EROSION AND SEDIMENT CONTROL
&
LOW IMPACT DEVELOPMENT/ HYDROMODIFICATION MANAGEMENT

WEDNESDAY, MAY 5, 2010

SAN LUIS OBISPO, CA

WEDNESDAY, MAY 12, 2010

SANTA BARBARA, CA

THURSDAY, MAY 13, 2010

SALINAS, CA

Water Boards

Caltrans

CTSW-OT-10-255.12.1

Introduction: Facilitators

- Course Sponsors
- Who are we?
- What are our backgrounds?

Introduction: About You

- Who are you?
- What is your storm water background?
- Have you ever had formal storm water training?

Agenda

7:30 AM Registration

8:15 AM Welcome and Video

"Hold on to Your Dirt: Preventing Erosion from Construction Projects"

8:45 AM Regulations and Responsibilities

Significant Changes and Additions to the California General Construction Permit, Federal-State Regulations, Enforcement

9:45 AM Break

10:00 AM Significant Changes to California General Construction Permit

11:00 AM Erosion and Sediment Control

Best Management Practices

12:30 PM Inspections, Monitoring, and Training Opportunities

1:00 PM Lunch Break

Visit with Vendors and See New Technologies

Santa Barbara Bonus: Walking tour of UCSB's LID BMPs

Agenda

2:15 PM What is Low Impact Development (LID)?

2:25 PM What is Hydromodification Management?

2:35 PM LID BMP Tools

Benefits and Incentives

Site Planning

Design, Construction, and Maintenance

Implementation

3:15 PM Break

3:30 PM More LID BMP Tools

How to Integrate LID into Site Design, Preparation, and Construction

4:30 PM Questions, Certificates, and Evaluations

5:00 PM Adjourn

Regulations and Responsibilities

May 2010

Prepared by:

Jennifer J. Bitting, PE

Storm Water Program Manager, CCRWQCB

and

Ed Othmer, PE, CPESC, CPSWQ

URS Corporation

Presented by:

John McCullah, CPESC

Salix Applied Earthcare

&

Ed Othmer, PE, CPESC, CPSWQ

URS Corporation

Water Boards

Caltrans


Why are we here?
Clean Water.

Why is clean water so important?

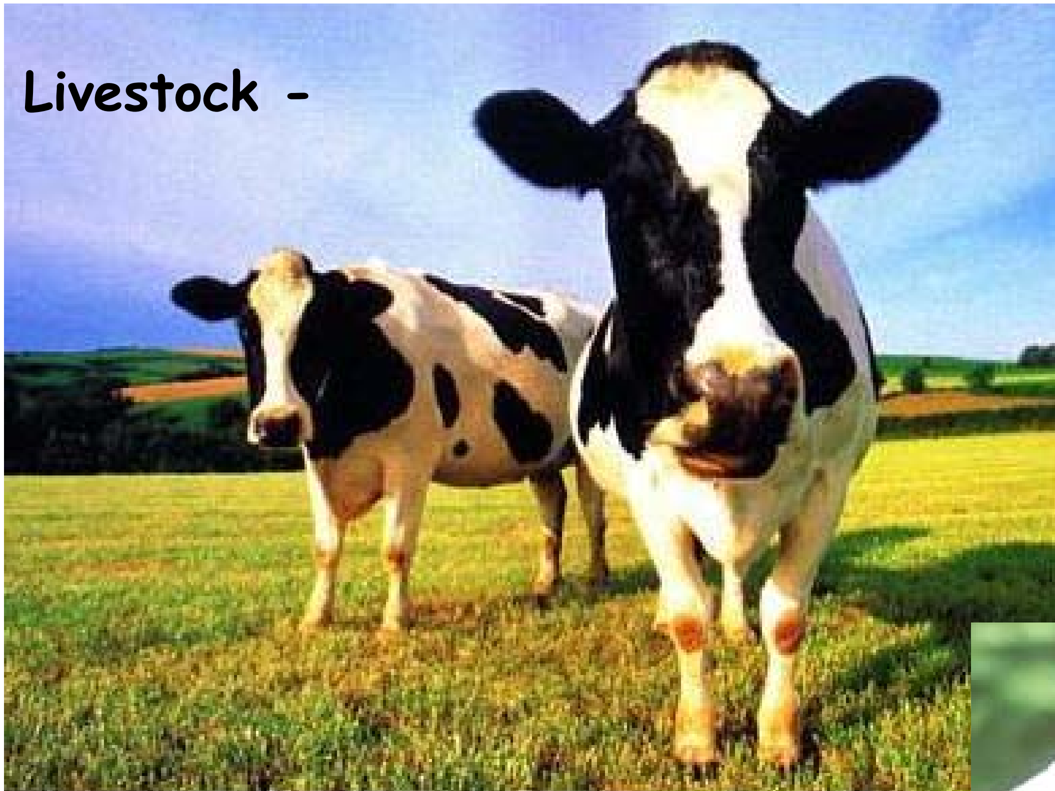
ALL the essential elements of life depend on it.


Plants – (and smaller organisms)


Fish -


Waterfowl -

Wildlife -



and People.

All of these life forms depend on clean water for their existence.

The Law

- 1972 Federal Clean Water Act (CWA)
  - Amend to Prohibit Any Discharge of Pollutants from a Point Source
- 1987 Amendments to the CWA
  - Added Section 402(p) Establishing the Framework for Regulations Regarding Municipal and Industrial Discharges
- 1990 EPA Published Final Regulations
  - Established Permit Requirements for Storm Water Discharges Associated with Industrial (Including Construction) Activities
- 1992 California's General Permit was Adopted
  - Established Requirements for Discharges Associated with Construction Activities
  - Revised in 1999; Modified in 2001 to Include Monitoring
  - Modified in 2002; Effective March 10, 2003 Construction Activity with Soil Disturbance ≥ 1 acre
- September 2, 2009 California's New General Permit (2009-0009-DWQ) Adopted
  - Effective July 1, 2010

Who Enforces These Laws?

- EPA
- SWRCB / RWQCB
- Other Agencies

- Private Citizens
  - NRDC
  - Baykeepers
  - Other Watchdog Groups

Roles and Responsibilities During New Development/Redevelopment

- **SWRCB/RWQCBs**
  - Issue permits (MS4 and CGP) and enforces requirements
- **Municipalities**
  - Establish local ordinances to comply with permit requirements
  - Review/approve new development redevelopment projects
  - Enforce permit requirements and local ordinances
- **Project Proponent**
  - Designs, constructs, and maintains project to comply with permits and local ordinances
- **Design Team (Collaborate and Coordinate)**
  - Civil Engineer - Hydrologist - Geotechnical Engineer
  - Soil Scientist - Botanist - Landscape Architect

Impacts of
Storm Water Pollution

Impacts

- Sediment is the number one pollutant of the nations rivers and lakes
- "An estimated 80 Millions Tons of solids are discharged annually from construction sites into receiving waters"

  According to the EPA

Impacts

- "On a unit basis, construction sites export sediment at 20 to 1,000 times the rates of other land uses."

According to the EPA

Storm water pollution can be many things...

- Soil, Dirt, and Sediment
- Paints and Solvents
- Pesticides/Herbicides
- Fertilizers
- Detergents
- Plaster or related products

- Concrete compounds
- Asphalt compounds
- Petroleum products (fuel, oil, and grease)
- Hazardous chemicals
- Acids, lime, glues, adhesives, and curing compounds
- And others...

You need to manage discharges into…

- Estuaries and deltas
- Rivers
- Creeks (including intermittent)
- Wetlands (tidal, seasonal…)
- Ponds
- Grassy swales
- Storm drains
- Off any project site

Uncontrolled erosion has enormous impacts on ecosystems.

Uncontrolled erosion has enormous impacts on ecosystems.

Sedimentation may lead to...

Cleanup Costs

Declining Fisheries


Impaired Recreational
Water Use


Dredging Costs

Economic Impacts and Loss of Tourism

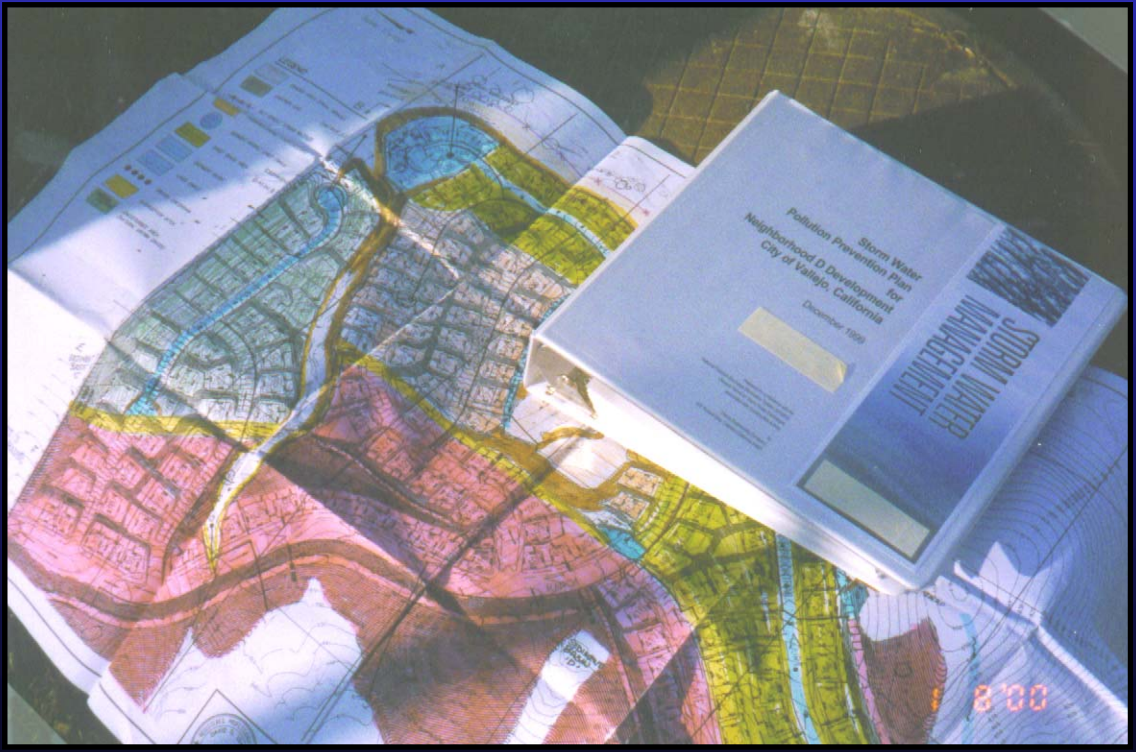
Aesthetic Losses

Regulatory Requirements

- Objective
- Applicable Construction Activities
- Activities Not Covered Under the Permit
- Fundamental Permit Requirements
- SWPPP Requirements
- RWQCB Notifications
- Other Permitting Obligations
- Enforcement

The objective of the General Permit is to eliminate discharges from the construction site to storm drains and water bodies.

This is achieved by developing and implementing an effective Storm Water Pollution Prevention Plan for the site.



Applicable Construction Activities

- Demolition, clearing, grading, grubbing, or excavation, and other land disturbance activities that disturb ≥ one acre of total land area
- Soil disturbances of less than one acre when part of a larger common plan of development that encompasses ≥ one acre of total land disturbance
- Linear Underground/Overhead Projects (LUPs)
- Oil and gas exploration, production, processing, or treatment operations associated with transmission facilities
- Construction of features on lands that are currently used for agriculture, but which are part of residential or commercial development (e.g., construction of roads for future residential development, buildings, dairy barns or food processing facilities)

General Permit Section I. B

Activities Not Covered Under the Permit

- Routine maintenance to maintain original line and grade, hydraulic
- capacity, or original purpose of the facility
- Disturbances to land surfaces solely related to agricultural operations such as disking, harrowing, terracing and leveling, and soil preparation
- Discharges of storm water from areas on tribal lands; construction on tribal lands is regulated by a federal permit
- Construction activity and land disturbance involving discharges of storm water within the Lake Tahoe Hydrologic Unit
- Construction activity that disturbs less than one acre of land surface, and that is not part of a larger common plan of development or the sale of one or more acres of disturbed land surface
- Construction activity covered by an individual NPDES Permit for storm water discharges

Activities Not Covered Under the Permit

- Discharges from small (1 to 5 acre) construction activities with an approved Rainfall Erosivity Waiver
- Landfill construction activity that is subject to the Industrial General Permit
- Construction activity that discharges to Combined Sewer Systems
- Conveyances that discharge storm water runoff combined with municipal sewage
- Discharges of storm water identified in CWA § 402(l)(2), 33 U.S.C. § 1342(l)(2)
- Discharges occurring in basins that are not tributary or hydrologically connected to waters of the United States (for more information contact your Regional Water Board).

General Permit Section I. C

7 FUNDAMENTAL PERMIT REQUIREMENTS

1. Obtain Permit coverage by submitting Permit Registration Documents (PRDs) to comply with terms of the Construction General Permit

2. Develop and Implement a Storm Water Pollution Prevention Plan (SWPPP) and Construction Site Monitoring Program for the site before constructions begins
   - SWPPP should be a dynamic, defensible, living document
   - Implement appropriate Best Management Practices
   - Monitor the site and perform inspections of control practices implemented as part of the SWPPP
   - Document the inspections and the results, as well as corrective action which is to be taken as a result
   - Evaluate and revise controls, and amend the SWPPP

7 FUNDAMENTAL PERMIT REQUIREMENTS

3. **Eliminate or minimize discharges from the construction site to the storm drain or water bodies**
    - Discharges resulting from rain events
    - Non storm water discharges resulting from dumping, leaking storage and maintenance areas and spillage of chemicals and waste materials
4. **Ensure only qualified staff work on project**
    - Have minimum credentials
    - Taken required training
    - Training is documented
5. **Prepare Annual Report**

Continued…

7 FUNDAMENTAL PERMIT REQUIREMENTS

6. **Notify the RWQCB of Non-Compliance**
   - Find the source of the problem and correct it immediately
   - Notify the RWQCB of incidences of non-compliance within thirty days
7. **Submit Notice of Termination (NOT)**
   - When construction is complete and disturbed soils have been permanently stabilized

SWPPP Minimum Requirements

- Specific to Risk Level
- Prepared, amended, and certified by QSD
- Designed to address the following objectives
  - Pollutants
  - Non-stormwater discharges
  - Minimum BMPs (selection, installation/use, maintenance)
  - Calculations and design of BMPs
  - Post-construction BMP and stabilization requirements
  - Maps/draws
  - Effluent requirements
  - Construction site monitoring program
  - Inspection/monitoring requirements

A general outline for a SWPPP

I. Title Page
II. Certification Page
III. Amendments
IV. Table of Contents
V. Introduction
VI. Source Identification
    I. Topography Map
    II. Site Map

Continued….

A general outline of a SWPPP cont.

VII. **Narrative Descriptions**

I. Site Estimates and Descriptions of On Site Soil

II. Pollutants Likely to be Present in Storm Water Discharges

III. Toxic Materials

IV. Minimum BMPs

V. Non-Storm Water Management

VI. Effluent Limits

VII. Maintenance, Inspection and Repair of BMPs

VIII. Spill Prevention and Control

IX. Post-Construction Storm Water Management (Permanent)

X. Personnel Training

XI. Lists of Contractors/Sub-Contractors

XII. Other Plans

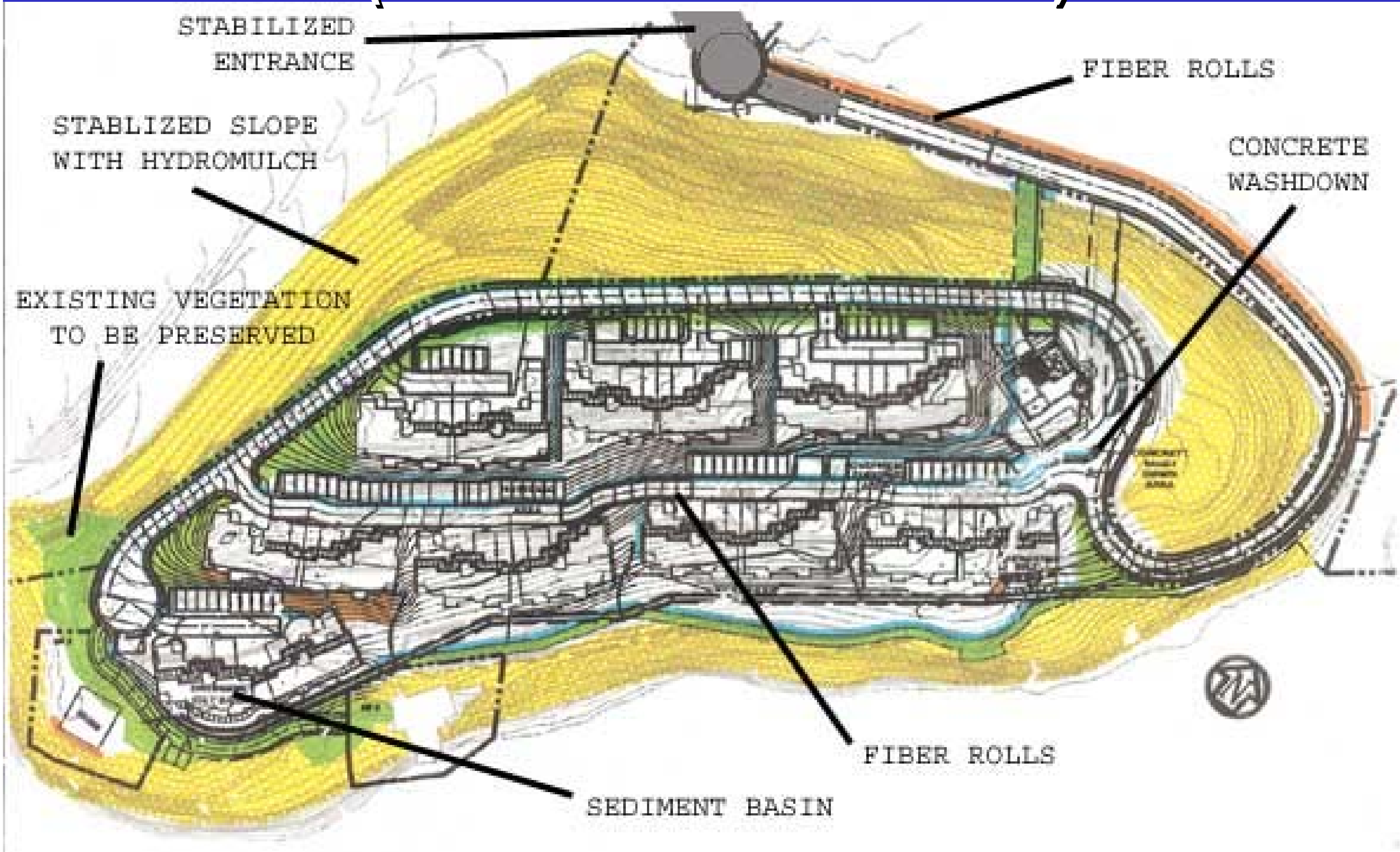
XIII. Construction Site Monitoring Program

XIV. Documentation

Topographic and site maps can be used to graphically depict locations of:

- Site layout
- Construction site boundaries
- Existing and planned paved areas and buildings
- Drainage patterns
- Discharge locations
- Surface water locations
- Sampling locations
- Areas of existing vegetation to be preserved
- Areas of soil disturbance
- Slopes as they will appear after major grading is completed
- BMP locations
  - Erosion control
  - Sediment control
  - Run-on control
  - ATS locations
- Areas and methods of storage for soils, materials and wastes
- Vehicle and equipment storage and service areas
- Location and type of post-construction control practices

COLOR CODED SWPPP SITE MAP (BMPs HIGHLIGHTED)



Notifications

- **Section I.H.59**

Exceedances of the NELs are a violation of this Permit. This General Permit requires dischargers with NEL exceedances to implement additional monitoring, BMPs, and revise their SWPPPs accordingly. Dischargers are required to notify the State and Regional Water Boards of the violation through the State Water Boards SMARTs system, and provide an NEL Violation Report sharing additional information concerning the NEL exceedance.

- **Section III.C**

The discharger shall notify the Regional Water Board of any anticipated non-storm water discharges not already authorized by this General Permit or another NPDES permit, to determine whether a separate NPDES permit is necessary.

Notifications

- **Section III.E**

The discharger shall notify the appropriate local, State, and federal agency(ies) when contaminated soil is found at a construction site, and will notify the appropriate Regional Water Board.

- **Attachment F, Section M.5.b (ATS)**

Upon any measurements that exceed water quality standards, the system operator shall immediately notify his supervisor or other responsible parties, who shall notify the Regional Water Board.

Other Permitting Obligations

You may need to comply with one or all of the following:

- National Environmental Protection Act (NEPA)
- California Environmental Quality Act (CEQA)
- Local grading and erosion control plans
- US Army Corps of Engineers: Clean Water Act Section 404 permit
- California Regional Water Quality Control Board: Clean Water Act Section 401 Certification
- California Department of Fish and Game Streambed Alteration Agreement

Enforcement

WHY WE ENFORCE STORM WATER REGULATIONS

1. We are mandated by the California Water Code to protect waters of the state and their beneficial uses
2. To prevent unfair business practices
   - Developers who are breaking the law should not have an economic advantage over conscientious developers; enforcement helps to keep the playing field level
3. Third parties can sue builders, state, and local governmental agencies for failing to enforce these regulations:
   - These lawsuits are viable, because they are based in the law (under Clean Water Act)
   - These lawsuits are becoming more common as environmental problems become more widespread and more dangerous

Informal Enforcement

When RWQCB inspectors initiate informal enforcement action, it can take the following forms:

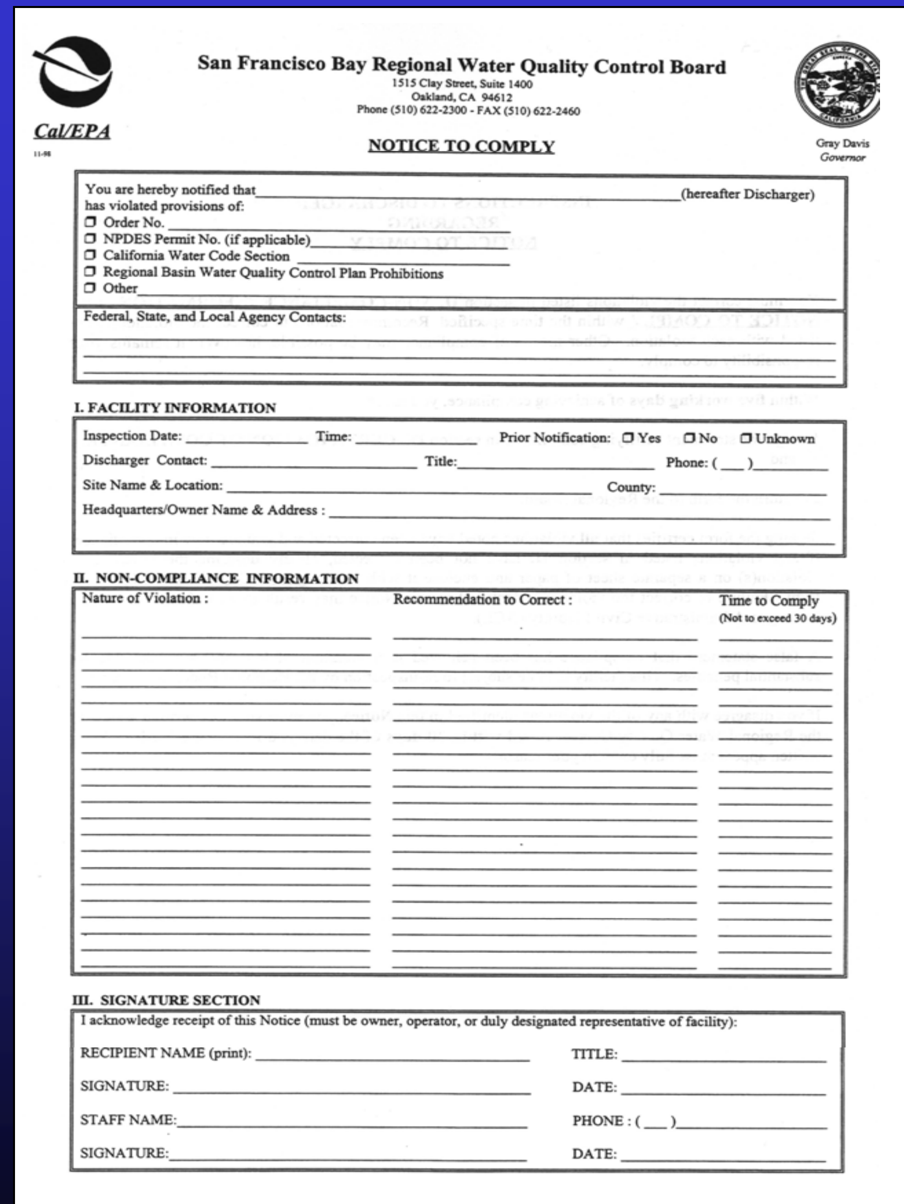
- Verbal Warning
- Staff Enforcement Letter
- Notice of Violation – compels action within a timeframe

Formal Enforcement

- Notice to Comply – fix-it ticket
- Notice of Noncompliance – issued after failure to follow a Notice to Comply
- Cleanup and Abatement Order
- Cease and Desist Order – Stoppage of work on your site until damage can be assessed and mitigated
- Administrative Civil Liabilities
- Attorney General/District Attorney referral

Here is a sample of a Notice to Comply, which is the first written step inspectors use to compel action.

If you receive a Notice to Comply, you should immediately remedy the listed deficiencies.



Cal/EPA

11-98

San Francisco Bay Regional Water Quality Control Board

1515 Clay Street, Suite 1400
Oakland, CA 94612
Phone (510) 622-2300 - FAX (510) 622-2460

Gray Davis
Governor

NOTICE TO COMPLY

You are hereby notified that ______________________ (hereafter Discharger)
has violated provisions of:
- ☐ Order No. ______________
- ☐ NPDES Permit No. (if applicable) ______________
- ☐ California Water Code Section ______________
- ☐ Regional Basin Water Quality Control Plan Prohibitions
- ☐ Other ______________

Federal, State, and Local Agency Contacts:

I. FACILITY INFORMATION

Inspection Date: ________ Time: ________ Prior Notification: ☐ Yes ☐ No ☐ Unknown

Discharger Contact: ________ Title: ________ Phone: (___) ________

Site Name & Location: ________ County: ________

Headquarters/Owner Name & Address : ________

II. NON-COMPLIANCE INFORMATION

Nature of Violation :	Recommendation to Correct :	Time to Comply (Not to exceed 30 days)

III. SIGNATURE SECTION

I acknowledge receipt of this Notice (must be owner, operator, or duly designated representative of facility):

RECIPIENT NAME (print): ________ TITLE: ________

SIGNATURE: ________ DATE: ________

STAFF NAME: ________ PHONE : (___) ________

SIGNATURE: ________ DATE: ________

Administrative Civil Liability (Monetary Penalties)

- Failure to Submit a Notice of Intent for Coverage under the appropriate storm water NPDES permit.

  Minimum $5,000 plus recovery of staff costs
- Failure to submit an annual report of construction certification when required by the Regional Board.

  Minimum $1,000 plus recovery of staff costs
- Violation of Permit Terms or Basin Plan Prohibitions

  Minimum amount is the economic savings of the violation

Fines (these can all happen at once)

- Federal – fines of up to $27,500 PER DAY can be imposed for UNINTENTIONAL violation, up to $55,000 per day for an intentional violation, in addition to criminal liability and responsibility for cleanup costs

- State – Penalties of up to an additional $10,000 per day plus $10/gallon of sediment-laden or polluted water discharged for each violation

2009 Water Code Section 13385(o) Enforcement Report

Table 6: Number of Violations of NPDES Stormwater Permits 2000 to 2009

Regional Offices	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009 (1)
1	71	64	52	89	13	6	5	87	103	68
2	139	18	104	65	5	437	7	300	266	156
3	19	29	96	30	204	457	68	62	236	47
4	263	1,263	1,243	926	577	294	229	156	238	80
5F	13	5	6	9	105	310	250	13	182	6
5R	71	27	133	30	153	59	96	73	75	65
5S	186	46	58	216	403	521	551	383	388	438
6A	25	32	71	54	83	44	88	26	21	6
6B	46	71	14	1	0	2	9	10	36	2
7	52	11	21	0	50	2	1	43	34	36
8	553	742	390	268	295	503	322	491	361	214
9	167	300	602	405	390	163	154	219	204	45
Total	**1,605**	**2,608**	**2,790**	**2,093**	**2,278**	**2,798**	**1,780**	**1,863**	**2,144**	**1,163**

(1) Data from 2000 to 2008 from CIWQS. Data for 2009 from SMARTS II and does not include 28 violations for Stormwater Municipal perm

2009 Water Code Section 13385(o) Enforcement Report

Table 7: NPDES Stormwater Violations by Category for 2009

Description of Violation Category (See Appendix B)	Non-Priority Violations	Priority Violations	Total	% of Total
Reporting	644	88	732	63%
Deficient BMP Implementation	285	6	291	25%
Incomplete/Insufficient SWPPP	84	6	90	8%
Unauthorized Discharge	31	2	33	3%
Other Requirement	11	0	11	1%
Failure to Pay Fees	4	0	4	0%
Monitoring	2	0	2	0%
Hydro Modification	0	0	0	0%
Category 1 Pollutant	0	0	0	0%
(blank)	0	0	0	0%
Category 2 Pollutant	0	0	0	0%
Effluent	0	0	0	0%
Total	**1,061**	**102**	**1,163**	**100%**

Construction Storm Water Enforcement Actions in Region 9

9/15/05

- Discharge of sediment to Escondido MS4 and waters of U.S.
- Failure to implement and maintain BMPs
- Failure to sample in accordance with CAO
- Failure to assess erosion and sediment controls
- Failure to submit reports
- Failure of City to require developer to implement SWPPP

Developer
$1,200,000

City
$50,000

Questions?

Construction General Permit Significant Changes and Additions

- Receiving Water Limitations
- Certification/Training Requirements for Key Project Personnel
- Rainfall Erosivity Waiver
- Obtaining Permit Coverage
- Revising Permit Coverage
- Risk-based Permitting Approach
- Technology-Based Numeric Action Levels and Numeric Effluent Limits
- Post-Construction Storm Water Performance Standards
- Minimum Best Management Practices
- Rain Event Action Plan (REAP)
- Visual Inspections
- Sampling and Analysis
- NEL Violation and NAL Exceedance Reporting
- Annual Reporting
- Terminating Permit Coverage
- Grandfathering
- Timeline

Receiving Water Limits

- Storm water discharges and authorized non-storm water discharges to any surface or ground water will not adversely affect human health or the environment
- Storm water discharges and authorized non-storm water discharges will not contain pollutants in quantities that threaten to cause pollution or a public nuisance

General Permit Section VI

Receiving Water Limits

- Storm water discharges and authorized non-storm water discharges will **not contain pollutants that cause or contribute to an exceedance of any applicable water quality objectives or water quality standards** (collectively, WQS) contained in a Statewide Water Quality Control Plan, the California Toxics Rule, the National Toxics Rule, or the applicable Regional Water Board's Water Quality Control Plan (Basin Plan)
- Dischargers located within the watershed of a CWA § 303(d) impaired water body, for which a TMDL has been approved by the U.S. EPA, shall **comply with the approved TMDL if it identifies "construction activity" or land disturbance as a source of the pollution**

General Permit Section VI

Certification and Training Requirements

- Qualified SWPPP Developer (Write, Amend, Certify)

+

California Environmental Protection Agency

STATE WATER RESOURCES CONTROL BOARD

QSD Training Course

(2 Years After Permit Adoption… September 2, 2011)

Required on July 1, 2010

General Permit Section VII.B.1

Certification and Training Requirements

- Qualified SWPPP Practitioner (BMP Implementation, Observations, S&A)

Qualified SWPPP
Developer

OR

CERTIFIED Erosion Sediment Storm Water CESSWI™ INSPECTOR

CERTIFIED INSPECTOR CISEC SEDIMENT AND EROSION CONTROL

\+

California Environmental Protection Agency
STATE WATER RESOURCES CONTROL BOARD

QSP Training Course
(2 Years After Permit Adoption…
September 2, 2011)

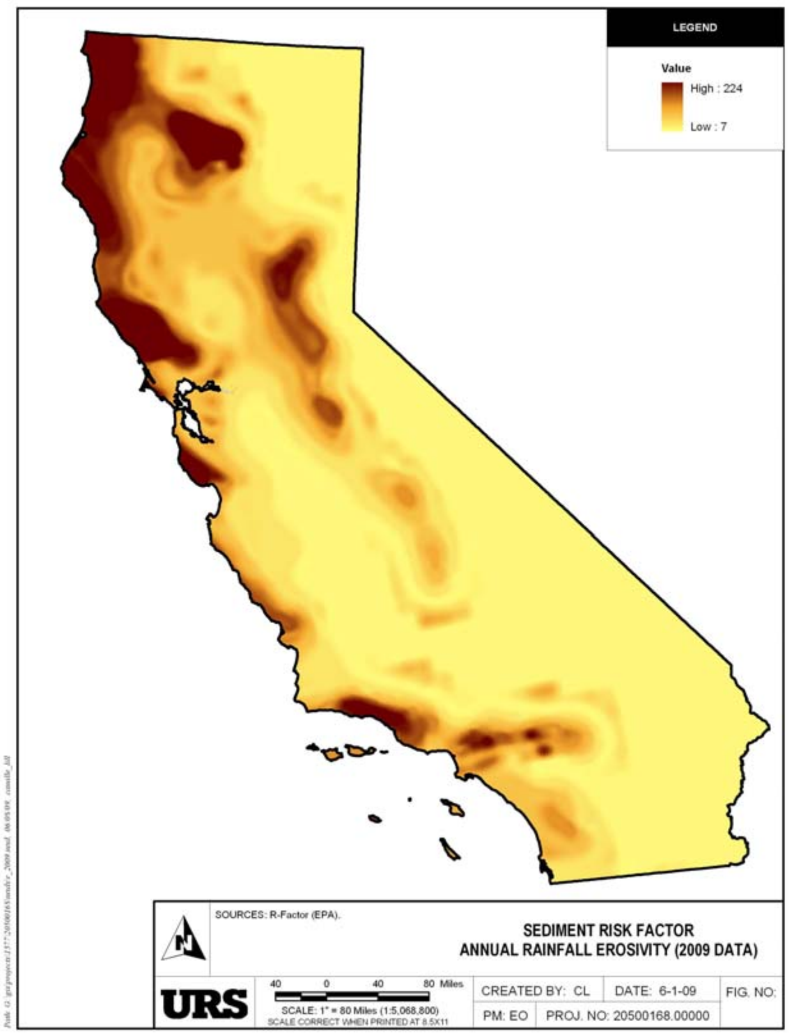
Required on September 2, 2011

General Permit Section VII.B.3

Rainfall Erosivity Waiver

Permit Exemption for projects:

- >1 and <5 acres, and
- Rainfall erosivity value (R value) less than equal to 5
- Certification done through the PRD process in SMARTS



General Permit Section II.B.7

Obtaining Permit Coverage

New Dischargers (On or After July 1, 2010)

Prepares PRDs

- NOI
- Risk Assessment
- Site Map
- SWPPP

Upload to SWRCB Storm Water Multi-application and Report Tracking System (SMARTS) (not to include security sensitive information)

Legally Responsible Person Signs Certification Statement via SMARTS

Pay Fee (mail no later than 7 days before construction)

SWRCB Issues WDID

LRP need not have the same qualifications as a QSD

General Permit Section II.B

Obtaining Permit Coverage

Existing Dischargers (Covered Under 99-08-DWQ or 2003-0007-DWQ)

Prepare PRDs
- NOI
- Risk Assessment
- Site Map
- Revised SWPPP

Upload to SWRCB Storm Water Multi-application and Report Tracking System (SMARTS)

Legally Responsible Person Signs Certification Statement via SMARTS
No Later than July 1, 2010

SWRCB will Re-issue Same WDID from 99-08-DWQ

LRP need not have the same qualifications as a QSD

General Permit Section II.B

Revising Permit Coverage for Change of Acreage or New Ownership

- Portion of site meet NOT requirements?

or

- Ownership of portion of site sold?

or

- New acreage?

Revise

- NOI
- SWPPP
- Site Map
  - acreage completed
  - acreage under construction
  - acreage sold/transferred/added
  - acreage stabilized
- Certification of new owner notification

Upload to SWRCB Storm Water Multi-application and Report Tracking System (SMARTS)

Legally Responsible Person Signs Certification Statement via SMARTS
Within 30 days of Acreage Change

If Increase in Acreage Pay Fee (mail no later than 14 days from receipt of revised annual fee notification)

General Permit Section II.C

Failure to submit an result in a $1,000 Fine!!

SWRCB Storm Water Multi-application and Report Tracking System (SMARTS)

- Rainfall Erosivity Waiver
- Permit Registration Documents (PRDs)
  - NOI
  - Risk Assessment
  - SWPPP
  - SWPPP Compliance Checklist
  - Fee (mail no later than 7 days before construction)
- NAL Exceedance Reports
- NEL Violation Reports
- NOT
- Annual Report
- Tracks RWQCB Inspections and Enforcement Actions

Various

SMARTS will be online by July 1, 2010

Risk-based Permitting Approach (Traditional Projects)

- Three Risk Levels
- Sediment Risk Factors:
  - "R" factor
  - "K" factor
  - "LS" Factor
- Receiving Water Risk Factors
  - 303(d) sediment impaired water bodies

    OR
  - SPAWN & COLD & MIGRATORY
- Complete Risk Determination Worksheet (Appendix 1)

Combined Risk Level Matrix

Receiving Water Risk	Sediment Risk: Low	Sediment Risk: Medium	Sediment Risk: High
Low	Level 1	Level 2	Level 2
High	Level 2	Level 2	Level 3

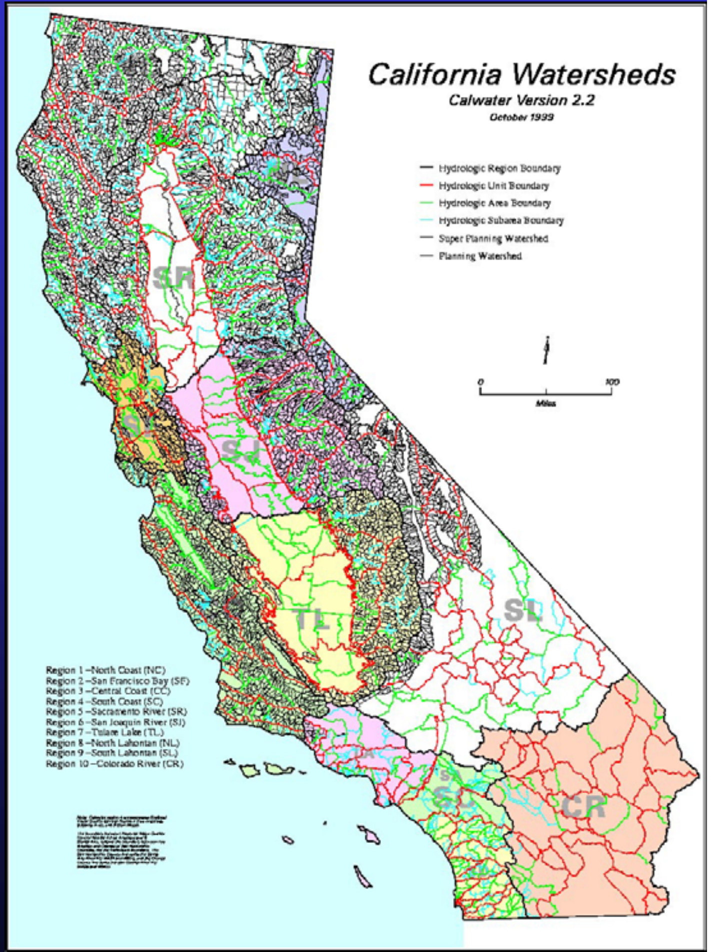
Sediment Sensitive Receiving Water also means one with a USEPA-approved TMDL implementation plan for sediment (Fact Sheet Section J.1.a)

Fact Sheet Section II.J.1.a, General Permit Section VIII, and Appendix 1

Risk-based Permitting Approach (Traditional Projects)

- Calculate separate Risk Levels for sites spanning 2 or more Planning Watersheds
- Planning Watershed defined by Calwater
  - 3,000 to 10,000 acres
  - 7th–level, 14 digit unit of the hydrologic unit hierarchy
- Discharger notifies SWRCB via PRDs
- RWQCB may choose to break project into separate implementation levels

http://cain.ice.ucdavis.edu/calwater/calwfaq.html, http://gis.ca.gov/catalog/BrowseRecord.epl?id=22175



Fact Sheet Section II.J.1.a, General Permit Section VIII, and Appendix 1

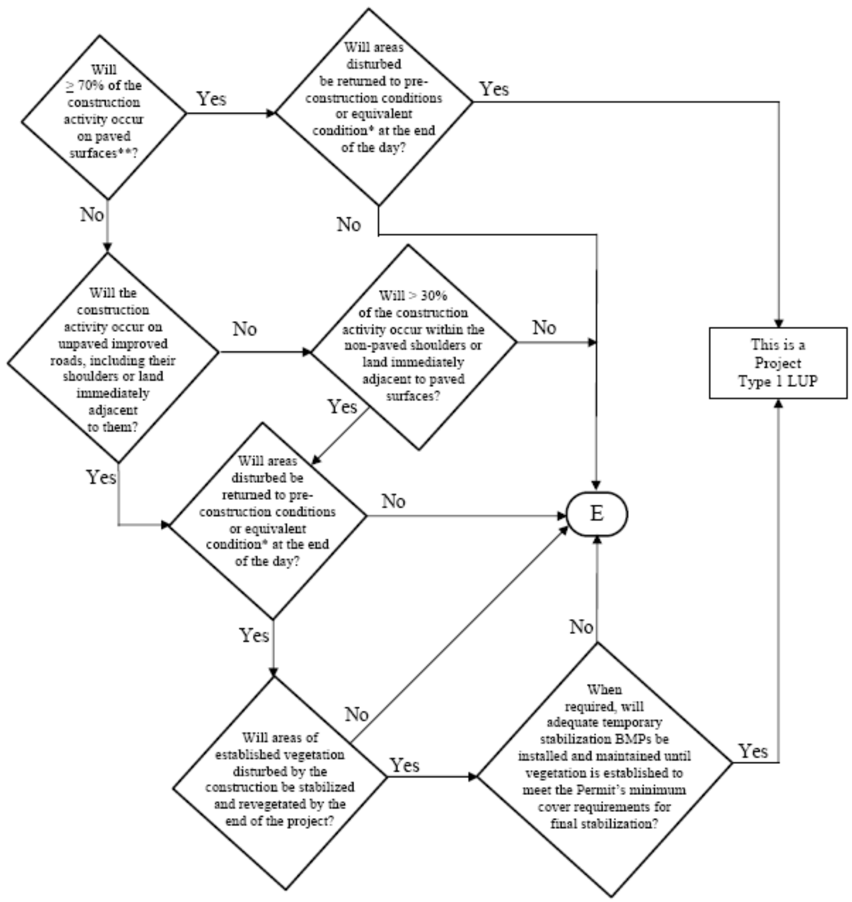
Risk-based Permitting Approach (Linear Underground/Overhead Projects)

- Three Types (1, 2, and 3)
- Factors Include:
  - Location
  - Sediment Risk
  - Receiving Water Risk
- Use Flow Charts (Attachment A.1)

Fact Sheet Section II.J.2.a, General Permit Attachment A.I, and Appendix 1

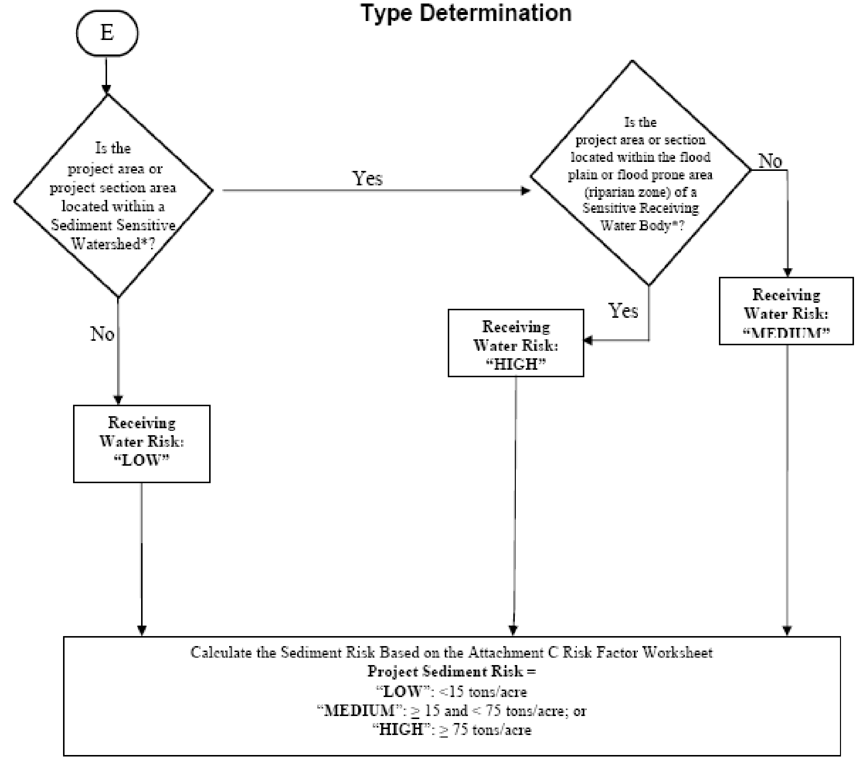
Risk-based Permitting Approach (Linear Underground/Overhead Projects)

ATTACHMENT A.1
LUP Project Area or Project Section Area Type Determination



*See Definition of Terms
** Or: "Will < 30% of the soil disturbance occur on unpaved surfaces?

ATTACHMENT A.1
LUP Project Area or Project Section Area Type Determination



* See Definition of Terms

PROJECT SEDIMENT RISK

RECEIVING WATER RISK	LOW	MEDIUM	HIGH
LOW	Type 1	Type 1	Type 2
MEDIUM	Type 1	Type 2	Type 3
HIGH	Type 2	Type 3	Type 3

How to Calculate Your Risk Level (Problem 1 – Method A)

- A facility will be constructed at MCAS Miramar, San Diego
- The Project will disturb 19.4 acres
- Project will have a duration of 18 months beginning in October
- The average slope is ~25%
- The average slope length is 100 feet
- The project discharges to Carol Canyon Creek

Determine your Risk Level

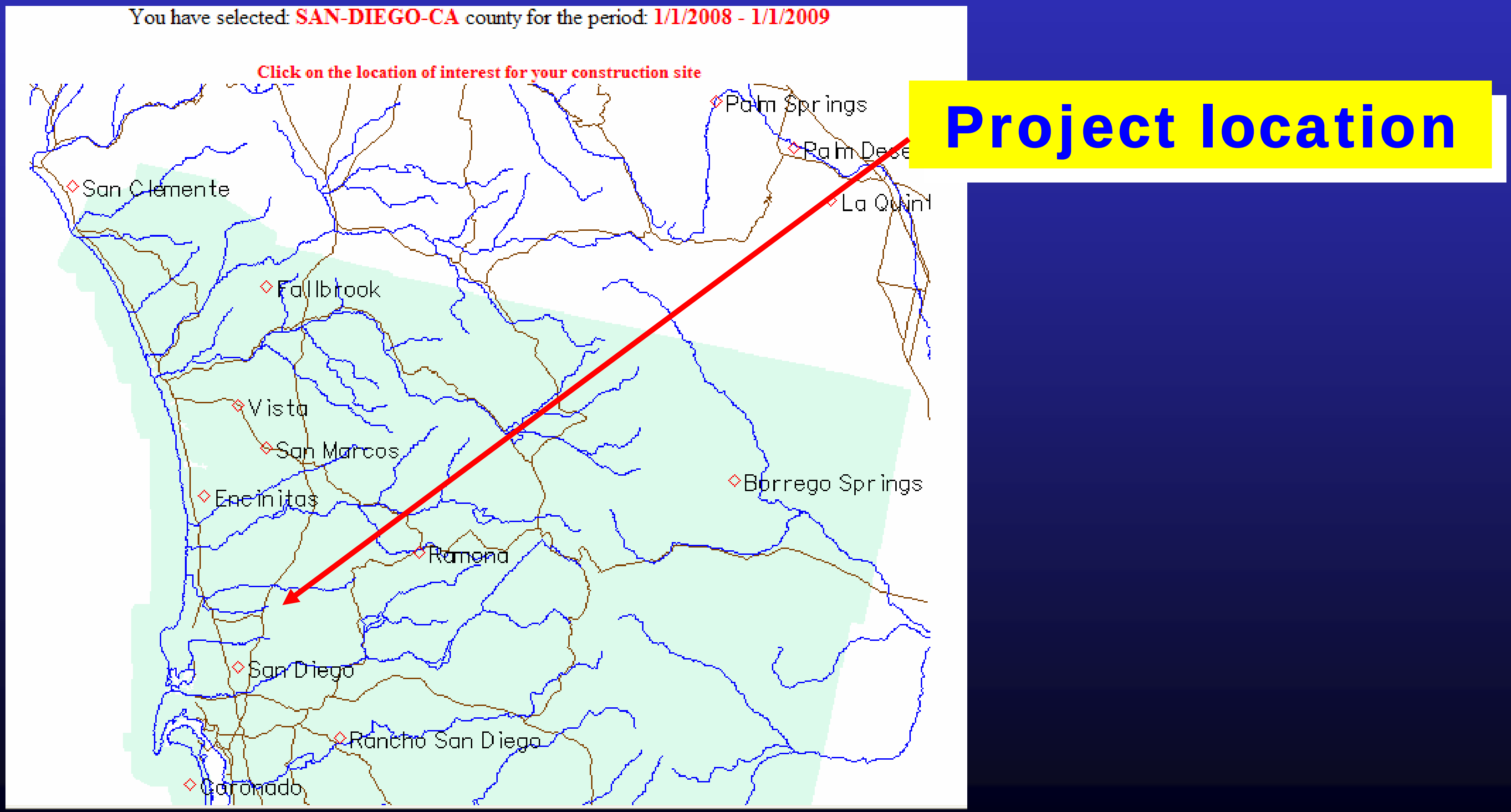
How to Calculate Your Risk Level (Problem 1 – Method A)

	A	B	C
1	**Sediment Risk Factor Worksheet**		**Entry**
2	**A) R Factor**		
3	Analyses of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy (E) times the maximum 30-min intensity (I30) (Wischmeier and Smith, 1958). The numerical value of R is the average annual sum of EI30 for storm events during a rainfall record of at least 22 years. "Isoerodent" maps were developed based on R values calculated for more than 1000 locations in the Western U.S. Refer to the link below to determine the R factor for the project site.		
4	http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm		
5	**R Factor Value**		0

7	detachment and they produce runoff at moderate rates. Soils having a high silt content are especially susceptible to erosion and have high K values, which can exceed 0.45 and can be as large as 0.65. Silt-size particles are easily detached and tend to crust, producing high rates and large volumes of runoff. Use Site-specific data must be submitted.	
8	Site-specific K factor guidance	
9	**K Factor Value**	0
10	**C) LS Factor (weighted average, by area, for all slopes)**	
11	The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.	
12	LS Table	
13	**LS Factor Value**	0
14		
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**	0
16	**Site Sediment Risk Factor**	**Low**
17	Low Sediment Risk: < 15 tons/acre	
18	Medium Sediment Risk: >=15 and <75 tons/acre	
19	High Sediment Risk: >= 75 tons/acre	
20		

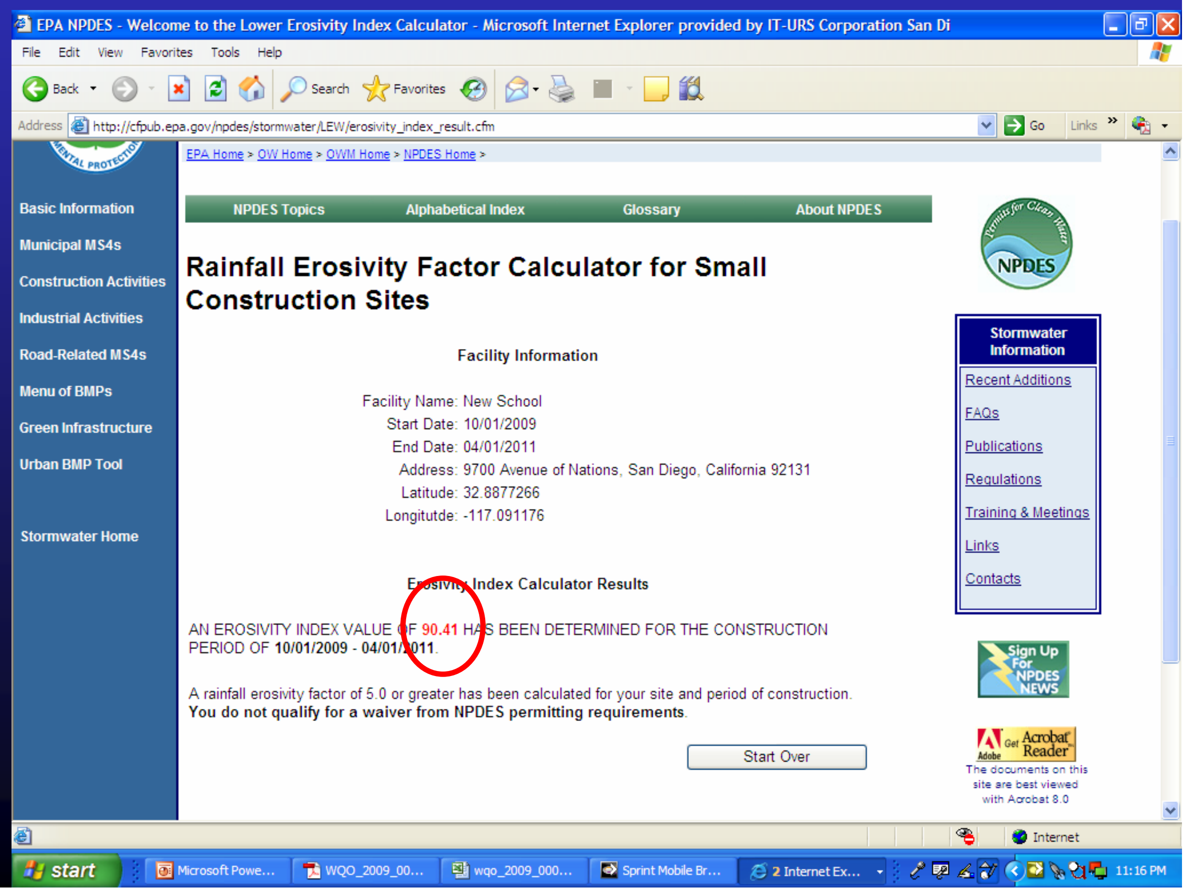
General Permit Appendix 1

How to Calculate Your Risk Level (Problem 1 – Method A)



How to Calculate Your Risk Level (Problem 1 – Method A)

- Obtain R from http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm
- Result: R = 90.41



How to Calculate Your Risk Level (Problem 1 – Method A)

	A	B	C
1	**Sediment Risk Factor Worksheet**		**Entry**
6	**B) K Factor (weighted average, by area, for all site soils)**		
7	The soil-erodibility factor K represents: (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. Fine-textured soils that are high in clay have low K values (about 0.05 to 0.15) because the particles are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low K values (about 0.05 to 0.2) because of high infiltration resulting in low runoff even though these particles are easily detached. Medium-textured soils, such as a silt loam, have moderate K values (about 0.25 to 0.45) because they are moderately susceptible to particle detachment and they produce runoff at moderate rates. Soils having a high silt content are especially susceptible to erosion and have high K values, which can exceed 0.45 and can be as large as 0.65. Silt-size particles are easily detached and tend to crust, producing high rates and large volumes of runoff. Use Site-specific data must be submitted.		
8	Site-specific K factor guidance		
9			0

11	The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.	
12	LS Table	
13	**LS Factor Value**	0
14		
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**	0
16	**Site Sediment Risk Factor**	**Low**
17	Low Sediment Risk: < 15 tons/acre	
18	Medium Sediment Risk: >=15 and <75 tons/acre	
19	High Sediment Risk: >= 75 tons/acre	
20		

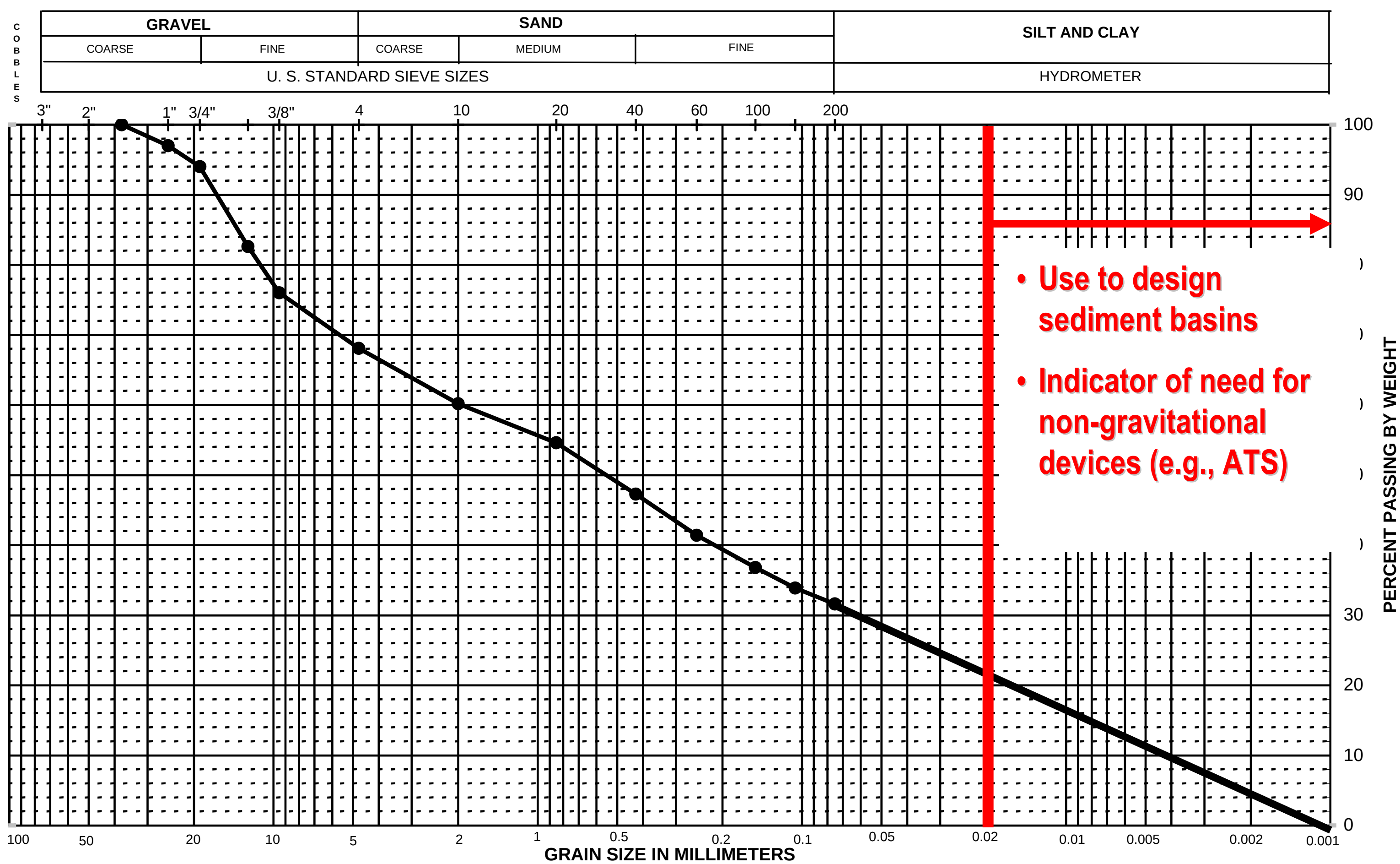
General Permit Appendix 1

How to Calculate Your Risk Level (Problem 1 – Method A)

- **Determine K from particle size analysis (ASTM D-422)**
- **Determine % particles <0.02 mm**
- **Several analyses may be necessary for each site**
- *May use other reliable sources to obtain K (e.g., NRCS)*

How to Calculate Your Risk Level (Problem 1 – Method A)

UNIFIED SOIL CLASSIFICATION



- Use to design sediment basins
- Indicator of need for non-gravitational devices (e.g., ATS)

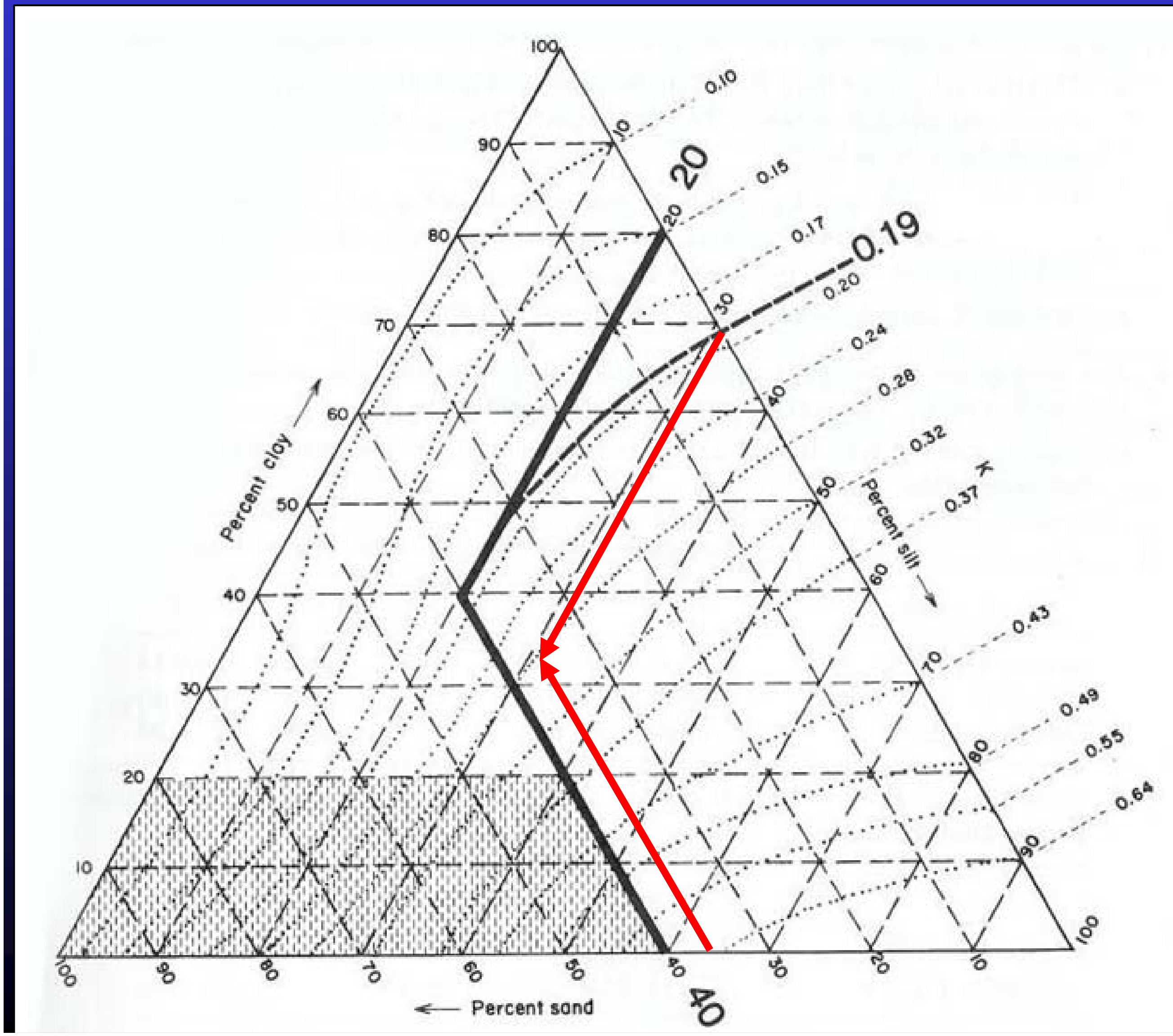
Sieve No.	Dia. mm	% Finer
3"	75.0	
2"	50.0	
1 1/2"	37.5	100.0
1"	25.0	97.0
3/4"	19.00	94.0
1/2"	12.50	82.6
3/8"	9.50	76.0
#4	4.75	68.1
#10	2.00	60.2
#20	0.850	54.6
#40	0.425	47.3
#60	0.250	41.4
#100	0.150	36.8
#140	0.106	33.9
#200	0.075	31.6
Hydrometer Analysis		

% Cobbles	
% Gravel	31.9
% Sand	36.5
% Fines	31.6
D_{60}	
D_{30}	
D_{10}	
C_u	
C_c	

Exploration	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% Clay	Description and Classification
Sacramento	3-215		●					Grayish brown clayey Sand with gravel (SC)

PROJECT NAME: RVTS Study | **PARTICLE-SIZE DISTRIBUTION CURVES**

How to Calculate Your Risk Level (Problem 1 – Method A)



- **Result: K = 0.29**

How to Calculate Your Risk Level (Problem 1 – Method A)

	A	B	C
1	**Sediment Risk Factor Worksheet**		**Entry**

	A	B	C
1	**Sediment Risk Factor Worksheet**		**Entry**
10	**C) LS Factor (weighted average, by area, for all slopes)**		
11	The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.		
12	LS Table		
13		**LS Factor Value**	0

	A	B	C
9		**K Factor Value**	0

	A	B	C
10	**C) LS Factor (weighted average, by area, for all slopes)**		
11	The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.		
12	LS Table		
13		**LS Factor Value**	0

	A	B	C
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**	0	
16	**Site Sediment Risk Factor**	**Low**	
17	Low Sediment Risk: < 15 tons/acre		
18	Medium Sediment Risk: >=15 and <75 tons/acre		
19	High Sediment Risk: >= 75 tons/acre		
20			

How to Calculate Your Risk Level (Problem 1 – Method A)

- **Obtain LS from Table**
- **Result: LS = 4.59**

Sheet Flow Length (ft)	Average Watershed Slope (%) 10.0	12.0	14.0	16.0	20.0	25.0	30.0	40.0	50.0	60.0
<3	0.35	0.36	0.38	0.39	0.41	0.45	0.48	0.53	0.58	0.63
6	0.37	0.41	0.45	0.49	0.56	0.64	0.72	0.85	0.97	1.07
9	0.38	0.45	0.51	0.56	0.67	0.80	0.91	1.13	1.31	1.47
12	0.39	0.47	0.55	0.62	0.76	0.93	1.08	1.37	1.62	1.84
15	0.40	0.49	0.58	0.67	0.84	1.04	1.24	1.59	1.91	2.19
25	0.57	0.71	0.85	0.98	1.24	1.56	1.86	2.41	2.91	3.36
50	0.91	1.15	1.40	1.64	2.10	2.67	3.22	4.24	5.16	5.97
75	1.20	1.54	1.87	2.21	2.86	3.67	4.44	5.89	7.20	8.37
100	1.46	1.88	2.31	2.73	3.57	4.59	5.58	7.44	9.13	10.63
150	1.92	2.51	3.09	3.68	4.85	6.30	7.70	10.35	12.75	14.89
200	2.34	3.07	3.81	4.56	6.04	7.88	9.67	13.07	16.16	18.92
250	2.72	3.60	4.48	5.37	7.16	9.38	11.55	15.67	19.42	22.78
300	3.09	4.09	5.11	6.15	8.23	10.81	13.35	18.17	22.57	26.51
400	3.75	5.01	6.30	7.60	10.24	13.53	16.77	22.95	28.60	33.67
600	4.95	6.67	8.45	10.26	13.94	18.57	23.14	31.89	39.95	47.18
800	6.03	8.17	10.40	12.69	17.35	23.24	29.07	40.29	50.63	59.93
1000	7.02	9.57	12.23	14.96	20.57	27.66	34.71	48.29	60.84	72.15

How to Calculate Your Risk Level (Problem 1 – Method A)

	A	B	C
1	**Sediment Risk Factor Worksheet**		**Entry**
2	**A) R Factor**		
3	Analyses of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy (E) times the maximum 30-min intensity (I30) (Wischmeier and Smith, 1958). The numerical value of R is the average annual sum of EI30 for storm events during a rainfall record of at least 22 years. "Isoerodent" maps were developed based on R values calculated for more than 1000 locations in the Western U.S. Refer to the link below to determine the R factor for the project site.		
4	http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm		
5	**R Factor Value**		90.41
6	**B) K Factor (weighted average, by area, for all site soils)**		
	The soil-erodibility factor K represents: (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. Fine-textured soils that are high in clay have low K values (about 0.05 to 0.15) because the particles are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low K values (about 0.05 to 0.2) because		

	A	B	C
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**		120.344751
16	**Site Sediment Risk Factor**		**High**
17	Low Sediment Risk: < 15 tons/acre		
18	Medium Sediment Risk: >=15 and <75 tons/acre		
19	High Sediment Risk: >= 75 tons/acre		
20			

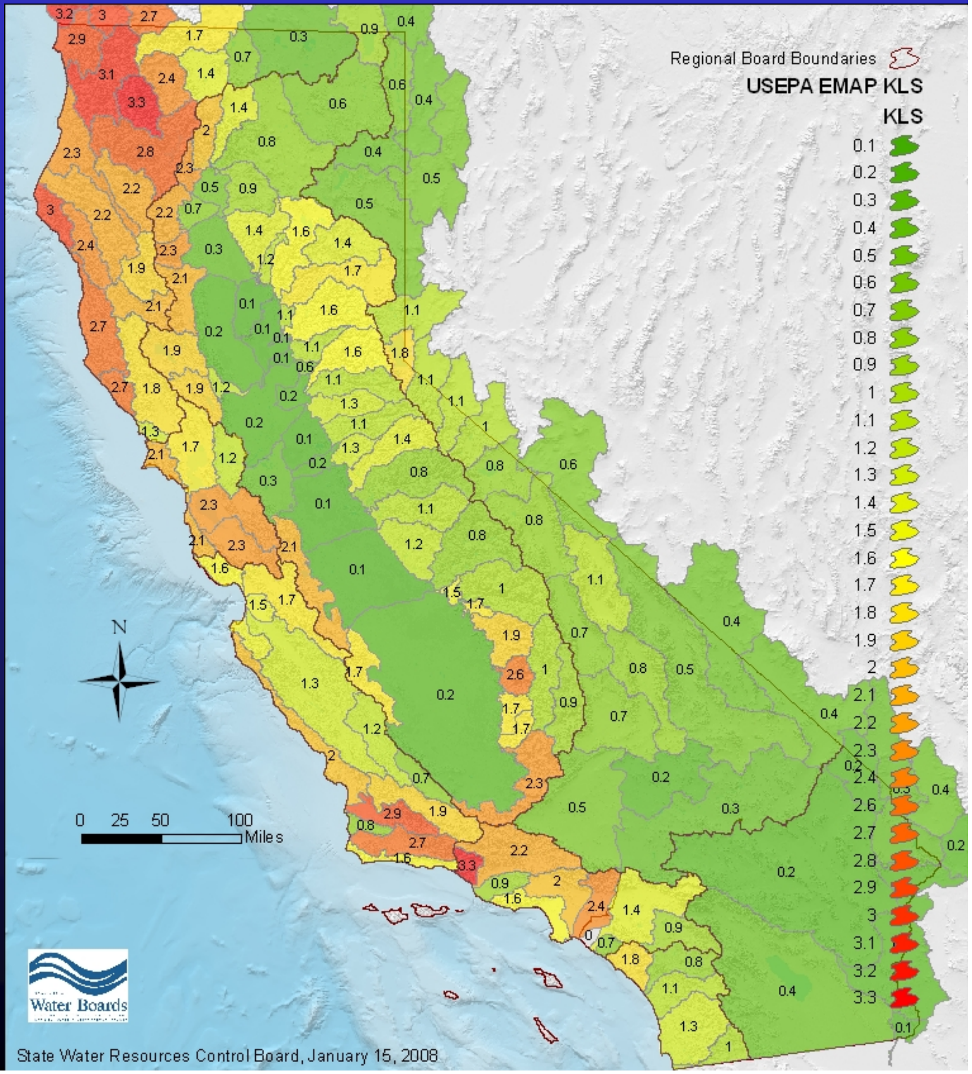
	A	B	C
11	progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.		
12	LS Table		
13	**LS Factor Value**		4.59
14			

	A	B	C
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**	120.344751	
16	**Site Sediment Risk Factor**	**High**	
17	Low Sediment Risk: < 15 tons/acre		
18	Medium Sediment Risk: >=15 and <75 tons/acre		
19	High Sediment Risk: >= 75 tons/acre		
20			

General Permit Appendix 1

How to Calculate Your Risk Level
(Problem 1 – Method B)

- **Use GIS map to determine K*LS**
- **Determine R from http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm**
- **Tons/acre = R x KLS**
- **Result:**
- **(R = 90.41) x (K*LS = 1.3) = 117.5 tons/acre**



General Permit Appendix 1

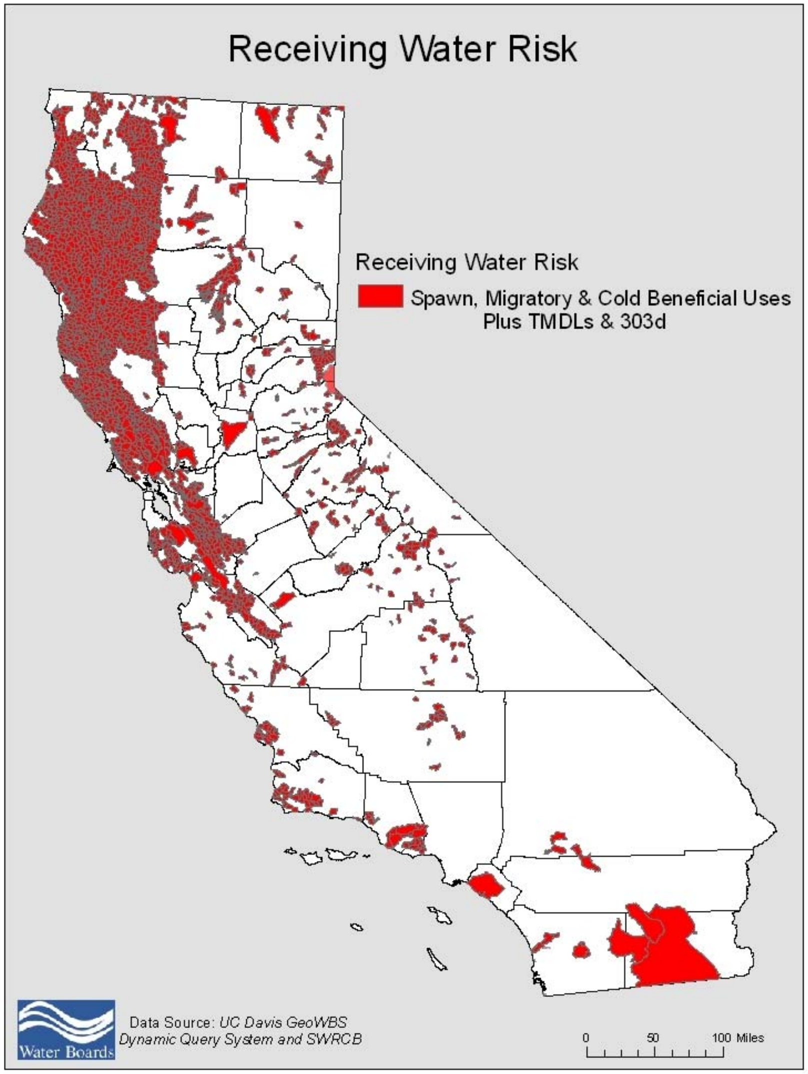
How to Calculate Your Risk Level (Problem 1)

Receiving Water (RW) Risk Factor Worksheet	Entry	Score
A. Watershed Characteristics	yes/no	
A.1. Does the disturbed area discharge (either directly or indirectly) to a **303(d)-listed waterbody impaired by sediment**? For help with impaired waterbodies please check the attached worksheet or visit the link below: 2006 Approved Sediment-impared WBs Worksheet http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml **OR** A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? http://www.ice.ucdavis.edu/geowbs/asp/wbquse.asp	**No**	**Low**

- **Direct Discharge:** A discharge that is routed directly to waters of the United States by means of a pipe, channel, or ditch (including a municipal storm sewer system), or through surface runoff.

General Permit Appendix 1

How to Calculate Your Risk Level (Problem 1)



General Permit Appendix 1

How to Calculate Your Risk Level (Problem 1)

Table 2-2. BENEFICIAL USES OF INLAND SURFACE WATERS

Inland Surface Waters [1, 2]	Hydrologic Unit Basin Number	BENEFICIAL USE MUN	AGR	IND	PROC	GWR	FRSH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
San Dieguito River Watershed - continued																
San Dieguito Reservoir	5.21	See Reservoirs & Lakes – Table 2-4														
Warren Canyon	5.21	●	●	●	●				●	●	●	●	●	●		
San Bernardo Valley	5.21	●	●	●	●				●	●		●		●	●	
unnamed intermittent streams	5.24	●	●	●	●				●	●		●		●		
unnamed intermittent streams	5.23	●	●	●	●				●	●		●		●		
unnamed intermittent streams	5.22	●	●	●	●				●	●		●		●		
San Dieguito River	5.11	+	○	○					●	●		●	●	●		●
Lusardi Creek	5.12	+	○	○					●	●		●		●		
Lusardi Creek	5.11	+	○	○					●	●		●		●		
La Zanja Canyon	5.11	+	○	○					●	●		●		●		
Gonzales Canyon	5.11	+	○	○					●	●		●		●		
San Dieguito Lagoon	5.11	See Coastal Waters – Table 2-3														
Los Penasquitos Creek Watershed																
Los Penasquitos Lagoon	6.10	See Coastal Waters – Table 2-3														
Soledad Canyon	6.10	+	●	●					○	●		●	●	●		
Carol Canyon	6.10	+	●	●					○	●		●	●	●	●	

● Existing Beneficial Use

○ Potential Beneficial Use

\+ Excepted from MUN (See Text)

[1] Waterbodies are listed multiple times if they cross hydrologic area or sub area boundaries.

[2] Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.

General Permit Appendix 1

How to Calculate Your Risk Level (Problem 1)

- Site does not discharge to 303(d) waterbody impaired for sediment
- Site does not discharge to waterbody with USEPA-approved TMDL implementation plan for sediment
- Site does not discharge to a waterbody with SPAWN & COLD & MIGR beneficial uses

How to Calculate Your Risk Level (Problem 1)

Combined Risk Level Matrix

Receiving Water Risk	Sediment Risk: Low	Sediment Risk: Medium	Sediment Risk: High
Low	Level 1	Level 2	Level 2
High	Level 2	Level 2	Level 3

Project Sediment Risk:	**High**
Project RW Risk:	**Low**
Project Combined Risk:	**Level 2**

General Permit Appendix 1

One last word…

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the <u>information submitted is, true, accurate, and complete</u>. I am aware that there are significant penalties for submitting false information, including the possibility of <u>fine and imprisonment for knowing violations</u>."

Technology-Based Numeric Action Levels and Numeric Effluent Limits

Parameter	Test Method / Protocol	Discharge Type	Min. Detection Limit	Reporting Units	Numeric Action Level	Numeric Effluent Limitation
pH	Field test with calibrated portable instrument	Risk Level 2, LUP Type 2 Discharges	0.2	pH units	lower NAL = 6.5 upper NAL = 8.5	N/A
		Risk Level 3, LUP Type 3 Discharges			lower NAL = 6.5 upper NAL = 8.5	lower NEL = 6.0 upper NEL = 9.0
Turbidity	EPA 180.1 and/or field test with calibrated portable instrument	Risk Level 2, LUP Type 2 Discharges	1	NTU	250 NTU	N/A
		Risk Level 3, LUP Type 3 Discharges other than ATS			250 NTU	500 NTU
		For ATS discharges	1	NTU	N/A	10 NTU for Daily Weighted Average & 20 NTU for Any Single Sample
SSC ASTM	Method D 3977-97[9]	Risk Level 3 (if NEL exceeded)	5	mg/L	N/A	N/A
Bioassessment	(STE) Level I of (SAFIT),[10] fixed-count of 600 org/sample	Risk Level 3 projects> 30 acres	N/A	N/A	N/A	N/A

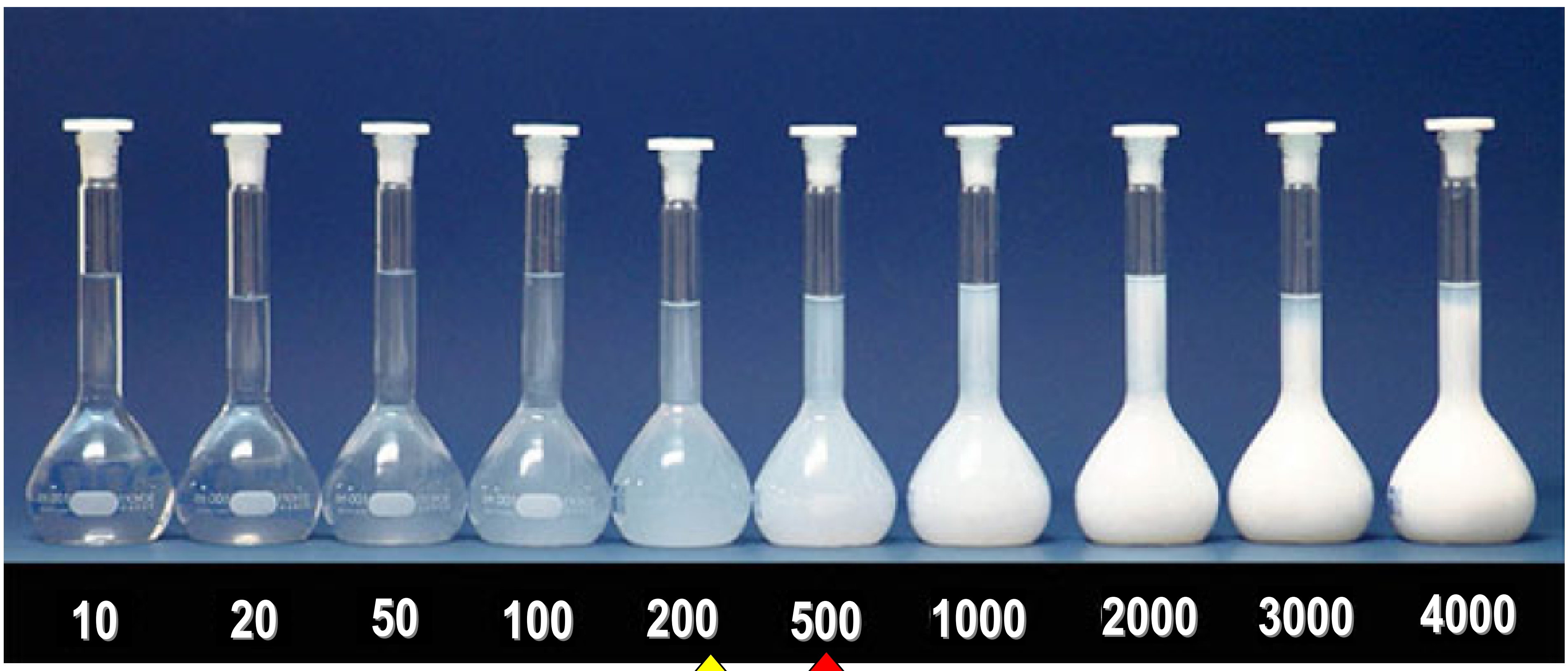
[9] ASTM, 1999, Standard Test Method for Determining Sediment Concentration in Water Samples: American Society of Testing and Materials, D 3977-97, Vol. 11.02, pp. 389-394.

[10] The current SAFIT STEs (28 November 2006) list requirements for both the Level I and Level II taxonomic effort, and are located at: http://www.swrcb.ca.gov/swamp/docs/safit/ste_list.pdf
When new editions are published by SAFIT, they will supersede all previous editions. All editions will be posted at the State Water Board's SWAMP website.

General Permit Section V.B

NALs – Storm Event, Daily Average
NEL - Storm Event, Daily Average
NEL (pH) – Applicable where there is High Risk of pH Discharge

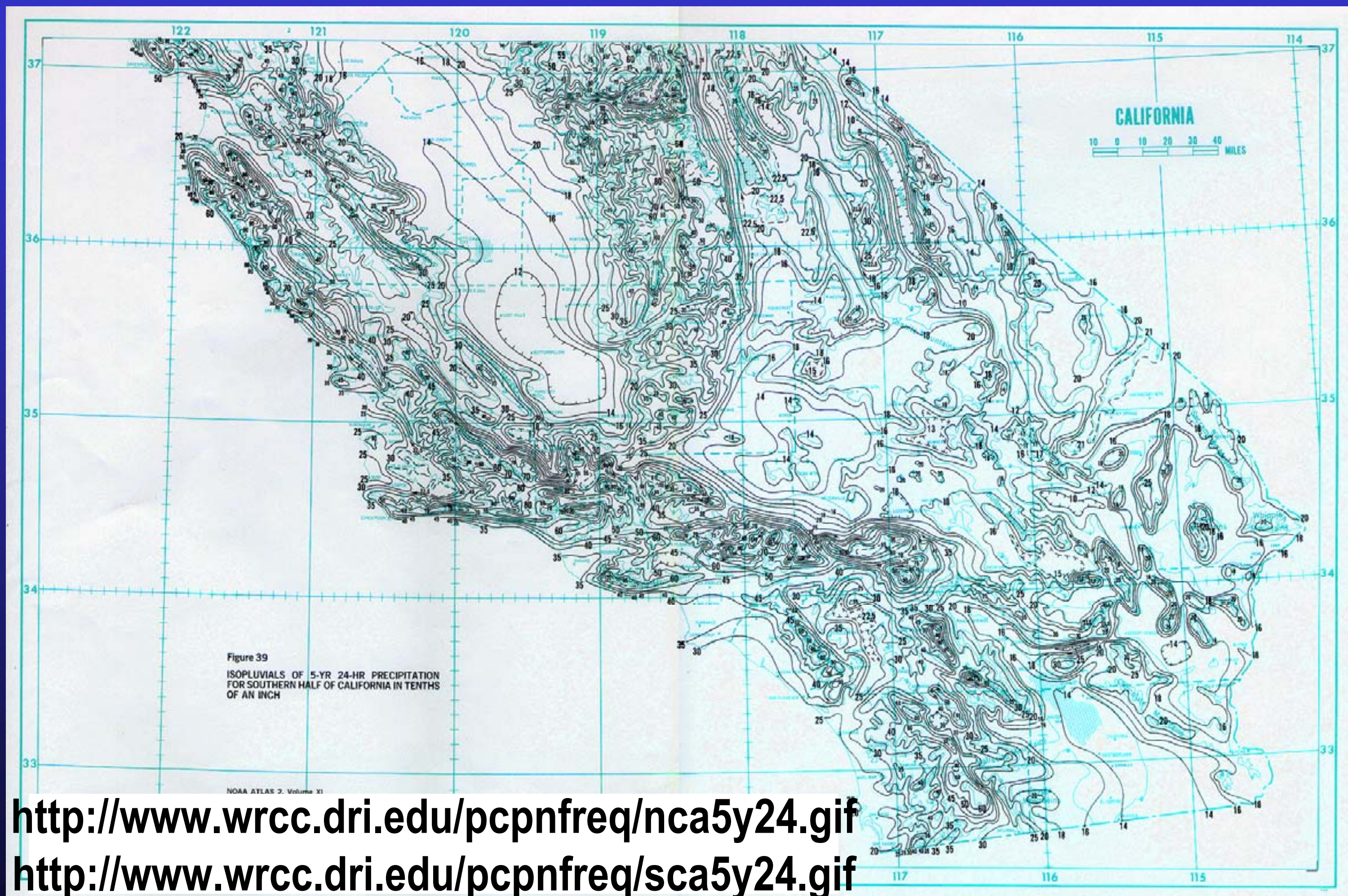
Technology-Based Numeric Action Levels and Numeric Effluent Limits



NAL NEL

General Permit Section V.B

Numeric Effluent Limit Compliance Event (Turbidity)



http://www.wrcc.dri.edu/pcpnfreq/nca5y24.gif
http://www.wrcc.dri.edu/pcpnfreq/sca5y24.gif

General Permit Section V.B.3

5-year, 24-hour Storm (~2.5” for San Diego Bay)

ATS: 10-year, 24-hour Storm (~3” for San Diego Bay)

Post-Construction Storm Water Performance Standards

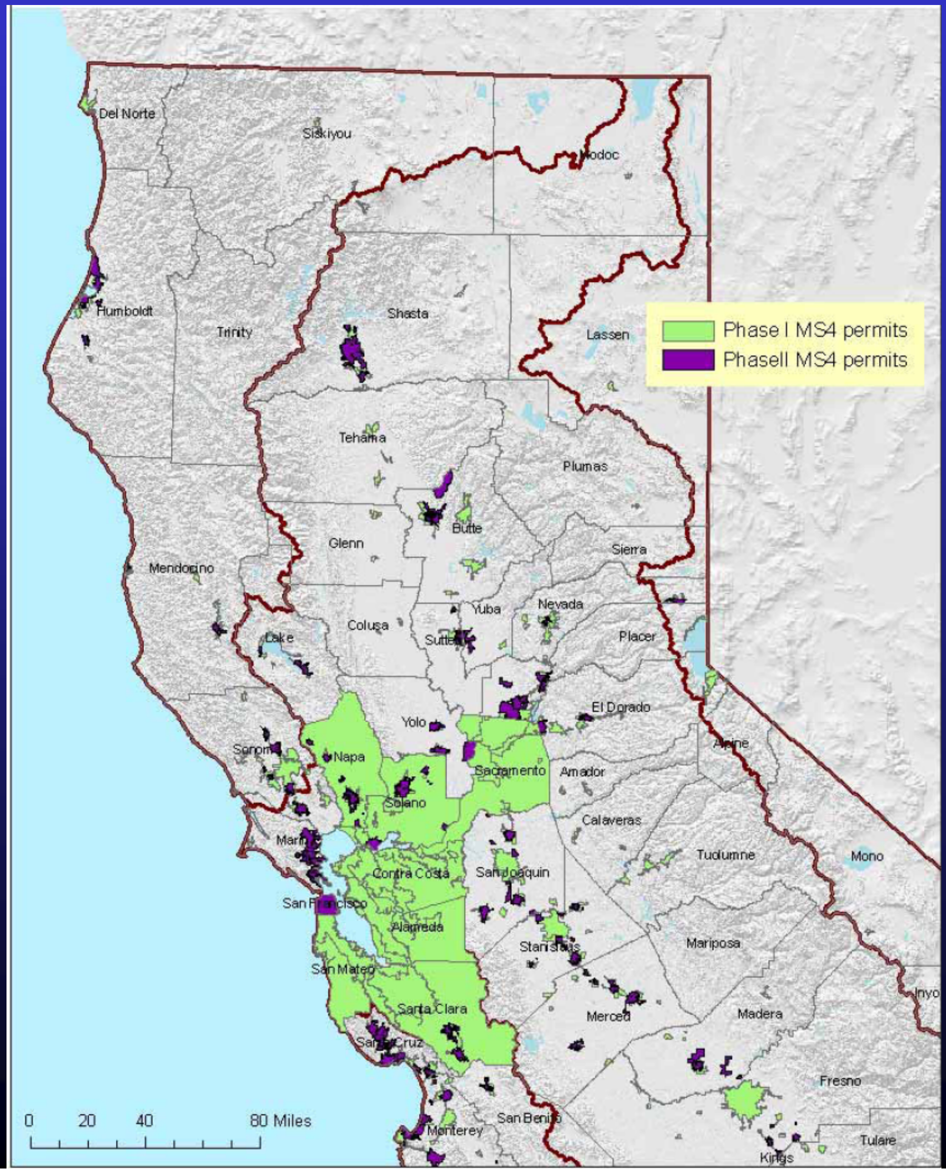
- **Construction – Sediment load increases and leads to aggradation**
  - Stream depths may decrease
    - Decreased channel capacity
    - Increased flooding
    - Increased overbank deposition
- **Post-Construction – Increased flows lead to degradation**
  - Eroded channels (deepened and widened)
  - Channels Narrow (sediment from incision deposits laterally)
  - Sediment size is altered
    - Less fine sediment
    - Increased course sand
    - Decreased gravel
  - Increased channel slope
  - Increased velocities
  - Increased sediment transport within channel

Post-Construction Storm Water Performance Standards

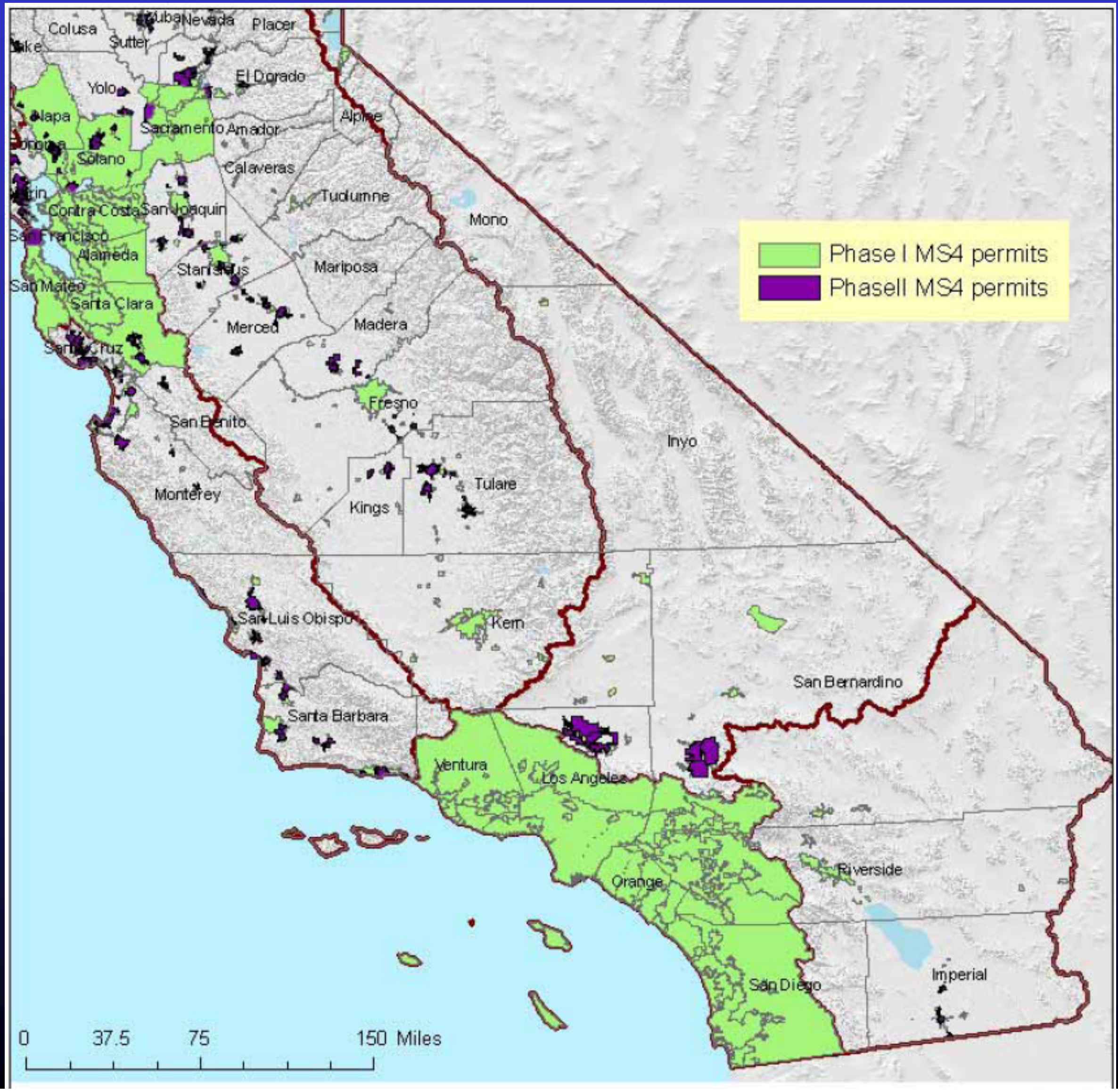
General Construction Permit Requirements Not Applicable to MS4-Permitted Areas with Approved Storm Water Management Plans

All Other Areas Must Comply General Construction Permit Requirements

Post-Construction Storm Water Performance Standards



Post-Construction Storm Water Performance Standards



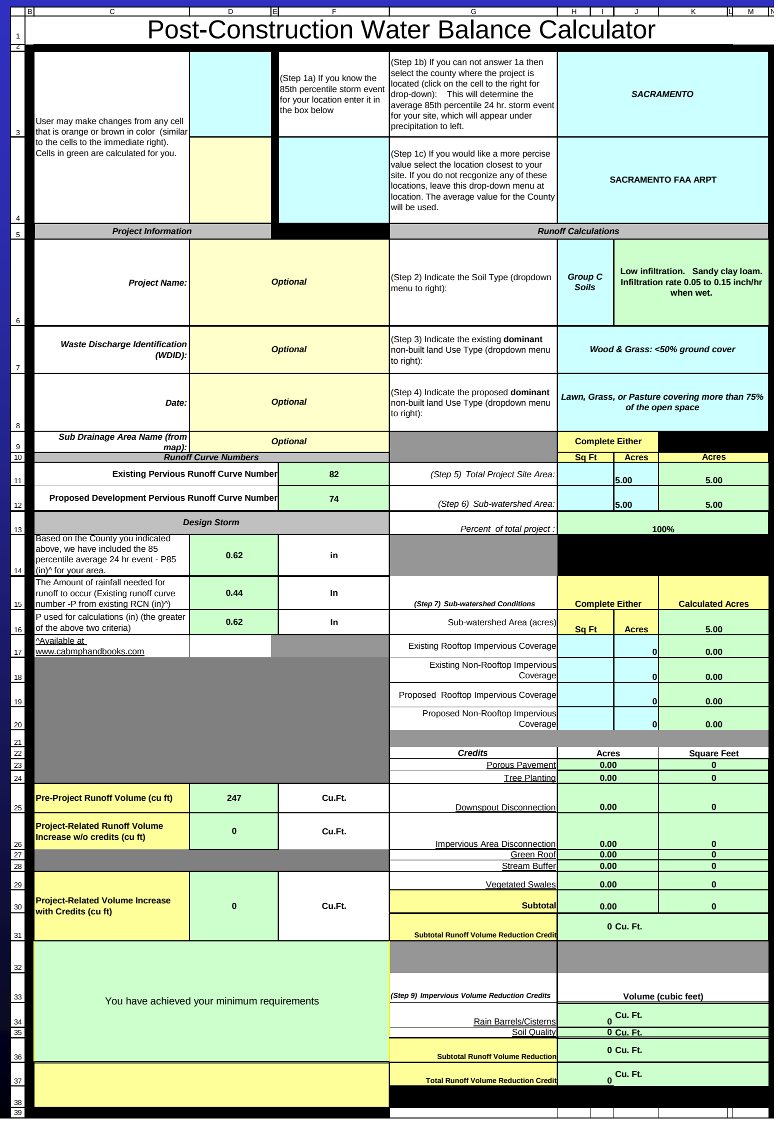
Post-Construction Storm Water Performance Standards

- Effective 3 years after permit adoption…September 2, 2012
- Replicate pre-project water balance
  - Rainfall that ends up as runoff for the smallest storms up to the 85th percentile storm event or the smallest storm event that generates runoff, whichever is larger
- Use structural and non-structural controls
- Structural controls require RWQCB approval (30-day notice)
- For projects with DSA > 2 acres:
  - Preserve pre-construction drainage density (miles of stream length per square mile of drainage area) for all drainage areas serving a first order stream (i.e., stream with no tributaries) or larger stream
  - Ensure Post-Project $T_c \geq$ Pre-Project T_c

General Permit Section XIII

Post-Construction Storm Water Performance Standards

- **Submit with NOI**
- **Map**
  - Existing contours
  - Pre- and post-construction drainage divides
  - Total stream length in each watershed
  - Scales – 1 in. = 20’, 30’, 40’ or 50’
  - 1’ to 5’ contour intervals
- **Web-based**
  - SWRCB Post-Construction Water Balance Calculator, SWMM, or HSPF
  - Complete for each sub-watershed area



Post-Construction Water Balance Calculator

User may make changes from any cell that is orange or brown in color (similar to the cells to the immediate right). Cells in green are calculated for you.

(Step 1a) If you know the 85th percentile storm event for your location enter it in the box below	
(Step 1b) If you can not answer 1a then select the county where the project is located (click on the cell to the right for drop-down): This will determine the average 85th percentile 24 hr. storm event for your site, which will appear under precipitation to left.	*SACRAMENTO*
(Step 1c) If you would like a more percise value select the location closest to your site. If you do not recgonize any of these locations, leave this drop-down menu at location. The average value for the County will be used.	SACRAMENTO FAA ARPT

Project Information	
Project Name:	*Optional*
Waste Discharge Identification (WDID):	*Optional*
Date:	*Optional*
Sub Drainage Area Name (from map):	*Optional*

Runoff Curve Numbers		
Existing Pervious Runoff Curve Number	82	
Proposed Development Pervious Runoff Curve Number	74	
Design Storm		
Based on the County you indicated above, we have included the 85 percentile average 24 hr event - P85 (in)^ for your area.	0.62	in
The Amount of rainfall needed for runoff to occur (Existing runoff curve number -P from existing RCN (in)^)	0.44	In
P used for calculations (in) (the greater of the above two criteria)	0.62	In
^Available at www.cabmphandbooks.com		
Pre-Project Runoff Volume (cu ft)	247	Cu.Ft.
Project-Related Runoff Volume Increase w/o credits (cu ft)	0	Cu.Ft.
Project-Related Volume Increase with Credits (cu ft)	0	Cu.Ft.

You have achieved your minimum requirements

Runoff Calculations			
(Step 2) Indicate the Soil Type (dropdown menu to right):	*Group C Soils*	Low infiltration. Sandy clay loam. Infiltration rate 0.05 to 0.15 inch/hr when wet.	
(Step 3) Indicate the existing **dominant** non-built land Use Type (dropdown menu to right):	*Wood & Grass: <50% ground cover*		
(Step 4) Indicate the proposed **dominant** non-built land Use Type (dropdown menu to right):	*Lawn, Grass, or Pasture covering more than 75% of the open space*		
	Complete Either		
	Sq Ft	Acres	Acres
(Step 5) Total Project Site Area:		5.00	5.00
(Step 6) Sub-watershed Area:		5.00	5.00
Percent of total project :	100%		

(Step 7) Sub-watershed Conditions	Complete Either		Calculated Acres
Sub-watershed Area (acres)	Sq Ft	Acres	5.00
Existing Rooftop Impervious Coverage		0	0.00
Existing Non-Rooftop Impervious Coverage		0	0.00
Proposed Rooftop Impervious Coverage		0	0.00
Proposed Non-Rooftop Impervious Coverage		0	0.00

Credits	Acres	Square Feet
Porous Pavement	0.00	0
Tree Planting	0.00	0
Downspout Disconnection	0.00	0
Impervious Area Disconnection	0.00	0
Green Roof	0.00	0
Stream Buffer	0.00	0
Vegetated Swales	0.00	0
Subtotal	0.00	0
Subtotal Runoff Volume Reduction Credit	0 Cu. Ft.	

(Step 9) Impervious Volume Reduction Credits	Volume (cubic feet)
Rain Barrels/Cisterns	0 Cu. Ft.
Soil Quality	0 Cu. Ft.
Subtotal Runoff Volume Reduction	0 Cu. Ft.
Total Runoff Volume Reduction Credit	0 Cu. Ft.

General Permit Appendix 2

Post-Construction Storm Water Performance Standards

- **Non-Structural Practices Available for Crediting**
  - *Porous Pavement*
  - *Tree Planting*
  - *Downspout Disconnection*
  - *Impervious Area Disconnection*
  - *Green Roof*
  - *Stream Buffer*
  - *Vegetated Swales*
  - *Rain Barrels and Cisterns*
  - *Landscape Soil Quality*

General Permit Appendix 2

Minimum BMPs

Best Management Practices	Risk Level		
	1	2	3
Good Site Management "Housekeeping"			
- Construction Materials	✓	✓	✓
- Waste Management	✓	✓	✓
- Vehicle Storage and Management	✓	✓	✓
- Landscape Materials Management	✓	✓	✓
- Assess Potential Pollutant Sources/Identify Additional BMPs	✓	✓	✓
- Control Air Deposition of Site Materials	✓	✓	✓
- Document All Housekeeping BMPs in SWPPP and REAPs		✓	✓

General Permit Sections IX – XI, Attachments C - E

Minimum BMPs

Best Management Practices	Risk Level		
	1	2	3
Non-Storm Water Management			
- Control Non-storm Water Discharges	✓	✓	✓
- Prevent Vehicle Washing Discharge	✓	✓	✓
- Prevent Street Cleaning Discharge	✓	✓	✓
Erosion Control			
- Wind Erosion Control	✓	✓	✓
- Soil Cover	✓	✓	✓
- Limit Use of Plastic Materials	✓	✓	✓

General Permit Sections IX – XI, Attachments C - E

Minimum BMPs

Best Management Practices	Risk Level 1	Risk Level 2	Risk Level 3
Sediment Control			
- Perimeter Controls/Stabilize Entrances and Exits	✓	✓	✓
- Sediment Basin Design Standards	✓	✓	✓
- Appropriate Erosion and Sediment Control BMPs for Active Areas		✓	✓
- Slope Sheet Flow Controls		✓	✓
- Activity Traffic Management and Tracking Control		✓	✓
- Maintain and Protect Sediment Controls from Activities Reducing Effectiveness		✓	✓
- Daily Inspection of Access Roads/Daily and Pre-storm Sediment Removal		✓	✓
- RWQCB Specified Sediment Controls (When Minimum Sediment Controls Are Inadequate)			✓

General Permit Sections IX – XI, Attachments C - E

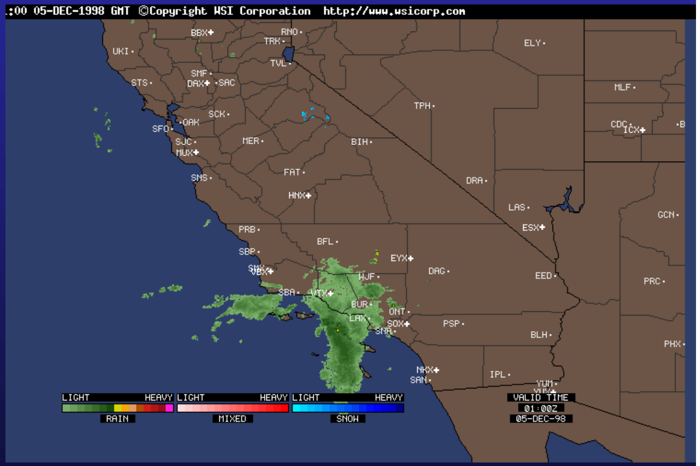
Minimum BMPs

Best Management Practices	Risk Level		
	1	2	3
Run-on and Runoff Control			
- Evaluate Quantity and Quality	✓	✓	✓
- Manage Run-on	✓	✓	✓

General Permit Sections IX – XI, Attachments C - E

Rain Event Action Plan (REAP)

- Required for Risk Levels 2 and 3
- Prepared QSP
- Develop REAP within 48 hours of likely precipitation event (≥50% probability – NWS); obtain probabilities from http://www.srh.noaa.gov/forecast).
- Additional REAPS for inactive (halted or postponed projects)
- No submittal requirement
- Specialized for each phase of construction
- Maintain onsite
- Specific to each rain event
- REAP shall include:
  - Contact Information
  - Site information
  - Calculated Risk Level
  - Project phase information
- Implement REAP within 24 hours of likely precipitation event



Visual Inspections

Risk Level	Visual Inspection					
	Quarterly Non-Storm Water Discharge (Drainage Areas)[4]	Weekly (BMPs)	Pre-Storm: Baseline (Drainage Areas, BMPs, Storage/ Containment Areas)[3]	Pre-Storm: REAP	Daily Storm (Discharges and BMPs)[1]	Post-Storm (Discharges and BMPs)[2]
1	✓	✓	✓		✓	✓
2	✓	✓	✓	✓	✓	✓
3	✓	✓	✓	✓	✓	✓

1 Within 48 hours after each qualifying event (≥ 1/2"); prior to discharge of stored/contained storm water; during business hours; every 24 hrs during extended storm events

2 Within 48 hours after each qualifying event (≥ 1/2"); prior to discharge of stored/contained storm water; during business hours

3 Within 48 hours prior to each qualifying event (≥ 1/2")

4 January - March, April - June, July - September, October - December; during daylight hours

Sampling and Analysis

Risk Level	Sample Collection: Non-Storm Water Discharge	Non-Visible Pollutants[5]	Storm Water Discharge[6,7]	Receiving Water[8,9]
1		✓		
2	✓	✓	✓	
3	✓	✓	✓	✓

5 Within first 2 hours during business hours

6 Minimum 3 samples per day subsequent to qualifying event (≥ 1/2" at time of discharge) at all discharge points

7 Submit results to SWRCB within 5 days after storm event

8 When NEL is exceeded sample upstream and downstream of discharge in receiving water

9 Benthic Macroinvertebrate Bioassessment for projects disturbing ≥ 30 acres

General Permit
Attachments C - E

NEL Violation Reporting and NAL Exceedance Reporting

NEL Exceeded

- pH	< 6.0 or > 9.0
-Turbidity	> 500 NTU
-Turbidity (ATS)	>10 NTU Daily Flow-weighted Average
-Turbidity (ATS)	>20 Any Single Sample

Tasks

- Electronically file NEL Violation Report within 24 hours of receiving results
- Construction site and run-on evaluation
  - Document evaluation in SWPPP
  - Current BMPs
  - Need for additional BMPs
  - Summary and evaluation of sampling and analysis results
  - Analytical methods, method reporting units, method detection limits
  - Date, time, location, observations (inspections), precipitation, other measurements
  - Description of Current BMPs, and proposed corrective actions
  - Certified
- Maintain report for 3 years from Annual Report
- Immediately implement corrective actions if appropriate
- Revise SWPPP
- Subject to RWQCB enforcement action

NAL Exceeded

- pH	< 6.5 or > 8.5
- Turbidity	> 250 NTU

Tasks

- Electronically file sampling results when NAL is exceeded within 10 days
- RWQCB may request submission of an Exceedance ReportConstruction site and run-on evaluation
  - Document evaluation in SWPPP
  - Current BMPs
  - Need for additional BMPs
  - Reduce/prevent pollutant discharges to receiving waters
  - Determine corrective actions and schedule
  - Summary and evaluation of sampling and analysis results
  - Analytical methods, method reporting units, method detection limits
  - Date, time, location, observations (inspections), precipitation, other measurements
  - Description of Current BMPs, and proposed corrective actions
  - Certified
- Maintain report for 3 years from Annual Report
- Immediately implement corrective actions if appropriate
- Revise SWPPP

Annual Report

- Electronically file Annual Report - By September 1 of each year
  - Summary and evaluation of all sample results
  - Laboratory reports
  - Analytical methods, method reporting units, method detection limits
  - Results less than MDL reported as “less than the method detection limit”
  - Summary of all corrective actions taken during compliance year
  - Compliance activities/corrective actions not implemented
  - Summary of all violation of the CGP
  - Individuals who performed inspections, sampling, observations, measurements
  - Date, time, and locations of inspections, sampling, observations, precipitation
  - Visual observations and sample collection exception records and reports specified in Attachments C, D, E
- Training documentation
- Must be certified
- Retain records for 3 years

First Annual Report Due on September 1, 2011

General Permit Section XVI

Terminating Permit Coverage

Prepare NOT and Uploads to SWRCB SMARTS

- Include final site map and photos
- Conditions must be met:
  - Final stabilization (no additional sediment discharge risk compared to pre-construction condition)
  - No potential for construction related storm water pollution
  - All SWPPP elements are complete, including final stabilization
  - Construction materials and waste have been disposed of properly
  - Post-construction Standards in General Permit, Section XIII has been demonstrated
  - Post-construction storm water management measures have been installed and a long-term (minimum 5-yr) maintenance plan has been established
  - All construction-related equipment, materials, and temporary BMPs no longer needed are removed from site

Legally Responsible Person Signs Certification Statement via SMARTS and Files in Official File (within 90 days of construction completion)

General Permit Section II.D

Terminating Permit Coverage

Final stabilization (demonstrated through photos, RUSLE, RUSLE2 or results of testing and analysis):

- **"70% Final Cover Method"**; no computation proof required

OR:

- **"RUSLE or RUSLE2 Method"**; computation proof required

OR:

- **"Custom Method"**; demonstrated in some other manner

General Permit Section II.D

Termination of permit coverage was denied, due to the lack of soil stabilization

Here is a site with adequate stabilization measures in place

The vegetation on the hillside in the background stabilizes soil, and mulch in the foreground prevents erosion and runoff

CGP Coverage Timeline

- Existing Dischargers
  - Continue to comply with the existing permit until July 1, 2010
  - Projects active on or after the July 1, 2010 effective date shall file electronically for coverage under the new permit.

99-08-DWQ

2009-0009-DWQ

July 1, 2010

- New dischargers
  - File PRDs electronically on our after July 1, 2010

Grandfathering

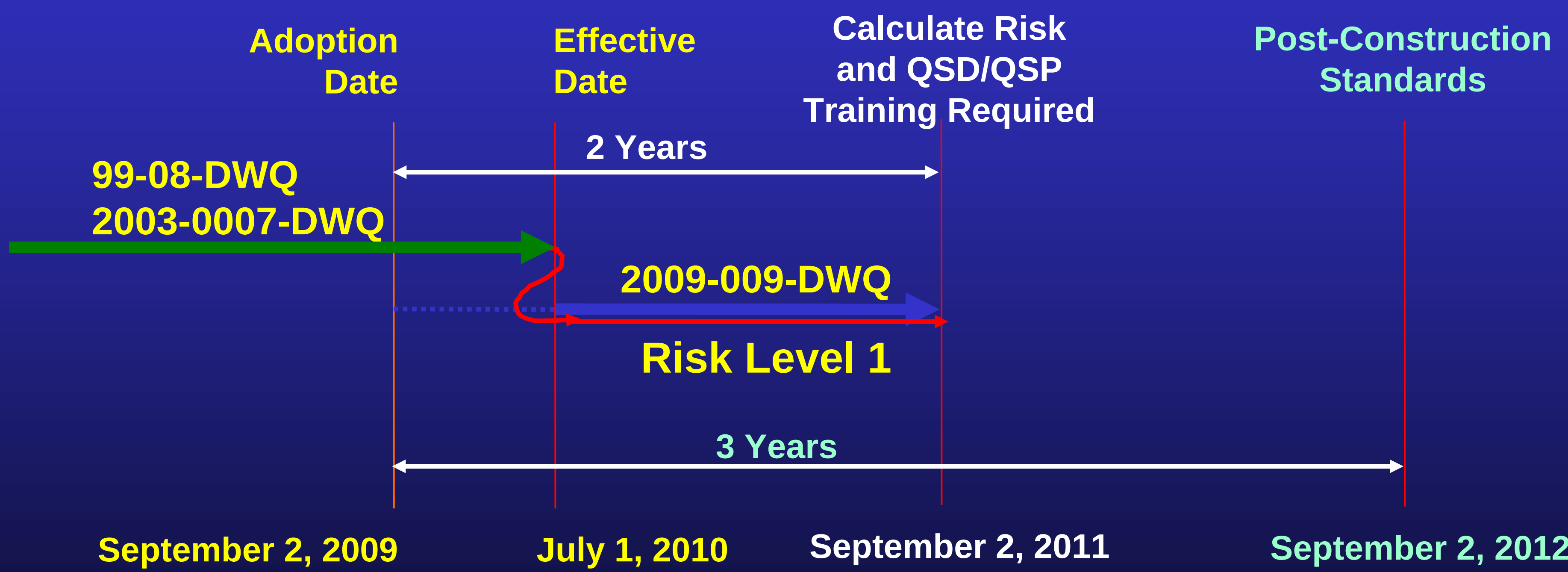
- Existing dischargers subject to Water Quality Order No. 99-08-DWQ shall obtain permit coverage at Risk Level 1
- LUP projects covered under Water Quality Order No. 2003-0007-DWQ shall obtain permit coverage at LUP Type 1

Grandfathering

- RWQCBs can require Risk Determination for projects currently covered under Water Quality Order No. 99-08-DWQ and 2003-0007-DWQ where they deem necessary
  - History of noncompliance with Order No. 99-08-DWQ or
  - Site poses a significant risk of causing or contributing to an exceedance of a water quality standard without implementation of additional Risk Level 2 or 3 requirements

Grandfathering

- Existing projects will be granted Risk Level 1 status
- Post-construction standards apply 3 years after adoption



On a case by case basis, dischargers may request an extension from the Executive Officer of the local Regional Water Board

Best Management Practices

May 2010

Prepared by:

Peter von Langen, PhD.
Storm Water Program Manager, CCRWQCB
and
Ed Othmer, PE, CPESC, CPSWQ
URS Corporation

Presented by:

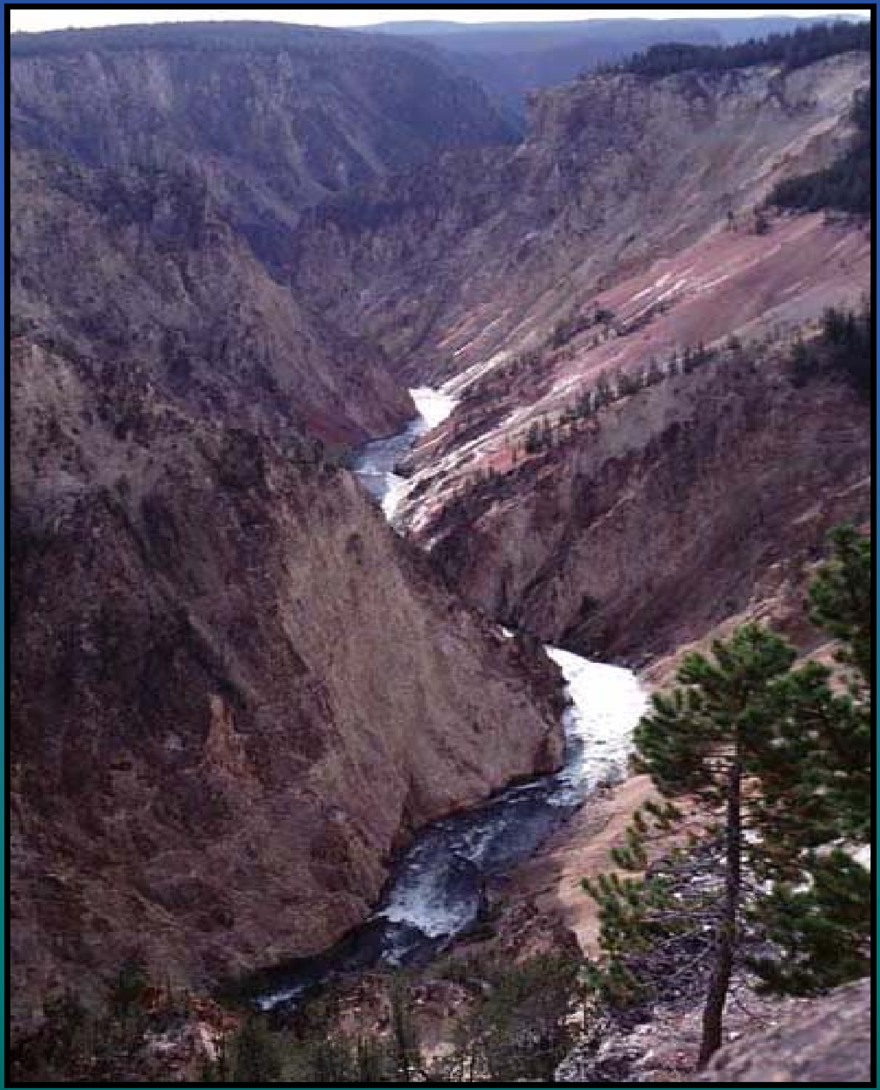
John McCullah, CPESC
Salix Applied Earthcare

Erosion

- Geologic Erosion
- Gully Erosion
- Splash Erosion
- Sheet Erosion

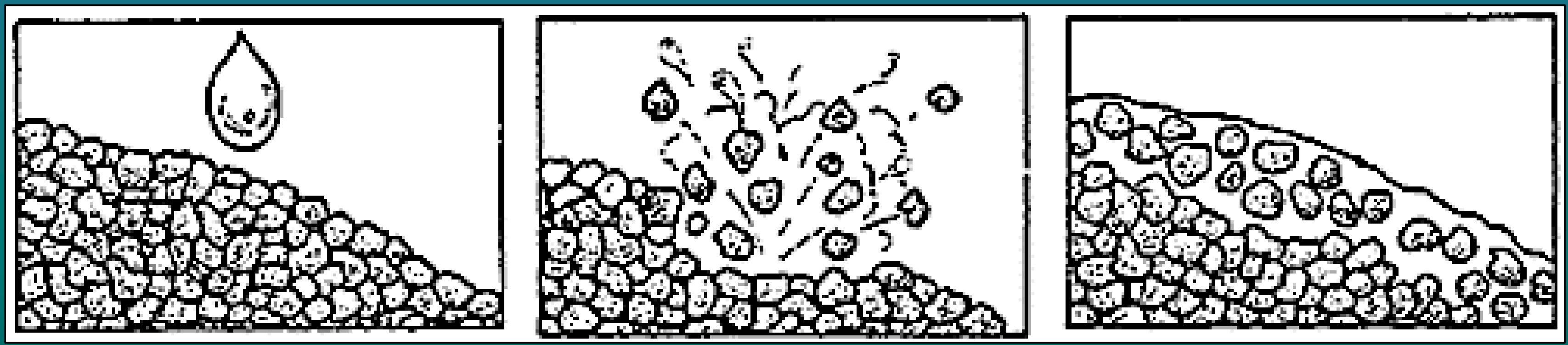
Geologic Erosion

- Natural process
- Created current features
- Tempered by natural forces
- Causes little damage (unless assisted by human activity)



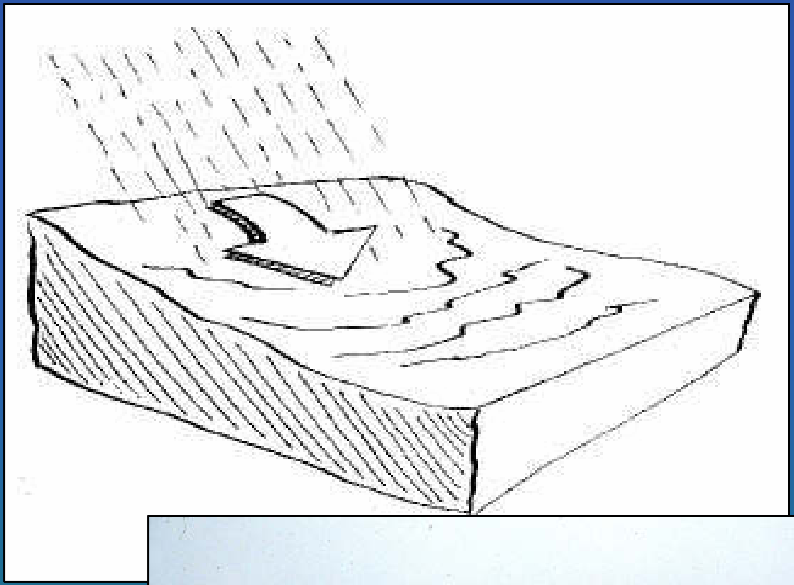
Splash Erosion

- **Rain drops striking bare soil directly at 20 mph**
  - Detaches soil particles
  - Particles can then be transported by the action of water and/or wind



Sheet Erosion (Overland Flow)

- The removal of a uniform thin layer of soil by raindrop splash or water run-off
- Surface film of water 2-3 mm deep
- This process may occur unnoticed on exposed soil even though raindrops are eroding large quantities of soil
- This process eventually becomes more dramatic via the formation of rills and gullies



Rill Erosion

- Shallow surface flows that become condensed
- Increased velocity and turbulence.
- Well-defined tiny channels
- The rate of rill erosion can be approximately 100 X greater than sheet erosion

Gully Erosion

- Accumulating runoff becomes concentrated and forms small rills throughout the soil
- Several rills may form throughout a slope and eventually may join together to form Gullies
- The rate of gully erosion can be approximately 100 X greater than rill erosion

Channel Erosion

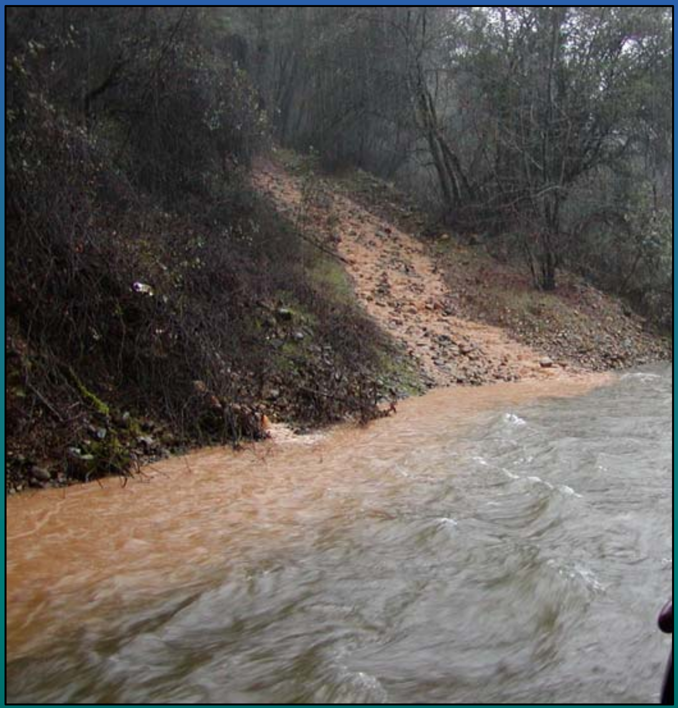
- Results from increased volume, velocity and or duration of flow, and concentration of flow - primarily from increased impervious surfaces.
- Channel erosion occurs in areas where tributaries, storm drains and or culverts flow into unprotected channels

What is Sedimentation?

- Sedimentation is the **deposition** of the eroded material

Sedimentation / Turbidity

- **Is solid particulate matter, that is in suspension, is being transported (Turbidity), or has been moved from its site by air, water, gravity or ice and has settled elsewhere (Sedimentation)**



Definitions

Erosion Control:

The protection of the soil surface and prevention of soil particles from being detached by rainfall or wind.

Sediment Control:

The trapping of soil particles after they have been dislodged and moved by wind or water.

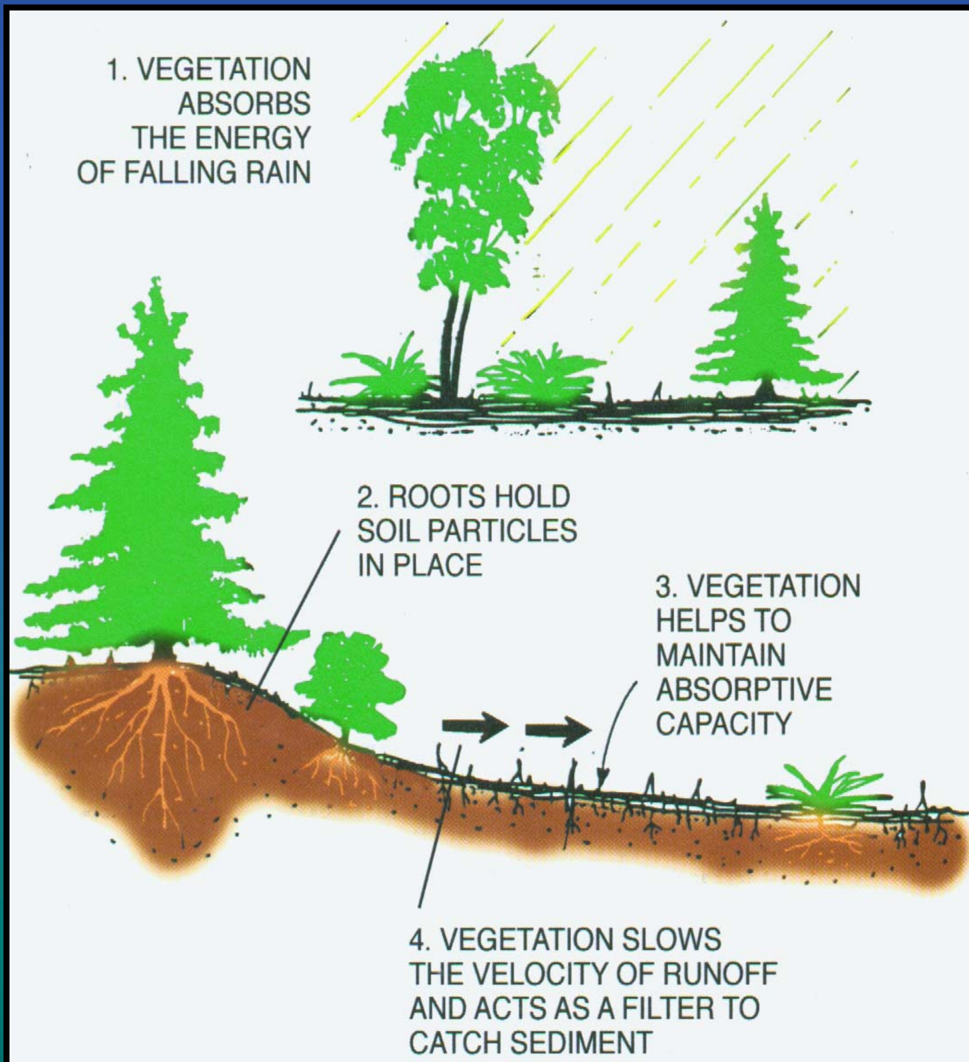
Erosion control and sediment control must be implemented simultaneously, prior to the wet season to be effective in preventing pollution of storm water runoff!

Neither method is sufficient without the other.

Best Management Practices

- Erosion Control
- Sediment Control
- Good Housekeeping

Timing



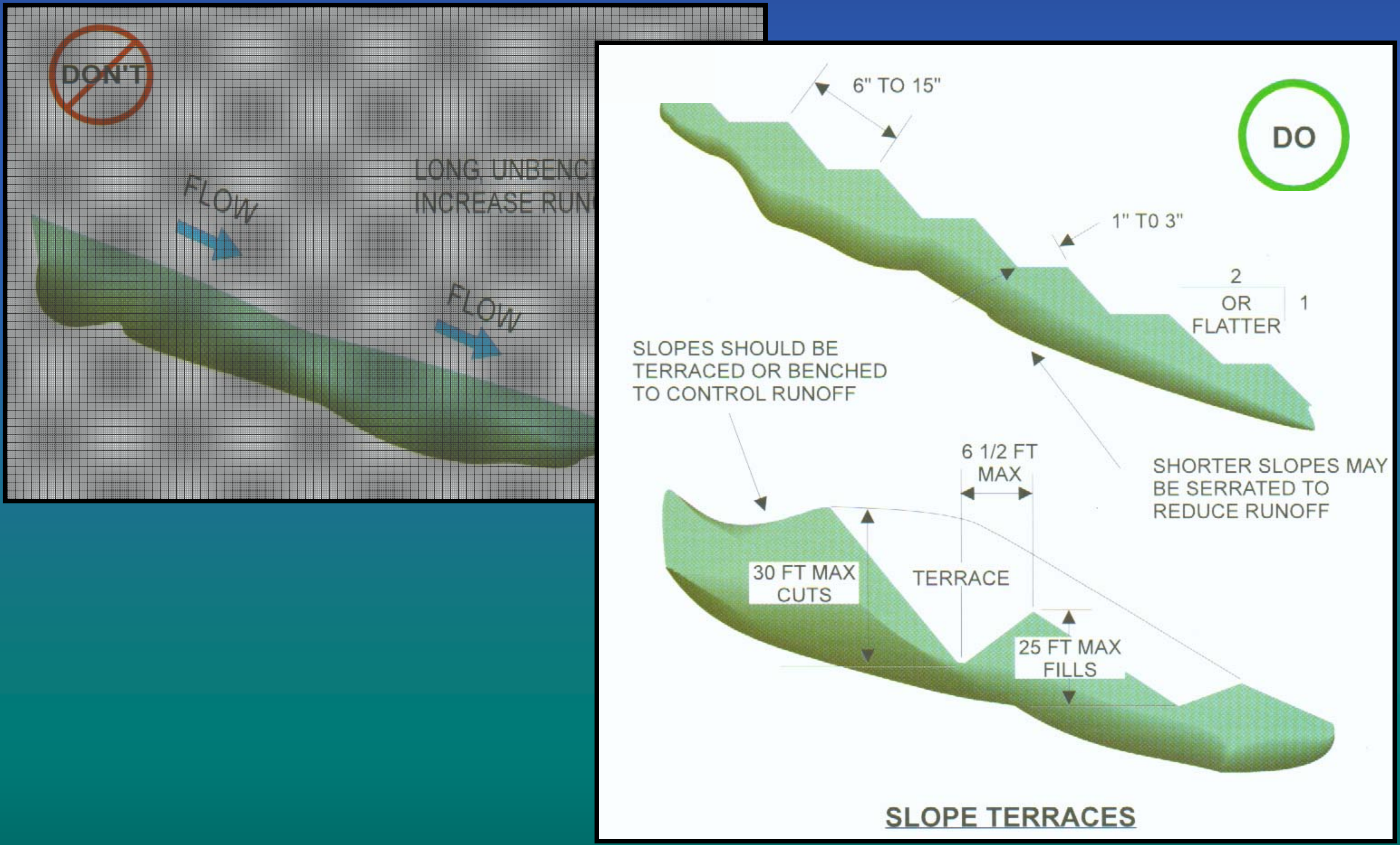
Don't Grade:

- **Until Necessary**
- **More than Necessary**

Erosion Control

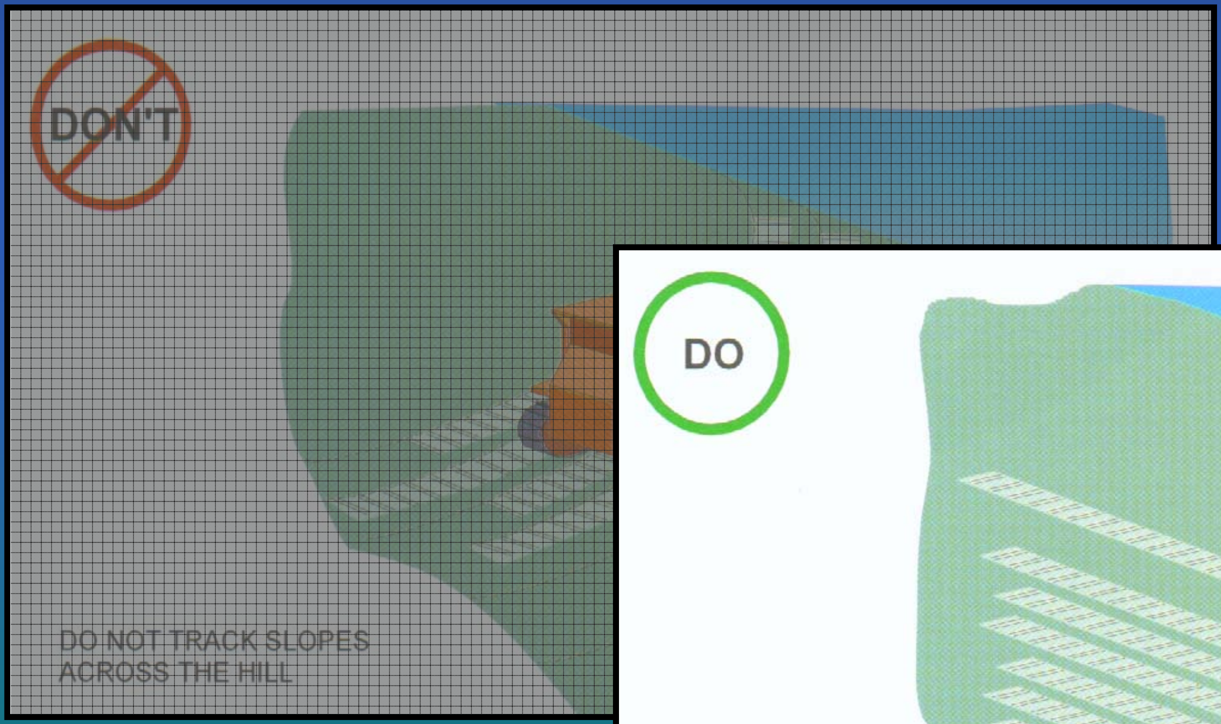
- Grading
- Tracking
- Erosion Control Blankets
- Straw Mulch
- Hydroseeding
- Energy Dissipaters
- Temporary Cover

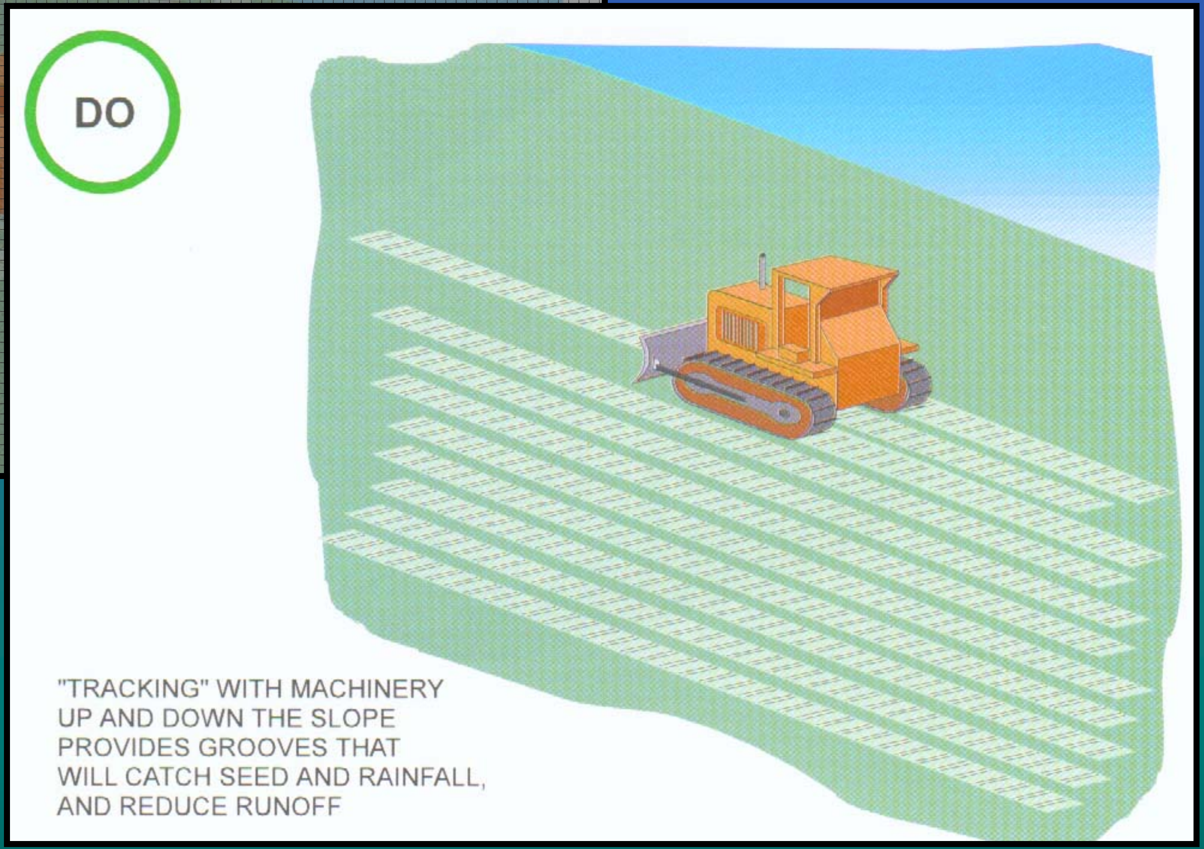
Grading



DON'T
FLOW
FLOW
6" TO 15"
DO
1" TO 3"
2
OR
FLATTER
1
SLOPES SHOULD BE
TERRACED OR BENCHED
TO CONTROL RUNOFF
6 1/2 FT
MAX
SHORTER SLOPES MAY
BE SERRATED TO
REDUCE RUNOFF
30 FT MAX
CUTS
TERRACE
25 FT MAX
FILLS
SLOPE TERRACES

Tracking

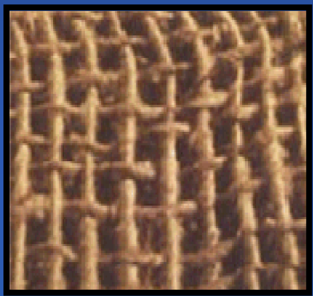

DON'T
DO NOT TRACK SLOPES
ACROSS THE HILL


DO
"TRACKING" WITH MACHINERY
UP AND DOWN THE SLOPE
PROVIDES GROOVES THAT
WILL CATCH SEED AND RAINFALL,
AND REDUCE RUNOFF

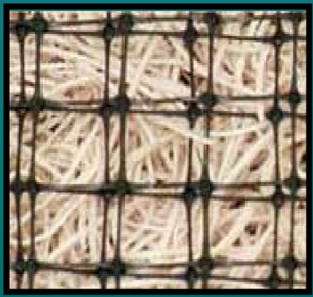
DON'T

Tracking

Erosion Control Blankets

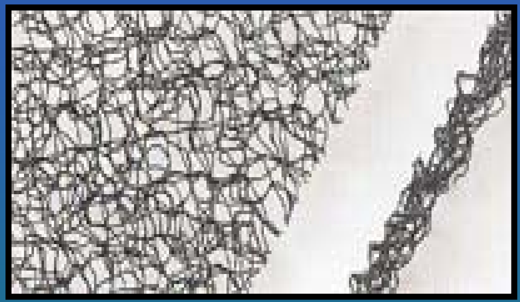


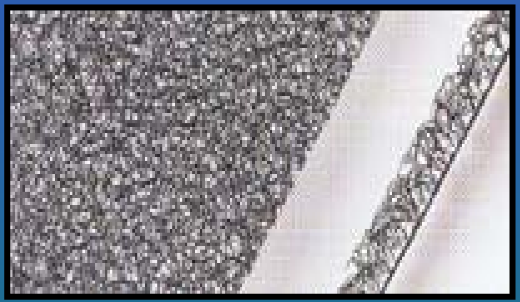

Natural Fiber Blankets

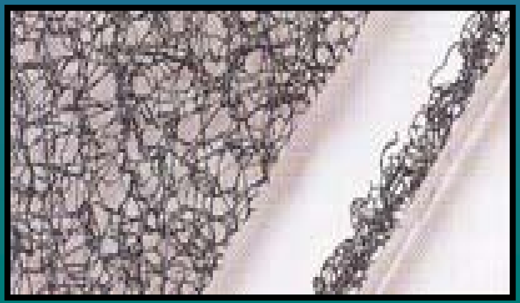


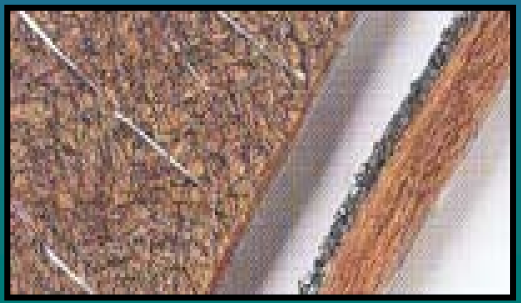

Erosion Control Blankets

Nylon Blankets



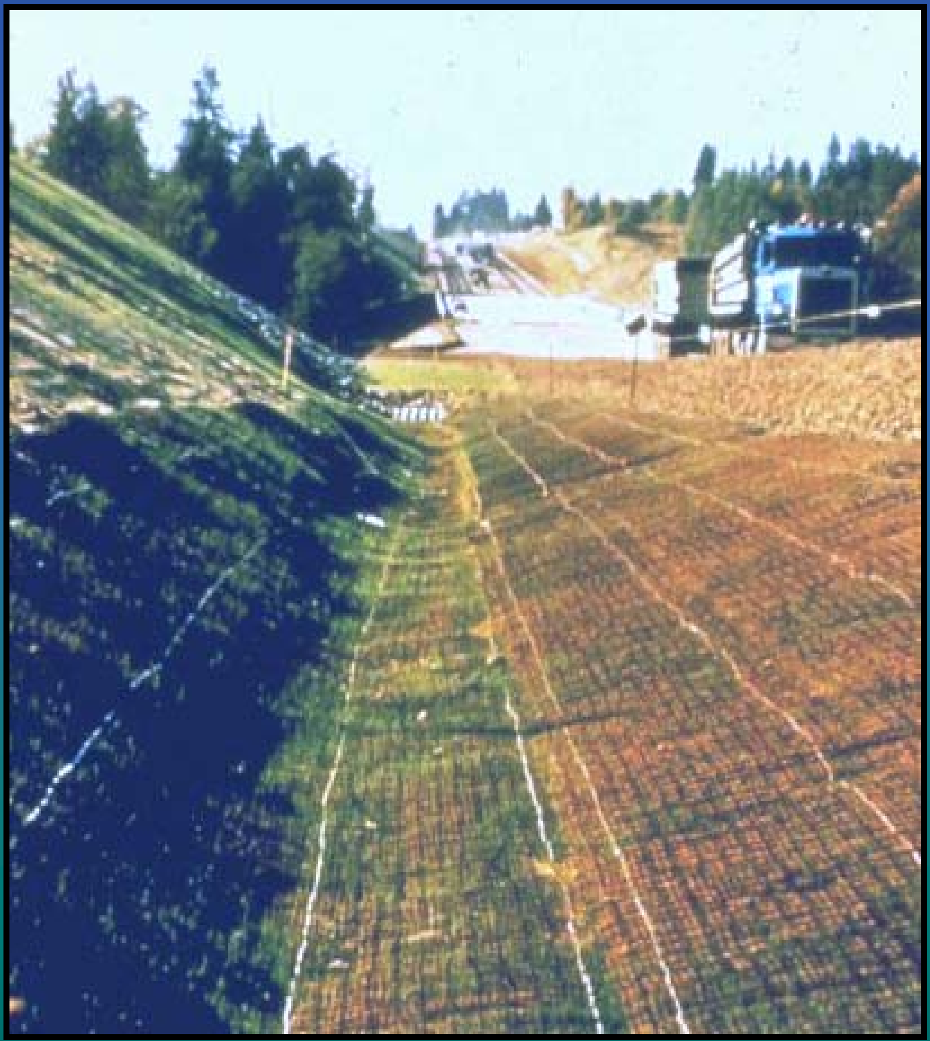




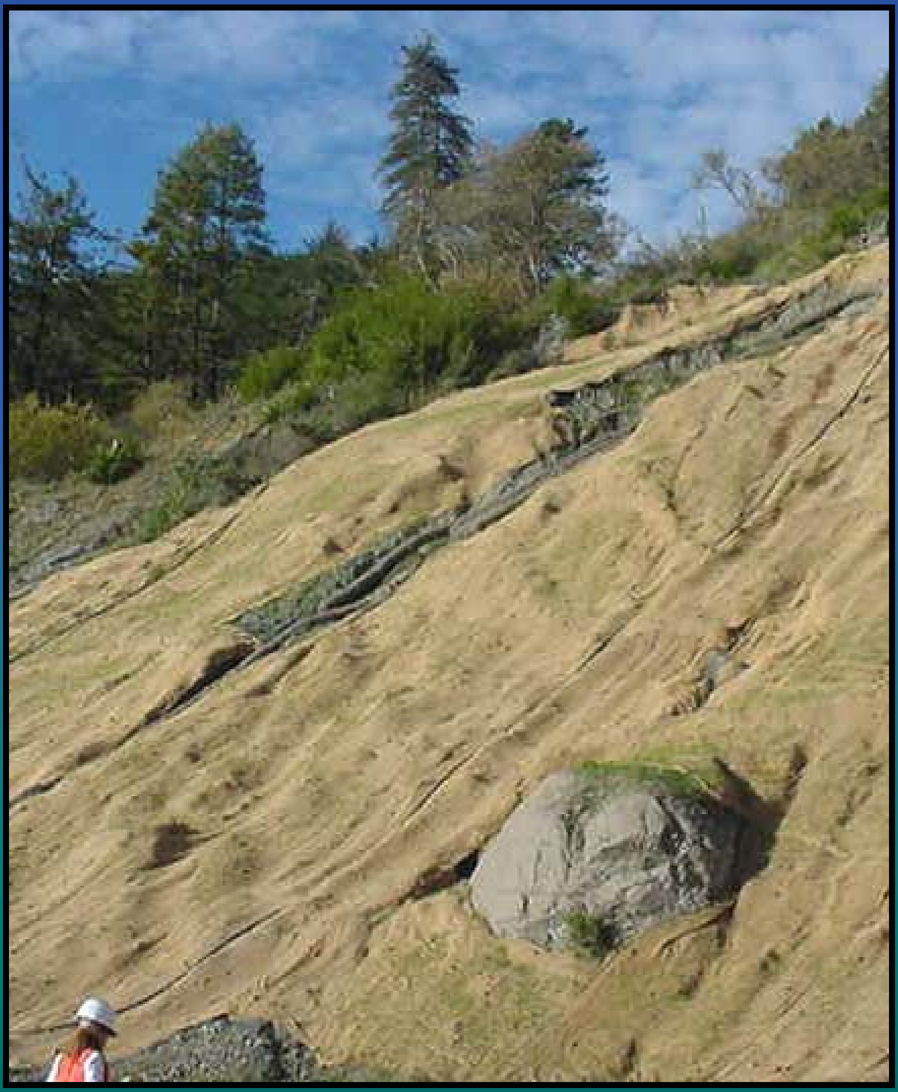


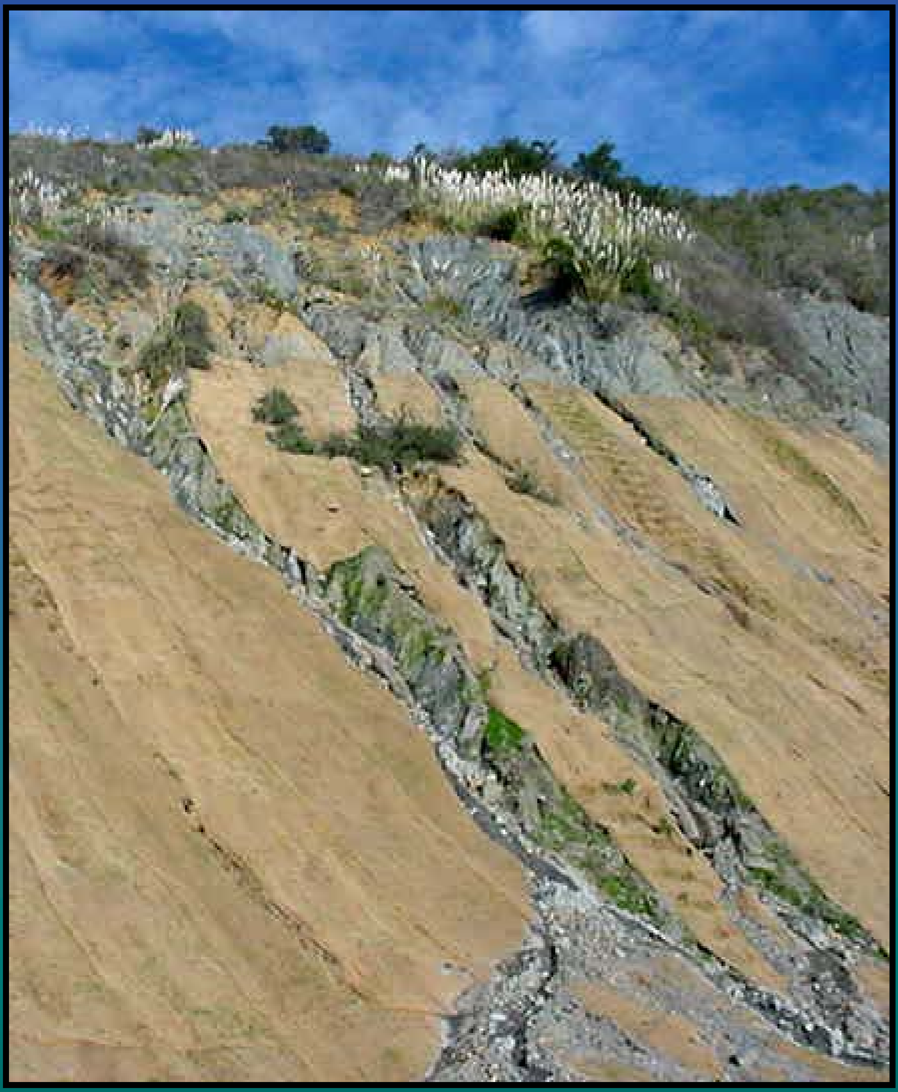
DO Erosion Control Blankets

DO Erosion Control Blankets



DON'T Erosion Control Blankets

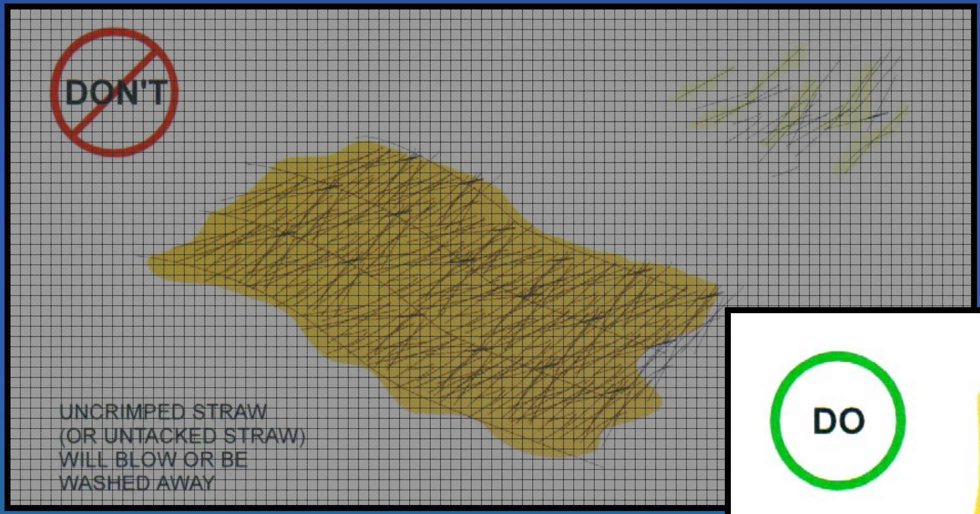


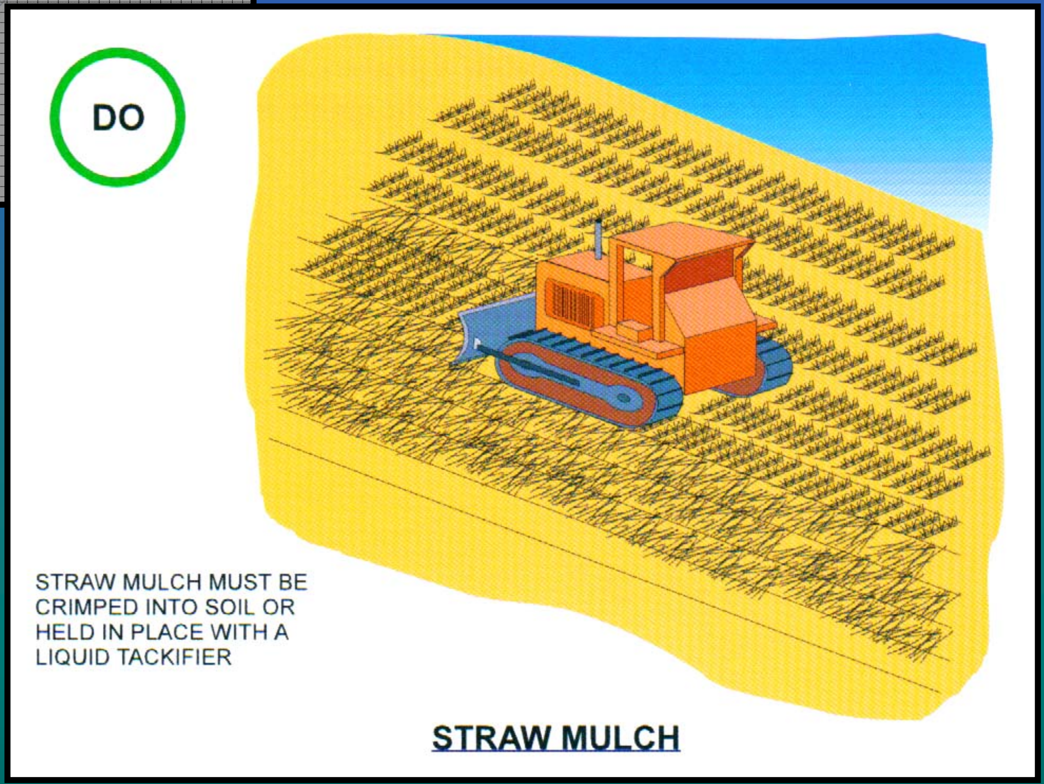


DO

Straw Mulch

Straw Mulch


DON'T
UNCRIMPED STRAW
(OR UNTACKED STRAW)
WILL BLOW OR BE
WASHED AWAY


DO
STRAW MULCH MUST BE
CRIMPED INTO SOIL OR
HELD IN PLACE WITH A
LIQUID TACKIFIER
STRAW MULCH

DON'T

Straw Mulch

DO

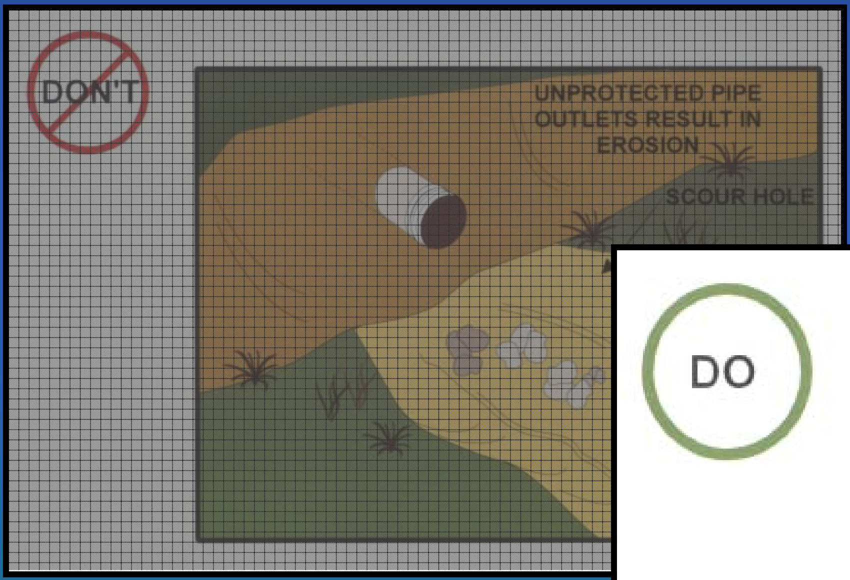
Hydroseeding

DON'T

Hydroseeding

- Do Not Hydroseed over existing rills

Energy Dissipaters



DON'T

Energy Dissipaters

DO

Energy Dissipaters

DO

Temporary Cover

DON'T

Temporary Cover

Sediment Control

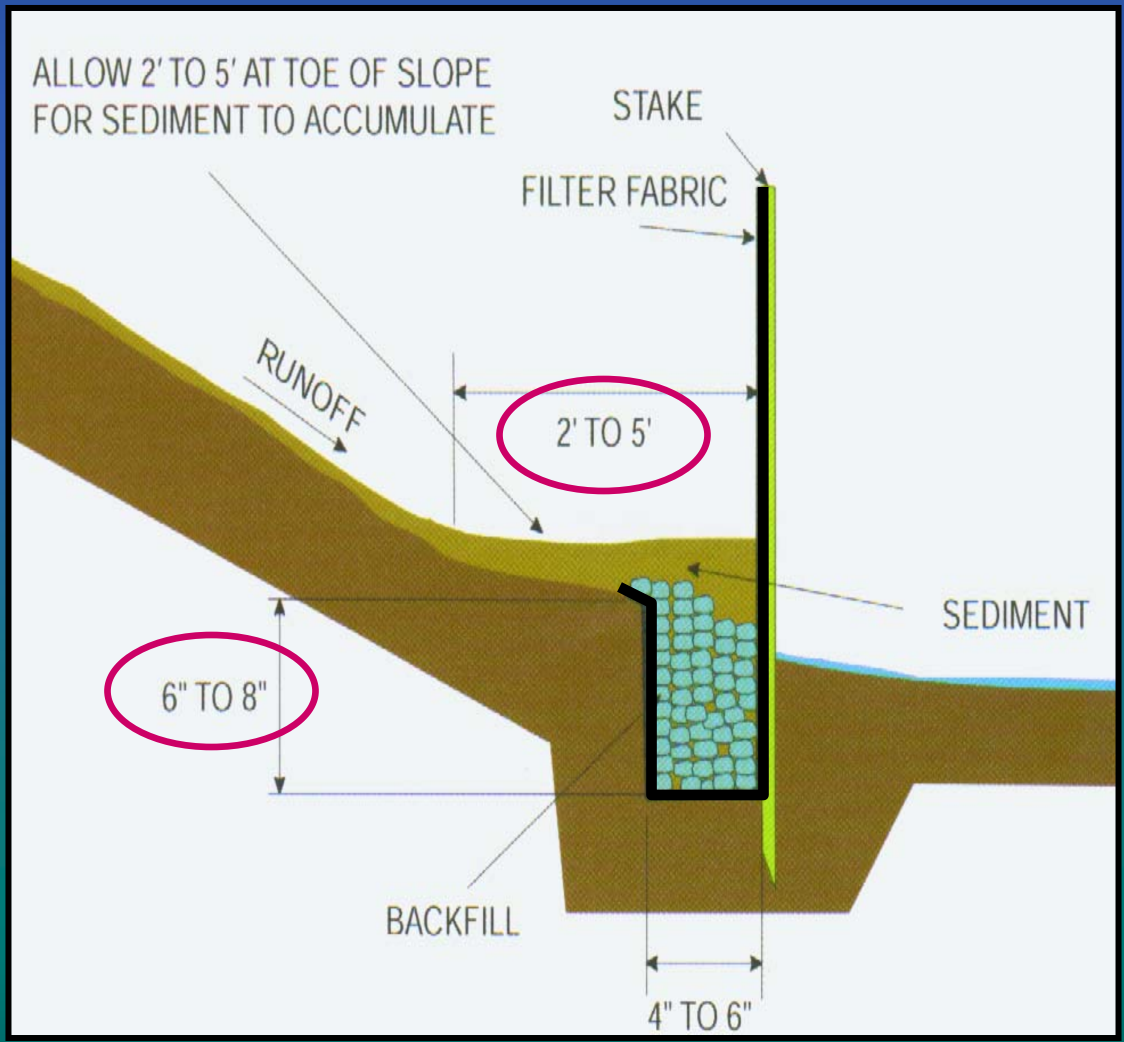
- Silt Fencing
- Gravel Bags
- Fiber Rolls
- Silt Bags
- Stabilized Site Exit
- Sediment Basins
- Filtration
- Settling Tanks

Silt Fencing

DON'T

DO

Silt Fencing



Silt Fencing

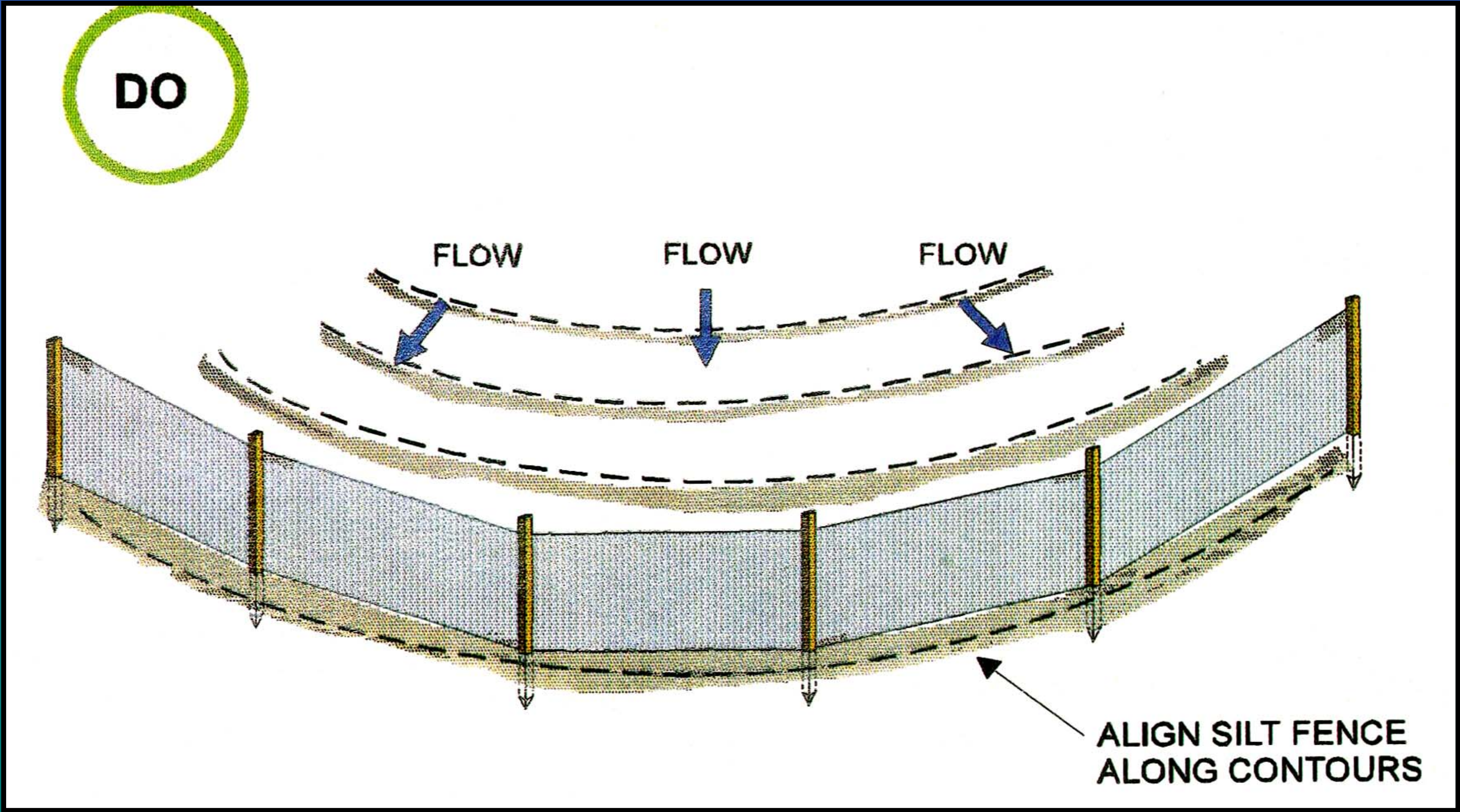
DO

+ Well-Entrenched

- No Erosion Control
- Placed too close to toe of slope

DON'T

Silt Fencing

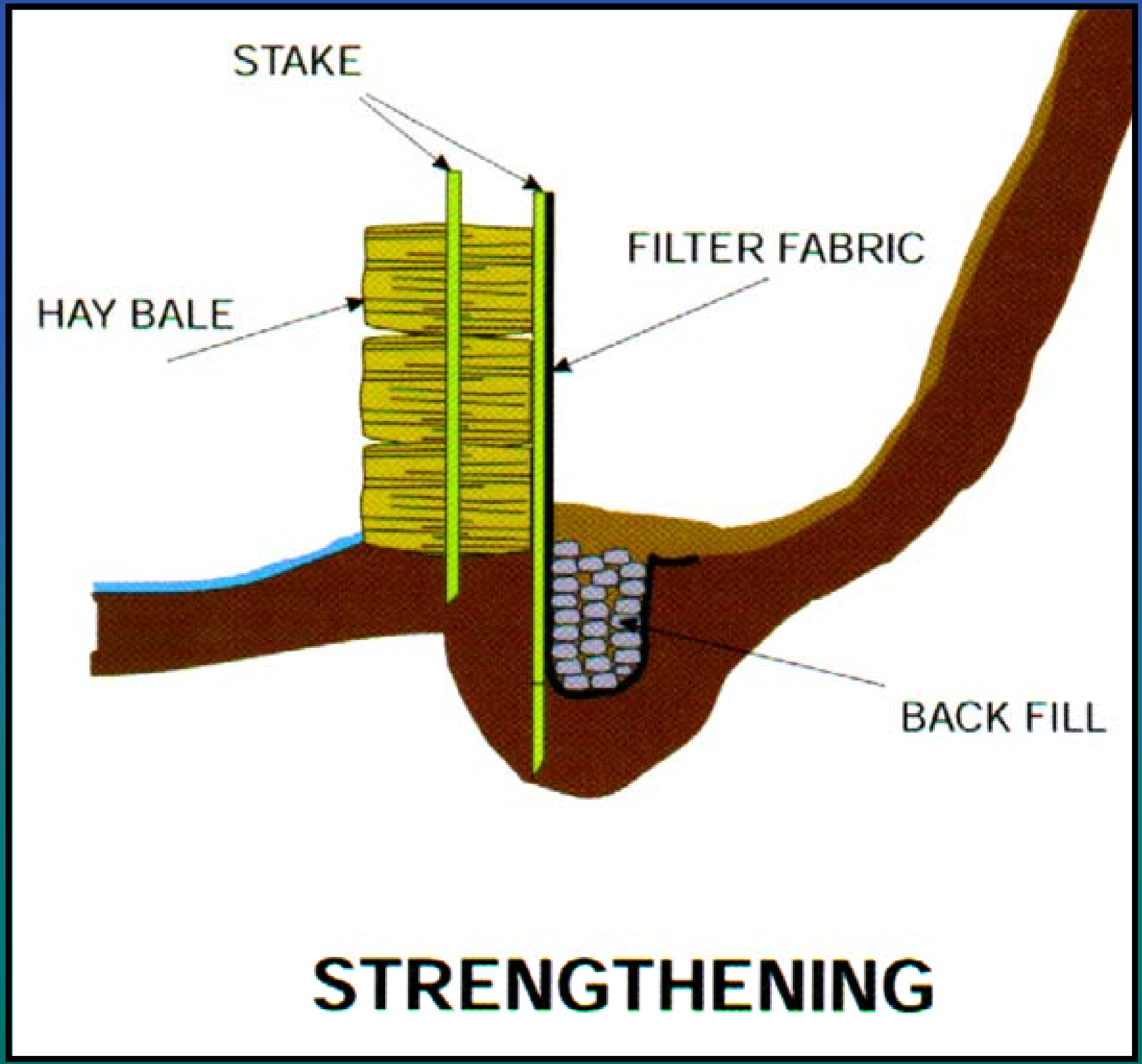


Silt Fencing

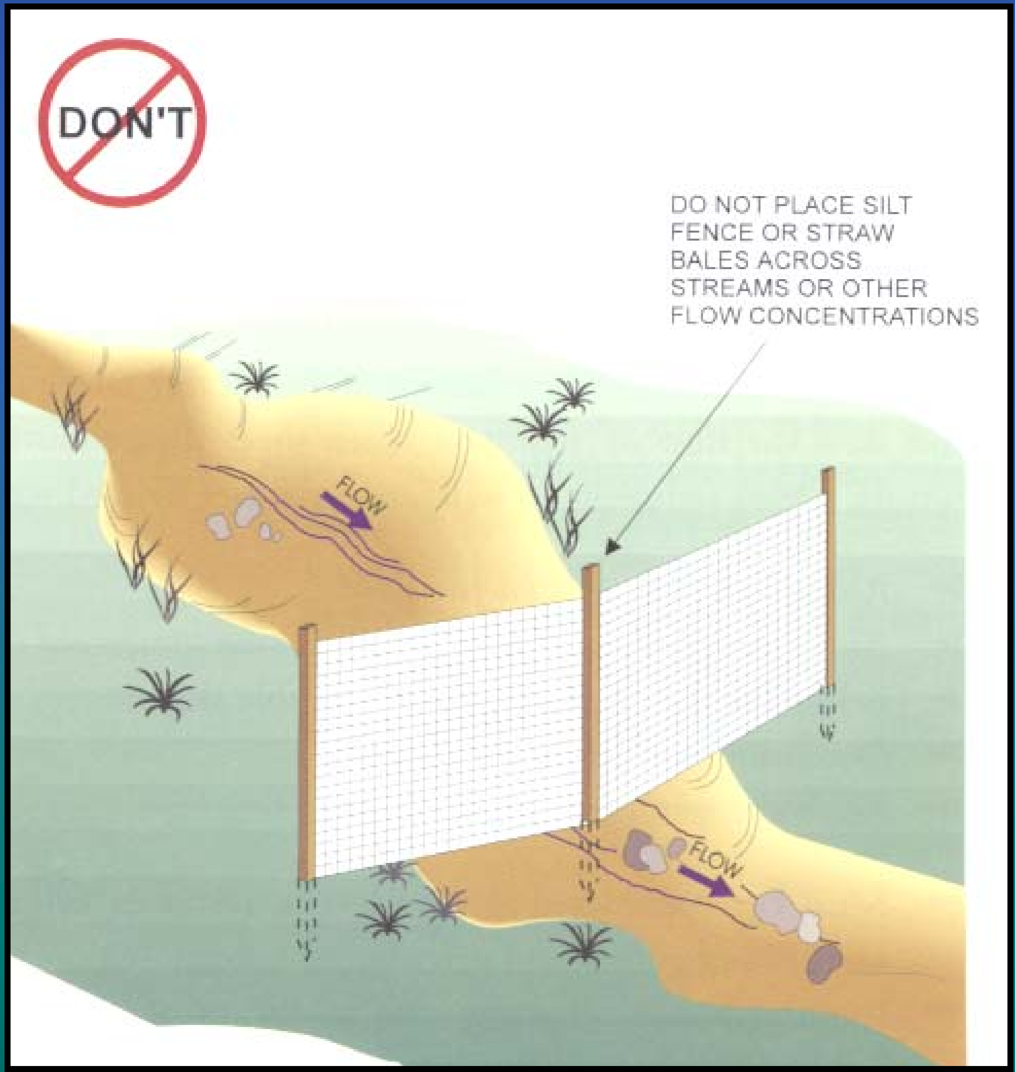
DON'T

DO

Silt Fencing



Silt Fencing

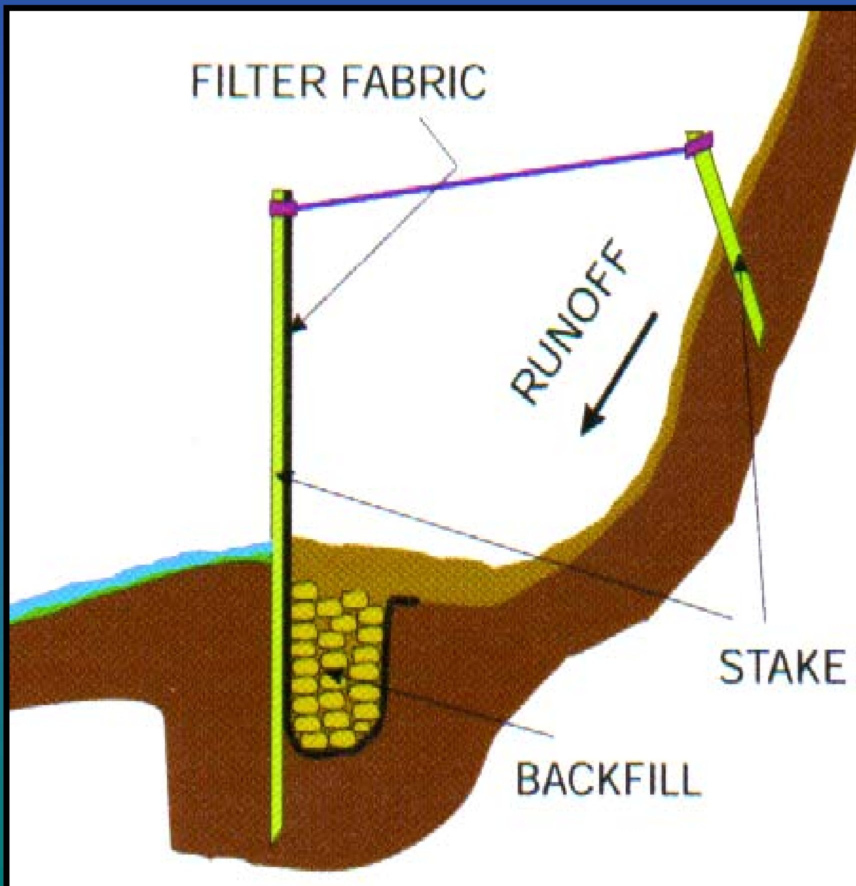


DON'T

Silt Fencing

DO

Silt Fencing



Anchoring

DON'T

Silt Fencing

Do Not Install:

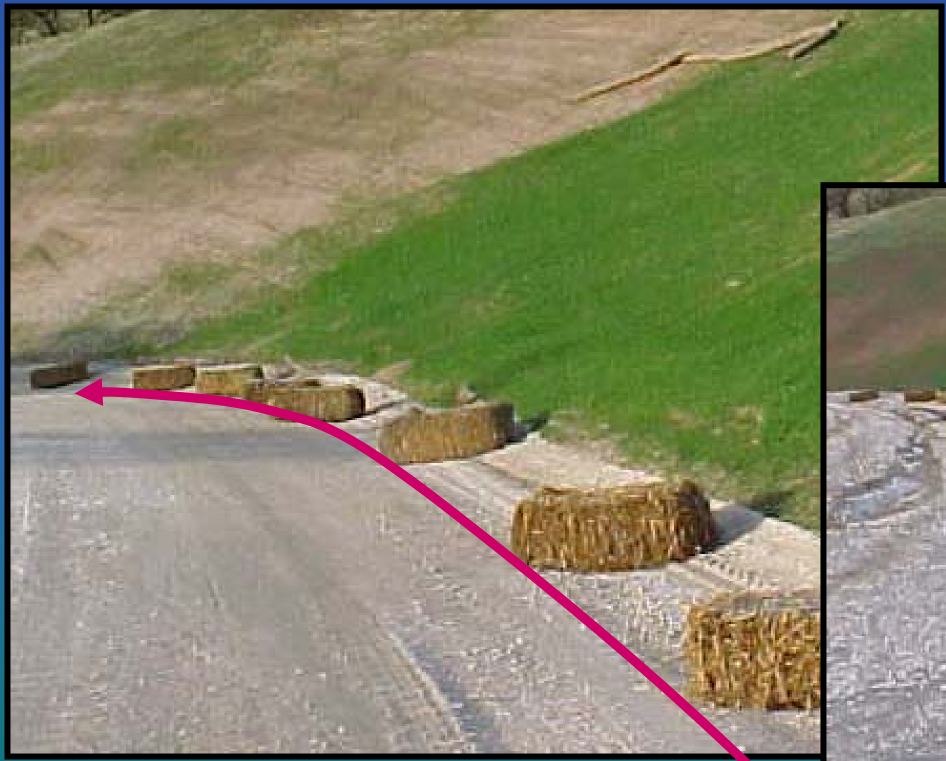
- In Channels
- Across Channels

DON'T

Hay Bales

DON'T

Hay Bales

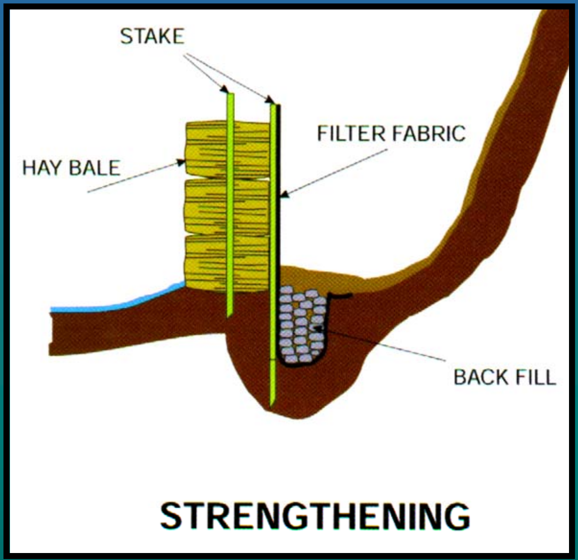


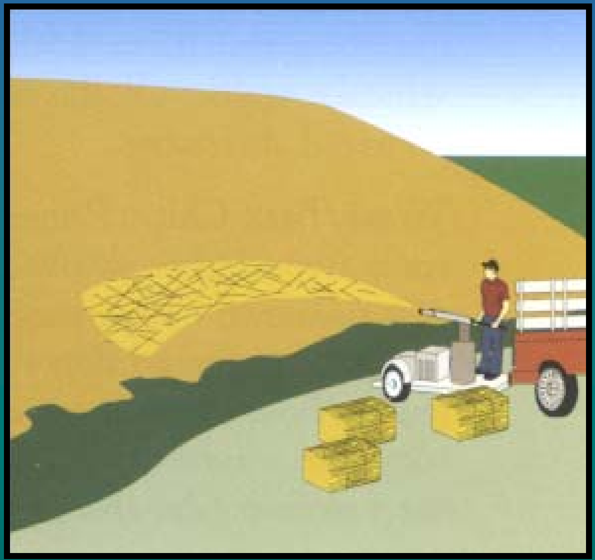
DON'T

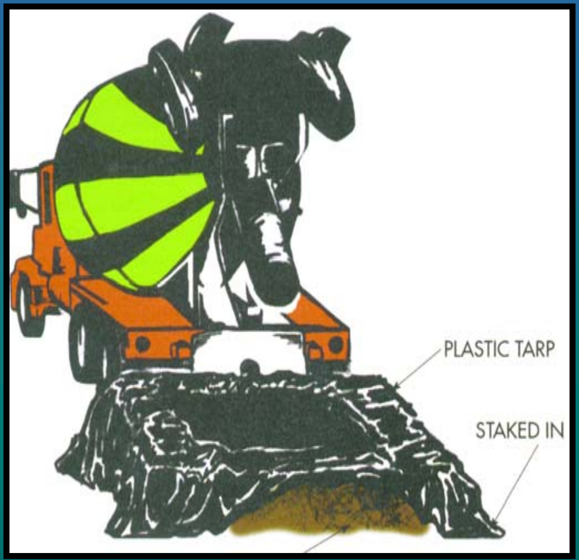
Hay Bales

Hay Bales

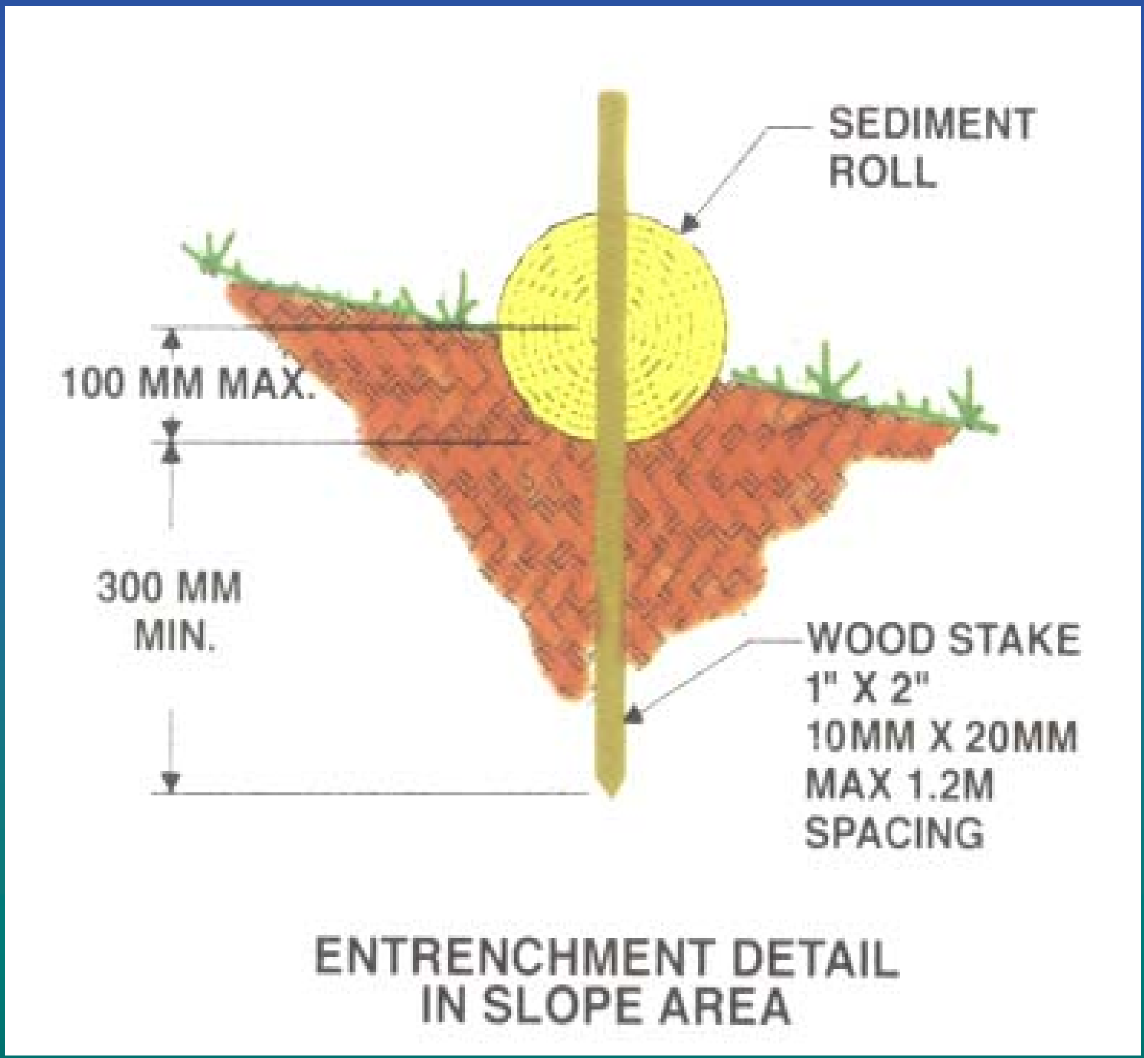
+ Strengthen Silt Fence
+ Apply as Mulch
+ Build Concrete Washout







Fiber Rolls


DO
SEDIMENT ROLL
100 MM MAX.
300 MM MIN.
WOOD STAKE 1" X 2" 10MM X 20MM MAX 1.2M SPACING
ENTRENCHMENT DETAIL IN SLOPE AREA

DO

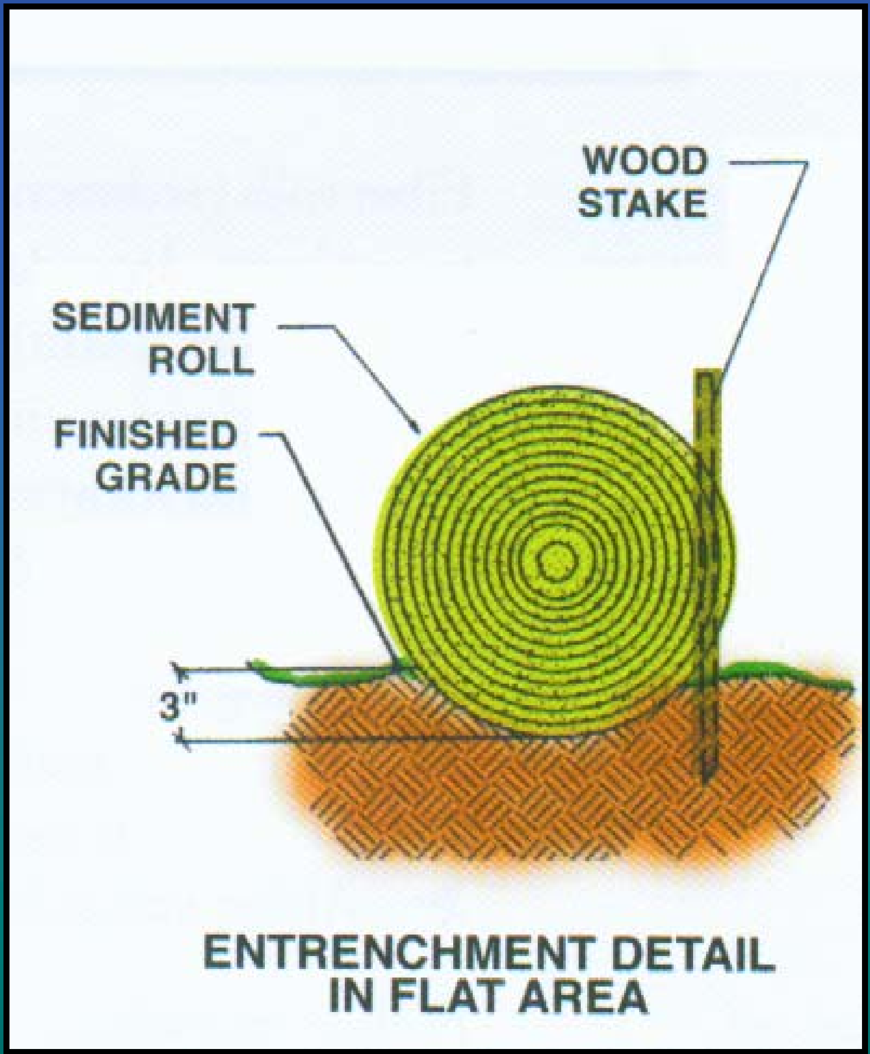
Fiber Rolls

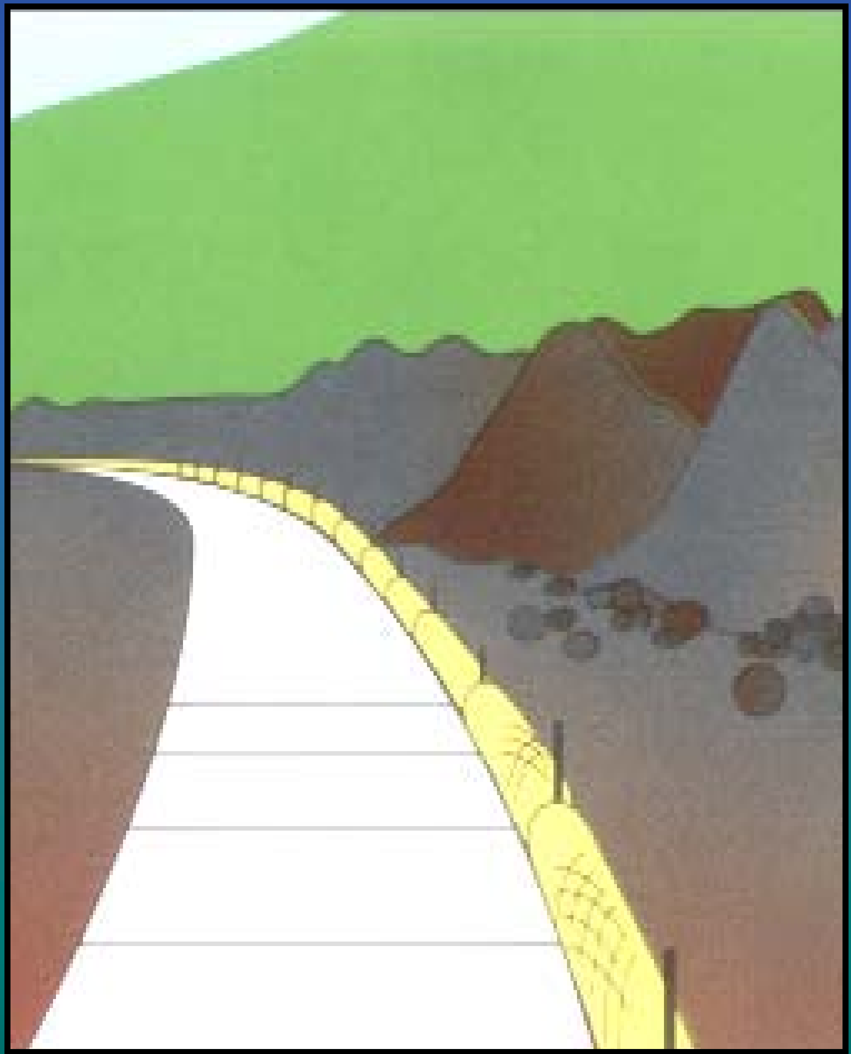
DON’T

Fiber Rolls

DO

Fiber Rolls





DO

Fiber Rolls

DON'T

Fiber Rolls

DO

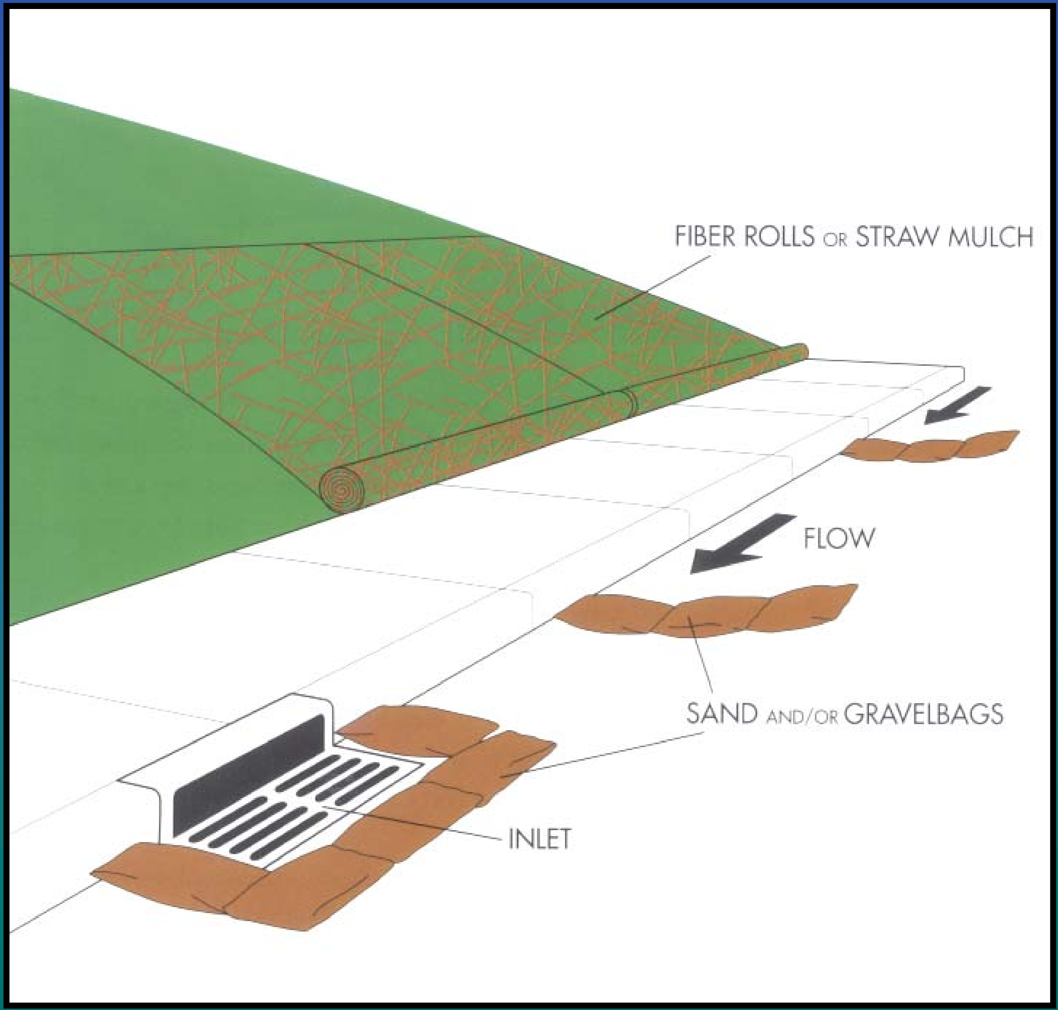
Fiber Rolls

DO

Silt Bags

Gravel Bags

DO



- Inlet protection
- Chevrons

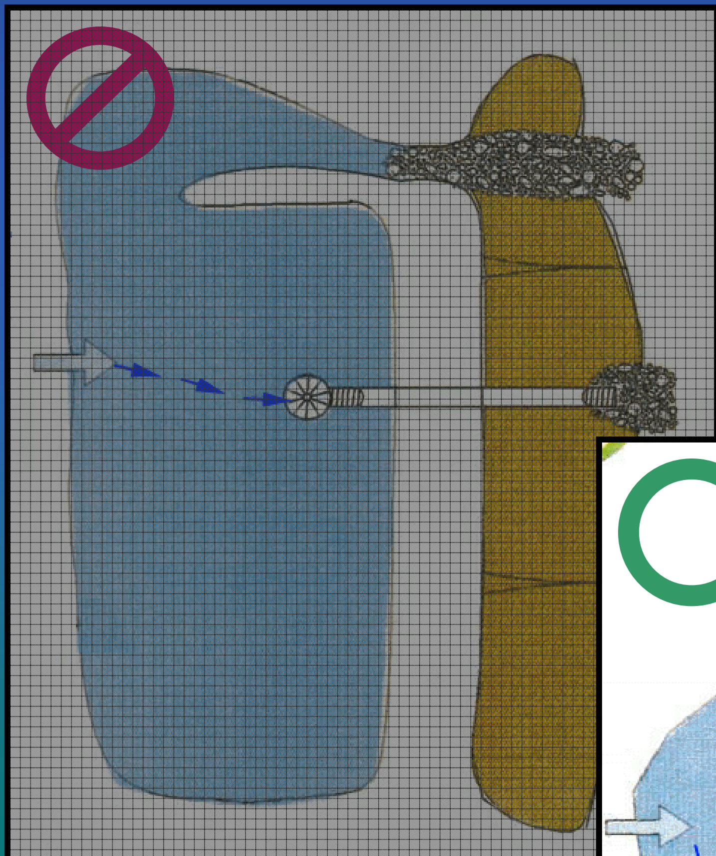
DON'T

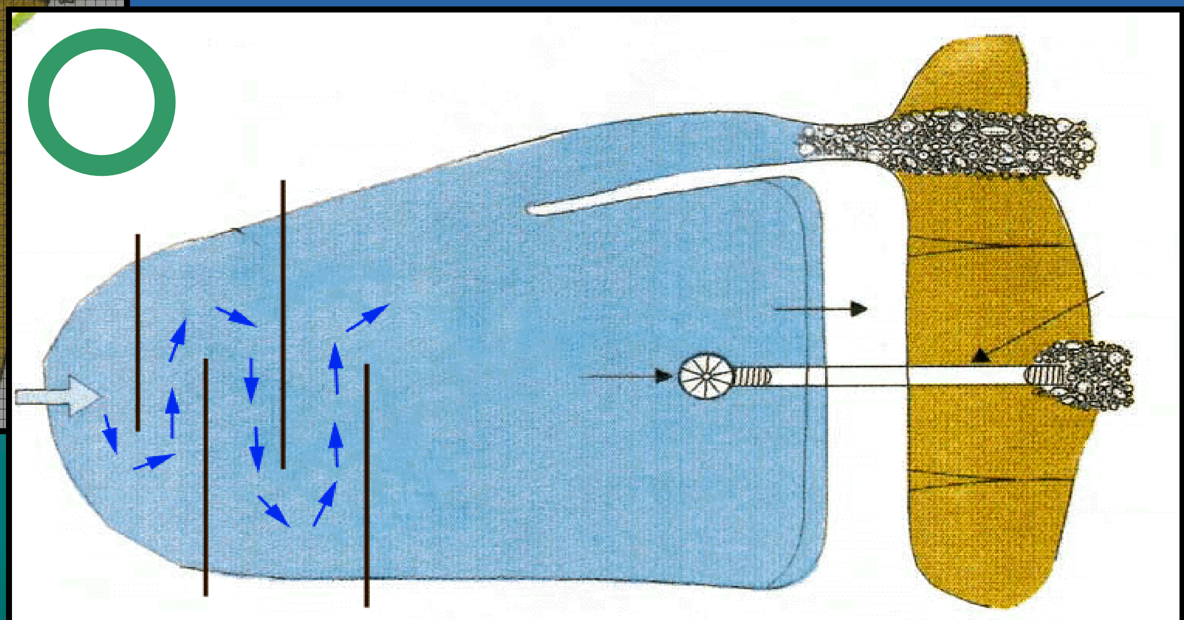
Sand Bags

DO

Gravel Bags

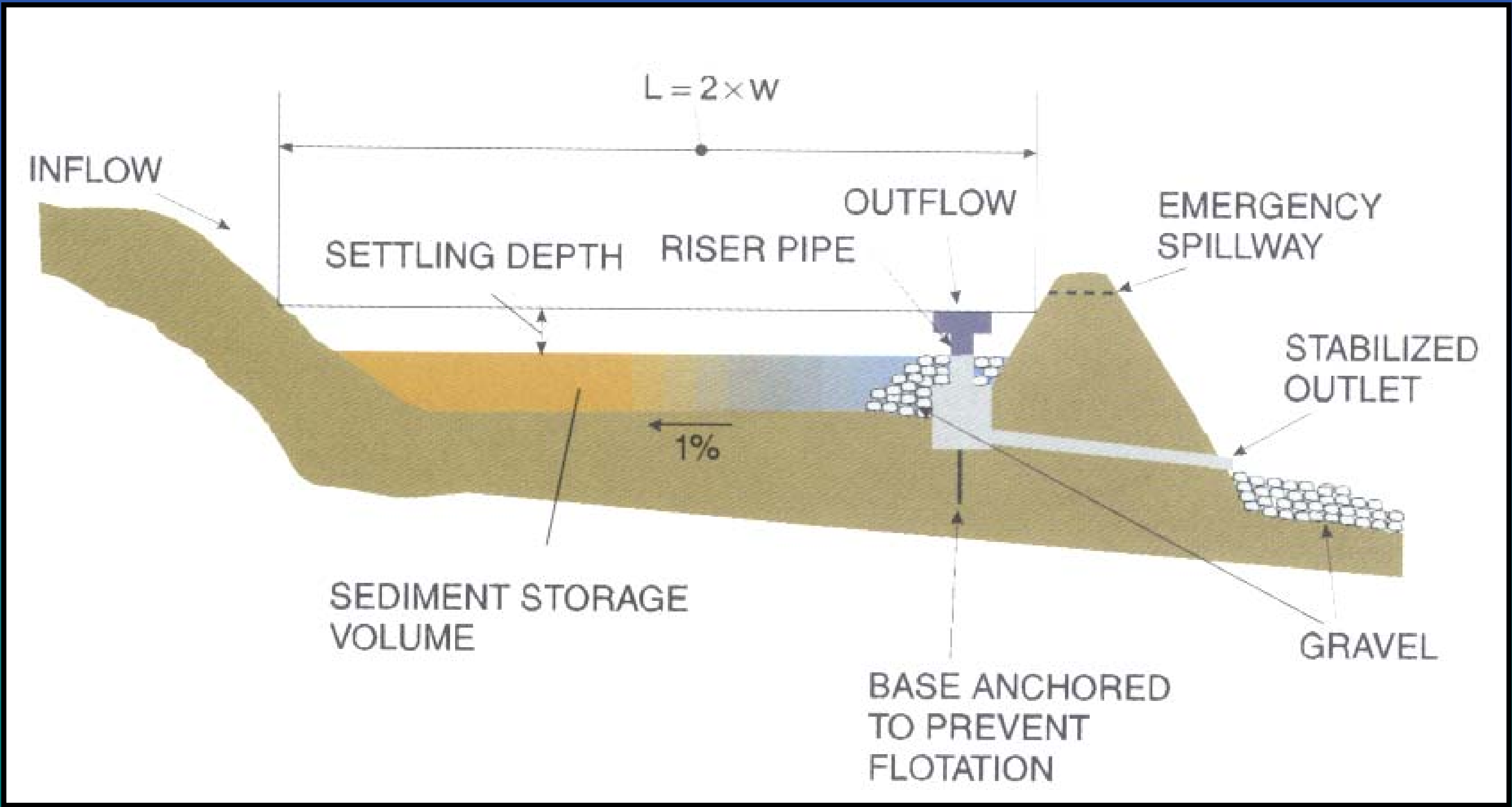
Sediment Basins





+ Elongated
+ Baffles

Sediment Basins



DO

Sediment Basins

DO

Sediment Basins

DON'T

Sediment Basins

A major obstacle to desilting basin effectiveness is the outlet design.

This site lacks soil stabilization, which puts pressure on the desilting basin.

DO

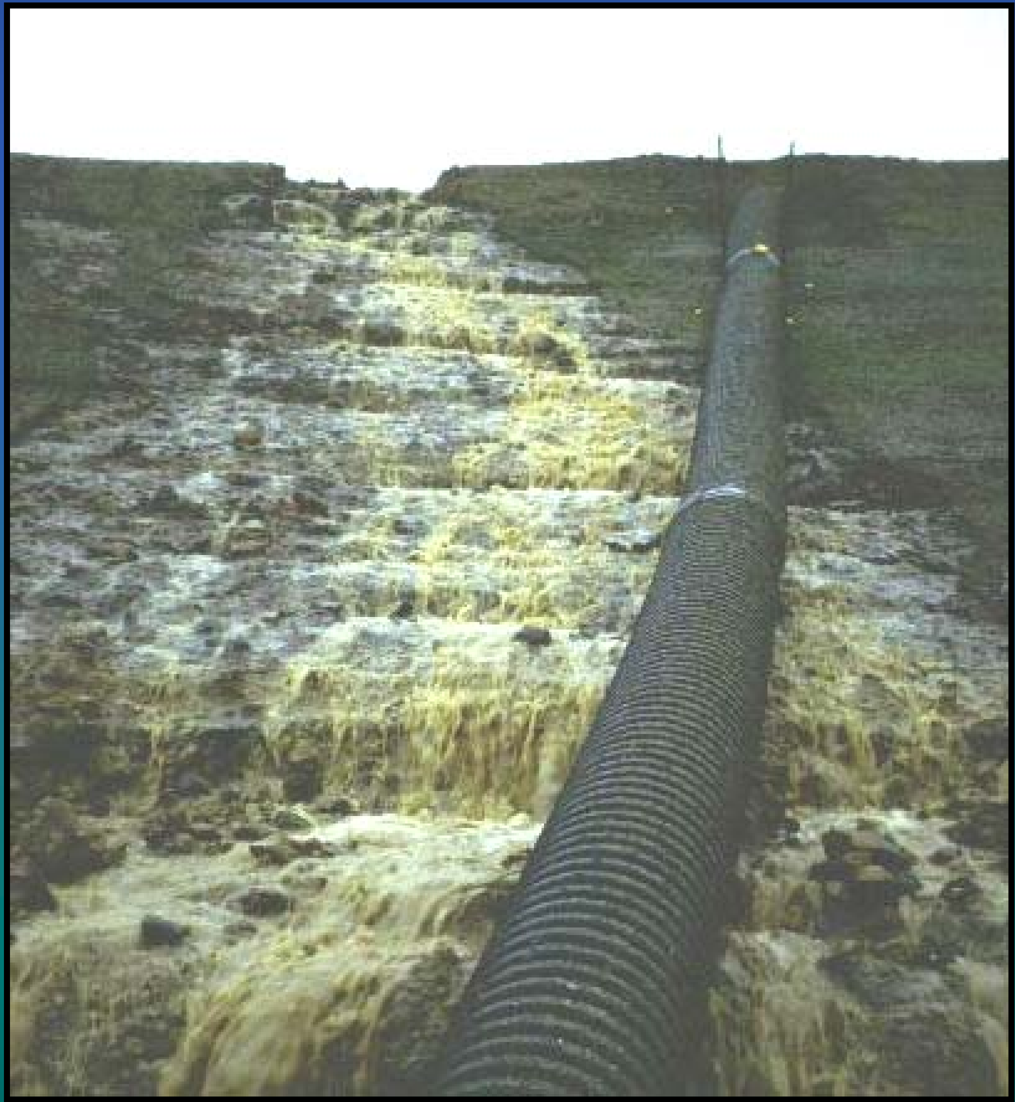
Sediment Basins

A desilting basin must have an emergency spillway for overflow.

DON'T

Sediment Basins

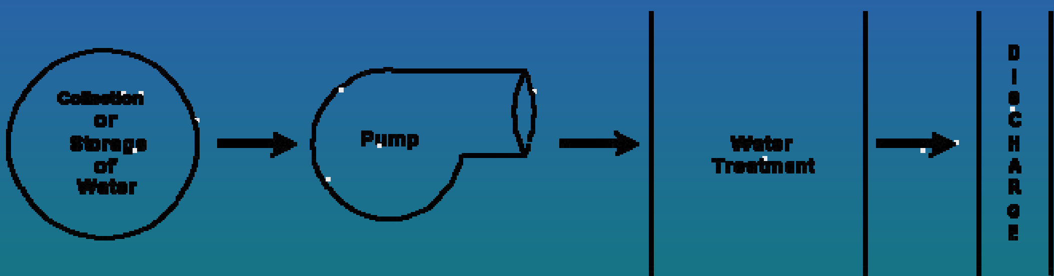
- Failed Sediment Basin



DO

Dewatering

- Notify the RWQCB
- May require monitoring
- Reporting will be required



0 NTUs

33 NTUs

113 NTUs

DO

Gravity Bag Filter

- Also known as a “dewatering bag”
- Square or rectangular bag made of non-woven geotextile fabric that collects sand, silt, and fine particles
- Water is pumped in one end and seeps out of sides and bottom
- May require a secondary barrier to capture escaping sediments; e.g. rock filter bed or straw bale barrier
- Effective for removing larger particles.

DO

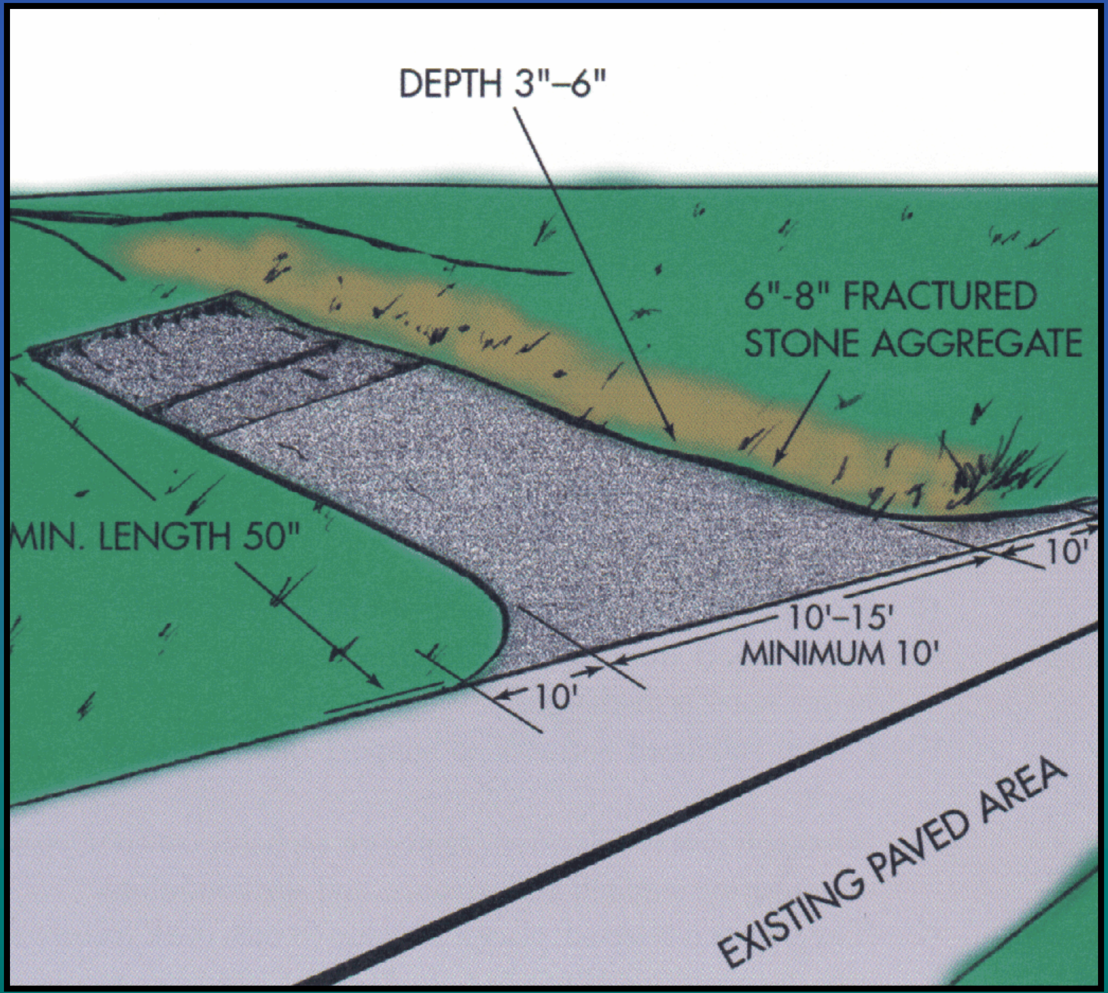
Settling Tank

DO

Filtration

DO

Stabilized Site Exit



DON'T

Unstable Site Exit

DO

Stabilized Site Exit

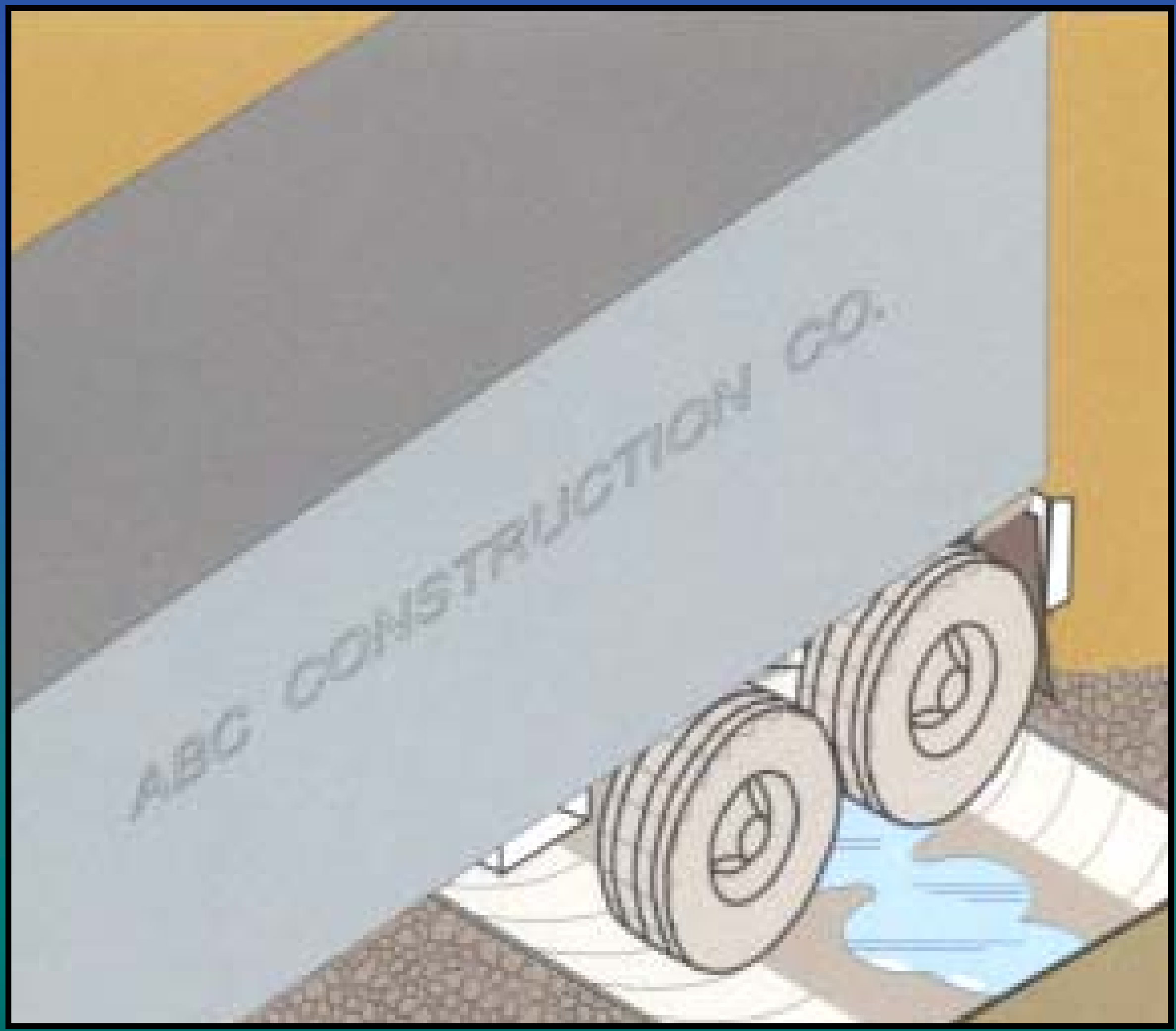
DO

Stabilized Site Exit

Salvaged metal beam guardrail used for tracking control at an exit point.

DO

Stabilized Site Exit



DO

Good Housekeeping

- Timing
- BMP Maintenance
- Concrete Washout
- Street Sweeping
- Containment
- Waste Management
- Water Conservation
- Prevent Non-SW Discharges

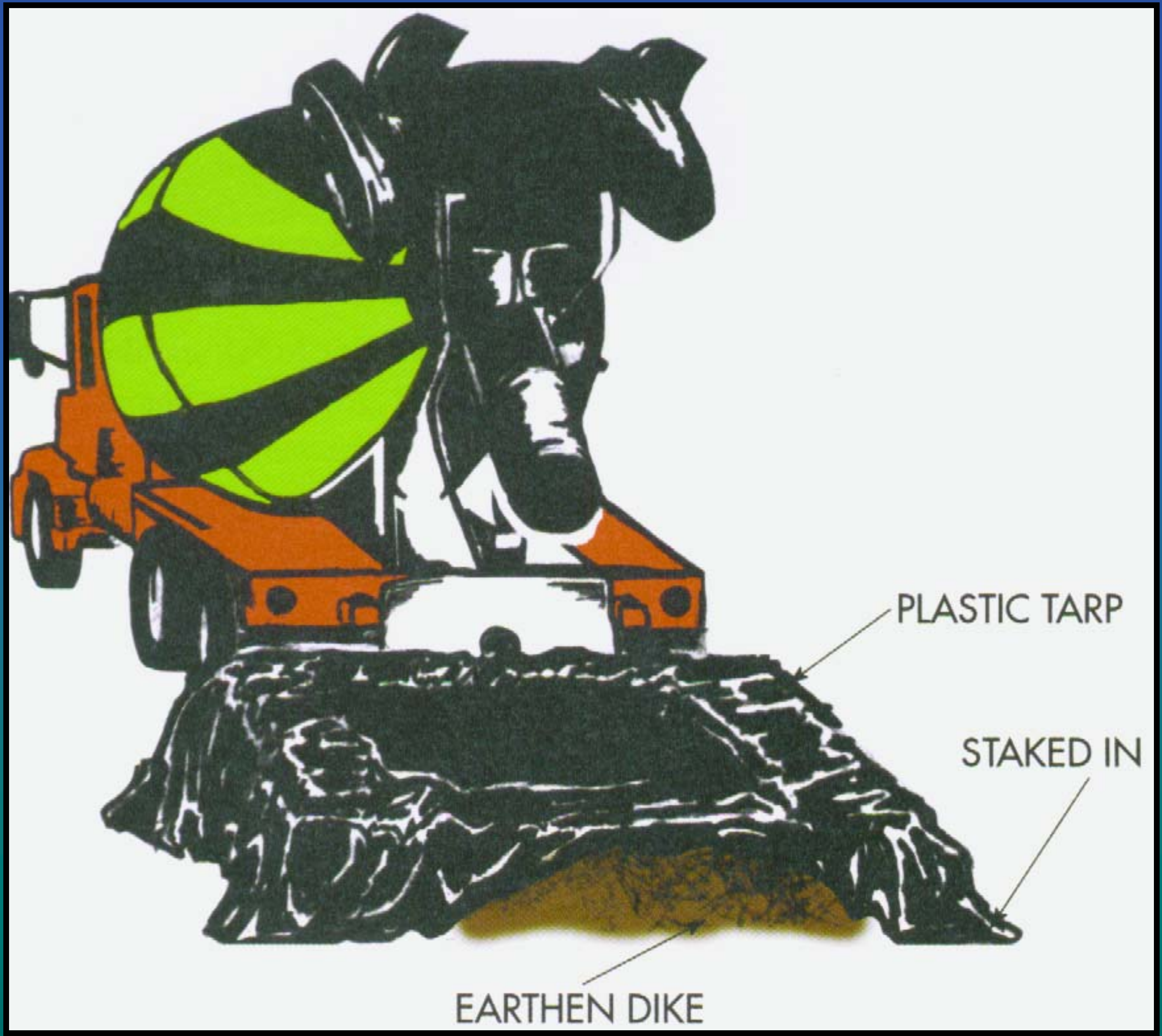
Timing

DON'T

BMP Maintenance

DO

Concrete Washout



DON'T

Concrete Washout

DO

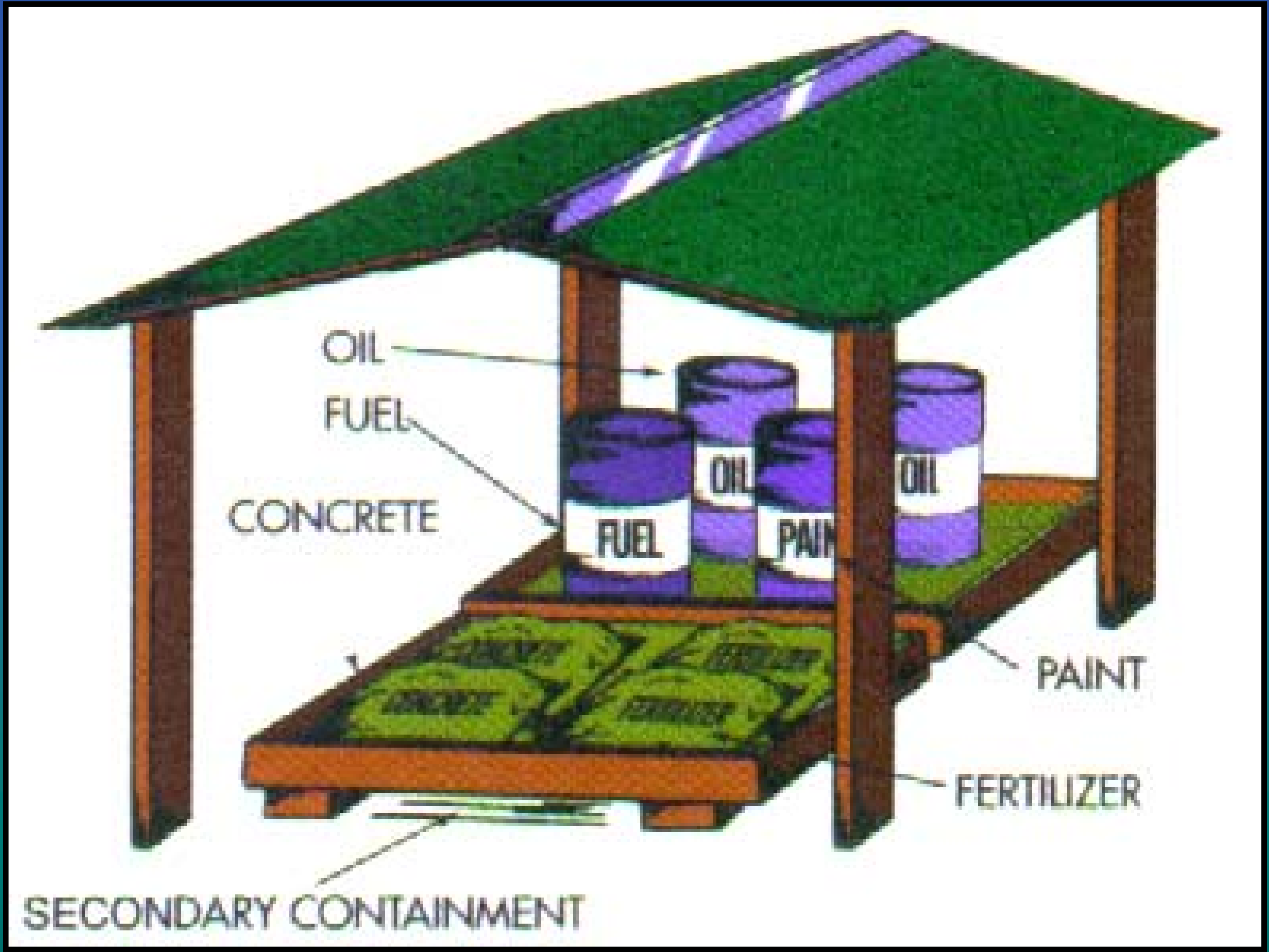
Concrete Washout

DO

Street Sweeping

DO

Containment



DO

Containment

DON'T

Containment

Containment

DON'T

DO

Waste Management

DON’T

Waste Management

DO

Water Conservation

DON'T

Avoid Non-SW Discharges

DON'T

Avoid Non-SW Discharges

DON'T


END

Inspections and Monitoring

May 2010

Prepared by:
Donette Dunaway
Storm Water Program Manager, CCRWQCB
and
Ed Othmer, PE, CPESC, CPSWQ
URS Corporation

Presented by:
John McCullah, CPESC
Salix Applied Earthcare
&
Ed Othmer, PE, CPESC, CPSWQ
URS Corporation

Water Boards

Caltrans

Why inspect the site?

- Permit SECTION B.3 requires site inspections
- Inspections will determine Permit compliance

Inspection goals:

- Identify areas contributing pollution
- Evaluate BMP effectiveness
- Determine if maintenance or changes are needed

BMP Effectiveness

Need BMP Additions, Maintenance, or Changes?

Who should do inspections?

QSP!!

When should the site be inspected?

Risk Level	Visual Inspection					
	Quarterly Non-Storm Water Discharge (Drainage Areas)[4]	Weekly (BMPs)	Pre-Storm: Baseline (Drainage Areas, BMPs, Storage/ Containment Areas)[3]	Pre-Storm: REAP	Daily Storm (Discharges and BMPs)[1]	Post-Storm (Discharges and BMPs)[2]
1	✓	✓	✓		✓	✓
2	✓	✓	✓	✓	✓	✓
3	✓	✓	✓	✓	✓	✓

1 Within 48 hours after each qualifying event (≥ 1/2"); prior to discharge of stored/contained storm water; during business hours; every 24 hrs during extended storm events

2 Within 48 hours after each qualifying event (≥ 1/2"); prior to discharge of stored/contained storm water; during business hours

3 Within 48 hours prior to each qualifying event (≥ 1/2")

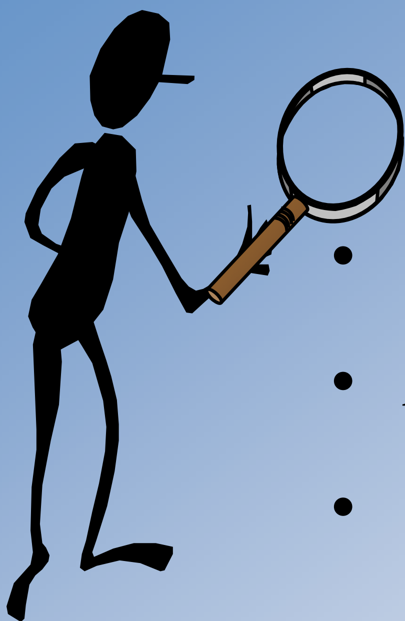
4 January - March, April - June, July - September, October - December; during daylight hours

What should you inspect?

Best Management Practices!

- Design
- Installation
- Maintenance
- Effectiveness

Where do you look?



Inspect:

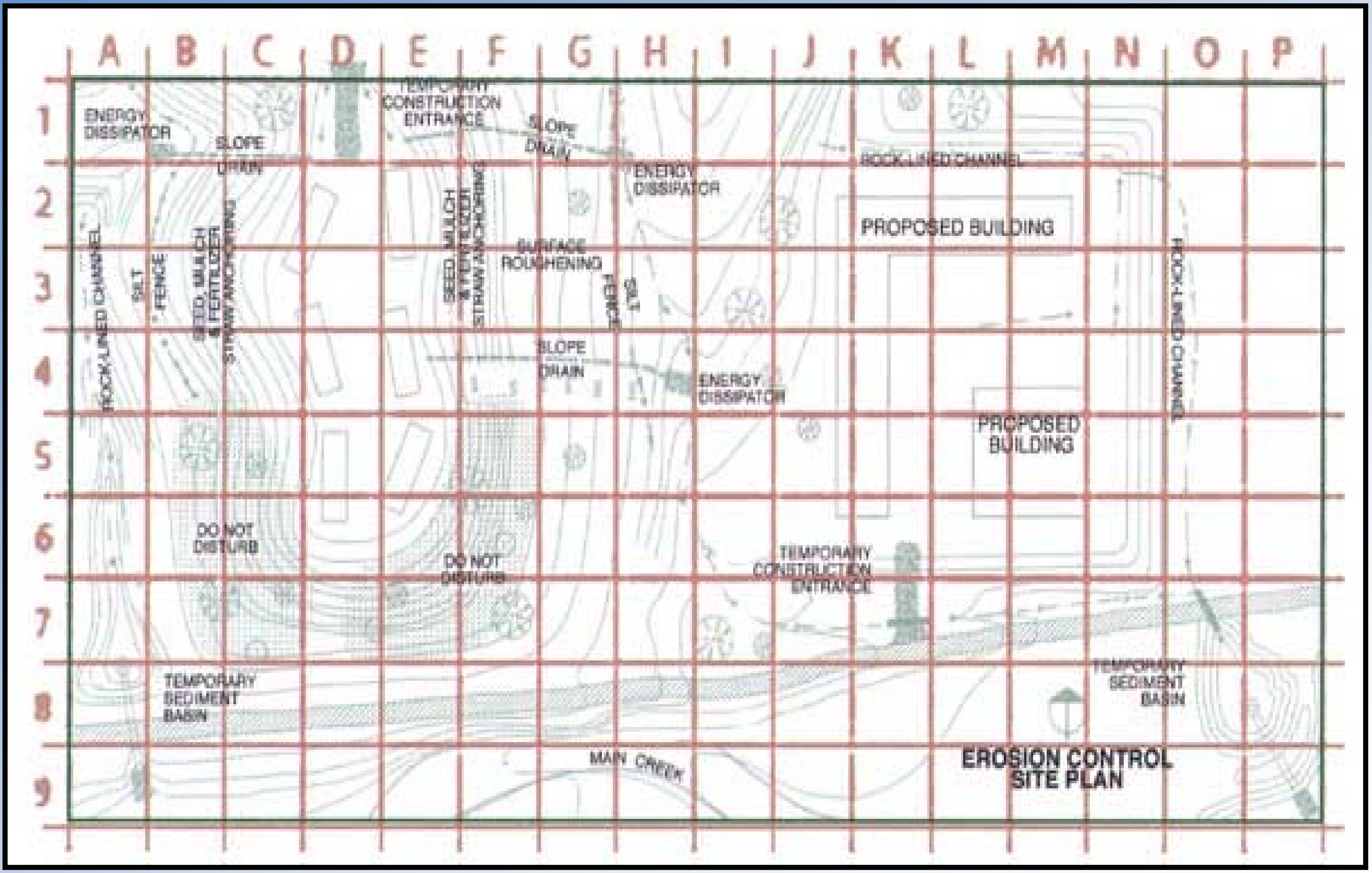
- Storage areas
- Active disturbed soil areas
- Site entrance/exit
- Storm drains
- Areas of applied vegetation
- Disposal areas

Storage Areas

Entrances/Exits and Active Areas

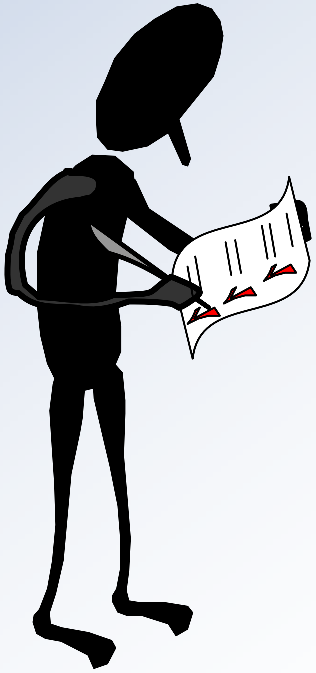
Areas of Applied Vegetation

Site Map with Grid Overlay



What should inspection forms contain?

- Time, date, weather, inspector
- Locations inspected
- BMPs inspected
- Status of BMPs
- Corrective action
- Sample analytes



Inspection Form

Pre-Storm, Post-Storm and Weekly Inspection Report

Date of Inspection:__________ Time:__________ Weather Conditions:__________

Location/ Coordinate	BMPs Implemented	Status	Actions Taken	Inspected by	Sample & Analysis
6A, 7A, 8A	Settlement Pond				
9A	Energy Dissipator				TSS Turb.
8O, 8P	Settlement Pond				
9P	Energy Dissipator				TSS Turb.
1D	Rock Egress Pad				

What is done after inspections?

- Perform maintenance
- Install additional controls
- Update SWPPP

What are the sampling requirements?

Risk Level	Sample Collection			
	Non-Storm Water Discharge	Non-Visible Pollutants[5]	Storm Water Discharge[6,7]	Receiving Water[8,9]
1		✓		
2	✓	✓	✓	
3	✓	✓	✓	✓

5 Within first 2 hours during business hours

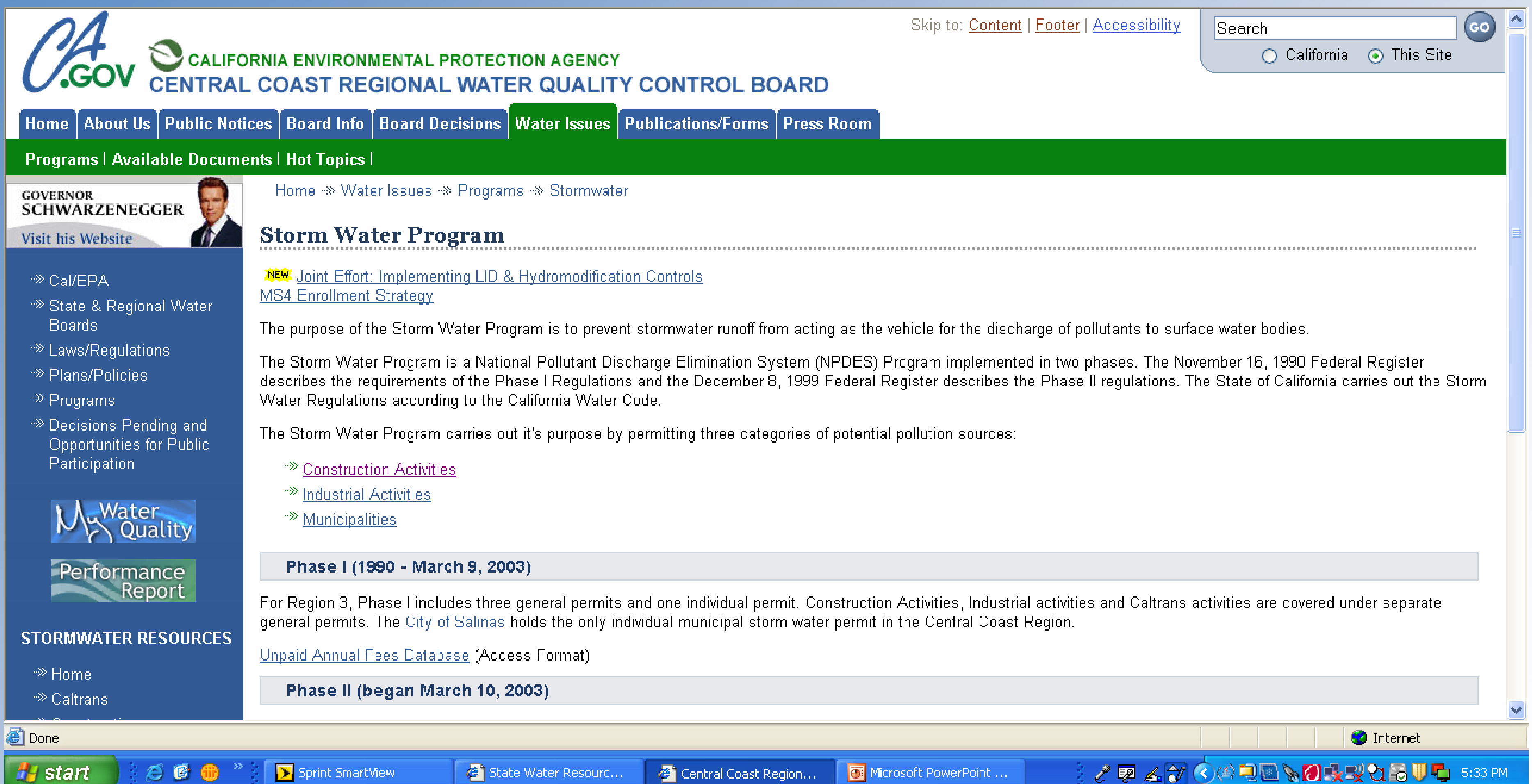
6 Minimum 3 samples per day subsequent to qualifying event (≥ 1/2" at time of discharge) at all discharge points

7 Submit results to SWRCB within 5 days after storm event

8 When NEL is exceeded sample upstream and downstream of discharge in receiving water

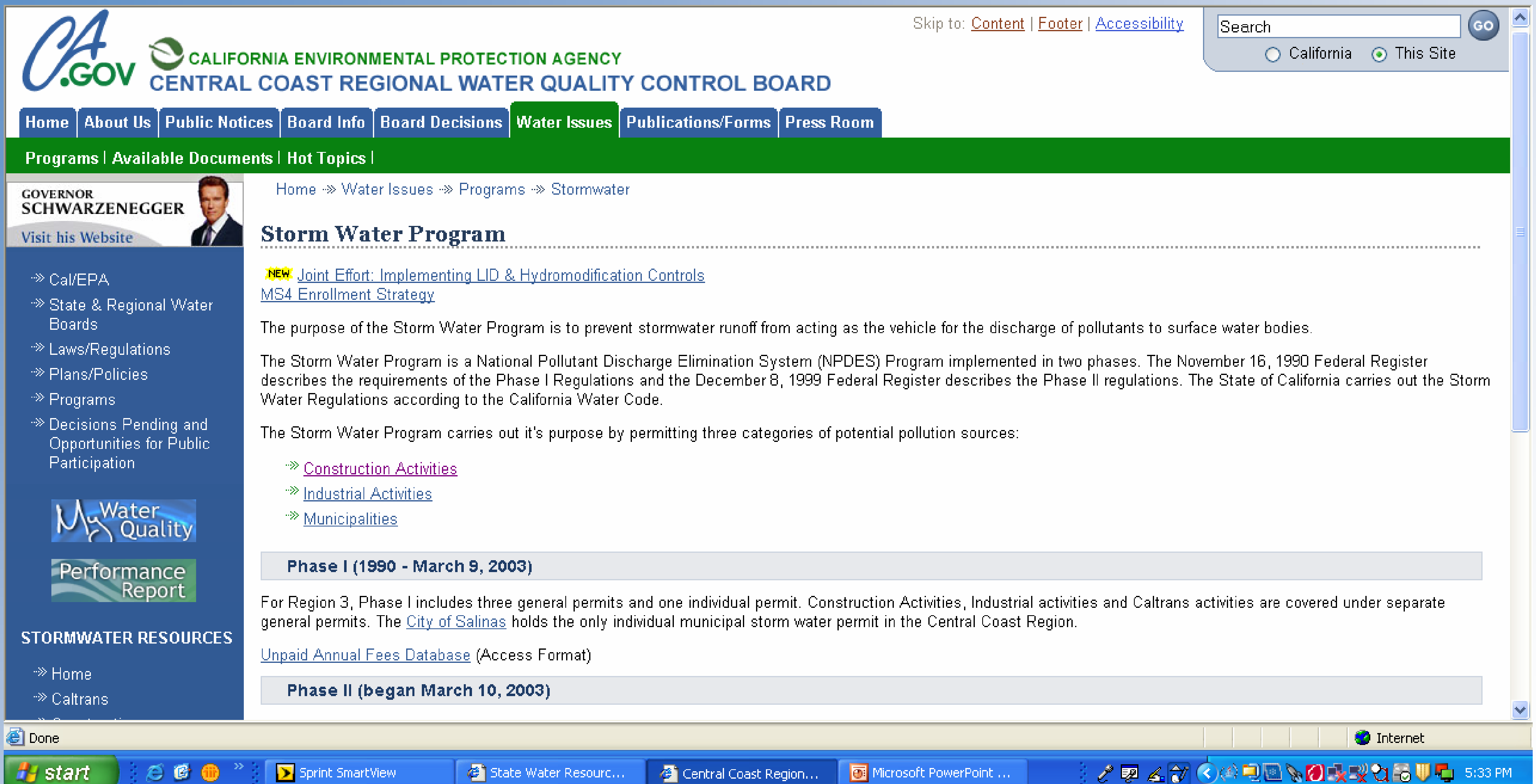
9 Benthic Macroinvertebrate Bioassessment for projects disturbing ≥ 30 acres

Resources



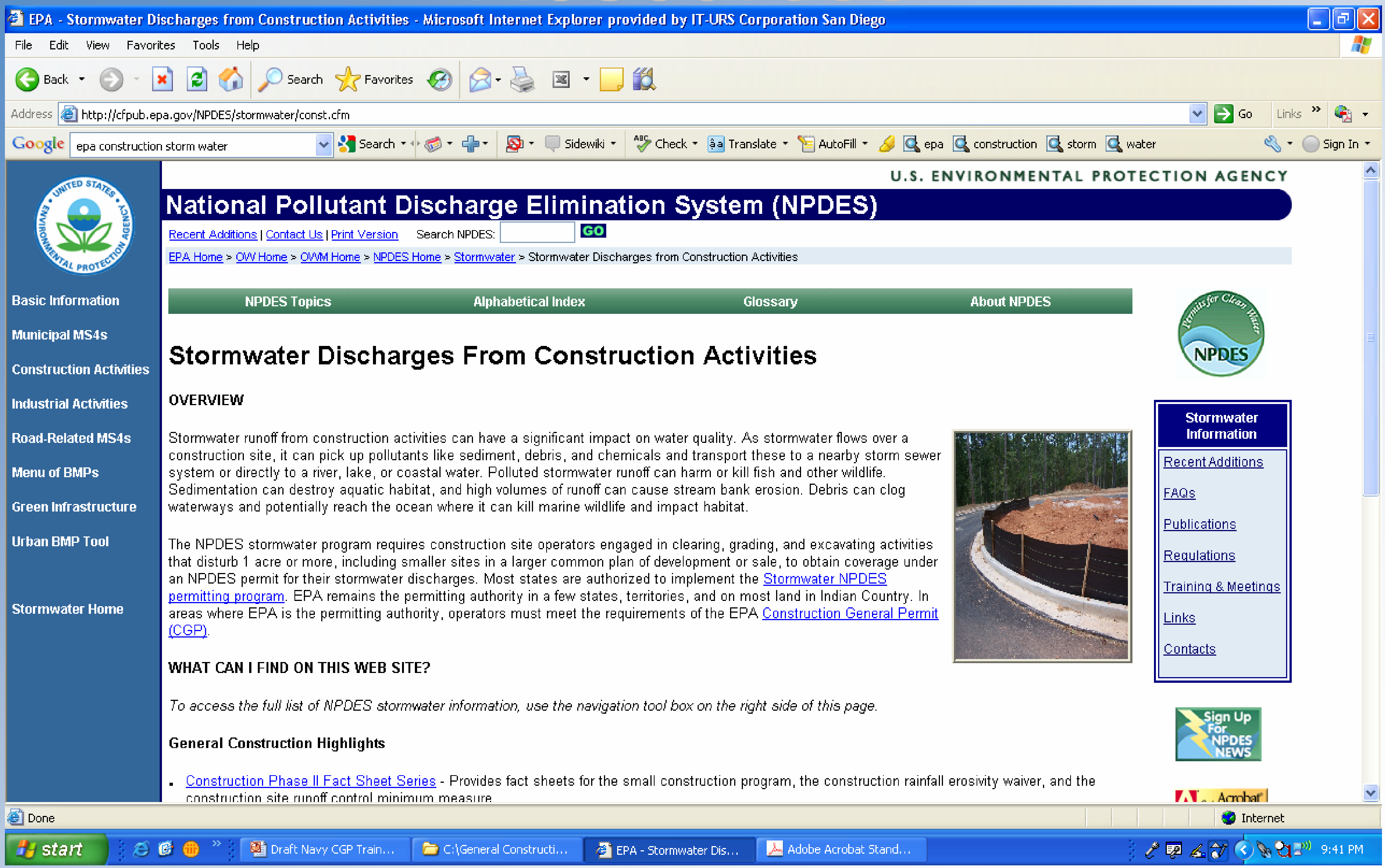
http://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/index.shtml

Resources



http://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/index.shtml

Resources

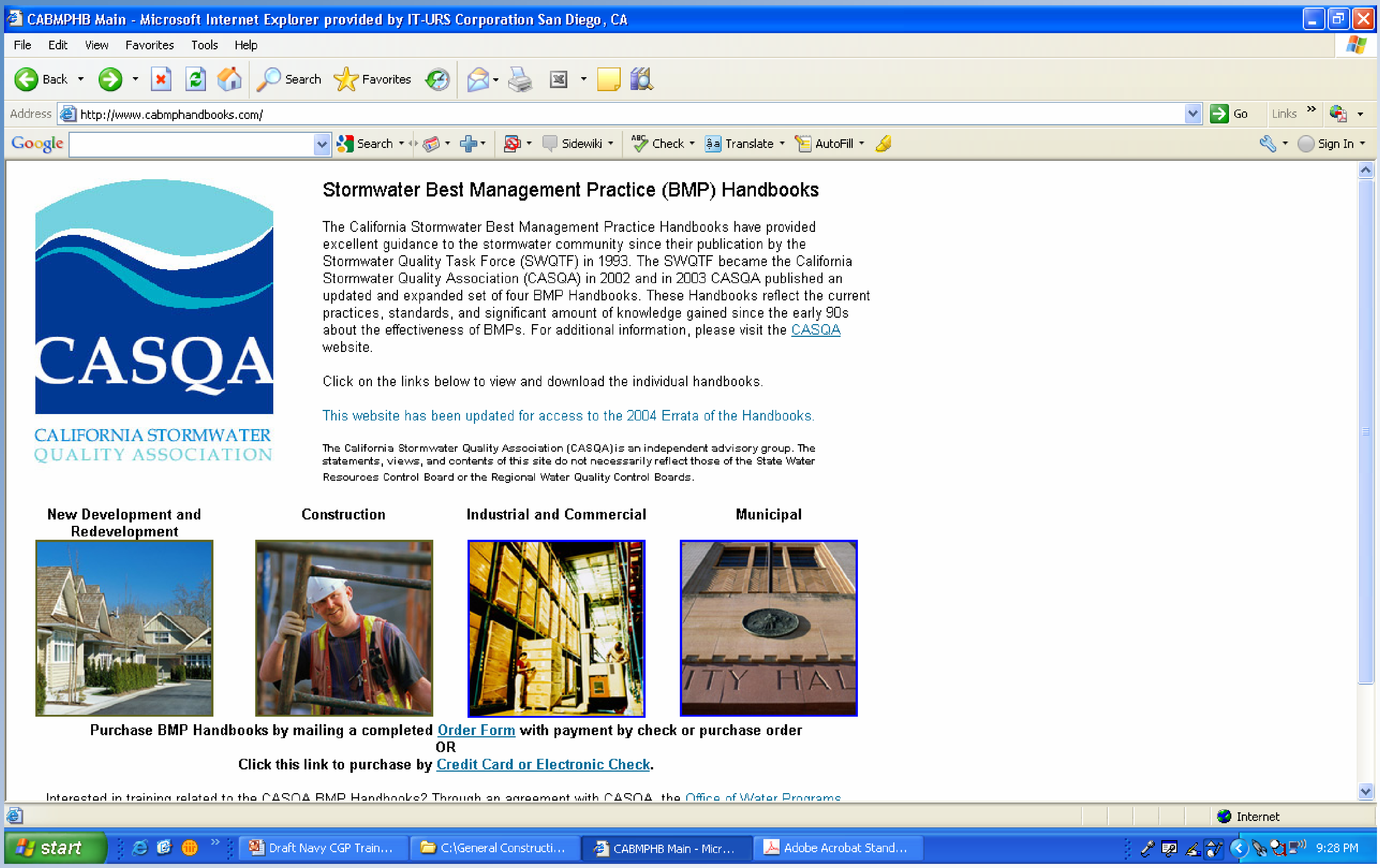


http://cfpub.epa.gov/NPDES/stormwater/const.cfm

Resources

http://www.ieca.org

Resources



http://www.cabmphandbooks.com/

Resources

EnviroCert International, Inc.

April 1, 2008 — Press Release announcing the organization of EnviroCert International, Inc.

EnviroCert International, Inc.

If you need information about EnviroCert International, please contact us as follows:

Phone: (828) 655-1600 **Email:** info@envirocertintl.org

Our office hours are 8:00 am to 5:00 pm Eastern Time. All U.S. Federal Government holidays are observed.

Certification Programs

EnviroCert International provides oversight and direction for the following certification programs. Please select one of the links below for information about a specific program.

CPESC® Certified Professional in Erosion and Sediment Control

Certified Erosion Sediment Storm Water CESSWI™ Inspector

CPSWQ® Certified Professional in Storm Water Quality

http://www.envirocertintl.org/

Resources

CISEC, Inc.

Home

CISEC, Inc. - Who are we?

Find a CISEC

Becoming a CISEC Instructor

Training and Exam dates

Training Modules

Minimum Qualifications for Exam

Payment and Exam Application Forms

Construction General Permit and Sample Inspection Form

Study Guide

Sample Exam Questions

Answers to Sample Questions

Certification Renewal

Newsletters

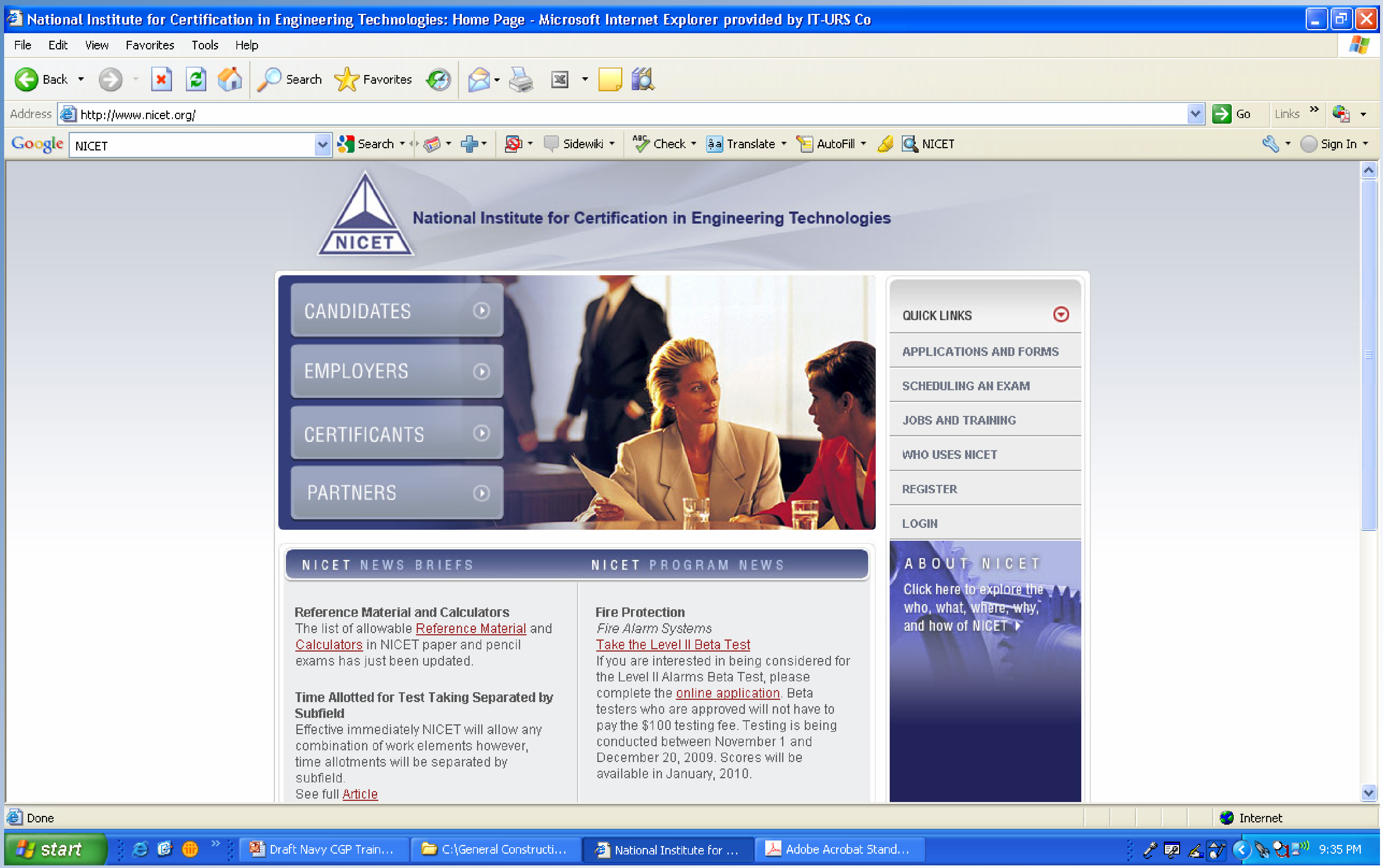
CISEC Manual

The Certified Inspector of Sediment and Erosion Control (CISEC) Program

The Certified Inspector of Sediment and Erosion Control (CISEC) program is administered by CISEC, Inc., a non-profit 501(c)6 organization based out of Parker, Colorado. Our nationwide training modules have been formulated to meet EPA's Construction General Permit program and to provide a practical perspective on inspecting BMPs, writing reports, and identifying limitations of commonly found construction site mitigation measures. In addition, the training modules provide participants with essential inspector background information along with an opportunity to hone inspecting skills on a virtual active construction site.

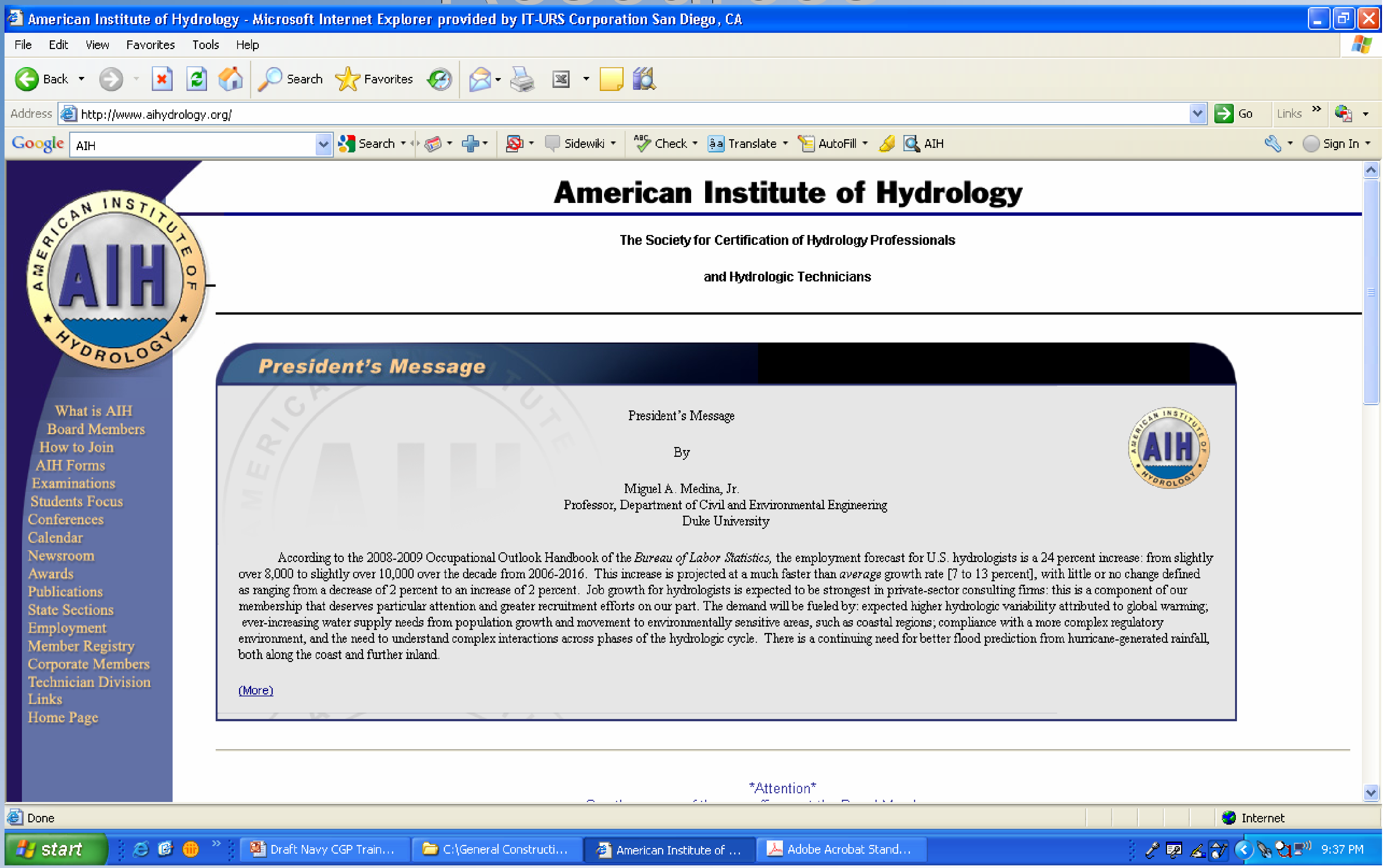
http://www.cisecinc.org/

Resources



http://www.nicet.org/

Resources



http://www.aihydrology.org/

Training

CALIFORNIA STORMWATER QUALITY ASSOCIATION®

CASQA

Dedicated to the Advancement of Stormwater Quality Management, Science, and Regulation

Logged in as: Ed Othmer | Logout | Cart

Search: Go!

Home | About Us | Contacts | LID | Links | Meetings | Membership | Members Only | Resources | Store

You are here: Training and Education » Construction General Permit Training

Saturday, May 01, 2010

- Welcome
- Abstract Submission 2010
- Announcements
- BMP Handbooks
- BMP Handbooks Portal
- CA LID Portal
- Conferences
- Downloads for Non-Members
- Meeting Registration
- Press Releases
- Resource Library
- Store
- Training and Education
- Upcoming Meetings

California Stormwater Quality Association
P.O. Box 2105
Menlo Park, CA 94026-2105

Construction General Permit Training for Qualified SWPPP Developer (QSD) and Practitioner (QSP)

CASQA and the State Water Board convened the California Construction General Permit Training Team (CGP Training Team) in early 2008 and have been working with the team since then to develop the State Water Board sponsored QSD/QSP training program required in the CGP. CASQA will administer the CGP Training Program on behalf of the State Water Board. For the latest update on the CGP Training Program please click on the link below.

CGP Training Program Update – 3/15/10

Interested parties in either becoming CGP QSD/QSP Trainer of Record, to provide the CGP QSD/QSP Training, or a Qualified SWPPP Developer (QSD) or Qualified SWPPP Practitioner (QSP) should click on the links below.

- CGP Trainer of Record *DEADLINE EXTENDED*
- Qualified SWPPP Developer (QSD), and/or Qualified SWPPP Practitioner (QSP)

https://www.casqa.org/TrainingandEducation/ConstructionGeneralPermitTraining/CGPTrainerofRecord/tabid/207/Default.aspx

Training

- CASQA will:
- Collect reasonable fees to cover the costs of administering the program
- Establish and maintain a web site to disseminate information about the program
- Oversee the QSD/QSP exam process to ensure it is objective and equitable
- Issue certificates or similar proof of “Trainer of Record” and QSD/QSP status. Names of qualified professionals will be posted on the web site for public access
- Periodically evaluate “Trainers of Record” and will address grievances about “Trainers of Record” and will take appropriate action as needed to address non – performance issues

Training

- QSD/QSP Trainers of Record to be posted by June 2010; training will be offered shortly thereafter
- QSP Training – 2 days
- QSD Training – 3 days
- Examination to be taken after training

Table 1. List of Modules

QSP/QSD Modules	Hours	QSD Only Modules	Hours
1. Training Overview and Regulations	1.5	6. Project Planning and Site Assessment	4
2. Erosion Processes and Sediment Control	2	7. SWPPP Development and PRDs	2
3. SWPPP Implementation	3	8. Project Closeout	1
4. Monitoring	4		
5. Reporting	3		

The Role of Low Impact Development in Project Design and Post-construction BMPs

Presented by: Darla Inglis, Ph.D.

Outline

Part 1: Hydrology and Low Impact Development (LID)

Part 2: LID methodology and site design strategies

Part 3: The LID toolbox

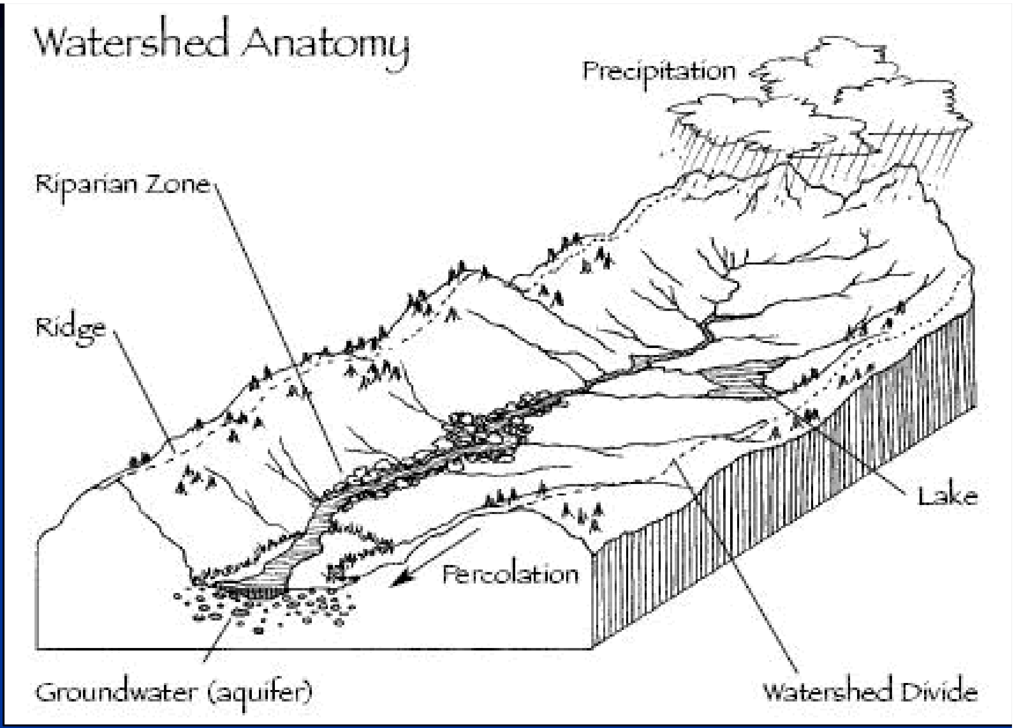
Part 4: Case studies

Part 5: LID BMP design and construction

Part 1

Hydrology and Low Impact Development

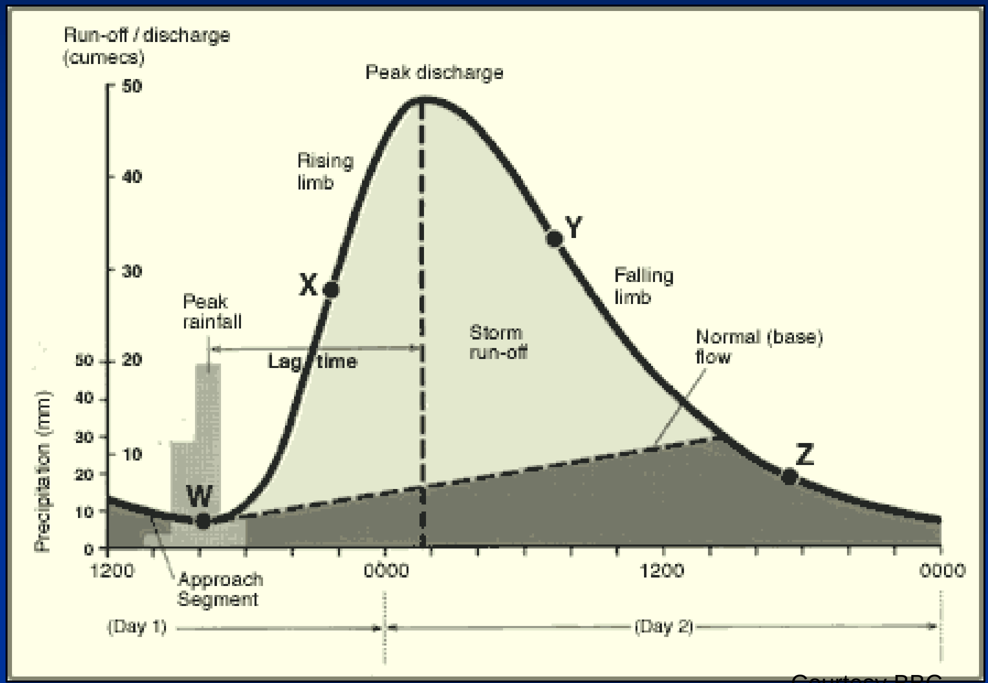
What defines a healthy watershed?



Courtesy San Pedro Creek Watershed Coalition

- Rainfall surface runoff in equilibrium with the landscape and receiving water
- Adequate storage, through infiltration, recharge, baseflow, and interflow
- Optimal riparian and aquatic habitats (including: stream flow, in-channel, and water quality)

Undeveloped Watershed Stream Hydrograph

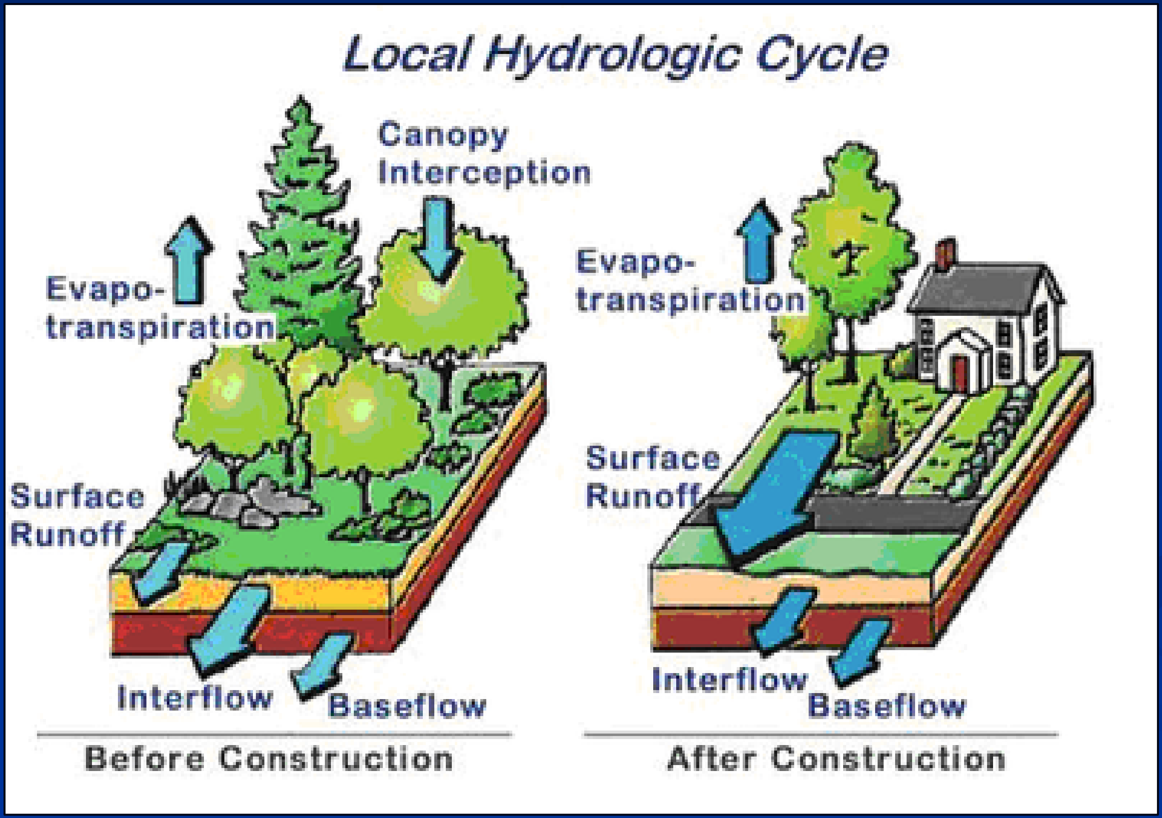


Courtesy BBC

The **peak rainfall** is the time of highest rainfall intensity. The **peak discharge** of the stream is later because it takes time for the water from the entire watershed to find its way to the stream **(lag time)**. The normal **base flow** of the stream starts to rise when run-off, ground, and soil water reaches the river.

How has urbanization affected the hydrology of a watershed?

Hydromodification as a result of Urbanization



Hydromodification is the alteration of the natural flow of water through a landscape.

History of Stormwater Management

Courtesy of the City of Seattle

Courtesy of the City of New Brighton

Courtesy of the City of Seattle

Protection of Public Health & Property

↓

WQ and Peak Flow Management

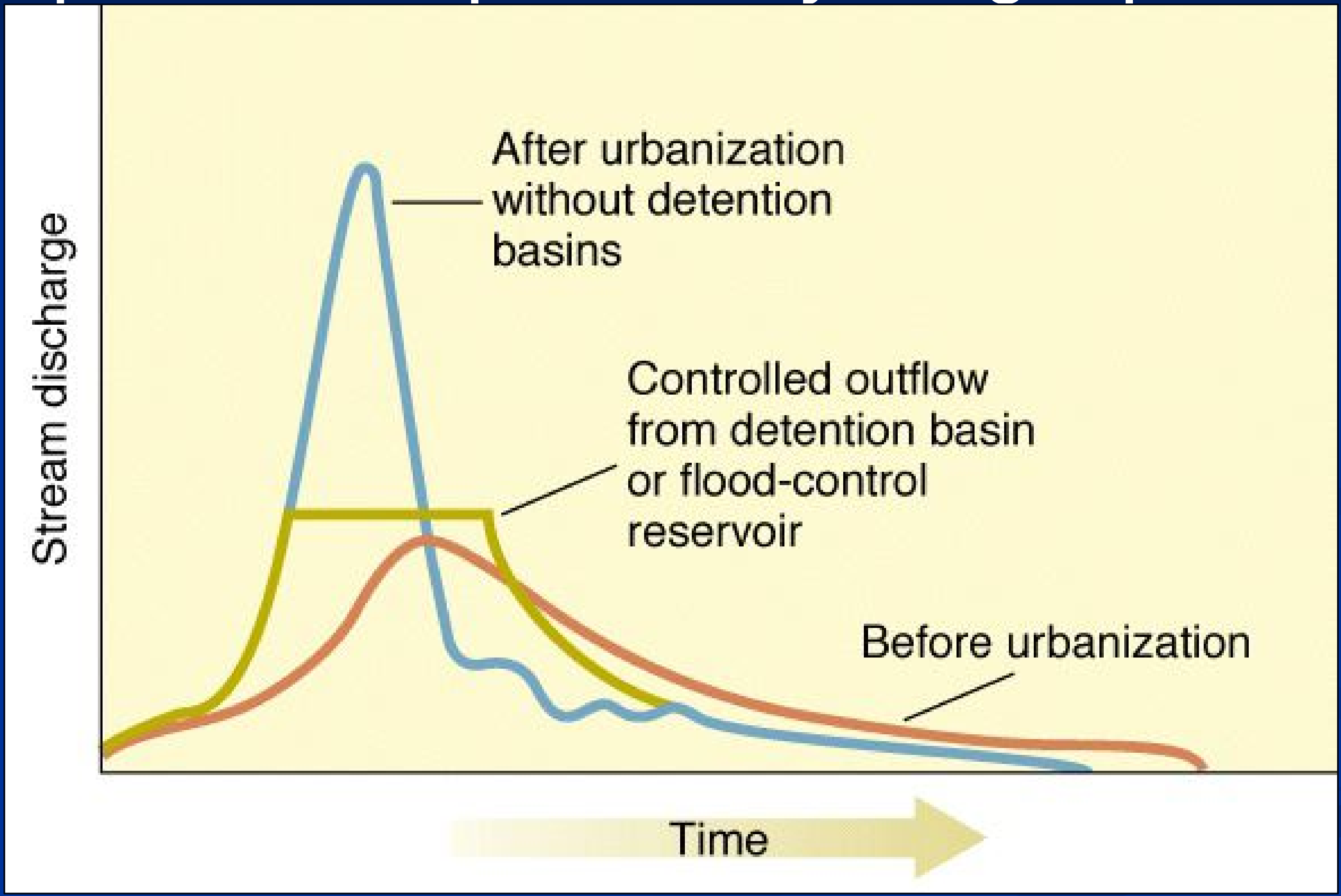
↓

Mimicking Natural Hydrologic Functions (LID)

Courtesy of the City of Seattle

Photo from Utility Vault for Stormwater Management, Inc.

What does it mean to "mimic the predevelopment hydrograph?"



Courtesy Carlton College, MN

must address peak, duration, & volume

LID is an approach that…..

…mimics the predevelopment site hydrology

by using:

site planning (nonstructural) and

management practices (structural)

that store, infiltrate, evaporate, and detain runoff.


7. 15. 2002

Benefits of LID

- environmental
- social
- economic

Environmental Benefits of LID

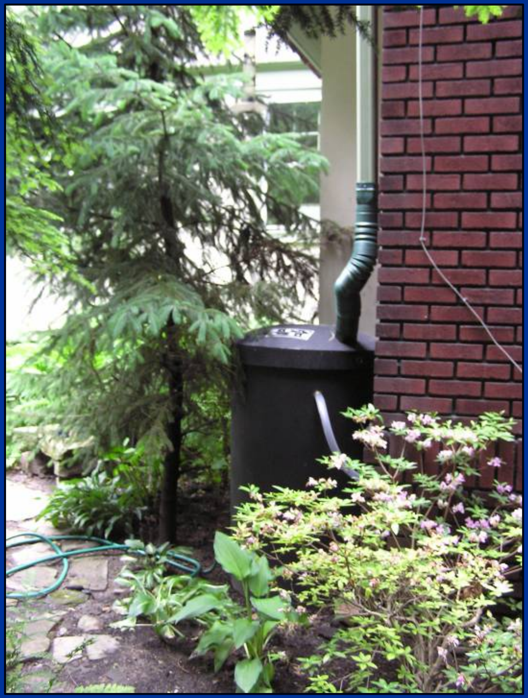
- recharges groundwater
- improves water quality
- provides channel protection
- conserves water
- provides habitat
- improves air quality
- reduces waste

Social Benefits of LID

- aesthetics
- reduced urban heat island effect
- recreational value
- noise reduction
- shade
- wind breaks

Source: Battery Park City,
www.batteryparkcity.org/Concept/green/pdf/Solaire_c4.pdf

Economic Benefits of LID



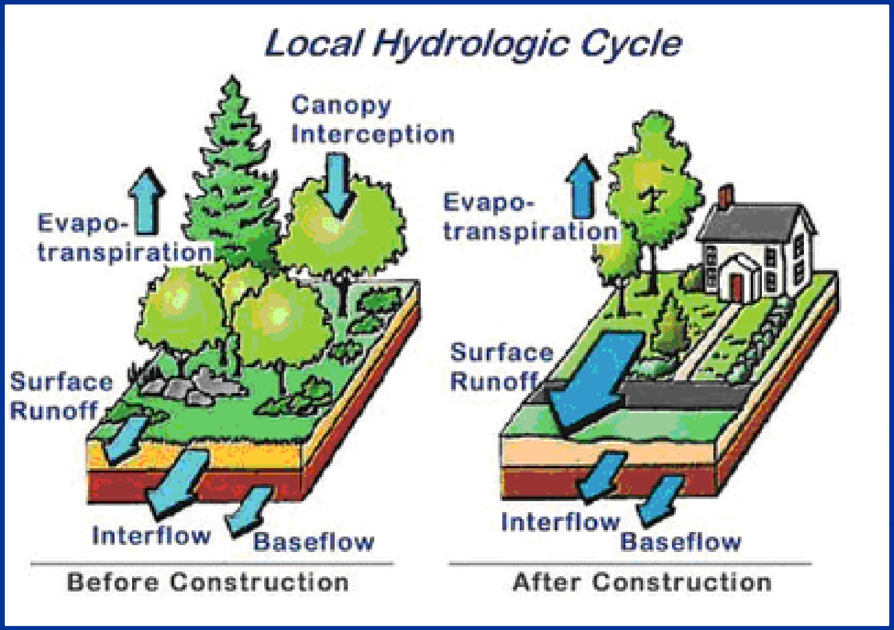
Source:
www.ninemilerun.org/programs/rainbarrel/index.htm

- creates green collar jobs
- increases property value
- reduces money spent on traditional storm sewer system infrastructure
- using captured rain water reduces potable water costs
- may eliminate or reduce the need for land intensive BMPs

Part 2

LID site design approach

LID site design guidelines: protect natural hydrologic functions



Center for Watershed Protection

Steps for a successful LID project design

- Step 1: Protect and Use Existing Site Features
- Step 2: Reduce amount and impact of impervious surfaces
- Step 3: Calculate stormwater runoff benefits
- Step 4: Integrate structural LID BMPs
- Step 5: Calculate stormwater runoff benefits

LID site design guidelines

LID Design Fact:
A good LID design incorporates site planning principles as well as structural BMPs to achieve site performance objectives

Site Planning	+	Structural BMPs	=	A Successful LID Design

Protect and Use Existing Site Features

Minimize Clearing and Grading

clearing and grading minimized

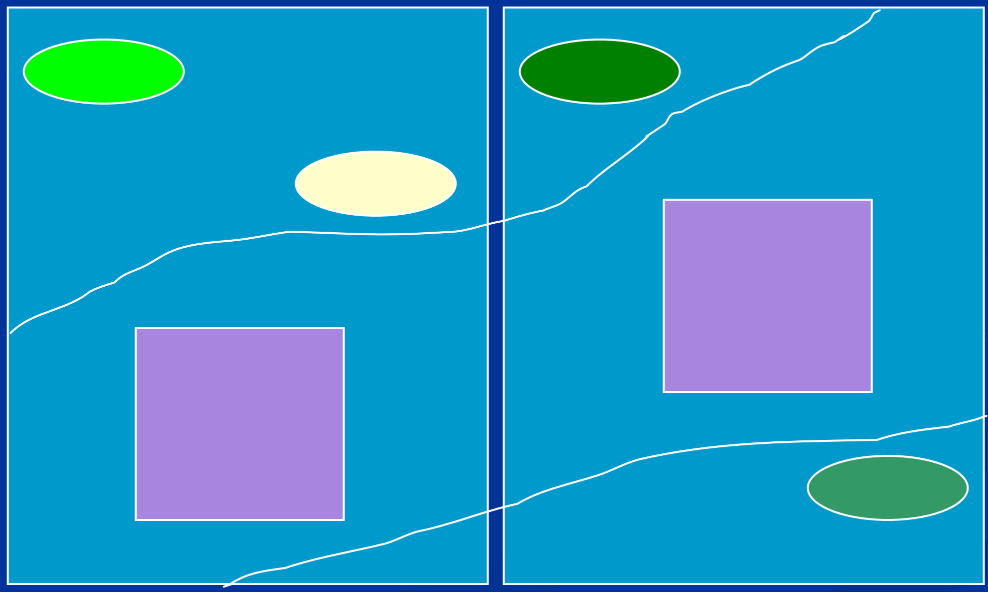
Source: Lake County Stormwater Management Department, Ohio

mass graded

Crystal Cove, CA
Source: Sukut Construction, Inc.

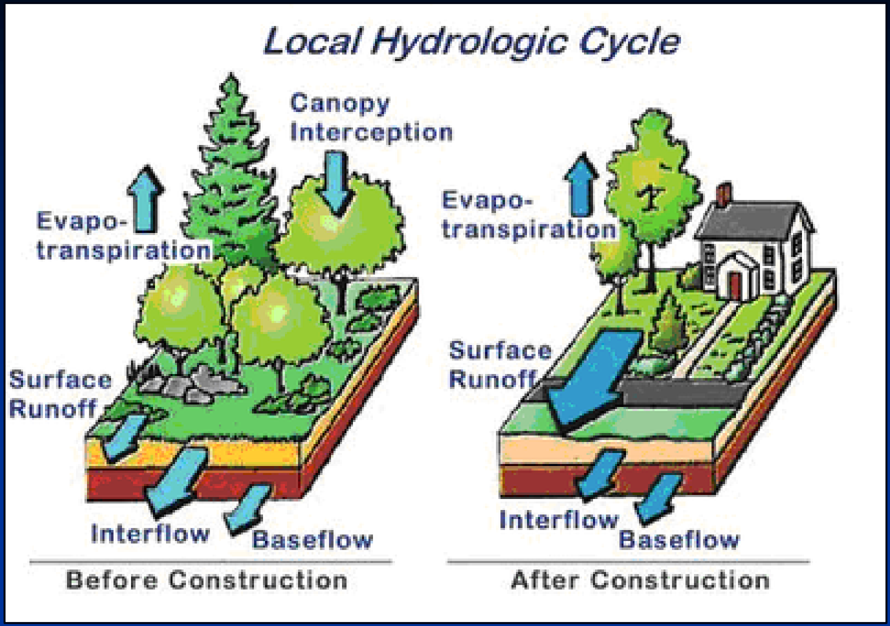
Use Site Fingerprinting

- place buildings in areas of poor draining soils
- save soils that drain well for groundwater recharge



Incorporate Existing Drainage

LID Site Planning Concepts



Center for Watershed Protection

- **mimic natural drainage**
- use small scale practices
- manage stormwater at the source
- use simple, natural practices
- make landscape and infrastructure multifunctional

LID Site Planning Concepts

- mimic natural drainage
- **use small scale practices**
- manage stormwater at the source
- use simple, natural practices
- make landscape and infrastructure multifunctional

LID Site Planning Concepts

- mimic natural drainage
- use small scale practices
- **manage stormwater at the source**
- use simple, natural practices
- make landscape and infrastructure multifunctional

LID Site Planning Concepts

- mimic natural drainage
- use small scale practices
- manage stormwater at the source
- **use simple, natural practices**
- make landscape and infrastructure multifunctional

LID Site Planning Concepts

Source: Illinois Environmental Protection Agency

- mimic natural drainage
- use small scale practices
- manage stormwater at the source
- use simple, natural practices
- **make landscape and infrastructure multifunctional**

LID Site Planning Strategies

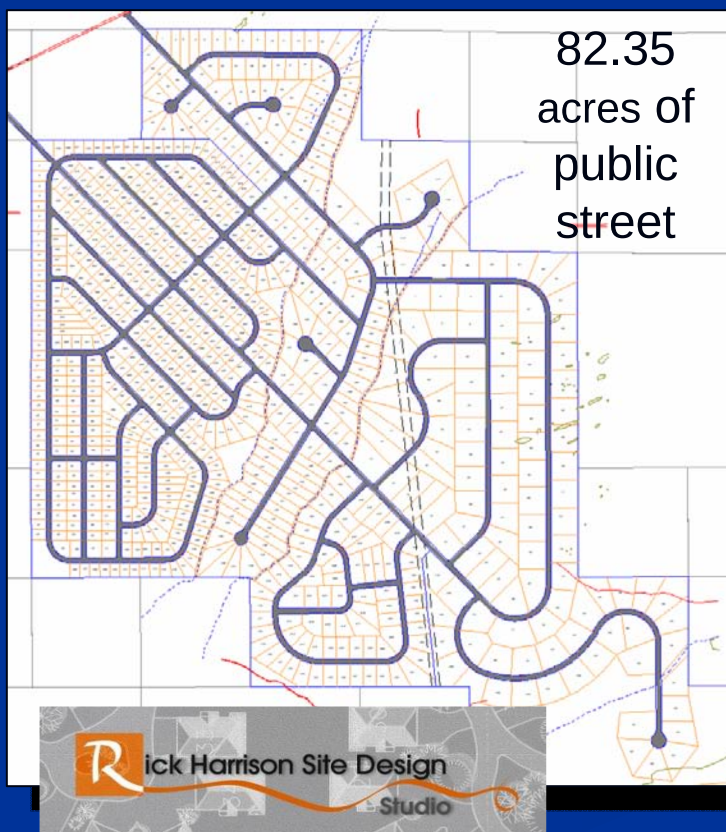
- minimize clearing and grading
- use site fingerprinting
- use drainage as a design element
- minimize impervious areas
- disconnect impervious areas
- increase flow path length

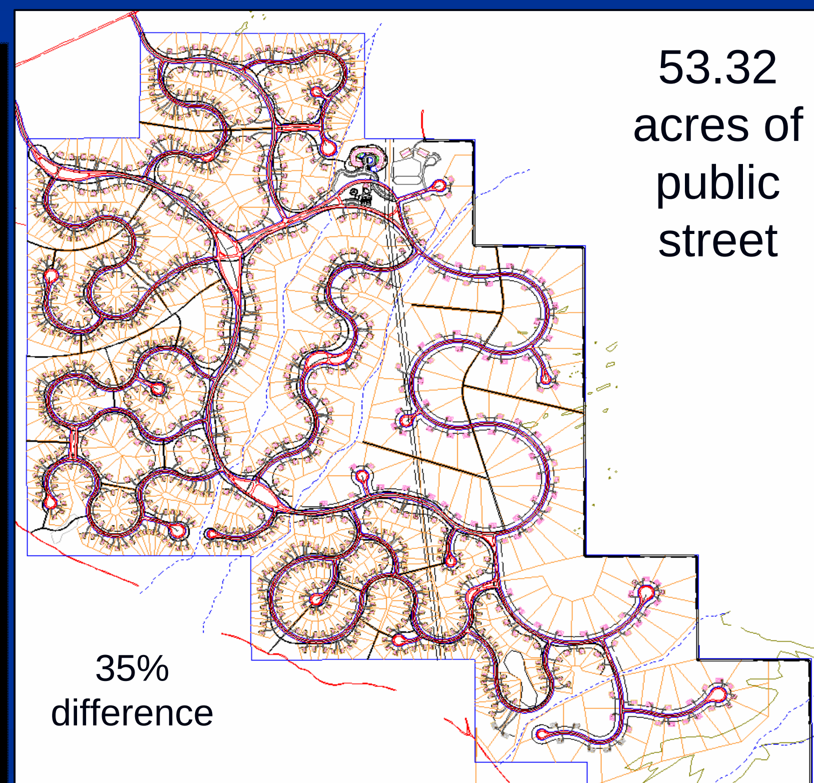
Use Drainage as a Design Element

Source: “Art for Rain’s Sake,” Landscape Architecture Magazine, September 2006

Minimize Impervious Areas

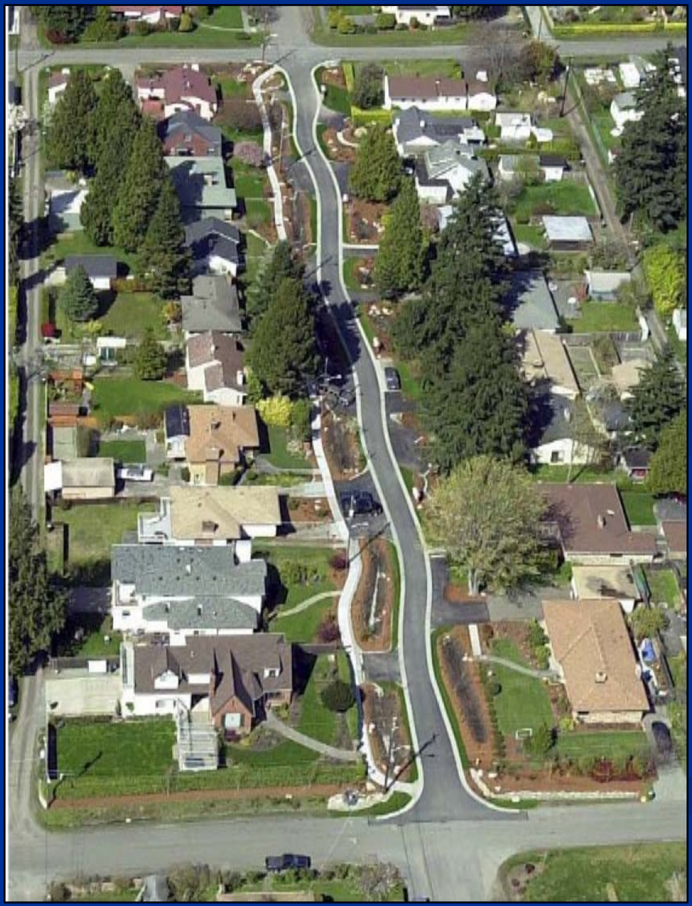
1) alternative roadway layout





Minimize Impervious Areas

2) narrow road sections



Courtesy Seattle Public Utilities

Minimize Impervious Areas

3) reduce sidewalks to one side of the road

Courtesy Seattle Public Utilities

Minimize Impervious Areas

4) reduce on-street parking

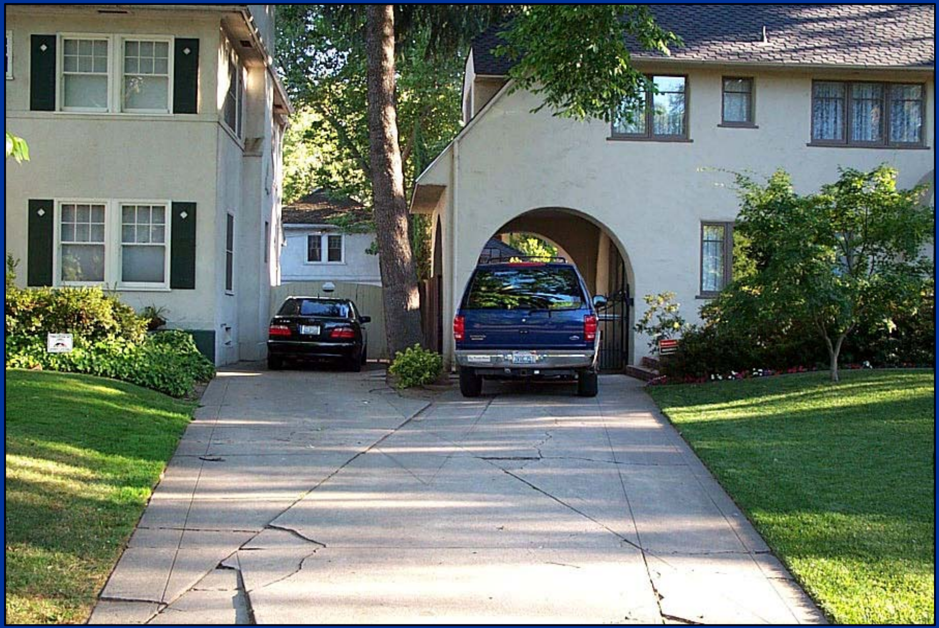
Courtesy of the Seattle Public Utilities

Minimize Impervious Areas

5) design driveways to be:

- shared
- narrow
- short
- permeable

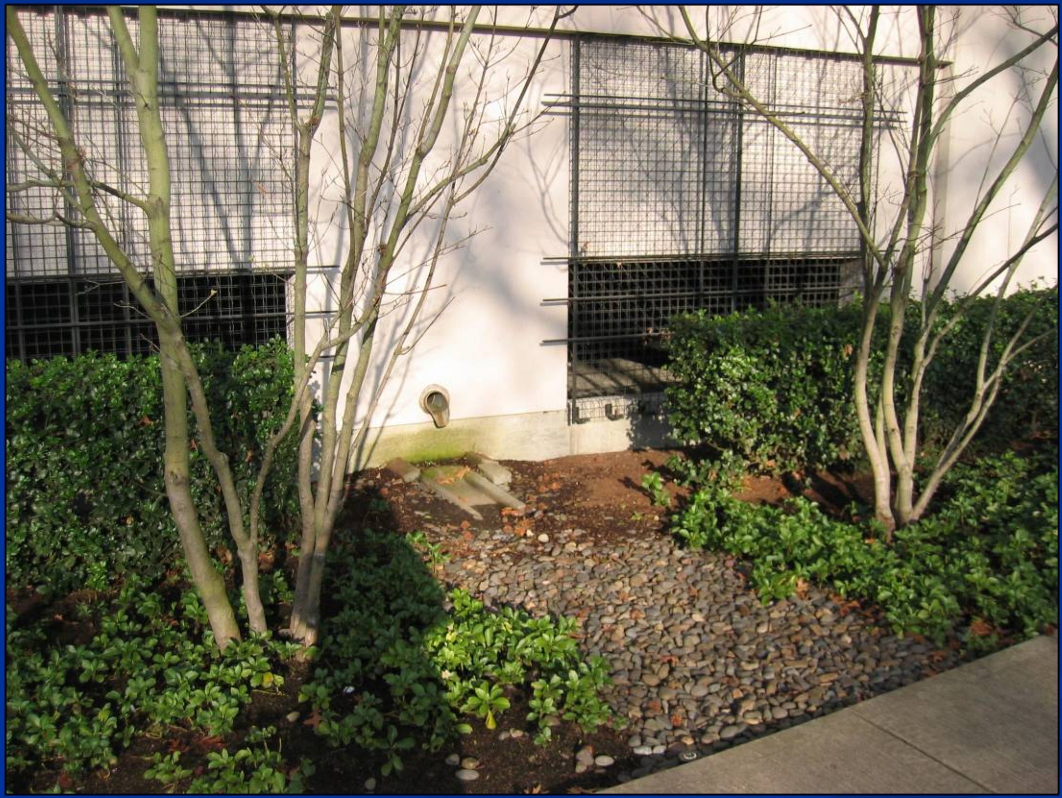
Source: www.weneedsolutions.com/Permeable_Paver_Driveway_1.jpg



McKinley Park, Sacramento, CA

Disconnect Impervious Areas

1) disconnect roof drains and direct flows to vegetated areas



Disconnect Impervious Areas

2) directing flows from paved areas to stabilized vegetated areas

Source: Illinois Environmental Protection Agency

Increase Flow Path Length

3) increase vegetation

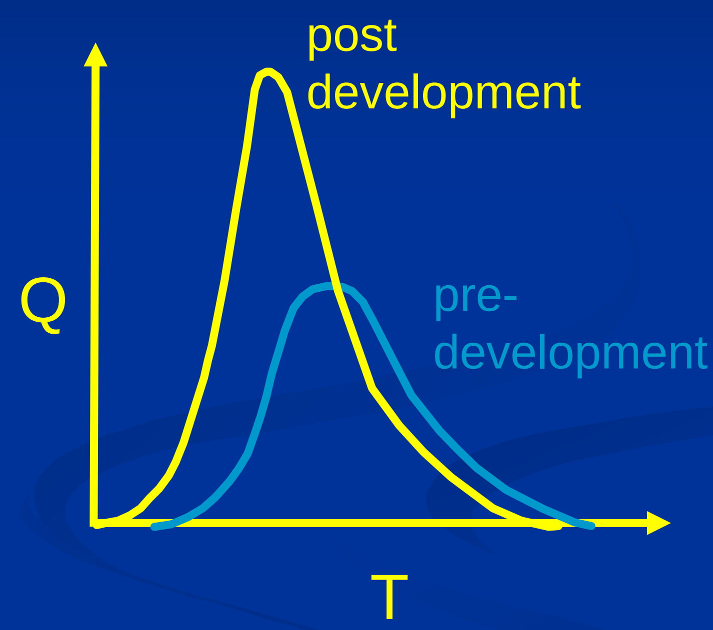
4) minimize slopes

5) increase surface roughness

Courtesy of the City of Seattle

Hydrologic Goals

- runoff volume control
- peak runoff rate control
- flow frequency/duration control
- water quality control



runoff hydrograph

Steps for a successful LID project design

- Step 1: Protect and Use Existing Site Features
- Step 2: Reduce amount and impact of impervious surfaces
- Step 3: Calculate stormwater runoff benefits
- Step 4: Integrate structural LID BMPs
- Step 5: Calculate stormwater runoff benefits

Part 3

The LID Toolbox

LID Technologies

- bioretention
- filter strips
- vegetated buffers
- bioswale/grassed swale
- rain barrels
- cisterns
- green roofs
- porous pavement

planter

Source: www.artfulrainwaterdesign.net/projects/

Bioretention

- removes pollutants
- reduces volume
- reduces peak rate
- recharges groundwater
- reduces thermal pollution

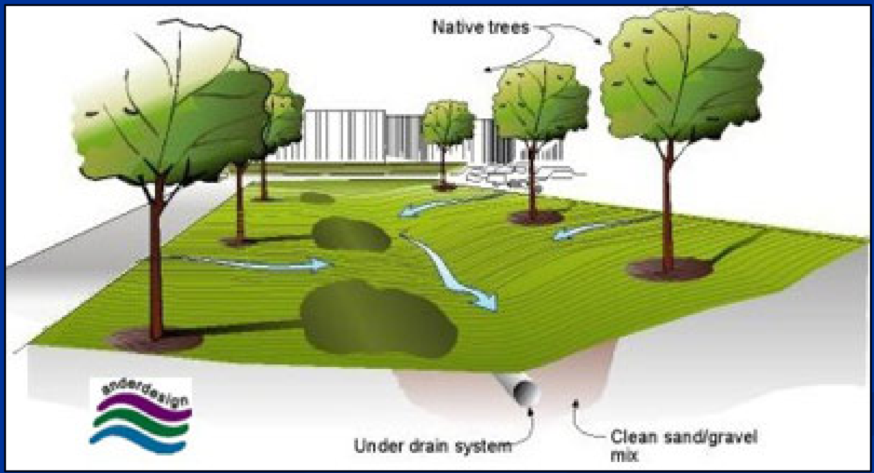
rain garden

Source: www.cuyahogaswcd.org/grantfunded-raingardens.htm

Bioswale

- filters pollutants
- reduces volume
- reduces velocity and peak rate
- recharges groundwater

Source: www.fceo.co.franklin.oh.us/images/Bioswale.jpg



Source: www.wbdg.org/resources/lidtech.php

Bioswale

Curb Bulb Extension

Vegetated Buffers

- reduces erosion
- prevents siltation
- increases habitat
- stabilizes banks

Source:
www.sf.adfg.state.ak.us/SARR/restoration/techniques/intro.cfm

Vegetated Filter Strip

Source:
www.wsdot.wa.gov/Environment/WaterQuality/Research/
Reports.htm

- filters pollutants
- reduces volume
- reduces velocity and peak rate
- recharges groundwater

Green Roofs

- lengthens roof life by 2 to 3 times
- reduces heating and air conditioning demand
- reduces volume and peak rates

extensive

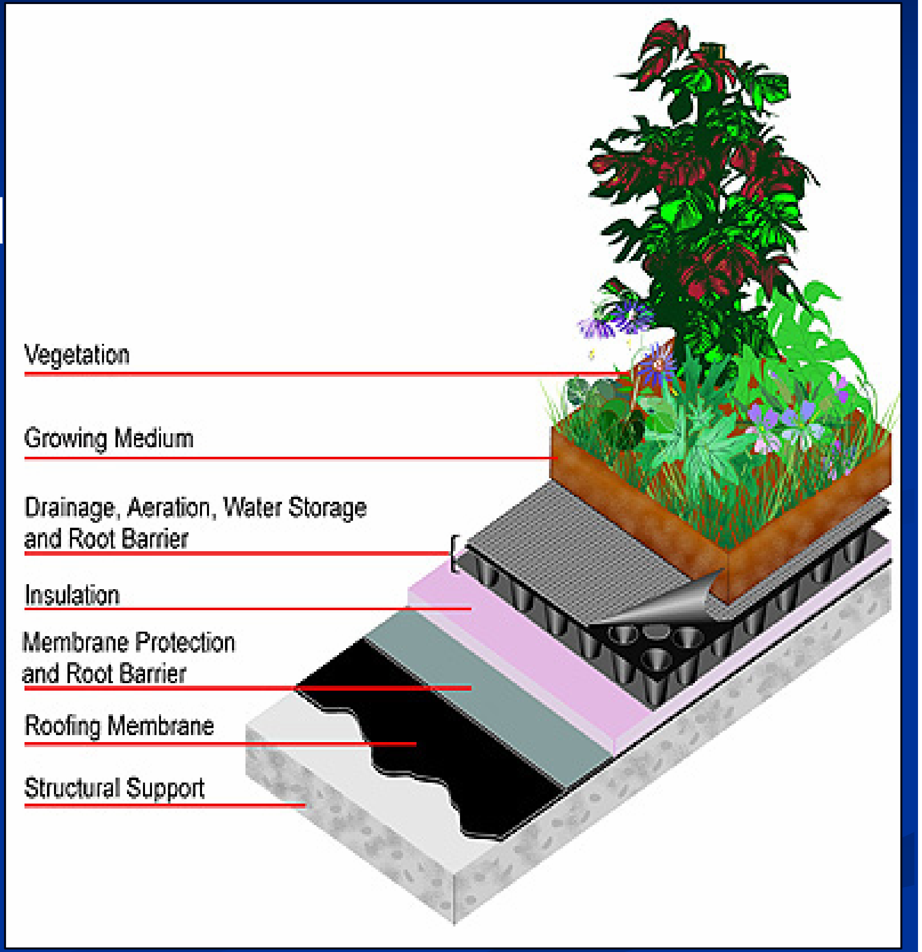
Source: www.thisoldhouse.com/toh/photos/

intensive

Source: www.wsud.org/Pic_Pages/Green_roofs.htm

Green Roof Layers

- Waterproofing membrane
- Root barrier (if the waterproofing is not certified as root resistant)
- Drainage layer
- Separation layer
- Growth media layer
- Plants



Source: American Wick Drain Corporation

www.americanwick.com

Green Roofs

Courtesy Grow Spot

The new California Academy of Sciences

Urban Heat Island Control

- The temperature above Chicago's City Hall green roof averages 10 -15°F lower than the black tar roof.
- Difference can be 50°F or greater during the summer.
- Energy savings of $3,600 per year.

Slide courtesy of the Center for Neighborhood Technology

Rain Barrels

- reduces volume
- reduces peak rate
- reduces potable water use

Source: johnwesleymillercompanies.com/tucson-water.html

Source: www.iaswcd.org/district_tools/PWQ/temp/PWQ/PathwayBarrel.htm

Cisterns

Source: www.tfssolar.com/134/sonora-co-housing-residence/

- reduces volume
- reduces peak rate
- reduces potable water use

Porous Pavement

Source: www.metrokc.gov/kcdot/roads/eng/lid/militaryS272/porousconcrete.cfm

- removes pollutants
- reduces volume
- reduces peak rate
- recharges groundwater

Source: www.hort.cornell.edu/UHI/outreach/index.html

Source: www.paving.org.uk/permeable.php

Part 4

LID Case Studies

Case Study 1:

Project:

Street Edge Alternatives (SEA) Street

By:

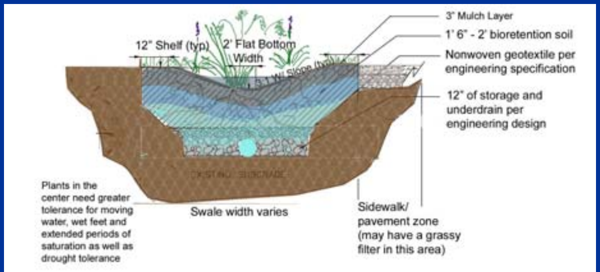
Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Project Objectives:

- Public Safety
- Emergency Vehicle Access
- Mobility
- Parking
- Environmental Protection

BEFORE



AFTER

Case Study 1: SEA Street, Seattle, WA

Courtesy of the Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Courtesy of the Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Courtesy of the Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Courtesy of the Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Courtesy of the Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Courtesy of the Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Plant Survival:

“The… designers followed the concept of **"right plant, right place“**

The landscape design includes **mostly native** Pacific Northwest species and some ornamentals. …over **100** deciduous and evergreen trees and **1100** shrubs were planted... Nearly **100%** of these plants… survived.”

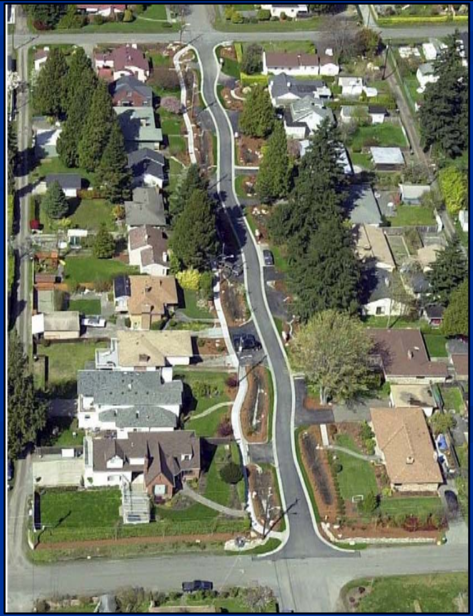
Courtesy of the Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Monitoring Results:

"…monitoring equipment (was) placed at the downstream end of the project."

"The first three years of… monitoring has shown that **98%** of **wet-season** and **100%** of **dry-season** stormwater runoff was **eliminated** by the project."



Courtesy of the Seattle Public Utilities

Case Study 1: SEA Street, Seattle, WA

Emergency Vehicle Access:

"**emergency vehicles** can safely access the entire street.

...the concrete "curbs" provide an additional 2 ft. of driving room on either side of the 14 ft. roadway, for a total of 18 ft. across (**enough for two fire trucks to pass each other**).

...the **roadside grass-planted strips** are...reinforced with a lattice of material that **can handle occasional traffic**."

Case Study 1: SEA Street, Seattle, WA

Mobility:

“The narrower driving lane and meandering shape of the roadway create visual interest and **traffic calming**.”

The location of the “sidewalk separates pedestrians from traffic and **increases the feeling of safety**...”

The “ ‘garden-street’ appeal, makes this street a common **destination** for nearby residents.”

Case Study 1: SEA Street, Seattle, WA

Parking:

"Parking needs for neighbors are… met …based on parking **surveys** conducted by project planners."

"…**parking distributed** along the roadway in clusters as well as home front locations…"

Case Study 1: SEA Street, Seattle, WA

LID Design:

- 650 feet by 14 feet of asphalt
- 2 foot wide concrete strips
- 100 evergreens & 1100 shrubs

Traditional Design:

- 650 feet by 25 feet of asphalt
- Curb and gutter
- Storm sewer pipe

Case Study 1: SEA Street, Seattle, WA

Cost Comparison:

Project Aspect	Conventional Retrofit Cost	SEA Street Cost	Cost Savings	Percent Savings
Site preparation	$65,084	$88,173	-$23,089	-35%
Stormwater management	$372,988	$264,212	$108,776	29%
Site paving and sidewalks	$287,646	$147,368	$140,278	49%
Landscaping	$78,729	$113,034	-$34,305	-44%
Misc. (mobilization, etc.)	$64,356	$38,761	$25,595	40%
Total:	**$868,803**	**$651,548**	**$217,255**	**29%**

Source: Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, U.S. EPA, December 2007

Case Study 3:

Project:

Tellabs Corporate Campus, Naperville, IL

By:

Tellabs, Inc.

Case Study 3: Tellabs Corporate Campus

Design used both Conventional and LID Site Design

FIGURE 10. Tellabs Site Photo. Image courtesy of Conservation Design Forum.

Case Study 3: Tellabs Corporate Campus

Conventional Site Design:

- storm sewer piping
- bedding
- excavation of a detention pond

Low Impact Site Design:

- parking lot bioretention cells
- bioswale conveyance systems

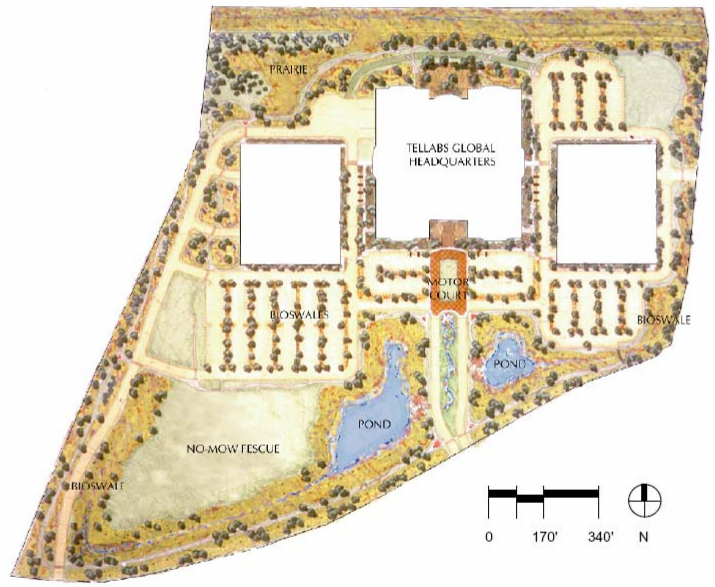


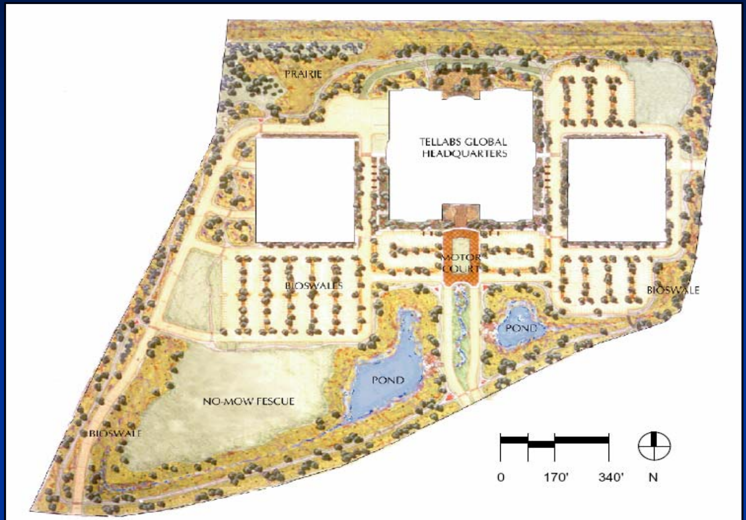
FIGURE 9. Tellabs Master Plan. Image courtesy of Conservation Design Forum

Case Study 3: Tellabs Corporate Campus

LID Site Design:

- Natural topography was maintained minimizing earthwork costs
- Naturalized landscape eliminated the need for irrigation systems and lowered maintenance costs
- Preserved trees and open space provided a half acre of wetland mitigation
- More plants increased the initial cost, but less water used decreased long-term costs

Case Study 3: Tellabs Corporate Campus



Tellabs Master Plan. Image courtesy of Conservation Design Forum

Cost Comparison:

Item	Conventional Design Cost	LID Design Cost	Cost Savings	Percent Savings
Site Preparation (clearing and grading)	$2,178,500	$1,966,000	$212,500	10%
Stormwater Management	$480,910	$418,000	$62,910	13%
Landscape development	$502,750	$316,650	$186,100	37%
Total:	**$3,162,160**	**$2,700,650**	**$461,510**	-

Source: Changing Cost Perceptions: An Analysis of Conservation Development, Illinois Conservation Foundation, Chicago Wilderness, February 2005

Part 5

LID BMPs: Design & Construction

LID BMPs:
Design & Construction

1. Bioretention
2. Permeable Pavement
3. Rainwater Harvesting
4. Green Roofs

Bioretention

- Types
- Pollutant removal mechanisms
- Design components
- Construction
- Maintenance
- Costs

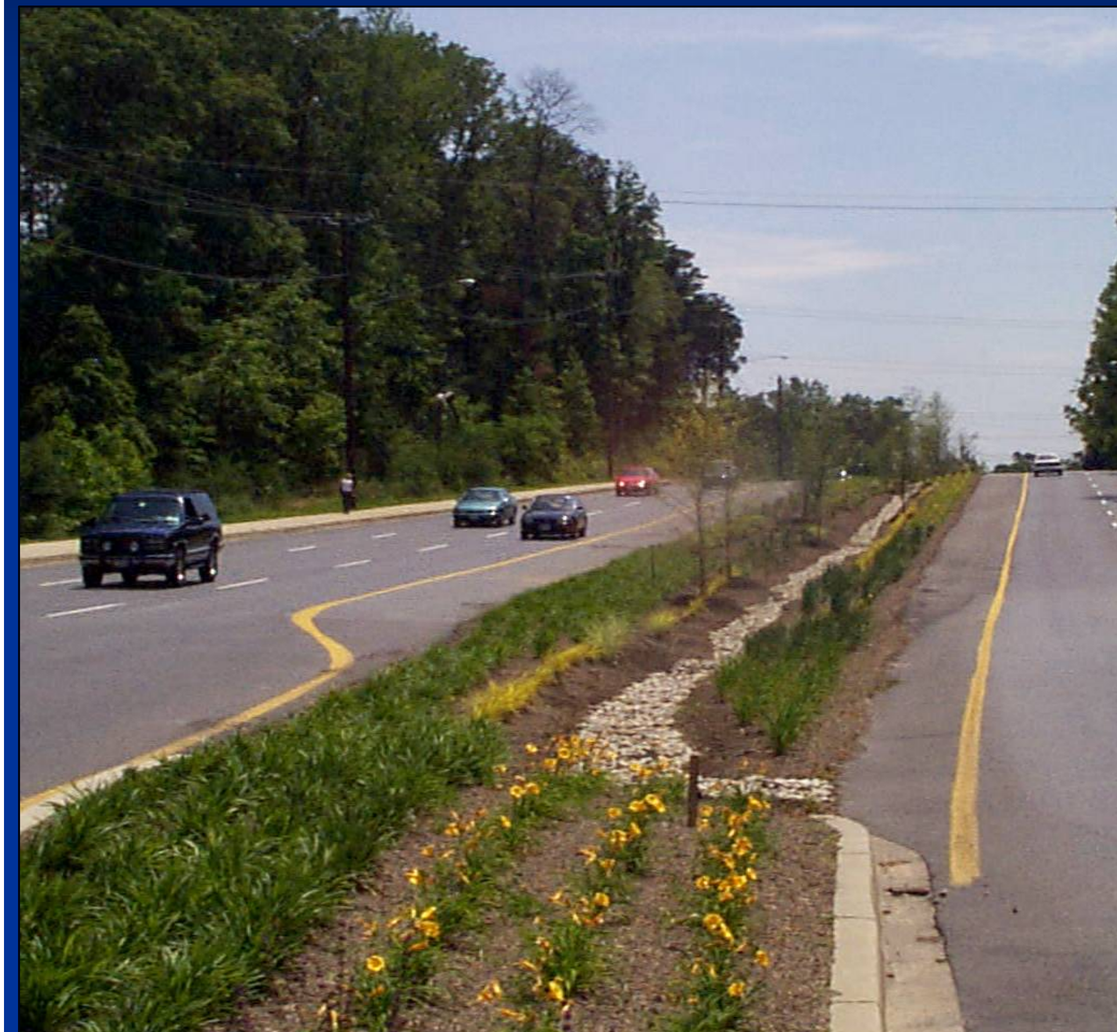
Types of Bioretention

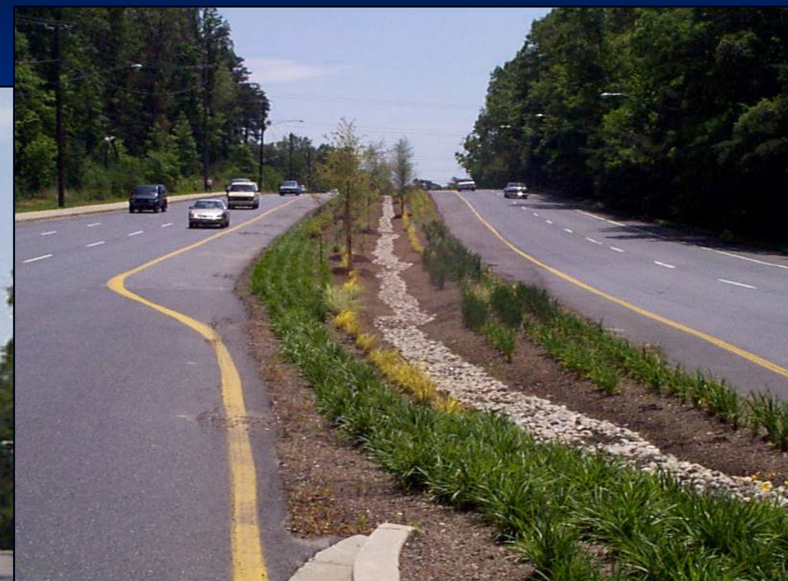
- Bioretention Cell
- Bioretention Planter
- Linear Bioretention
- In-line and off-line systems

Bioretention Cell

Bioretention Planter

Linear Bioretention

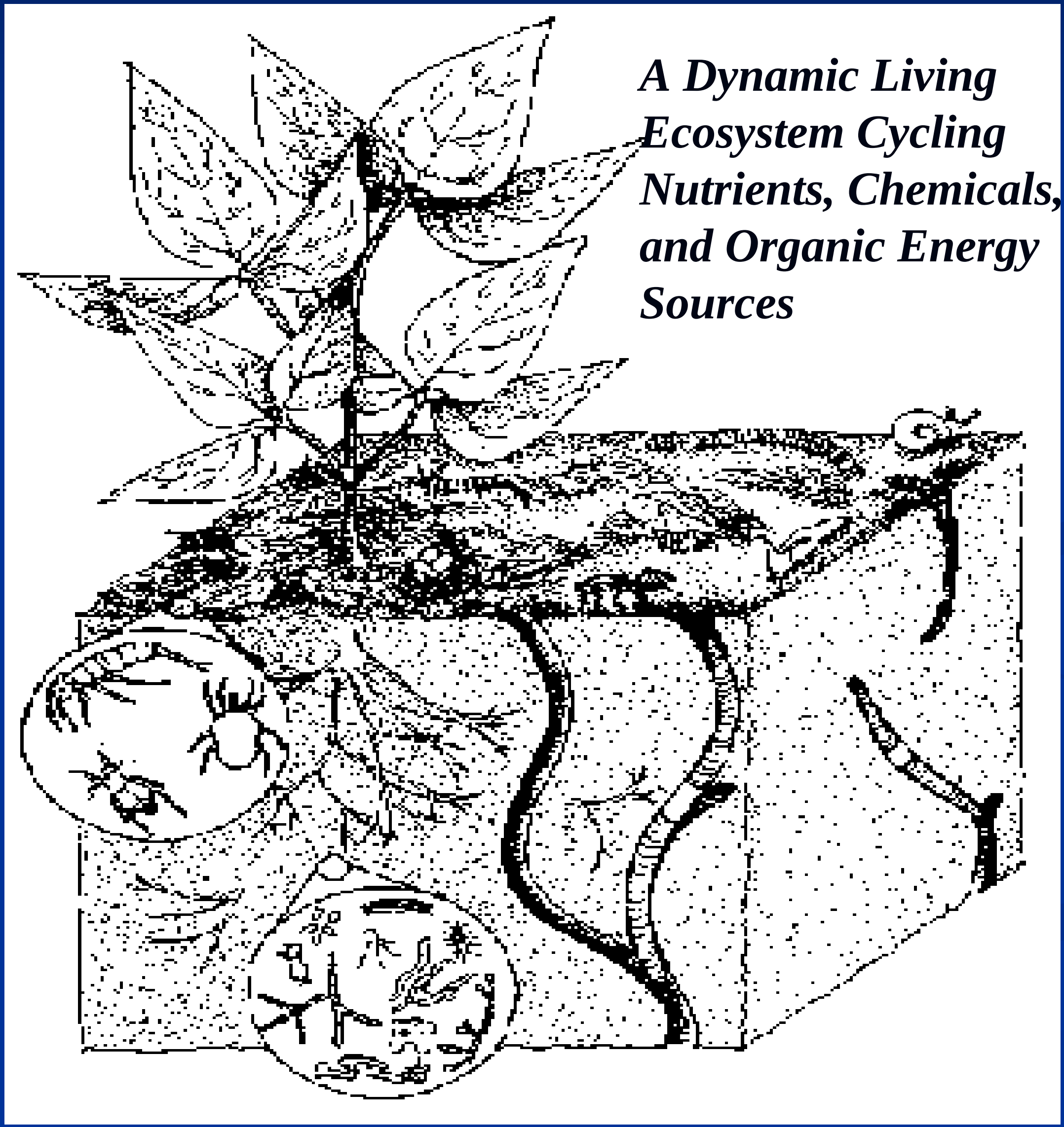




Inline

Offline

Bioretention: Pollutant Removal Mechanisms



- Plants
- Bacteria
- Protozoa
- Fungus
- Worms
- Insects
- Mammals

Bioretention: Pollutant Removal Mechanisms

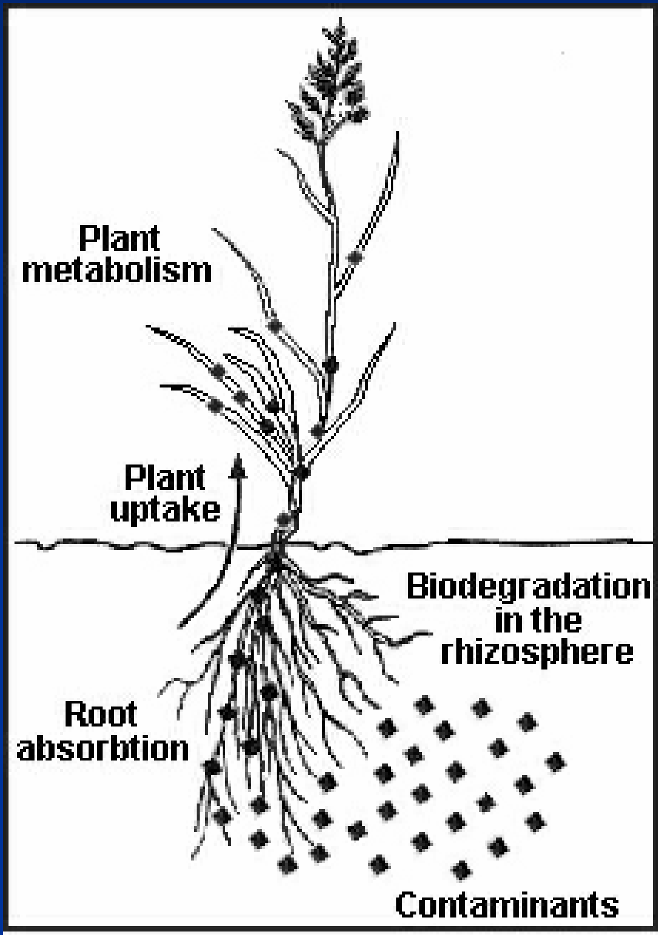
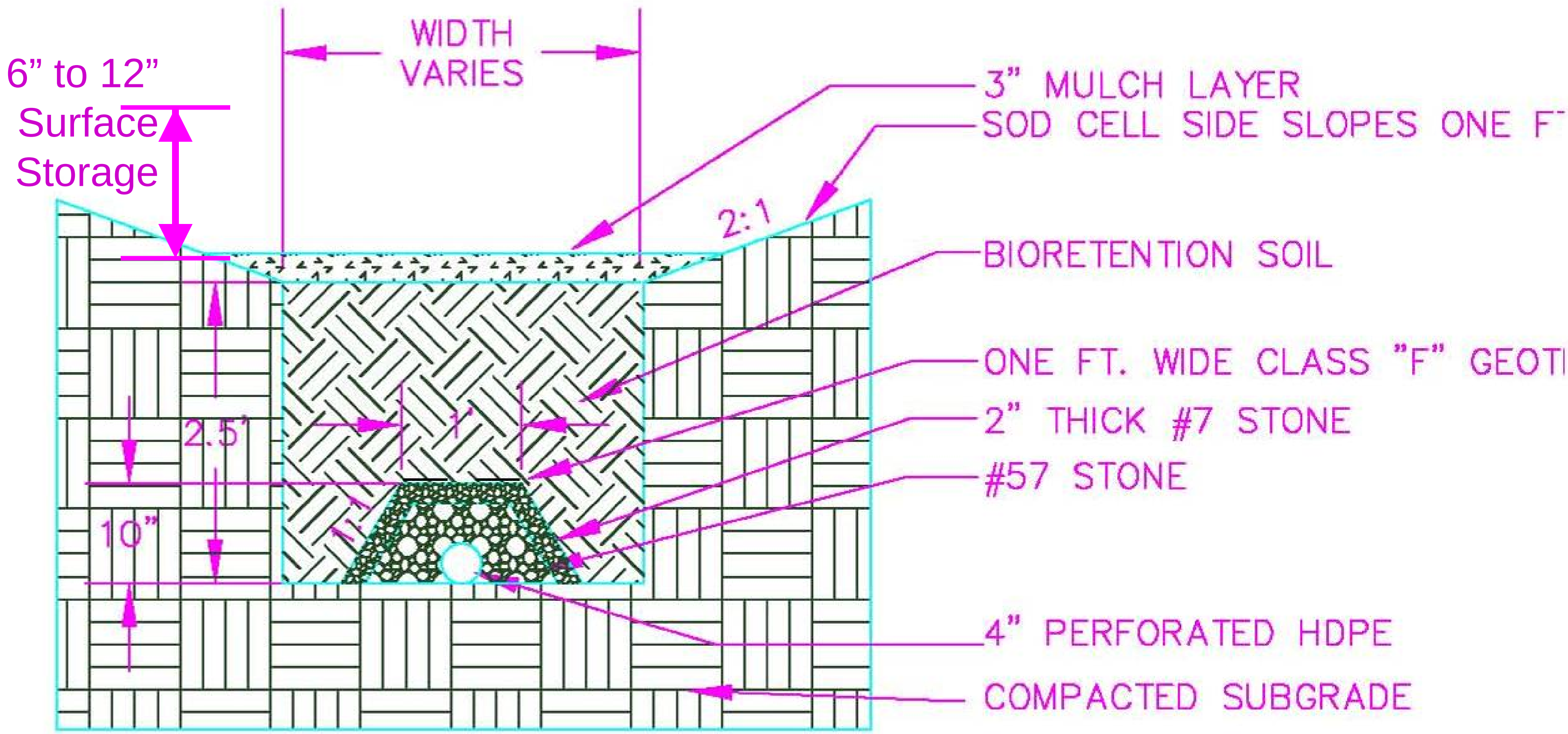


Figure 1. The fate of soil contaminants in the root-zone

- Chemical
  - -Electrostatic / ion exchange within humic / clays / silts
- Biological
  - -Phytoremediation
  - -Bioremediation
  - -Storing and cycling nutrients
- Physical
  - -Sedimentation
  - -Filtration
  - -Adsorption

Components: Bioretention Detail



BIORETENTION CELL

Components: Bioretention Soil Mix

- 50% by volume washed sharp sand (ASTM C-33)
- 30% by volume topsoil (ASTM D5268-92)
  - modified clay content <10%
  - organic content <20%
- 15% by volume double shredded hardwood mulch
- 5% by volume compost or peat moss

Components: Plants

- Aesthetics
- Habitat
- Treatment
- Air Pollution
- Carbon Sequestration

Bioretention Construction

Willard Park Bioretention

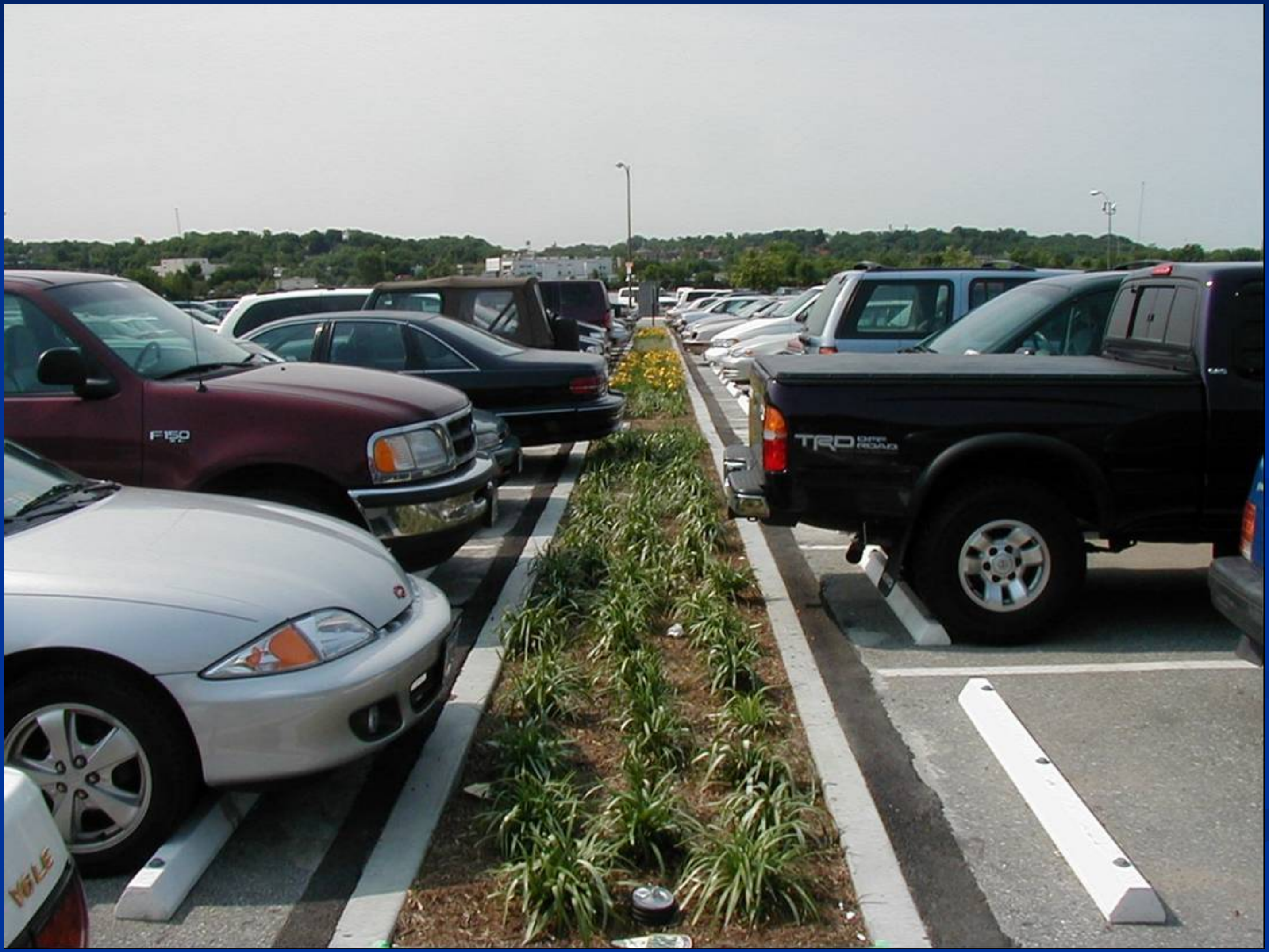
The Willard Park parking area was retrofitted during the storm sewer system rehab project using bioretention as the main storm water LID technique.

Willard Park Bioretention Strip

Willard Park Bioretention Strip

Under drain and soil installation

Willard Park Bioretention Strip



Willard Park Bioretention Cell Under Construction

Overflow Weir to Storm Sewer

Native Plantings

Mulch Layer

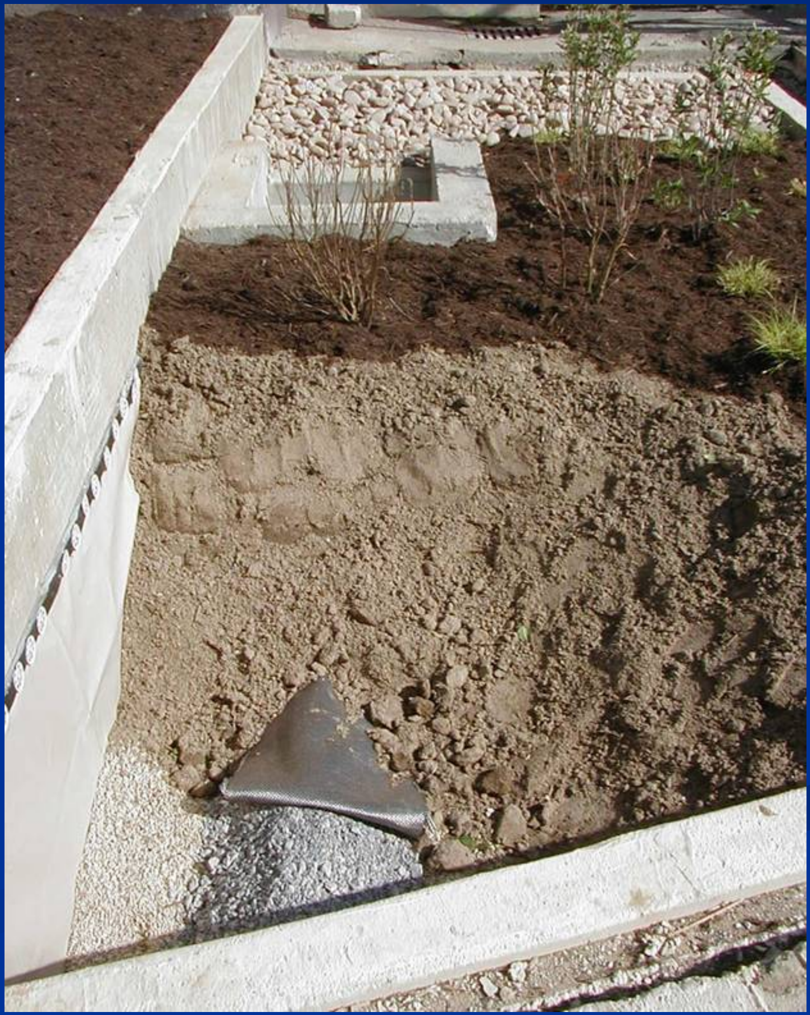
Bioretention Soil Mix

Geotextile

Gravel Layer

Perforated Underdrain

Impermeable Liner




'98 3 24

'98 3 25

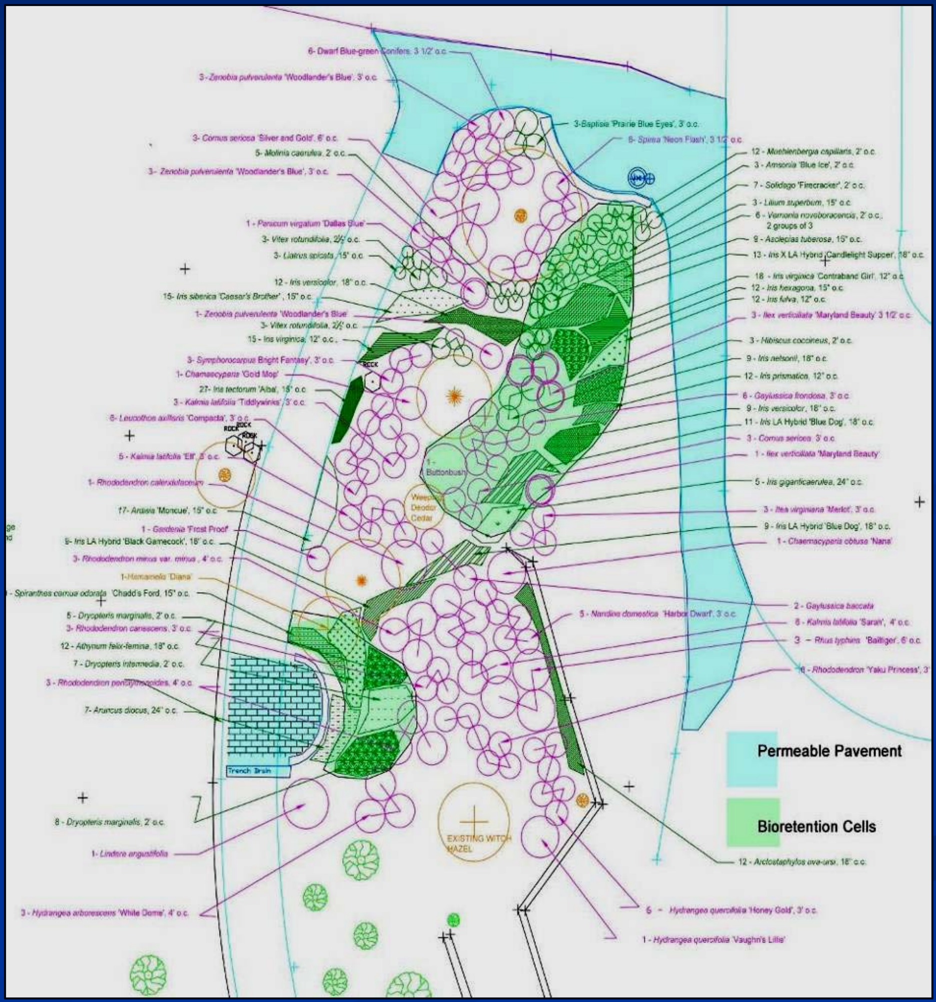

'98 5 5

Bioretention: Media Placement

- Add media in 6” lifts
- Thoroughly wet and allow soil to drain
- Make sure the media is at specified height below overflow

Bioretention: Landscaping Plan

- Follow the landscaping plan
- Incorporate the plan into the maintenance plan
- Modify plan when plants are added, replaced, or removed



Bioretention: Common Construction Errors

Inadequate Erosion Control or Protection of BMP Areas

Solution:
Keep Erosion Controls in Place Until Drainage Area is Stabilized

Unapproved Material Substitutions

Unapproved Material Substitutions

Insufficient Plant Density

Incorrect Plant Location

Incorrect Planting Method or Plant Type

Improper Pooling Depth & Drainage

Bioretention: Construction Cost Factors

Industrial/Institutional costs range from $10-$40/sf based on the inclusion of:

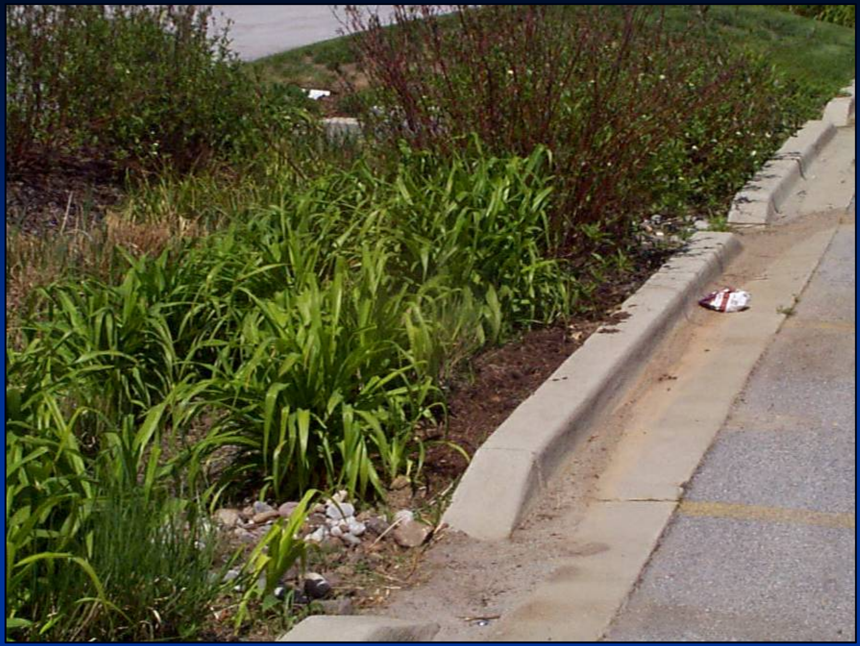
- Pre-treatment area or flow entrance
- Growing medium
- Plants and other vegetation
- Gravel material
- Mulch
- Outfall/overflow pipe
- Underdrain (optional)
- Liner (optional)

Bioretention: Maintenance

Routine Maintenance

Typical landscaping work:

- Regularly water and weed during plant establishment phase
- Remove litter and sediment buildup
- Add mulch in spring and fall (remove and replace layer every 2-3 years)
- Maintain drainage areas, keep stabilized
- Replace unhealthy and dead plants



Remove litter and sediment buildup…

…by hand or using a street sweeper

Add mulch in spring and fall
(remove and replace layer every 2-3 years)

Litter is captured before reaching water resources, but still needs to be removed

Provide Maintenance Staff with Planting Plan

May 2006 trees planted

Dec 2008 trees removed by bush hog

Bioretention: Corrective Action Maintenance

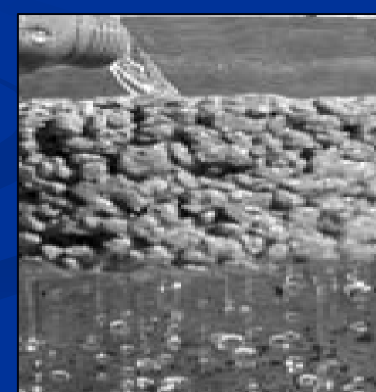
To solve:

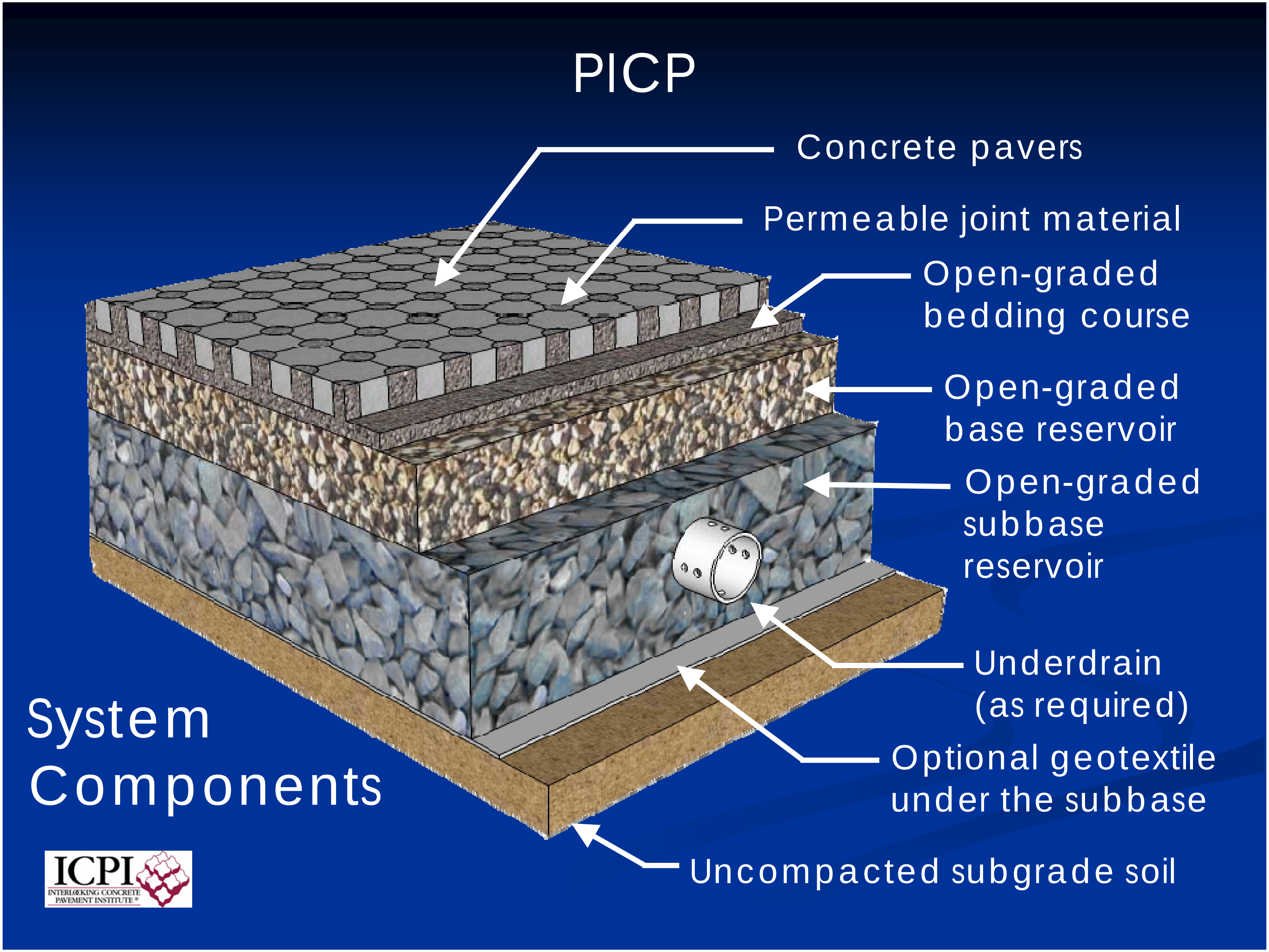
- Erosion
  - add river rock or other velocity dissipater to inlet
  - spread concentrated flow
  - re-mulch and plant eroded slopes
- Standing water, extended drawdown time
  - flush or vacuum underdrain through cleanout
  - remove and replace mulch and 2-3” of soil
  - replace all soil and clogged components
- Plant disease or pests
  - use least toxic approach
  - consider replacing with resistant plant species

Permeable Pavement: Design, Construction and Maintenance

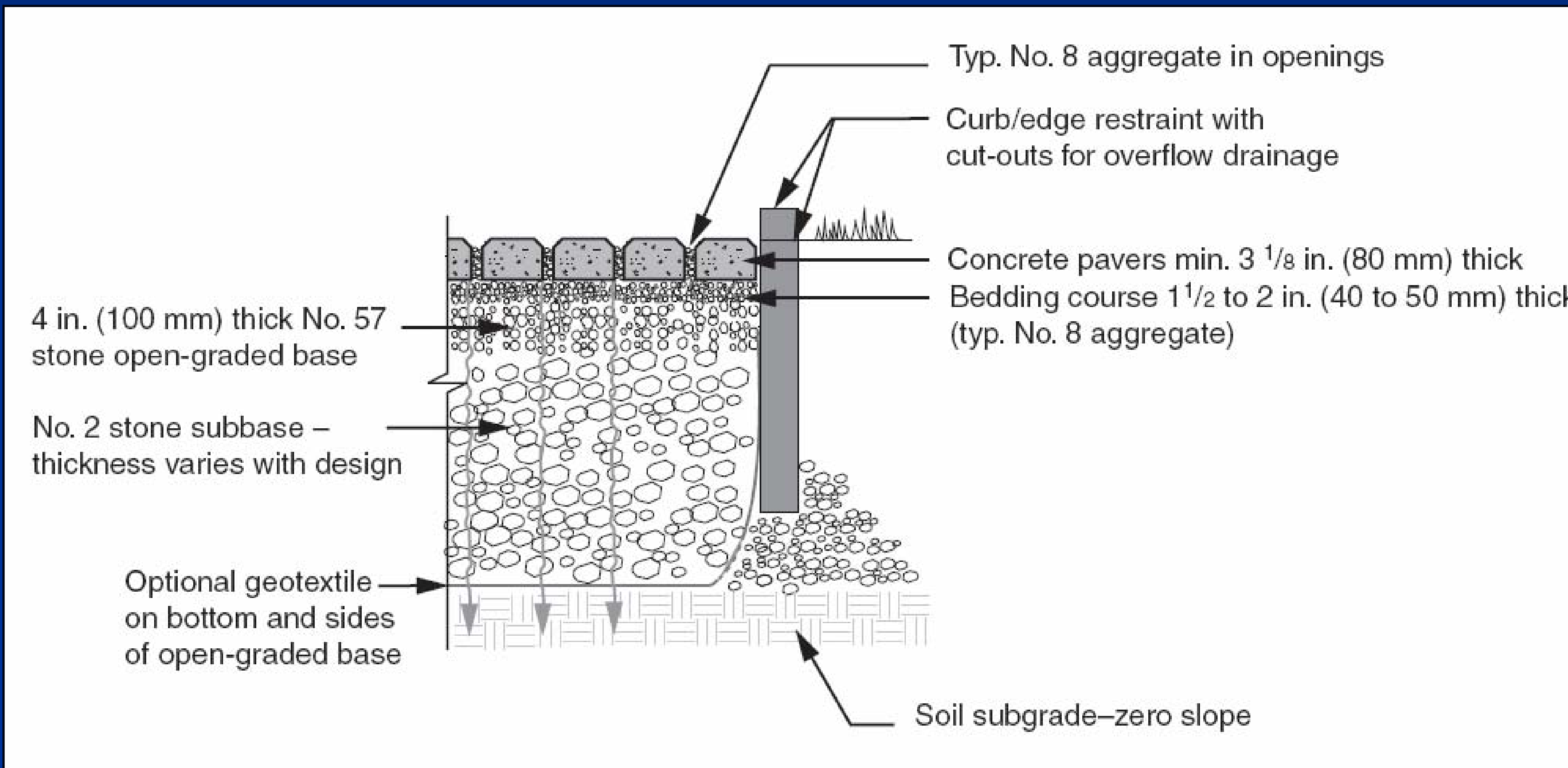
Permeable Paving Types

- Concrete or plastic grid pavers
- Permeable interlocking concrete pavers (PICP)
- Porous asphalt
- Pervious concrete

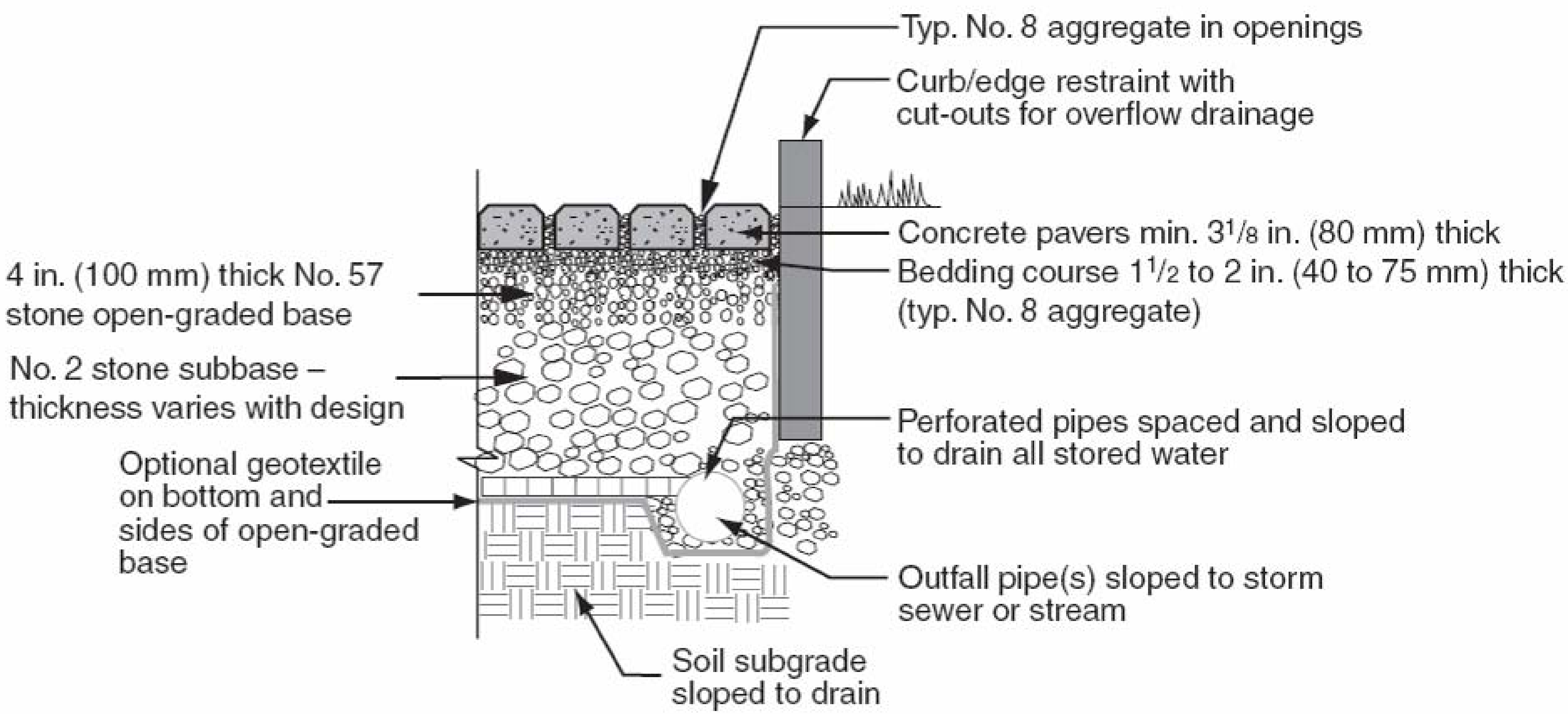



PICP
Concrete pavers
Permeable joint material
Open-graded bedding course
Open-graded base reservoir
Open-graded subbase reservoir
Underdrain (as required)
Optional geotextile under the subbase
Uncompacted subgrade soil
System Components
ICPI
INTERLOCKING CONCRETE PAVEMENT INSTITUTE®

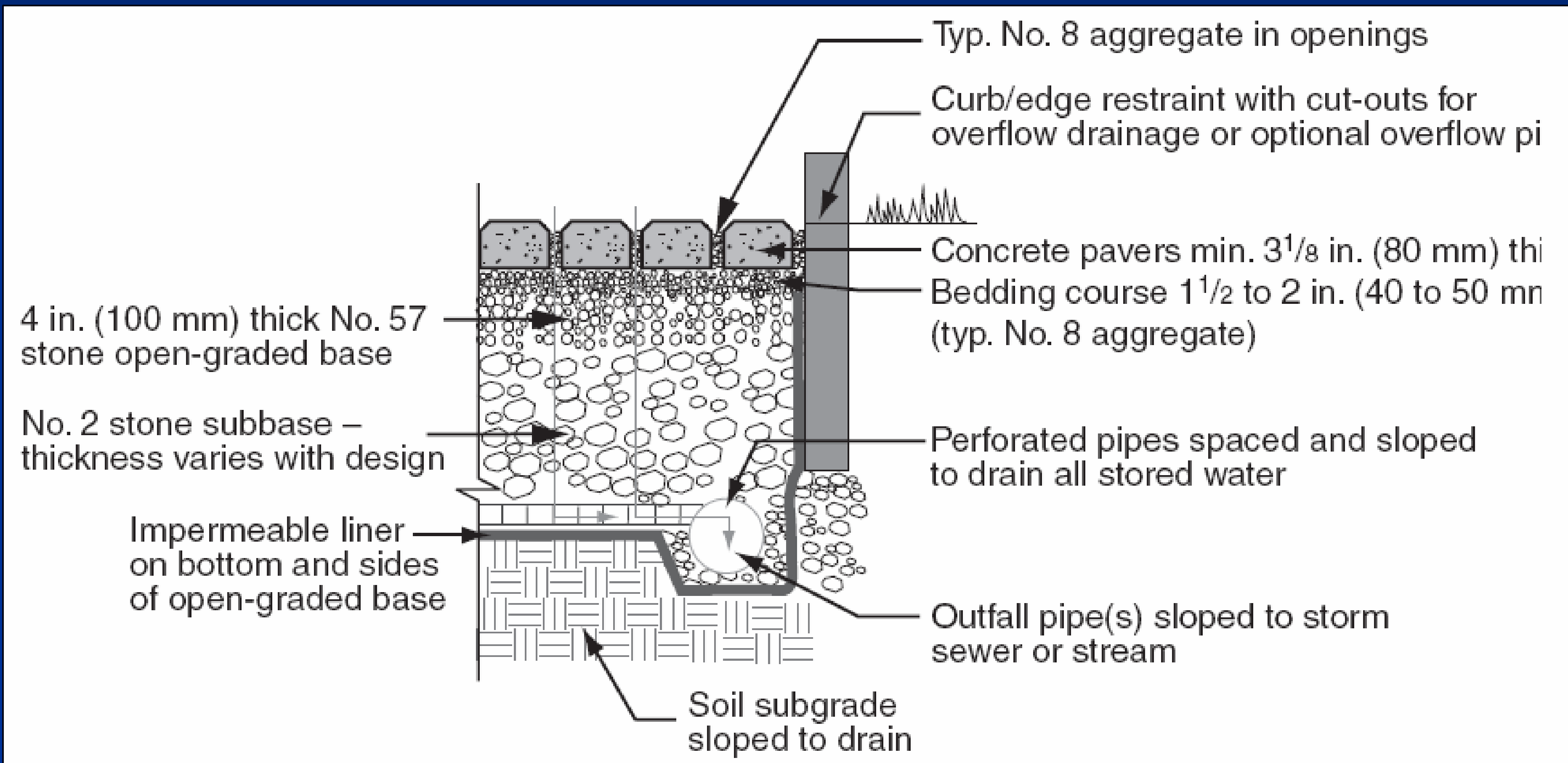
Full Exfiltration



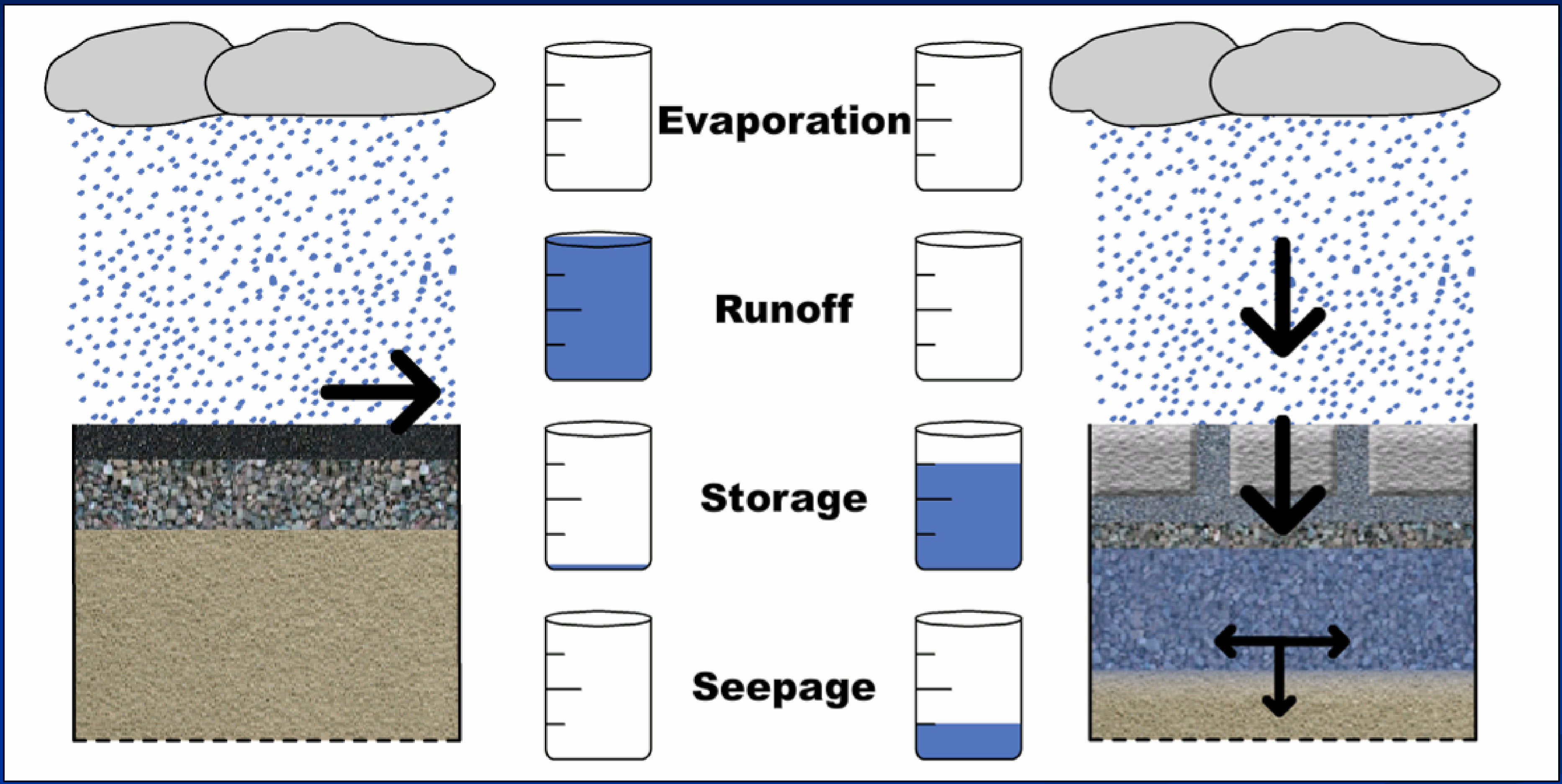
Partial Exfiltration



No Exfiltration



PCIP Hydrology Example



Construction: Subbase & Base Preparation

Porous Asphalt Installation

Source: CA Coastal Commission

- 3.5” - 4” pervious asphalt placed directly on stone base
- Rolled to a finished depth of 2.5” - 3”

Porous Concrete Installation

Jointing

- Roughly ½ the shrinkage of normal concrete
- Joints are typically placed every 20'
- Best practice is to tool joints
  - Sawing can cause raveling

Curing

- Curing pervious concrete is <u>critical</u> due to the porosity and low water/cement ratio
- Without curing, surface will dry out and deteriorate easily
- Moist cure (7 days preferred)

Permeable Paver Installation

PICP Joint Aggregate Installation

Permeable Pavement Construction Cost Elements

- Costs range from $5-$10/sf based on the inclusion of:
  - Pavement materials (paver blocks, permeable concrete, or asphalt)
  - Gravel material
  - Geotextile fabric
  - Underdrain

Benefits of Permeable Pavement

- Conserves space: a useable hardscape and a stormwater management facility
- 100% runoff reduction for low intensity storms
- Reduces retention requirements
- Filters and reduces pollutants
- Increases groundwater recharge

Structural Soil Supports PICP & Tree Growth

Hoboken, N.J., 1998 Pier A Park

Image courtesy of Bruce K. Ferguson

High Albedo Pavement

asphalt

concrete

High Albedo Pavement in Chicago's Green Alleys

High albedo concrete and permeable concrete trench in Chicago Alley

Photo courtesy of Abby Hall, U.S. EPA

High albedo permeable pavers in Chicago Alley

Photo courtesy of Abby Hall, U.S. EPA

Reduce Storm Sewer System Costs

Alley in Chicago with impermeable pavement and poor drainage

Green alley in Chicago

Images courtesy of Chicago DOT

Permeable Pavement: Maintenance

Routine Maintenance

- Vacuum sweep four times a year
  - Do not use water; it can force debris deeper into the pavement
  - Properly dispose of captured material
- Restrict use by heavy vehicles
- Limit use of sand and de-icing chemical
- Maintain drainage areas, keep stabilized

Sweeper Effectiveness

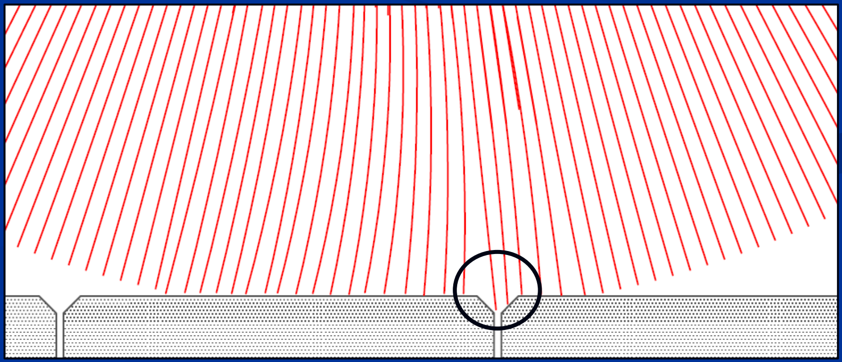
Vacuum sweeper
(no water)

Source: Elgin Sweeper Company

Regenerative air (broom) sweeper (no water)

Source: Elgin Sweeper Company

Vacuum is essential as brush bristles clean ~ ¼ in. into surface



Corrective Action Maintenance

To solve:

- Cracks & Potholes
  - Concrete and asphalt: fill with patching mix
  - Permeable pavers: replace broken pavers, add or remove stone to level
- Clogged surface
  - Concrete and asphalt: drill ½” diameter holes every few feet
  - Permeable pavers: pull up pavers and replace filler stone

Outline

Part 1: Hydrology and Low Impact Development (LID)

Part 2: LID methodology and site design strategies

Part 3: The LID toolbox

Part 4: Case studies

Part 5: LID BMP design and construction

LID Resources

Low Impact Development Center www.lowimpactdevelopment.org

U.S. EPA www.epa.gov/owow/nps/urban.html

Stormwater Manager's Resource Center www.stormwatercenter.net

National NEMO Network www.nemonet.uconn.edu

LID Urban Design Tools www.lid-stormwater.net

Nat'l Assoc. of Home Builders www.toolbase.org/index-toolbase.asp

California Stormwater Quality Association www.cabmphandbooks.com