gully requires added effort to be traversed. The rate of rill erosion can easily be one hundred times greater than that of sheet flow, and the rate of gully erosion can easily be one hundred times greater than rill erosion. Due to the significant amount of sediment generated by rill and gully erosion, these types of erosion must be given top priority for elimination, reduction, and control. Rills and gullies form sooner on exposed soils than on vegetated soils.

Stream and Channel Erosion

In general, one or more of the following factors that may occur during construction can change the hydrology of the area to affect erosion of the banks and bottoms of natural drainage channels:

- Clearing the soil and re-contouring the site during construction may increase the volume and rate of runoff leaving the site.

- Replacing pervious natural ground with impervious cover such as buildings and pavement further increases runoff.

- Detention basins used to capture sediment extend the duration of flows leaving the site.

Control of erosion in streams and channels downstream of the construction site as a result of construction activities is a complex issue and is usually best addressed by local agencies through a comprehensive drainage master plan. Where these plans are available, the local drainage-planning agency may specify specific BMP requirements applicable to construction projects, which in turn must be incorporated into the SWPPP. Where these plans are not available, the goal of the SWPPP should be to minimize the difference between the predevelopment, construction, and post-construction hydrographs, and to minimize increases in sediment discharges. In some situations, local agencies may require developers of large projects to conduct a study of the specific impacts related to development of the project. This will most likely be the case where municipal permits include new development and redevelopment provisions such as Standard Urban Stormwater Mitigation Plans (SUSMPs).

Wind Erosion

Dust is defined as solid particles or particulate matters which are predominately large enough to eventually settle out from the air but small enough to remain temporarily suspended in the air for an extended period of time. Dust from a construction site originates from rock and soil surfaces, material storage piles and construction materials. It is generated by earthwork, demolition, traffic on unpaved surfaces, and strong winds. See Table 1-2.

Table 1-2 Examples of Dust Sources at Construction Sites

Vehicle and Equipment Use	Exposed Areas	Contractor Activities
▪ Vehicle and equipment entering and leaving the project site ▪ Vehicle and equipment movement and use within the project site ▪ Sediment tracking off-site ▪ Temporary parking lots and staging areas ▪ On-site construction traffic	▪ Areas of exposed soil that have been cleared and grubbed ▪ Areas of exposed soil that have been excavated, filled, compacted, or graded ▪ Construction staging areas ▪ Vehicle and equipment storage and service areas ▪ Material processing areas and transfer points. ▪ Construction roads ▪ Construction sites, bare ground areas ▪ Spilled materials ▪ Construction stockpiles ▪ Soil and debris piles	▪ Land clearing and grubbing ▪ Earthwork including soil excavation, filling, soil compaction, rough grading, and final grading ▪ Drilling and blasting ▪ Materials handling, including material stockpiling, transfer, and processing ▪ Batch dropping, dumping ▪ Conveyor transfer and stacking ▪ Material transferring ▪ Crushing, milling and screening operations ▪ Demolition and debris disposal ▪ Tilling

1.2.3 Other Pollutants

Erosion and sedimentation discharges are perhaps the most visible and significant source of pollutants associated with construction sites. However, pollutants such as nutrients, bacteria, viruses, oil, grease, metals, organics, pesticides, gross pollutants, and vectors must always be considered, as they can be associated with both acute and chronic problems in receiving waters. Table 1-3 presents a matrix that identifies the most common source of these other pollutants at construction sites.

Table 1-3 Other Construction Activity Pollutants

Construction Activity	Pollutants						
	Sediment	Nutrients	Trace Metals	Pesticides	Oil, Grease, Fuels	Other Toxic Chemicals	Miscellaneous Waste
Construction Practices							
Dewatering Operations	X					X	
Paving Operations	X			X	X	X	X
Structure Construction/Painting			X			X	X
Material Management							
Material Delivery and Storage	X	X	X	X	X	X	
Material Use		X	X	X	X	X	
Waste Management							
Solid Waste	X	X					X
Hazardous Waste						X	
Contaminated Spills	X					X	
Concrete Waste							X
Sanitary/Septic Waste							X
Vehicle/Equipment Management						X	X
Vehicle/Equipment Fueling						X	X
Vehicle/Equipment Maintenance						X	X

1.2.4 Impacts of Erosion and Sedimentation, and Other Pollutants

The impacts due to erosion and sedimentation can be placed in three categories:

- Degradation of aquatic and riparian ecosystems
- Pollutant transport
- Erosion of land and sedimentation within waterways and public facilities (i.e. storm drains).

Sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, and fish) by interfering with photosynthesis, respiration, growth, reproduction, and oxygen exchange in water bodies. In addition, sediment particles can transport other pollutants that are attached to them including nutrients, trace metals, and hydrocarbons. Sediment particles such as silts and clays are the primary components of total suspended solids (TSS), a common water quality analytical parameter.

In addition to impacts directly associated with sedimentation, various pollutants can also be transported along with sediment particles leaving construction sites. Such pollutants include metals, nutrients, conventional pollutants, pesticides, and coliform. These pollutants often originate from organic components, plant residues, and nutrient elements within soils on the construction site, and are thus mobilized by erosion and later deposited downstream during sedimentation. Alternatively, these other pollutants may be generated independent of erosion and because of their nature can have significant detrimental affects to receiving waters.

Construction activity may cause increased erosion and sedimentation within waterways and public facilities. Some construction activity will increase impervious area and/or change drainage patterns, resulting in increased runoff volumes and rates, which have the potential to erode downstream watercourses. Other construction activities such as grading may increase erosion from the construction site by disturbing and exposing the soil. The eroded soil particles from the construction site may flow downstream and fill drainage systems, reservoirs, and harbors.

In order to control the impact of erosion, sedimentation, and other pollutants on receiving waters, the *State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Stormwater Runoff Associated with Construction Activity (General Permit)* requires the implementation of BMPs to eliminate or reduce the discharge of pollutants in stormwater discharges, and prohibits the discharge of non-stormwater from the construction site as these non-stormwater discharges are likely to carry pollutants to receiving waters. The General Permit recognizes that discharges of non-stormwater may be necessary for the completion of certain construction projects. Such discharges include, but are not limited to:

- Irrigation of vegetative erosion control measures

- Pipe flushing and testing
- Street cleaning, and
- Dewatering

Such discharges are authorized by this General Permit as long as they (a) do comply with Section A.9 of the General Permit, (b) do not cause or contribute to violation of any water quality standard, (c) do not violate any other provision of the General Permit, (d) do not require a non-stormwater permit as issued by some RWQCBs, and (e) are not prohibited by a Basin Plan. If a non-stormwater discharge is subject to a separate permit adopted by a RWQCB, the discharge must additionally be authorized by the RWQCB.

1.3 Regulatory Programs

The need to protect our environment has resulted in a number of laws and subsequent regulations and programs. In the following sections, various federal, state, and local programs are discussed in relationship to the control of pollutants in stormwater. The programs are expected to change over the next several years and the user is advised to contact state and local officials for further information.

1.3.1 Federal NPDES Programs

In 1972, the Federal Water Pollution Control Act (also referred to as the Clean Water Act [CWA]) was amended to provide that the discharge of pollutants to waters of the United States from any point source is unlawful unless the discharge is in compliance with an NPDES permit. The 1987 amendments to the CWA added Section 402(p), which establishes a framework for regulating municipal and industrial stormwater discharges, including discharges associated with construction activities, under the NPDES Program.

On November 16, 1990, the U.S. Environmental Protection Agency (USEPA) published final regulations that establish stormwater permit application requirements. The regulations, also known as Phase I of the NPDES program, provide that discharges of stormwater to waters of the Unites States from construction projects that encompass five or more acres of soil disturbance are effectively prohibited unless the discharge complies with an NPDES Permit.

Phase II of the NPDES program expands the requirements by requiring operators of small MS4s in urbanized areas and small construction sites to be covered under an NPDES permit, and to implement programs and practices to control polluted stormwater runoff. The program applies to:

- Operators of small MS4s located in "urbanized areas" as delineated by the Bureau of the Census. A "small" MS4 is any MS4 not already covered by the Phase I NPDES stormwater program.
- Small construction sites with a soil disturbance equal to or greater than one and less than five acres of land or part of a larger common plan of development which disturbs more than one acre.

1.3.2 State NPDES Programs

In California, the NPDES stormwater permitting program is administered by the State Water Resources Control Board (SWRCB) through its nine Regional Water Quality Control Boards (RWQCBs). The SWRCB has established a construction General Permit that can be applied to most construction activities in the state. Construction permittees may choose to obtain individual NPDES permits instead of obtaining coverage under the General Permit, but this can be an expensive and complicated process, and its use should generally be limited to very large construction projects that discharge to critical receiving waters. Because individual permits are rare and would likely follow the General Permit to a large extent, this Handbook is structured around the General Permit.

In California, owners of construction projects may obtain NPDES permit coverage by filing a Notice of Intent (NOI) to be covered under the *State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Stormwater Runoff Associated with Construction Activity (General Permit)* and subsequent adopted modifications.

The primary objectives of the General Permit are to:

- Reduce erosion
- Minimize or eliminate sediment in stormwater discharges
- Prevent materials used at a construction site from contacting stormwater
- Implement a sampling and analysis program if stormwater is exposed to construction materials.
- Eliminate unauthorized non-stormwater discharges from the construction sites
- Implement appropriate measures to reduce potential impacts on waterways both during and after construction of projects
- Establish maintenance commitments on post-construction pollution control measures

Failure to comply with the General Permit may result in significant fines for each violation and possible imprisonment.

Who must comply with the Construction General Permit?

- The General Permit applies to stormwater discharges associated with construction activity which disturbs one acre or greater of soil.
- The owner of the land is responsible for compliance.

Who does not need to seek coverage under the Construction General Permit?

- Projects on Tribal Lands, in the Lake Tahoe Hydrologic Unit, the San Jacinto Watershed, covered by an individual NPDES Permit for stormwater discharges, and landfill construction that is subject to the General Industrial Permit.

- Activities to maintain the original line, grade, and hydraulic function of a facility, and emergency activities, do not require coverage under the General Permit. However, reasonable pollution control during these activities may still be required under other state and local regulations and ordinances.

- Construction activities meeting all three of the following criteria do not require coverage under the General Permit; (1) result in soil disturbances of less than one acre, (2) are not part of a larger common plan of development that disturbs one or more acres of soil, and (3) do not constitute a threat to water quality.

How to comply with Construction General Permit

- Submit a Notice of Intent (NOI) and pay fees prior to the beginning of construction. Allow ten working days for processing the NOI and issuing the WDID number. A copy of the General Permit (SWQ 99-08) and the NOI can be found at http://www.swrcb.ca.gov/stormwtr/construction.html or in Appendix A.

- Prepare the SWPPP before construction begins. The SWPPP describes:

  - The project location, site features, and materials/activities that may result in the off-site discharge of pollutants during construction.

  - Controls to be implemented during construction - BMPs selected to control erosion, the discharge of sediment, and other pollutant sources.

  - An inspection and maintenance program for BMPs.

  - A sampling and analysis plan for sediment discharges to impaired water bodies as well as a plan to sample for non-visible pollutants.

  - Post construction controls – BMPs to prevent or control pollutants in runoff after construction is complete, including long-term maintenance.

- Keep the SWPPP on the site; implement it during construction and revise it as needed to reflect all phases of construction.

- Submit Notice of Termination (NOT) when construction is complete and conditions of termination listed in the NOT have been satisfied. A copy of the NOT can be found at http://www.swrcb.ca.gov/stormwtr/construction.html or at Attachment P in Appendix B.

1.3.3 Municipal NPDES Programs

Phase I Municipal Stormwater Program and municipal NPDES Permits cover and regulate municipalities with populations of over 100,000, drainage systems interconnected with these municipalities' systems, or municipalities determined to be significant contributors of pollutants. In California, most of the major urbanized counties have already obtained NPDES stormwater permits.

Municipalities with NPDES stormwater permits for their own municipal separate storm sewer system (MS4s) are responsible for developing a management program for public and private construction activities in their jurisdiction. Each program addresses appropriate planning and construction procedures; ensures the implementation, inspection, and monitoring of construction sites which discharge stormwater into their systems; and provides for education and training for construction site operators.

Phase II of the Stormwater Program will regulate municipalities with populations less than 100,000, including urbanized areas (areas with a population of 50,000 and density greater than 1,000 people per square mile), cities, and county areas designated by the state based on site-specific criteria, and various state and federal facilities. Each designated entity must submit a Notice of Intent (NOI) along with a copy of its Stormwater Management Program. The Phase II Stormwater Management Program must address six minimum control measures, including the following measures related to construction activities:

- Illicit Discharge Detection and Elimination - Developing and implementing a plan to detect and eliminate illicit discharges to the storm drain system including illicit connections and illegal dumping.
- Construction Site Stormwater Runoff Control - Developing, implementing, and enforcing an erosion and sediment control program for construction activities that disturb one or more acres of land.
- Post Construction Stormwater Management in New Development and Redevelopment - Developing, implementing, and enforcing a program to address discharges of stormwater runoff from new and redevelopment areas.

While Phase I and Phase II programs for construction sites vary throughout the state, the programs have many similarities, including the requirement for construction sites to comply with the General Permit. For specific information on local program requirements, construction site owners must contact the municipal stormwater program coordinator in the jurisdiction where the project will be constructed.

1.4 Definitions

Many of the most common terms related to stormwater quality control are defined in the Glossary (see Section 5). Throughout the handbook, the user will find references to the following terms:

NPDES General Permit for Stormwater Discharges. NPDES is an acronym for National Pollutant Discharge Elimination System. NPDES is the national program for administering and regulating Sections 307, 318, 402, and 405 of the Clean Water Act (CWA). In California, the State Water Resources Control Board (SWRCB) has issued a General Permit for stormwater discharges associated with industrial activities (see Appendix A).

Notice of Intent (NOI) is a formal notice to the SWRCB submitted by the owner/operators of existing industrial facilities. The NOI provides information on the permittee, location of discharge, type of discharge and certifies that the permittee will comply with conditions of the Industrial General Permit. The NOI is not a permit application and does not require approval.

Sediment includes particles of sand, clay, silt, and other substances that settle at the bottom of a body of water. Sediment can come from the erosion of soil or from the decomposition of plants and animals. Wind, water, and ice often carry these particles great distances.

Stormwater Pollution Prevention Plan (SWPPP) is a written plan that documents the series of phases and activities that, first, characterizes your site, and then, prompts the implementers to select and carry out actions which reduce pollutants in stormwater discharges.

Stormwater Pollution Control Plan (SWPCP) is a less formal plan than the SWPPP that addresses the implementation of BMPs at facilities and businesses not covered by a General Permit but that have the potential to discharge pollutants.

Best Management Practices (BMP) is defined as any program, technology, process, siting criteria, operating method, measure, or device, which controls, prevents, removes, or reduces pollution.

Source Control BMPs are operational practices that prevent pollution by reducing potential pollutants at the source.

Treatment Control BMPs are methods of treatment to remove pollutants from stormwater.

1.5 References

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State Water Resources Control Board, (1999), *NPDES General Permit No. CA2000002: Waste Discharge requirements for Discharges of Storm Water Runoff Associated with Construction Activity.* On-line: http://www.swrcb.ca.gov/stormwtr/construction

Stormwater Managers Resource Center. On-line: http://www.stormwatercenter.net

United States Environmental Protection Agency, Region 9: Water Programs: NPDES Storm Water Program. On-line: http://www.epa.gov/region09/water/npdes/stormwater.html

United States Environmental Protection Agency, (1992), *Draft Stormwater Pollution Prevention for Industrial Activities*, Office of Wastewater Enforcement and Compliance.

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Urban Runoff Quality Management. Water Environment Federation/American Society of Civil Engineers. 1998. On-line: http://www.wef.org

Attachment 4:
Introduction to the California Stormwater Quality Association Industrial and Commercial BMP Handbook

Section 1 Introduction

Stormwater runoff is part of a natural hydrologic cycle. However, human activities particularly urbanization and agriculture, can alter natural drainage patterns and add pollutants to rivers, lakes, and streams as well as coastal bays and estuaries, and ultimately, the ocean. Urban runoff is a significant source of water pollution, causing possible declines in fisheries, restrictions on swimming, and limiting our ability to enjoy many of the other benefits that water resources provide (USEPA, 1992). Urban runoff in this context includes all flows discharged from urban land uses into stormwater conveyance systems and receiving waters and includes both dry weather non-stormwater sources (e.g., runoff from landscape irrigation, etc.) and wet weather stormwater runoff. In this handbook, urban runoff and stormwater runoff are used interchangeably.

For many years the effort to control the discharge of stormwater focused on quantity (e.g., drainage, flood control) and, to a limited extent, on quality of the stormwater (e.g., sediment and erosion control). However, in recent years awareness of the need to improve water quality has increased. With this awareness federal, state and local programs have been established to pursue the ultimate goal of reducing pollutants contained in stormwater discharges to our waterways. The emphasis of these programs is to promote the concept and the practice of preventing pollution at the source, before it can cause environmental problems (USEPA, 1992). However, where further controls are needed, treatment of polluted runoff may be required.

1.1 Handbook Purpose and Scope

The purpose of this handbook is to provide general guidance for selecting and implementing Best Management Practices (BMPs) to reduce the discharge of pollutants in runoff from industrial facilities and selected commercial businesses to waters of the state.

Federal and state programs require selected industries to obtain a National Pollutant Discharge Elimination System (NPDES) permit and to prepare a Stormwater Pollution Prevention Plan (SWPPP). This handbook provides guidance on the identification and selection of BMPs that are the cornerstone of an effective SWPPP. Due to the diversity in receiving waters, site conditions, and local requirements across California, it is not the intent of this handbook to dictate the actual selection of BMPs or guarantee compliance with NPDES permit requirements or local requirements, but rather to provide the framework for an informed selection of BMPs.

1.1.1 Users of the Handbook

This handbook provides guidance suitable for use by individuals involved with controlling urban runoff pollution from industrial and commercial sites urban runoff pollution control. The target audience for this handbook includes: operators and owners of industrial and commercial facilities that are required to obtain an NPDES permit for stormwater discharges; and operators and owners of other industrial and commercial facilities that are not required to obtain an NPDES permit, but are committed to implementing BMPs for their sites or activities.

1.1.2 Organization of the Handbook

The handbook is organized to assist the user in selecting and implementing BMPs to reduce impacts of stormwater discharges on receiving waters. The handbook consists of the following sections:

Section 1
Introduction
This section provides a general review of the sources and impacts of urban stormwater discharges and provides an overview of the federal and state programs regulating stormwater discharges.

Section 2
Stormwater Pollution Prevention Planning for Industrial and Commercial Facilities
This section describes the process that is followed in preparing an industrial Stormwater Pollution Prevention Plan (SWPPP).

Section 3
Source Control BMPs
BMP fact sheets presented in this section address source control BMPs to be considered for industrial facilities. The section also addresses source control BMPs for commercial businesses and introduces business-specific guide sheets.

Section 4
Treatment Control BMPs
BMP fact sheets presented in this section address maintenance and inspection requirements for treatment control BMPs that may be in use at industrial and commercial facilities.

Section 5
Monitoring, Reporting, and Program Evaluation
This section outlines the monitoring program used to assess the implementation of the SWPPP. Record keeping and reporting requirements are also addressed.

Section 6
Glossary and List of Acronyms
This section identifies terms and abbreviations used in the handbooks.

Appendix A
General Industrial Activities Stormwater Permit
This appendix includes a copy of the statewide General NPDES Permit for industrial facilities.

Appendix B
This appendix identifies facilities with stormwater discharges associated with industrial activity.

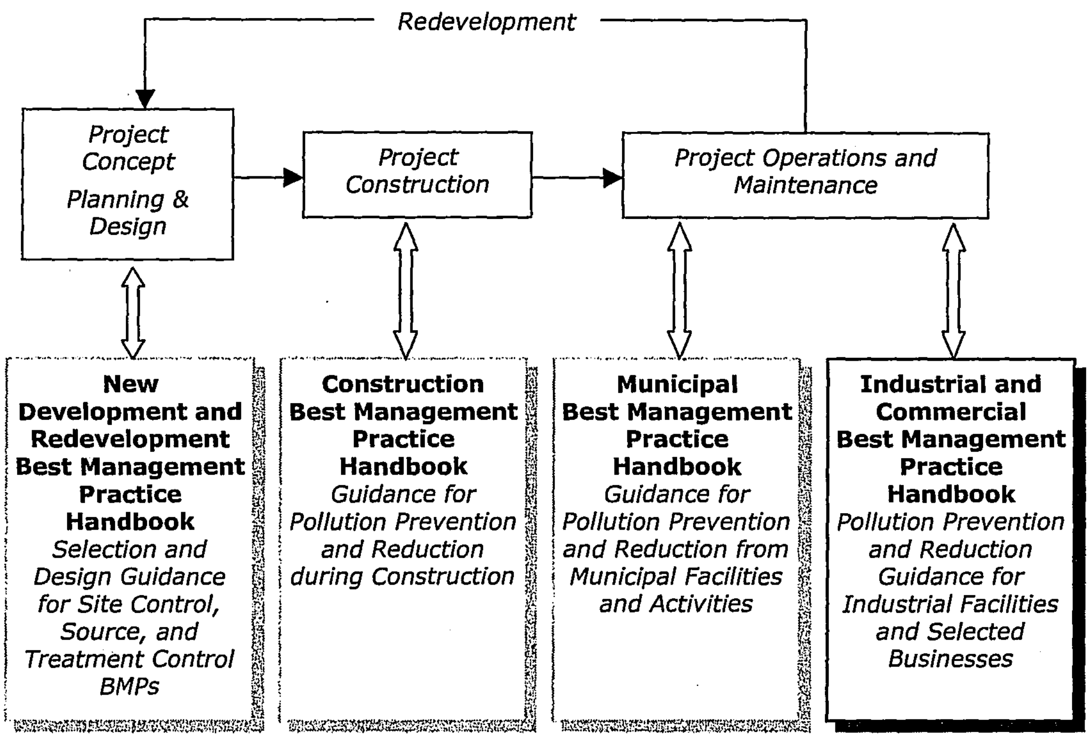
Appendix C
Sample SWPPP
This appendix contains a sample SWPPP.

Appendix D
Business Category Stormwater Pollution Control Guide Sheets
This appendix contains "guide sheets" for specific categories and subcategories of commercial businesses.

1.1.3 Relationship to other Handbooks

This handbook is one of four handbooks developed by the California Stormwater Quality Association (CASQA) to address BMP selection. Collectively, the four handbooks address BMP selection throughout the life of a project – from planning and design – through construction – and into operation and maintenance. Individually, each handbook is geared to a specific target audience during each stage of a project.

Project Lifecycle



This handbook, the Industrial and Commercial Handbook, addresses selection and implementation of BMPs to eliminate or to reduce the discharge of pollutants associated with industrial and commercial activities.

For a comprehensive understanding of stormwater pollution control throughout the life cycle of the project, it is recommended that the reader obtain and become familiar with all four handbooks. Typically, municipal stormwater program managers, regulators, environmental organizations, and stormwater quality professionals will have an interest in all four handbooks. For a focused understanding of stormwater pollution control during a single phase of the project life cycle, a reader may obtain and become familiar with the handbook associated with the appropriate phase. Typically, contractors, construction inspectors, industrial site operators, commercial site operators, some regulators, and some municipal staff may have an interest in a single handbook.

1.2 Stormwater Pollutants and Impacts on Water Quality

Stormwater runoff naturally contains numerous constituents; however, urbanization and urban activities (including industrial and commercial activities) typically increase constituent concentrations to levels that may impact water quality. Pollutants associated with stormwater include sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, pesticides, and gross pollutants (floatables). In addition, nutrient-rich stormwater runoff is an attractive medium for vector production when it accumulates and stands for more than 72 hours. Stormwater pollutants are described in Table 1-1.

1.3 Regulatory Requirements

The Federal Clean Water Act, as amended in 1987, is the principal vehicle for the control of stormwater pollutants. Other programs that directly or indirectly deal with the control of stormwater pollutants include: Federal Coastal Zone Act Reauthorization Amendments of 1990; the Porter-Cologne Act; and the State Hazardous Waste Source Reduction and Management Review Act. The implementation of stormwater programs must take place at a number of levels: federal, state, local, and industrial. The industrial owner and operator must understand the relationship between the agencies, their jurisdictions, and the requirements of each as shown in Figure 1-1.

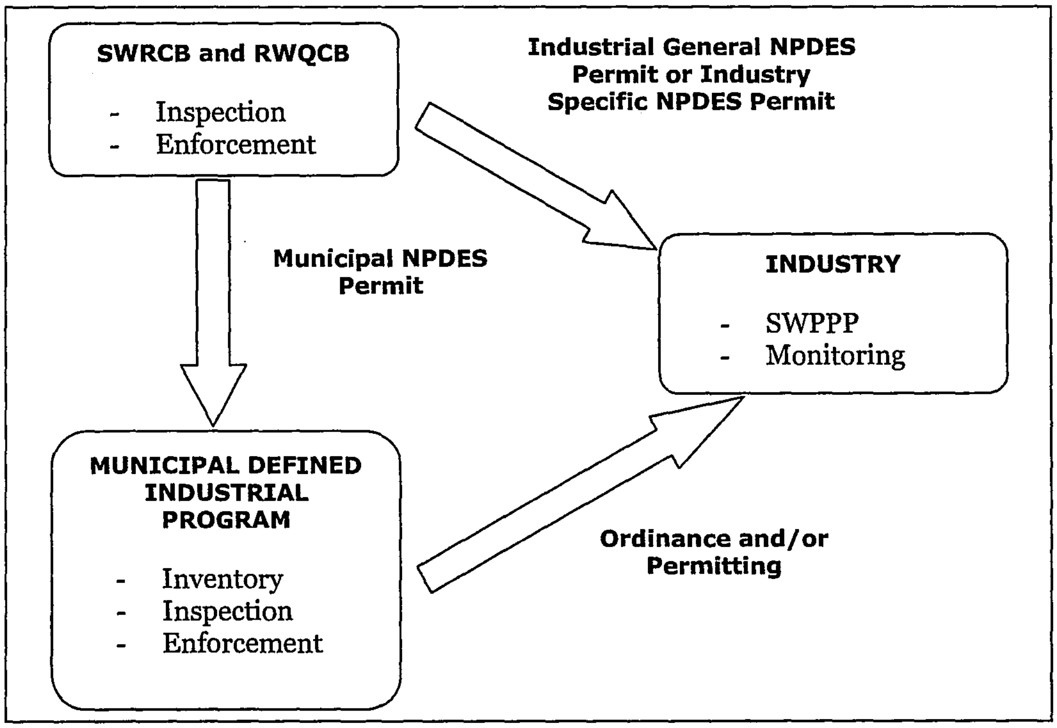


Figure 1-1
California Regulatory Framework Associated with Industrial Stormwater

Table 1-1 Pollutant Impacts on Water Quality

Sediment	Sediment is a common component of stormwaters, and can be a pollutant. Sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, and fish) by interfering with photosynthesis, respiration, growth, reproduction, and oxygen exchange in water bodies. Sediment can transport other pollutants that are attached to it including nutrients, trace metals, and hydrocarbons. Sediment is the primary component of total suspended solids (TSS), a common water quality analytical parameter.
Nutrients	Nutrients including nitrogen and phosphorous are the major plant nutrients used for fertilizing landscapes, and are often found in stormwater. These nutrients can result in excessive or accelerated growth of vegetation, such as algae, resulting in impaired use of water in lakes and other sources of water supply. For example, nutrients have led to a loss of water clarity in Lake Tahoe. In addition, un-ionized ammonia (one of the nitrogen forms) can be toxic to fish.
Bacteria and viruses	Bacteria and viruses are common contaminants of stormwater. For separate storm drain systems, sources of these contaminants include animal excrement and sanitary sewer overflow. High levels of indicator bacteria in stormwater have led to the closure of beaches, lakes, and rivers to contact recreation such as swimming.
Oil and Grease	Oil and grease includes a wide array of hydrocarbon compounds, some of which are toxic to aquatic organisms at low concentrations. Sources of oil and grease include leakage, spills, cleaning and sloughing associated with vehicle and equipment engines and suspensions, leaking and breaks in hydraulic systems, restaurants, and waste oil disposal.
Metals	Metals including lead, zinc, cadmium, copper, chromium, and nickel are commonly found in stormwater. Many of the artificial surfaces of the urban environment (e.g., galvanized metal, paint, automobiles, or preserved wood) contain metals, which enter stormwater as the surfaces corrode, flake, dissolve, decay, or leach. Over half the trace metal load carried in stormwater is associated with sediments. Metals are of concern because they are toxic to aquatic organisms, can bioaccumulate (accumulate to toxic levels in aquatic animals such as fish), and have the potential to contaminate drinking water supplies.
Organics	Organics may be found in stormwater in low concentrations. Often synthetic organic compounds (adhesives, cleaners, sealants, solvents, etc.) are widely applied and may be improperly stored and disposed. In addition, deliberate dumping of these chemicals into storm drains and inlets causes environmental harm to waterways.
Pesticides	Pesticides (including herbicides, fungicides, rodenticides, and insecticides) have been repeatedly detected in stormwater at toxic levels, even when pesticides have been applied in accordance with label instructions. As pesticide use has increased, so too have concerns about adverse effects of pesticides on the environment and human health. Accumulation of these compounds in simple aquatic organisms, such as plankton, provides an avenue for biomagnification through the food web, potentially resulting in elevated levels of toxins in organisms that feed on them, such as fish and birds.
Gross Pollutants	Gross Pollutants (trash, debris, and floatables) may include heavy metals, pesticides, and bacteria in stormwater. Typically resulting from an urban environment, industrial sites and construction sites, trash and floatables may create an aesthetic "eye sore" in waterways. Gross pollutants also include plant debris (such as leaves and lawn-clippings from landscape maintenance), animal excrement, street litter, and other organic matter. Such substances may harbor bacteria, viruses, vectors, and depress the dissolved oxygen levels in streams, lakes, and estuaries sometimes causing fish kills.
Vector Production	Vector production (e.g., mosquitoes, flies, and rodents) is frequently associated with sheltered habitats and standing water. Unless designed and maintained properly, standing water may occur in treatment control BMPs for 72 hours or more, thus providing a source for vector habitat and reproduction (Metzger, 2002).

The regulatory relationship presented in Figure 1-1 applies to industrial facilities. For commercial businesses, oversight is provided by local jurisdictions and typically reflects a less formally regulated approach. Further discussion regarding this approach is presented in Section 2.

In the following sections, various programs are discussed in relationship to the control of pollutants in industrial stormwater. The discussion, however, is not conclusive and the user is advised to contact local regulatory officials for further information.

1.3.1 Federal NPDES Program

In 1972, the Clean Water Act (CWA) was amended to provide that the discharge of pollutants to waters of the United States from any point source is effectively prohibited, unless the discharge is in compliance with a NPDES permit. The 1987 amendments to the CWA added Section 402(p), which establishes a framework for regulating municipal and industrial stormwater discharges under the NPDES program.

The stormwater regulations associated with the CWA require specific categories of industrial facilities which discharge industrial stormwater, to obtain an NPDES permit. Those facilities which discharge industrial stormwater either directly to surface waters (e.g., rivers, lakes, etc.) or indirectly, through municipal separate storm drains, must be covered by a permit. This includes the discharge of "sheet flow" through a drainage system or other conveyance.

Federal law requires that industrial stormwater discharges meet all provisions of Section 301 and 402 of the CWA in order to control pollutant discharges. These provisions require the use of best available technology (BAT) economically available and best conventional pollution control technology (BCT) to reduce pollutants and any more stringent controls necessary to meet water quality standards.

1.3.2 State NPDES Program

In California, the State Water Resources Control Board (SWRCB) through the nine Regional Water Quality Control Boards (RWQCB) administers the NPDES stormwater permitting program. For industrial facilities and construction activities, the SWRCB elected to issue statewide general permits that apply to all stormwater discharges requiring an NPDES permit. A copy of the General Permit for industrial facilities is provided in Appendix A.

In addition to the stormwater industrial General Permit, the RWQCB may, at their discretion, issue an industry-specific General Permit. For this reason, the readers are advised to contact their local RWQCB. Industries may also request an individual NPDES permit instead of the general permit. The process, however, is expensive and time consuming and the RWQCB may eventually choose not to issue an individual permit. RWQCBs are only expected to consider individual permits where an individual facility has unique characteristics or poses a significant threat to water quality.

The General Permit generally requires facility operators to:

1. Eliminate unauthorized non-stormwater discharges.

2. Develop and implement a stormwater pollution prevention plan (SWPPP).

3. Perform monitoring of stormwater discharges and authorized non-stormwater discharges.

1.3.3 Municipal NPDES Program

Municipalities are also required to develop programs to monitor and control pollutants in stormwater discharges from their municipal systems. Such control may include regulating stormwater discharges from industrial and commercial facilities that the municipality determines are contributing pollutants to the municipal storm drain system. Thus, it is important for the industrial and commercial facility owners and operators located within such municipalities to realize that there may be municipal requirements on stormwater discharges from their facilities. It is imperative that owners and operators check with the local authority responsible for stormwater management. Note that in most cases, compliance with the General Permit will effectuate compliance with local requirements. More often than not, local regulations represent a narrowing of the range of references under the General Permit to reflect local conditions. Many municipal NPDES permits require the municipality to develop and implement a program to address discharges of urban runoff associated with certain commercial facilities. These programs vary widely throughout the state.

1.4 Definitions

Many of the most common terms related to stormwater quality control are defined in the Glossary (see Section 6). Throughout the handbook the user will find references to the following terms:

NPDES General Permit for Stormwater Discharges. NPDES is an acronym for National Pollutant Discharge Elimination System. NPDES is the national program for administering and regulating Sections 307, 318, 402 and 405 of the Clean Water Act (CWA). In California, the State Water Resources Control Board (SWRCB) has issued a General Permit for stormwater discharges associated with industrial activities (see Appendix A).

Notice of Intent (NOI) is a formal notice to the SWRCB submitted by the owner/operators of existing industrial facilities. The NOI provides information on the permittee, location of discharge, type of discharge and certifies that the permittee will comply with conditions of the Industrial General Permit. The NOI is not a permit application and does not require approval.

Stormwater Pollution Prevention Plan (SWPPP) is a written plan that documents the series of phases and activities that, first, characterizes your site, and then, prompts you to select and carry out actions which reduce pollutants in stormwater discharges.

Stormwater Pollution Control Plan (SWPCP) is a less formal plan than the SWPPP that addresses the implementation of BMPs at facilities and businesses not covered by a General Permit but that have the potential to discharge pollutants.

Best Management Practices (BMP) is defined as any program, technology, process, siting criteria, operating method, measure, or device, which controls, prevents, removes, or reduces pollution.

Source Control BMPs are operational practices that prevent pollution by reducing potential pollutants at the source. They typically do not require maintenance or construction.

Treatment Control BMPs are methods of treatment to remove pollutants from stormwater.

1.5 References and Resources

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Attachment 5: Introduction to the California Stormwater Quality Association Municipal BMP Handbook

Section 1
Introduction

Stormwater runoff is part of a natural hydrologic process. Human activities particularly urbanization and agriculture, can alter natural drainage patterns and add pollutants to rivers, lakes, and streams as well as coastal bays, estuaries, and ultimately, the ocean. Numerous studies have shown urban runoff to be a significant source of water pollution, causing declines in fisheries, restricting swimming, and limiting our ability to enjoy many of the other benefits that water resources provide (USEPA, 1992). Urban runoff in this context includes all flows discharged from urban land uses into stormwater conveyance systems and receiving waters and includes both dry weather non-stormwater sources (e.g., runoff from landscape irrigation, water line and hydrant flushing) and wet weather stormwater runoff. In this handbook, urban runoff and stormwater runoff are used interchangeably.

For many years, the effort to control the discharge of stormwater focused mainly on the quantity (e.g. drainage, flood control) and, only to a limited extent, on the quality of the stormwater (e.g. sediment and erosion control). In recent years, however, awareness of the need to improve water quality has increased. With this awareness, federal, state, and local programs have been established to reduce pollutants contained in stormwater discharges to our waterways. The emphasis of these programs is to promote the concept and the practice of preventing pollution at the source, before it can cause environmental problems (USEPA, 1992). Where further controls are needed, treatment of polluted runoff may be required.

1.1 Handbook Purpose and Scope

The purpose of this handbook is to provide general guidance for selecting and implementing Best Management Practices (BMPs) to reduce pollutants in runoff from municipal operations. Federal and state programs require selected municipalities to reduce the discharge of pollutants in their stormwater discharges to the maximum extent practicable (MEP) using an array of control measures including BMPs. It is not the intent of this handbook to dictate the actual selection of BMPs (this will be done by the municipality), but rather to provide the framework for an informed selection of BMPs for the program.

Although MEP has not been defined by the federal regulations, the use of this handbook and the selection process presented herein should assist municipalities in achieving MEP. In selecting BMPs that will achieve MEP, it is important to remember that municipalities will be responsible to reduce the discharge of pollutants in stormwater to the maximum extent practicable. The following factors should be considered in deciding if a BMP is practicable:

- Pollutant Removal - Will the BMP remove (or control) the pollutant(s) of concern?
- Regulatory Compliance - Is the BMP compatible with stormwater regulations as well as other regulations for air, hazardous wastes, solid waste disposal, groundwater protection, etc.?
- Public Acceptance - Does the BMP have public support?

- Implementation - Is the BMP compatible with land uses, facilities, or activities in question?

- Cost - Will the cost for implementing the BMP significantly exceed the pollution control benefits? Does a revenue stream exist for ongoing maintenance?

- Technical Feasibility - Is the BMP technically feasible considering soils, geography, water resources, etc.?

Ultimately, the municipality must implement and maintain the selected BMPs and prepare and adhere to a schedule for implementation and maintenance.

1.1.1 Users of the Handbook

This handbook is primarily designed to assist municipal staff with incorporating pollution prevention controls into their overall stormwater management program and specifically publicly owned/operated facilities (fixed facilities) and field activities (field programs). Users include public and private sector engineers, planners, environmental specialists, and stormwater program managers. Managers and employees of the various municipal facilities and municipal field programs may find this handbook especially helpful when implementing and evaluating the effectiveness of these stormwater management efforts.

1.1.2 Organization of the Handbook

The handbook is organized to assist the user in selecting and implementing best management practices to reduce impacts of stormwater discharges on receiving waters. The handbook consists of the following sections:

Section 1
Introduction
This section provides a general review of the sources and impacts of municipal stormwater discharges and provides an overview of the federal and state programs regulating stormwater discharges.

Section 2
Stormwater Pollution Prevention Planning for Municipal Operations
This section describes a process to follow in identifying and selecting BMPs for pollutant generating activities.

Section 3
Source Control BMPs
BMP fact sheets presented in this section address BMPs (or procedures) to control or eliminate sources of stormwater pollutants. These BMPs should be considered in all efforts to reduce pollutants from municipal operations

Section 4
Treatment Control BMPs
BMP fact sheets presented in this section address BMPs that remove pollutants from runoff (treatment controls). These fact sheets focus on the maintenance requirements of these controls.

Section 5
BMP Implementation and Evaluation
This section outlines development of a program to monitor BMP effectiveness and evaluate additional BMP requirements. Topics include site inspections, BMP monitoring, recordkeeping, and BMP review/modifications.

Section 6
Glossary and List of Acronyms
This section identifies terms and abbreviations used in the handbooks.

Appendix A
Inventory of Municipal Operations
This appendix provides an example of an inventory of municipal operations that may be sources of pollutants in stormwater runoff.

Appendix B
Assessment of Municipal Operations
This appendix provides an example worksheet for assessing fixed facilities to determine the level of BMP implementation.

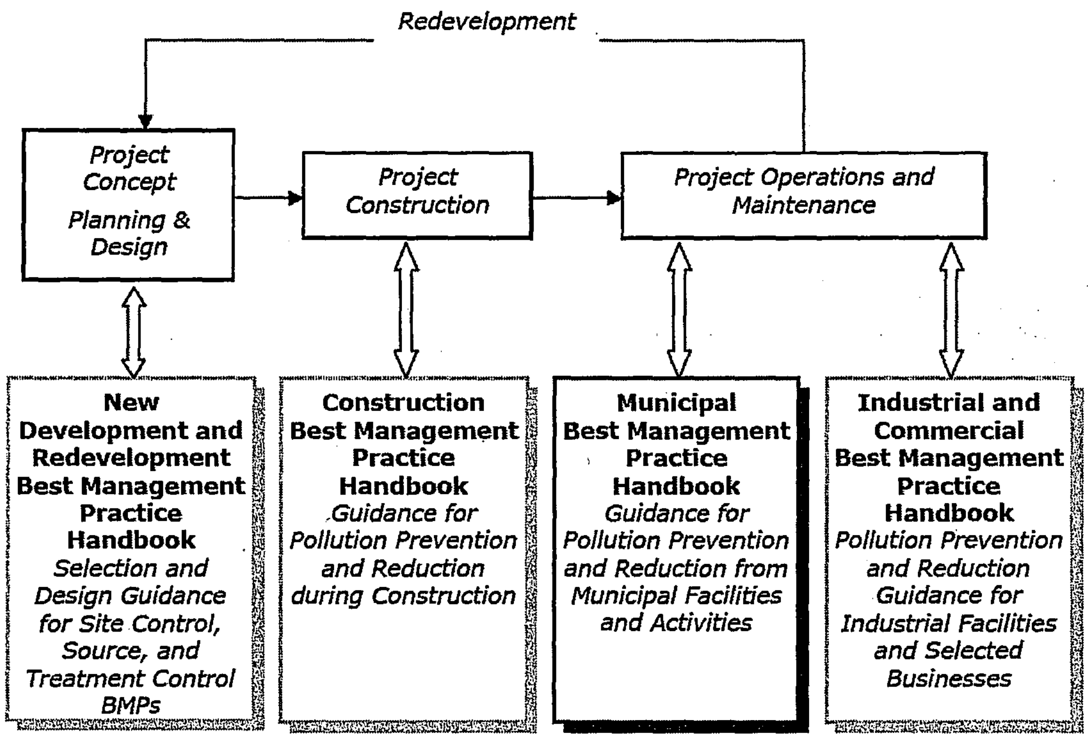
Appendix C
BMP Selection Process
This appendix provides an example of BMP selection for a fixed facility.

Appendix D
Contract/Lease Agreement
This appendix provides example lease language for fixed facilities.

1.1.3 Relationship to Other Handbooks

This handbook is one of four handbooks developed by the California Stormwater Quality Associations (CASQA) to address BMP selection. Collectively, the four handbooks address BMP selection throughout the life of a project,from planning and design through construction and into operation and maintenance. Individually, each handbook is geared to a specific target audience during each stage of a project.

Project Lifecycle



This handbook, the Municipal Handbook, provides information primarily for municipalities to use in selecting and implementing control measures for municipal operations including fixed facilities and field programs. In this context, information provided in Section 4, Treatment Control BMPs, is focused on maintenance requirements for existing treatment control BMPs. If a new treatment control BMP is being considered at an existing or new municipal facility, the reader is referred to the New Development and Redevelopment Handbook.

For a comprehensive understanding of stormwater pollution controls throughout the life cycle of development, it is recommended that the readers obtain and become familiar with all four handbooks. Typically, municipal stormwater program managers, regulators, environmental organizations, and stormwater quality professionals will have an interest in all four handbooks. For a focused understanding of stormwater pollution control during a single phase of the project life cycle, a reader may obtain and become familiar with the handbook associated with the appropriate phase. Typically, contractors, construction inspectors, industrial site operators, commercial site operators, some regulators, and some municipal staff may have an interest in a single handbook.

1.2 Stormwater Pollutants and Impacts on Water Quality

Stormwater runoff naturally contains numerous constituents; however, urbanization and urban activities (including municipal activities) typically increase constituent concentrations to levels that may impact water quality. Pollutants associated with stormwater include sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, pesticides, and gross pollutants (floatables). In addition, nutrient-rich stormwater runoff is an attractive medium for vector production when it accumulates and stands for more than 72 hours. Stormwater pollutants are described in Table 1-1.

Municipal Activities Generating Pollutants

Municipalities conduct various activities that are sources of pollutants in stormwater runoff. For the purpose of this handbook, these activities are categorized according to whether they occur at a specific location (fixed facility) or across a broader and non-specific area (field programs). Some of these activities are summarized in the list below. All activities are discussed in more detail in Section 2. These activities must be addressed through the implementation of BMPs to minimize or eliminate the pollutants from entering the local water bodies or drainage system.

Typical Municipal Operations that Generate Pollutants

Fixed Facilities Activities	***Field Program Activities***
Building Maintenance & Repair	Street Sweeping and Cleaning
Parking Lot Maintenance	Street Repair and Maintenance
Landscape Maintenance	Bridge and Structure Maintenance
Waste Handling and Disposal	Sidewalk Surface Cleaning
Vehicle Fueling and Storage Tank Filling	Graffiti Cleaning
Equipment Maintenance & Repair	Sidewalk Repair
Vehicle and Equipment Storage	Controlling Litter
Vehicle and Equipment Cleaning	Fountain Maintenance
Material Handling & Storage	Landscape Mowing/Trimming/Planting
Material Loading & Unloading	Fertilizer & Pesticide Management
Minor Construction	Controlling Illicit Connections
Over Water Activities	Controlling Illegal Dumping
	Solid Waste Collection and Recycling

Table 1-1 Pollutant Impacts on Water Quality

Sediment	Sediment is a common component of stormwater, and can be a pollutant. Sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, and fish) by interfering with photosynthesis, respiration, growth, reproduction, and oxygen exchange in water bodies. Sediment can transport other pollutants that are attached to it including nutrients, trace metals, and hydrocarbons. Sediment is the primary component of total suspended solids (TSS), a common water quality analytical parameter.
Nutrients	Nutrients including nitrogen and phosphorous are the major plant nutrients used for fertilizing landscapes, and are often found in stormwater. These nutrients can result in excessive or accelerated growth of vegetation, such as algae, resulting in impaired use of water in lakes and other sources of water supply. For example, nutrients have led to a loss of water clarity in Lake Tahoe. In addition, un-ionized ammonia (one of the nitrogen forms) can be toxic to fish.
Bacteria and viruses	Bacteria and viruses are common contaminants of stormwater. For separate storm drain systems, sources of these contaminants include animal excrement and sanitary sewer overflow. High levels of indicator bacteria in stormwater have led to the closure of beaches, lakes, and rivers to contact recreation such as swimming.
Oil and Grease	Oil and grease includes a wide array of hydrocarbon compounds, some of which are toxic to aquatic organisms at low concentrations. Sources of oil and grease include leakage, spills, cleaning and sloughing associated with vehicle and equipment engines and suspensions, leaking and breaks in hydraulic systems, restaurants, and waste oil disposal.
Metals	Metals including lead, zinc, cadmium, copper, chromium, and nickel are commonly found in stormwater. Many of the artificial surfaces of the urban environment (e.g., galvanized metal, paint, automobiles, or preserved wood) contain metals, which enter stormwater as the surfaces corrode, flake, dissolve, decay, or leach. Over half the trace metal load carried in stormwater is associated with sediments. Metals are of concern because they are toxic to aquatic organisms, can bioaccumulate (accumulate to toxic levels in aquatic animals such as fish), and have the potential to contaminate drinking water supplies.
Organics	Organics may be found in stormwater in low concentrations. Often synthetic organic compounds (adhesives, cleaners, sealants, solvents, etc.) are widely applied and may be improperly stored and disposed. In addition, deliberate dumping of these chemicals into storm drains and inlets causes environmental harm to waterways.
Pesticides	Pesticides (including herbicides, fungicides, rodenticides, and insecticides) have been repeatedly detected in stormwater at toxic levels, even when pesticides have been applied in accordance with label instructions. As pesticide use has increased, so too have concerns about adverse effects of pesticides on the environment and human health. Accumulation of these compounds in simple aquatic organisms, such as plankton, provides an avenue for biomagnification through the food web, potentially resulting in elevated levels of toxins in organisms that feed on them, such as fish and birds.
Gross Pollutants	Gross Pollutants (trash, debris, and floatables) may include heavy metals, pesticides, and bacteria in stormwater. Typically resulting from an urban environment, industrial sites and construction sites, trash and floatables may create an aesthetic "eye sore" in waterways. Gross pollutants also include plant debris (such as leaves and lawn-clippings from landscape maintenance), animal excrement, street litter, and other organic matter. Such substances may harbor bacteria, viruses, vectors, and depress the dissolved oxygen levels in streams, lakes, and estuaries sometimes causing fish kills.
Vector Production	Vector production (e.g., mosquitoes, flies, and rodents) is frequently associated with sheltered habitats and standing water. Unless designed and maintained properly, standing water may occur in treatment control BMPs for 72 hours or more, thus providing a source for vector habitat and reproduction (Metzger, 2002).

1.3 Regulatory Requirements

The federal Clean Water Act (CWA), as amended in 1987, is the principal legislation for establishing requirements for the control of stormwater pollutants. Enforcement of the CWA and other laws such as the Endangered Species Act and California's Porter-Cologne Act has generated a number of federal, state and local requirements and programs that deal directly or indirectly with controlling stormwater discharges. In the following sections, various programs are discussed in relationship to control of pollutants in stormwater from municipal storm drain systems. These programs are expected to evolve over the next several years and the user is advised to contact local regulatory and/or municipal officials for further information.

1.3.1 Federal NPDES Programs

In 1972, provisions of the federal Water Pollution Control Act, also referred to as the Clean Water Act (CWA), were amended so that discharge of pollutants to waters of the United States from any point source is effectively prohibited, unless the discharge is in compliance with a National Pollutant Discharge Elimination (NPDES) permit. The 1987 amendments to the CWA added Section 402(p), which established a framework for regulating municipal, industrial, and construction stormwater discharges under the NPDES program. On November 16, 1990, USEPA published final Phase I regulations that established application requirements for stormwater permits for municipal separate storm sewer systems (MS4s) serving a population of over 100,000 and certain industrial facilities, including construction sites greater than 5 acres. These regulations were revised in July 1998 (USEPA, 1998). On December 8, 1999, USEPA published the final Phase II regulations for communities under 100,000 and operators of construction sites between 1 and 5 acres (USEPA, 1999).

1.3.2 State NPDES Programs

The state Porter-Cologne Act (Water Code 13000, et seq.) is the principal legislation for controlling stormwater pollutants in California. The Act requires development of Basin Plans for drainage basins within California. Each plan serves as a blueprint for protecting water quality within the various watersheds. These basin plans are used in turn to identify more specific controls for discharges (e.g., wastewater treatment plant effluent, urban runoff, and agriculture drainage). Specific controls are implemented through permits called Waste Discharge Requirements.

In California, the federal NPDES stormwater permitting program is administered by the State Water Resources Control Board (SWRCB) through the nine Regional Water Quality Control Boards (RWQCBs) by issuing joint Waste Discharge Requirements and NPDES permits. SWRCB and RWQCBs use three types of NPDES permits to regulate stormwater discharges. These include:

- Individual Permits
- Area Wide Permits
- General Permits

The current set of stormwater NPDES permits in California includes a combination of stormwater discharge type and permit type (Table 1-2). The following sections describe minimum requirements in each of the municipal discharge-permit combinations.

Table 1-2 Stormwater Discharge-Permit Type Combinations

	Discharge Type		
Permit type	**Municipal**	**Construction**	**Industrial**
Individual	Phase I MS4 Caltrans		Facility-specific
Area Wide	Phase I MS4s		
General	Phase II MS4	Phase I and II	Phase I

1.3.3 Municipal NPDES Stormwater Programs

Municipalities with a population of over 100,000 or that have been determined to be a significant contributor of pollutants are required to obtain an individual NPDES stormwater permit. These municipalities are classified as Phase I communities and are typically referred to as MS4s (municipal separate storm sewer systems). To meet CWA Section 402(p) requirements, Phase I MS4s are required to implement a stormwater management program that contains the following elements:

- **Program Management**: including program structure, institutional arrangements, legal authority, and fiscal resources
- **Illicit Discharges**: including prohibition of illicit connections and dumping, and enforcement procedures.
- **Industrial / Commercial Discharges**: including identification of sources, BMPs, outreach, inspections, staff training, and coordination with state General Permit.
- **New Development and Re-development**: including planning processes, local permits, staff training, post-construction structural BMPs, and outreach.
- **Construction**: including erosion and grading permits, construction BMPs, site inspections, enforcement, and coordination with state General Permit.
- **Public Agency (Municipal) Operations**: including inventory and BMPs for corporation yards, parks and recreation, storm drain system operation and maintenance, streets and roads, flood control, public facilities, and ponds, fountains and other public water bodies. (This is a primary focus of this handbook.)
- **Public Information and Participation**: including general and focused outreach, school education programs, citizen participation, and effectiveness evaluation of the public information program.

- **Program Evaluation**: including performance standards, annual and sub-annual reports, internal reporting and record keeping, and Stormwater Management Plan revisions.
- **Monitoring**: including system characterization, source identification, control measure effectiveness, pollutant loading, and data management

Smaller, Phase II communities (under 100,000 population) are covered by a General Permit. Phase II communities are required to develop and implement a stormwater management plan with the following six minimum control measures:

- **Public Education and Outreach** - Distributing educational materials and performing outreach to inform citizens about the impacts polluted stormwater runoff discharges can have on water quality.
- **Public Involvement and Participation** - Providing opportunities for citizens to participate in program development, implementation, and review, including effectively publicizing public hearings or participation.
- **Illicit Discharge Detection and Elimination** - Developing and implementing a plan to detect and eliminate illicit discharges to the storm drain system including illicit connections and illegal dumping.
- **Construction Site Runoff Control** - Developing, implementing, and enforcing an erosion and sediment control program for construction activities that disturb one or more acres of land.
- **Pollution Prevention / Good Housekeeping for Municipal Operations** - Developing and implementing a program to prevent or reduce pollutant runoff from municipal operations. (This is a primary focus of this handbook.)
- **Post-Construction Stormwater Management in New Development and Redevelopment** - Developing, implementing, and enforcing a program to address discharges of stormwater runoff from new and redevelopment areas.

In addition to the six measures listed above, the stormwater management plan must identify measurable goals (or performance standards) for each minimum control measure. Measurable goals will be used by the MS4 and the RWQCB to gauge compliance and evaluate the effectiveness of individual BMPs or control measures and the stormwater management program as a whole. Phase II communities must also monitor their efforts and prepare annual reports demonstrating that the community has implemented the minimum control measures and complied with the measurable goals.

1.4 Definitions

Many of the common definitions for stormwater control are found in the Glossary (see Section 6). Throughout the handbook, the user will find references to the following terms:

NPDES Permit for Stormwater Discharges NPDES is an acronym for National Pollutant Discharge Elimination System. NPDES is the national program for administering and regulating Sections 307, 318, 402 and 405 of the Clean Water Act (CWA). In California, the State Water Resources Control Board (SWRCB) has issued a General Permit for stormwater discharges associated with Phase II communities. For Phase I communities the Regional Water Quality Control Boards issue individual NPDES permits to either an individual permittee or a group of permittees.

Notice of Intent (NOI) is a formal notice to the SWRCB submitted by a Phase II municipality. The NOI provides information on the permittee, location of discharge, type of discharge and certifies that the permittee will comply with conditions of the Phase II General Permit. The NOI is not a permit application and does not require approval.

A ***Best Management Practice (BMP)*** is defined as any program, technology, process, siting criteria, operating method, measure, or device which controls, prevents, removes, or reduces pollution.

Source Control BMPs are operational practices that prevent pollution by reducing potential pollutants at the source. They typically do not require maintenance or construction.

Treatment Control BMPs are methods of treatment to remove pollutants from stormwater.

Non-Stormwater Discharge is any discharge to municipal separate storm sewer that is not composed entirely of stormwater.

Vector as defined in the California Health & Safety Code, Section 2200, is any animal capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury, including, but not limited to, mosquitoes, flies, other insects, ticks, mites, and rodents.

1.5 References and Resources

California Department of Transportation, *Guidance Manual: Stormwater Monitoring Protocols*, 2nd ed., July 2000. Available at www.dot.ca.gov/hq/env/stormwater/special/index.htm

Metzger, M.E., D.F. Messer, C.L. Beitia, C.M. Myers, and V.L. Kramer. 2002. *The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs.* Stormwater 3(2): 24-39.

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United States Environmental Protection Agency (USEPA). 1998. Federal Register. 40 CFR Part 122. Subpart B – Permit Application and Special NPDES Program Requirements. Section 122.26 Stormwater discharges (applicable to state NPDES programs). Revised July 1, 1998.

United States Environmental Protection Agency (USEPA). 1999. Federal Register. 40 CFR Parts 9, 122, 123, and 124 National Pollutant Discharge Elimination System – Regulations for Revision of the Water Pollution Control Program Addressing Stormwater Discharges; Final Rule. Report to Congress on the Phase II Stormwater Regulations. Wednesday, December 8, 1999.

United States Environmental Protection Agency (U.S.E.P.A). *Measurable Goals Guidance for Phase II Small MS4s*, http://cfpub.epa.gov/npdes/stormwater/measurablegoals/part4.cfm#sub7

United States Environmental Protection Agency (U.S.E.P.A.). *NPDES Stormwater Sampling Guidance Document.* 1992, EPA 833-B-92-001, U.S. Environmental Protection Office, Office of Wastewater Enforcement and Compliance, Washington, DC.

http://www.swrcb.ca.gov/stormwtr/municipal.html#phaseii. This link on the State Water Resources Control Board website provides Phase I MS4 area wide permits in each region, a link to Phase I and II resources.

http://cfpub.epa.gov/npdes/stormwater/swphase1.cfm. This link on the USEPA website provides an overview of the Phase I NPDES stormwater program and specific information on requirements pertaining to Phase I stormwater discharges.

Municipal Programs

City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. Model Urban Runoff Program, A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. July 1998 (Revised February 2002).

City of Watsonville, City of Monterey, Monterey Bay National Marine Sanctuary, California Coastal Commission, and Central Coast Regional Water Quality Control Board, 2000. Model Urban Runoff Program, Supplementary 2000 Workbook: A Resource for Implementing Your Municipal Urban Runoff Program.

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

Orange County Stormwater Program. http://www.ocwatersheds.com/StormWater/swp_documents_intro.asp

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Plan. 2001. Municipal Activities Model Program Guidance. November 2001.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

Attachment 6:
EPA Small MS4 Stormwater Program Overview (Storm water municipal program for communities in urbanized areas with a population smaller than 100,000, known as Phase II)

United States Environmental Protection Agency | Office of Water (4203) | EPA 833-F-00-002 January 2000 (revised December 2005) Fact Sheet 2.0

EPA

Stormwater Phase II Final Rule

Small MS4 Stormwater Program Overview

Stormwater Phase II Final Rule Fact Sheet Series

Polluted storm water runoff is often transported to municipal separate storm sewer systems (MS4s) and ultimately discharged into local rivers and streams without treatment. EPA's Stormwater Phase II Rule establishes an MS4 stormwater management program that is intended to improve the Nation's waterways by reducing the quantity of pollutants that stormwater picks up and carries into storm sewer systems during storm events. Common pollutants include oil and grease from roadways, pesticides from lawns, sediment from construction sites, and carelessly discarded trash, such as cigarette butts, paper wrappers, and plastic bottles. When deposited into nearby waterways through MS4 discharges, these pollutants can impair the waterways, thereby discouraging recreational use of the resource, contaminating drinking water supplies, and interfering with the habitat for fish, other aquatic organisms, and wildlife.

In 1990, EPA promulgated rules establishing Phase I of the National Pollutant Discharge Elimination System (NPDES) stormwater program. The Phase I program for MS4s requires operators of "medium" and "large" MS4s, that is, those that generally serve populations of 100,000 or greater, to implement a stormwater management program as a means to control polluted discharges from these MS4s. The Stormwater Phase II Rule extends coverage of the NPDES stormwater program to certain "small" MS4s but takes a slightly different approach to how the stormwater management program is developed and implemented.

What Is a Phase II Small MS4?

A small MS4 is any MS4 not already covered by the Phase I program as a medium or large MS4. The Phase II Rule automatically covers on a nationwide basis all small MS4s located in "urbanized areas" (UAs) as defined by the Bureau of the Census (unless waived by the NPDES permitting authority), and on a case-by-case basis those small MS4s located outside of UAs that the NPDES permitting authority designates. For more information on Phase II small MS4 coverage, see Fact Sheets 2.1 and 2.2.

What Are the Phase II Small MS4 Program Requirements?

Operators of regulated small MS4s are required to design their programs to:

- Reduce the discharge of pollutants to the "maximum extent practicable" (MEP);
- Protect water quality; and
- Satisfy the appropriate water quality requirements of the Clean Water Act.

Implementation of the MEP standard will typically require the development and implementation of BMPs and the achievement of measurable goals to satisfy each of the six minimum control measures.

The Phase II Rule defines a small MS4 stormwater management program as a program comprising six elements that, when implemented in concert, are expected to result in significant reductions of pollutants discharged into receiving waterbodies.

The six MS4 program elements, termed "minimum control measures," are outlined below. For more information on each of these required control measures, see Fact Sheets 2.3 – 2.8.

❶ ***Public Education and Outreach***
Distributing educational materials and performing outreach to inform citizens about the impacts polluted stormwater runoff discharges can have on water quality.

❷ ***Public Participation/Involvement***
Providing opportunities for citizens to participate in program development and implementation, including effectively publicizing public hearings and/or encouraging citizen representatives on a stormwater management panel.

❸ ***Illicit Discharge Detection and Elimination***
Developing and implementing a plan to detect and eliminate illicit discharges to the storm sewer system (includes developing a system map and informing the community about hazards associated with illegal discharges and improper disposal of waste).

❹ ***Construction Site Runoff Control***
Developing, implementing, and enforcing an erosion and sediment control program for construction activities that disturb 1 or more acres of land (controls could include silt fences and temporary stormwater detention ponds).

❺ ***Post-Construction Runoff Control***
Developing, implementing, and enforcing a program to address discharges of post-construction stormwater runoff from new development and redevelopment areas. Applicable controls could include preventative actions such as protecting sensitive areas (e.g., wetlands) or the use of structural BMPs such as grassed swales or porous pavement.

❻ ***Pollution Prevention/Good Housekeeping***
Developing and implementing a program with the goal of preventing or reducing pollutant runoff from municipal operations. The program must include municipal staff training on pollution prevention measures and techniques (e.g., regular street sweeping, reduction in the use of pesticides or street salt, or frequent catch-basin cleaning).

What Information Must the NPDES Permit Application Include?

The Phase II program for MS4s is designed to accommodate a general permit approach using a Notice of Intent (NOI) as the permit application. The operator of a regulated small MS4 must include in its permit application, or NOI, its chosen BMPs and measurable goals for each minimum control measure. To help permittees identify the most appropriate BMPs for their programs, EPA issued a Menu of BMPs to serve as guidance. NPDES permitting authorities can modify the EPA menu or develop their own list. For more information on application requirements, see Fact Sheet 2.9.

What Are the Implementation Options?

The rule identifies a number of implementation options for regulated small MS4 operators. These include sharing responsibility for program development with a nearby regulated small MS4, taking advantage of existing local or State programs, or participating in the implementation of an existing Phase I MS4's stormwater program as a co-permittee. These options are intended to promote a regional approach to stormwater management coordinated on a watershed basis.

What Kind of Program Evaluation/Assessment Is Required?

Permittees need to evaluate the effectiveness of their chosen BMPs to determine whether the BMPs are reducing the discharge of pollutants from their systems to the "maximum extent practicable" and to determine if the BMP mix is satisfying the water quality requirements of the Clean Water Act. Permittees also are required to assess their progress in achieving their program's measurable goals. While monitoring is not required under the rule, the NPDES permitting authority has the discretion to require monitoring if deemed necessary. If there is an indication of a need for improved controls, permittees can revise their mix of BMPs to create a more effective program. For more information on program evaluation/assessment, see Fact Sheet 2.9.

Attachment 7:
Introduction to the California Stormwater Quality Association New Development and Redevelopment BMP Handbook

Section 1
Introduction

Stormwater runoff is part of a natural hydrologic process. However, human activities particularly urbanization and agriculture, can alter natural drainage patterns and add pollutants to rivers, lakes, and streams as well as coastal bays and estuaries, and ultimately, the ocean. Numerous studies have shown urban runoff to be a significant source of water pollution, causing declines in fisheries, restrictions on swimming, and limiting our ability to enjoy many of the other benefits that water resources provide. Urban runoff in this context includes all flows discharged from urban land uses into stormwater conveyance systems and receiving waters and includes both dry weather non-stormwater sources (e.g., runoff from landscape irrigation, etc.) and wet weather stormwater runoff. In this handbook, urban runoff and stormwater runoff are used interchangeably.

For many years the effort to control the discharge of stormwater focused on quantity (e.g. drainage, flood control) and only to a limited extent on quality of the stormwater (e.g. sediment and erosion control). However, in recent years awareness of the need to improve water quality has increased. With this awareness federal, state and, local programs have been established to pursue the ultimate goal of reducing pollutants contained in stormwater discharges to our waterways. The emphasis of these programs is to promote the concept and the practice of preventing pollution at the source, before it can cause environmental problems (USEPA, 1992). However, where further controls are needed, treatment of polluted runoff may be required.

1.1 Handbook Purpose and Scope

The purpose of this handbook is to provide general guidance for selecting and implementing Best Management Practices (BMPs) to reduce pollutants in runoff in newly developed areas and redeveloped areas to waters of the state. This handbook also provides guidance on developing project-specific stormwater management plans including selection and implementation of BMPs for a particular development or redevelopment project.

This handbook provides the framework for an informed selection of BMPs. However, due to the diversity in climate, receiving waters, construction site conditions, and local requirements across California, this handbook does not dictate the use of specific BMPs and therefore cannot guarantee compliance with NPDES permit requirements or local requirements specific to the user's site.

1.1.1 Users of the Handbook

This handbook provides guidance suitable for use by individuals involved in development or redevelopment site water pollution control and planning. Each user of the handbook is responsible for working within their capabilities obtained through training and experience, and for seeking the advice and consultation of appropriate experts at all times.

The target audience for this handbook includes: Developers, including their planners and engineers; contractors and subcontractors, including their engineers, superintendents, foremen, and construction staff; municipal agencies involved in site development and redevelopment including their engineers, planners, and construction staff; regulatory agencies including permit and planning staff; and the general public with an interest in stormwater pollution control.

1.1.2 Organization of the Handbook

The handbook is organized to assist the user in selecting and implementing BMPs to reduce impacts of stormwater and non-stormwater discharges on receiving waters. The handbook consists of the following sections:

Section 1
Introduction
This section provides a general review of the sources and impacts of urban stormwater discharges and provides an overview of the Federal and state programs regulating stormwater discharges.

Section 2
Stormwater Pollution Prevention Planning for New Development and Redevelopment
This section describes typical permit requirements, planning principles, and site assessment. It also covers identifying BMPs, integrating BMPs into the project, maintaining BMPs, and preparing stormwater pollution control plans.

Section 3
Site and Facility Design for Water Quality Protection
This section describes planning approaches to reduce, eliminate, control and treat runoff from development and redevelopment, and integration of BMPS into common site, drainage, and building features.

Section 4
Source Control BMPs
BMP fact sheets presented in this section address structural source control BMPs to be considered for development and redevelopment.

Section 5
Treatment Control BMPs
BMP fact sheets presented in this section address treatment control BMPs that may be used for development/ redevelopment sites.

Section 6
Long Term BMP Maintenance
This section outlines approaches to maintain BMPs, monitor BMP effectiveness, and evaluate additional BMP requirements.

Section 7
Glossary and List of Acronyms
This section identifies terms and abbreviations used in the handbooks.

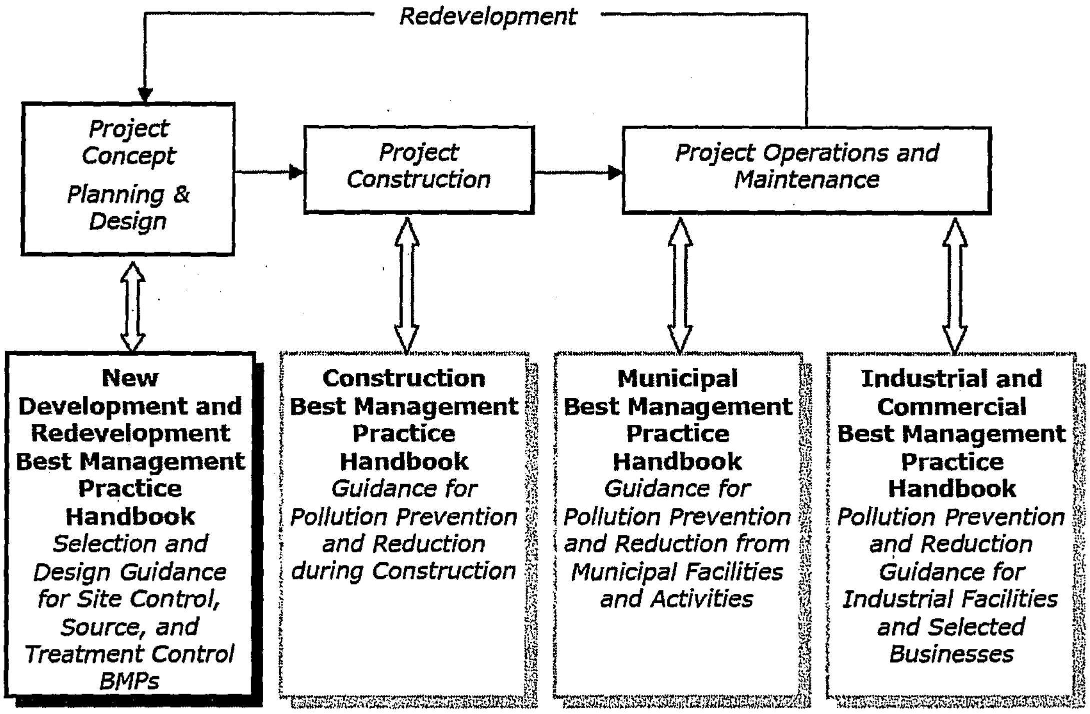
Appendix A
Channel Impacts from Watershed Changes
This appendix describes a stream balance equation affected by changes in runoff or sediment loads.

Appendix B
General Applicability of Effluent Probability Method
This appendix discusses concerns about the general applicability of this probability technique.

Appendix C
Effluent Concentrations of Additional Metals and Nutrients
This appendix compares effluent concentrations of constituents not described in Section 5.

Appendix D
Rain Intensity and BMP Sizing Curves
This appendix includes rain intensity cumulative frequency curves and volume-based BMP sizing curves.

Project Lifecycle



1.1.3 Relationship to Other Handbooks

This handbook is one of four handbooks developed by the California Stormwater Quality Association (CASQA) to address BMP selection. Collectively, the four handbooks address BMP selection throughout the life of a project – from planning and design – through construction – and into operation and maintenance. Individually, each handbook is geared to a specific target audience during each stage of a project.

This handbook, the New Development and Redevelopment Handbook, addresses selection and implementation of BMPs to eliminate or to reduce the discharge of pollutants associated with development and redevelopment activities.

For a comprehensive understanding of stormwater pollution control throughout the life cycle of the project, it is recommended that the reader obtain and become familiar with all four handbooks. Typically, municipal stormwater program managers, regulators, environmental organizations, and stormwater quality professionals will have an interest in all four handbooks. For a focused understanding of stormwater pollution control during a single phase of the project life cycle, a reader may obtain and become familiar with the handbook associated with the appropriate phase. Typically, contractors, construction inspectors, industrial site operators, commercial site operators, some regulators and some municipal staff may have an interest in a single handbook.

1.2 Stormwater Pollutants and Impacts on Water Quality

Stormwater runoff naturally contains numerous constituents, however, urbanization and urban activities including development and redevelopment typically increase constituent concentrations to levels that impact water quality. Pollutants associated with stormwater include sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, pesticides, and trash (floatables). In addition, nutrient-rich stormwater runoff is an attractive medium for vector production when it accumulates and stands for more than 72 hours. Stormwater pollutants are described in Table 1-1.

Development and redevelopment activities can result in two types of water quality impacts: erosion and sedimentation and discharge of other pollutants during construction; and long term impacts from runoff from the completed development and associated land uses. Control of water quality impacts during construction is covered in the Construction edition of the Stormwater Best Management Practice Handbook. This handbook addresses potential water quality impacts from completed development that can include the following:

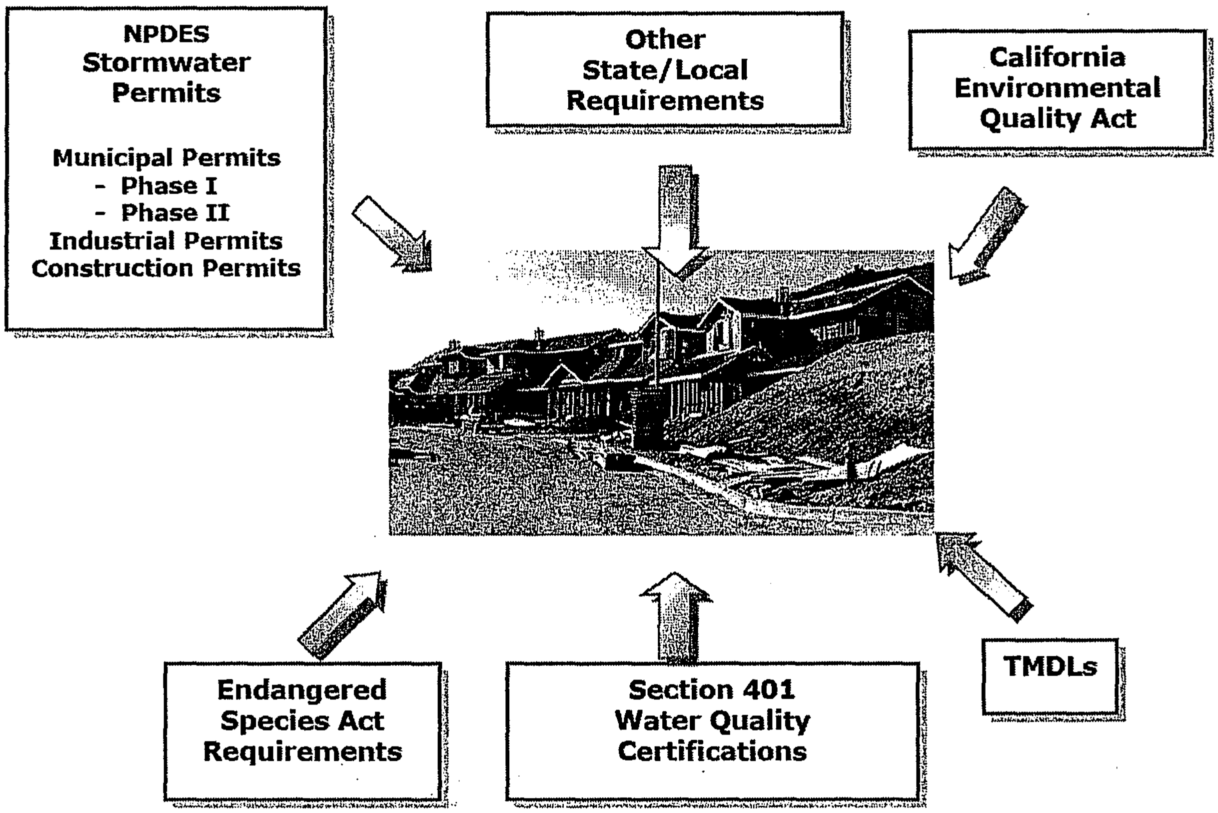
- Urban activities can result in the generation of new dry-weather runoff that may contain many of the pollutants listed above
- Impervious surfaces associated with development, such as streets, rooftops, and parking lots, prevent runoff infiltration and increase the rate and volume of stormwater runoff that may increase downstream erosion potential and associated potential water quality impairment
- Urban activities and increased impervious surfaces which can increase the concentration and/or total load of many of the pollutants listed above in wet weather stormwater runoff

Table 1-1 Pollutant Impacts on Water Quality

Sediment	Sediment is a common component of stormwater, and can be a pollutant. Sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, and fish) by interfering with photosynthesis, respiration, growth, reproduction, and oxygen exchange in water bodies. Sediment can transport other pollutants that are attached to it including nutrients, trace metals, and hydrocarbons. Sediment is the primary component of total suspended solids (TSS), a common water quality analytical parameter.
Nutrients	Nutrients including nitrogen and phosphorous are the major plant nutrients used for fertilizing landscapes, and are often found in stormwater. These nutrients can result in excessive or accelerated growth of vegetation, such as algae, resulting in impaired use of water in lakes and other sources of water supply. For example, nutrients have led to a loss of water clarity in Lake Tahoe. In addition, un-ionized ammonia (one of the nitrogen forms) can be toxic to fish.
Bacteria and viruses	Bacteria and viruses are common contaminants of stormwater. For separate storm drain systems, sources of these contaminants include animal excrement and sanitary sewer overflow. High levels of indicator bacteria in stormwater have led to the closure of beaches, lakes, and rivers to contact recreation such as swimming.
Oil and Grease	Oil and grease includes a wide array of hydrocarbon compounds, some of which are toxic to aquatic organisms at low concentrations. Sources of oil and grease include leakage, spills, cleaning and sloughing associated with vehicle and equipment engines and suspensions, leaking and breaks in hydraulic systems, restaurants, and waste oil disposal.
Metals	Metals including lead, zinc, cadmium, copper, chromium, and nickel are commonly found in stormwater. Many of the artificial surfaces of the urban environment (e.g., galvanized metal, paint, automobiles, or preserved wood) contain metals, which enter stormwater as the surfaces corrode, flake, dissolve, decay, or leach. Over half the trace metal load carried in stormwater is associated with sediments. Metals are of concern because they are toxic to aquatic organisms, can bioaccumulate (accumulate to toxic levels in aquatic animals such as fish), and have the potential to contaminate drinking water supplies.
Organics	Organics may be found in stormwater in low concentrations. Often synthetic organic compounds (adhesives, cleaners, sealants, solvents, etc.) are widely applied and may be improperly stored and disposed. In addition, deliberate dumping of these chemicals into storm drains and inlets causes environmental harm to waterways.
Pesticides	Pesticides (including herbicides, fungicides, rodenticides, and insecticides) have been repeatedly detected in stormwater at toxic levels, even when pesticides have been applied in accordance with label instructions. As pesticide use has increased, so too have concerns about adverse effects of pesticides on the environment and human health. Accumulation of these compounds in simple aquatic organisms, such as plankton, provides an avenue for biomagnification through the food web, potentially resulting in elevated levels of toxins in organisms that feed on them, such as fish and birds.
Gross Pollutants	Gross Pollutants (trash, debris, and floatables) may include heavy metals, pesticides, and bacteria in stormwater. Typically resulting from an urban environment, industrial sites and construction sites, trash and floatables may create an aesthetic "eye sore" in waterways. Gross pollutants also include plant debris (such as leaves and lawn-clippings from landscape maintenance), animal excrement, street litter, and other organic matter. Such substances may harbor bacteria, viruses, vectors, and depress the dissolved oxygen levels in streams, lakes, and estuaries sometimes causing fish kills.
Vector Production	Vector production (e.g., mosquitoes, flies, and rodents) is frequently associated with sheltered habitats and standing water. Unless designed and maintained properly, standing water may occur in treatment control BMPs for 72 hours or more, thus providing a source for vector habitat and reproduction (Metzger, 2002).

1.3 Regulatory Requirements

The Federal Clean Water Act, as amended in 1987, is the principal legislation for establishing requirements for the control of stormwater pollutants from urbanization and related activities. However, other federal, state, and local requirements deal directly or indirectly with controlling stormwater discharges. Requirements for stormwater under some of these programs, such as Basin Planning, Total Maximum Daily Loads (TMDLs), the California Environmental Quality Act (CEQA), 401 Water Quality Certifications and Endangered Species Act (ESA) are evolving, and the user is advised to contact local regulatory and/ or municipal officials for further information.



1.3.1 Federal Programs

In 1972, provisions of the Federal Water Pollution Control Act, also referred to as the Clean Water Act (CWA), were amended so that discharge of pollutants to waters of the United States from any point source is effectively prohibited, unless the discharge is in compliance with a National Pollutant Discharge Elimination (NPDES) permit. The 1987 amendments to the CWA added Section 402(p), which established a framework for regulating municipal, industrial, and construction stormwater discharges under the NPDES program. On November 16, 1990, USEPA published final regulations that established application requirements for stormwater permits for municipal separate storm sewer systems (MS4s) serving a population of over 100,000 (Phase I communities) and certain industrial facilities, including construction sites greater than 5 acres.

On December 8, 1999, USEPA published the final regulations for communities under 100,000 (Phase II MS4s) and operators of construction sites between 1 and 5 acres.

1.3.2 State Programs

The State Porter-Cologne Act (Water Code 13000, et seq.) is the principal legislation for controlling stormwater pollutants in California. The Act requires development of Basin Plans for drainage basins within California. Each plan serves as a blueprint for protecting water quality within the various watersheds. These basin plans are used in turn to identify more specific controls for discharges (e.g., wastewater treatment plant effluent, urban runoff, and agriculture drainage). Under Porter-Cologne, specific controls are implemented through permits called Waste Discharge Requirements issued by the nine Regional Water Quality Control Boards. For discharges to surface waters, the Waste Discharge Requirement also serves as NPDES permits.

1.3.3 Municipal NPDES Stormwater Programs

Phase I MS4s are required to obtain an individual NPDES stormwater permit and develop a stormwater management plan (SWMP) that is implemented by the municipality's stormwater management program. One of the elements of the municipal NPDES Stormwater Program are new development and redevelopment activities including: planning processes, design review, BMPs, outreach, and enforcement.

Smaller, Phase II communities are covered by a General Permit. Six Phase II measures are required in Phase II permits. One addresses post-construction stormwater management in new development and redevelopment, including developing, implementing, and enforcing a program to address discharges of stormwater runoff from new and redevelopment areas.

Phase I permits and the Phase II General Permit in California contain standard requirements for planning and design BMPs including minimum requirements for treatment of runoff from new development. These standards are called Standard Urban Stormwater Mitigation Plans (SUSMPs) in some permits, or equivalent terminology is used in others. These are discussed further in Section 2.

1.3.4 Other Relevant Regulatory Programs

In addition to meeting municipal stormwater program requirements under CWA section 402(p), municipalities are increasingly subject to other regulatory drivers that relate to the protection of surface water quality and beneficial uses of waterbodies in their communities. Several other regulatory programs that can significantly affect new development and redevelopment planning and design are:

- Total Maximum Daily Loads (TMDLs)
- Endangered Species Act
- CWA Section 404 Dredge and Fill Permits
- Section 401 Water Quality Certification

In the coming years, these regulatory drivers will likely have at least as much impact on the design and implementation of municipal stormwater programs and BMP selection and maintenance as current stormwater regulations.

TMDLs

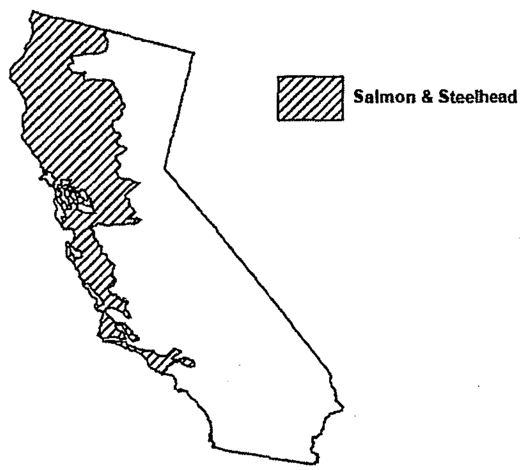
TMDL's are a regulatory mechanism to identify and implement additional controls on both point and non-point source discharges in water bodies that are impaired from one or more pollutants and are not expected to be restored through normal point source controls. States identify impairments and pollutants by putting impaired water bodies on a list as required under Section 303(d) of the CWA.

Stormwater or urban runoff is listed as a suspected source for many of the waterbody pollutant combinations in the current 303(d) list. Stormwater programs must be designed not only to be in compliance with the stormwater NPDES permit regulations, but they must also be designed to implement TMDLs in which stormwater or urban runoff is named as a source.

Endangered Species Act

Like TMDLs, Endangered Species Act issues are becoming increasingly important to stormwater program design and implementation. The presence or potential presence of an endangered species impacts stormwater management programs and the selection and maintenance of BMPs. Although there are numerous endangered species that may impact the program, two that have particular impacts are salmon and steelhead trout.

Critical Area for Salmon & Steelhead



The National Marine Fisheries Service (NMFS) has designated critical habitat for salmon and steelhead trout in large areas of the north and central coast and central valley of California.

Developers or public agency intending to conduct activities in or discharge to an area that serves as a critical habitat must contact resource agencies such as NMFS, the US Fish & Wildlife Service, and the California Department of Fish & Game to learn about specific compliance requirements and actions.

CWA Section 401 Water Quality Certification

In 1972, Section 404 of the Clean Water Act (CWA) was passed. It prohibits discharging dredged or fill material into U.S. waters without a permit from the Army Corps of Engineers (USACE). Subsequent court rulings and litigation further defined "Waters of the U.S." to include virtually all surface waters, including wetlands. A 1991 Supreme Court decision eliminated federal jurisdiction based on Commerce factors over a poorly defined set of "isolated" waters; however, such waters remain subject to state jurisdiction under the Porter-Cologne Act. Activities in waters of the United States that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry.

The basic premise of the program is that no discharge of dredged or fill material is permitted if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. When applying for a permit, it must be shown that:

- Steps have been taken to avoid wetland impacts where practicable.
- Potential impacts to wetlands have been minimized.
- Compensation for any remaining, unavoidable impacts through activities has been provided to restore or create wetlands.

An individual permit is usually required for potentially significant impacts. However, for most discharges that will have only minimal adverse effects, the USACE often grants up-front general permits. These may be issued on a nationwide, regional, or state basis for particular categories of activities (for example, minor road crossings, utility line backfill, and bedding) as a means to expedite the permitting process.

Anyone proposing to conduct a project that requires a federal permit (404) or involves dredge or fill activities that may result in a discharge to U.S. surface waters and/or "Waters of the State" are required to obtain a CWA Section 401 Water Quality Certification and/or Waste Discharge Requirements (Dredge/Fill Projects) from the Regional Water Quality Control Board (RWQCB), verifying that the project activities will comply with state water quality standards. The rules and regulations apply to all "Waters of the State", including isolated wetlands and stream channels that may be dry during much of the year, have been modified in the past, look like a depression or drainage ditch, have no riparian corridor, or are on private land.

Section 401 of the CWA grants each state the right to ensure that the State's interests are protected on any federally permitted activity occurring in or adjacent to "Waters of the State". In California, the nine RWQCBs are the agency mandated to ensure protection of the State's waters. If a proposed project requires a USACE, CWA Section 404 permit and has the potential to impact Waters of the State, the RWQCB will regulate the project and associated activities through a Water Quality Certification determination (Section 401), as part of the 404 process.

However, if a proposed project does not require a federal permit, but does involve dredge or fill activities that may result in a discharge to "Waters of the State", the RWQCB has the option to regulate the project under its state authority (Porter-Cologne) in the form of Waste Discharge Requirements or Waiver of Waste Discharge Requirements. In addition, California Department of Fish and Game (DFG) may regulate the project through the Streambed Alteration Agreement process. DFG issues Streambed Alteration Agreements when project activities have the potential to impact intermittent and perennial streams, rivers, or lakes.

Developers should be aware of these permits, and make arrangements with the appropriate agency to obtain a permit and comply with permit regulations.

1.4 Definitions

Many of the common definitions for stormwater control are found in the Glossary (see Section 7). Throughout the handbook the user will find references to the following terms:

MS4 is a municipality owned separate storm sewer system. Operators of MS4s are usually permitted under Phase II of the NPDES program. NPDES is an acronym for National Pollutant Discharge Elimination System. NPDES is the national program for administering and regulating Sections 307, 318, 402 and 405 of the Clean Water Act (CWA).

A ***Best Management Practice (BMP)*** is defined as any program, technology, process, siting criteria, operating method, measure, or device, which controls, prevents, removes, or reduces pollution.

Source Control BMPs are operational practices that prevent pollution by reducing potential pollutants at the source. They typically do not require maintenance or construction.

Source Control BMPs for design are planning methods and concepts that should be taken into consideration by developers during project design.

Treatment Control BMPs are methods of treatment to remove pollutants from stormwater.

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Attachment 8:
State Water Resources Control Board Resolution No. 2008-0030 Requiring Sustainable Water Resources Management

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 2008-0030

REQUIRING SUSTAINABLE WATER RESOURCES MANAGEMENT

WHEREAS:

1. Sustainable water resources management is vital to California's future;
2. California continues to live beyond its means in water and energy resources. The threats of urban sprawl, climate change, water overdraft, and emerging pollutants require the State Water Resources Control Board and Regional Water Quality Control Boards (Water Boards) to stretch the scope of traditional water quality control efforts;
3. Low Impact Development (LID) includes stormwater management techniques to maintain or restore the natural hydrologic functions of a site by detaining water onsite, filtering out pollutants, and facilitating the infiltration of water into the ground. This innovative approach helps meet water quality and water supply objectives and maintain healthy, sustainable watersheds;
4. Regional Water Quality Control Boards (Regional Water Boards) have already begun to integrate LID and other sustainable water management strategies into compliance documents;
5. The Water Boards recognize the importance of continuing to apply climate change strategies and LID principles in regulatory and financial assistance programs to benefit water supply and contribute to water quality protection;
6. Training for Water Board staff and stakeholders is important to ensure successful implementation of climate change strategies and LID practices;
7. The State Water Resources Control Board (State Water Board) recognizes the relationship between energy, water supply, water quality and resource protection, and has already begun to integrate climate change strategies into its policies and program areas; and
8. Continued coordination with partners from other government agencies, non-profit organizations, and private industry and business will enhance and encourage sustainable activities within the administration of Water Board programs and activities.

THEREFORE BE IT RESOLVED THAT:

The State Water Board:

1. Continues to commit to sustainability as a core value for all Water Boards' activities and programs;

2. Directs Water Boards' staff to require sustainable water resources management such as LID and climate change considerations, in all future policies, guidelines, and regulatory actions;
3. Directs State Water Board staff to identify policies and program areas to integrate climate change strategies and comply with the goals stated in Assembly Bill 32, based on the Water-Energy Climate Action Team process;
4. Directs Regional Water Boards to aggressively promote measures such as recycled water, conservation, and LID Best Management Practices where appropriate and work with Dischargers to ensure proposed compliance documents include appropriate, sustainable water management strategies;
5. Directs State Water Board staff to assign a higher grant priority to climate-related and LID projects, particularly those that are supported by local policies or ordinances;
6. Supports training for Water Board staff and stakeholders to ensure successful implementation of climate change strategies and LID practices; and
7. Directs Water Boards' staff to coordinate with partners from other government agencies, non-profit organizations, and private industry and business to further enhance and encourage sustainable activities within the administration of Water Board programs and activities.

CERTIFICATION

The undersigned, Clerk 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 Board held on May 6, 2008.

AYE: Chair Tam M. Doduc
Vice Chair Gary Wolff, P.E., Ph.D
Charles R. Hoppin
Frances Spivy-Weber

NAY: None

ABSENT: Arthur G. Baggett, Jr.

ABSTAIN: None

Jeanine Townsend

Jeanine Townsend
Clerk to the Board

Attachment 9:
December 26, 2000 letter from the Office of the Chief Counsel discussing the State Water Board's precedential decision concerning the use of Standard Urban Storm Water Mitigation Plans

Winston H. Hickox
Secretary for Environmental Protection

State Water Resources Control Board

Office of Chief Counsel
1001 I Street • Sacramento, California 95814 • (916) 341-5161
Mailing Address: P.O. Box 100 • Sacramento, California 95812-0100
FAX (916) 341-5199 • Internet Address: http://www.swrcb.ca.gov

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SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

TO: RWQCB Executive Officers

FROM: Craig M. Wilson
Chief Counsel
OFFICE OF CHIEF COUNSEL

DATE: DEC 26 2000

SUBJECT: STATE WATER BOARD ORDER WQ 2000-11: SUSMP

On October 5, 2000, the State Water Resources Control Board (State Water Board) adopted a precedential decision concerning the use of Standard Urban Storm Water Mitigation Plans (SUSMPs) in municipal storm water permits. (Order WQ 2000-11; hereafter referred to as "the Order.") The Order arose from the municipal storm water permit in the Los Angeles region. As a precedential decision, the State Water Board has recognized that the decision includes significant legal or policy determinations that are likely to recur. (Gov. Code §11425.60.) The Regional Water Quality Control Board (Regional Water Board) orders must be consistent with applicable portions of the State Water Board's precedential decisions.

In the Order, the State Water Board considered SUSMPs related to new development and redevelopment. The SUSMPs include a list of best management practices (BMPs) for specific development categories, and a numeric design standard for structural or treatment control BMPs. The numeric design standard created objective and measurable criteria for the amount of runoff that must be treated or infiltrated by BMPs. The purpose of the SUSMPs is to control runoff both during and after construction.

Several of the conclusions reached in the Order are likely to recur, and future municipal storm water permits must be consistent with the principles set forth therein.[1] Pursuant to the Clean Water Act, municipal storm water permits must require controls to reduce the discharge of pollutants to the maximum extent practicable (MEP). The Order finds that the provisions in the SUSMPs, as revised in the Order, constitute MEP. The Order also discusses areas where the Regional Water Boards may exercise more discretion.

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[1] The Order considered a Phase I storm water permit, applicable to urban areas with populations of 100,000 and greater. The State Water Board will soon embark on Phase II, which will include municipal permits for smaller municipalities. The Order did not address Phase II requirements, which may be different than Phase I requirements.

1. The Order finds that the design standard in the SUSMPs, which essentially requires that 85 percent of the runoff from specified categories of development be infiltrated or treated, reflects MEP. It is conceivable that the specific design standard could vary depending on such factors as rainfall and soil characteristics.

2. The Order determined that SUSMPs appropriately applied to the following categories of development: single-family hillside residences, 100,000 square foot commercial developments, automotive repair shops, restaurants, home subdivisions with 10 to 99 housing units, home subdivisions with 100 or more housing units, and parking lots with 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to storm water runoff. Redevelopment projects that are within one of these categories are included if the redevelopment adds or creates at least 5,000 square feet of impervious surface to the original developments; if the addition constitutes less than 50 percent of the original development, the design standard only applies to the addition. The Order approved a waiver from compliance with the design standard where there is a risk of groundwater 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.

3. The Order allows broader discretion by the Regional Water Boards to decide whether to include additional types of development in future SUSMPs. These areas for potential future inclusion in SUSMPs include retail gasoline outlets, ministerial projects (only discretionary projects are included in the approved SUSMPs), and projects in environmentally sensitive areas. If Boards include these types of developments in future permits, the Order explains the types of evidence and findings that are necessary.

4. The Order encourages regional solutions. The Order endorses establishment of a mitigation fund or "bank" that could be funded by developers who obtain waivers from the design standards. The Order explains that such a funding mechanism must be developed after consultation with appropriate local agencies.

The SUSMPs as developed by the Los Angeles Regional Water Board resulted from a requirement in a municipal storm water permit to draft and submit a proposal. The Regional Water Board then made revisions to the SUSMPs, and the State Water Board made further revisions prior to approving the SUSMPs. In light of the specificity and detail in the Order, Regional Water Boards should simply incorporate SUSMP requirements for new development and redevelopment into new municipal permits, rather than adopting a process of submittal, review and revision of proposals. In adopting SUSMPs in permits, the requirements should be substantially similar to the SUSMPs approved in the Order. If, for example, the Regional Water Board determines that a different design standard than 85 percent of the runoff is appropriate, the permit findings should explain how the alternative design standard is generally equivalent to the standards approved in the Order, and why the alternative standard is appropriate to the area. The general principles of the Order—that design standards for BMPs for new development and redevelopment are required—must be implemented.

cc: Edward C. Anton
Acting Executive Director

Attachment 10:
EPA brochure: Incorporating Environmentally Sensitive Development into Municipal Stormwater Programs

EPA
United States Environmental Protection Agency and the EPA Region III states of Pennsylvania, Maryland, Delaware, District of Columbia, Virginia and West Virginia

Incorporating Environmentally Sensitive Development Into Municipal Stormwater Programs

EPA 833-F-07-011

January 2008

Executive Summary

This document is intended to assist local stormwater managers who wish to encourage or require low impact development practices to meet stormwater goals. Managing stormwater with low impact site design techniques can help jurisdictions meet National Pollutant Discharge Elimination System (NPDES) requirements, and the techniques offer construction cost savings as well as a variety of other benefits when compared to traditional stormwater management approaches.

Introduction

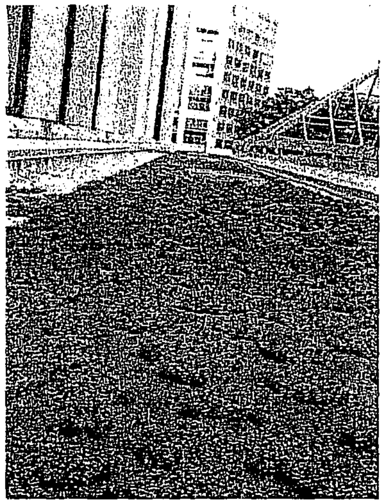
Consideration of the impacts of construction and land development on water resources is becoming increasingly important as more undeveloped land is being converted to impervious surfaces. The effects of urbanization on water resources are well known: degraded habitat, incised channels, impaired aquatic life, high pollutant loads, depleted groundwater, and higher incidence of flooding, among others. The mid-twentieth century approach to stormwater management was to dispose of stormwater as quickly as possible using engineered systems of curbs, gutters, pipes, and open channels, resulting in unexpected consequences for water quality. Since then, new approaches have evolved to mitigate impacts and reverse damage caused by existing development. These approaches, commonly referred to as Low Impact Development (LID), focus on emulating the functions of natural systems to reintegrate rainfall into the water cycle rather than disposing of it as a waste product.

LID is an environmentally sensitive approach to stormwater management that seeks to manage rainfall where it falls using decentralized, small-scale controls that are integrated into a site's landscape features. These include open space, rooftops, streetscapes, parking lots, sidewalks, and medians. The goal of this technique is to mimic a site's predevelopment hydrology by infiltrating, filtering, storing, evaporating, and detaining runoff close to its source (Low Impact Development Center, 2007).

Environmentally Sensitive Development (ESD) has many analogous terms, such as:

- Better site design
- Conservation design
- LID
- Smart Growth
- Green infrastructure
- Integrated site design
- Sustainable development

To incorporate LID at a neighborhood or watershed level to fully protect water resources, communities can consider employing a wide range of land use strategies including building a range of development densities, incorporating adequate open space, preserving critical ecological and buffer areas, and minimizing land disturbance.


An ecoroof in Arlington, Virginia

ESD offers a number of advantages over traditional, engineered stormwater drainage approaches, including:

- **Addresses stormwater at its source:** LID practices seek to manage rainfall where it falls, reducing or eliminating the need for regional detention ponds and flood controls.
- **More protective of streams and watersheds:** Because LID practices infiltrate rainfall and prevent runoff, they reduce pollutant loads as well as streambank erosion associated with peak flows.
- **Promotes groundwater recharge:** Many LID techniques infiltrate stormwater, recharging groundwater aquifers and providing baseflow to streams during dry weather. These infiltration practices also reduce stream temperature because surface runoff is warmer than groundwater.
- **Allows for more flexible site layouts:** The small-scale, dispersed nature of LID practices means that designers can include stormwater management in a variety of open spaces and landscaped areas—traditional stormwater management required large set-asides for ponds and wetlands that consumed valuable real estate.
- **Enhanced aesthetics and public access/use:** Well-designed, vegetated practices can provide a visual amenity, particularly when compared to hardened drainage infrastructure such as pipes, curbs, gutters, and concrete-lined channels. Some practices can double as park space, offering recreational amenities.
- **Cost savings:** A common myth is that LID costs more than traditional stormwater management, but case studies have shown the opposite to be true (see Table 1). Typically, cost savings arise from a reduction in the size and extent of pipes and other infrastructure needed to handle runoff. Savings can also arise from the ability to build additional units that would not have been feasible using traditional stormwater management approaches.

Table 1. Cost Benefits of Low Impact Development Designs

Project Name and Location	Description	Cost Benefit
Poplar Street Apartments [1] Aberdeen, NC	◆ 270-unit apartment complex ◆ Most of the curb-and-gutter systems were eliminated ◆ Stormwater managed with a variety of LID BMPs	$175,000 in savings over conventional stormwater costs
Somerset [1] Prince George's County, MD	◆ Residential subdivision ◆ Most of the site was designed with swales and rain gardens ◆ Curbs and gutters were eliminated	Conventional: $2,456,843 LID Design: $1,671,461 Savings: $785,382 ◆ Able to develop 6 additional lots ◆ Decreased cost per lot by $4,000
Gap Creek [1] Sherwood, AR	◆ Residential subdivision ◆ Drainage areas preserved ◆ Greenbelts created for drainage area protection and recreation ◆ Streets designed to follow land contour	◆ $2.2 million in additional profit ◆ Lots sold for $3,000 more than competitors' lots ◆ Able to develop 17 additional lots ◆ Decreased cost per lot by $4,800
Kensington Estates [1] Pierce County, WA	◆ 103-lot residential development ◆ Decreased roadway width ◆ Porous paving ◆ Cul-de-sacs with vegetated depressions in the center	Estimated cost savings of 20% of conventional construction costs
Circle C Ranch [1] Austin, TX	◆ Residential subdivision ◆ Stormwater directed as sheet flow to a stream buffer ◆ Four bioretention areas	Conventional: $250,000 LID Design: $65,000 Savings: $185,000 Additional savings from reduced storm drain pipe size and trenching depth
Green Roof Density Bonus [2] Portland, OR	Portland offers a density bonus of 5,000 ft^2 for installation of a green roof on a commercial property	An estimated $225 million in additional economic development generated since inception
Laurel Springs [3] Jackson, WI	◆ Residential subdivision ◆ Developed using a clustered design Open space preserved ◆ Grading and paving reduced	Conventional: $3,200,081 Conservation: $2,570,555 Savings: $629,526

Sources: [1] U.S. Environmental Protection Agency, 2005; [2] Liptan, 2007; [3] Winer-Skonovd et al., 2006.

NPDES Requirements Addressed by LID

LID can be integrated into a municipal stormwater program at a variety of levels in addition to new development and redevelopment. The following are ways in which LID can help communities meet NPDES permit requirements.

- **Public Education and Outreach on Stormwater Impacts:** Municipalities and developers can post signs describing the functions and benefits of LID BMPs, including information about the impacts of urbanization on water resources.
- **Public Involvement and Participation:** Municipalities can encourage citizens and community groups to get involved in stormwater management by implementing rain gardens and other BMPs at their homes and businesses. Municipalities can sponsor workshops and demonstrations of environmentally friendly landscaping, including rainwater harvesting and reuse and selection of native plants. The State of West Virginia conducted several popular rain barrel workshops in partnership with a local municipality and are planning more by request from citizens.
- **Construction Site Stormwater Runoff:** Preservation of open space reduces the amount of area cleared and graded, decreasing costs for erosion and sediment control. Municipalities can include this practice as one of their required or recommended BMPs for developers and can incorporate this practice into capital improvement projects.
- **Post-Construction Stormwater Management in New Development and Redevelopment:** Most NPDES permits require post-construction stormwater management practices that reduce total suspended solids in stormwater by 80 percent. Permits also typically dictate performance standards for volume and peak discharge control to address channel

stabilization and flooding. LID practices have been shown to remove pollutants beyond the 80 percent standard and are highly effective at maintaining or restoring a site's hydrology to protect stream channels.

- **Pollution Prevention/Good Housekeeping for Municipal Operations:** The use of native plants in landscaping reduces the need for municipal crews to irrigate or use pesticides, herbicides or fertilizers. Municipalities can incorporate selection of native plants into its landscaping guidelines and can train its maintenance crews to use integrated pest management.

State Requirements feature "Green Technology" and "Environmental Site Design"

The State of Delaware requires that "Green Technology BMPs" be considered first for water quality protection for development projects. Other practices can be considered only after these "Green" BMPs have been eliminated for engineering or hardship reasons as approved by the plan reviewer. See **www.swc.dnrec.delaware.gov/SedimentStormwater.htm** for more information.

The State of Maryland passed the Stormwater Management Act of 2007 (**http://mlis.state.md.us/2007RS/billfile/SB0784.htm**), which requires the implementation of environmental site design for new development and redevelopment projects. Under the new legislation, local jurisdictions are tasked with reviewing and modifying existing codes and ordinances that would impede environmental site design. Also, developers are tasked with demonstrating that environmental site design is implemented to the maximum extent practicable at their site. Traditional stormwater controls are only allowed where absolutely necessary. The legislation also includes a groundwater recharge standard (100 percent of the predevelopment volume) and references Maryland's Model Stormwater Management Ordinance, which can be downloaded at **www.mde.state.md.us/assets/document/sedimentstormwater/model_ordinance.pdf.**

Types of LID BMPs

LID is a flexible technique that can be applied to nearly any site, including both infill/redevelopment sites and new development. Neighborhood or regional level techniques such as compact development and open space preservation further mitigate the impacts of development. When used in combination with site techniques, these regional-level techniques can reduce runoff and associated pollutants across a watershed.

- **Disconnected impervious surfaces:** Runoff from rooftops, sidewalks, driveways, and roads can be directed to landscaped areas or porous pavement to promote infiltration and reduce stormwater volumes.
- **Preservation of open space/natural features:** Areas of a development site that will not contain buildings or other infrastructure can be protected from clearing, grading, and other construction-related impacts, reducing the amount of disturbed land and maintaining mature vegetation.
- **Bioretention:** Also known as rain gardens, biofilters, bioswales, and bioinfiltration practices, these are landscaped depressions that collect runoff and manage it through infiltration, evapotranspiration, and biological uptake of nutrients and other pollutants.
- **Flow-through planters and tree boxes:** Planters and tree boxes enhance streetscapes and courtyards with attractive vegetation and shade and also provide pervious areas for rainfall interception and stormwater infiltration.
- **Porous pavement:** A variety of paving surfaces have been developed that contain pore spaces that store and infiltrate runoff. Pavement types include porous concrete, porous asphalt, and interlocking pavers.
- **Water harvesting (rain barrels, cisterns):** Rainfall from rooftops can be collected via downspouts and stored for reuse. Rain barrels are typically used to store water for landscaping, and cisterns, which offer more storage volume, can store water for toilet flushing, landscape irrigation, or other gray water applications.
- **Ecoroofs:** Also known as green roofs, ecoroofs consist of a layer of soil and plants installed on a roof surface. Ecoroofs provide stormwater retention, reducing stormwater volumes and promoting evaporation and transpiration. Ecoroofs have been shown to have energy-saving benefits and help to reduce the heat-island effect in urban areas.
- **Low-input landscaping:** Choosing native plants that are easy to maintain and adapted to local climate and soil conditions decreases or eliminates the need for watering, fertilizers, and pesticides.

Steps for Permittees

Municipalities

Update development standards and pass ordinances with LID incentives

- Evaluate transportation design specifications, plumbing codes, landscaping requirements, and other standards that might prohibit the use of LID practices. Identify language that may be incompatible with LID and work with other municipal departments to discuss the changes and identify alternatives. It is important to address the other departments' concerns about safety, cost, etc. to ensure their buy-in.
- Depending on how new requirements are codified in your community, develop new code language, propose changes to the zoning or development ordinance, or develop a separate stormwater ordinance that outline the new standards. The town of Warsaw, Virginia, and Stafford County, Virginia, incorporated LID into their ordinances, the text of which can be viewed at the Publications page of the Friends of the Rappahannock website (**www.riverfriends.org**).
- Identify possible incentives that can be offered to encourage LID implementation. Incentives can be in the form of density bonuses, reduced size of required drainage infrastructure, discounted utility fees, and tax credits.

- Provide guidance for implementing the new standards. Develop a standards manual or adopt your state manual if it meets your needs. Wherever possible to conserve resources, adapt existing resources to local situations. Prince George's County, Maryland, developed two design manuals with technical specifications for LID practices: *Low-Impact Development Design Strategies: An Integrated Design Approach* and *Low-Impact Development Hydrologic Analysis*, both of which are available on EPA's website at **www.epa.gov/owow/nps/lid.**
- Implement demonstration projects and monitor them for effectiveness and suitability of design. Municipalities should take the initiative to experiment with BMP designs and identify those that work well in local conditions. Demonstration projects show developers and citizens the potential associated with attractive stormwater BMPs and instill confidence in their performance.
- Evaluate constraints (areas of high groundwater, poorly drained soils, etc.) and inform the development community about where the new BMP requirements apply and where site constraints prohibit LID implementation.

Bringing Developers Up to Speed on New Requirements

The City of Philadelphia implemented a new stormwater ordinance with performance-based requirements that allow developers more flexibility in meeting stormwater, combined sewer overflow abatement, and flood control standards. To aid engineers and developers in adapting to the new policies, the City does not charge for plan reviews. They have brought in on-site contractors in addition to regular staff to review and suggest revisions to submissions. As time has passed they have seen a substantial drop in resubmissions.

Require LID for capital improvement projects

A municipality can set a good example, show confidence in the use of new technology, and demonstrate success with pilot projects in the public right-of-way. Municipalities have jurisdiction over development activities in the right-of-way and on public lands, which allows greater design flexibility and more reliable maintenance using municipal crews. LID projects adapt well to linear applications (streetscapes, courtyards, medians, etc.) and small-scale open spaces. Work with facilities management and landscaping crews because maintenance of vegetated LID practices sometimes requires special handling, such as hand-weeding and prohibiting heavy equipment and pesticide use. Also, consider adopting Leadership in Energy and Environmental Design (LEED) Green Building Rating System standards for all municipal building and development projects (see "Expanded Stormwater Guidelines for the LEED Green Building Rating System" sidebar for more information).

Educate developers and maintenance crews

Allow time and dedicate staff resources for bringing design engineers and landscape architects up to speed on new requirements. Provide checklists to help ensure compliance with new procedures. Develop locally based coefficients where appropriate in order to streamline sizing calculations and include example calculations to ensure consistency and transparency in project submittals. Hold periodic training sessions on LID applications, and request that plan reviewers provide specific comments when submitted designs do not meet standards.

Curb cuts allow water from the street to flow into bioretention areas

Establish a maintenance tracking system

Determine whether property owners or the municipality will be responsible for maintenance. If property owners will be responsible, there are a number of ways in which the municipality can assure maintenance:

- Require maintenance agreements, which are recorded with the property deed, for new and existing BMPs.
- Require a performance bond for new BMPs.
- Perform spot inspections to identify maintenance problems and check maintenance records.
- Require that property owners submit maintenance records or other evidence that maintenance was performed as prescribed.

Municipalities should consider a balance between compliance assistance and enforcement mechanisms to ensure that property owners uphold their maintenance responsibilities.

Maintain a database or geographic information system (GIS) of locations of all LID BMPs. This database is needed for maintenance assurance and can also be used for other efforts, such as watershed modeling, stormwater master planning, and inspection programs. Publicly owned BMPs should be tracked for maintenance purposes as well as for asset inventories required under Governmental Accounting Standards Board (GASB) Statement No. 34 (**www.gasb.org**).

Quantify the benefits of LID

Present case studies showing the water quality and community benefits of LID, whether modeled or measured. Good examples and reliable data will help to make a case for changes in development standards by describing potential cost savings and other amenities offered by LID. This information can be part of a larger effort to educate municipal decision makers, such as city councils, the mayor, commissioners, etc., about the benefits of LID and to dispel any myths and misconceptions surrounding "green" infrastructure. These studies can also be used to gain buy-in from state permitting authorities and to quantify stormwater management benefits in terms of volume reductions and pollutant removal. One tool that can be used to estimate the benefits of LID and conservation practices is the Center for Neighborhood

Technology's (2007) Green Values Stormwater Calculator (**http://greenvalues.cnt.org/calculator**), which allows users to input site development characteristics and green practices and returns financial and hydrologic outcomes for different scenarios.

Modeling Tangible Benefits of Stormwater Retrofits: The Green Build-Out Model

The Casey Trees Foundation (Deutsch et al., 2007) used the Green Build-Out Model to estimate how the addition of just two BMPs, tree cover and ecoroofs affected stormwater runoff volumes in Washington, DC. Researchers modeled two scenarios: a "green build-out" scenario, in which trees and green roofs were placed wherever possible, and a "lowend" scenario where trees and green roofs were placed wherever practical. Using a continuous wet weather simulation based on an average year with a 1-year, 6-hour design storm, the two scenarios showed the following reductions in stormwater entering the sewer system and discharges to Washington's streams and rivers. A follow up analysis is being conducted that adds several of the most commonly used LID practices and is expected to show a significant increase in flow reduction higher than figures listed below.

Result	Low-End Scenario	High-End Scenario
Stormwater prevented from entering the sewer system	310 million gallons	1.2 billion gallons
Reduction in discharges	282 million gallons	1 billion gallons

Other key findings: green roofs were found to offer more storage than trees per unit area, trees are more beneficial when they overhang impervious areas, and larger tree boxes provide greater benefits by reducing imperviousness and allowing more tree growth.

Grant credit for LID and conservation measures

Communities can offer incentives to developers to preserve open space, protect or plant trees, and implement LID site design techniques by offering stormwater credits. The goal of the credits is to reduce the required capacity (and therefore the cost) of stormwater treatment practices using non-structural site design and conservation measures. Credits can also be used to reduce the stormwater utility rate or user fee, if applicable. A number of municipalities across the nation offer some form of stormwater credit, and some states have developed guidance to encourage municipalities to adopt a credit system. For example, the State of Minnesota (2006) describes six types of credits that local jurisdictions can adopt:

- Natural area conservation
- Site reforestation or prairie restoration
- Drainage to stream, wetland or shoreline buffers
- Surface impervious cover disconnection
- Rooftop disconnection
- Grass channels

Minnesota also identifies four factors necessary for successful establishment of a credit system:

- Interest in and experience with LID techniques
- A review process in which stormwater management is discussed prior to initial site layout
- Communication between plan reviewers and design consultants
- Field verification of BMP efficacy by both parties

To establish a stormwater credit system, local jurisdictions should choose which credits to offer based on local feasibility factors, encourage designers to evaluate credit applicability early in the design process, have plan reviewers ensure that credits are applied properly, and inspect sites after construction to ensure that stormwater features are in place and functioning as intended.

Developers

Review new requirements and standards

Obtain and review new BMP standards and requirements from the municipal planning department, including technical design manuals, sample review checklists, and other educational materials. Send design staff to any training workshops offered by the municipality or any other organization that offers this kind of training (e.g., the Center for Watershed Protection).

Get early buy-in for stormwater BMP plans

During the conceptual design stage, meet with a representative from the municipal planning department to discuss ways in which LID can be incorporated into the site to avoid multiple design iterations. Identify areas that are especially well-suited to LID BMPs, such as areas with well-drained soils, stands of mature trees and other mature vegetation, and natural depressions or low-lying areas of the site. Attempt to site buildings, roads, and other infrastructure around these features if possible. Arendt (1996) describes in detail a methodology for evaluating a development site to maximize open space, reduce impervious surfaces, and optimize stormwater management. Delaware's (1997) *Conservation Design for Stormwater Management* (**www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/New/Delaware_CD_Manual.pdf**) provides additional guidance on designing low-impact site layouts, including case studies comparing the impacts of different designs.

Space for BMPs is more limited in infill developments, though many options are still available, such as the use of flow-through planters in courtyards and along sidewalks, ecoroofs, and narrow swales along the site's perimeter. Porous pavers can be substituted for traditional pavement, and cisterns can be used to store roof runoff for reuse.

Design for long-term maintenance

Developers should design BMPs with maintenance in mind. Native plants should be selected wherever possible to reduce chemical inputs and eliminate the need for watering. Limited access areas or those that require special maintenance can be set off from the surrounding landscape using low walls with cuts to allow stormwater to enter, a row of stones, or other physical or visual barriers. Access should be provided for periodic maintenance that might require heavy equipment.

Developers should include detailed guidance on BMP maintenance with the property deed, including prescribed maintenance activities, inspection schedules and checklists, plant lists, and guidance on how to recognize problems or malfunctions. The maintenance information should distinguish between inspections and maintenance activities that require special expertise versus those that can be performed by homeowners or laborers.

Phase construction activities and practice site fingerprinting

When planning construction activities, developers should identify ways to minimize the amount of earth disturbed at any one time. This can be accomplished by phasing construction activities so that only a portion of the site is cleared and graded at one time. The remainder of the site can be left undisturbed to reduce erosion. Also, developers should make every effort to disturb as little of the site as possible. This practice, called "site fingerprinting," involves clearing only the areas of a site that will contain buildings or infrastructure, leaving open spaces in a natural condition and preserving existing vegetation.

Revise corporate policies to promote LID

Developers can choose to implement LID and other environmentally friendly business practices across the board by adopting a corporate policy to require site analyses for all development projects that identify opportunities for "greening" developments. Because consumers are becoming more aware of the impacts of development on the environment, developers who regularly incorporate environmentally sensitive features into their projects can market their properties as "environmentally friendly" to appeal to this increased level of awareness.

Expanded Stormwater Guidelines for the LEED Green Building Rating System

The U.S. Green Building Council developed The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ as a nationally accepted benchmark for the design, construction, and operation of high performance green buildings. The LEED rating system includes "points" or credits for onsite stormwater management, including construction site pollution prevention, protecting/restoring habitat, maximizing open space, controlling stormwater quantity and quality, and using water-efficient landscaping. The Council has recently developed a Neighborhood Development Rating System that integrates the principles of smart growth, urbanism, and green building into a national standard for neighborhood design. This rating system provides greater specificity related to water quality enhancement, offering up to 5 points for a comprehensive stormwater management plan that infiltrates, re-uses, or evapotranspirates runoff from impervious surfaces. Infill development has less stringent requirements than new development. See **www.usgbc.org** for more information about the LEED rating system.

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Additional Resources

Manuals and Reports

Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows
www.nrdc.org/water/pollution/rooftops/rooftops.pdf (PDF, 3.0 MB, 54 pages)
Provides policy guidance for decision makers and includes nine case studies of cities that employed green techniques successfully.

The Practice of Low Impact Development (LID)
www.huduser.org/Publications/PDF/practLowImpctDevel.pdf (PDF, 3.31 MB, 131 pages)
Provides a brief introduction LID and discusses conventional and alternative techniques and technologies that developers can integrate into their existing land development practices. Focuses on technologies that affect both the cost impacts and environmental issues associated with land development.

Conservation Design for Stormwater Management
www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/New/Delaware_CD_Manual.pdf (PDF, 9.7 MB, 228 pages)
Provides guidance for incorporating conservation into site designs, including six case studies comparing conservation designs to traditional designs.

Delaware Green Technology BMPs
www.swc.dnrec.delaware.gov/SedimentStormwater.htm
Delaware's Sediment and Stormwater Program website contains links to Delaware's resources for green technology, including a Green Technology Best Practices Brochure and Standards & Specifications for Green Technology BMPs.

Growing Greener: Conservation by Design
www.natlands.org/uploads/document_33200515638.pdf (PDF, 1.63 BM, 20 pages)
A statewide community planning initiative designed to help communities use the development regulation process to their advantage to protect interconnected networks of greenways and permanent open space. The booklet can be downloaded in PDF format at.

Better Site Design: A Handbook for Changing Development Rules in Your Community
www.cwp.org/pubs_download.htm (available for purchase)
Outlines 22 guidelines for better developments and provides a detailed rationale for each principle. Also examines current practices in local communities, details the economic and environmental benefits of better site designs, and presents case studies from across the country.

Conservation Design for Subdivisions: A Practical Guide for Creating Open Space Networks
www.amazon.com/Conservation-Design-Subdivisions-Practical-Creating/dp/1559634898
A plain-language, illustrated guide for designing open space subdivisions (available for purchase).

Low-Impact Development Design Strategies: An Integrated Design Approach
www.epa.gov/owow/nps/lid/lidnatl.pdf (PDF, 9MB, 150 pages)
This document was prepared by the Prince George's County Maryland Department of Environmental Resources Programs and Planning Division, with assistance from EPA.

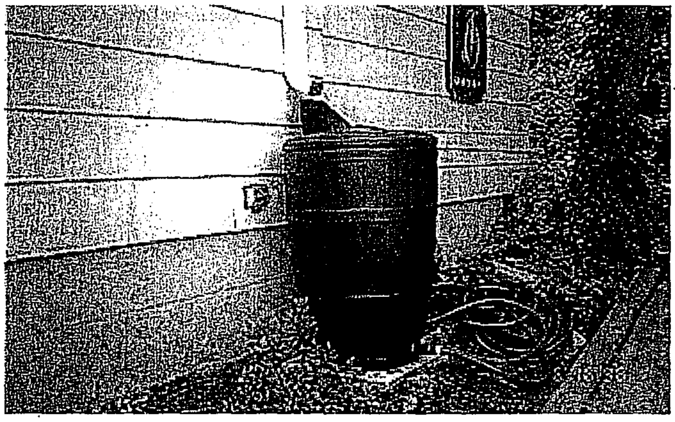
Low-Impact Development Hydrologic Analysis
www.epa.gov/owow/nps/lid/lid_hydr.pdf (PDF, 2MB, 45 pages)
This document was prepared by the Prince George's County Maryland Department of Environmental Resources Programs and Planning Division, with assistance from EPA. The design charts from the appendices of this document are not available in PDF format.

Websites

EPA LID Website
www.epa.gov/owow/nps/lid
A compilation of a number of resources, with links to Web sites, a literature review, fact sheets, and technical guidance.

Low Impact Development Center Website
www.lowimpactdevelopment.org
A nonprofit organization whose goal is to promote water resource and environmental protection through proper site design techniques that replicate preexisting hydrologic site conditions. Their website contains a variety of technical resources and case studies exemplifying LID techniques.

Center for Watershed Protection Website
www.cwp.org
A nonprofit organization that provides technical tools for protecting water resources to local governments, activists, and watershed organizations. The Center has developed a number of excellent publications pertaining to site design and watershed protection.



Rain barrels are appropriate for residential settings.

Green Values Stormwater Toolbox
http://greenvalues.cnt.org
This site by the Center for Neighborhood Technology contains an overview and definition of green infrastructure practices and hosts the "Green Values Stormwater Calculator" that allows users to select "green interventions" and enter site characteristics, returning hydrologic and financial outcomes for each scenario. It also includes a pocket guide called Water: From Trouble to Treasure, A Pocket Guide to Green Solutions.

Ordinances

Maryland Model Stormwater Management Ordinance
www.mde.state.md.us/assets/document/sedimentstormwater/model_ordinance.pdf (PDF, 2.1MB, 28 pages)

Stafford County, Virginia, Low Impact Development Subdivision Ordinance Amendments
www.riverfriends.org/LinkClick.aspx?fileticket=qm80RtwjwG0%3d&tabid=86&mid=425 (PDF, 137KB, 6 pages)

Stafford County, Virginia, Low Impact Development Stormwater Code Amendments
www.riverfriends.org/LinkClick.aspx?fileticket=tcM6iE7Ko3I%3d&tabid=86&mid=425 (PDF, 226 KB, 32 pages)

Warsaw, Virginia, Low Impact Development Ordinance Amendments
www.riverfriends.org/LinkClick.aspx?fileticket=VIaUwo%2fvYtQ%3d&tabid=86&mid=425 (PDF, 104 KB, 3 pages)

Permits

Ventura, California, MS4 Permit
www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/venturaMs4.html

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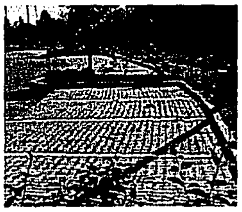
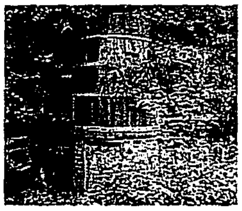
NOTE: This document is not law or regulation; it provides recommendations and explanations that MS4s may consider in determining how to comply with requirements of the CWA and NPDES permit requirements.

Attachment 11:
EPA Managing Wet Weather with Green Infrastructure March 2008 Newsletter

Managing Wet Weather with
Green Infrastructure
a periodic update on activities

Volume 2008, Issue 2 March 2008

On January 30, 2008 the New York City Council amended the administrative code to tackle the sewage overflow problem in the City's overburdened sewer system, and on February 19, 2008 Mayor Bloomburg signed it into law. The legislation advances the implementation of green infrastructure elements in the City's existing streets, parks, and other public spaces and into existing and new development projects. By adopting green infrastructure solutions, such as green roofs, permeable pavement, wetland restoration, and smarter design of street tree plantings, stormwater can be captured where it falls and used to green the city, instead of overwhelming sewers and flushing raw sewage directly into City waterways. The legislation, City Council Intro No. 630, ensures that New York City will follow through with the initiatives outlined in Mayor Bloomberg's PlaNYC 2030, by requiring the development of a city-wide Sustainable Stormwater Management Plan focusing on such measures. For more information on the water quality components of PlaNYC 2030, see http://www.nyc.gov/html/planyc2030/html/plan/water_quality.shtml

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Kansas City, Missouri has passed an administrative regulation to implement the City's Green Solutions Policy Resolution. The administrative regulation went into effect Feb. 25, 2008 and directs City departments to incorporate green solutions into City policies, projects and programs. Green solutions include green infrastructure such as rain gardens, bio-retention facilities and stream buffers, which reduce storm water runoff and water pollution, create recreational amenities and protect natural resources. Green solutions also include renewable energy, solid waste recycling, mass transit, bike/pedestrian infrastructure and other measures that reduce greenhouse gas emissions and improve environmental quality. The policy also provides for the creation of a Green Team Committee, which will direct the City's green solutions efforts, approve modification of internal business processes necessary to implement green solutions throughout the City and provide direction on innovative ways to add green solutions to City projects.

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Cistern at Chicago Center for Green Technology

For more information on managing wet weather with green infrastructure see the website at: www.epa.gov/npdes/greeninfrastructure. To be added to an e-mail distribution list for future issues of this bulletin and other notices, send an e-mail request to molloy.jennifer@epa.gov.

On February 27, 2008 the U.S. House Science and Technology Committee approved legislation that would fund new research into ways to reduce transportation-related runoff. H.R. 5161, from Technology and Innovation Subcommittee Chairman David Wu (D-Ore.), would fund transportation research centers within at least 10 universities to study "green transportation infrastructure." This would include new technology, construction techniques and integration of green elements into existing transportation and waste management systems. The bill also instructs the Federal Highway Administration's National Highway Institute to work with other agencies to design a curriculum for builders and contractors that includes green transportation infrastructure. A corresponding measure has not been introduced in the Senate.

In Lexington, Kentucky the Bluegrass Rain Garden Alliance has announced an initiative called "2010 Rain Gardens by 2010". The initiative was launched on February 25, 2008 at a meeting that drew representatives of large corporations, small business owners, landscape architects, educators and homeowners. A web site will be set up where individuals can register their rain garden and post pictures of it. Everyone who registers will get a plaque to put in their rain garden.

New Publications

A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption. Prepared by The Low Impact Development Center. Sponsored by California State Water Resources Control Board Stormwater Program and the Water Board Academy. December 2007.

Jun Wang, Theodore A. Endreny, and David J. Nowak. *Mechanistic Simulation of Tree Effects in an Urban Water Balance Model*. Journal of the American Water Resources Association, 44(1), February 2008.

University of New Hampshire Stormwater Center 2007 Annual Report. http://www.unh.edu/erg/cstev/2007_stormwater_annual_report.pdf

Partner Features

The USDA Forest Service's Center for Urban Forest Research recently released their study of the urban tree canopy of the San Francisco Bay area, San Francisco Bay Area State of the Urban Forest Final Report. The report: (1) describes the historic changes to the region's urban canopy cover and amount of impervious surface, (2) quantifies the value of ecosystem services the current forest provides, and (3) estimates future benefits based on possible expansion of the urban forest. http://www.fs.fed.us/psw/programs/cufr/products/2/psw_cufr719_SFBay.pdf

The U.S. Forest Service Pacific Southwest Research Station has also released a simple tree selection tool for Los Angeles called Million Trees LA. The tool helps private property owners in the LA area decide which trees best fit their locations, conditions and certain preferences such as evergreen or deciduous, fall foliage colors and edible fruit. http://www.fs.fed.us/psw/programs/cufr/milliontrees/

Upcoming Forums & Events

Building Sustainable Communities for the 21st Century. Southeast Watershed Forum. August 12-14, 2008. Charleston SC. Abstract Submission deadline March 14, 2008. http://www.southeastwaterforum.org/roundtables/default.asp

The Conservation Leadership Network has announced its spring courses for 2008. http://www.conservationfund.org/training_education/upcoming_training_courses


Stormwater wetland, Saylor Grove, Philadelphia

Attachment 12:
EPA Stakeholder Statement of Support for Green Infrastructure

Stakeholder Statement of Support for Green Infrastructure

Purpose

To bring together organizations that recognize the benefits of using green infrastructure in mitigating overflows from combined and separate sewers and reducing stormwater pollution and to encourage the use of green infrastructure by cities and wastewater treatment plants as a prominent component of their Combined and Separate Sewer Overflow (CSO & SSO) and municipal stormwater (MS4) programs.

Goals

Green infrastructure can be both a cost effective and an environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions. The undersigned organizations support:

- Use of green infrastructure by cities and utilities where it is an effective and feasible means of reducing stormwater pollution and sewer overflows;

- Development of models to quantify stormwater detention, retention, and filtration potential of green infrastructure to better identify opportunities to successfully use green infrastructure in CSO, SSO, MS4 and nonpoint source programs;

- Monitoring to verify the amount of CSO, SSO, and stormwater discharge reduction that cities obtain through using green infrastructure;

- Measurement of economic and environmental benefits realized from the use of green infrastructure in sewer systems and quantification of its life-cycle costs;

- Increased federal, state, and local funding for green infrastructure initiatives;

- Elimination of barriers to the incorporation of green infrastructure in stormwater and sewer system programs;

- Development and funding of a plan to identify research needs to further green infrastructure;

- Preparation of guidance documents to assist cities and wastewater treatment plants in developing green infrastructure initiatives in their CSO, SSO, and MS4 programs; and

- Development of model provisions to incorporate green infrastructure into CSO and MS4 permits; SSO capacity, management, operations, and maintenance plans; and consent decrees and other enforcement vehicles.

Background
Many communities in the United States are looking for ways to reduce overflows from sewer systems and stormwater discharges. Overflows occur when combined sewage and stormwater pipes overflow due to rainfall or other wet weather events. In the late 20^{th} century, most cities that attempted to reduce sewer overflows did so by separating combined sewers, expanding treatment capacity or storage within the sewer system, or by replacing broken or decaying pipes. More recently, a number of cities and utilities have recognized that sewer overflows can also be reduced effectively by diverting stormwater from the sewer system and directing it to areas where it can be infiltrated, evapotranspirated or re-used. These approaches are often referred to as "green infrastructure" because soil and vegetation are used instead of, or in addition to, pipes, pumps, storage tunnels, and other "hard infrastructure" that is traditionally used to store and treat the combined sewage and stormwater. Green infrastructure can also be used to reduce stormwater discharges and help to restore the natural hydrology, water quality and habitat of urban and suburban watersheds.

Green Infrastructure Benefits
Green infrastructure approaches currently in use include green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, vegetated median strips, reforestation, and protection and enhancement of riparian buffers and floodplains. Green infrastructure can be used almost anywhere where soil and vegetation can be worked into the urban or suburban landscape. Green infrastructure is most effective when supplemented with other decentralized storage and infiltration approaches, such as the use of permeable pavement and rain barrels and cisterns to capture and re-use rainfall for watering plants or flushing toilets. These approaches can be used to keep rainwater out of the sewer system so that it does not contribute to a sewer overflow and also to reduce the amount of untreated stormwater discharging to surface waters. Green infrastructure also allows stormwater to be absorbed and cleansed by soil and vegetation and either re-used or allowed to flow back into groundwater or surface water resources.

Green infrastructure has a number of other environmental and economic benefits in addition to reducing the volume of sewer overflows and stormwater discharges.

- *Cleaner Water* – Vegetation and green space reduce the amount of stormwater runoff and, in combined systems, the volume of combined sewer overflows.

- *Enhanced Water Supplies* – Most green infiltration approaches involve allowing stormwater to percolate through the soil where it recharges the groundwater and the base flow for streams, thus ensuring adequate water supplies for humans and more stable aquatic ecosystems.

- *Cleaner Air* – Trees and vegetation improve air quality by filtering many airborne pollutants and can help reduce the amount of respiratory illness.

- *Reduced Urban Temperatures* – Summer city temperatures can average 10°F higher than nearby suburban temperatures. High temperatures are linked to higher ground level ozone concentrations. Vegetation creates shade, reduces the amount of heat absorbing materials and emits water vapor – all of which cool hot air.

- *Increased Energy Efficiency* – Green space helps lower ambient temperatures and, when incorporated on and around buildings, helps shade and insulate buildings from wide temperature swings, decreasing the energy needed for heating and cooling.

- *Community Benefits* – Trees and plants improve urban aesthetics and community livability by providing recreational and wildlife areas. Studies show that property values are higher when trees and other vegetation are present.

- *Cost Savings* - Green infrastructure may save capital costs associated with digging big tunnels and centralized stormwater ponds, operations and maintenance expenses for treatment plants, pumping stations, pipes, and other hard infrastructure; energy costs for pumping water around; cost of treatment during wet weather; and costs of repairing the damage caused by stormwater and sewage pollution, such as streambank restoration.

Attachment 13:
Storm Water Links

Storm Water Links:

State Water Board Storm Water Program:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/

Erase the Waste Campaign – California Storm Water Toolbox
http://www.waterboards.ca.gov/water_issues/programs/outreach/erase_waste/

State Water Board Storm Water Grant Program:
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/prop84/index.shtml

EPA Storm Water Program:
http://cfpub.epa.gov/npdes/home.cfm?program_id=6

Federal Funding Sources for Watershed Protection:
http://cfpub.epa.gov/fedfund/

California Stormwater Quality Association:
http://www.casqa.org/

Stormwater Manger's Resource Center:
http://www.stormwatercenter.net/

Low Impact Development Links:

Low Impact Development – Sustainable Storm Water Management:
http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/

Central Coast Regional Water Quality Control Board LID:
http://www.waterboards.ca.gov/centralcoast/stormwater/low%20impact%20devel/lid_index.htm

EPA Green Infrastructure Basic Information:
http://cfpub.epa.gov/npdes/greeninfrastructure/information.cfm

Managing Wet Weather with Green Infrastructure:
http://cfpub.epa.gov/npdes/home.cfm?program_id=298

EPA Managing Wet Weather with Green Infrastructure March 2008 Newsletter:
http://www.epa.gov/npdes/pubs/gi_newsletter_mar08.pdf

Low Impact Development Center:
http://www.lowimpactdevelopment.org/

A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption:
http://www.waterboards.ca.gov/lid/docs/ca_lid_policy_review.pdf

State Water Board Funded Projects That Include Low Impact Development:
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/low_impact_development/