# CALTRANS STORM WATER QUALITY HANDBOOK

# MAINTENANCE STAFF GUIDE

CTSW-RT-02-057

California Department of Transportation
Division of Maintenance
1120 "N" Street
Sacramento, California 95814

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# Disclaimer

This *Caltrans Storm Water Quality Handbook Maintenance Staff Guide* is published solely to provide information and guidance to the employees of the California Department of Transportation. It is not designed to, nor does it establish, a legal standard of care. It is subject to modifications as conditions warrant.

It is not intended that any standard of conduct or duty toward the public shall be created or imposed by the publication of this *Maintenance Staff Guide.*

The Maintenance organization is assigned the care and upkeep of State highways such that the investment in such highways will be preserved, and the maximum benefits afforded by constructed facilities will continue to be available to the traveling public.

This *Maintenance Staff Guide* is issued as a supplement to the *Maintenance Manual* to assist Maintenance personnel in complying with National Pollution Discharge Elimination System permit issued by the State Water Resources Control Board and Regional Water Quality Control Boards. It is Caltrans' goal to reduce storm water pollution to the maximum extent practicable through the implementation of Best Management Practices identified herein.

Uniform standards for all Caltrans maintenance activities may be impossible to maintain due to the resource limitations, volume and type of traffic, climatic conditions, variations in water quality objectives and other factors.

The Maintenance employee should attempt to perform each operation in the safest and most efficient manner, while maintaining good relations with the public. The employee should understand the contents of this *Maintenance Staff Guide* and be familiar with similar manuals issued by other offices or branches of Caltrans (*Construction Site Best Management Practices (BMPs) Guide, Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Program (WPCP) Preparation Manual and Project Planning and Design Staff Guide*).

# Table of Contents



**FIGURES**



**APPENDICES**

# SECTION 1

# INTRODUCTION

## 1.1 MAINTENANCE STAFF GUIDE PURPOSE AND SCOPE

The California Department of Transportation (Caltrans) - Division of Maintenance (Maintenance) developed the Storm Water Quality Handbook – Maintenance Staff Guide (Staff Guide) as an employee handbook for the protection of water resources. The Staff Guide provides detailed instructions on applying the approved Maintenance storm water best management practices (BMPs) to Maintenance facility operations and highway activities.

For each Maintenance operation or activity, multiple approved Maintenance BMPs may be applicable. Because it may be impracticable to review all the potentially applicable BMPs for each operation or activity, Activity Cut-Sheets were developed in a user-friendly format for common Maintenance facility operations and highway activities that have a high potential to affect storm water quality. Each Activity Cut-Sheet summarizes the approved Maintenance BMPs that may be applied to the operation or activity. It is not the intent of the Staff Guide to provide Activity Cut-Sheets covering all the Maintenance operations and activities.

The intent of the Staff Guide is to aid the user in understanding and applying the approved Maintenance BMPs. The user has the option of using the Activity Cut-Sheets in the Staff Guide (Appendix B) or using only the approved Maintenance BMPs (Appendix C). The Staff Guide is an employee handbook and does not replace or supersede the approved Maintenance BMPs.

## 1.2 REGULATORY BACKGROUND

Federal regulations for controlling discharges of pollutants from municipal separate storm sewer systems (MS4s), construction sites, and industrial activities were incorporated into the National Pollutant Discharge Elimination System (NPDES) permit process by the 1987 amendments to the Federal Water Pollution Control Act (also referred to as the Clean Water Act [CWA]) and the federal storm water regulations issued by the U.S. Environmental Protection Agency (EPA) in 1990.

In California, the EPA delegated the NPDES permitting authority to the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs). Figure 1-1 depicts how the Caltrans district boundaries and RWQCB boundaries overlap.

Under federal regulations, aspects of Caltrans' facilities and highway systems are under the jurisdiction of NPDES storm water regulations for two primary reasons:

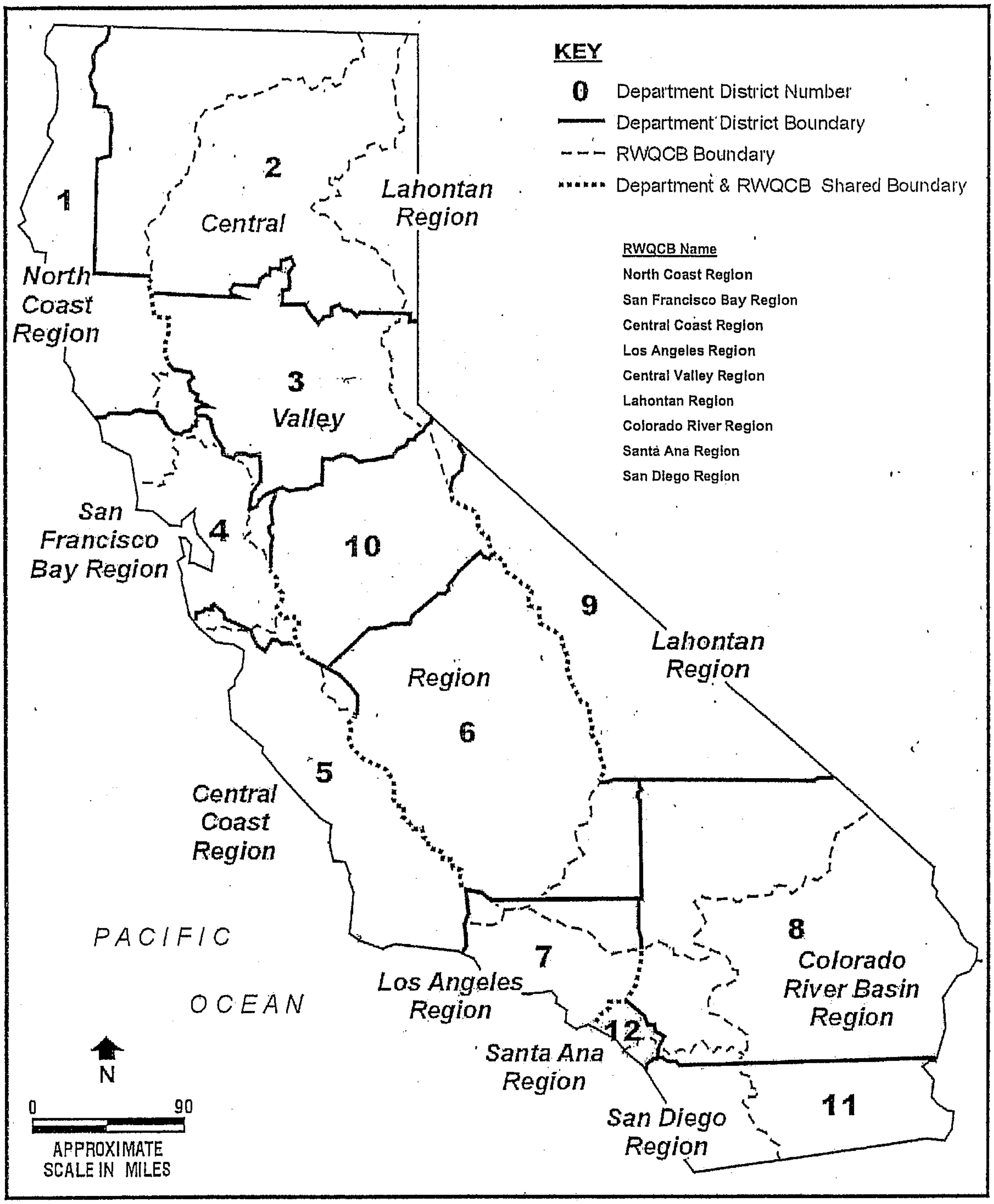



Figure 1-1
Map of California with RWQCB and District Boundaries

1. Highways and related facilities are served by extensive storm water drainage systems that in urban areas are often connected to, and are considered to be comparable to, municipal storm drain systems, which are covered explicitly in the regulations.
2. Construction of highways and related facilities often results in soil disturbance for which specific requirements are contained in the federal regulations and the State's General Permit for Storm Water Discharges Associated with Construction Activity.

### 1.2.1 Caltrans NPDES Statewide Storm Water Permit

To achieve a consistent approach to compliance with the storm water regulations, Caltrans determined that a statewide permit would be the most effective means to address its activities in all Districts. To comply with the storm water regulations, Caltrans implemented a program to reduce the discharge of pollutants to storm water drainage systems that serve highways and highway-related properties, facilities and activities. This program is described in Caltrans' Statewide Storm Water Management Plan (SWMP) and other guidance documents.

The SWRCB issued an NPDES Statewide Storm Water Permit (Permit) to Caltrans in 1999 (Order No. 99-06-DWQ [NPDES No. CAS000003]) to regulate storm water discharges from Caltrans facilities. The Permit regulates storm water discharges from Caltrans' rights-of-way both during and after construction, as well as from existing facilities and operations. The Permit also gave the RWQCBs the option to specify additional requirements considered necessary to meet water quality standards. A copy of the Permit can be downloaded from the Caltrans Storm Water Management Program web site (http://www.dot.ca.gov/hq/env/stormwater/ special/index.htm) or requested from the Headquarters Maintenance Storm Water Coordinator.

The Permit requires Caltrans to implement a year-round program in all parts of the State to effectively control storm water and non-storm water discharges.

Discharges from Caltrans' rights-of-way that are not composed entirely of storm water are prohibited. The permit language states that "Any discharge from Caltrans right-of-way or Caltrans properties, facilities, and activities within those rights-of-way that is not composed entirely of 'storm water' to waters of the United States is prohibited unless authorized pursuant to...this NPDES Permit (Permit, General Discharge Prohibitions, A.1)." To meet this requirement, Caltrans developed a series of BMPs to minimize pollutants in the storm water to the maximum extent practicable (MEP).

### 1.2.2 Statewide Storm Water Management Plan

The Permit directs Caltrans to implement and maintain an effective SWMP. The SWMP is the Caltrans policy document that describes how Caltrans conducts its storm water management activities (i.e., procedures and practices), provides descriptions of each of the major management program elements, discusses the processes used to evaluate and select appropriate BMPs and presents key implementation responsibilities and schedules. The Maintenance Storm Water Management Program is a component of the SWMP that describes:

- The program to implement Maintenance BMPs (Category IA) as part of the ongoing maintenance activities for existing highways and highway-related properties, facilities and activities.
- The activities to manage potential storm water pollution from accidental spills, illicit connections, illegal discharges and illegal dumping within the Caltrans rights-of-way.
- Implementation of BMPs to reduce the potential for storm water pollution at Maintenance facilities by minimizing contact between storm water and various materials and substances used and stored at Maintenance facilities (Caltrans Statewide SWMP, Section 5.0).

However, the SWMP does not provide the details to implement the Maintenance BMPs. The details are proved in the Statewide Storm Water Quality Practice Guidelines (Guidelines).

### 1.2.3 Statewide Storm Water Quality Practice Guidelines

The Guidelines describe each approved BMP listed in the SWMP for statewide application and include the approved Maintenance, Division of Design, Division of Construction and the Treatment BMPs. The Guidelines provide Caltrans personnel with details on implementation expectations on each approved BMP. The approved BMPs are subsequently incorporated into various specifications, policy manuals, training materials and employee handbooks including the Staff Guide. The approved Maintenance BMPs are provided in Appendix C.

## 1.3 ROLES AND RESPONSIBILITIES

The Headquarters Division of Environmental Analysis coordinates implementation of the SWMP through two lines of authority, traditional line management and functional line management. Traditional line management consists of 12 District Directors and the functional Division Chiefs within each District (i.e., Maintenance, Planning, etc.). Functional line management consists of the Director, the Deputy Directors and the Headquarters' Division Chiefs (i.e., Maintenance, Environmental, etc.) and their functional counterparts in the Districts (e.g., functional Division Chiefs). The management responsibilities for the Maintenance storm water program is presented in Figure 1-2.

The Headquarters Division of Maintenance, in consultation and coordination with the Headquarters Division of Environmental Analysis, is responsible for:

- Managing the Maintenance Storm Water Management Program as presented in the Statewide SWMP;
- Developing and maintaining guidance documents, such as the Caltrans Maintenance Manual and this Staff Guide;
- Providing general guidance on the implementation of BMPs;
- Monitoring the Maintenance Storm Water Management Program in the Districts to ensure the BMPs are adequately implemented; and
- Evaluating the Districts' implementation of BMPs in managing storm water discharges associated with the maintenance of the Caltrans facilities, highways, highway-related properties and assisting in the preparation of the Caltrans Annual Report to the SWRCB, as it relates to Maintenance activities.

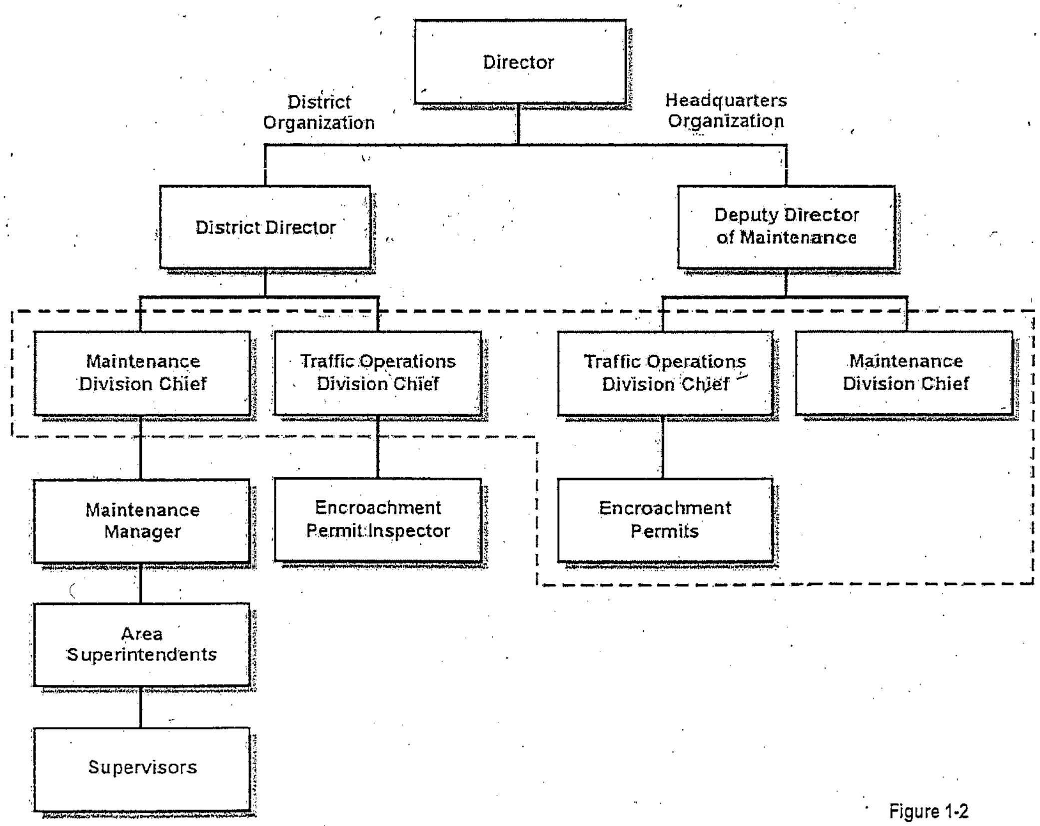



Figure 1-2
Maintenance Management Responsibility

The Headquarters **Maintenance Division Chief** is responsible for statewide implementation policies and procedures, the personnel and equipment of the Division of Maintenance. This includes ensuring compliance with all elements of the Statewide SWMP required by the Division of Maintenance.

The **Headquarters Maintenance Storm Water Coordinator** is the liaison with Headquarters Division of Environmental Analysis. The coordinator provides guidance to District NPDES (or District Maintenance Storm Water) Coordinators regarding water quality issues. The coordinator is responsible for overseeing development of storm water guidance documents used by Maintenance.

The Districts are responsible for implementing the SWMP within the District and complying with the Permit and any RWQCB-specific requirements.

- The **Maintenance District Division Chiefs** are responsible for the implementation of the policies, procedures, personnel and equipment of the District Maintenance Stormwater Management Program within their respective Districts. This includes ensuring compliance with all elements of the SWMP required to be implemented by the District Maintenance Divisions.
- The District **Maintenance Managers** direct maintenance activities within regions or programs of a District. Each region is subdivided into Maintenance Areas. The Maintenance Manager provides direct supervision to the Maintenance Superintendent within each region or program.
- The District **Maintenance Superintendents** direct maintenance activities within Maintenance Areas with a region and provide direction to Maintenance Supervisors. Maintenance Areas contain multiple maintenance facilities. The Superintendents are responsible for ensuring that maintenance BMPs are implemented in their jurisdictions.
- The District **Maintenance Supervisors** are responsible for direct supervision of a maintenance crew. Supervisors provide on-the-job training for specific crew assignments, including compliance with water quality protection requirements. Supervisors have on-site responsibility for BMP implementation.
- The **District NPDES Storm Water Coordinators** serve as liaison with the Water Quality Program. Liaison activities include conducting meetings related to storm water management issues with the coordinators from each functional unit and with other MS4 permittees to resolve problems and concerns. Liaison activities also include regular communications with representatives of the RWQCB. The functional unit coordinators will assist the District Divisions in implementing the Division's storm water management activities.
- The **District Maintenance Storm Water Coordinators** (also referred to as District Maintenance Storm Water Managers) are established in each District. Districts have designated Storm Water Coordinators, in other functional units such as, Environmental, Construction and Design. District Maintenance Storm Water Coordinator responsibilities include:

- Serving as the point of contact for regulatory inquiries regarding implementation of the Maintenance Storm Water Management Program;
- Reviewing proposed storm water compliance programs for elements related to Maintenance activities;
- Monitoring and evaluating BMPs implementation and effectiveness as related to Maintenance activities;
- Participating in meetings related to storm water management issues with storm water coordinators from other functional units in the District to resolve problems, concerns and areas that need attention;
- Coordinating with Headquarters Division of Maintenance to arrange training of District Maintenance personnel in storm water quality management; and
- Compiling and preparing materials for the Maintenance portion of the Department's Statewide SWMP Annual Report to the SWRCB.

- The **District Hazardous Material Coordinators** (also referred to as a District Hazardous Material Managers) coordinate response to spills of hazardous substances on Caltrans rights-of-way and coordinates management of Caltrans-generated hazardous waste. The coordinator is usually responsible for providing training information associated with hazardous materials and may be responsible to assist in implementing storm water quality protection practices in the District.
- The **District Landscape Specialists** provide guidance regarding use of pesticides and chemical control of vegetation in field maintenance operations. The Landscape Specialist is responsible for ensuring that all chemicals used in the District are approved by the responsible regulatory agencies.
- The **Leadworkers** conduct tailgate meetings (in absence of the Maintenance Supervisor) to review environmental concerns, BMPs and ensures that appropriate procedures are implemented during maintenance activities.
- The **Maintenance Workers/Landscape Workers/Equipment Operators** are responsible for implementing BMPs while conducting maintenance activities.
- The **District Equipment Managers** ensures that vehicle inspections include checks for leaks on District Maintenance vehicles.
- The **Equipment Shop Superintendents** are the front line manager who directs vehicle servicing and repair activities within an equipment shop or service region.
- The **Mechanics** (Resident/Traveling) are responsible for implementing BMPs while conducting vehicle servicing and repair activities.

## 1.4 MAINTENANCE STAFF GUIDE ORGANIZATION

The Staff Guide is organized as follows:

Section 1 - Introduction. This section identifies the purpose and scope of the Staff Guide, provides the regulatory background to storm water protection and the roles and responsibilities of the Maintenance staff.

Section 2 – Objectives. This section provides the objectives of the Maintenance Storm Water Management Program, the pollutants of concern for Maintenance facilities and highway activities, how the BMPs are incorporated into the Maintenance program and the program evaluation.

Appendix A - Acronyms and Definition of Terms.

Appendix B - Activity Cut-Sheets. This appendix contains Maintenance activities organized as Maintenance Family activities for facility operations and highway activities. The BMPs are summarized for common Family activities that have the potential to affect water quality.

Appendix C - Maintenance BMPs. This appendix contains the detailed Maintenance BMPs that were developed in the Caltrans Statewide Storm Water Quality Practice Guidelines to be used for Maintenance facility operations and highway activities.

## SECTION 2

## OBJECTIVES OF MAINTENANCE STORM WATER MANAGEMENT PROGRAM

## 2.1 GENERAL OBJECTIVES OF THE PROGRAM

The Caltrans Maintenance Manual provides direction, guidance, policies and procedures for all the maintenance activities performed by Maintenance personnel. To ensure that maintenance activities are conducted in a manner that prevents or controls the pollutants discharged to surface waters, Caltrans Maintenance Manual Volume 1 established a Maintenance Storm Water Management Program providing this overall program objective.

A key component to meeting the Maintenance Storm Water Management Program objective is the development of the Staff Guide. The Staff Guide is a Maintenance employee handbook that incorporates the approved Maintenance BMPs presented in the Statewide SWMP and Guidelines. Reviewing all the potentially applicable Maintenance BMPs may not be practicable for each Maintenance activity and facility operation. By associating the BMPs to the Maintenance activities defined in the Caltrans Maintenance Manual, the Staff Guide focuses on providing detailed instructions on how to apply the BMPs to maintenance activities. The Staff Guide is organized to include the:

- Objectives of the Maintenance storm water program,
- Pollutants of concern at Maintenance facilities and activities,
- Incorporation of storm water controls into Maintenance operations and activities,
- [Storm Water] Program evaluation, and
- Detailed Activity Cut-Sheets, and
- Maintenance BMPs.

The Permit and the Statewide SWMP require the use of BMPs to control potential pollutants that could be discharged to storm water drainage systems. Maintenance field personnel perform a key role in this program. They observe and correct situations that could cause water pollution. In addition, they conduct highway activities such as road and bridge repair and vegetation management, using BMPs described in this Staff Guide. Other BMPs described herein are intended for use at Maintenance facilities. The BMPs described in this Staff Guide have been selected to focus on those storm water-related pollutants of concern most likely to come from Maintenance facility operations and highway activities.

## 2.2 POLLUTANTS OF CONCERN FOR HIGHWAY MAINTENANCE ACTIVITIES AND FACILITIES

Maintenance activities are organized into several Families (Families A to T) consistent with the Department's methods used to record, report and monitor maintenance work as it is planned and performed. Within each Family, there are numerous specific activities, each of which may contribute pollutants via the storm water drainage system. Selecting the appropriate BMP(s) requires an understanding of the types of pollutants that the BMP is designed to remove.

"Pollutants of concern" include a broad range of materials that could result in adverse effects if discharged to receiving waters. Caltrans' maintenance activities involve the use of a wide variety of products. Under normal, intended conditions of use, these materials are generally not considered "pollutants of concern." However, if these products are used, stored, spilled or disposed of in a way that may cause them to contact storm water, they may become a concern for water quality. The typical pollutants generated by Caltrans' Maintenance facility operations and during highway activities are described below.

### 2.2.1 Petroleum Products

Petroleum products (e.g., gasoline, diesel fuel, motor oil and other lubricants) are common pollutants deposited on the highways and Caltrans' rights-of-way. Some fuels and lubricants contain additives, which may themselves be toxic to humans and aquatic life.

Potential sources of petroleum products from Caltrans' activities include leaks from vehicles and machinery and maintenance activities such as fueling, changing oil and washing. Although petroleum products are commonly used on a daily basis, it is important to be careful about how they are used and disposed.

### 2.2.2 Sediment

In general, sediment is considered a pollutant when it significantly exceeds natural concentrations. Sometimes other potential pollutants (e.g., lead) may become attached to sediments and are transported with the sediments to receiving waters, increasing the potential for water quality impacts.

Possible sources of sediment in runoff from Maintenance facilities and highway maintenance activities include the tracking, transport and storage of loose bulk materials (e.g., sand or other aggregate), grading-related activities and soil erosion.

### 2.2.3 Litter and Debris

Litter in storm water is defined as manufactured objects and includes items such as paper, aluminum cans, styrofoam cups and other items commonly discarded which can be transported by wind and storm water into the storm drainage system. This definition does not include materials of natural origin such as gravel or vegetation. Litter is quantified by 24-hour air-dried volume and weight measurements.

Litter in surface waters can inhibit the growth of aquatic vegetation, harm aquatic organisms by ingestion or entanglement, convey other pollutants, such as toxic substances and cause aesthetic problems on shorelines. In addition to impacting water quality, these items may obstruct the storm water drainage system.

### 2.2.4 Metals

The term "metals," as used here, refers to dissolved and suspended metals. Metals found in highway storm water runoff are considered pollutants because above a certain threshold even low concentrations of these materials may harm aquatic life.

These metals come from various sources and activities, including fuel combustion, brake pad wear (copper), tire wear (cadmium and zinc), metal corrosion, pressure-treated wood and creosote posts used for guard rails (arsenic), paints, herbicides and other materials.

### 2.2.5 pH

The pH of a water sample is a measure of its acidity or alkalinity. Water that is acidic or alkaline potentially causes harm to aquatic organisms or consumers of the water, and may even result in damage to equipment and materials.

Some Caltrans' maintenance activities that may change the pH of runoff include the storage of cracked batteries resulting in leaking battery acid, tube and tunnel washing and management of concrete wastes.

### 2.2.6 Nutrients

A nutrient is any substance assimilated by living things that promote growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential trace elements.

Excessive nutrients, such as phosphorus and nitrogen, to receiving waters can over-stimulate the growth of aquatic plants causing abnormal algal blooms which contribute to low dissolved oxygen levels and can result in fish kills. Nutrients generally have more adverse effects in water bodies with slow flushing rates, such as slow-moving streams and lakes. Also, nutrients attached to suspended solids in storm water runoff can cause problems where they settle out downstream.

Some of the possible sources of nitrogen and phosphorous from Caltrans' maintenance activities and facilities include storage of fertilizers, decaying plant materials from tree trimming, vegetation management surfactants and emulsifiers and natural sources such as the mineralized organic matter in soils.

### 2.2.7 Pathogens

Pathogenic microorganisms, including viruses, bacteria, protozoa and helminth worms, are of concern in storm water runoff. The direct measurement of specific pathogens in water is extremely difficult. For that reason, the coliform group of organisms is commonly used as an indicator of the potential presence of pathogens of fecal origin. Sources of total and fecal coliforms in storm water runoff are ubiquitous (e.g., soil microorganisms, wild and domestic animal droppings, etc.). Human sources could include illicit sewer connections, seepage from septic tanks and spillage from portable toilets.

### 2.2.8 Pesticides

A pesticide is a chemical agent designed to control pest organisms. The most common forms of pesticides are organic chemicals designed to target insects (insecticides) or vascular plants (herbicides). Pesticides have been repeatedly detected in surface waters and precipitation in the United States. Water is one of the primary media in which pesticides are transported from targeted applications to other parts of the environment. As the use of pesticides has increased, concerns about the potential adverse effects of pesticides on the environment and human health have also increased. Pesticides and herbicides are used in Caltrans' chemical weed control and integrated pest management activities.

### 2.2.9 Other Pollutants

Other pollutants originating from Caltrans' maintenance facilities and activities include asphalt, detergents and epoxy resins.

A common product used extensively in Caltrans' maintenance activities is asphalt (especially cold mix), which, while not a pollutant under normal conditions of use, could potentially contribute pollutants to surface waters if mishandled or disposed of improperly.

Synthetic detergents and their additives also contain a variety of chemicals that are potentially harmful in the environment. Some of these additives, such as bleaches, dyes, fragrances and enzymes, are toxic to aquatic life. Detergents are commonly used in cleaning and washing activities as part of routine maintenance of vehicles and equipment.

Some bonding, adhesive materials and protective coatings contain epoxy resins. Caltrans' maintenance activities that use epoxy resins include repairs of cracks, joints, bridges, barriers and irrigation lines. Some of the constituents of epoxy products may be toxic to aquatic life and some are potentially carcinogenic (cancer-causing) to humans.

## 2.3 INCORPORATION OF BMPS INTO MAINTENANCE PROGRAMS AND ACTIVITIES

As described above, the potential pollutants of concern for Caltrans' Maintenance operations and activities include petroleum products, sediment, litter and debris, metals, pH, nutrients, pathogens, pesticides and other pollutants. Many of these potential pollutants can be prevented from being discharged via the storm water drainage system. This can be achieved by selecting and implementing appropriate BMPs.

Caltrans established BMP categories in the Statewide SWMP. The categories include:

1. Maintenance BMPs (Category IA),
2. Design Pollution Prevention BMPs (Category IB),
3. Construction Site BMPs (Category II), and
4. Treatment BMPs (Category III).

Within each category, the BMPs are grouped as either:

- Approved: These BMPs have been approved for statewide implementation by Caltrans.
- Further Research Needed: Statewide implementation of these BMPs is deferred until further research is completed.
- Rejected: These BMPs have been evaluated and rejected.

This Staff Guide applies the approved Maintenance BMPs (Category IA) to the Maintenance facility operations and highway activities that may affect storm water quality.

Caltrans developed a wide range of Maintenance BMPs that are suitable for implementation by Maintenance personnel throughout the State. They are provided in Appendix C of the Staff Guide for easy referencing.

## 2.4 HOW TO USE ACTIVITY CUT-SHEETS AND GENERAL BMPS

The following section provides information on how to use the Activity Cut-Sheets and General BMPs.

### 2.4.1 Activity Cut-Sheets

Typically, several BMPs are potentially applicable to a maintenance activity. Prior to implementing a maintenance activity, the Supervisor and work crew should review each BMP identified for the activity. However, review of each BMP as presented in Appendix C may not be practicable for every maintenance activity. To simplify the review process, BMPs were summarized in the Activity Cut-Sheets for common maintenance activities. The objective of the Activity Cut-Sheet is to provide a straightforward working-level approach to implement pollution control measures. The Activity Cut-Sheets are presented in Appendix B.

The Activity Cut-Sheets presented in the Staff Guide consist of common highway activities implemented by Maintenance with a potential to affect water quality. They do not represent a comprehensive inventory of activities encountered by Maintenance. For the Maintenance activities that are not represented by an Activity Cut-Sheet, the BMPs provided in Appendix C should be selected for an activity and reviewed for application.

### 2.4.2 General BMPs

In addition to Activity Cut-Sheets, General BMPs were assembled. There are several Maintenance BMPs that are commonly applied to all Caltrans' maintenance activities. These have been termed General BMPs in the Staff Guide. To minimize the redundant presentation of these more common BMPs in the Activity Cut-Sheets, the General BMPs are applied to all the maintenance activities and should be reviewed with the Activity Cut-Sheets. The General BMPs include Scheduling and Planning; Spill Prevention and Control; Sanitary/Septic Waste Management; Material Use; Safer Alternative Products; Vehicle/Equipment Cleaning, Fueling, and Maintenance; Illicit Connections Detection, Reporting and Removal; Illegal Spill Discharge Control and Maintenance Facility Housekeeping Practices (Appendix B).

### 2.4.3 Activity Cut-Sheet and General BMPs Selection Process

This section describes the process for selecting the Activity Cut-Sheet. Figure 2-1 illustrates the selection of the Activity Cut-Sheets for review with General BMPs and the review of the Maintenance BMPs if additional information is needed.

For example, a work crew is scheduled to conduct asphalt paving. The Maintenance Supervisor (or Leadworker) would select the General BMPs and the "A Family - Flexible Pavement/Asphalt Paving" Activity Cut-Sheet for review with the work crew (Appendix B).

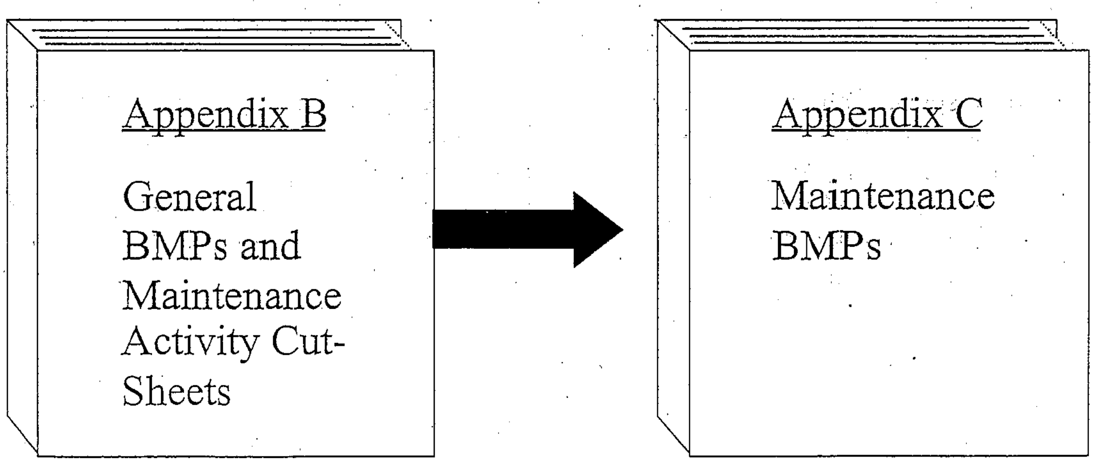



Figure 2-1
How to Use Activity
Cut-Sheets and BMPs

If more information or detail is needed beyond the General BMPs and the specific Activity Cut-Sheet, the Supervisor can select and review the individual Maintenance BMPs for an activity or operation provided in Appendix C.

Maintenance BMPs that may be applicable for the operation or activity are shown on a table specified for the operation or activity (Appendix C). Based on the information provided on the table, the individual Maintenance BMPs for an activity or operation are selected and reviewed for applicability. The tables are provided in Appendix C and are designed to provide a quick reference to the user. Tables C-1 to C-60 are organized by Maintenance Activities. Each Maintenance BMP identified on any table, identifies the location of the Maintenance BMP in the appendix.

## 2.5 FEEDBACK PROCESS

Evaluation and implementation of BMPs by field personnel is key to the process of continually improving the Maintenance Storm Water Management Program. As part of implementing the Statewide SWMP, Caltrans regularly reviews its activities, inspects its facilities, oversees and guides its personnel and conducts focused studies to refine, enhance and improve BMPs. Information obtained will support responsible management of the limited resources available to implement the BMPs and control pollutants from entering storm water drainage systems to the MEP. This monitoring and evaluation program serves as a quality control mechanism to help assess the effectiveness of the implementation of activities as required by the Statewide SWMP. The program evaluation will be an iterative process - a continuous loop of gathering information about implementation, evaluating and learning from the information that is collected and providing feedback that will result in continuous improvement. Field personnel are encouraged to complete the BMP Questionnaire (Figure 2-2).

Field personnel can submit the questionnaire to their Maintenance Supervisor, who will then forward it to the Maintenance Superintendent. The Maintenance Superintendent will submit the questionnaire to the Maintenance Manager for review. The Maintenance Manager will forward it to the District Maintenance Storm Water Coordinator who will compile questionnaires and forward them to the Headquarters Maintenance Storm Water Coordinator. The Headquarters Maintenance Storm Water Coordinator will review the questionnaires and identify BMPs requiring modification (Figure 2-3).

**Maintenance Activity Questionnaire**

Activity:

Date: County:

District: Route:

Name: Post Mile:

Title: Maintenance Facility:

Can any of the BMP procedures being implemented be improved? Please describe new or improved BMP procedures. (Attach additional comments as necessary.)

If the BMP is not being implemented as described in the Maintenance Staff Guide, what is the cause:

☐ Safety Concern ☐ Lack of Training

Describe:

☐ Operational

Describe:

☐ Equipment or material availability

Describe equipment or material needs:

☐ Personnel (Additional personnel are needed.)

Describe additional person-years (PYs) required:

☐ Financial Resources

Describe the category of financial resources:

Reviewed by: Supervisor ☐ Superintendent ☐ Region Manager ☐ Storm Water Coordinator ☐

Figure 2-2
BMP Questionnaire

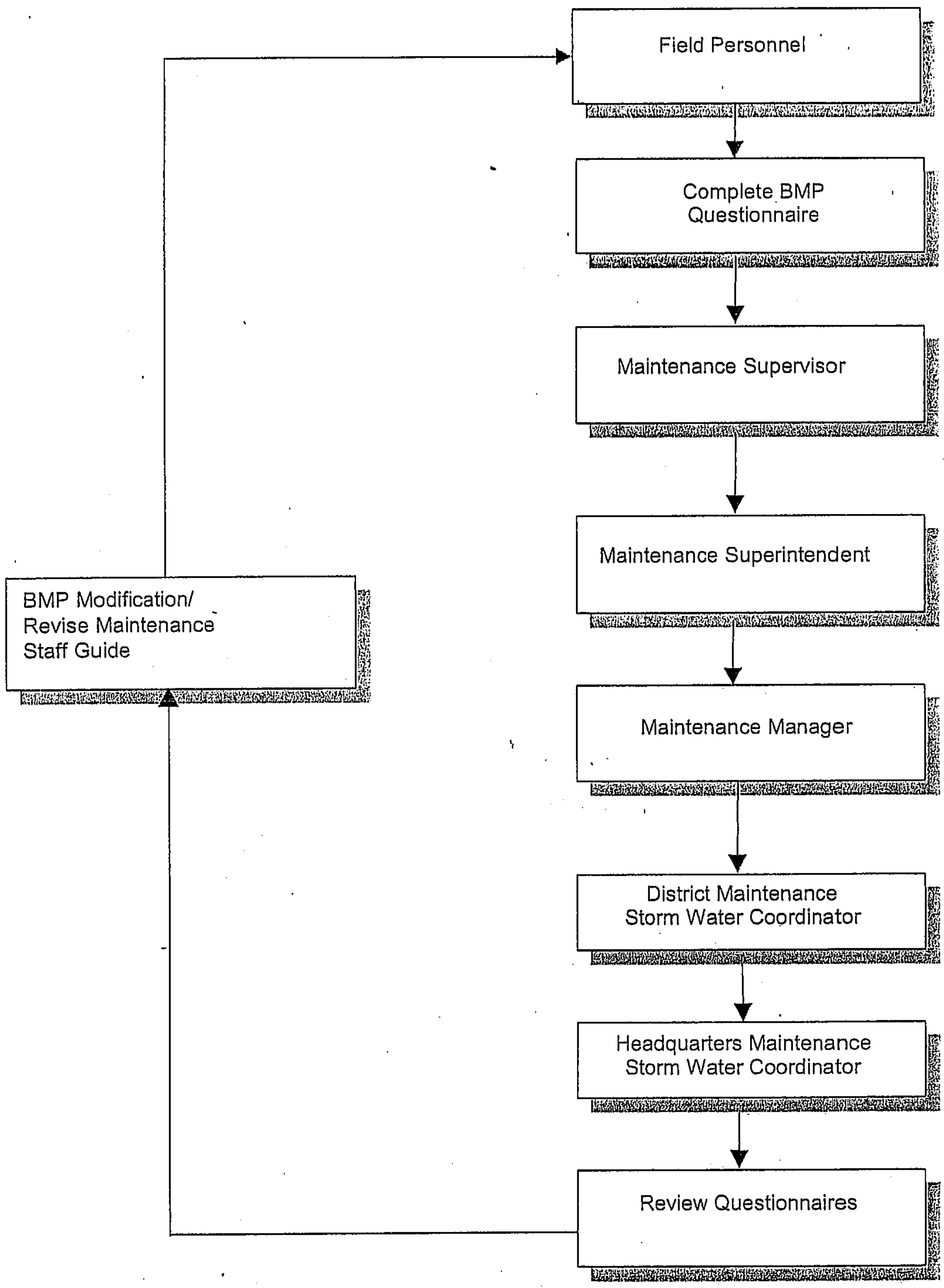



**Figure 2-3**
**Feedback Process**

# APPENDIX A

# ACRONYMS AND DEFINITION OF TERMS

## Acronyms

| | |
|---|---|
| BMP | Best Management Practice |
| Cal/OSHA | California Occupational Safety and Health Administration |
| Caltrans | California Department of Transportation |
| CCR | California Code of Regulations |
| CWA | Clean Water Act |
| EPA | U.S. Environmental Protection Agency |
| IMMS | Integrated Maintenance Management System |
| MEP | Maximum Extent Practicable |
| MOU | Memorandum of Understanding |
| MS4 | Municipal Separate Storm Sewer System |
| NPDES | National Pollutant Discharge Elimination System |
| OES | Office of Emergency Services |
| PCA | Pest Control Advisor |
| PCC | Portland Cement Concrete |
| POTW | Publicly owned treatment works |
| PY | Person-year |
| RWQCB | California Regional Water Quality Control Board |
| SPCC | Spill Prevention Control and Countermeasure |
| SWMP | Storm Water Management Plan |
| SWRCB | California State Water Resources Control Board |
| U.S. | United States |
| USA | Underground Service Alert |

## Definition of Terms

**Best Management Practice (BMP)**: A measure implemented to protect water quality and reduce potential for pollution associated with storm water runoff. Any program, technology, process, siting criteria, operating method, or device that controls, prevents, removes, or reduces pollution. Caltrans established categories of BMPs: Maintenance, Design Pollution Prevention, Construction Site and Treatment.

**Clean Water Act**: Refers to the Federal Water Pollution Control Act enacted by Congress in 1972 by Public Law 92-500 and amended by the Water Quality Act in 1987 (also called the Clean Water Act). The Clean Water Act prohibits the discharge of pollutants to waters of the United States unless the discharge is covered by the terms of a discharge permit. The Clean Water Act is probably best known for its stated objective of "fishable and swimmable" waters. The 1987 amendment to the Clean Water Act includes guidelines for regulating discharges from storm water drainage systems for certain municipalities, industries and construction activities.

**Compliance monitoring**: Refers to various information-gathering activities that Caltrans will use to assess its efforts to comply with the requirements in the Permit and the Statewide SWMP. Compliance monitoring will involve a broad variety of observations and inspections that will help Caltrans managers know whether the storm water management procedures and practices described in the Statewide SWMP are being implemented as intended.

**Drainage inlet**: A drainage structure which collects surface runoff and conveys it to an underground storm water drainage system.

**Erosion**: The wearing away of land surface primarily by wind or water. Erosion occurs naturally as a result of weather or runoff, but can be intensified by clearing, grading or excavation of the land surface may increase the erosion rate.

**Existing vegetation**: Any vegetated area that has not already been cleared and grubbed.

**Fire protection strips**: Buffer strips adjacent to the right-of-way where vegetation is controlled to reduce the risk of fire.

**Good housekeeping**: A common practice related to the storage, use, or cleanup of materials, performed in a manner that minimizes the discharge of pollutants.

**Grubbed**: Vegetation has been removed by mechanical or manual methods.

**Hazardous waste**: A hazardous waste possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special EPA or state lists. A waste or combination of wastes, that, may either cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed, because of its quantity, concentration, or physical, chemical or infectious characteristics. Regulated under the federal Resource Conservation and Recovery Act and the California Health and Safety Code.

**Herbicide**: Chemical compounds that are used to control weeds.

**Hydrologic unit**: A subunit of a basin as defined by a RWQCB.

**Illicit connections**: Connections made to Caltrans' storm water drainage systems by others without permission.

**Illegal discharge**: Any non-permitted discharge to a receiving water.

**Integrated Maintenance Management System (IMMS)**: A system used to record, report and monitor maintenance work as it is planned and performed. The IMMS uses an alpha-numeric numbering system and provides descriptions of the maintenance program components and the "Family" problem structure model.

**Maintenance activities**: Routine maintenance activities that may require clearing, grading or excavation to maintain original line and grade, hydraulic capacity, or original purpose of the facility.

**Maintenance facilities**: Facilities under Caltrans' ownership or control that contain such areas as fueling areas, waste storage or disposal facilities, wash racks, equipment or vehicle storage and materials storage areas.

**Maintenance Staff Guide**: An employee handbook for Caltrans Maintenance personnel designed to provide guidance on potential pollutant sources and BMPs for Caltrans' maintenance facilities and activities.

**Maintenance Storm Water Management Program**: The component of the Statewide Storm Water Management Plan (SWMP) that describes: The program to implement BMPs as part of the ongoing maintenance activities for existing highways and highway-related properties, facilities and activities; surveillance activities to help manage potential storm water contamination from accidental spills, illicit connections, illegal discharges and illegal dumping on Caltrans' property; and implementation of BMPs to reduce the potential for storm water pollution at existing highway maintenance facilities by minimizing contact between storm water and the various substances used at maintenance facilities.

**Maximum Extent Practicable (MEP)**: The extent of implementation of storm water management practices that are effective at reducing storm water pollution except when any of the following conditions are met: (1) other effective management practices would achieve greater or substantially the same pollution control benefits; (2) the management practice would not be technically feasible; (3) the cost of management practice implementation would greatly outweigh pollution control benefits; or (4) implementation of the management practice would compromise other legal and institutional constraints, expectations and obligations imposed by federal or state statute or case law.

**Median area**: The portion of a divided highway separating the traveled ways for traffic in opposite directions. Often contains storm drain system facilities, such as ditches and swales.

**Monitoring**: Refers to a variety of activities and processes through which Caltrans will obtain information relevant to its implementation of the storm water quality management program and so that the need for and/or opportunities for revising or refining its program can be identified.

**National Pollutant Discharge Elimination System (NPDES)**: The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits under the Clean Water Act. In California, the NPDES permits are incorporated into Waste Discharge Requirements.

**Nonpoint source discharge**: Discharge from a diffuse pollution source (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet).

**Non-storm water discharge**: Any discharge to a storm drain system or receiving water that is not composed entirely of storm water.

**Oil waste**: Oil of any kind or in any form, including but not limited to, petroleum, fuel oil, sludge, oil refuse and oil mixed with wastes other than dredged soil.

**Outfall**: The point source where a municipal storm sewer discharges to waters of the United States.

**Permit**: Refers to the NPDES Storm Water Permit (Order No. 99-06-DWQ) adopted by the SWRCB on July 15, 1999 (or the most recent permit issued).

**Pump station**: A complete pumping installation including a storage box, pump or pumps, standby pumps, connecting pipes, electrical equipment, pumphouse and outlet chamber.

**Regional Water Quality Control Boards (RWQCBs)**: "Regional Board" means any California Regional Water Quality Control Board for a region specified in Section 13200 of the California Water Code.

**Reporting**: Refers primarily to information Caltrans will report to the SWRCB, although there also will be instances where information will be reported or otherwise communicated within Caltrans.

**Retention basin**: An infiltration basin designed to capture runoff volume from the water quality design storm and infiltrate it prior to a significant storm event.

**Sanitary sewer**: Underground pipes that carry off only domestic or industrial waste, not storm water.

**Sediment**: Organic or inorganic material that is carried by or is suspended in water and that settles out to form deposits in the storm drain system or receiving waters.

**Site**: The land or water area where any facility or activity is physically located or conducted, including adjacent land used in connection with the facility or activity.

**Soil Stabilization**: Control measures used to minimize erosion.

**Spill**: An accidental dumping or spilling of a potential pollutant onto the ground or into a waterway.

**State Water Resources Control Board (SWRCB)**: As delegated by EPA, California agency that implements and enforces Clean Water Act Section 402(p) NPDES permit requirements, and is issuer and administrator of Caltrans' NPDES Storm Water Permit. Works with the nine Regional Water Quality Control Boards.

**Storm drain inlet**: A drainage structure that collects surface runoff and conveys it to an underground storm drain system.

**Storm water**: Storm water means storm water runoff, snow melt runoff, surface runoff and drainage.

**Storm water drainage system**: Streets, gutters, inlets, conduits, natural or artificial drains, channels and watercourses, or other facilities that are owned, operated, maintained and used for the purpose of collecting, storing, transporting or disposing of storm water.

**Storm Water Management Plan (SWMP)**: The plan that describes Caltrans' statewide program to reduce the discharge of pollutants from storm water drainage systems associated with Caltrans' highways and highway-related facilities, properties and activities to the maximum extent practicable. Caltrans Planning and Design, Construction and Maintenance activities statewide are addressed by the SWMP. The SWMP also describes assignment of responsibilities for implementing BMPs, as well as training, public education and participation, monitoring, program evaluation and reporting activities.

**Storm water management practice**: Activities, prohibitions or modifications of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State.

**Storm Water Quality Practice Guidelines (Guidelines)**: A document that provides a description of each approved best management practioe included in the Statewide Storm Water Management Plan (SWMP) for statewide application.

**Sump**: In drainage, any low area which does not permit the escape of water by gravity flow.

**Surface runoff**: Precipitation, snow-melt or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions.

**Vegetation control**: Maintenance of vegetation on facilities owned by Caltrans by a combination of chemical application (herbicides) and mechanical methods (mowing, cutting, etc.).

**Vista point**: A paved area beyond the shoulder which permits travelers to safely exit the highway to stop and view a scenic area. In addition to parking areas, trash receptacles, interpretive displays, restrooms, drinking water and telephones may also be provided.

**Watercourse**: Surface water bodies including streams, lakes, bays, estuaries, lagoons, reservoirs and ponds.

# APPENDIX B

# ACTIVITY CUT-SHEETS

## Activity Cut-Sheet Table of Contents

# GENERAL BEST MANAGEMENT PRACTICES

There are Best Management Practices (BMPs) that are commonly applied to all Maintenance activities. For the purpose of this Staff Guide, these have been termed General BMPs. Summaries of these General BMPs are provided below with the detailed Maintenance BMPs found in Appendix C. The General BMPs should be reviewed with the Activity Cut-Sheet(s) prior to beginning the scheduled Maintenance activity.

| GENERAL BMPS | IMPLEMENTATION |
| --- | --- |
| **Scheduling and Planning** | • Plan and schedule all Maintenance activities in a manner that considers the use of BMPs. Recognize how the activity will affect storm water so that the proper BMPs can be placed or utilized at the proper time. Some Maintenance activities shall not be performed during rain events or when storms are predicted unless required by emergency conditions. The Activity Cut-Sheets will advise of these conditions. Poor planning does not constitute an emergency condition.<br>• Reduce the potential for erosion and pollutant transport through wind, rain, runoff and vehicle track-out by not scheduling maintenance activities that could adversely impact storm water during the rainy season and prior to forecast storm events.<br>• Plan your work to protect storm water drainage systems and watercourses from discharge of potential pollutants. Plan ahead when working near storm water drainage systems and sensitive water bodies. They may need a higher level of awareness and protection.<br>• Be aware of where the flow of a leak, spill, or other runoff would go.<br>• Identify drain inlets and watercourses, both upstream and downstream of the work site.<br>• All vehicles and equipment should be clean and in good operating condition. Perform a thorough pre-operational inspection of vehicles and equipment.<br>• Set-up the work area to minimize the tracking of material by vehicles and equipment in or out of the work area. |

**Spill Prevention and Control**

Practice spill prevention and control at the work site:

- Keep spill cleanup materials available at all sites.
- Any spills should be controlled as soon as it is safe to do so. Transport collected materials back to a Maintenance facility or approved storage or disposal site.
- Use drip pans and/or absorbent materials to contain leaks or spills of vehicle fluids.
- If a leak or spill occurs, protect drainage systems and watercourses from spilled material by covering and blocking drain inlets. Remove covers and blocks once cleanup is completed.
- Use dry cleanup methods for storm water pollutants whenever possible. If water must be used for spill cleanup and/or decontamination, contain the water used for spill cleanup and decontamination and do not discharge to the storm water drainage system or watercourses.
- Large spills must be contained and cleaned up by trained personnel. Contact your Hazmat Specialist if needed.
- To the extent cleanup activities and safety is not compromised, storm water pollutant spills shall be covered and protected from storm water run-on.

**Sanitary/Septic Waste Management**

Portable toilet units are used at locations where permanent bathrooms are unavailable.

- To prevent leakage, inspect and repair portable toilet units before leaving the Maintenance facility.
- Locate portable toilet units away from storm water drainage system and watercourses.
- Prevent spills by securing the units to prevent tipping on windy days when necessary.
- Septic waste can only be discharged to a municipal- or state-approved sewage disposal system.
- Inspect hose and connections to prevent spills prior to flushing holding tank at sanitary station.
- Control the water used to flush the holding tank to prevent non-storm water discharges. Use of a positive shutoff valve is advisable.
- After flushing the holding tank, if it is necessary to rinse or clean the walls, floor and outside of the unit, clean at a designated rinsing area or wash rack to prevent non-storm water discharges.

**Material Use**

Prevent materials used by Maintenance from entering the storm water drainage systems, watercourses or water bodies. Materials must be delivered, stored, prepared, transported and used in a manner that minimizes or eliminates the discharge of materials to the storm water drainage systems, watercourses or water bodies.

- Keep a supply of spill cleanup materials and tools near the material use area and clean up all spills as soon as it is safe to do so.
- Use materials only where and when needed to complete the maintenance activity.
- Train employees on proper loading and unloading techniques to prevent spills.
- Avoid depositing materials on the roadway by securing loads, using proper containers and covering loose materials when transporting in open bed trucks.
- When transporting liquids, inspect the condition of containers or tanks to ensure leakage does not occur. Make sure lids or covers are in place and secure.
- When transporting loose materials, inspect truck beds, sideboards, tailgates, cab protectors and pintle hooks both before transporting, and after completing the material delivery.
- Return unused materials to the Maintenance facility for reuse, recycling or proper disposal.

**Safer Alternative Products**

A variety of products may be harmful to the environment. In some cases, a less harmful product, commonly referred to as a safer alternative product, can be used for the same purpose. Safer alternative products should be considered for all maintenance activities.

- **The Districts must approve safer alternative products.**
- Use safer alternative products when possible. These may include cleaning and painting products, herbicides, graffiti removers, automotive products and fertilizers.
- While safer alternative products may be less harmful to the environment, they are not harmless. Use the materials according to the manufacturers instructions and keep the materials out of the storm water drainage system and watercourses.

**Vehicle/Equipment Cleaning, Fueling and Maintenance**

- Vehicle and equipment washing is allowed only at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the proper location for a designated rinsing area.
- Maintain vehicles and equipment in a covered maintenance area where possible. Inspect vehicles and equipment daily for leaks and repair as soon as possible. Use drip pans or absorbent pads to contain leaks until repairs are complete.
- Fueling in the field shall not be performed near unprotected drain inlets or watercourses.
- Keep a supply of spill cleanup material near the fueling area and the maintenance area. Cleanup spills as soon as it is safe to do so and dispose of properly. Hosing down of leaks, drips or spills is prohibited. Cleanup is not complete until all absorbent materials are removed from the pavement.
- See T Family Cut-Sheets for vehicle and equipment cleaning, vehicle and equipment fueling and vehicle and equipment maintenance for further details.

**Illicit Connection Detection, Reporting and Removal**

Illicit connections are connections to the Caltrans storm water drainage system that have not been approved by Caltrans.

- Maintenance personnel, as part of their routine inspections and maintenance work, shall report all observed suspected illicit connections to the District Maintenance Storm Water Coordinator, who will forward these observations to the District NPDES Storm Water Coordinator. A Storm Water Pollution/Drainage Problem report form has been developed for use in this activity.
- All public initiated calls should be directed to the District's Public Affairs Officer. Calls regarding illicit connections should be logged and routed to the District NPDES Storm Water Coordinator.

**Illegal Spill Discharge Control**

This BMP is directed at incidents involving dumping, discharges or spills that affect storm water.

- Maintenance Supervisors shall report any reports from field personnel observing illegal dumping or spilling of materials as part of their routine inspections and maintenance work to the District Maintenance Storm Water Coordinator. The District Maintenance Storm Water Coordinator will forward these observations to the District NPDES Storm Water Coordinator. A Storm Water Pollution/Drainage problem report form has been developed for this use.

- If suspected hazardous materials or hazardous waste dumping has occurred, Maintenance Supervisors shall also report the incident to the District Maintenance Hazardous Materials Manager.
- Spill cleanup shall be handled in accordance with the legal authority presented in Section 2.6 of the SWMP.

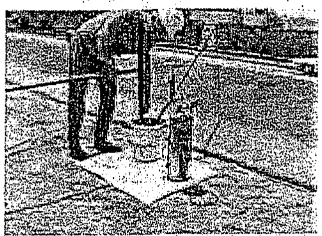
**Maintenance Facility Housekeeping Practices**

Good housekeeping practices are intended to eliminate the potential of discharge of pollutants to drainage paths, storm water drainage systems and watercourses by promoting efficient and safe storage, use and cleanup of potentially harmful materials. Good housekeeping should be practiced both at the Maintenance facility and at the work site.

- Maintain clean and orderly material and equipment storage areas.
- Use the "first in, first out" policy for material storage and control. Avoid ordering more materials that can be stored properly or used in a reasonable timeframe.
- Properly reuse, recycle or dispose of properly cleaned empty containers, excess materials and equipment or parts.
- Cover materials that have the potential to discharge pollutants to the storm water drainage system before predicted rains.
- Containers of liquids should be secured with lids until needed.
- Inspect the storage areas regularly and maintain a clean work area.
- Clean up spills promptly.
- Use drip pans or absorbent pads under leaking vehicle and equipment to capture fluids.
- Wash water shall not be discharged to the storm water drainage system or watercourses.
- Collect and transport litter, debris and waste materials from job sites to the Maintenance facility for proper disposal. Manage waste appropriately.

# A FAMILY – FLEXIBLE PAVEMENT

## Asphalt Cement Crack And Joint Grinding/Sealing



Paving Operation:
Asphalt application equipment was cleaned in a bucket over an absorbent splash pad.

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Asphalt products
- Emulsion
- Fuel
- Non-storm water
- Rubberized sealant
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Crack and joint grinding/sealing involves the sealing and filling of cracks and joints in flexible pavement. This work is done to prevent the entrance of moisture and foreign material into the subgrade, and to maintain the integrity of the pavement surface.

**APPROPRIATE APPLICATION**

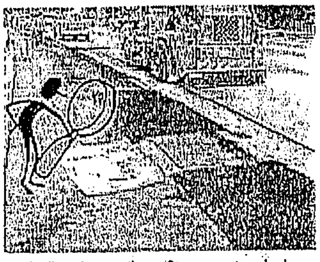
The following procedures are used where grinding or sealing may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Protect drains, watercourses and manholes from all potential spills including sealing products.
- Release agents shall not be discharged to the storm water drainage system or watercourses.
- Minimize airborne dust. Use water spray during grinding but minimize runoff.
- Clean equipment over absorbent pads, drip pans, plastic sheeting or other material to capture all spillage. Properly dispose of all generated waste material.
- Do not stockpile sand, sediment or grindings in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barriers during rainstorms.
- Liquid waste should be collected in a container, with a secure lid or transported to the Maintenance facility to be reused, recycled or disposed of properly.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport back to the Maintenance facility to be reused, recycled or disposed of properly.
- Reuse of asphalt grindings shall be in accordance with the California Department of Fish and Game "Memorandum of Understanding on the Use of Asphalt (January 12, 1993)."

# A FAMILY – FLEXIBLE PAVEMENT

## Asphalt Paving



Grinding Operation: Storm water drain inlets were protected prior to work and a broom sweeper cleaned up loose debris when completed.

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Asphalt products
- Cleaning agents
- Fuel
- Non-storm water
- Sediment
- Vehicle fluids

### DEFINITION AND PURPOSE

Paving of degraded asphalt surfaces involves patching or resurfacing roadbed with a mineral aggregate and bituminous binder mixture.

### APPROPRIATE APPLICATION

The following procedures are used to prevent releases of paving material to storm water drainage system and watercourses.

### OPERATIONAL PROCEDURES

- This activity shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- If chemicals are used for cleaning, consider safer alternative products where practical and effective.
- Protect drain inlets, watercourses and manholes from potential spills including paving products and tack coat.
- Release agents shall not be discharged to the storm water drainage system or watercourses.
- Prevent runoff. Minimize water used with the roller and for evaporative cooling of the asphalt.
- Do not stockpile sand or sediment in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barriers during rainstorms.
- Clean equipment over absorbent pads, drip pans, plastic sheeting or other material to capture all spillage.
- Liquid waste should be collected in a container, with a secure lid, and transported to the Maintenance facility to be reused, recycled or disposed of properly.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport back to the Maintenance facility to be reused, recycled or disposed of properly.

# A FAMILY – FLEXIBLE PAVEMENT

## Structural Pavement Failure (Digouts) Pavement Grinding and Paving

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Asphalt products
- Binder
- Cleaning agents
- Concrete
- Fuel
- Non-storm water
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Digouts include major repairs to the structural pavement and require removal of the roadway surface using graders and grinders.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent release of paving materials and grindings to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Protect drain inlets, watercourses and manholes from potential spills including grindings, paving products and tack coat.
- Place the "cold-mix" asphalt (i.e., pre-mixed aggregate and asphalt binder) under a protective cover during rainstorms.
- Tarp loads before hauling to storage site, if necessary. Do not overfill trucks.
- Prevent runoff. Minimize water used with the roller and for evaporative cooling.
- Release agents shall not be discharged to the storm water drainage system or watercourses.
- Minimize airborne dust. Use water spray during grinding but minimize runoff.
- Do not stockpile soil, sediment, asphalt material and asphalt grindings materials or rubble in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barriers during rainstorms.
- Clean equipment over absorbent pads, drip pans, plastic sheeting or other material to capture all spillage. If chemicals are used for cleaning, consider safer alternative products where practical and effective.

## Structural Pavement Failure (Digouts) Pavement Grinding and Paving

OPERATIONAL PROCEDURES (CONT'D)

- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility to be reused, recycled or disposed of properly.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# A FAMILY – FLEXIBLE PAVEMENT

## Emergency Pothole Repairs

**Environmental Concerns**
Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Non-storm water
- Pothole asphalt material
- Vehicle fluides

**DEFINITION AND PURPOSE**

Unscheduled pothole repairs involve the filling and resurfacing of potholes in flexible pavement portions of roadways to eliminate holes.

**APPROPRIATE APPLICATION**

The following procedures are used where spilled patch material may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Emergency pothole work is not restricted by rain events or predicted storm events.
- Protect drain inlets, watercourses and manholes from potential spills including patch material.
- Use only enough compacted material to fill the pothole.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# Sealing Operations

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Aggregate
- Asphalt products
- Fuel
- Non-storm water
- Sand
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Seal coats are required for asphalt pavement due to erosion or oxidation of the road surface. Seal coats include fog seal, sand seal chip seal and slurry seal to reduce road surface permeability and increase traction.

**APPROPRIATE APPLICATION**

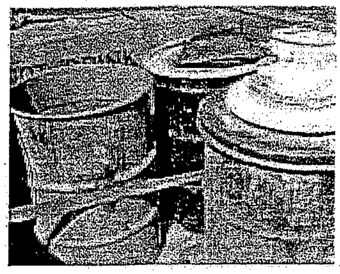
The following procedures are used where sealing materials may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Protect drain inlets, watercourses and manholes from potential spills including sealing products.
- Release agents shall not be discharged to the storm water drainage system or watercourses.
- Minimize airborne dust. Use water spray during grinding but minimize runoff.
- Prevent runoff. Minimize water used with the roller.
- Do not stockpile sediment, aggregate, sand or asphalt in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barriers during rainstorms.
- Clean equipment over absorbent pads, drip pans, plastic sheeting or other material to capture all spillage.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility to be reused, recycled or disposed of properly.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport back to the Maintenance facility to be reused, recycled or disposed of properly.

# B FAMILY – RIGID PAVEMENT

## Portland Cement Crack And Joint Sealing



**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Asphalt products
- Fuel
- Release agents
- Rubberized sealant
- Sand
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Crack and joint repair involves the sealing and filling of cracks and joints in rigid pavement. This work is done to prevent the entrance of moisture and foreign material into the subgrade, and to maintain the integrity of the pavement surface.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of sealing material to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Protect drain inlets and manholes from potential spills during sealing operation.
- Release agents shall not be discharged to the storm water drainage system or watercourses.
- Minimize airborne dust. Use water spray during grinding but minimize runoff.
- Clean equipment over absorbent pads, drip pans, plastic sheeting or other material to capture all spillage.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility to be reused, recycled or disposed of properly.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

## Mudjacking And Drilling

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Concrete | • Sediment |
| • Fuel | • Slurry |
| • Non-storm water | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Mudjacking is used to maintain and repair rigid type surfacing, its associated base and any Portland concrete cement shoulders less than two feet in width. A Portland cement and pozzolan grout mixture is pumped below the slab (i.e., mudjacking) to replace lost or settled base material.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of grout material to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Prevent spills. Secure vehicle loads and cover loose materials in open-bed vehicles.
- Protect drain inlets, watercourses and manholes from potential spills including grout, slurries and concrete washout.
- Water applied during the drilling and pumping must be controlled to prevent non-storm water discharges.
- Grout and slurries shall not be discharged to the storm water drainage system or watercourses.
- Vehicle and equipment washing is only allowed at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.
- Liquid waste and concrete washout should be collected in a container with a secure lid and transported to the Maintenance facility or decanting area for proper disposal. Concrete contractors are required to comply with Caltrans Standard Specifications, Section 7-1.01G Water Pollution.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# B FAMILY – RIGID PAVEMENT

## Concrete Slab and Spall Repair

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Concrete | • Sediment |
| • Fuel | • Slurry |
| • Non-storm water | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Spalling, slab cracking and settlement are common problems associated with Portland cement concrete pavement that require repairs.

**APPROPRIATE APPLICATION**

The procedures are used to prevent releases of concrete wastes (e.g., concrete grindings and cuttings, concrete washout) to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Slab repairs shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Protect drain inlets, watercourses and manholes from potential spills including concrete products and concrete waste.
- When using release agents (e.g., citrus, soy-based or diesel) for cleaning or coating equipment and tools, all products and by-products shall be captured and reused, recycled or properly disposed.
- Release agents shall not be discharged to the storm water drainage system or watercourses.
- Minimize airborne dust. Use water spray during grinding but minimize runoff.
- Minimize amount of water used to clean and cure concrete to prevent runoff.
- Do not stockpile sediment, concrete grindings and cuttings in or near storm water drainage system or watercourses.
- Vehicle and equipment washing is allowed only at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.
- Liquid waste and concrete washout should be collected in a container with a secure lid and transported to the Maintenance facility or decanting area for proper disposal. Concrete contractors are required to comply with Caltrans Standard Specifications, Section 7-1.01G Water Pollution.

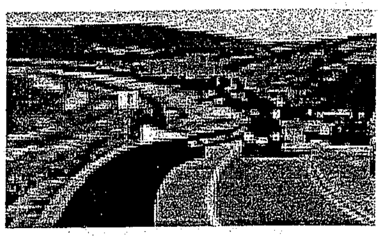
## Concrete Slab and Spall Repair

**OPERATIONAL PROCEDURES (CONT'D)**

- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# C FAMILY – SLOPE/DRAINS/VEGETATION

## Shoulder Grading



**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Aggregate
- Asphalt products
- Fuel
- Non-storm water
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Areas adjacent to surfaced and unsurfaced road shoulders require maintenance to prevent the loss of lateral support, to prevent the deterioration or failure of the road edge and to maintain roadside drainage patterns.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of sediment and equipment fluids to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Tarp imported fill material and other materials that may drift when transporting them to the work area in open-bed trucks. Do not overfill trucks.
- Protect drain inlets, watercourses and manholes from potential spills including sediment, aggregate and asphalt grindings.
- Compact unpaved shoulder as soon as possible after grading. Use water to aid compaction, but prevent runoff.
- Prevent runoff. Water applied during sweeping operations must be controlled to prevent unpermitted non-storm water discharges.
- Control dust and erosion in windy or wind-prone areas using covers, water or soil stabilizers.
- Preserve existing vegetation by defining the work area and following the existing contours. Replace any damaged vegetation outside the defined work area.
- Do not stockpile sediment, aggregate and asphalt grindings in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barriers during rainstorms.
- Vehicle and equipment washing is allowed only at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.

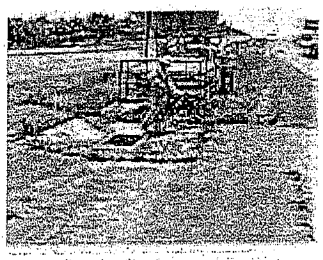
## Shoulder Grading

**OPERATIONAL PROCEDURES (CONT'D)**

- Prevent runoff. Sediment from equipment rinsing shall not discharge to the storm water drainage system or watercourses.
- Reuse of asphalt grindings shall be in accordance with the California Department of Fish and Game "Memorandum of Understanding on the Use of Asphalt (January 12, 1993)."
- Sweep up or vacuum sediment and excess asphalt. Keep asphalt grindings out of the storm water drainage system and watercourses. Incorporate back into the work area or properly dispose of all generated materials.

# C FAMILY – SLOPE/DRAINS/VEGETATION

## Nonlandscaped Chemical Vegetation Control



Minimize the use of herbicides.
Protect drain inlets and watercourses.

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Sediment
- Non-storm water
- Vehicle fluids
- Pesticides

**DEFINITION AND PURPOSE**

This method of vegetation control uses pesticides (e.g., herbicides, pre-emergents) to eliminate and prevent the growth of undesirable vegetation within the highway right-of-way. Chemical vegetation controls are used to protect preferred vegetation, to provide fire protection and to improve roadside appearance. The activity includes the operation of support equipment, mixing and loading chemicals and chemical application to native vegetation.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of pesticides, sediment and equipment fluids to storm water drainage system and watercourses.

**LIMITATIONS**

Vegetation management can result in reduced erosion control effectiveness. BMP implementation will depend on traffic, weather, available resources and safety conditions.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events that produce runoff unless required by emergency conditions.
- A licensed Agricultural Pest Control Adviser (PCA) should approve the activities.
- Identify drain inlets and watercourses, both upstream and downstream of the activity site. Protect the drain inlets, storm water drainage system and watercourses from discharges of potential pollutants.
- Mixing and loading into spray equipment should be in a containment area away from drain inlets and watercourses.
- Apply pesticides in compliance with federal, state and local pesticide use regulations as recommended by the District Annual Vegetation Control Plan. Apply pesticides only as specified on the "Pesticide Use Recommendation" on the label and as approved by the PCA.

## Nonlandscaped Chemical Vegetation Control

**OPERATIONAL PROCEDURES (CONT'D)**

- Minimize the use of pesticides in or near storm water drainage system or watercourses.
- Calibrate the spray rig to ensure accurate application of pesticides.
- Do not spray chemicals when rainfall-causing runoff is forecast within 12 hours.
- Water used for chemical mixing or in application must be controlled to prevent unpermitted non-storm water discharges.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.

# Nonlandscaped Mechanical Vegetation Control/Mowing

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Vegetation debris
- Non-storm water
- Vehicle fluids
- Sediment

**DEFINITION AND PURPOSE**

Mechanical vegetation control includes the removal of grass and weeds within the highway right-of-way using machinery and mobile equipment. The purpose is to control grass and weeds to improve roadside appearance and provide fire control.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of sediment and equipment fluids to storm water drainage system and watercourses.

**LIMITATIONS**

Vegetation management can result in reduced erosion control effectiveness. BMP implementation will depend on traffic, weather, available resources and safety conditions.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and watercourses from potential spills and vegetative debris.
- Do not fuel equipment near drain inlets or watercourses.
- Keep vegetation and clippings out of the storm water drainage system and watercourses. Solid waste should be disposed of properly.
- Prevent runoff. Sediment from equipment rinsing shall not be discharged to the storm water drainage system or watercourses. Rinse sediment in designated rinsing areas to prevent discharge to the storm water drainage system or watercourses.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area



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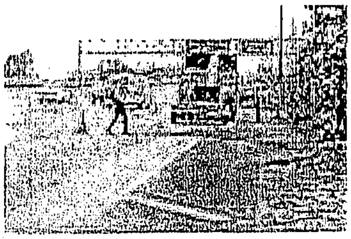
# Nonlandscaped Tree and Shrub Pruning, Brush Chipping, Tree and Shrub Removal



Vegetation debris is removed from pavement.

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Non-storm water
- Sawdust
- Sediment
- Vegetation debris
- Vehicle fluids
- Wood
- Wood mulch

**DEFINITION AND PURPOSE**

Trees and shrubs are pruned to preserve their health, remove dead branches, protect utilities, maintain sight distances, preserve aesthetics and prevent property damage.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of removed vegetation and equipment fluids to storm water drainage system and watercourses.

**LIMITATIONS**

Vegetation management can result in reduced erosion control effectiveness. BMP implementation will depend on traffic, weather, available resources and safety conditions.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and watercourses from potential spills and vegetative debris.
- Do not fuel equipment near drain inlets or watercourses.
- Keep vegetation debris, clippings and mulch out of the storm water drainage system and watercourses. Brush cuttings chipped into wood mulch should not be used at locations prone to washout.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.
- Prevent runoff. Sediment from equipment rinsing shall not be discharged to the storm water drainage system or watercourses.
- Do not stockpile prunings and clippings in or near storm water drainage system or watercourses.
- Brush cuttings that are not chipped should be transported to the maintenance facility for proper disposal.

# C FAMILY – SLOPE/DRAINS/VEGETATION

## Fence Repair

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Concrete
- Fuel
- Litter and debris
- Metal Debris
- Non-storm water
- Vehicle fluids

**DEFINITION AND PURPOSE**

Fences provide a physical barrier to control access and prevent crossing by vehicles or pedestrians. The three categories include freeway and right-of-way fences, property fences and median fences.

**APPROPRIATE APPLICATION**

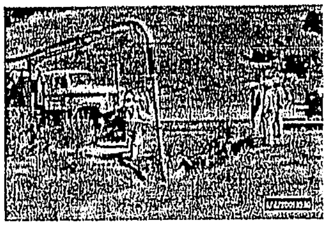
The following procedures are used to prevent releases of concrete, metal debris and equipment fluids to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and watercourses from potential spills.
- Stabilize the entrance/exits to the work area if necessary to avoid tracking mud or sediment on to public roads.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.
- Equipment and tools can be cleaned on a mud rinse pad at the Maintenance facility. If a washout needs to occur at the activity site, make sure all liquids are contained and disposed of properly.
- If concrete is used, do not allow concrete waste or slurry to enter storm water drainage system or watercourses. Liquid waste and concrete washout should be collected in a container with a secure lid and transported to the Maintenance facility to be reused, recycled or disposed of properly. Concrete contractors are required to comply with Caltrans Standard Specifications, Section 7-1.01G Water Pollution.
- Sweep and vacuum roadway. If working off-road, inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris and sediment onto public roadways.
- Solid waste should be collected and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# C FAMILY – SLOPE/DRAINS/VEGETATION

## Drainage Ditch and Channel Maintenance



| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Concrete | • Non-storm water |
| • Fuel | • Sediment |
| • Litter and debris | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Ditches and channels are maintained to avoid obstruction and maintain flow. Fill material may be imported to repair eroded channel walls.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of sediment and equipment fluids to storm water drainage system and watercourses.

**PRE-OPERATIONAL PROCEDURES**

- Before working on ditches and channels, determine what regulatory permits or approvals are required.
- Inspect ditches and channels for sufficient flow capacity and damage. Clean during the dry or low-flow season, if possible. If chemical contamination is suspected, stop work and notify the Supervisor for further instructions.

**OPERATIONAL PROCEDURES**

- Tarp loads before hauling to and from the site if necessary. Do not over-fill trucks.
- Stabilize the entrance/exists to the work area and the erodible ground surface adjacent to the ditch and channel using soil stabilization BMPs requiring protection as soon as possible after completing ditch and channel maintenance. Compact soil if re-vegetation is not desired.
- Minimize water quality degradation and maintain a sufficient water flow downstream to maintain aquatic life. Divert the water flow around the work area. Remove diversions when the maintenance activity is completed.
- When cleaning ditches and channels below cut slopes or steep slopes, avoid cutting the toe of the slope.
- Check dams may be used to restrict water flow. Remove the check dams and accumulated sediment when the activity is completed.
- Use drip pans and absorbents to contain equipment fluids such as fuels and hydraulic oils.
- Contain the water used, materials and soil generated during ditch and channel cleaning and manage as liquid or solid waste. Noncontaminated soil may be acceptable for reuse if approved.

# C FAMILY – SLOPE/DRAINS/VEGETATION

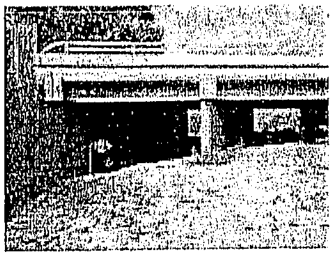
## Drainage Ditch and Channel Maintenance

**OPERATIONAL PROCEDURES (CONT'D)**

- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.
- Control dust and erosion in windy or wind-prone areas using covers, water or soil stabilizers.
- Do not stockpile sediment in or near the storm water drainage system or watercourses.
- The District Maintenance Storm Water Coordinator will provide written instructions for pre-approved decanting sites for liquid waste and the proper disposal site for contaminated soil.
- Vehicle and equipment washing is allowed only at District-designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.
- Liquid waste may be collected in a Vactor™ and transported to the Maintenance facility or decanting area for proper disposal.
- If working off-road, inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris and sediment onto public roadways.

# C FAMILY – SLOPE/DRAINS/VEGETATION

## Drain and Culvert Maintenance



**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Concrete
- Fuel
- Litter and debris
- Non-storm water
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

This activity includes the maintenance of under drains, horizontal drains, down drains, gutters, overside drains, scuppers and deck drains. Drains are maintained to prevent flooding and allow unobstructed flow.[1]

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of sediment and equipment fluids to storm water drainage system and watercourses.

**LIMITATIONS**

BMP implementation will depend on traffic, weather, available resources and safety conditions. Access to the storm water drainage system and worker safety may limit inspection and cleaning.

**PRE-OPERATIONAL PROCEDURES**

- Before working on drain and culvert maintenance, determine what regulatory permits or approvals are required.
- Inspect drains and culverts for sufficient flow capacity and damage. Clean during the dry or low-flow season, if possible. If chemical contamination is suspected, stop work and notify the Supervisor for further instructions.

**OPERATIONAL PROCEDURES**

- Keep the gearbox of equipment above water when equipment is in a water body.
- Construct a barrier to intercept sediment from discharging into storm water drainage system or watercourses. Remove the barriers when the maintenance activity is completed.
- Stabilize the entrance/exits to the work area as necessary to avoid tracking mud or sediments onto public roadways.

[1] An annual storm drain inlet inspection and cleaning program is implemented in the metropolitan areas of San Diego, Orange, Los Angeles and Ventura Counties mandated by court order. These areas follow the Enhanced Storm Drain Inlet Inspection and Cleaning Program BMP.

## Drain and Culvert Maintenance

**OPERATIONAL PROCEDURES (CONT'D)**

- Use the minimum amount of water to clear drains and culverts. Water applied during cleaning operations must be controlled to prevent unpermitted non-storm water discharges.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.
- Stabilize ground surfaces that require erosion protection as soon as possible after completing drain and culvert maintenance. Compact soil if revegetation is not desired.
- Do not stockpile sediment in or near the storm water drainage system or watercourses.
- Vehicle and equipment washing is allowed only at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.
- Contain the water used and materials generated during drain and culvert cleaning and managed as liquid or solid waste. The District Supervisor and District Maintenance Storm Water Coordinator or Manager will provide written instruction for pre-approved decanting sites for liquid waste and the proper disposal site for contaminated soil.
- If working off-road, inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris, and sediment onto public roadways.
- Liquid waste may be collected in a Vactor™ and transported back to the Maintenance facility or decanting area for proper disposal.

## Curb and Sidewalk Repair

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Concrete
- Fuel
- Litter and debris
- Non-storm water
- Sediment
- Slurry
- Vehicle fluids

**DEFINITION AND PURPOSE**

This activity includes repairs made to concrete curbs and sidewalks for the traveling motorists and pedestrians.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of sediment, concrete materials and equipment fluids to storm water drainages system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Protect drain inlets, watercourses and manholes from potential spills including sediment, aggregate, grindings, concrete products and concrete waste.
- Release agents shall not be discharged to the storm water drainage system or watercourses.
- Minimize amount of water used to clean and cure concrete to prevent runoff.
- Minimize airborne dust. Use water spray during grinding but minimize runoff.
- Do not stockpile sediment or concrete rubble in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barriers during rainstorms.
- Vehicle and equipment washing is only allowed at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.
- Liquid waste and concrete washout should be collected in a container with a secure lid and transported to the Maintenance facility or decanting area for proper disposal. Concrete contractors are required to comply with Caltrans Standard Specifications, Section 7-1.01G Water Pollution.

## Curb and Sidewalk Repair

**OPERATIONAL PROCEDURES (CONT'D)**

- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# Sweeping Operations

| **Environmental Concerns** | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Sediment |
| • Litter and debris | • Vehicle fluids |
| • Non-storm water | |

**DEFINITION AND PURPOSE**

Sweeping operations remove litter and debris from the traveled way and shoulder to prevent the collection of materials in drain inlets, reduce the sediment loading of culverts, reduce traffic hazards and improve aesthetics.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of sediment and equipment fluids to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Do not load hoppers beyond their capacity.
- Adjust brooms frequently for maximum efficiency.
- Do not discharge fluids from sweeping operation to storm water drainage system or watercourses.
- Prevent runoff. Sediment from equipment rinsing shall not be discharged to the storm water drainage system or watercourses. Rinse sediment in designated rinsing areas to prevent discharge to the storm water drainage system or watercourses.
- Do not sweep any unknown substances that may be potentially hazardous.
- Before deadheading the sweeper, stow gutter brooms, but keep the pickup broom down for approximately 150 feet. Lift the pickup broom, and to the maximum extent possible, clear the sweeper's brooms and elevators before merging onto the public roadway or highway.
- Do not stockpile sediment in or near storm drainage system or watercourses. Protect stockpiles with a cover or sediment barriers during rainstorms.
- Sweeper waste should be transported back to the Maintenance facility or temporary pre-designated location to be reused, recycled or disposed of properly.

# D FAMILY – LITTER/DEBRIS/GRAFFITI

## Litter and Debris Removal

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Sediment |
| • Litter and debris | • Vehicle fluids |
| • Non-storm water | |

**DEFINITION AND PURPOSE**

Litter and debris are periodically collected from the Department's rights-of-way and removed from drainage grates, trash racks and ditch lines.

**APPROPRIATE APPLICATION**

The following procedures are used where litter and debris may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Tarp or secure materials transported in open-bed trucks to and from the work area to prevent spillage to the roadway. Do not overfill truck.
- Supervisors should observe the overall condition of their assigned sections and assess the need for litter removal and installation of anti-litter signs.
- Pick up litter as needed or at the assigned frequencies.
- Remove litter and debris from drainage grates, trash racks and ditch lines that have the potential to reduce flows in storm water drainage systems.
- Litter and debris should be removed using dry techniques.
- Solid waste should be put into bags or buckets and secured for transport to the Maintenance facility to be reused, recycled or disposed of properly.
- Do not pick up or handle unmarked containers that may have contaminated materials inside.
- Inspect and replace unreadable anti-litter signs.

# D FAMILY – LITTER/DEBRIS/GRAFFITI

## Emergency Response and Cleanup Practices

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Debris
- Fuel
- Materials
- Non-storm water
- Sediment
- Unknown materials
- Vehicle fluids

**DEFINITION AND PURPOSE**

After proper identification and hazard assessment, emergency response and cleanup includes the isolation, containment, removal and disposal of spilled substances on highway rights-of-way. Proper containment and clean-up of spilled material, will reduce the discharge of potential pollutants to the storm water drainage system and watercourses.

**APPROPRIATE APPLICATION**

The following procedures are used where hazardous substances may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**LIMITATIONS**

The BMPs presented for this activity only provide operating methods or measures for the purpose of storm water pollution prevention. The applicable local, state and federal hazardous materials, hazardous waste and employee safety requirements are not present. All emergency response and cleanup practices must comply with the requirements of Chapter D5 of the Maintenance Manual, Volume 1.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and manholes from receiving waste from spills, if it can be done safely.
- Stabilize the entrance/exits to the work area if necessary to avoid tracking mud or sediment on to public roadways.
- Water used for cleaning and non-emergency decontamination shall not be allowed to enter storm water drainage system or watercourses. However, first responders should undertake any necessary emergency actions to save lives and protect the public and themselves.
- Do not track spilled material. Without compromising safety or cleanup efforts, protect spilled material from storm water run-on during rainfall or trackout from motorists.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.

## Emergency Response and Cleanup Practices

**OPERATIONAL PROCEDURES (CONT'D)**

- Avoid stockpiling contaminated soils or hazardous material. If temporary stockpiling is unavoidable, do not stockpile in or near storm water drainage system or watercourses.
- If working off-road, inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris and sediment onto public roadways.
- Coordinate removal of the solid, liquid and hazardous waste with the District Hazardous Materials Coordinator or Manager.

## Graffiti Removal

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Graffiti removal products
- Grit
- Non-storm water
- Paint
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Graffiti is removed or painted over. The primary activities are the operation of support equipment, paint removal (may include hydroblasting, sandblasting, soda blasting or washing with graffiti removal products) and painting.

**APPROPRIATE APPLICATION**

The following procedures are used where paint, grit and non-storm water may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events.
- Secure paint while transporting to avoid spills.
- Refer to H Family activity when sandblasting or hydroblasting.
- Protect drain inlets and watercourses from potential spills.
- Tarps and similar control measures should be used to prevent spills or material drift from being deposited into storm water drainage system or watercourses.
- Only headquarters pre-approved graffiti removal products should be used.
- Mix paint indoors or in a containment area away from drain inlets.
- Water used for cleaning and decontamination shall not be allowed to enter storm water drainage system or watercourses.
- Waste from cleaning paint equipment or brushes should be collected and put into a bucket or drum with a secure lid for transport back to the maintenance facility to be reused, recycled or disposed of properly. Paint waste, especially if it is oil based or contains paint thinner, would need approval from the publicly owned treatment works to dispose of in sewer.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport back to the Maintenance facility to be reused, recycled or disposed of properly.

# E FAMILY – LANDSCAPING

## Chemical Vegetation Control

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Sediment
- Non-storm water
- Vehicle fluids
- Pesticides

**DEFINITION AND PURPOSE**

This method of vegetation control uses pesticides (e.g., herbicides, pre-emergents) to eliminate and prevent the growth of undesirable vegetation within the highway right-of-way. Chemical vegetation controls are used to protect preferred vegetation, to maintain unobstructed views of the road edge and traffic safety devices, to provide fire protection and to improve roadside appearance. The activity includes the operation of support equipment, mixing and loading chemicals and chemical application to native vegetation.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of pesticides, sediment and equipment fluids to storm water drainage system and watercourses.

**LIMITATIONS**

Vegetation management can result in reduced erosion control effectiveness. BMP implementation will depend on traffic, weather, available resources and safety conditions.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events that produce runoff unless required by emergency conditions.
- A licensed Agricultural Pest Control Adviser (PCA) should approve the activities.
- Identify drain inlets and watercourses, both upstream and downstream of the activity site. Protect the drain inlets, storm water drainage system and watercourses from discharges of potential pollutants.
- Mixing and loading into spray equipment should be in a containment area away from drain inlets and watercourses.
- Apply pesticides in compliance with federal, state and local pesticide use regulations as recommended by the District Annual Vegetation Control Plan. Apply pesticides only as specified on the "Pesticide Use Recommendation" on the label and as approved by the PCA.

## Chemical Vegetation Control

**OPERATIONAL PROCEDURES (CONT'D)**

- Minimize the use of pesticides in or near storm water drainage system or watercourses.
- Calibrate the spray rig to ensure accurate application of pesticides.
- Do not spray chemicals when rainfall causing runoff is forecast within 12 hours.
- Water used for chemical mixing or in application must be controlled to prevent unpermitted non-storm water discharges.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.
- Avoid using overhead irrigation for as long as the chemical manufacturer recommends after applying pesticides.

# E FAMILY – LANDSCAPING

## Manual Vegetation Control

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Vegetation debris |
| • Non-storm water | • Vehicle fluids |
| • Sediment | |

**DEFINITION AND PURPOSE**

Manual vegetation control is the use of handheld equipment (some equipment may be gas-powered) to control grass and weeds within the highway right-of-way. Manual vegetation controls are used to protect existing vegetation, to maintain unobstructed views of the road edge and traffic safety devices, to provide fire protection, and to improve roadside appearance.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of debris and equipment fluids to storm water drainage system and watercourses.

**LIMITATIONS**

Vegetation management can result in reduced erosion control effectiveness. BMP implementation will depend on traffic, weather, available resources and safety conditions.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and watercourses from potential spills and vegetative debris.
- Do not fuel equipment near drain inlets or watercourses.
- Keep vegetation and clippings out of the storm water drainage system and watercourses. Solid waste should be disposed of properly.
- Prevent runoff. Sediment from equipment rinsing shall not be discharged to the storm water drainage system or watercourses. Rinse sediment in designated rinsing areas to prevent discharge to the storm water drainage system.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.

# E FAMILY – LANDSCAPING

## Landscaped Mechanical Vegetation Control/Mowing

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Non-storm water
- Sediment
- Vegetation debris
- Vehicle fluids

**DEFINITION AND PURPOSE**

Mechanical vegetation control includes removal of grasses and weeds within the highway right-of-way using machinery and mobile equipment. Mechanical vegetation controls are used to protect preferred vegetation, to maintain unobstructed views of the road edge and traffic safety devices, to provide fire protection and to improve roadside appearance.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of clippings, sediment and equipment fluids to storm water drainage system and watercourses.

**LIMITATIONS**

Vegetation management can result in reduced erosion control effectiveness. BMP implementation will depend on traffic, weather, available resources and safety conditions.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and watercourses from potential spills and vegetative debris.
- Do not fuel equipment near drain inlets or watercourses.
- Keep vegetation and clippings out of the storm water drainage system and watercourses. Solid waste should be disposed of properly.
- Prevent runoff. Sediment from equipment rinsing shall not be discharged to the storm water drainage system or watercourses. Rinse sediment in designated rinsing areas to prevent discharge to the storm water drainage system.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.

# E FAMILY – LANDSCAPING

## Landscaped Tree and Shrub Pruning, Brush Chipping, Tree and Shrub Removal

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Non-storm water
- Sawdust
- Sediment
- Vegetation debris
- Vehicle fluids
- Wood
- Wood mulch

**DEFINITION AND PURPOSE**

Trees and shrubs of planted landscape vegetation along the highway right-of-way are pruned to preserve their health, remove dead branches, protect utilities, maintain sight distances, preserve aesthetics and prevent property damage. The wood is chipped with mechanical chippers to facilitate the removal of tree and shrub limbs from the roadside. Chipped material can be used as mulch. Dead or diseased trees and shrubs may be removed to protect public safety.

**APPROPRIATE APPLICATION**

The following procedures are used to prevent releases of removed vegetation and equipment fluids to storm water drainage system and watercourses.

**LIMITATIONS**

Vegetation management can result in reduced erosion control effectiveness. BMP implementation will depend on traffic, weather, available resources and safety conditions.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and watercourses from potential spills and vegetative debris.
- Do not fuel equipment near drain inlets or watercourses.
- Keep vegetation debris, clippings and mulch out of the storm water drainage system and watercourses. Brush cuttings chipped into wood mulch should not be used at locations prone to washout.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.
- Prevent runoff. Sediment from equipment rinsing shall not be discharged to the storm water drainage system or watercourses.
- Do not stockpile prunings and clippings in or near storm water drainage system or watercourses.
- Brush cuttings that are not chipped should be transported to the maintenance facility for proper disposal.

# E FAMILY – LANDSCAPING

## Irrigation Line Repairs

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Debris | • PVC glue |
| • Fuel | • Sand |
| • Non-storm water | • Sediment |
| • Primer | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Irrigation line repairs include maintenance (water line flushing) and repair activities on broken water lines, sprinklers and valves.[1]

**APPROPRIATE APPLICATION**

The following procedures are used where debris and irrigation materials may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Tarp imported fill material transported in open-bed trucks to the work area. Do not overfill trucks.
- Shut off the water source to isolate a broken line, sprinkler or valve as soon as possible to minimize the loss of water.
- Protect downstream storm water drainage system and watercourse from water pumped or bailed from trenches excavated to repair water lines.
- Protect drain inlets and watercourses from potential spills and debris.
- Do not fuel equipment near drain inlets or watercourses.
- When possible, water used to flush the line should be applied to the landscape.
- Manage irrigation systems to ensure the appropriate amount of water is used and runoff is minimized.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.
- Stabilize the erodible ground surface that require protection as soon as possible after completing repairs. Compact soil or apply wood mulch if revegetation is not desired.
- Sweep or vacuum site and inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris and sediment from the site. Properly dispose of all solid waste.

[1] Irrigation water and landscape irrigation are conditionally exempt discharges if appropriate control measures are developed and implemented under the SWMP.

# E FAMILY – LANDSCAPING

## Irrigation (Watering), Potable and Nonpotable

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Sediment |
| • Non-storm water | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Irrigation or watering activities are performed using potable and non-potable water.[1]

**APPROPRIATE APPLICATION**

The following procedures are used where equipment fluids may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Frequently inspect and repair broken water lines.
- Protect drain inlets and watercourses from potential spills and debris.
- Do not fuel equipment near drain inlets or watercourses.
- When possible, water used to flush the line should be applied to the landscape.
- Avoid overwatering. Manage irrigation systems to ensure the appropriate amount of water is used and runoff is minimized.
- Minimize disturbance of existing vegetation.

[1] Irrigation water and landscape irrigation are conditionally exempt discharges if appropriate control measures are developed and implemented under the SWMP.

# F FAMILY – ENVIRONMENTAL

## Storm Drain Stenciling

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Sediment |
| • Non-storm water | • Trash |
| • Paint | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Stencils are applied to facility storm drain inlets in areas with pedestrian use for communities with over 10,000 residents or in smaller communities with MS4 permits.

**APPROPRIATE APPLICATION**

The following procedures are used where storm drain stenciling may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Protect drains, watercourses and manholes from potential spills and stenciling products.
- Non-storm water discharges to drainage paths, drainage systems and watercourses are prohibited.
- Verify that spill control cleanup materials are located in the unloading and use areas.
- Avoid sweeping sediment into drain inlets.
- The use of safer alternative products may still be harmful if discharged to drainage paths, storm water drainage system or watercourses. Use safer alternative products in accordance with manufacturer recommendations.
- Mixing of paint and loading of equipment should be away from drain inlets.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# F FAMILY – ENVIRONMENTAL

## Roadside Slope Inspection

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Sediment
- Non-storm water
- Vehicle fluids

**DEFINITION AND PURPOSE**

Roadside vegetated slopes are periodically inspected to determine the need for erosion control measures.

**APPROPRIATE APPLICATION**

The following procedures are used to identify potential pollutant sources to storm water runoff or discharge to storm water drainage systems and watercourses during roadside slope inspection.

**OPERATIONAL PROCEDURES**

- Inspect slopes for erosion on a five-year cycle. Slopes with recurring problems should be inspected on an as-needed basis.
- District Maintenance staff will conduct initial inspections of roadside vegetated slope erosion and prepare an evaluation report on an approved inspection form (Preliminary Maintenance Slope Inspection Form [CT-Maint-NPDES-005]) for each slope inspected.
- Minor erosion repairs and stabilization, as determined by existing Department Division of Maintenance policy, may be completed by District Maintenance crews.
- When complex roadside vegetated slope erosion problems are identified, a District multi-disciplinary review team will consider solutions and may recommend the needed corrective action as a future project for the State Highway Operation and Protection Program (SHOPP).
- Record the inspection findings and repairs.

# F FAMILY – ENVIRONMENTAL

## Roadside Stabilization

| **Environmental Concerns** | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Binders | • Non-storm water |
| • Fertilizer | • Sediment |
| • Fiber | • Seed |
| • Fuel | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Roadside stabilization refers to the erosion control and/or soil stabilization practices on slopes within the highway right-of-way.

**APPROPRIATE APPLICATION**

The following procedures are used where roadside stabilization material may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Inspect roadside slopes for erosion on a five-year cycle. Areas with recurring problems should be inspected on an as-needed basis.
- Tarp imported fill material and other roadside stabilization materials with drift potential when transporting them to the work area in open bed trucks. Do not overfill trucks.
- Protect drain inlets and watercourses from potential spills including roadside stabilization materials.
- Stabilize the entrance/exits to the work area, if necessary, to avoid tracking mud or sediments on to public roadways.
- Do not stockpile sediment or material in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barrier during rainstorms.
- Check dams are used in the work area receiving concentrated flow. Sediment buildup should be removed before reaching 1/3 the height of check dam. Remove the check dams when the maintenance activity is completed.
- Install sediment barriers around the toe of the slope, downslope and around the slope and stockpiles to allow sediment to settle before any runoff leaves the work area. Sediment can be controlled with silt fences, sandbags or gravel bags, straw bales and fiber rolls.
- Hydromulch, hydroseed/handseed or straw mulch the erodible ground surface requiring protection as soon as possible after completing stabilization work. Contact the District Landscape Specialist, District Erosion Control Specialist or Landscape Architect for the appropriate application rates.

## Roadside Stabilization

**SEDIMENT CONTROL (CONT'D)**

- Silt fences should be constructed with a setback of at least 1 meter beyond the toe of a slope, if possible. Remove sediment prior to accumulation reaching one-third of the fence height. Incorporate removed sediment into the maintenance activity site if possible. Remove the silt fence when it is no longer needed.
- Fiber rolls are not used for high water flows. Fiber rolls that are used to reduce slope length should be placed in a shallow trench on a level contour and staked securely. Fiber rolls may be left at the site to biodegrade.
- Inspect and repair silt fence, sandbags, gravel bags, straw bale barriers or fiber rolls to ensure the sediment barrier(s) is functioning properly.
- Preserve existing vegetation by defining the work area and replacing the damaged vegetation outside the defined work area.
- Control dust and erosion in windy or wind-prone areas using covers, water or soil stabilizers.
- Use appropriate amount of water so that runoff and erosion is minimized.
- Compact soil if revegetation is not desired. Consider applying wood mulch. Contact the District Landscape Specialist, District Erosion Control Specialist or Landscape Architect for the appropriate application rate.
- Sweep or vacuum excess over spray of binders, fertilizers fiber and seed on hardscape. Incorporate the materials into the maintenance activity area.
- Sweep and vacuum site and inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris, and sediment from the site. Recycle or dispose of material properly.

# F FAMILY – ENVIRONMENTAL

## Storm Water Treatment Devices

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Sediment |
| • Non-storm water | • Trash |
| • Oil | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Storm water treatment devices are measures or structures installed primarily to reduce storm water pollutants and improve water quality. The devices include vegetated treatment systems, infiltration basins and detention devices.

**APPROPRIATE APPLICATION**

Storm water treatment devices are planned, designed and installed through the Caltrans new construction, major reconstruction and retrofit project delivery process where a storm drain system discharges directly or indirectly to surface water. The devices are maintained in accordance with the procedures specified in the Storm Water Quality Practice Guidelines.

**OPERATIONAL PROCEDURES**

- Limit the entrance/exit points to the activity site and stabilized against erosion.
- Avoid stockpiling contaminated soil or sediment and dispose of properly.
- If clean sediment cannot be recycled, transport the material back to the Maintenance facility or an approved storage site.
- Remove gravel and sediment from tires before reentering the highway.
- See operation and maintenance procedures in Vegetated Treatment Systems (Biofiltration Swales and Strips) BMP.
- See operation and maintenance procedures in Detention Device BMP.
- See operation and maintenance procedures in Infiltration Basins BMP.

# F FAMILY – ENVIRONMENTAL

## Traction Sand Trap Devices

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Sediment |
| • Oil | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Storm water treatment devices are structures installed primarily to reduce storm water pollutants and improve water quality. The devices include vegetated treatment systems, infiltration basins, detention devices and traction sand traps. Sand trap devices are maintained as effective devices for treating runoff discharges.

**APPROPRIATE APPLICATION**

Storm water treatment devices are planned, designed and installed through the Caltrans new construction, major reconstruction and retrofit project delivery process where a storm drain system discharges directly or indirectly to surface water. The devices are maintained in accordance with the procedures specified in the Guidelines.

**OPERATIONAL PROCEDURES**

- Inspect annually and after significant storms. Remove accumulated sediment if sediment exceeds design capacity.
- Inspect 72 hours after one significant storm per year and drain facility, if possible. If standing water cannot be removed then notify vector control authority (mosquito abatement). Notify engineer to consider removing sediment to restore infiltration capacity. If infiltration rate is unacceptable or unable to implement alternative solution then decommission sand trap device.
- Inspect semi-annually for general maintenance including inlet/outlet structural integrity, damaged structures, graffiti or vandalism, etc.
- Protect drain inlets and watercourses from potential spills and debris.
- Avoid stockpiling contaminated soil or sediment and dispose of properly.
- If clean sediment cannot be recycled, transport the material back to the Maintenance facility or approved storage site.

# G FAMILY – PUBLIC FACILITIES

## Public Facilities

**Environmental Concerns**
Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Litter
- Non-storm water
- Paint
- Pesticides
- Sand blast grit
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Public facilities include safety roadside rest areas, weigh stations, park-and-ride lots and vista points. The degree of maintenance includes a range of custodial responsibilities that may include restrooms, fountains, picnic areas, and other public facilities. Maintenance of appurtenances such as roadway surfacing, signs, pavement markings, buildings, landscaping and electrical installations are also considered under this category.

**APPROPRIATE APPLICATION**

The following procedures are used where maintenance of public facilities may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Secure or cover transported materials, equipment and supplies to and from public facilities to prevent spillage to the roadway.
- Keep the storage areas clean, well organized, and stocked with spill cleanup supplies.
- Inspect and replace unreadable anti-litter signs and storm drain stenciling at public facilities.
- Protect drain inlets and watercourses from potential spills.
- Do not fuel equipment near drain inlets or watercourses.
- Preserve existing vegetation by defining the work area and replace the damaged vegetation outside the defined work area.
- Avoid overwatering. Ensure irrigation controllers are programmed to minimize runoff.
- When using chemicals for cleaning, consider safer alternative products where practical and effective.
- Used spill cleanup materials, contaminated materials and recovered spill material that are not reusable shall be disposed of properly. Do not pick up any unknown items or materials that may be potentially hazardous. Notify the District Supervisor.

## Public Facilities

**OPERATIONAL PROCEDURES (CONT'D)**

- Liquid waste and concrete washout should be collected in a container with a secure lid and transported back to the Maintenance facility for proper disposal. Concrete contractors are required to comply with Caltrans Standard Specifications 7-1.01G Water Pollution.
- Solid waste should be stored away from storm water drainage system and watercourses.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport back to the Maintenance facility to be reused, recycled or disposed of properly.

## Welding and Grinding

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Debris | • Non-storm water |
| • Fuel | • Paint |
| • Grit | • Sediment |
| • Lead contaminated materials | • Solder |
| • Metal grindings | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Welding and grinding is performed on bridges to repair damaged or deteriorating components, but has been expanded to also include roads and individual service facilities.

**APPROPRIATE APPLICATION**

The following procedures are used where welding and grinding work may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**LIMITATIONS**

The BMPs for this activity provide operating methods or measures only for the purpose of storm water pollution prevention. The applicable local, state and federal hazardous materials, employee safety and fire prevention requirements are not presented.

Although not a BMP, it is important that only properly trained employees with the appropriate personal protection equipment shall conduct work on bridges containing lead-based paint.

**OPERATIONAL PROCEDURES**

- Secure all equipment and tools. Prevent foreign objects from being dropped into the watercourse or bay.
- Use appropriate containment when welding over the side of a bridge to capture slag and metal grindings.
- For welding work over a storm drain inlet, protect the drain inlet to prevent grindings and debris from entering the storm water drainage system or watercourses.
- For welding work on the deck services or expansion plates, use maintenance traveler or wing staging to capture grindings and debris.
- Remove all slag and debris from the deck or other work sites when the job is completed.

## Welding and Grinding

**OPERATIONAL PROCEDURES (CONT'D)**

- Use an appropriate container to collect slag, excess materials and solid waste and transport to the Maintenance facility for reuse, recycling or proper disposal.

# Sandblasting, Wet Blast with Sand Injection and Hydroblasting

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Grit
- Lead contaminated materials
- Non-storm water
- Paint
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

This activity involves the removal of graffiti and is used to clean concrete walls and structural steel. Subtasks include the operation of support vehicles and equipment and the blasting operations.

**APPROPRIATE APPLICATION**

The following procedures are used where blasting grit and paint may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**LIMITATIONS**

The BMPs presented for this activity provide operating methods or measures only for the purpose of storm water pollution prevention. The applicable local, state and federal hazardous materials, employee safety and fire prevention requirements are not presented.

Although not a BMP, it is important that only properly trained employees with the appropriate personal protection equipment shall conduct work on bridges containing lead-based paint.

**OPERATIONAL PROCEDURES**

- Secure all equipment and tools. Prevent foreign objects from being dropped into the watercourses or bay.
- Protect drain inlets and watercourses from potential spills and debris.
- If chemicals are used for cleaning, consider safer alternative products where practical and effective.
- Evaluate the possibility of using a hydroblaster to complete work.
- While performing hydroblasting using a permanent traveler, use control measures to prevent solid and liquid spills or materials from entering the watercourses.

## Sandblasting, Wet Blast with Sand Injection and

**OPERATIONAL PROCEDURES (CONT'D)**

- Use minimum amount of sand necessary when sandblasting.
- Avoid excess use of water to minimize runoff.
- Use approved removal and disposal procedures when sand blasting to remove lead-based paint.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility for proper disposal.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# H FAMILY – BRIDGES

## Painting

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Paint |
| • Non-storm water | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Painting operations apply to the painting of bridge surfaces, but have also been expanded to include painting of facilities and highway structures. Routine maintenance of painting equipment is also included in this activity.

**APPROPRIATE APPLICATION**

The following procedures are used where paint may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events, unless required by emergency conditions.
- Make sure paint containers are secure during transport to prevent spillage to the roadway.
- Mix paint indoor away from drain inlets or in a containment area. Load the paint spray equipment at the Maintenance facility.
- Protect drain inlets and watercourses from potential spills including painting products.
- Monitor weather and wind when using spray equipment.
- Use tarps or canvas under work area to capture excess paint or paint chips. Tarps and other control measures should be used to prevent spills or material drift to watercourse (e.g., during bridge maintenance). Transfer material captured into a waste container for proper disposal at a Maintenance facility.
- Do not remove original product label from paint or other hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Collect all paint equipment wash water and return it to a Maintenance facility for proper disposal.

# H FAMILY – BRIDGES

## Bridge Repairs

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Concrete | • Tools, equipment or parts |
| • Debris | • Unused material |
| • Fuel | • Vehicle fluids |
| • Non-storm water | |

**DEFINITION AND PURPOSE**

Bridge maintenance activities include repairing bent or damaged steel beams, cracked or spalled concrete, damaged expansion joints and bent or damaged railings.

**APPROPRIATE APPLICATION**

The following procedures are used where materials released from the bridge repairs may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- When working over watercourses, stage the operation to capture and collect all debris, leaks and spills.
- Vehicle and equipment washing is allowed only at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility for proper disposal.
- Collect broken or damaged treated bridge pier fender posts. Solid waste should be collected by vacuum or sweeping and put into bags or buckets and secured for transport to the Maintenance facility to be reused, recycled or disposed of properly.
- See Activity Cut-Sheet Structural Pavement Failure (Digouts) Pavement Grinding and Paving.
- See Activity Cut-Sheet Concrete Slab and Spall Repair.
- See Activity Cut-Sheet Welding and Grinding, if applicable.

# Draw Bridge Maintenance

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Vehicle fluids
- Non-storm water

**DEFINITION AND PURPOSE**

Drawbridge maintenance activities include maintaining mechanical and electrical equipment, removing debris and drift and removing debris from sumps.

**APPROPRIATE APPLICATION**

The following procedures are used where bridge maintenance may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Secure all equipment and tools. Prevent foreign objects from being dropped into the watercourses.
- When working over watercourses, stage the operation to capture and collect all debris, leaks or spills as possible.
- Tarps and similar control measures should be used to prevent spills or capture material drift into watercourses.
- Use drip pans under equipment with grease fittings to capture excess grease. Dispose of waste properly.
- Do not remove original product label from paint or hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Clean-up excess grease after greasing fittings by wiping down equipment, fittings and metal surfaces. Use the minimum amount of materials necessary to complete the job.
- Clean area by sweeping or vacuuming. Do not hose down.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility for proper disposal.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# J FAMILY – OTHER STRUCTURES

## Pump Station Cleaning

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Sediment
- Litter and debris
- Vehicle fluids
- Non-storm water

**DEFINITION AND PURPOSE**

Pump stations are used to dewater depressed highway sections where water routinely collects. Maintenance work includes structural repairs, removal of material from sumps, and periodic servicing or repairs of electrical and mechanical equipment.

**APPROPRIATE APPLICATION**

Periodic pump station inspection and cleaning will reduce the discharge of potential pollutants to the storm water drainage system or watercourses.

**LIMITATIONS**

The BMPs for this activity only provide operating methods or measures for the purpose of storm water pollution prevention. The applicable local, state and federal hazardous materials and employee safety requirements are not presented.

Although not a BMP, it is important that work in confined space shall be conducted only by properly trained employees who use appropriate personal protection equipment.

**OPERATIONAL PROCEDURES**

- Protect drains and watercourses from potential spills.
- Stabilize the entrance/exits to the work area with soil stabilizers as necessary.
- Inspect pump stations routinely, per District policy, during the rainy season and off-season. Inspect screen to ensure it is free of debris. Remove solids in the sumps routinely to prevent damage to pumps. Inspect and clean pump outfall facilities, when possible, to ensure a free flow of water beyond the pumping station.
- During maintenance and repair of pump station, remove all waste oil and put into buckets or drums with a secure lid for transport back to the maintenance facility to be reused, recycled or disposed of properly.
- Avoid use of excess water during cleaning to minimize waste and runoff.

## Pump Station Cleaning

**OPERATIONAL PROCEDURES (CONT'D)**

- Contaminated water used for cleaning and decontamination shall not be allowed to enter storm water drainage system or watercourses.
- Dispose of liquid waste collected in the Vactor™ trucks in an approved method.
- The District Supervisor and District Maintenance Storm Water Coordinator or Manager will provide written instruction for pre-approved decanting sites for liquid waste and the proper disposal site for contaminated soil.
- Sweep and vacuum site and inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris, and sediment from the site. Recycle or dispose of material properly.
- Do not stockpile sediment in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barrier during rainstorms.

# J FAMILY – OTHER STRUCTURES

## Tube and Tunnel Maintenance and Repair

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Cement
- Cleaning agents
- Fuel
- Grout
- Litter and debris
- Non-storm water
- Paint
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Maintenance of tunnels and tubes involves removing dirt and debris from the tunnel and repairing the pavement and walls.

**APPROPRIATE APPLICATION**

Tunnel and tube washing and maintenance reduces the accumulation of dirt, debris, and potential pollutants in these passageways, preserves capital investment and improves aesthetics.

**OPERATIONAL PROCEDURES**

- Sweep tunnel prior to conducting wash operations and properly dispose of swept material.
- Protect drain inlets prior to using cleaning agents and paints.
- Mix paint indoors or in a containment area. Do not clean paint brushes or rinse paint containers into drains or watercourses.
- Prevent cement, grout, concrete waste and non-storm water discharges from entering drains and watercourses. Concrete contractors are required to comply with Caltrans Standard Specifications, Section 7-1.01G Water Pollution.
- If chemicals are used for cleaning, consider safer alternative products where practical and effective.
- Do not remove original product label from paint or hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Avoid excess use of water to minimize waste and runoff.
- Properly dispose of wastewater and debris. If acceptable to local sewer agency, dispose of wash water to the sanitary sewer system or the liquid waste should be collected and transported to the Maintenance facility for proper disposal.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# J FAMILY – OTHER STRUCTURES

## Ferryboat Operations

| Environmental Concerns |
|---|
| Discharge of the following materials into the storm water drainage system or watercourse: |
| • Fuel • Toxic materials |
| • Litter • Vehicle fluids |
| • Non-storm water |

**DEFINITION AND PURPOSE** Ferryboats conveying vehicles and the public are maintained jointly by Maintenance and the Equipment Service Center.

**APPROPRIATE APPLICATION** The following procedures are used where ferry operations may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Perform a thorough pre-operational check to observe any equipment that could fail during ferry operation.
- Contain any leaks onboard by closing cofferdam drains and securing fuel and oil emergency shutoff valves.
- Carry spill clean up material. Clean spills immediately and dispose of waste properly.
- Check refueling equipment and hoses before use. Monitor refueling operation closely and cease operation immediately if a leak develops.
- Do not discharge wash water or waste water to the water channel.
- Notify U.S. Coast Guard of any spills in the watercourses.

# J FAMILY – OTHER STRUCTURES

## Tow Truck Operations

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Plastics |
| • Glass | • Rubber |
| • Metal fragments | • Sediment |
| • Non-storm water | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Tow truck operations involve the removal of vehicles from Caltrans' rights-of-way.

**APPROPRIATE APPLICATION**

Potential pollution is possible from spills of vehicle parts and fluids from vehicle accidents and servicing of vehicles.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and watercourses when necessary to prevent contaminants from entering drainage inlets.
- Clean up fluids or parts that are spilled onto the roadway from an accident site before leaving the scene.
- Use absorbent pads to soak up vehicle fluids, then sweep the area thoroughly to remove all loose debris and eliminate material and residue from entering drainage inlets.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility for proper disposal.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.
- Also see Activity Cut-Sheet, D Family - Emergency Response and Cleanup Practices.

# Toll Booth Lane Scrubbing Operations

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Cleaning agents
- Process water
- Non-storm water
- Sediment

**DEFINITION AND PURPOSE**

Lane scrubbing operations reduce the accumulation of dirt and oily buildup from vehicles. Lane scrubbing is implemented only near toll plazas.

**APPROPRIATE APPLICATION**

The following procedures are used where lane scrubbing may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Use lane scrubbers with vacuum capability to remove wastewater from pavement during lane scrubbing operations.
- If chemicals are used for cleaning, consider safer alternatives where practical and effective.
- Liquid waste collected in the scrubber should be transported to the Maintenance facility or decanting area for proper disposal.

# K FAMILY – ELECTRICAL

## Sawcutting for Loop Installation

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Concrete
- Concrete slurry
- Fuel
- Non-storm water
- Sealant
- Vehicle fluids

**DEFINITION AND PURPOSE**

Detector loops are electrical sensors used to trigger a traffic signal at an intersection and/or for long-term traffic counts. Installation of detector loops is accomplished by cutting into the road surface with a concrete saw, inserting the electric wire into the cut and sealing the cut with loop sealant.

**APPROPRIATE APPLICATION**

The following procedures are used where saw cutting for loop installation may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

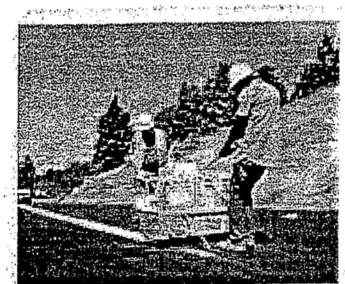
- Avoid cutting concrete and installing loop detectors during rain events.
- Protect drain inlets and watercourses from potential spills and debris.
- Avoid excess use of water to minimize runoff. Apply water only to the cutting site.
- Minimize the use of loop sealant by carefully estimating the amount needed. Clean-up excess loop sealant and place the collected material in a bucket or drum for transport to the Maintenance facility to be reused, recycled or disposed of properly.
- Do not remove original product label from paint or hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Vehicle and equipment washing is allowed only at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.
- Contain all sawcutting waste including water used to cool the cutting blade. Sweep or vacuum the site to collect all sawcutting waste prior to leaving the site.

## Sawcutting for Loop Installation

OPERATIONAL PROCEDURES (CONT'D)

- Liquid waste should be collected in a container with a secure lid for transport to the Maintenance facility for proper disposal.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# Thermoplastic Striping and Marking



**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Plastic
- Grit
- Sand
- Non-storm water
- Vehicle fluids

**DEFINITION AND PURPOSE**

Thermoplastic materials are used for lane stripes and other pavement markings to guide motorists. Thermoplastic material is heated in a preheater and then applied to the pavement by thermoplastic striper or applicators.

**APPROPRIATE APPLICATION**

The following procedures are used where thermoplastic striping and marking may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events, unless required by emergency conditions.
- Prior to leaving the maintenance facility or work site, make certain all thermoplastic striper and preheater equipment shutoff valves are working properly to prevent leaking.
- The preheater should be filled carefully to prevent splashing or spilling of hot thermoplastic. Leave adequate space at the top of the container when filling thermoplastic to allow room for material to move when deadheading the vehicle.
- Do not preheat, transfer or load thermoplastic near storm water drainage system or watercourses.
- Sweep or vacuum site to reduce the potential of material and debris entering the storm water drainage system or watercourses and reduce the potential of tracking material and debris from the site.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# M FAMILY – TRAFFIC GUIDANCE

## Paint Striping and Marking

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Sediment
- Non-storm water
- Vehicle fluids
- Paint

**DEFINITION AND PURPOSE**

Pavement striping and marking is used to supplement traffic signs and to guide and control vehicular and pedestrian traffic. Pavement striping delineates the separation of traffic flow on highways and freeways. Paints are applied to pavement by using stencil or striper paint systems.

**APPROPRIATE APPLICATION**

The following procedures are implemented where paint striping and marking may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events, unless required by emergency conditions.
- Pre-sweeping should be accompanied by watering to reduce the amount of dust generated, if necessary. Avoid excess use of water to minimize runoff.
- Be sure no pressure remains in paint striper system when setting up, cleaning, pulling filters or servicing spray guns. Release pressure on bead tank before removing lid.
- Check to make sure that the paint spray gun remains closed when not in use to prevent leaks. Check for leaking or ruptured paint containers.
- Paint should be loaded and mixed away from storm water drainage system or watercourses. Monitor weather and wind direction to ensure that paint is not entering the storm water drainage system or watercourses during spraying.
- Do not remove original product label from paint or other hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility for proper disposal.

# M FAMILY – TRAFFIC GUIDANCE

## Paint Striping and Marking

**OPERATIONAL PROCEDURES (CONT'D)**

- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.
- Do not stockpile sediment in or near storm water drainage system or watercourses.
- If pre-sweeping is needed, refer to Activity Cut-Sheets, D Family-Sweeping Operations and D Family - Litter and Debris Removal.

# M FAMILY – TRAFFIC GUIDANCE

## Raised/Recessed Pavement Marker Application and Removal

| **Environmental Concerns** | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Bitumen adhesive | • Non-storm water |
| • Epoxy | • Vehicle fluids |
| • Fuel | |

**DEFINITION AND PURPOSE**

Pavement markers are used to supplement traffic signs and convey messages or direction to motorists. Pavement markers are either surface mounted (raised) or placed in recessed slots in the pavement. Markers are applied using bitumen/epoxy adhesives. Damaged or old markers are removed for replacement using hand tools or special attachments on a motor grader.

**APPROPRIATE APPLICATION**

The following procedures are used where pavement marking and removal may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- This activity shall not be performed during rain events or prior to predicted rain events, unless required by emergency conditions.
- Prior to leaving the maintenance facility or work site ensure all shutoff valves on equipment are working properly to prevent spills.
- Melting tanks should be loaded with adequate space at the top to leave room for splashing when deadheading the vehicle.
- When servicing or filling melting tanks, ensure all pressure is released before removing lids to avoid spills.
- Do not pre-heat transfer or load bituminous material near storm water drainage system or watercourses.
- Collect as much excess bituminous material and epoxy as possible from the roadway after removal of markers.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility for proper disposal.
- Solid waste should be collected by vacuum or sweeping and put into bags or buckets and secured for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# M FAMILY – TRAFFIC GUIDANCE

## Sign Repair and Maintenance

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Concrete | • Non-storm water |
| • Debris | • Sediment |
| • Fuel | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Sign installation may range from digging a hole for a small one-post roadside sign to more complex activities such as mounting large multi-panel signs on overhead sign structures. When signs are damaged or obsolete, they are replaced or removed.

**APPROPRIATE APPLICATION**

The following procedures are used where sign installation and removal may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Be careful when digging in landscaped areas to avoid damaging buried water lines (call USA at 1-800-227-2600, or 1-800-422-4133), so as to prevent work area debris from being transported by flow from damaged water lines to storm water drainage system or watercourses. Protect storm water drainage system and watercourses in case a leak or spill does occur.
- Compaction should be performed as soon as possible after grading or soil disturbance.
- If concrete is used, do not allow concrete waste or slurry to enter storm water drainage system or watercourses. Liquid waste and concrete washout should be collected in a container with a secure lid and transported to the Maintenance facility to be reused, recycled or disposed of properly. Concrete contractors are required to comply with Caltrans Standard Specifications, Section 7-1.01G Water Pollution.
- Do not remove original product label from paint or hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Vehicle and equipment washing is allowed only at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.

## Sign Repair and Maintenance

**OPERATIONAL PROCEDURES (CONT'D)**

- Sweep or vacuum prior to leaving the site to reduce the potential of tracking litter, debris and sediment onto public roadways.
- Debris from damaged signposts should be collected and secured in an appropriate container for transport back to the Maintenance facility to be reused, recycled or disposed of properly.

# M FAMILY – TRAFFIC GUIDANCE

## Median Barrier and Guard Rail Repair

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Concrete | • Non-storm water |
| • Debris | • Vehicle fluids |
| • Fuel | |

**DEFINITION AND PURPOSE**

Median barriers and guardrails may require repair following an accident, or as part of routine maintenance activities.

**APPROPRIATE APPLICATION**

The following procedures are used where median barrier and guardrail repair may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Be careful when digging in landscaped areas to avoid damaging buried water lines (call USA at 1-800-227-2600, or 1-800-422-4133), so as to prevent work area debris from being transported by flow from damaged water lines to storm water drainage system or watercourses. Protect storm water drainage system and watercourses in case a leak or spill does occur.
- Stabilize the entrance/exits to the work area, if necessary, to avoid tracking mud or sediments on to public roadways.
- Compaction should be performed as soon as possible after grading or soil disturbance.
- If concrete is used, do not allow concrete waste or slurry to enter storm water drainage system or watercourses. Concrete contractors are required to comply with Caltrans Standard Specifications, Section 7-1.01G Water Pollution.
- Do not remove original product label from paint or hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Vehicle and equipment washing is only allowed at designated rinsing areas, wash racks or other designated areas. All engine compartment and undercarriage rinsing/washing must be performed within a wash rack facility. The District Maintenance Storm Water Coordinator will approve or provide input on the approved location for a designated rinsing area.
- Sweep or vacuum the site. If working off-road, inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris and sediment onto public roadways.

## Median Barrier and Guard Rail Repair

**OPERATIONAL PROCEDURES (CONT'D)**

- Collect all debris from damaged guardrail or median barrier. Solid waste should be secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# Emergency Vehicle Energy Attenuator Repair

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Debris | • Sediment (sand) |
| • Fuel | • Vehicle fluids |
| • Non-storm water | |

**DEFINITION AND PURPOSE**

Emergency Vehicle Energy Attenuators, or Impact Energy Attenuators, are intended to reduce the severity of a collision with a fixed object that cannot be removed or protected by other types of protective systems. Vehicle Energy Attenuators are typically canisters, which are filled with water or sand, or are of a lightweight, crushable design. Vehicle Energy Attenuators require periodic maintenance to ensure that they are viable and in the correct position following contact with a moving vehicle.

**APPROPRIATE APPLICATION**

The following procedures are used where vehicle energy attenuator repair may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Protect drain inlets and watercourses from potential spills, debris and energy attenuator materials.
- During clean up and repair operations, make sure that all debris is removed.
- Cleanup and properly dispose of any vehicle fluids or parts, and attenuator debris.
- Liquid waste should be collected in a container with a secure lid and transported to the Maintenance facility or decanting area for proper disposal.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# R FAMILY – SNOW AND ICE CONTROL

## Snow Removal

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Fuel | • Sediment (sand, cinder) |
| • Non-storm water | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Snow removal includes all work in connection with snow removal, drift prevention, installation and maintenance of snow fences, snow pole installation and removal.[1]

**APPROPRIATE APPLICATION**

Proper snow removal will reduce the discharge of sediment and potential pollutants to the storm water drainage system or watercourses.

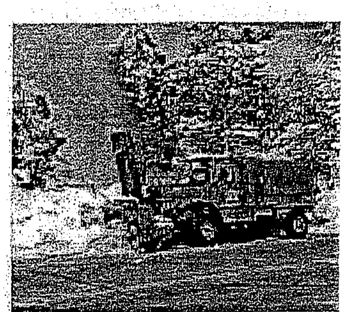
**OPERATIONAL PROCEDURES**

- Where possible, avoid blowing or pushing snow or other debris into watercourses, the storm water drainage system, or where a storm drain inlet can be blocked.
- When necessary, sweep after storms to remove sand and cinders and dispose of properly.

[1] Snow removal is considered an emergency operation due to insufficient forecast of extent, duration, severity and location of hazard presented to the public.

# R FAMILY – SNOW AND ICE CONTROL

## Ice Control



| Environmental Concerns |
|---|
| Discharge of the following materials into the storm water drainage system or watercourse: |
| • Deicing agents (salt) • Sediment (sand, cinder) |
| • Fuel • Vehicle fluids |
| • Non-storm water |

**DEFINITION AND PURPOSE**

Ice control involves the use of deicing agents and abrasives to maintain public safety.[1]

**APPROPRIATE APPLICATION**

Proper ice control will reduce the discharge of deicing agents and sediment to the storm water drainage system or watercourses.

**OPERATIONAL PROCEDURES**

- Where necessary, sweep after storms to remove sand and cinders and dispose of properly.
- District 2, 3, 8, 9 and 10 should record the volume of abrasives and deicing materials used within the Lahontan Region on each major route. Recommended salt application rates can be found in Chapter R of the *Caltrans Maintenance Manual, Volume 1*.
- Routinely calibrate spreaders. Because of potentially detrimental effects of deicing agents, personnel should use no more than is necessary for effective ice control.
- Use road abrasives that have been washed, screened, or graded to reduce silt and clay to insignificant levels.
- When using detergents, wash equipment used in the application of deicing agents at a wash area that discharges to a sanitary sewer system or water recovery system.
- Where possible, avoid blowing or pushing ice, snow, abrasives, or other debris into watercourse, the storm water drainage system or where a storm drain inlet can be blocked.
- Where possible, store sand in covered stockpiles in areas where a frozen crust will not form on the stockpile.
- Store deicing agents in covered areas, bunkers, or storage buildings. Do not store deicing chemicals where they will come in contact with storm water runoff.

[1] Ice control is considered an emergency operation due to insufficient forecast of extent, duration, severity and location of hazard presented to the public.

# S FAMILY – STORM MAINTENANCE

## Minor Slides and Slipouts Cleanup/Repair

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Asphalt
- Debris
- Fuel
- Non-storm water
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

Repair of minor slides and slip-outs includes cleaning up or backfilling minor slides and minor damage to the roadside. Soil, rocks and boulders deposited on the roadway are removed, and minor erosion damage can be repaired. Downed or damaged vegetation may also be removed.

**APPROPRIATE APPLICATION**

The following procedures are used where the repair and cleanup of slides and slip outs may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

- Prior to working in a water body or wetland, alternatives should first be considered. If still deemed necessary, the appropriate permits must be obtained.
- Locate and protect storm water drainage systems and watercourses downstream of the area where minor slides and slip-outs are being repaired or cleared.
- Stabilize the entrance/exits to the work area with soil stabilizers as necessary.
- When clearing the roadside of downed or damaged vegetation, avoid placing the vegetation near drain inlets, watercourses or drainage ditches.
- Tires should be cleaned before entering the water, equipment should be cleaned of petroleum residue, and water levels should be kept below the gearboxes of equipment. All lubricants and fuels should be properly sealed.
- Remove sediment build up behind check dams prior to accumulation reaching one-third of the check dam height. Remove check dam when no longer needed.
- Preserve existing vegetation by defining the work area and replace the damaged vegetation outside the defined work area.
- When using dewatering measures, ensure that discharge does not cause erosion.
- Disturbed soil areas should be stabilized to avoid erosion.

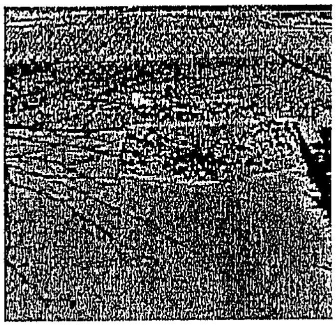
## Minor Slides and Slipouts Cleanup/Repair

**OPERATIONAL PROCEDURES (CONT'D)**

- Control dust and erosion in windy or wind-prone areas using covers, water or soil stabilizers.
- Do not stockpile sediment or concrete rubble in or near storm water drainage system or watercourses. Protect stockpiles with a cover or sediment barriers during rainstorms.
- Inspect and remove rock and sediment from tires prior to leaving the site to reduce the potential of tracking litter, debris and sediment from the site.
- Solid waste should be collected by vacuum or sweeping and secured in an appropriate container for transport to the Maintenance facility to be reused, recycled or disposed of properly.

# T FAMILY – MANAGEMENT AND SUPPORT

## Building and Grounds Maintenance



**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fertilizer
- Fuel
- Litter
- Non-storm water[1]
- Pesticides/herbicides
- Sediment
- Sewage
- Trash
- Vehicle fluids

**DEFINITION AND PURPOSE**

Permanent maintenance facilities need building and ground maintenance, which includes care of landscaped areas around each facility, cleaning of parking areas and pavements other than areas of industrial activity and maintenance of the storm water drainage system.

**APPROPRIATE APPLICATION**

The following procedures are used where building and grounds maintenance may pollute storm water runoff or discharge to storm water drainage system and watercourses.

**OPERATIONAL PROCEDURES**

**Building Maintenance**

- Inspect storm drains regularly for litter and debris. Clean storm water drainage systems in the fall before the first rains, and as often as necessary to keep litter and debris out of the storm water.
- Minimize water use in washing activities.
- Properly dispose of wash water generated by building maintenance activities. Dispose of wash water to the sanitary sewer system.
- Dispose of sweepings and cleaning wastes as solid waste.
- Sanitary and septic waste shall be discharged to a sanitary sewer or managed by a licensed hauler.

**Grounds Maintenance**

- The maintenance facility should be routinely swept to keep litter and sediment out of drainage systems.
- Apply fertilizers and pesticides in accordance with the label instructions. See Activity Cut-Sheet, E Family - Chemical Vegetation Control. Use integrated pest management where appropriate.

[1] Irrigation water and landscape irrigation are conditionally exempt discharges if appropriate control measures are developed and implemented under the SWMP.

## Building and Grounds Maintenance

**OPERATIONAL PROCEDURES (CONT'D)**

**Grounds Maintenance (cont'd)**

- Do not remove original product label from paint or hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Avoid excessive irrigation of landscaped areas to minimize potential runoff.
- Control erosion and sediment runoff.
- Preserve existing vegetation by defining the work area and replace the damaged vegetation outside the defined work area.
- Do not locate stockpiles near drain inlets or watercourses.
- All wastes should be put into containers and stored appropriately until it can be recycled or disposed of properly.
- All materials of environmental concern shall be properly stored in appropriate secure containment. See Activity Cut-Sheet, T Family - Storage of Hazardous Materials (Working Stock).
- See Activity Cut Sheet, E Family - Irrigation (Watering), Potable and Non-potable.

## Storage of Hazardous Materials (Working Stock)

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Asphalt products
- Cement
- Epoxy resins
- Fertilizer
- Fuel
- Paints
- Pesticides/herbicides
- Solvents
- Vehicle fluids

**DEFINITION AND PURPOSE**

Maintenance facilities store a variety of products which may be harmful to the environment if they come in contact with surface waters.

**APPROPRIATE APPLICATION**

The following procedures are used reduce the potential for the discharge of materials from hazardous material storage sites to the storm water drainage system or watercourses by minimizing exposure of the materials to storm water and safeguarding against accidental release of materials.

**LIMITATIONS**

The BMPs for this activity provide operating methods or measures only for the purpose of storm water pollution prevention. The applicable local, state and federal hazardous materials, employee safety and fire prevention requirements are not presented.

Although not a BMP, it should be acknowledged that other environmental laws and regulations do require spill or secondary containment for some hazardous materials and waste.

**OPERATIONAL PROCEDURES**

Proper hazardous materials storage procedures can be found in the Hazardous Materials Business Plan. Maintenance facilities that store hazardous materials at or above the regulated thresholds will have a Hazardous Materials Business Plan as required by regulation. Hazardous materials storage must conform to this plan.

- Store hazardous materials in a designated area containing chemically compatible materials. Do not store incompatible products in the same storage area without some type of physical barrier separating the containers. For example, do not store strong oxidizers with organics, or flammable/combustible materials. Where feasible, store hazardous materials under cover and away from areas that might drain into the storm water drainage system or watercourses. Ensure container covers or caps are secure.

# T FAMILY – MANAGEMENT AND SUPPORT

## Storage of Hazardous Materials (Working Stock)

**OPERATIONAL PROCEDURES (CONT'D)**

- Do not remove original product label from paint or hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before properly disposing of the container. Appropriately label all secondary containers.
- Install safeguards to prevent accidental releases such as overflow protection devices, automatic shutdown transfer pumps, protection guards around tanks and piping to prevent vehicle or forklift damage. Limit access to unauthorized persons.
- Review Material Safety Data Sheets with personnel on proper labeling requirements, spill cleanup procedures and disposal of hazardous materials.
- Regularly inspect and maintain hazardous materials storage areas to minimize exposure to storm water. Use the Daily/Weekly/Monthly inspection form. Store hazardous materials on impervious surfaces if possible.
- Maintain spill cleanup materials near the storage area. Cleanup spills or leaks immediately if it is safe to do so.
- Store used lead acid batteries in spill or secondary containment. All cracked batteries shall be stored in spill containment.

**Regular Maintenance of Outdoor Container Storage Area**

- Inspect storage areas as required. Ensure all containers are properly labeled, with lids securely fastened, and in good condition.
- If a container is corroded or leaking, contact the District Hazardous Material Coordinator or Manager to have the waste or material transferred to a new container by trained and qualified personnel. Label the new container appropriately and properly dispose of the old container.

**Paint Storage Area**

- Inspect all paint pallets to ensure that all product containers are secured before transfer or transportation.
- Load and off-load paint on level ground when using a forklift to minimize possible spills and ruptures of paint containers.
- Where feasible, store paint materials in an area with a canopy or roof designed to direct runoff away from the area.

**Wood Post Storage Area**

- Cover treated wood posts during the rainy season.

# Material Storage Control (Hazardous Waste)

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Asphalt products | • Paints |
| • Fuel | • Solvents |
| • Lead-acid batteries | • Vehicle fluids |

**DEFINITION AND PURPOSE**

Maintenance facilities store a variety of products that may adversely impact water quality if they come in contact with surface waters.

**APPROPRIATE APPLICATION**

These procedures are applicable to all maintenance facilities that store any material considered by the State of California or federal regulations to be hazardous waste, and intended to reduce the potential for the discharge of hazardous waste to storm water drainage system or watercourses by providing safeguards against accidental releases.

**LIMITATIONS**

The BMPs for this activity provide operating methods or measures only for the purpose of storm water pollution prevention. The applicable local, state and federal hazardous materials, employee safety and fire prevention requirements are not presented.

Although not a BMP, it should be acknowledged that other environmental laws and regulations do require spill or secondary containment for some hazardous materials and waste.

**OPERATIONAL PROCEDURES**

- Weekly inspections are required for hazardous waste storage areas. Use the Daily/Weekly/Monthly inspection form. Storage areas should be properly secured to prevent unauthorized access.
- Hazardous waste shall be stored in appropriate containers, with lids securely fastened, constructed of compatible materials and properly labeled in accordance with federal, state and local regulations. Refer to the Maintenance Hazardous Waste Manual.
- Containment facilities shall provide for appropriate spill containment volume.
- Maintain an ample supply of appropriate spill cleanup materials near hazardous materials storage areas.
- In the event of a spill, dry cleanup methods should be used. Contaminated cleanup materials, contaminated materials and recovered spill material shall be disposed of properly.

# T FAMILY – MANAGEMENT AND SUPPORT

## Outdoor Storage of Raw Materials

| Environmental Concerns | |
|---|---|
| Discharge of the following materials into the storm water drainage system or watercourse: | |
| • Asphaltic material | • Sand |
| • Deicing agents | • Vehicle fluids |
| • Fuel | |

**DEFINITION AND PURPOSE**

Maintenance facilities store a variety of raw materials that may adversely impact water quality if they come in contact with surface waters.

**APPROPRIATE APPLICATION**

These procedures are applicable to all maintenance facilities that store raw material such as asphalt, sand, soils, treated wood posts and mulch outdoors, and are intended to reduce the potential for discharges of potential pollutants to storm water drainage system or watercourses.

**OPERATIONAL PROCEDURES**

- Inspect storage areas regularly. Use the Daily/Weekly/Monthly inspection form.
- Protect storm drain inlets and watercourses from potential spills of raw materials.
- Maintain spill cleanup materials and tools. Cleanup spills immediately, if it is safe to do so, and dispose of any generated waste properly.
- Keep surfaces swept clean where material is blown or washed from the storage area, keeping materials covered and keeping storage containers in good condition.
- Store materials away from storm water drainage systems or watercourses.
- Where feasible, cover the storage area with a canopy or roof that is designed to direct the runoff away from the storage area, or cover (tarp) dry materials to prevent water intrusion during the winter season.
- During rain events, stockpiles of cold-mix asphalt shall be covered. Other stockpiles shall be covered or protected with soil stabilization measures or a perimeter sediment barrier. Contact the District Maintenance Storm Water Coordinator if problems arise.

# Vehicle and Equipment Fueling

| **Environmental Concerns** |
|---|
| Discharge of the following materials into the storm water drainage system or watercourse:<br>• Fuel |

**DEFINITION AND PURPOSE**

When vehicle and equipment fueling takes place at a maintenance facility, there is the potential for fuel to be leaked or spilled at the site. The procedures for vehicle and equipment fueling are designed to minimize contact between storm water runoff and spilled fuel, oil or other leaked vehicle fluids at equipment fueling areas.

**APPROPRIATE**

These procedures should be used at all equipment fueling areas.

**OPERATIONAL PROCEDURES**

- Fuel tanks and fuel dispensers shall have current permits with the appropriate agencies.
- Personnel at maintenance facility shall be trained to ensure that materials are properly handled and stored.
- Inspect all aboveground fueling tanks and fueling dispensers daily, using the Daily Inspection Form. Report any nozzle, hose leaks or malfunctions to the Supervisor immediately. Repair as necessary.
- When in use, inspect portable fueling tanks regularly for cracks and leaks. Repair as necessary.
- Proper fueling and spill cleanup instructions shall be posted at fueling areas.
- Clean up spills immediately, if it is safe to do so, using dry cleanup techniques and materials.
- Hosing down of leaks, drips and spills is prohibited.
- Automatic shut-off valves shall be installed at each pump where required. Manual shut-off valves shall be near fuel pumps and clearly posted where required.
- Spill cleanup materials and spill control equipment shall be maintained near fueling areas to clean up spills. Spills should be cleaned immediately and waste disposed of properly.

# Vehicle and Equipment Cleaning


**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Cleaning agents
- Fuel
- Metals
- Non-storm water
- Sediment
- Vehicle fluids

**DEFINITION AND PURPOSE**

When vehicle and equipment cleaning is conducted at a Maintenance facility, it is essential that the wash water not be disposed to the storm water drainage system or watercourses.

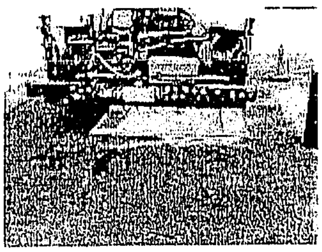
**APPROPRIATE APPLICATION**

Proper vehicle and equipment cleaning minimizes contact between storm water runoff and the equipment washing area, and ensures that the wash water is not discharged to the storm water drainage system or watercourses.

**OPERATIONAL PROCEDURES**

- Vehicle and equipment washing areas should be inspected daily and cleaned as needed.
- The sump should be serviced regularly.
- Use designated areas for rinsing of vehicles and equipment to capture solid materials and minimize waste.
- Vehicle washing activities should be located at a structure or building equipped with a municipal sewer connection or closed loop system.
- If a washing area must be located outdoors, the area should have the following characteristics: The area should be surrounded by berms or graded to minimize contact with storm water running onto the area. The area should be paved with concrete. The pressure washing area should drain to a dead-end sump or directly into the sanitary sewer system.
- Wash water containing cleaning solutions such as detergents and degreasers, or hydrocarbons, shall be prevented from entering the storm water drainage system or watercourses.
- Approved safer alternative products should be used where practical and effective.
- Do not remove original product label from paint or hazardous materials containers as it contains important spill cleanup and disposal information. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Water usage should be minimized.

# Vehicle and Equipment Maintenance and Repair



**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Fuel
- Vehicle fluids
- Lead-acid batteries
- Paint products
- Metals
- Used oil filters

**DEFINITION AND PURPOSE**

Vehicle and equipment maintenance and repair may include vehicle fluid removal, engine and parts cleaning, body repair and painting.

**APPROPRIATE APPLICATION**

This procedure is intended to reduce the discharge of potential pollutants from areas in which vehicle maintenance and repair activities are conducted by employing controls which minimize contact between storm water and the activity areas and products used in each activity.

**OPERATIONAL PROCEDURES**

- Outdoor vehicle and equipment maintenance shall not be performed during rain events or prior to predicted rain events unless required by emergency conditions.
- Maintenance activity areas should be kept clean, well organized and equipped with cleanup supplies.
- Use absorbent pads, drip pans or absorbent material as appropriate. If rags and absorbents are saturated or contaminated with high concentrations of regulated hazardous materials, dispose of rags and absorbents as hazardous waste.

**Vehicle Fluid Removal**

- Transfer removed vehicle fluids to recycling storage tank or drums by the end of the shift (daily).
- Transfer fluids from drip pans or other temporary containers into recycling storage tanks or drums by the end of the shift (daily).
- Ensure safeguards, such as oil shut-off valves, are installed and maintained on recovery equipment.

**Engine and Parts Cleaning**

- Use self-contained sinks or tanks when working with solvents. Periodically check degreasing solvent tanks for leaks. Make necessary repairs as soon as possible. Report leaks or malfunctions to the Supervisor immediately.

# Vehicle and Equipment Maintenance and Repair

**OPERATIONAL PROCEDURES (CONT'D)**

**Engine and Parts Cleaning (Cont'd)**

- Allow parts to drain over the solvent sink or tank. Do not allow the solvents to drip or spill onto the floor. Allow parts to dry over the hot tank, if available. If rinsing is required, rinse over the hot tank.
- When finished using parts washer, be sure to shut it off, close the unit and cleanup area.

**Body Repair and Painting**

- When receiving damaged vehicles, inspect for fluid leaks and use drip pans, if necessary.
- Minimize use of "hose-off degreasers" to clean body parts before painting. Discharge wash water to sanitary sewer system.
- Use a shop vacuum to clean up dust from sanding material. Do not use vacuums for flammable liquids. Debris from wet sanding can be allowed to dry overnight then swept or vacuumed. Dispose of dust as solid waste.
- Minimize waste paint and thinner by carefully calculating paint needs based on surface area and using proper sprayer cup size.
- Do not use water to control overspray or dust in the paint booth unless you collect this wastewater. This water is to be treated prior to discharge into the sanitary sewer system.
- Clean spray guns in a self-contained cleaner. Recycle the cleaning solution when it becomes too dirty to use. Do not discharge cleaning waste to the sewer or storm drain.

**Drain Control**

- Keep internal floor drains plugged unless they drain to the sanitary sewer. Use dry cleanup methods, such as sweeping, when possible.
- Keep spill control equipment and covers available to protect external drain inlets.

# Aboveground and Underground Tank Leak and Spill Control

**Environmental Concerns**

Discharge of the following materials into the storm water drainage system or watercourse:

- Emulsions
- Vehicle fluids
- Fuel

**DEFINITION AND PURPOSE**

Maintenance facilities may use aboveground storage tanks for storage of bulk quantities of liquids.

**APPROPRIATE APPLICATION**

This procedure is intended to reduce the discharge of pollutants to storm water drainage system or watercourses from storage tanks by installing safeguards against accidental releases.

**OPERATIONAL PROCEDURES**

- Review the Spill Prevention Control and Countermeasures (SPCC) plan for the Maintenance facility aboveground tank(s) if available.
- Tanks, hoses and pumps shall be maintained and inspected daily.
- Maintain good housekeeping practices and cleanup leaks or drips immediately, if it is safe to do so.
- If a spill occurs, protect drain inlets from the releases if safe to do so.
- Maintain an ample amount of spill cleanup materials near the tanks. Clean spills immediately, if it is safe to do so, and dispose of waste properly. Use dry cleanup techniques when possible.
- Rainwater in spill containment is to be inspected or tested before it is discharged. Drain valves shall be closed after releasing clean rainwater.

# APPENDIX C

# MAINTENANCE BMPs

## SECTION C MAINTENANCE BMPS

A001803

## C.1 MAINTENANCE BMPS[1]

Caltrans performs a variety of maintenance activities on highways throughout California to maintain a safe and usable condition for the motoring public. In contrast to construction projects, maintenance activities are performed by a small crew for a short duration (most activities are completed within one day) and minimal soil disturbance (generally less than 0.4 ha [1 acre]). This section of the Guidelines describes the storm water pollution prevention BMPs that are used at Maintenance facility operations and during highway activities. Maintenance activity sites are located along the state's highways and rights-of-way. The practices described in this section may be used for purposes other than storm water pollution prevention, but those uses are not described in this Appendix.

This section describes those BMPs to be considered during maintenance activities. These BMPs shall be considered for implementation on an activity-by-activity basis. Caltrans Maintenance Managers provide supervision to the Maintenance Superintendents who ensure the maintenance BMPs are implemented within their jurisdictions. Maintenance Supervisors have on-site responsibility for BMP implementation and maintenance.

Section 1.3.4 of the Statewide SWMP defines emergency conditions under which the protection of public health, safety and property takes precedence over the BMPs in these Guidelines. Maintenance personnel are frequently tasked with responding to emergency situations where some elements of the Guidelines cannot be applied for the duration of the emergency.

The terms "may, should and shall" are used throughout these Guidelines. These terms are used consistently with other Caltrans maintenance guidance documents. They are defined as follows:

- May: Maintenance staff have the flexibility to use or not use the guidance provided based on their best professional judgment.
- Should: Maintenance staff will follow the guidance provided unless there is a strong justification for doing otherwise. Maintenance staff need to document the justification for not implementing a BMP.
- Shall: Maintenance staff must follow the provided guidance.

## C.2 MAINTENANCE ACTIVITY TABLES

This section introduces a series of tables that have been prepared for each maintenance activity provided in this section. The purpose of these tables is to identify the approved Maintenance

[1] Appendix C was edited from the Statewide Storm Water Quality Practices Guidelines (Guidelines). The Guidelines contain all the best management practices (BMPs) applied to the maintenance activities approved by the California Department of Transportation Maintenance Division. The Maintenance Activity Tables provided do not represent an exhaustive inventory of Maintenance activities. However, the tables do represent typical activities that may affect storm water and the pollution prevention control methods for consideration.

BMPs that may be applicable for each Caltrans maintenance operation and activity. Personnel performing maintenance activities can determine which BMPs should be applied for each activity by consulting these tables.

For some activities, maintenance personnel may select from a variety of BMPs for storm water pollution prevention. For example, during cleanup or repair of minor slides and slip-outs, several sediment controls are available that may adequately contain sediment. Personnel will need to select one or a combination of the available control methods to address the sediment they encounter at the site. Also, individual BMPs identified on the tables will not necessarily be applicable to all projects involving the activity. For example, not all projects will have on-site fueling operations, but those that do should be required to perform those operations in a manner consistent with the intent of the BMP descriptions that follow the tables.

**TABLE C-1: A FAMILY – ASPHALT CEMENT CRACK AND JOINT GRINDING/SEALING**

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Liquid Waste Management, C.13.6 | Stockpile Management, C.17 |
| Paving Operations Procedures, C.16 | Storm Drain Inlet Protection, C.5 |
| Safer Alternative Products, C.21 | Sweeping and Vacuuming, C.29 |
| Sanitary/Septic Waste Management, C.13.5 | Vehicle and Equipment Operations, C.15 |

**TABLE C-2: A FAMILY – ASPHALT PAVING**

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Liquid Waste Management, C.13.6 | Stockpile Management, C.17 |
| Material Use, C.14.2 | Storm Drain Inlet Protection, C.5 |
| Paving Operations Procedures, C.16 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Sanitary/Septic Waste Management, C.13.5 | Water Conservation Practice, C.18 |

### TABLE C-3: A FAMILY – STRUCTURAL PAVEMENT FAILURE (DIGOUT) PAVEMENT GRINDING AND PAVING

| | |
|---|---|
| Concrete Waste Management, C.13.7 | Scheduling and Planning, C.3 |
| Hazardous Waste Management, C.13.3 | Solid Waste Management, C.13.2 |
| Illegal Spill Discharge Control, C.22.4 | Spill Prevention and Control, C.13.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Stockpile Management, C.17 |
| Liquid Waste Management, C.13.6 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Paving Operations Procedures, C.16 | Vehicle and Equipment Operations, C.15 |
| Safer Alternative Products, C.21 | Water Conservation Practice, C.18 |
| Sanitary/Septic Waste Management, C.13.5 | |

### TABLE C-4: A FAMILY – EMERGENCY POTHOLE REPAIRS

| | |
|---|---|
| Material Use, C.14.2 | Vehicle and Equipment Operations, C.15 |
| Safer Alternative Products, C.21 | |

### TABLE C-5: A FAMILY – SEALING OPERATIONS

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Liquid Waste Management, C.13.6 | Stockpile Management, C.17 |
| Material Use, C.14.2 | Storm Drain Inlet Protection, C.5 |
| Paving Operations Procedures, C.16 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Sanitary/Septic Waste Management, C.13.5 | Water Conservation Practice, C.18 |

**TABLE C-6: B FAMILY – PORTLAND CEMENT CRACK AND JOINT SEALING**

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Liquid Waste Management, C.13.6 | Storm Drain Inlet Protection; C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Sanitary/Septic Waste Management, C.13.5 | |

**TABLE C-7: B FAMILY – MUDJACKING AND DRILLING**

| | |
|---|---|
| Concrete Waste Management, C.13.7 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Liquid Waste Management, C.13.6 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Sanitary/Septic Waste Management, C.13.5 | Water Conservation Practice, C.18 |

**TABLE C-8: B FAMILY – CONCRETE SLAB AND SPALL REPAIR**

| | |
|---|---|
| Concrete Waste Management, C.13.7 | Scheduling and Planning, C.3 |
| Hazardous Waste Management, C.13.3 | Solid Waste Management, C.13.2 |
| Illegal Spill Discharge Control, C.22.4 | Spill Prevention and Control, C.13.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Stockpile Management, C.17 |
| Liquid Waste Management, C.13.6 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Sanitary/Septic Waste Management, C.13.5 | Water Conservation Practice, C.18 |

### TABLE C-9: C FAMILY – SHOULDER GRADING

| | |
|---|---|
| Compaction, C.7.1 | Spill Prevention and Control, C.13.1 |
| Illegal Spill Discharge Control, C.22.4 | Stockpile Management, C.17 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Preservation of Existing Vegetation, C.8 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | Water Conservation Practice, C.18 |
| Solid Waste Management, C.13.2 | Wind Erosion Control, C.11 |

### TABLE C-10: C FAMILY – NONLANDSCAPED CHEMICAL VEGETATION CONTROL

| | |
|---|---|
| Chemical Vegetation Control, C.25 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Spill Prevention and Control, C.13.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Vehicle and Equipment Operations, C.15 |
| Preservation of Existing Vegetation, C.8 | Water Conservation Practice, C.18 |
| Safer Alternative Products, C.21 | |

### TABLE C-11: C FAMILY – NONLANDSCAPED MECHANICAL VEGETATION CONTROL/MOWING

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Preservation of Existing Vegetation, C.8 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | |

### TABLE C-12: C FAMILY – NONLANDSCAPED TREE AND SHRUB PRUNING, BRUSH CHIPPING, TREE AND SHRUB REMOVAL

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Preservation of Existing Vegetation, C.8 | Stockpile Management, C.17 |
| Sanitary/Septic Waste Management, C.13.5 | Storm Drain Inlet Protection, C.5 |
| Scheduling and Planning, C.3 | Vehicle and Equipment Operations, C.15 |

### TABLE C-13: C FAMILY – FENCE REPAIR

| | |
|---|---|
| Compaction, C.7.1 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Stabilized Activity Entrance/Exit, C.21.1 |
| Material Use, C.14.2 | Tire Inspection and Sediment Removal, C.12.2 |
| | Vehicle and Equipment Operations, C.15 |

### TABLE C-14: C FAMILY – DRAINAGE DITCH AND CHANNEL MAINTENANCE

| | |
|---|---|
| Baseline Storm Water Drainage Facilities Inspection and Cleaning, C.22.1 | Liquid Waste Management, C.13.6 |
| Clear-Water Diversion, C.9 | Material Use, C.14.2 |
| Compaction, C.7.1 | Preservation of Existing Vegetation, C.8 |
| Concrete Waste Management, C.13.7 | Scheduling and Planning, C.3 |
| Contaminated Soil Management, C.13.4 | Sediment Control, C.4 |
| Geotextiles, Mats/Plastic Covers and Erosion Control Blankets, C.7.7 | Solid Waste Management, C.13.2 |
| Hydroseeding/Handseeding, C.7.4 | Stabilized Activity Entrance/Exit, C.12.1 |
| Illegal Spill Discharge Control, C.22.4 | Stockpile Management, C.17 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Storm Drain Inlet Protection, C.5 |
| | Tire Inspection and Sediment Removal, C.12.2 |
| | Vehicle and Equipment Operations, C.15 |

### TABLE C-15: C FAMILY – DRAIN AND CULVERT MAINTENANCE

| | |
|---|---|
| Baseline Storm Water Drainage Facilities Inspection and Cleaning, C.22.1 | Preservation of Existing Vegetation, C.8 |
| Compaction, C.7.1 | Sanitary/Septic Waste Management, C.13.5 |
| Concrete Waste Management, C.13.7 | Scheduling and Planning, C.3 |
| Contaminated Soil Management, C.13.4 | Sediment Control, C.4 |
| Enhanced Storm Drain Inlet Inspection and Cleaning Program, C.22.2 | Solid Waste Management, C.13.2 |
| Hydroseeding/Handseeding, C.7.4 | Stabilized Activity Entrance/Exit, C.12.1 |
| Illegal Spill Discharge Control, C.22.4 | Stockpile Management, C.17 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Tire Inspection and Sediment Removal, C.12.2 |
| Liquid Waste Management, C.13.6 | Vehicle and Equipment Operation, C.15 |
| | Water Conservation Practice, C.18 |

### TABLE C-16: C FAMILY – CURB AND SIDEWALK REPAIR

| | |
|---|---|
| Concrete Waste Management, C.13.7 | Solid Waste Management, C.13.2 |
| Hazardous Waste Management, C.13.3 | Spill Prevention and Control, C.13.1 |
| Illegal Spill Discharge Control, C.22.4 | Stockpile Management, C.17 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Storm Drain Inlet Protection, C.5 |
| Liquid Waste Management, C.13.6 | Sweeping and Vacuuming, C.29 |
| Material Use, C.14.2 | Vehicle and Equipment Operations, C.15 |
| Safer Alternative Products, C.2.1 | Water Conservation Practice, C.18 |
| Scheduling and Planning, C.3 | |

### TABLE C-17: D FAMILY – SWEEPING OPERATIONS

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Stockpile Management, C.17 |
| Liquid Waste Management, C.13.6 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | Water Conservation Practice, C.18 |

### TABLE C-18: D FAMILY – LITTER AND DEBRIS REMOVAL

| | |
|---|---|
| Anti-Litter Signs, C.24.2 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Sweeping and Vacuuming, C.29 |
| Litter and Debris, C.24.1 | Vehicle and Equipment Operations, C.15 |
| Sanitary/Septic Waste Management, C.13.5 | Water Conservation Practice, C.18 |

TABLE C-19: D FAMILY – EMERGENCY RESPONSE AND CLEANUP PRACTICES

| | |
|---|---|
| Contaminated Soil Management, C.13.4 | Scheduling and Planning, C.3 |
| Hazardous Waste Management, C.13.3 | Solid Waste Management, C.13.2 |
| Illegal Spill Discharge Control, C.22.4 | Spill Prevention and Control, C.13.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Stabilized Activity Entrance/Exit, C.12.1 |
| Liquid Waste Management, C.13.6 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Preservation of Existing Vegetation, C.8 | Tire Inspection and Sediment Removal, C.12.2 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Sanitary/Septic Waste Management, C.13.5 | Water Conservation Practice, C.18 |

TABLE C-20: D FAMILY – GRAFFITI REMOVAL

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Liquid Waste Management, C.13.6 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | Water Conservation Practice, C.18 |

TABLE C-21: E FAMILY – CHEMICAL VEGETATION CONTROL

| | |
|---|---|
| Chemical Vegetation Control, C.25 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Spill Prevention and Control, C.13.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Vehicle and Equipment Operations, C.15 |
| Preservation of Existing Vegetation, C.8 | Water Conservation Practice, C.18 |
| Safer Alternative Products, C.21 | |

### TABLE C-22: E FAMILY – MANUAL VEGETATION CONTROL

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Preservation of Existing Vegetation, C.8 | Storm Drain Inlet Protection, C.5 |
| Sanitary/Septic Waste Management, C.3.5 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | |

### TABLE C-23: E FAMILY – LANDSCAPED MECHANICAL VEGETATION CONTROL/MOWING

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Preservation of Existing Vegetation, C.8 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | |

### TABLE C-24: E FAMILY – LANDSCAPED TREE AND SHRUB PRUNING, BRUSH CHIPPING AND TREE AND SHRUB REMOVAL

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Preservation of Existing Vegetation, C.8 | Stockpile Management, C.17 |
| Sanitary/Septic Waste Management, C.13.5 | Storm Drain Inlet Protection, C.5 |
| Scheduling and Planning, C.3 | Vehicle and Equipment Operations, C.15 |

### TABLE C-25: E FAMILY – IRRIGATION LINE REPAIRS

| | |
|---|---|
| Compaction, C.7.1 | Scheduling and Planning, C.3 |
| Hydroseeding/Handseeding, C.7.4 | Sediment Control, C.4 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Material Use, C.14.2 | Storm Drain Inlet Protection, C.5 |
| Potable Water/Irrigation, C.19 | Vehicle and Equipment Operations, C.15 |
| Preservation of Existing Vegetation, C.8 | Water Conservation Practice, C.18 |

TABLE C-26: E FAMILY – IRRIGATION (WATERING), POTABLE AND NONPOTABLE

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Scheduling and Planning, C.3 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Vehicle and Equipment Operations, C.15 |
| Potable Water/Irrigation, C.19 | Water Conservation Practice, C.18 |

TABLE C-27: F FAMILY – STORM DRAIN STENCILING

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Liquid Waste Management, C.13.6 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Storm Drain Stenciling, C.20 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | |

TABLE C-28: F FAMILY – ROADSIDE SLOPE INSPECTION

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Vegetated Slope Inspection, C.26 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Vehicle and Equipment Operations, C.15 |

TABLE C-29: F FAMILY – ROADSIDE STABILIZATION

| | |
|---|---|
| Compaction, C.7.1 | Soil Binders, C.7.5 |
| Hydraulic Mulch, C.7.3 | Spill Prevention and Control, C.13.1 |
| Hydroseeding/Handseeding, C.7.4 | Stabilized Activity Entrance/Exit, C.12.1 |
| Illegal Spill Discharge Control, C.22.4 | Stockpile Management, C.17 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Preservation of Existing Vegetation, C.8 | Tire Inspection and Sediment Removal, C.12.2 |
| Safer Alternative Products, C.21 | Vegetated Slope Inspection, C.26 |
| Sanitary/Septic Waste Management, C.13.5 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | Water Conservation Practice, C.18 |
| Sediment Control, C.4 | Wind Erosion Control, C.11 |

### TABLE C-30: F FAMILY – STORM WATER TREATMENT DEVICES

| | |
|---|---|
| Contaminated Soil Management, C.13.4 | Scheduling and Planning, C.3 |
| Detention Devices, C.23.3 | Solid Waste Management, C.13.2 |
| Illegal Spill Discharge Control, C.22.4 | Stabilized Activity Entrance/Exit, C.12.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Tire Inspection and Sediment Removal, C.12.2 |
| Infiltration Basins, C.23.2 | Vegetated Treatment Systems, C.23.1 |
| Litter and Debris, C.24.1 | Vehicle and Equipment Operations, C.15 |

### TABLE C-31: F FAMILY – TRACTION SAND TRAP DEVICES

| | |
|---|---|
| Contaminated Soil Management, C.13.4 | Solid Waste Management, C.13.2 |
| Illegal Spill Discharge Control, C.22.4 | Storm Drain Inlet Protection, C.5 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Traction Sand Trap Devices, C.23.4 |
| Scheduling and Planning, C.3 | Vehicle and Equipment Operations, C.15 |

### TABLE C-32: G FAMILY – PUBLIC FACILITIES

| | |
|---|---|
| Anti-Litter Signs, C.24.2 | Preservation of Existing Vegetation, C.8 |
| Concrete Waste Management, C.13.7 | Safer Alternative Products, C.21 |
| Illegal Spill Discharge Control, C.22.4 | Sanitary/Septic Waste Management, C.13.5 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Scheduling and Planning, C.3 |
| Liquid Waste Management, C.13.6 | Solid Waste Management, C.13.2 |
| Litter and Debris, C.24.1 | Spill Prevention and Control, C.13.1 |
| Maintenance Facility Housekeeping Practices, C.30 | Storm Drain Inlet Protection, C.5 |
| Material Delivery and Storage, C.14.1 | Storm Drain Stenciling, C.20 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Potable Water/Irrigation, C.19 | Vehicle and Equipment Operations, C.15 |
| | Water Conservation Practice, C.18 |

### TABLE C-33: H FAMILY – WELDING AND GRINDING

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Vehicle and Equipment Operations, C.15 |
| Safer Alternative Products, C.21 | |

### TABLE C-34: H FAMILY – SANDBLASTING, WET BLAST WITH SAND INJECTION AND HYDROBLASTING

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Sediment Control, C.4 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Solid Waste Management, C.13.2 |
| Liquid Waste Management, C.13.6 | Spill Prevention and Control, C.13.1 |
| Material Use, C.14.2 | Storm Drain Inlet Protection, C.5 |
| Safer Alternative Products, C.21 | Sweeping and Vacuuming, C.29 |
| Sanitary/Septic Waste Management, C.13.5 | Vehicle and Equipment Operations, C.15 |
| | Water Conservation Practice, C.18 |

### TABLE C-35: H FAMILY – PAINTING

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Sanitary/Septic Waste Management, C.13.5 |
| Illegal Spill Discharge Control, C.22.4 | Scheduling and Planning, C.3 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Solid Waste Management, C.13.2 |
| Liquid Waste Management, C.13.6 | Spill Prevention and Control, C.13.1 |
| Material Use, C.14.2 | Storm Drain Inlet Protection, C.5 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |

### TABLE C-36: H FAMILY – BRIDGE REPAIRS

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Vehicle and Equipment Operations, C.15 |
| Sanitary/Septic Waste Management, C.13.5 | See A Family - Structural Pavement Failure (Digouts) Grinding and Paving |
| Scheduling and Planning, C.3 | See B Family - Concrete Slab and Spall Repair |
| Spill Prevention and Control, C.13.1 | See H Family - Welding and Grinding |

### TABLE C-37: H FAMILY – DRAW BRIDGE MAINTENANCE

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Sanitary/Septic Waste Management, C.13.5 |
| Illegal Spill Discharge Control, C.22.4 | Scheduling and Planning, C.3 |
| Liquid Waste Management, C.13.6 | Solid Waste Management, C.13.2 |
| Material Use, C.14.2 | Spill Prevention and Control, C.13.1 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |

### TABLE C-38: J FAMILY – PUMP STATION CLEANING

| | |
|---|---|
| Contaminated Soil Management, C.13.4 | Spill Prevention and Control, C.13.1 |
| Illegal Spill Discharge Control, C.22.4 | Stabilized Activity Entrance/Exit, C.12.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Stockpile Management, C.17 |
| Liquid Waste Management, C.13.6 | Sweeping and Vacuuming, C.29 |
| Maintenance Facility Housekeeping Practices, C.30 | Tire Inspections and Sediment Removal, C.12.2 |
| Scheduling and Planning, C.3 | Vehicle and Equipment Operations, C.15 |
| Solid Waste Management, C.13.2 | Water Conservation Practice, C.18 |

### TABLE C-39: J FAMILY – TUBE AND TUNNEL MAINTENANCE AND REPAIR

| | |
|---|---|
| Concrete Waste Management, C.13.7 | Solid Waste Management, C.13.2 |
| Illegal Spill Discharge Control, C.22.4 | Spill Prevention and Control, C.13.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Storm Drain Inlet Protection, C.5 |
| Liquid Waste Management, C.13.6 | Vehicle and Equipment Operations, C.15 |
| Material Use, C.14.2 | Water Conservation Practice, C.18 |
| Safer Alternative Products, C.21 | See A Family - Structural Pavement Failure (Digouts) Pavement Grinding and Paving |
| Scheduling and Planning, C.3 | See B Family - Concrete Slab and Spall Repair |

### TABLE C-40: J FAMILY – FERRYBOAT OPERATIONS

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Liquid Waste Management, C.13.6 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Solid Waste Management, C.13.2 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | Water Conservation Practice, C.18 |

### TABLE C-41: J FAMILY – TOW TRUCK OPERATIONS

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Safer Alternative Products, C.21 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Liquid Waste Management, C.13.6 | Spill Prevention and Control, C.13.1 |
| Maintenance Facility Housekeeping Practices, C.30 | Vehicle and Equipment Maintenance, C.15 |

### TABLE C-42: J FAMILY – TOLL BOTH LANE SCRUBBING OPERATIONS

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Stockpile Management, C.17 |
| Liquid Waste Management, C.13.6 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | Water Conservation Practice, C.18 |

### TABLE C-43: K FAMILY – SAWCUTTING FOR LOOP INSTALLATION

| | |
|---|---|
| Concrete Waste Management, C.13.7 | Solid Waste Management, C.13.2 |
| Illegal Spill Discharge Control, C.22.4 | Storm Drain Inlet Protection, C.5 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Sweeping and Vacuuming, C.29 |
| Liquid Waste Management, C.13.6 | Vehicle and Equipment Operations, C.15 |
| Material Use, C.14.2 | Water Conservation Practice, C.18 |
| Scheduling and Planning, C.3 | |

### TABLE C-44: M FAMILY – THERMOPLASTIC STRIPING AND MARKING

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |

### TABLE C-45: M FAMILY – PAINT STRIPING AND MARKING

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.3 | Spill Prevention and Control, C.13.1 |
| Illicit Connection Detection, Reporting and Removal, C.22.4 | Stockpile Management, C.17 |
| Liquid Waste Management, C.13.6 | Storm Drain Inlet Protection, C.5 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | Water Conservation Practice, C.18 |
| Solid Waste Management, C.13.2 | |

### TABLE C-46: M FAMILY – RAISED/RECESSED PAVEMENT MARKER APPLICATION AND REMOVAL

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Material Use, C.14.2 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | |

### TABLE C-47: M FAMILY – SIGN REPAIR AND MAINTENANCE

| | |
|---|---|
| Compaction, C.7.1 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Vehicle and Equipment Operations, C.15 |
| Material Use, C.14.2 | |

### TABLE C-48: M FAMILY – MEDIAN BARRIER AND GUARD RAIL REPAIR

| | |
|---|---|
| Compaction, C.7.1 | Stabilized Activity Entrance/Exit, C.12.1 |
| Concrete Waste Management, C.13.7 | Sweeping and Vacuuming, C.29 |
| Illegal Spill Discharge Control, C.22.4 | Tire Inspection and Sediment Removal, C.12.2 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | Water Conservation Practice, C.18 |
| Solid Waste Management, C.13.2 | |

### TABLE C-49: M FAMILY – EMERGENCY VEHICLE ENERGY ATTENUATOR REPAIR

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Storm Drain Inlet Protection, C.5 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Sweeping and Vacuuming, C.29 |
| Solid Waste Management, C.13.2 | Vehicle and Equipment Operations, C.15 |
| Spill Prevention and Control, C.13.1 | Water Conservation Practice, C.18 |

### TABLE C-50: R FAMILY – SNOW REMOVAL

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Snow Removal and De-Icing Agents, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | |

### TABLE C-51: R FAMILY – ICE CONTROL

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Snow Removal and De-Icing Agents, C.29 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Spill Prevention and Control, C.13.1 |
| Material Use, C.14.2 | Sweeping and Vacuuming, C.29 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |
| Scheduling and Planning, C.3 | |

### TABLE C-52: S FAMILY – MINOR SLIDES AND SLIPOUTS CLEANUP/REPAIR

| | |
|---|---|
| Ditches, Berms, Dikes and Swales, C.6.2 | Storm Drain Inlet Protection, C.5 |
| Illegal Spill Discharge Control, C.22.4 | Storm Water Dewatering Operation, C.28 |
| Illicit Connection Detection, Reporting and Removal, C.22.3 | Sweeping and Vacuuming, C.29 |
| Overside/ Slope Drains, C.6.1 | Temporary Diversion Ditches, C.6.3 |
| Preservation of Existing Vegetation, C.8 | Tire Inspection and Sediment Removal, C.12.2 |
| Sediment Control, C.4 | Vegetated Slope Inspection, C.26 |
| Soil Stabilization, C.7 | Vehicle and Equipment Operations, C.15 |
| Solid Waste Management, C.13.2 | Wind Erosion Control, C.11 |
| Stabilized Activity Entrance/Exit, C.12.1 | Work in a Water Body, C.10 |
| Stockpile Management, C.17 | |

### TABLE C-53: T FAMILY – BUILDING AND GROUNDS MAINTENANCE

| | |
|---|---|
| Chemical Vegetation Control, C.25 | Safer Alternatives Products, C.21 |
| Compaction, C.71 | Sanitary/Septic Waste Management, C.13.5 |
| Concrete Waste Management, C.13.7 | Scheduling and Planning, C.3 |
| Hazardous Waste Management, C.13.3 | Sediment Control, C.4 |
| Illegal Spill Discharge Control, C.22.4 | Solid Waste Management, C.13.2 |
| Liquid Waste Management, C.13.6 | Spill Prevention and Control, C.13.1 |
| Litter and Debris, C.24.1 | Stockpile Management, C.17 |
| Maintenance Facility Housekeeping Practices, C.30 | Storm Drain Stenciling, C.20 |
| Material Delivery and Storage, C.14.1 | Sweeping and Vacuuming, C.29 |
| Material Use, C.14.2 | Vehicle and Equipment Operations, C.15 |
| Potable Water/Irrigation, C.19 | Water Conservation Practice, C.18 |
| Preservation of Existing Vegetation, C.8 | |

### TABLE C-54: T FAMILY – STORAGE OF HAZARDOUS MATERIALS (WORKING STOCK)

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Scheduling and Planning, C.3 |
| Material Delivery and Storage, C.14.1 | Spill Prevention and Control, C.13.1 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |

### TABLE C-55: T FAMILY – MATERIAL STORAGE CONTROL (HAZARDOUS WASTE)

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Scheduling and Planning, C.3 |
| Illegal Spill Discharge Control, C.22.4 | Spill Prevention and Control, C.13.1 |
| Material Delivery and Storage, C.14.1 | Vehicle and Equipment Operations, C.15 |

### TABLE C-56: T FAMILY – OUTDOOR STORAGE OF RAW MATERIALS

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Scheduling and Planning, C.3 |
| Maintenance Facility Housekeeping Practices, C.30 | Spill Prevention and Control, C.13.1 |
| Material Delivery and Storage, C.14.1 | Stockpile Management, C.17 |
| Safer Alternative Products, C.21 | Vehicle and Equipment Operations, C.15 |

### TABLE C-57: T FAMILY – VEHICLE AND EQUIPMENT FUELING

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Spill Prevention and Control, C.13.1 |
| Material Delivery and Storage, C.14.1 | Vehicle and Equipment Fueling, C.15.2 |

### TABLE C-58: T FAMILY – VEHICLE AND EQUIPMENT CLEANING

| | |
|---|---|
| Illegal Spill Discharge Control, C.22.4 | Vehicle and Equipment Cleaning, C.15.1 |
| Liquid Waste Management, C.13.6 | Water Conservation Practice, C.18 |
| Material Use, C.14.2 | |

### TABLE C-59: T FAMILY – VEHICLE AND EQUIPMENT MAINTENANCE AND REPAIR

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Safer Alternative Products, C.21 |
| Illegal Spill Discharge Control, C22.4 | Solid Waste Management, C.13.2 |
| Liquid Waste Management, C.13.6 | Spill Prevention and Control, C.13.1 |
| Maintenance Facility Housekeeping Practices, C.30 | Vehicle and Equipment Maintenance, C.15 |

TABLE C-60: T FAMILY – ABOVEGROUND AND UNDERGROUND TANK LEAK AND SPILL CONTROL

| | |
|---|---|
| Hazardous Waste Management, C.13.3 | Material Delivery and Storage, C.14.1 |
| Illegal Spill Discharge Control, C.22.4 | Scheduling and Planning, C.3 |
| Liquid Waste Management, C.13.6 | Spill Prevention and Control, C.13.1 |
| Maintenance Facility Housekeeping Practices, C.30 | Storm Drain Inlet Protection, C.5 |

## C.3 SCHEDULING AND PLANNING

Description:

This BMP involves scheduling and planning of all activities (at maintenance facilities or maintenance activity sites) in a manner that considers the use of BMPs. Planning is needed to reduce the exposure of potential pollutants to wind, rain, runoff and vehicle tracking. Planning is important when working in the vicinity of a drainage system or water body. Caltrans Regional Work Plans identify sensitive water bodies where even higher levels of protection are needed. This BMP also includes the scheduling of maintenance activities and control practices to minimize potential water quality impacts during rainfall events.

Appropriate Applications:

Except for emergency conditions, the following activities shall not be performed during rain events or when storms are predicted:

- Asphalt cement crack and joint grinding/sealing;
- Asphalt paving;
- Structural pavement failure (digouts) pavement grinding and paving;
- Sealing operations;
- Portland cement crack and joint sealing;
- Mudjacking and drilling;
- Shoulder grading (should not be performed if runoff is visible);
- Nonlandscaped chemical vegetation control;
- Curb and sidewalk repair;
- Chemical vegetation control;
- Painting;
- Thermoplastic striping and marking;
- Paint striping and marking;
- Raised/recessed pavement marker application and removal; and
- Outdoor vehicle and equipment maintenance and repair.

Maintenance activities should be scheduled to minimize land disturbance during the rainy season.

Implementation:

- During the rainy season and prior to forecast storm events, avoid scheduling maintenance activities that could adversely affect storm water quality.
- Establish the appropriate planting time when introducing vegetation. If it is necessary to vegetate disturbed soil at other times of the year, then perform more frequent inspections and maintenance. Apply other BMPs (e.g., Section C.7.2 Wood Mulch BMP or Section C.7.6 Straw Mulch BMP) if the vegetation is not successfully established.

Maintenance:

- Verify that work is progressing in accordance with the schedule. If the schedule changes, revise BMPs as necessary.
- Inspect vegetation and perform maintenance to ensure it is established.

## C.4 SEDIMENT CONTROL

Sediment control includes those practices that intercept, slow or detain the flow of storm water and allow sediment to settle and be trapped. These practices can consist of installing linear sediment barriers (e.g., Section C.4.1 Silt Fences BMP, Section C.4.2 Sandbag or Gravel Bag Barriers BMP and Section C.4.3 Straw Bale Barriers BMP), Fiber Rolls BMP (Section C.4.4) or Check Dams BMP (Section C.4.5) to break up slope length or flow; they may also include constructing a Sediment Trap BMP (Section C.4.6). Sediment barriers are typically placed below the toe of exposed and/or erodible slopes, downslope of exposed soil areas, around stockpiles, and at other appropriate locations along the perimeter of disturbed soil areas. All sediment barriers require periodic inspection and maintenance.

### C.4.1 Silt Fence

Description:

A silt fence is a linear sediment barrier of permeable fabric designed to intercept and slow the flow of sediment-laden sheet flow runoff. Silt fences allow sediment to settle from runoff before water leaves a disturbed soil area. Silt fences are more difficult to construct and maintain than most other sediment control options. This limits their use for short-term maintenance activities.

Appropriate Applications:

- Silt fences may be used for temporary stockpiles.
- For cleanup/repair of minor slides and slipouts, silt fences may be placed below the toe of exposed and erodible slopes or downslope of exposed soil areas to address long-term erosion concerns.
- Silt fences may be used as a temporary measure during roadside stabilization activities.
- Silt fences may also be considered when performing work in the vicinity of sensitive water bodies.
- Silt fences cannot be used under extremely muddy or rocky conditions where the fence cannot be properly anchored.

Implementation:

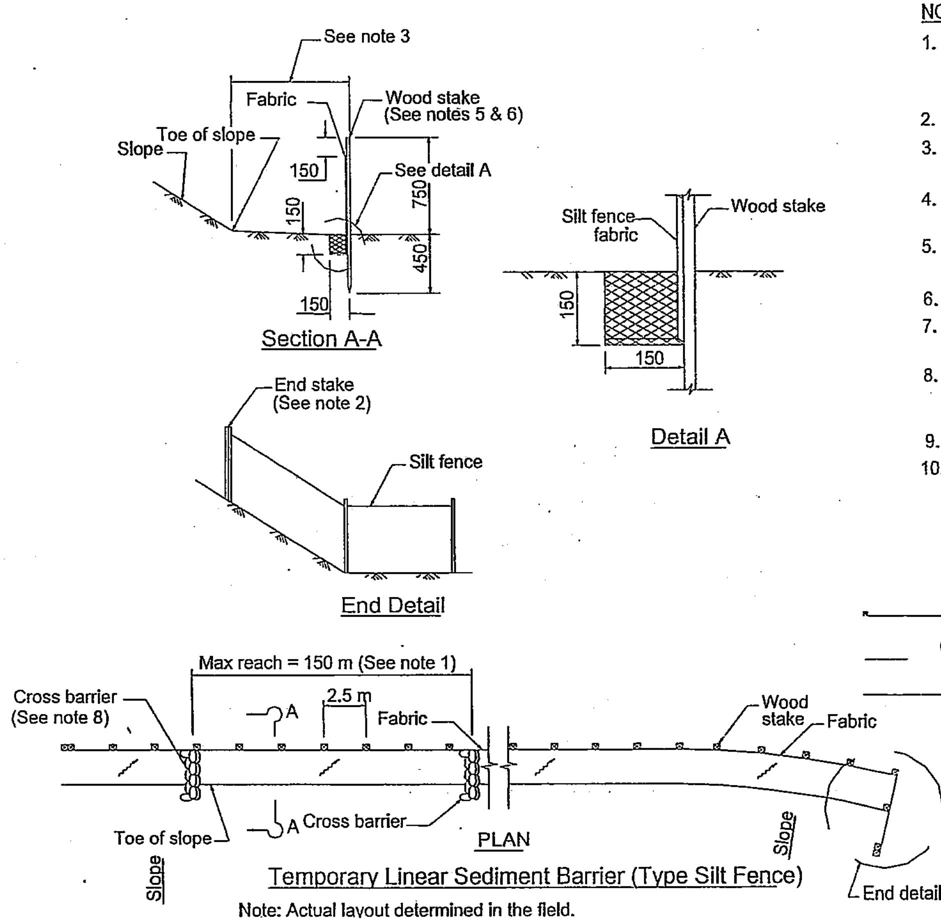
- Silt fences should be constructed with a setback of at least 1 meter (1.09 yds.) from the toe of a slope or stockpile (see Section C.17). Where a silt fence cannot have a 1-meter setback due to specific site conditions, the silt fence may be constructed as far from the toe of the slope as practicable.
- A conceptual silt fence is shown in Figure C-1. The notes on the figure provide guidance for the proper installation of silt fences.

Maintenance:

- Inspect silt fences to ensure they are functioning properly.
- Repair undercut silt fences. Repair or replace split, torn, slumping or weathered fabric.
- Remove sediment prior to accumulation reaching one-third of the fence height. Consideration should be given to incorporating removed sediment into the maintenance activity site.
- Remove a silt fence when it is no longer needed. Fill postholes and anchorage trench and remove sediment accumulation to conform to existing grade.



A001827




NOTES:

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the linear barrier, in no case shall the reach length exceed 150m.
2. The last 2.5 m of fence shall be turned up slope.
3. Locate away from toe of slope at least 1 m unless determined to be not practicable.
4. Stakes shall be spaced at 2.5 m maximum and shall be positioned on downstream side of fence.
5. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with staples.
6. Stakes and joints shall prevent flow through at joints.
7. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
8. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier. Cross barriers not needed if silt fence installed along a level contour.
9. Joining sections shall not be placed at sump locations.
10. Sandbag rows and layers shall be offset to eliminate gaps.

LEGEND
Tamped backfill
Slope direction
Direction of flow

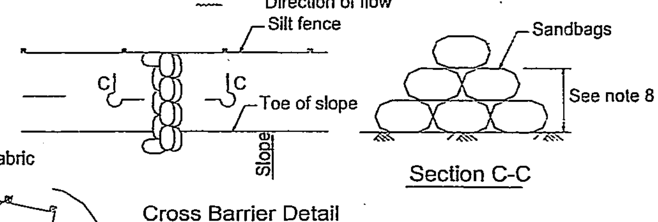



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**Figure C-1**
**Conceptual Temporary Linear Sediment Barrier (Silt Fence)**



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### C.4.2 Sandbag or Gravel Bag Barrier

Description:

A sandbag or gravel bag barrier is a linear sediment barrier consisting of stacked sand- or gravel-filled bags designed to intercept and slow the flow of sediment-laden sheet flow runoff. Sandbag and gravel bag barriers allow sediment to settle from runoff before water leaves a disturbed soil area. Sandbag or gravel bag barriers may also be used to divert the flow of water (see Section C.6.2 Ditches, Berms, Dikes and Swales BMP). Gravel bag barriers may be preferred because the gravel is easier to contain if the bag fails.

Appropriate Applications:

- Sandbag and gravel bag barriers are a temporary measure used to divert water and intercept sediment. They may be used during Drain and Culvert Maintenance, Drainage Ditch and Channel Maintenance, Irrigation Line Repairs, Roadside Stabilization, Sandblasting, Wet Blast with Sand Injection and Hydroblasting, Minor Slides and Slipouts Cleanup/Repair and Building and Grounds Maintenance. Other BMPs are preferred if the barrier is required for more than a few months.
- Sandbag and gravel bag barriers should be placed below the toe of slopes with exposed and erodible soil.
- Sandbag or gravel bag barriers may be placed around stockpiles at maintenance activity sites or maintenance facilities.
- They may also be used to protect drain inlets and ditch lines during maintenance activities at maintenance activity sites or maintenance facilities (see Section C.5 Storm Drain Inlet Protection BMP).
- Due to their density, sandbags are preferable to divert flows or to prevent flows from entering a storm water conveyance system or watercourse. Gravel bags are better suited for filtration purposes.

Implementation:

- Sandbag or gravel bag materials:
  - Bag material should be canvas, polypropylene, polyethylene, burlap or polyamide woven fabric.
  - Fill material should consist of clean coarse sand or gravel.
- A conceptual sandbag barrier is shown in Figure C-2. Notes on the figure provide guidance for implementation.

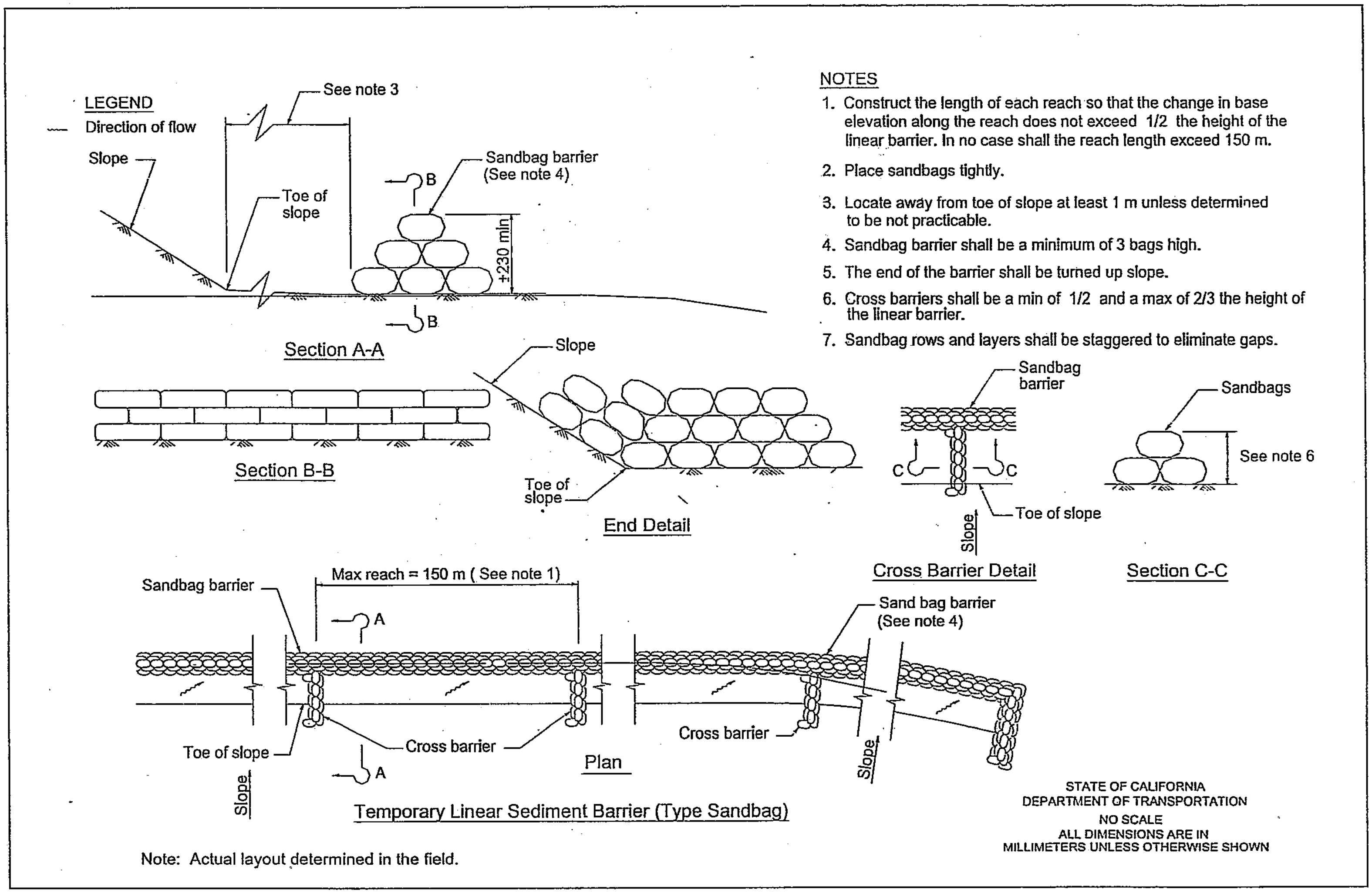



**Figure C-2**
**Conceptual Temporary Linear Sediment Barrier (Sandbag)**

Maintenance:

- Inspect sandbags and gravel bags to ensure the sediment barrier is functioning properly.
- Reshape or replace sandbags and gravel bags as needed.
- Repair washouts or other damage as needed.
- Consideration should be given to incorporating removed sediment into the maintenance activity site.
- Remove sandbags and gravel bags when no longer needed. Remove sediment accumulation, clean the maintenance activity site of debris, regrade if necessary and stabilize the area.

### C.4.3 Straw Bale Barrier

Description:

A straw bale barrier is a linear sediment barrier consisting of straw bales designed to intercept and slow the flow of and filter sediment-laden sheet flow runoff. Straw bale barriers allow sediment to settle from runoff before water leaves a disturbed soil area. Straw bale barriers are readily available and suitable for many short-term applications in maintenance activities. Straw bale barriers have the disadvantages of being bulky and heavy when wet.

Appropriate Applications:

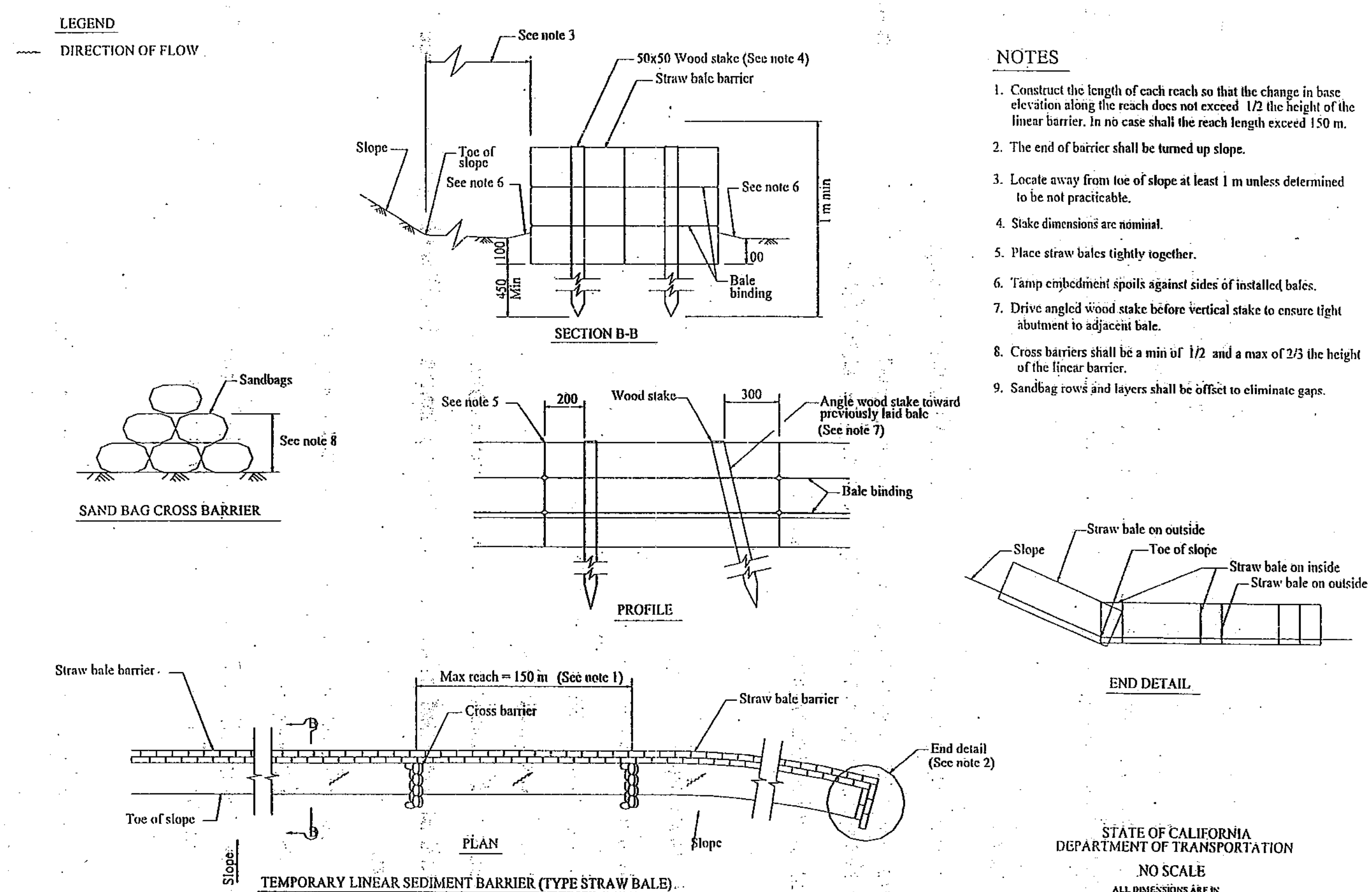
- Straw bale barriers are best suited for short-term applications and should not be placed into areas receiving concentrated flow.
- Straw bale barriers are typically placed below the toe of exposed and erodible slopes, downslope of disturbed soil areas (e.g., Minor Slides and Slipouts Cleanup/Repair).
- Straw bale barriers may be placed around stockpiles at maintenance activity sites or at maintenance facilities.
- Straw bale barriers may also be used to protect drain inlets(see Section C.5 Storm Drain Inlet Protection BMP) and ditch lines at maintenance activity sites or maintenance facilities during maintenance activities.

Implementation:

- A conceptual straw bale barrier is shown in Figure C-3. The notes on the figure are useful guidance for the placement and anchoring of larger barriers.

Maintenance:

- Repair or replace damaged straw bales as needed.
- Repair washouts or other damage as needed.
- Consideration should be given to incorporating removed sediment into the maintenance activity site.
- Remove straw bales when no longer needed. Remove or redistribute accumulated sediment to grade and stabilize the area.




NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 150 m.
2. The end of barrier shall be turned up slope.
3. Locate away from toe of slope at least 1 m unless determined to be not practicable.
4. Stake dimensions are nominal.
5. Place straw bales tightly together.
6. Tamp embedment spoils against sides of installed bales.
7. Drive angled wood stake before vertical stake to ensure tight abutment to adjacent bale.
8. Cross barriers shall be a min of 1/2 and a max of 2/3 the height of the linear barrier.
9. Sandbag rows and layers shall be offset to eliminate gaps.

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**Figure C-3**
**Conceptual Temporary Linear Sediment Barrier (Straw Bale)**



A001833

### C.4.4 Fiber Rolls

Description:

A fiber roll consists of commercially available straw (straw wattles), native grasses, flax or similar materials that are rolled or bound into a tight tubular roll and placed on the face of slopes at regular intervals. Fiber rolls intercept runoff, reduce flow velocity, release the runoff as sheet flow and provide some removal of sediment from the runoff. Fiber rolls are preferred at activity sites where the rolls may be left in place for assimilation into the site.

Appropriate Applications:

- Fiber rolls may be used for Minor Slides and Slipouts Cleanup/Repair.
- Fiber rolls may be used along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- Fiber rolls provide some sediment control.

Implementation:

- Fiber roll materials are either:
  - Prefabricated rolls; or
  - Rolled tubes of erosion control blanket.
- Assembly of field-rolled fiber roll:
  - Roll length of erosion control blanket into a tube.
  - Bind roll at each end (may be bound along length of roll with jute-type twine).
- Installation:
  - Install fiber rolls on level contours in a shallow trench.
  - Stake fiber rolls securely.
- A conceptual fiber roll installation is shown in Figure C-4. The notes on the figure are useful guidance for the installation of fiber rolls.

Maintenance:

- Replace or repair split, torn, unraveling or slumping fiber rolls.
- Fiber rolls should be inspected for sediment accumulation, that can render the fiber roll ineffective. Normally, removed sediment may be disposed of in accordance with the Department's solid waste management practices. However, if the sediment exhibits characteristics such as odor, color and texture that are not similar to the surrounding native soil, an unknown material may be present. Notify the District HazMat Manager immediately.

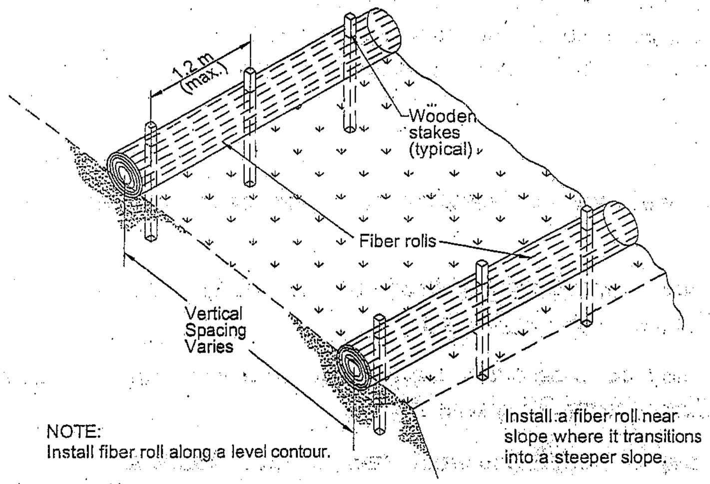


Figure C-4
**Conceptual Fiber Roll Installation**

### C.4.5 Check Dam

Description:

A check dam is a small, temporary device constructed of rock, fiber rolls, gravel bags or sandbags placed across a natural or man-made channel or drainage ditch. Restricting the flow velocity in the ditch line reduces erosion of the drainage ditch.

Appropriate Applications:

- Check dams shall not be installed in watercourses without required regulatory permits.
- Check dams are primarily considered for use during emergency situations (Minor Slides and Slipouts Cleanup/Repair).
- Check dams may be used when working in areas receiving concentrated flow (see Section C.9 Clear-Water Diversion BMP).
- Check dams may be installed in small open or steep channels.

Implementation:

- Check dams should be placed at a distance and height to allow small pools to form behind them.
- A conceptual rock check dam is shown in Figure C-5. The notes on the figure provide guidance for the implementation of check dams.

Maintenance:

- Remove sediment prior to accumulation reaching one-third of the check dam height and consider incorporating removed sediment into the maintenance activity site.
- Remove the check dam when no longer needed.

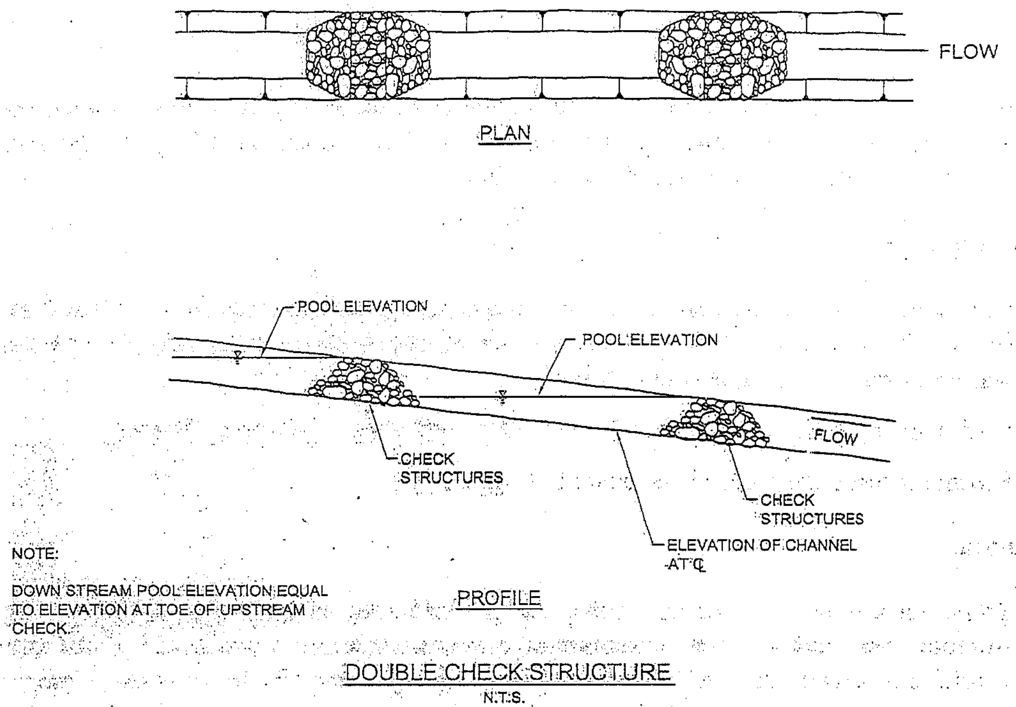


**Figure C-5**
**Conceptual Rock Check Dam**



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### C.4.6 Sediment Trap

Description:

A sediment trap is a basin formed by excavating or constructing an earthen embankment across a ditch line or low drainage area (see Figure C-6). A sediment trap is appropriate for long-term application at a maintenance activity.

Appropriate Applications:

- Sediment traps may be used where the contributing drainage area is less than 2 ha (5 acres). Traps should be placed where sediment-laden storm water may enter a storm water drainage system or watercourse.
- Sediment traps may be used for Minor Slides and Slipouts Cleanup/Repair.
- Sediment traps shall not to be located in waterways.

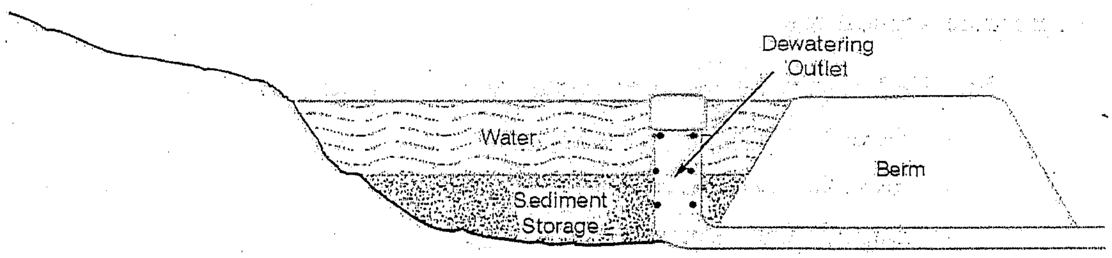
Implementation:

- Traps should be situated according to the following criteria: (1) by excavating a suitable area, such as a low embankment constructed across a swale; (2) where failure would not cause loss of life or property damage; and (3) to provide access for maintenance, including sediment removal and temporary storage of sediment in a protected area.
- Sediment traps should be adequately sized to allow settling of sediment.
- Trap inlets should be located to maximize the travel distance to the trap outlet. Rock or vegetation may be used to protect the trap outlets against erosion (see Section C.7.8 Riprap [Rock Slope Protection] BMP).
- To dewater the trap, the outlet may be constructed in one of the following two ways: (1) use a small diameter riser pipe with dewatering holes encased in gravel; or (2) construct a crushed stone outlet section of the embankment at the low point of the trap.

Maintenance:

- Check sediment trap for seepage and structural soundness.
- Check outlet structure and spillway for any damage or obstructions. Repair damages and remove obstructions as needed.
- Check outlet area for erosion and stabilize if required.
- Remove sediment prior to accumulating one-third the volume of the trap.
- Properly dispose of sediment and debris removed from the trap as follows:

- Dispose of debris in accordance with Section C.13.2 Solid Waste Management BMP.
- Incorporate sediment into the maintenance activity site or manage in accordance with Section C.13.2 Solid Waste Management BMP.




Note: Actual layout determined in the field

**Figure C-6**
**Conceptual Sediment Trap**

## C.5 STORM DRAIN INLET PROTECTION

Description:

This control practice is used in two ways: (1) to detain and/or to filter sediment-laden storm water runoff and (2) to prevent unpermitted non-storm water discharges into storm water drainage systems or watercourses.

Appropriate Applications:

This BMP may be implemented during the following activities:

- Flexible Pavement (A Family);
- Rigid Pavement (B Family);
- Slope/Drains/Vegetation (C Family);
- Traction Sand Trap Devices (F Family);
- Public Facilities (G Family);
- Welding or Grinding (H Family);
- Sawcutting for Loop Installation (K Family);
- Paint Striping/Marking (M Family);
- Minor Slides and Slipouts Cleanup/Repair (S Family);
- Vehicle and Equipment Maintenance and Repair (if required in the field) (T Family); and
- Aboveground and Underground Tank Leak and Spill Control (T Family).

- Storm drain inlet protection should be considered for activities where sediment-laden storm water may enter a drain inlet.
- Use this BMP only where ponding of water will not encroach into highway traffic or onto erodible surfaces or slopes.

Implementation:

- Impermeable covers should be used to prevent the unauthorized discharge of non-storm water.
- Storm drain inlets may be temporarily covered with spill pads and/or mats during maintenance activities.
- Storm drain inlets may also be protected by surrounding an inlet with one or a combination of the following:
  - Silt fence (storm water only);
  - Fiber rolls (storm water only);

- Straw bale barrier (storm water only);
- Polyurethane barrier (storm water or non-storm water);
- Rubber barrier (storm water or non-storm water);
- Sandbag or gravel bag barrier (gravel or aggregate preferred for storm water only); or
- Excavated culvert inlet sediment trap (storm water only).

Maintenance:

- Make sure silt fence stakes are securely driven into the ground. Replace damaged stakes.
- Repair fabric as needed. Replace or clean fabric prior to fabric becoming clogged with sediment.
- Check sandbags for proper installation. Replace damaged bags as needed.
- Remove sediment prior to accumulation reaching one-third of the fence height or before the volume of the basin has been reduced by one-half. Sediment removed shall be disposed of in accordance with Section C.13.2 Solid Waste Management BMP or incorporated in the maintenance activity site.
- Remove all inlet protection when no longer needed.

# C.6 CONCENTRATED FLOW CONVEYANCE CONTROLS

## C.6.1 Overside/Slope Drains

Description:

An overside/slope drain is a pipe used to intercept and direct surface runoff into a stabilized watercourse, a trapping device or a stabilized area. Overside/slope drains are typically used to intercept and direct surface flow away from slope areas to protect slopes. Overside/slope drains installed during maintenance efforts may be temporary. Maintenance staff may receive assistance from engineering for long-term installations or where installation is difficult.

Appropriate Applications:

- Slope drains may be used at sites where slopes have been eroded by surface runoff (Minor Slides and Slipouts Cleanup/Repair).
- Severe erosion may result if overside/slope drains fail (overside/slope drains shall be inspected and maintained).

Implementation:

- When installing overside/slope drains:
  - Limit drainage area per pipe. For areas larger than 4 ha (10 acre), use a lined channel or a series of pipes.
  - Use ditches, berms, dikes and swales to direct surface runoff into the overside/slope drain.
  - Secure the drain to the slope surface.
- Consider the following for installing overside/slope drains:
  - Install perpendicular to slope contours.
  - Protect area around inlet. Protect outlet with riprap or other energy dissipation device. For high-energy discharges, reinforce riprap with concrete or use reinforced concrete device.
  - Compact soil around and under entrance, outlet and along length of pipe.
  - Securely anchor and stabilize pipe and appurtenances into soil.

Maintenance:

- Regularly inspect overside/slope drains and maintain drains to ensure they are secured to the slope.

- Check outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventive measures are implemented.
- Check slope drain for accumulation of debris and sediment. Clean drains to maintain their capacity.

### C.6.2 Ditches, Berms, Dikes and Swales

Description:

Ditches, berms, dikes and swales are temporary or permanent measures used to intercept and direct surface runoff to an overside/slope drain or stabilized watercourse.

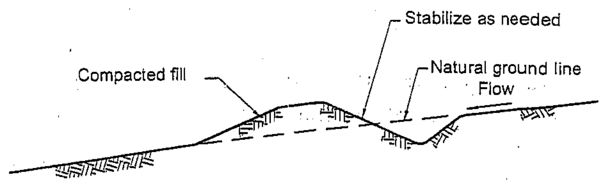
Appropriate Applications:

Ditches, berms, dikes and swales may be implemented for the following purposes:

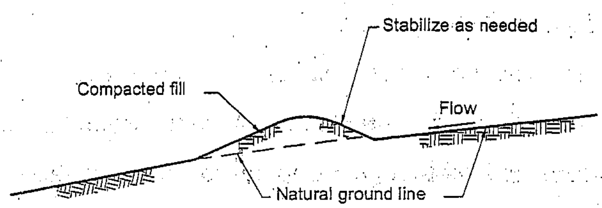
- To convey flow around maintenance activities;
- To divert flow away from maintenance stockpiles;
- At the top of slopes to divert run-on from adjacent slopes and areas;
- At bottom and mid-slope locations to intercept sheet flow and convey concentrated flows;
- At other locations to convey runoff to overside/drains, stabilized watercourses, storm water drainage system inlets (catch basins), pipes and channels;
- To intercept runoff from paved surfaces; and
- Along roadways and facilities subject to flood drainage.

Implementation:

- Evaluate risks due to erosion, overtopping, flow backups or washout.
- Consider outlet protection where localized scour is anticipated.
- Examine the site for run-on from off-site sources.
- Conveyances should be lined if high flow velocity is anticipated. Consider use of riprap, engineering fabric, asphalt concrete or concrete.
- Conceptual ditches, berms, dikes and swales are shown in Figure C-7.




Conceptual Diversion Ditch/Drainage Swale
Not to Scale




Conceptual Diversion Dike/Berm
Not to Scale

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**Figure C-7**
**Conceptual Ditches, Berms, Dikes and Swales**

### C.6.3 Temporary Diversion Ditches

Description:

These are temporary measures used to intercept and direct surface runoff to an overside (or slope) drain or stabilized watercourse.

Appropriate Applications:

Temporary diversion ditches may be implemented for one or more of the following purposes:

- To convey flow around maintenance activities (most commonly during Minor Slides and Slipouts Cleanup/Repair);
- To divert flow away from maintenance stockpiles;
- At the top of slopes to divert run-on from adjacent slopes and areas;
- At bottom and mid-slope locations to intercept sheet flow and convey concentrated flows;
- At other locations to convey runoff to overside drains, stabilized watercourses, storm water drainage system inlets (catch basins), pipes and channels; and
- To intercept runoff from paved surfaces.

Implementation:

- Evaluate risks due to erosion, overtopping, flow backups or washout.
- Consider protection where localized scour is anticipated.
- Examine the site for run-on from off-site sources.
- Conveyances should be lined if high flow velocity is anticipated. Consider use of riprap, engineering fabric, asphalt concrete or concrete.

## C.7 SOIL STABILIZATION

Disturbed soil areas should be inspected and evaluated for soil stabilization/revegetation to reduce erosion. At the completion of maintenance activities, disturbed soil areas should be stabilized. Stabilization is also required for Minor Slides and Slipouts Cleanup/Repair. Follow-up inspections should be performed to ensure that soil stabilization was successfully implemented.

Soil stabilization consists of preparing the soil surface and applying one of the following BMPs, or combination thereof, to disturbed soil areas or erodible slopes:

- Section C.7.1 Compaction;
- Section C.7.2 Wood Mulch;
- Section C.7.3 Hydraulic Mulch;
- Section C.7.4 Hydroseeding/Handseeding;
- Section C.7.5 Soil Binders;
- Section C.7.6 Straw Mulch;
- Section C.7.7 Geotextiles, Mats/Plastic Covers and Erosion Control Blankets; and
- Section C.7.8 Riprap (Rock Slope Protection).

In some instances, disturbed soil areas may contain seed that will naturally germinate under the right conditions. Maintenance staff may elect to allow natural germination to occur, but these areas must be inspected and otherwise repaired if vegetation does not sprout. Temporary sediment control BMPs will need to be implemented to avoid erosion from these areas while the vegetation is being established.

### C.7.1 Compaction

Description:

Soil may be compacted to reduce the potential for erosion and transport of sediment to drainage systems or watercourse.

Appropriate Applications:

- Compaction is not an alternative to restoring vegetation. Compaction is restricted to areas where vegetation is undesirable or is not sustainable.
- Compaction is appropriate for unpaved shoulder areas following shoulder grading activities, guard rail post installation and sign post installation.

Implementation:

- The effect of runoff from the compacted soil on nearby surface water should be considered.
- The area should be evenly graded or leveled prior to compaction.
- Compaction should not be performed while storm water runoff is observed.
- Compaction should be performed as soon as possible after grading or soil disturbance.
- Compaction may be combined with other BMPs (see Section C.7.2 Wood Mulch BMP and Section C.7.6 Straw Mulch BMP).

Maintenance:

- Compacted areas shall be inspected to identify any evidence of erosion upon the completion of maintenance activities.

## C.7.2 Wood Mulch

Description:

Wood mulch consists of applying chipped material or commercially available wood mulch products to reduce the potential for eroding the underlying soil. Wood mulch is readily available and has an attractive appearance. Wood mulch may be chosen over other stabilization measures to reduce germination of noxious weeds and the need for vegetation control measures.

Appropriate Applications:

- Wood mulch is appropriate for landscaping applications (Building and Grounds Maintenance).
- Wood mulch may be considered as an option for the Roadside Stabilization activity (see Section C.26 Vegetated Slope Inspection BMP).
- Wood mulch may also be considered as an option during Irrigation Line Repairs.
- Wood mulch should not be applied to steep slopes or placed into drainage paths that could receive concentrated flow. Wood mulch is prone to displacement under these conditions.

Implementation:

- Contact the District Landscape Specialist, District Erosion Control Specialist or Landscape Architect for the appropriate application rates. Use the recommended application rate.
- Wood mulch may be applied by hand, with blowers or with chippers.
- Avoid application onto hardscaped areas.

Maintenance

- Periodically inspect areas where mulch has been applied.

### C.7.3 Hydraulic Mulch

Description:

Hydraulic mulch is applied to disturbed soil areas that require protection. Hydraulic mulch consists of applying a mixture of natural or recycled fiber and a tackifier with hydro-mulching equipment. The mulch stabilizes the soil, reduces wind and water erosion and provides protection to seeds increasing survivability (see Section C.7.4 Hydroseeding/Handseeding BMP). It may be used as a temporary repair measure following maintenance activities (to be followed by other soil stabilization BMPs).

Appropriate Applications:

- Hydraulic mulch may be applied to steeper slopes than wood mulch.
- Hydraulic mulch can be applied to areas that receive more concentrated flow where wood mulch would be washed away.
- Hydraulic mulch may be an appropriate measure for Minor Slides and Slipouts Cleanup/Repair.
- Hydraulic mulch may be used for stockpiled soil (see Section C.17 Stockpile Management BMP).

Implementation:

- Contact the District Landscape Specialist, District Erosion Control Specialist or Landscape Architect for the appropriate application rates. Use the recommended application rate.
- Hydro-mulching equipment is used to apply hydraulic mulch.
- Avoid mulch over-spray onto hardscaped areas.

### C.7.4 Hydroseeding/Handseeding

Description:

Hydroseeding/Handseeding is a permanent soil stabilization method. Hydroseeding consists of applying a mixture of fiber, seed, fertilizer and stabilizing emulsion with hydro-mulching equipment. Other methods of seeding may also be used, including spreading by hand broadcasting or with a mechanical handspreader. Replacement planting is also covered under this BMP.

Appropriate Applications:

- Hydroseeding/handseeding may be used on erodible surfaces which require protection (e.g., Minor Slides and Slipouts Cleanup/Repair).

Implementation:

- Hydroseeding can be accomplished using a multiple-step or one-step process.
- Avoid over-spray onto hardscaped areas.
- Seed should be uniformly applied.
- Seed should be "scratched in" or covered with straw or soil (see Section C.7.6 Straw Mulch BMP).
- Contact the District Landscape Specialist or Landscape Architect for the appropriate seed type and application rate. The recommended seed type and application rate for the site conditions should be used.

Maintenance:

Seeded or planted areas should be inspected for failures and revegetated, fertilized or mulched.

### C.7.5 Soil Binders

Description:

Soil binders consist of applying and maintaining polymeric or lignin sulfonate soil stabilizers or emulsions.

Appropriate Applications:

Soil binders may be applied to disturbed soil areas or soil stockpiles requiring short-term protection.

A variety of soil binders are available for use. Prior to use, the manufacturers' specifications should be reviewed and compared to the site-specific conditions. In selecting a soil binder, the following criteria should be considered:

- Availability of product;
- Ease of cleanup;
- Degradability (how the product degrades and what its by-products are);
- Length of drying time;
- Erosion control effectiveness;
- Longevity;
- Mode of application and availability of application equipment; and
- Water quality impact.

Implementation:

- Apply soil binders per manufacturer's specifications.
- Soil binders shall be nontoxic to plant and animal life.
- Soil binders shall not be applied to frozen soil or areas with standing water.
- Soil binders should not be applied during or immediately before rainfall.
- Avoid over-spray onto hardscaped areas.

Maintenance:

Check protected areas to ensure proper coverage and re-apply soil binder as needed, or implement additional BMPs.

### C.7.6 Straw Mulch

Description:

The application of straw mulch consists of placing of a uniform layer of straw. It may be attached by wetting, with an organic tackifier or by mechanical means. It is effective for short-term applications and may be combined with other BMPs (e.g., Section C.7.4 Hydroseeding/Handseeding BMP).

Appropriate Applications:

- Straw mulch may be an appropriate temporary measure for responding to Minor Slides and Slipouts Cleanup/Repair.
- Straw mulch may be applied as a short-term measure to disturbed soil areas. It can be used in this manner for Building and Grounds Maintenance.
- Straw mulch may be used for Roadside Stabilization (see Section C.26 Vegetated Slope Inspection BMP).
- Straw mulch may also be used in combination with permanent seeding strategies (Section C.7.4 Hydroseeding/Handseeding BMP) to enhance plant establishment.
- Straw mulch can be applied to steeper slopes than wood mulch.

Implementation:

- Straw mulch should be derived from native grass, oat, wheat, rice or barley.
- Straw mulch with organic tackifier should not be applied during or immediately before rainfall.
- Avoid placing straw mulch onto hardscaped areas.

Maintenance:

- Straw mulch should be periodically inspected and maintained until permanent stabilization measures or repairs are successful.

### C.7.7 Geotextiles, Mats/Plastic Covers and Erosion Control Blankets

Description:

This BMP involves the placement of geotextiles, mats, chainlink fencing, plastic covers or alternative erosion control products to stabilize disturbed soil areas. These measures may be temporary or permanent.

Appropriate Applications:

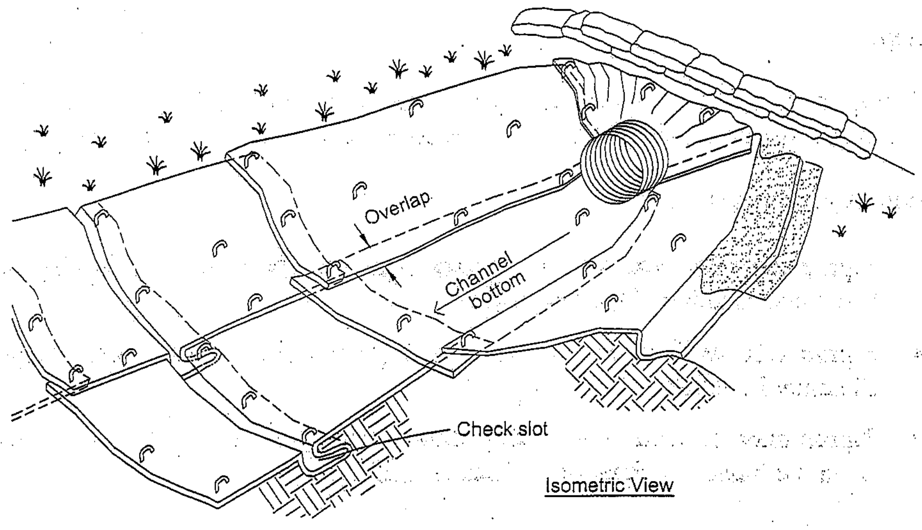
- These measures are used where disturbed soils may be particularly difficult to stabilize, including steep slopes, slopes where erosion hazard is high and slopes where mulch must be anchored. They may be used for Slides and Slipouts Cleanup/Repair or Roadside Stabilization (see Section C.26 Vegetated Slope Inspection BMP).
- Geotextiles, mats/plastic covers and erosion control blankets may also be used for disturbed soil areas where plants are slow to develop or where it is not the appropriate planting season.
- Geotextiles and mats/plastic covers may also be used in areas receiving concentrated flow.

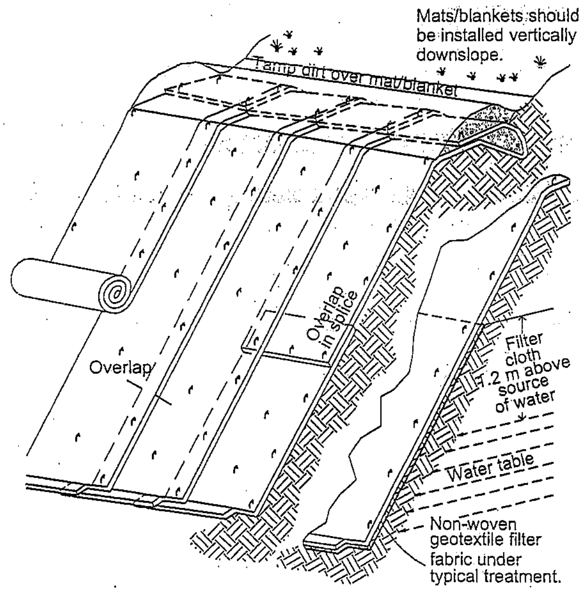
Implementation:

- These measures may be designed with input from geotechnical engineering or hydrology (especially if they are intended as permanent measures).
- Geotextiles, mats/plastic covers and erosion control blankets must be secured to the slope.
- Illustrations of conceptual geotextiles, mats/plastic covers and erosion control blankets are shown in Figure C-8.

Maintenance:

- Inspect for erosion and undermining. Ensure the controls are secured to the slope until permanent soil stabilization has been successfully attained.
- If washout or breaks occur, repair the damage to the slope or channel whenever possible and re-install the material.




Note: Actual layout determined in the field.

Figure C-8
**Conceptual Geotextiles, Mats/Plastic Covers and Erosion Control Blankets**

### C.7.8 Riprap (Rock Slope Protection)

Description:

Riprap is placed in locations that receive concentrated flows including ditches, channels, slides and slipouts to prevent scour or reduce the energy of storm water flows.

Appropriate Applications:

- Riprap may be used as a temporary measure when working in channels (Drainage Ditch and Channel Maintenance).
- Riprap can be used as a temporary or permanent measure for Slides and Slipouts Cleanup/Repair.
- Riprap may be used as a velocity dissipation measure on slopes and near pipe outlets or on the banks of channels to reduce erosion.

Implementation:

- Install riprap or grouted riprap.

Maintenance:

- Inspect riprap periodically and restore as necessary.
- Check for scour beneath riprap and repair damage as needed.

## C.8 PRESERVATION OF EXISTING VEGETATION

Description:

Preservation of existing vegetation is the identification and protection of desirable vegetation that provides erosion and sediment control benefits. For activities involving the removal of vegetation, the limits of disturbance should be defined to minimize adverse effects on vegetation outside the working area.

Appropriate Applications:

- Vegetation should be preserved during the following activities:
  - Shoulder Grading;
  - Drain and Culvert Maintenance;
  - Drainage Ditch and Channel Maintenance;
  - Chemical Vegetation Control;
  - Manual Vegetation Control;
  - Mechanical Vegetation Control/Mowing;
  - Tree and Shrub Pruning, Brush Chipping, Tree and Shrub Removal;
  - Public Facilities;
  - Minor Slides and Slipouts Cleanup/Repair; and
  - Buildings and Grounds Maintenance.
- Preserve existing vegetation where no maintenance activity is planned or where activities will occur at a later date. Preserve existing vegetation to the maximum extent practicable.

Implementation:

The following general steps should be taken to preserve existing vegetation:

- Ensure that the limits of disturbance are identified. Vegetation disturbed outside these limits should be replaced if damaged (see Section C.7.4 Hydroseeding/Handseeding BMP).
- Minimize disturbed areas by locating temporary roadways to avoid stands of trees and shrubs. Follow existing contours to reduce cutting and filling.
- Minimize the number of access and egress points and locate them to reduce damage to existing vegetation.
- Maintenance materials and equipment storage and parking areas should be located where they will not cause root compaction.

- Keep equipment away from trees to prevent trunk damage and root damage.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Avoid placing soil around trunks of trees.

## C.9 CLEAR-WATER DIVERSION

Description:

Clear-water diversion consists of a system of structures and measures that intercept clear water, transport it around a maintenance activity site and discharge it downstream with minimal water quality degradation. Structures commonly used as part of this system include diversion ditches, berms, dikes, slope drains and drainage and interceptor swales.

Appropriate Applications:

- Clear-water diversions would most likely be implemented during Minor Slides and Slipouts Cleanup/Repair.
- It is possible that a clear-water diversion may be implemented when working on a ditch line or channel.

Implementation:

- Clear-water diversions shall not be performed without required regulatory permits.
- Stationary equipment (such as motors and pumps) located within or adjacent to a water body should be positioned over drip pans.
- When any artificial obstruction is being constructed, maintained or placed in operation, sufficient water shall at all times be allowed to pass downstream to maintain aquatic life downstream.
- Disturbance or removal of vegetation should not exceed the minimum necessary to complete operations.
- Remove diversions when the maintenance activity is completed.

## C.10 WORK IN A WATER BODY

Description:

Maintenance activities occasionally require equipment or personnel to enter a stream, river, channel or other water body. This BMP describes measures that are required for maintenance activities in water bodies.

Appropriate Applications:

- Although working in a water body is not routine, Minor Slides and Slipouts Cleanup/Repair, Drainage Ditch and Channel Maintenance, Bridge Repairs and Draw Bridge Maintenance could require work in a water body.

Implementation

- Maintenance equipment shall not enter a water body without the required regulatory permits (*e.g.*, Army Corps of Engineers Clean Water Act Section 404 permit, California Department of Fish and Game Code Section 1601 Agreement, SWRCB Clean Water Act Section 401 Water Quality Certification). The Maintenance Storm Water Coordinator should be contacted to identify the appropriate permits.
- Evaluate alternatives to performing work in the water body.
- Tires shall be cleaned before entering a water body.
- Heavy equipment driven into a water body to accomplish work should be clean of petroleum residue.
- Water levels should be below the gear boxes of the equipment in use, or equipment lubricants and fuels should be sealed such that inundation by water shall not result in leaks.

## C.11 WIND EROSION CONTROL

Description:

Wind erosion control consists of applying water or other dust palliatives as necessary to prevent or alleviate dust nuisances. Covering of small stockpiles is an alternative to applying water or other dust palliatives. This BMP may be combined with Section C.4 Sediment Controls BMP.

Appropriate Applications:

- Wind erosion controls should be implemented for stockpiles of loose materials.
- This practice is also implemented on disturbed soils subject to wind erosion (including Shoulder Grading, Roadside Stabilization and Minor Slides and Slipouts Cleanup/Repair).

Implementation:

- Evaluate suspending work under windy conditions when loose materials are prone to erosion.
- All distribution equipment shall be equipped with a positive means of shutoff.
- At least one mobile unit should be available to apply water or dust palliative to the maintenance activity site.
- Only potable and nonpotable (uncontaminated) water shall be used. Reclaimed wastewater or otherwise contaminated water shall not be used.
- Materials applied as temporary soil stabilizers may also provide wind erosion control benefits (see Section C.7 Soil Stabilization BMPs).
- Do not apply excess water. Non-storm water discharges are prohibited.

Maintenance:

Inspect protected areas to ensure proper coverage.

## C.12 SEDIMENT TRACKING CONTROL

Sediment tracking controls are implemented to avoid tracking sediment from maintenance activity sites or maintenance facilities onto public roads or the highway. These controls include:

- Section C.12.1 Stabilized Activity Entrance/Exit; and
- Section C.12.2 Tire Inspection and Sediment Removal.

The Sweeping and Vacuuming BMP (see Section C.29) may also be applied as a tracking control. At least one of these BMPs should be implemented when off-road maintenance activities are likely to introduce sediment onto the highway. For extended maintenance activities or site conditions where considerable material tracking will occur, a combination of these BMPs should be considered.

## C.12.1 Stabilized Activity Entrance/Exit

Description:

This temporary control practice is a defined point of entrance/exit to a maintenance site that is stabilized to reduce the tracking of mud and soil onto public roads by maintenance vehicles.

Appropriate Applications:

- Use at maintenance activity sites where sediment may be tracked onto public roads by maintenance vehicles.

Implementation:

- Limit the points of entrance/exit to the maintenance activity site.
- Stabilize entrance/exits with wood chips, straw, rock aggregate, commercially available manufactured steel-ribbed plate or other suitable material.

Maintenance:

- Inspect entrance/exit for functionality.
- Replace or supplement rock aggregate as needed.
- Periodically clean steel-ribbed plates.
- Incorporate removed sediment or soil back into the maintenance activity site.

### C.12.2 Tire Inspection and Sediment Removal

Description:

Tires are inspected and sediment is removed to reduce tracking of sediment onto public roads or the highway.

Appropriate Actions:

- Tires should be inspected after the completion of off-road activities. Sediment should be removed as needed.

Implementation:

- Inspect tires prior to entering the roadway after off-road work.
- Use dry cleanup techniques to remove rock and sediment from tires prior to leaving the worksite.

## C.13 WASTE MANAGEMENT

Waste management consists of implementing procedural and structural BMPs for handling, storing and disposing of wastes generated by a maintenance activity to prevent the release of waste materials into storm water discharges. Waste management includes the following BMPs:

- Section C.13.1 Spill Prevention and Control;
- Section C.13.2 Solid Waste Management;
- Section C.13.3 Hazardous Waste Management;
- Section C.13.4 Contaminated Soil Management;
- Section C.13.5 Sanitary/Septic Waste Management;
- Section C.13.6 Liquid Waste Management; and
- Section C.13.7 Concrete Waste Management.

These controls shall be implemented for all applicable activities, material usage and site conditions.

### C.13.1 Spill Prevention and Control

Description:

Spill prevention and control procedures and practices are implemented to prevent and control spills in a manner that minimizes or prevents discharge to storm water drainage systems or watercourses at maintenance activity sites and maintenance facilities (see Section C.14.2 Material Use BMP for additional materials handling procedures).

Appropriate Applications:

- These controls apply at maintenance activity sites and at maintenance facilities.
- Spill prevention and control procedures are implemented wherever non-hazardous chemicals and/or hazardous substances are stored or used. Substances may include, but are not limited to, soil stabilizers, dust palliatives, pesticides, growth inhibitors, fertilizers, paints, de-icing chemicals, fuels, lubricants and other petroleum distillates.
- To the extent that the clean up work can be accomplished safely, wastes shall be contained and cleaned up immediately.

Implementation:

- In the event of a spill or leak, the Section C.5 Storm Drain Inlet Protection BMP should be implemented to prevent non-storm water discharge.
- If a spill or leak occurs in the containment area, accumulated rainwater shall be evaluated to determine appropriate disposal method.
  - If accumulated rainwater is hazardous, dispose of in accordance with the Section C.13.3 Hazardous Waste Management BMP.
  - If accumulated rainwater is chemically contaminated, but nonhazardous, dispose of in accordance with the Section C.13.6 Liquid Waste Management BMP.
- To the extent that cleanup activities and safety are not compromised, spills shall be covered and protected from storm water run-on during rainfall.
- Dry cleanup methods should be used when possible.
- Used cleanup materials, contaminated materials and recovered spill material that is no longer suitable for its intended purpose shall be disposed in accordance with the Section C.13.3 Hazardous Waste Management BMP or Section C.13.2 Solid Waste Management BMP, depending on waste characteristics.
- Contaminated water used for cleaning and decontamination shall not be allowed to enter storm water drainage systems or watercourses.
- Waste storage areas shall be kept clean, well organized and equipped with cleanup supplies that are appropriate for the materials being stored. Perimeter controls,

containment structures, covers and liners shall be repaired or replaced as needed to maintain proper function.

- Tarps and similar control measures should be used to prevent spills or material drift from being deposited into watercourses (e.g., during bridge maintenance).

Maintenance:

- Verify that spill control cleanup materials are located near material storage, unloading and use areas.
- Update spill prevention and control plans and stock appropriate cleanup materials whenever changes occur in the types of chemicals stored on site.

### C.13.2 Solid Waste Management

Description:

Solid waste management procedures and practices are designed to minimize or eliminate the discharge of pollutants to drainage systems or watercourses associated with the stockpiling or removal of maintenance activity wastes.

Appropriate Applications:

Solid waste management practices are implemented during maintenance activities that generate solid wastes. These solid wastes include, but are not limited to:

- Maintenance wastes, including brick, mortar, asphalt concrete, Portland cement, concrete, timber, steel and metal scraps, pipe and electrical cuttings, nonhazardous equipment parts, styrofoam, grindings, sandblast grit and other materials used to transport and package maintenance materials;
- Highway planting wastes, including vegetative material, plant containers and packaging materials; and
- Litter and debris, including food containers, beverage cans, coffee cups, paper bags and plastic wrappers.

Implementation:

- Use dry cleanup techniques (e.g., vacuuming, sweeping, dry rags) to remove solid waste from the maintenance activity site when practicable. Use another technique only when dry cleanup techniques are not practicable, such as having to wet for dust control for safety or air quality reasons.
- Recycle, reuse or properly dispose of solid waste.
- Storm water run-on shall be prevented from contacting stored solid waste through the use of ditches, berms, dikes and swales (see Section C.6 Concentrated Flow Conveyance Controls BMP).
- Solid waste storage areas at maintenance facilities should be located away from drainage facilities and watercourses and shall not be located in areas prone to flooding or ponding.
- Reuse of asphalt grindings shall be in accordance with the California Department of Fish and Game MOU.
- Reused asphalt grindings shall be compacted when the material is placed near water bodies (see Section C.7.1 Compaction BMP).

Maintenance:

- Periodically inspect the solid waste storage areas and review the disposal procedures.
- Repair or replace damaged or missing BMPs.

### C.13.3 Hazardous Waste Management

Description:

Hazardous waste management procedures and practices are designed to minimize or eliminate the discharge of pollutants at maintenance activity sites and maintenance facilities to storm water drainage systems or watercourses.

Appropriate Applications:

Hazardous waste management practices are implemented during maintenance activities and at maintenance facilities that generate or store hazardous waste from the use of petroleum products, asphalt products, concrete curing compounds, pesticides, acids, paints, solvents, wood preservatives, stains, roofing tar and any other materials considered a hazardous waste.

Implementation:

- At the Department's Maintenance Facilities, hazardous waste shall be stored in sealed containers constructed of a compatible material and shall be properly labeled in accordance with the Department's Maintenance Hazardous Waste Manual; Chapter 2 *Hazardous Waste Storage*.
- All hazardous waste shall be stored, transported and disposed in accordance with federal, state and local regulations. Refer to the Department's Maintenance Hazardous Waste Manual. For example, the Hazardous Waste Manual includes the following: Chapter 2 *Hazardous Waste Storage*; Chapter 3 *Disposal of Hazardous Waste*; and Appendix E Section D5.07 *Cleanup and Transport Requirements for Government Agencies*.
- Maintenance staff are to follow label instructions regarding the proper handling, mixing and application of materials which could generate hazardous waste and a discharge to waterways.
- Maintenance staff shall implement good housekeeping procedures and exercise care and caution when handling hazardous materials capable of generating wastes that could create a contaminated water discharge. For example: Paint brushes and equipment for water- and oil-based paints shall be cleaned within a contained area and associated waste shall not be allowed to contaminate site soils, watercourses or storm water drainage systems; containers shall not be overfilled.
- The District HazMat Manager is the Maintenance Division lead for Maintenance HazMat activities. Maintenance staff shall contact the HazMat Manager immediately if wastes are generated or encountered within the Department's Right of Way requiring special HazMat handling procedures.

Maintenance:

Periodically inspect the maintenance facility storage site to ensure all requirements are met and to review storage, disposal, and transport procedures.

### C.13.4 Contaminated Soil Management

Description:

These are procedures and practices to minimize or eliminate the discharges of pollutants from contaminated soil/sediment to storm water drainage systems or watercourses.

Appropriate Applications:

Contaminated soil/sediment generated during emergency response or other maintenance activities should be collected and managed for treatment or disposal.

Implementation:

- Work with the local regulatory agencies to develop options for treatment, reuse and/or disposal of contaminated soil. Disposal of contaminated soil shall be in accordance with the Section C.13.2 Solid Waste Management BMP or Section C.13.3 Hazardous Waste Management BMP, depending on soil characteristics.
- Avoid stockpiling contaminated soils or hazardous material.
- Do not stockpile in or near storm water drainage systems or watercourses.
- If temporary stockpiling is necessary:
  - Cover the stockpile with plastic sheeting or tarps; and/or
  - Install a berm or barrier around the stockpile to prevent runoff from leaving the area.

Maintenance:

Temporary stockpiles of contaminated soil should be inspected regularly and controls shall be repaired as needed.

### C.13.5 Sanitary/Septic Waste Management

Description:

Sanitary/septic waste management procedures and practices are designed to minimize or eliminate the discharge of sanitary/septic waste materials to storm drain systems or watercourses.

Appropriate Applications:

Sanitary/septic waste management practices are implemented for all maintenance activities that use portable sanitary/septic waste systems.

Implementation:

- Sanitary facilities shall be located away from drainage facilities and watercourses. When subjected to risk of high winds, sanitary facilities shall be secured to prevent overturning.
- Wastewater shall not be discharged (unless the discharge is to a permitted leach field or pond) or buried within the highway right-of-way.

Maintenance:

- Sanitary/septic waste should be discharged to a sanitary sewer or managed by a licensed hauler.
- Sanitary/septic waste storage and the disposal procedures should be managed to prevent non-storm water discharge.

### C.13.6 Liquid Waste Management

Description:

Liquid waste management procedures and practices are designed to prevent the discharge of pollutants to storm water drainage systems or watercourses as a result of the creation, collection or disposal of nonhazardous materials that may be unauthorized non-storm water discharges.

Appropriate Applications:

- Liquid waste management is applicable to maintenance activities that generate nonhazardous byproducts, residuals or wastes, including drilling slurries and drilling fluids; grease-free and oil-free wastewater and rinse water; dredging; and other non–storm water liquid discharges.
- Unpermitted non-storm water discharges are prohibited.

Implementation:

- Non-storm water discharges to drainage paths, drain systems and watercourses are prohibited.
- Drilling and saw cutting fluids:
  - Stick-down berms may be used to improve containment.
  - Fluids may be collected by vacuum or other methods.
  - Collected fluids shall be contained and recycled, evaporated or discharged to the sanitary sewer system with approval from the publicly-owned treatment works (POTW).
  - Fluids shall not be discharged to storm water drainage systems or watercourses.
- Vactor™ liquid wastes:
  a) A visual inspection of water drainage facilities shall be performed prior to cleaning. Caltrans operators are trained to visually inspect for petroleum products, odors, discoloration and other physical evidence of contamination. If chemical contamination is suspected, the operators will stop work and notify the Maintenance Supervisor. The Supervisor will follow existing Caltrans Hazardous Materials Spills procedures and coordinate removal of the contamination with the District Maintenance Hazardous Materials Coordinator.

  b) Liquid waste collected in the Vactor™ trucks may be evaporated or discharged to a Regional Water Quality Control Board approved temporary decanting location in the District. The Maintenance Supervisor shall ensure Vactor™

crews are aware of approved decanting procedures and the approved decanting location.

- Tunnel cleaning:
  - Discharge to storm water drainage systems or watercourses from tunnel maintenance is prohibited.
  - Storm drain inlets and systems shall be adequately protected from liquid waste discharges (see Section C.5 Storm Drain Inlet Protection BMP).
  - Nonhazardous spent solvents shall be captured and reused, recycled or disposed in accordance with federal, state and local requirements.
  - Refer to the Section C.14 Materials Handling BMPs for appropriate handling and storage of liquids at maintenance activity sites.
  - Refer to the Section C.13.7 Concrete Waste Management BMP for appropriate management of concrete waste.

Maintenance:

- At the completion of the task, remove deposited solids from containment areas and capturing devices.
- Check containment areas and capturing devices for damage and repair.

### C.13.7 Concrete Waste Management

Description:

Concrete waste management procedures and practices are designed to ensure that concrete wastes are properly handled and eliminate the discharge of concrete waste to storm water drainage systems or watercourses.

Appropriate Applications:

Concrete waste can be generated in various maintenance activities including Curb and Sidewalk Repair, Mudjacking and Drilling, Drain and Culvert Maintenance, Drainage Ditch and Channel Maintenance, Public Facilities, Sawcutting for Loop Installation, Sign Repair and Maintenance, Median Barrier and Guard Rail Repair, and Building and Grounds Maintenance.

Implementation:

- Contracts for concrete providers require contractors to appropriately manage any concrete waste and prohibit non-storm water discharges generated at the job site. The Department's *Standard Specifications Section 7-1.01G Water Pollution* requires compliance to applicable statutes relating to the prevention or abatement of water pollution.
- Portland cement concrete waste shall not be allowed to enter storm water drainage or watercourses.
- Concrete waste from grout pumping operations shall be contained.
- Concrete residue should be collected by vacuum or shovel for proper disposal. Concrete debris may be disposed of through on-site burial consistent with the requirements of Caltrans Standard Specification 15-3.02.
- Liquid waste can be contained in a bucket or drum with a tight-fitting lid for transport and approved off-site disposal. Plastic bags may be used if nothing else is available. Avoid breaking the bags by double-bagging and filling the bags to about one-fifth of their capacity. Allow solids to settle and recycle or dispose of in accordance with the Section C.13.2 Solid Waste Management BMP. The liquid waste may be evaporated. Decanted liquid waste shall be discharged to sanitary sewer only with the POTW's approval. Decanted liquid waste may also be removed for disposal as hazardous waste. Refer to the Section C.13.3 Hazardous Waste Management BMP.
- A temporary concrete washout facility may be constructed at the maintenance activity area. Below-grade concrete washout facilities are preferred. Above-grade facilities are used if excavation is not practical. Designated washout areas should be located at least 15 meters (50 feet) away from drainage facilities.
- Below-grade facilities consist of a pit excavated away from watercourses. Above-grade washout facilities should be bermed using sandbags or straw bales. Local

requirements or other environmental restrictions should be reviewed prior to placing concrete waste on the ground.

Maintenance:

The supervisor or the designee shall monitor the concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure that concrete waste is collected and disposed of properly.

## C.14 MATERIALS HANDLING

Materials handling consists of implementing procedural and structural BMPs for handling, storing and using maintenance materials in a manner that prevents the release of those materials into storm water.

### C.14.1 Material Delivery and Storage

Description:

Material delivery and storage procedures and practices are designed for the proper handling and storage of materials at the maintenance facility. These procedures and practices minimize or eliminate the discharge of these materials to storm water drainage systems or watercourses.

Appropriate Applications:

- These procedures are implemented at maintenance facilities involved in the delivery and storage of aggregate, pesticides, fertilizers, detergents, plaster, petroleum products, asphalt and concrete components, hazardous chemicals, concrete compounds or other materials that may be detrimental if released to storm water drainage systems or watercourses.
- Refer to Section C.14.2 Material Use BMP and Section C.17 Stockpile Management BMP for procedures that apply to any materials that are assembled for use at a maintenance activity site.

Implementation:

- Containment facilities shall provide for a spill containment volume equal to 110% of the largest container in the facility.
- Containment facilities shall be impervious to the materials stored there.
- Containment facilities should be maintained free of rainwater and spills.
- Rainwater in containment facilities should be inspected prior to discharge. Drain valves should remain closed except to release clean rainwater.
- Personnel at maintenance facilities shall be trained to ensure that materials are properly handled and stored.
- Separation should be provided between stored containers to allow for spill cleanup and emergency response cleanup.
- To provide protection from rain, bagged and boxed materials stored outdoors shall be stored on pallets throughout the rainy season.
- To provide protection from rain, bagged and boxed materials shall be covered prior to rain events.
- Storage areas shall be kept clean, well organized and equipped with cleanup supplies for the materials being stored. Perimeter controls, containment structures, covers and liners shall be repaired or replaced as needed.

Maintenance:

- Check to ensure that designated storage areas are kept clean and well organized.
- Repair and/or replace perimeter controls, containment structures and covers as needed to keep them functioning properly.

### C.14.2 Material Use

Description:

Material use procedures and practices are used at maintenance facilities and maintenance activity sites to prevent the discharge of materials to storm water drainage systems or watercourses.

Appropriate Applications:

These procedures are implemented at maintenance facilities and at maintenance activity sites where pesticides, fertilizers, detergents, plaster, petroleum products, asphalt and concrete components, hazardous chemicals, concrete compounds and other material that may be detrimental if released to the environment are used or prepared.

Implementation:

- Contract agreements with haulers who supply materials to maintenance activity sites should require them to supply materials in accordance with the requirements of this BMP.
- Latex paint and paint cans, used brushes, rags, absorbent materials and drop cloths shall be disposed of in accordance with federal, state and local requirements.
- Do not remove the original product label from a container as it contains important spill cleanup and disposal information. Make copies of the label information or material safety data sheet if needed. Use the entire product before disposing of the container. Appropriately label all secondary containers.
- Mix paint indoors or in a containment area. Do not clean paintbrushes or rinse paint containers where rinsate may discharge into a street, gutter, storm water drainage systems or watercourses. Rinsate from latex paint cleaning may be recycled or discharged to the sanitary sewer. Empty paint cans shall be dry prior to disposal as solid waste. See Section C.13.6 Liquid Waste Management BMP and Section C.13.2 Hazardous Waste Management BMP.
- Paint should be loaded into spray equipment at a maintenance facility. Nearby drain inlets should be protected at maintenance facilities and at maintenance activity site.
- Use materials only where and when needed to complete the maintenance activity. Consider the use of safer alternative materials (See Section C.21) when possible. Reduce or eliminate use of hazardous materials on site when possible.
- Keep a supply of spill cleanup material near material use areas. Train employees in spill cleanup procedures.
- Secure loads and cover loose materials in open-bed trucks during hauling to activity sites.

- Truck beds should be inspected after the completion of material delivery to avoid depositing materials on the roadway.
- Use proper loading and unloading techniques to prevent spills.

## C.15 VEHICLE AND EQUIPMENT OPERATIONS

Vehicle and equipment operations, procedures and practices are designed to minimize or eliminate the discharge of pollutants from vehicle and equipment cleaning, fueling and maintenance operations to storm water drainage systems or watercourses.

### C.15.1 Vehicle and Equipment Cleaning

Description:

Discharges to storm water drainage systems or watercourses from vehicle and equipment cleaning are prohibited. Vehicle and equipment cleaning procedures and practices are used to eliminate the discharge of pollutants from vehicle and equipment cleaning operations to storm water drainage systems or watercourses.

Appropriate Applications:

- These procedures apply whenever vehicle and equipment cleaning is performed.
- Waste generated during concrete washout must be managed in accordance with the Section C.13.7 Concrete Waste Management BMP. Non-storm water discharges of concrete washout are prohibited.

Implementation:

- Contractual provisions require contractors to use cleaning practices consistent with the requirements of this BMP when working at maintenance activity sites.
- When using solvents for cleaning vehicles and equipment, used solvents and by-products shall be captured and reused, recycled or disposed of according to the requirements of the Section 13.6 Liquid Waste Management BMP or Section C.13.3 Hazardous Waste Management BMP, depending on waste characteristics. Minimize use of solvents.
- When possible, truck beds should be cleaned using a dry cleanup technique (sweep up or shovel out).
- Vehicle and equipment washing shall occur only at designated rinsing areas, facility wash racks or other designated areas:
  - Whether at rinsing areas at the maintenance facility or the field, vehicle and equipment wash water shall be discharged to a sanitary sewer. If no connection to the sanitary sewer available, wash water should be contained for percolation (if preapproved by the RWQCB) or evaporative drying away from storm drain inlets or watercourses.
  - Facility wash racks shall discharge to a sanitary sewer, recycle system or other approved discharge system and shall not discharge to the storm water drainage systems or watercourses.
  - Concrete washout areas are described under Section C.13.7 Concrete Waste Management BMP.
- Minimize water use to reduce potential for unpermitted non-storm water discharges (e.g., provide a positive shutoff type of hose nozzle).

- Post signs for rinsing and wash areas that identify the allowable cleaning methods for the location and discharge prohibitions.

Maintenance:

- Regularly inspect and maintain the designated rinsing areas, facility wash racks, designated cleaning areas, wash pads, clarifiers, oil-water separators, sumps and sediment traps.

### C.15.2 Vehicle and Equipment Fueling

Description:

Vehicle and equipment fueling procedures and practices are designed to minimize or eliminate the discharge of fuel spills and leaks into storm water drainage systems or watercourses during equipment fueling and the bulk delivery of fuel.

Appropriate Applications:

These procedures apply at all maintenance sites where vehicle and equipment fueling occurs.

Implementation:

Bulk Fuel Delivery

- All aboveground and underground storage tanks shall be equipped with automatic overfill shutoff valves.
- Implement Section C.13.1 Spill Prevention and Control BMP to prevent spillage.
- Implement Section C.5 Storm Drain Inlet Protection BMP to prevent non-storm water discharges to the storm water drainage systems and watercourses.

Fueling Area Maintenance

- Label drains at fuel dispensing areas to indicate if they discharge to the storm drain or to the sewer.
- Storm drain inlets may be temporarily covered with spill pads and/or mats during fueling operations.
- Absorbent spill cleanup materials or drip pans shall be stored in fueling and maintenance areas and used materials shall be disposed in accordance with the Section C.13.3 Hazardous Waste Management BMP.
- Immediately clean up leaks and drips.
- Hosing off the fueling area is prohibited. Dry shop clean up practices should be used.
- Manage wastes to reduce adverse impacts on storm water quality (see Section C.13.2 Solid Waste Management BMP and Section C.13.3 Hazardous Waste Management BMP). Fueling areas should be kept free of litter and debris that might become contaminated with petroleum products.
- Maintain and implement a current spill response plan for fueling operations.

Refueling Practices

- Nozzles used at dedicated fueling areas shall be equipped with an automatic shutoff.
- Warnings against "topping off" fuel tanks should be posted at fuel dispensers.
- Fueling operations shall not be left unattended.
- Fueling in the field shall not be performed near unprotected drainage facilities or watercourses. See Section C.13.1 Spill Prevention and Control BMP and Section C.5 Storm Drain Inlet Protection BMP for pollution prevention and response requirements.

Maintenance:

- Inspect fueling facilities daily and correct deficiencies.
- Keep a supply of spill cleanup materials on site.

### C.15.3 Vehicle and Equipment Maintenance

Description:

Vehicle and equipment maintenance procedures and practices are designed to minimize or eliminate the discharge of pollutants to storm water drainage systems or watercourses from vehicle and equipment maintenance.

Appropriate Applications:

- These procedures are applied where equipment and vehicles are stored or repaired.
- These procedures should be implemented to avoid prohibited discharges to the storm water drainage system of fuel, oil, hydraulic fluid, brake fluid, antifreeze and wiper fluid.

Implementation:

Indoor Maintenance

- Maintenance should be performed in covered or indoor maintenance areas where potential pollutants cannot be introduced into storm water drainage systems.

Field or Outdoor Maintenance

- Drip pans or absorbent materials shall be used during vehicle and equipment maintenance work that involves fluids.
- See Section C.13.1 Spill Prevention and Control BMP for pollution prevention and response measures.
- The Section C.13.4 Contaminated Soil Management BMP should be used to address any contaminated soil resulting from vehicle or equipment repair.
- Use dry methods (e.g., dry rags, vacuuming or sweeping) for cleaning associated with maintenance in outdoor areas.

General Maintenance (in the field or in the yard)

- Vehicles and equipment shall be inspected for leaks on each day of use. Leaks should be repaired immediately; problematic vehicles or equipment shall be removed from the maintenance activity site.
- All parts washing should be performed in designated areas. Do not wash parts where wash waste cannot be captured. Use self-contained sinks or tanks when working with solvents.
- Non-storm water discharges into storm water drainage systems or watercourses are prohibited.

- Wastes should be collected and reused, recycled, removed or disposed of in accordance with the Section C.13.3 Hazardous Waste Management BMP.

Maintenance:

- Inspect areas following field maintenance areas to ensure there is no residual contamination that might impact storm water quality. Clean areas as needed using dry methods, (e.g., sweeping or vacuuming).
- Maintain waste fluid containers in leak-proof condition.
- Inspect equipment for damaged hoses and leaky gaskets. Repair or replace as necessary.

## C.16 PAVING OPERATIONS PROCEDURES

Description:

Paving operations procedures are designed to minimize pollution of storm water runoff during paving operations.

Appropriate Applications:

These procedures are implemented where paving, surfacing, resurfacing or saw cutting may pollute storm water runoff or discharge to storm water drainage systems or watercourses.

Implementation:

- Protect drainage inlet structures and manholes during paving operations including when seal coat, tack coat, slurry seal or fog seal is applied.
- Seal coat, tack coat, slurry seal or fog seal should not be applied if rainfall is predicted to occur during the application or curing period.
- When using asphalt release agents (e.g., citrus, soy-based or diesel) for cleaning and coating of equipment and tools, all products and by-products shall be captured and reused, recycled or disposed in accordance with the requirements of the Section C.13.3 Hazardous Waste Management BMP. Asphalt release agents shall not be discharged to the storm water drainage systems or watercourses.
- Clean pavers over absorbent pads, drip pans, plastic sheeting or other materials to collect residual cleaning wastes. Section C.5 Storm Drain Inlet Protection BMP should be used during cleaning to prevent any unauthorized non-storm water discharge. Dispose of removed material in accordance with the Section C.13.3 Hazardous Waste Management BMP.
- Pick up and reuse, recycle or dispose of cured material in accordance with the Section C.13.2 Solid Waste Management BMP.
- Prevent water used to clean emulsion kettles from discharging into storm water drainage systems or watercourses (see Section C.5 Storm Drain Inlet Protection BMP). Recycle products where possible to avoid discharge.
- Diesel fuel used in kettle cleaning shall be contained and reused, recycled or disposed of in accordance with the Section C.13.3 Hazardous Waste Management BMP.

Maintenance:

Maintain machinery regularly to minimize leaks and drips.

## C.17 STOCKPILE MANAGEMENT

Description:

Stockpile management procedures and practices are designed to reduce or eliminate pollution of storm water from stockpiles of vegetative wastes and paving materials.

Appropriate Applications:

- Stockpile management procedures are used for stockpiles of contaminated and uncontaminated soil.
- Stockpile management procedures are used for the stockpiling of vegetative waste and paving materials.
- Stockpile management procedures are used for materials removed from drains, ditches and culverts.
- Stockpile management procedures are used for waste piles.
- Stockpile management procedures are used for any other material or waste that could impact storm water quality (e.g., snow haul in the Lahontan Region).

Implementation:

- Do not locate stockpiles in areas of concentrated flows of storm water, drainage systems, inlets or watercourses.
- Do not locate stockpiles adjacent to sensitive water bodies.
- Divert storm water run-on away from stockpiles. See Section C.6.2, Ditches, Berms, Dikes and Swales BMP.
- Wind erosion control practices shall be implemented on stockpile material. See Section C.11, Wind Erosion Control BMP.
- Manage stockpiles of contaminated soil in accordance with the Section C.13.4, Contaminated Soil Management BMP.
- Minor slides/slipouts usually occur during major storms. Stockpiles should be removed as soon as practicable and materials should be placed so that waterways are not impacted (see Section C.4 Sediment Control BMP).
- During rain events, stockpiles of "cold mix" asphalt (i.e., pre-mixed aggregate and asphalt binder) shall be covered. Any deviation from this BMP for "cold mix" shall be coordinated with the RWQCB.
- During rain events, soil stockpiles shall be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier.

- During rain events, stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base or aggregate subbase shall be covered or protected with a temporary perimeter sediment barrier.

Maintenance:

Repair and/or replace perimeter controls and covers as necessary to keep them functioning properly.

## C.18 WATER CONSERVATION PRACTICES

Description:

Water conservation practices minimize water use during a maintenance activity to avoid causing erosion and/or the transport of pollutants into the drainage system and watercourses. Non-storm water discharges to storm water drainage systems and watercourses are prohibited unless the discharge is authorized by a separate National Pollutant Discharge Elimination System (NPDES) permit, exempted or conditionally exempt as provided in the Caltrans Statewide Storm Water Permit.

Appropriate Applications:

- All maintenance activities should practice water conservation.
- Unpermitted non-storm water discharges are prohibited.

Implementation:

- Keep water application equipment in good working condition.
- Avoid using water to clean maintenance areas. Use dry cleanup methods where practical. Sweep paved areas.
- Use the minimum amount of water needed to complete each maintenance activity.

Maintenance:

- Repair water supply and distribution equipment to minimize the loss of water.

## C.19 POTABLE WATER/IRRIGATION

Description:

In accordance with Table 5-2 of the Statewide SWMP, some non-storm water discharges are conditionally exempt by the Permit. The conditionally exempt non-storm water discharges include irrigation water, potable water sources and water from line and hydrant flushing. This BMP is intended to reduce the possibility for the discharge of potential pollutants associated with conditionally exempt discharges from irrigation systems, planned and unplanned discharges from potable water sources and water line or hydrant flushing.

Appropriate Applications:

This BMP should be implemented on a site-specific basis whenever the above activities or discharges occur.

Implementation:

- When possible, flushed water should be applied for landscaping purposes.
- Shut off the water source to isolate a broken line, sprinkler or valve as soon as possible to minimize the loss of water.
- Repair broken water lines as soon as possible.
- Protect downstream storm water drainage systems and watercourses from water pumped or bailed from trenches excavated to repair water lines.
- Manage irrigation systems to ensure the appropriate amount of water is used and runoff is minimized.

## C.20 STORM DRAIN STENCILING

Description:

Stenciled messages at storm drain inlets are intended to educate the public about storm water runoff pollution. Where required, warnings prohibiting discharges to storm drains should be placed near inlet structures.

Appropriate Applications:

Storm drain stenciling is approved for park-and-ride lots, safety roadside rest areas, vista points, commercial vehicle enforcement facilities and along roads and highways legally accessible by the public in developed communities with a population greater than 10,000 or that traverse through cities, towns and communities with populations of 10,000 or more, or less if the area is covered by a MS4 permit. Stenciling is not required in areas where pedestrians are prohibited.

Implementation:

Warnings to discourage illegal discharges should be stenciled onto or adjacent to drain inlets where appropriate. The goal is to increase public awareness of how rainfall runoff can carry litter, automotive fluids, motor oil and other contaminants into waterways.

Maintenance:

Stenciling should be inspected and replaced when unreadable.

## C.21 SAFER ALTERNATIVE PRODUCTS

Description:

A variety of products that may be harmful to the environment if they come into contact with surface waters are used in maintenance facilities and activities. In some cases, a less harmful product that serves the same purpose can replace a harmful product. The less harmful product is referred to as a safer alternative product. The primary purpose of using safer alternative products is to reduce the potential for the discharge of toxic products to drainage paths, storm water drainage systems or watercourses.

Appropriate Applications:

Safer alternative products should be considered for all maintenance activities. For example, when safer alternative products exist for cleaning products, paints, herbicides, automotive products and fertilizers, they should be used where practical and effective. Alternative products may not be available, effective or cost effective in every situation.

Implementation:

- Create awareness among employees regarding the benefits of safer alternative products. Safer alternative product awareness will be incorporated into the Maintenance Division storm water staff training program. For example the use of lower phosphate detergents where applicable at facilities and the use of water based cleaners versus halogenated solvents (cleaning fluids).
- The materials used on Maintenance projects shall conform to approved materials in the current *State of California, Department of Transportation, Standard Specifications*. The Department's Translab has an established testing protocol for product review and testing before a material becoming a standard material for use. For example, the Standard Specifications include approved asphalt mixtures and thermoplastic striping materials.
- The use of a safer alternative product may still result in the discharge of harmful materials to drainage paths, storm water drainage systems or watercourses. All products are to be used in accordance with manufacturers' recommendations.

## C.22 DRAINAGE FACILITIES

These BMPs address the maintenance of drainage facilities to reduce the potential for pollutant discharge. Drainage Facilities BMPs include Baseline Storm Water Drainage Facilities Inspection and Cleaning BMP (Section C.22.1), Enhanced Storm Drain Inlet Inspection and Cleaning Program BMP (Section C.22.2), Illicit Connection Detection, Reporting and Removal BMP (Section C.22.3) and Illegal Spill Discharge Control BMP (Section C.22.4).

### C.22.1 Baseline Storm Water Drainage Facilities Inspection and Cleaning

Description:

Culverts, ditches, gutters, underdrains, horizontal drains and downdrains require inspection and cleaning to prevent flooding and to provide for sufficient hydraulic capacity.

Appropriate Applications:

These procedures are applicable to maintenance personnel who conduct storm water drainage system facilities inspection and cleaning. BMP implementation will depend on traffic, weather, available resources, safety conditions and access to storm water drainage systems.

Implementation:

- Inspect culverts, ditches, gutters, underdrains, horizontal drains, downdrains and outlets annually and as needed during the winter season to determine if cleaning is required or if damage has occurred.
- Clean culverts to maintain sufficient hydraulic capacity of the culvert.
- Inspect ditches and gutters to maintain sufficient hydraulic capacity. Schedule routine ditch-cleaning activities designed to maintain sufficient hydraulic capacity of ditches prior to the rainy season.
- When cleaning drainage ditches below cut slopes or steep slopes, avoid cutting the toe of the slope. This can also prevent damage to the ditch.
- Water used and the material generated during drainage facility cleaning should be collected and managed per the requirements of the Section C.13.2 Solid Waste Management and Section C.13.6 Liquid Waste Management BMPs.
- Where waterways are affected, coordinate maintenance activities with the appropriate regulatory agency.
- Temporary stockpiles of removed material should be managed per the requirements of the Section C.17 Stockpile Management BMP.
- The Maintenance Supervisors in charge of the activity will provide Vactor™ operators with written instructions identifying pre-approved decanting sites.
- Maintenance Supervisors will work with the District Maintenance Storm Water Coordinator in establishing approved decanting sites for Vactor™ waste.

### C.22.2 Enhanced Storm Drain Inlet Inspection and Cleaning Program

Description:

Caltrans will implement an annual storm drain inlet inspection and cleaning program in the metropolitan areas of San Diego, Orange, Los Angeles and Ventura Counties.

Appropriate Applications:

Within the target counties, an annual inspection and cleaning program should be implemented. This program will not address left shoulder, median or ramp inlets that require lane closures for access. Right shoulder inlets and other inlets that do not require lane closures should be inspected and the impact of litter and debris from these inlets should be assessed in the Monitoring and Research Program. Inspection and cleaning activities should be reported annually by county, route and post mile.

Implementation:

- Inspect drain inlets annually in the target counties to determine if cleaning is required or if damage has occurred.
- Clean inlets with 12 inches or more of accumulated material.
- Maintain records and a database of inspection and cleaning information.

### C.22.3 Illicit Connection Detection, Reporting and Removal

Description:

This procedure directs maintenance staff to detect and report illicit connections and illegal discharges into Caltrans storm water drainage systems. Illicit connections are connections to Caltrans drainage systems that have not been approved by Caltrans.

This management practice is directed at continuous or recurring discharges through direct connections to storm water drainage systems or as run-on from adjacent properties.

Appropriate Applications:

Detecting and reporting illicit connections applies to all field activities performed by maintenance staff. If an illicit connection is discovered, it shall be reported.

Implementation:

- Maintenance personnel, as part of their routine inspections and maintenance work, shall report all observed suspected illicit connections to the District Maintenance Storm Water Coordinator, who will forward these observations to the NPDES Storm Water Coordinator. A Storm Water Pollution/Drainage report has been has been developed for use in this activity.
- All public-initiated calls should be directed to the District's Public Affairs Officer. Calls regarding illicit connections should be logged and routed to the NPDES Storm Water Coordinator.
- Response and permitting or removal of illegal connections will be in accordance with Section 1.3.3 of the Statewide SWMP.

### C.22.4 Illegal Spill Discharge Control

Description:

This procedure calls for maintenance field staff who detect illegal dumping, discharges and spills of pollutants on Caltrans properties and facilities to report them.

This BMP is directed at incidents involving dumping, discharges or spills that affect storm water.

Appropriate Applications:

- Any spills or dumped materials that are observed by maintenance personnel shall be reported.

Implementation:

- Maintenance supervisors shall report to the District Maintenance Storm Water Coordinator any field personnel observed illegal dumping or spilling of materials as part of their routine inspections and maintenance work. The District Maintenance Storm Water Coordinator will forward these observations to the District NPDES Coordinator. A Storm Water Pollution/Drainage Problem report form has been developed for this use.
- If suspected hazardous materials or hazardous waste dumping has occurred, Maintenance Supervisors shall also report the incident to the District Maintenance Hazardous Materials Manager.
- Spill cleanup shall be handled in accordance with the legal authority presented in Section 2.6 of the SWMP.

## C.23 TREATMENT SYSTEM MAINTENANCE

The treatment systems represent the approved treatment BMPs that were identified as technically and fiscally feasible in reducing constituents of concern to improve water quality. See Guidelines, Section 5, for more details. The Treatment System Maintenance BMPs include Vegetated Treatment Systems BMP (Section C.23.1), Infiltration Basins BMP (Section C.23.2), Detention Devices BMP (Section C.23.3) and Traction Sand Traps BMP (Section C.23.4).

Prior to intrusive maintenance at any BMP, maintenance personnel should check with a District biologist to ensure there are no endangered species, threatened species or species of special concern within the BMP maintenance area. For applicable areas, emergent habitat could attract endangered or threatened species, or species of concern whose residence would prevent necessary maintenance. If BMP function will not be impaired, remove habitat or discourage attraction as recommended by District Environmental.

### C.23.1 Vegetated Treatment Systems (Biofiltration Swales and Strips)

Description:

These measures are intended to maintain established swales as effective devices for treating runoff discharges. These requirements for inspection and maintenance will allow the devices to continue to function as designed for water quality purposes.

Appropriate Application:

The BMP maintenance activities described in Table C-61 apply to personnel that inspect and maintain vegetative treatment systems. Chemical vegetative control measures will not be used on vegetated treatment BMPs except where Caltrans is directed by the California Department of Food and Agriculture to treat the BMPs for invasive weeds. Fire control strips up to 2.4 meters (8 feet) wide may be maintained through pesticide applications adjacent to biofiltration swales. The areas used for fire control will not be considered as part of the treatment system. Caltrans will report the use of chemicals in its Annual Report.

Implementation:

Field measurements of maintenance indicators are made by visual observation. Frequencies provided are for the minimum required level of service. Greater maintenance frequencies may be required depending on the particular site and level of traffic.

**TABLE C-61: VEGETATED TREATMENT SYSTEMS MAINTENANCE**

| Maintenance Indicator | Measurement Frequency | Maintenance Activity |
|---|---|---|
| Presence of overgrowth or woody species. | Inspect two times per year. | Mow grass, grass-lined swales and strips to an average height no less than 100 mm (4 inches). |
| Debris/trash present in inlet or outlet structures. | Inspect two times per year. | Remove and dispose trash and debris to permit free flow. |
| Bare areas as a result of excessive erosion or sedimentation and/or ponding/vector problems. | Inspect ditches and channels two times per year for shape and serviceability to detect conditions that may cause scour, undermining, washout or other damage to the highway or facilities by water or wave action. | Repair deficiencies promptly. Clean, reshape and revegetate lined ditches and channels when needed. Maintenance activities are preferably conducted in the summer prior to winter rainfalls. |

## C.23.2 Infiltration Basins

Description:

These measures are intended to maintain infiltration basins as effective devices for treating runoff discharges. These requirements for inspection and maintenance will allow the devices to continue to function as designed for water quality purposes.

Appropriate Applications:

The BMP maintenance activities described in Table C-62 apply to personnel who inspect and maintain infiltration devices.

Implementation:

Field measurements of maintenance indicators are made by visual observation.

**TABLE C-62: INFILTRATION BASIN MAINTENANCE**

| Maintenance Indicator | Measurement Frequency | Maintenance Activity |
|---|---|---|
| Sediment volume exceeds design capacity. | Inspect annually. | Remove accumulated sediment. |
| Debris/trash present. | Inspect during routine trash collection. | Remove and dispose trash and debris. |
| Standing water 72 hours after a storm event. | Inspect 72 hours after one significant storm per year. | • Drain facility, if possible.<br>• Notify engineer to consider:<br>- Remove sediment, scarify invert and regrade if necessary.<br>- If unable to achieve acceptable infiltration rate or implement alternative solution then move to decommission.<br>- If standing water can not be removed than notify vector control authority[1]. |
| Borrows, holes, or mounds. | Inspect annually and after vegetation trimming. | Where burrows cause seepage, erosion and leakage, backfill firmly. |
| General maintenance items: Inlet/outlet structural integrity, side slopes or other features damaged, significant erosion, graffiti or vandalism, etc. | Inspect semi-annually. | Take corrective action prior to wet season. Consult engineer if immediate solution is not evident. |



A001904

TABLE C-62: INFILTRATION BASIN MAINTENANCE

| Maintenance Indicator | Measurement Frequency | Maintenance Activity |
|---|---|---|
| Evidence of erosion. | Inspect before rainy season. | Reseed/revegetate barren spots as appropriate for the area. Scarify surface if needed. If after two applications (2 seasons) of reseeding/revegetating growth is still unsuccessful, consider installation of an erosion blanket or equivalent protection over eroding areas. No erosion blanket should be installed in the basin invert. |
| Average plant height is greater than 12 inches. | Inspect once during wet season and once during dry season. | Cut or remove vegetation and clippings as appropriate. |

1 MONITORING AND ABATEMENT OF VECTORS MAY BE DONE THROUGH AGREEMENT WITH THE LOCAL VECTOR CONTROL AUTHORITY.

### C.23.3 Detention Devices

Description:

These measures are intended to maintain effective detention devices for treating runoff discharges. These requirements for inspection and maintenance will allow the devices to continue to function as designed for water quality purposes.

Appropriate Application:

The BMP maintenance activities described in Table C-63 apply to personnel who inspect and maintain detention devices.

Implementation:

Field measurements of maintenance indicators are made by visual observation.

TABLE C-63: DETENTION DEVICE MAINTENANCE

| Maintenance Indicator | Measurement Frequency | Maintenance Activity |
|---|---|---|
| Sediment volume exceeds design capacity. | Inspect annually. | Remove accumulated sediment. |
| Trash/debris present. | Inspect during routine trash collection. | Remove and dispose trash and debris. |
| Standing water 72 hours after a storm event. | Inspect 72 hours after one significant storm per year. | • Drain facility.<br>• Check and unclog clogged orifice.<br><br>Notify engineer, if immediate solution is not evident. |
| Borrows, holes, or mounds. | Inspect annually and after vegetation trimming. | Where burrows cause seepage, erosion and leakage, backfill firmly. |
| General maintenance items: Inlet/outlet structural integrity, side slopes or other features damaged, significant erosion, graffiti or vandalism, etc. | Inspect semi-annually. | Take corrective action prior to wet season. Consult engineer if immediate solution is not evident. |
| Evidence of erosion. | Inspect before rainy season. | Reseed/revegetate barren spots as appropriate for the area. Scarify surface if needed.<br>If after two applications (2 seasons) of reseeding/revegetating growth is still unsuccessful, consider installation of an erosion blanket or equivalent protection over eroding areas. No erosion blanket should be installed in the basin invert. Contact environmental or landscape architect for appropriate seed mix. |

## TABLE C-63: DETENTION DEVICE MAINTENANCE

| Maintenance Indicator | Measurement Frequency | Maintenance Activity |
|---|---|---|
| Average plant height is greater than 12 inches. | Inspect once during wet season and once during dry season. | Cut or remove vegetation and clippings as appropriate. |

### C.23.4 Traction Sand Trap Devices

Description:

This BMP is intended to maintain sand trap devices as effective devices for treating runoff discharges. These requirements for regular inspection and maintenance will allow the devices to continue to function as designed.

Appropriate Applications:

The BMP maintenance activities described in Table C-64 apply to personnel who inspect and maintain traction sand trap devices.

Implementation:

Field measurements of maintenance indicators are made by visual observation.

**TABLE C-64: TRACTION SAND TRAP DEVICE MAINTENANCE**

| Maintenance Indicator | Measurement Frequency | Maintenance Activity |
|---|---|---|
| Sediment volume exceeds design capacity. | Inspect annually and after significant storms. | Remove accumulated sediment. |
| Standing water 72 hours after a storm event. | Inspect 72 hours after one significant storm per year. | • Drain facility, if possible.<br>• Notify engineer to consider:<br>- Remove sediment and restore infiltration capacity.<br>- If unable to achieve acceptable infiltration rate or implement alternative solution then move to decommission.<br>- If standing water can not be removed then notify vector control authority[1]. |
| General maintenance items: Inlet/outlet structural integrity, damaged structures, graffiti or vandalism, etc. | Inspect semi-annually. | Take corrective action prior to wet season. Consult engineer if immediate solution is not evident. |

1 MONITORING AND ABATEMENT OF VECTORS MAY BE DONE THROUGH AGREEMENT WITH THE LOCAL VECTOR CONTROL AUTHORITY.



A001908

## C.24 LITTER AND DEBRIS REMOVAL

Litter and debris removal consists of removing and properly disposing of Litter and implementing procedures to discourage littering to reduce the discharge of potential pollutants. Litter and Debris removal BMPs include Litter and Debris BMP (Section C.24.1) and Anti-Litter Signs BMP (Section C.24.2).

### C.24.1 Litter and Debris

Description:

These measures are intended to reduce the discharge of litter to storm water drainage systems or watercourses.

Appropriate Applications:

This BMP should be implemented on a site-specific basis whenever litter and debris removal activities are performed. The frequency of removal is dependent on the availability of resources, safety considerations and rate of accumulation.

Implementation:

- Remove litter and debris from drainage grates, trash racks and ditch lines to reduce discharge to the storm water drainage systems and watercourses.
- Secure or cover transported materials, equipment and supplies to and from maintenance activity sites to prevent spillage to the roadway.

### C.24.2 Anti-Litter Signs

Description:

Caltrans conducts a signage program that warns against dumping and littering (e.g., "No Dumping" and "$1,000 Fine for Littering"). These signs are placed along highways where littering violations are frequent. The purpose of this program is to discourage littering by educating motorists about the fine for littering.

The Care for California Program displays signs showing an image of trash being placed into a garbage can. These signs encourage positive behavior.

Appropriate Applications:

Anti-litter signs may be placed:

- Along corridors that receive an unsightly amount of litter.
- Along freeways, safety roadside rest areas, vista points and park-and-ride facilities.

Implementation:

Maintenance Supervisors travel highways in their assigned section to observe overall conditions and assess the need for litter removal and installation of anti-litter signs. Anti-litter signs can be requested when litter removal becomes a concern.

## C.25 CHEMICAL VEGETATION CONTROL

Description:

This practice is intended to reduce the potential for the discharge of pollutants generated during chemical vegetation control. This method of vegetation control uses herbicides to eliminate and prevent weed growth. The purpose is to control weed growth that may threaten the growth and health of preferred vegetation, that may become a fire hazard or raise other safety concerns.

Appropriate Applications:

The BMPs should be implemented on a site-specific basis whenever chemical vegetation control activities are performed. Chemical vegetative control measures will not be used on vegetated treatment BMPs (see Section C.23 Treatment System Maintenance BMP) except where Caltrans is directed by the California Department of Food and Agriculture to treat the BMPs for invasive weeds. Caltrans will report the use of these required chemicals in its Annual Report.

Implementation:

- Caltrans has an Integrated Vegetation Management Plan that integrates manual, chemical, mechanical, cultural and biological methods to provide the most effective pest management approach.
- Caltrans follows an approved list of chemicals developed by Maintenance Headquarters that is generally more restrictive than herbicide use options available to other agencies and the public.
- The Caltrans goal is to reduce chemical usage.
- To achieve effective vegetation control through chemical application, maintenance personnel should consider the following: (1) use of the correct herbicide, (2) seasonal timing of applications, (3) timing in relation to expected precipitation events, (4) proximity to water bodies, (5) speed of travel when applying herbicides and (6) proper agitation of the spray tank.
- Apply herbicides in compliance with federal, state and local pesticide use regulations.
- Apply herbicides only as specified on the "Pesticide Use Recommendation" and the label.
- Activities should be approved by a licensed Agricultural Pest Control Adviser.
- Apply herbicides as recommended by the District Annual Vegetation Control Plan.
- Minimize the use of herbicides in or near storm water drainage systems or watercourses.
- Calibrate the spray rig to ensure accurate application of herbicides.

- Avoid using overhead irrigation for as long as the chemical manufacturer recommends after applying herbicides.
- Do not spray chemicals when rainfall causing runoff is forecast within 12 hours.
- Herbicide use should be documented and summarized in the Annual Report.

## C.26 VEGETATED SLOPE INSPECTION

Description:

Districts have established Maintenance Inspection/Slope Stabilization Teams to review vegetated slopes. The program will identify problematic slopes for repair to reducc erosion.

Appropriate Application:

Slope and unpaved areas should be inspected on a five-year cycle.

Implementation:

The following general steps should be taken to evaluate slopes and re-establish vegetation:

- Minor slides and slipouts requiring a Maintenance Division response shall be inspected and evaluated at the time of response field activities.
- Areas should be inspected for erosion on a five-year cycle.
- Areas with recurring problems should be inspected on an as-needed basis.
- Slope repairs that are within the abilities of the Maintenance Inspection/Slope Stabilization Team should be repaired by that team.
- Each District will establish a multi-disciplinary team to review problem slopes.
- Problem slopes with erosion concerns that cannot be repaired by the Maintenance Inspection/Slope Stabilization Team should be reported to the multi-disciplinary team. These projects should be forwarded to the State Highway Operation and Protection Program for possible funding and repair.
- A standard Maintenance Division reporting format for scheduling, inspection findings and repairs has been developed for the program. *The Preliminary Maintenance Slope Inspection Form* (number CT-MAINT-NPDE-S005) is to be used and is available electronically from the Department's Headquarters Maintenance Division.

## C.27 SNOW REMOVAL AND DE-ICING AGENTS

Description:

This BMP is intended to reduce the discharge of potential pollutants generated during ice control activities. Ice control activities include:

- The mechanical spreading of abrasives and de-icing agents;
- The mechanical removal of snow from the travel way;
- Opening of drains covered by snow and ice; and
- Opening of roads that are normally allowed to close for the winter season.

Appropriate Applications:

- This BMP provides guidance to maintenance personnel who are involved in snow and ice removal activities. The use or nonuse of de-icing agents is based on driver safety, traffic delay, geographic location, weather and total cost.
- In areas of the state where significant amounts of abrasives are required, the sweeping frequency should be increased to remove accumulated abrasives.

Implementation:

- Calibrate spreader to avoid the over-application of de-icing agents or abrasives. Use no more than is necessary for snow and ice control. Consider using alternative de-icing agents where runoff from roads discharges directly to sensitive watercourses.
- Maintain accurate records of the locations of de-icing agents and abrasives application and the quantities of de-icing agents and abrasives used.
- Store de-icing agents (e.g., salt) in appropriate areas, bunkers or storage buildings. Do not store de-icing agents where they will come into contact with storm water runoff.
- Abrasives (e.g., sand and cinders) can be stored in bunkers or storage buildings. Abrasives stored outdoors must be managed in accordance with the requirements of the Section C.17 Stockpile Management BMP.
- Avoid blowing, pushing or dumping snow into the watercourse.

## C.28 STORM WATER DEWATERING OPERATIONS (TEMPORARY PUMPING OPERATIONS)

Description:

These practices are implemented where storm water is pumped. This BMP addresses discharge from portable pumps used by maintenance personnel during repairs and to prevent damage to the highway.

Appropriate Applications:

These practices are implemented where storm water is pumped as part of a maintenance activity. Note that per Section 5 of the Statewide SWMP, some discharges are exempt or conditionally exempt.

Implementation:

- Ensure that dewatering discharges do not cause erosion at the discharge point.
- Pumping systems should be equipped with screens on the intake.
- Intakes should be located to reduce the pumping of sediment. Pumping areas near the storm water surface often contain less sediment than areas near the bottom.
- Sediment Control BMPs may be installed at intake or outlet locations to trap excessive sediment.

## C.29 SWEEPING AND VACUUMING

Description:

Sweeping and vacuuming are performed to remove litter, debris and de-icing abrasives from paved roads and shoulders. Sweeping to reduce track-out generally involves manual sweeping or use of small equipment, but does not exclude the use of sweepers should the need arise (e.g., for slides and slipouts).

Appropriate Applications:

- Sweeping and vacuuming operations are appropriate for removing de-icing abrasives, material from small slides, litter and debris.
- Sweeping and vacuuming may be implemented anywhere sediment is tracked from off-road maintenance activity sites onto public or private paved roads typically at the points of egress (see Section C.12.1 Stabilized Activity Entrance/Exit BMP).

Implementation:

- Highway Sweeping:
  - Do not sweep up any unknown substance that may be potentially hazardous. If a substance is known to be hazardous, suspected of being hazardous or cannot be identified, notify the District Maintenance HazMat Manager immediately. If an illegally dumped substance within the Department's Right of Way has the potential of entering a municipal drain system, the immediate supervisor and the District Storm Water Coordinator must be notified so that the downstream municipality can be contacted.
  - Adjust brooms to maximize the efficiency of sweeping operations.
  - Do not load hoppers beyond their capacity.
  - Dispose of waste to a landfill or approved site in accordance with local regulations and Section C.13.2, Solid Waste Management BMP. There is to be no dumping on site, especially during the rainy season or during unseasonal storm events to abate wash out. Clean materials may be incorporated into the maintenance activity area.
- Tracking Control:
  - Substantially visible sediment shall be swept or vacuumed from the maintenance activity site.
  - If not mixed with debris or trash, consider incorporating the removed sediment back into the maintenance activity site.

- Washing and rinsing of equipment shall be performed in designated areas and the resulting runoff shall not be discharged to the storm drain system.

## C.30 MAINTENANCE FACILITY HOUSEKEEPING PRACTICES

Description:

Daily activities occurring at maintenance facilities often involve the use of materials and products that are potentially harmful to the environment. Good housekeeping practices are intended to eliminate the potential for discharge of pollutants to drainage paths, storm water drainage systems or watercourses by promoting efficient and safe storage, use and cleanup of potentially harmful materials.

Appropriate Applications:

Proper housekeeping practices apply to all maintenance personnel who participate in activities that have a potential to generate pollutants that could discharge to storm water drainage systems or watercourses.

Implementation:

- Maintain clean, orderly material and equipment storage areas. Provide covers for materials as needed.
- Use the 'first in first out' policy for material storage and control. Avoid ordering more materials than can be stored properly or used in a reasonable timeframe.
- Properly reuse, recycle or dispose of empty containers, excess materials, equipment and parts that are not likely to be used. All solid wastes shall be managed per the requirements of the Section C.13.2 Solid Waste Management BMP.
- Maintain equipment and buildings to avoid peeling paint, rust and degradation. Request funding for major repairs.
- Sweep or vacuum maintenance facility floors and pavement.
- If mopping is used to clean floors or pavement, contain the mop water and dispose of it to the sanitary sewer system according to the following guidelines:
  - Do not dispose of mop water into the parking lot, street, gutter or drain inlet; and
  - If an oil/water separator is available, pour the mop water into the separator so that the wastewater is treated before being discharged to the sanitary sewer system.
- Secure and close lids on waste receptacles and bins when not in use.
- Clean up spills promptly. See Section C.13.1, Spill Prevention and Control BMP.
- Use drip pans or absorbent material under leaking vehicles and equipment to capture fluids.
- If it is necessary to use a hose for cleaning, wash water shall not be discharged to the storm water drainage systems or watercourses.

- Minimize the possibility of storm water pollution from outdoor waste receptacles by doing at least one of the following:
  - Use only watertight waste receptacle(s) and keep the lid(s) closed;
  - Grade and pave the waste receptacle area to prevent run-on of storm water;
  - Install a roof over the waste receptacle area;
  - Install a low containment berm around the waste receptacle area; or
  - Use and maintain drip pans under waste receptacles.

# Storm Water
# Treatment BMP New Technology Report

April 2004

SW-04-069.04.02

Final Report

State of California
Department of Transportation

A001921

# EXECUTIVE SUMMARY

The Treatment BMP New Technology Report consolidates and standardizes information on new technologies that are part of the Department's BMP identification, evaluation and approval process described in Section 3.3.2 of the Storm Water Management Plan (SWMP). New technologies include the latest innovations in permanent storm water treatment and control, as well as existing technologies currently in use by municipal or Department of Transportation (DOT) storm water management programs, but not previously approved as BMPs by the Department.

The Department collects information for treatment BMPs not yet approved by the Department. To introduce products to the Department, manufacturers and suppliers must contact the New Product Coordinator at (916) 227-7185. Fact sheets are prepared for each identified technology and added to the report. Appendix A explains the format and content of the fact sheets found in Appendices B and C.

Fact sheets in Appendix B summarize information for technologies unapproved and untested by the Department. Appendix B has six new fact sheets included in this year's report:

- Aeration
- Detention Below Grade Storage
- Filtration Integrated Filter and Detention Basin
- Infiltration Below Grade Storage
- Litter and Debris Removal: Stormscreen™
- Water Quality Inlets

Favorable evaluations of promising BMP technologies can lead to pilot studies to gather cost and performance data. Fact sheets in Appendix C summarize information for existing and completed full-scale pilot studies of unapproved technologies. Over 130 past and current full-scale and small-scale pilot studies are listed in Table 2-1. Current studies are described in the Storm Water Monitoring and BMP Development Status Report (SW-04-069.04.01). Successfully piloted technologies may be approved and listed in the Department's SWMP to be used according to the BMP implementation procedures also contained in the SWMP. Approved BMPs listed in the Department's SWMP are not considered in this report.

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# TABLE OF CONTENTS

# 1.0 INTRODUCTION

The Treatment BMP New Technology Report consolidates and standardizes information on new technologies that are part of the Department's BMP identification, evaluation and approval process described in Section 3.3.2 of the SWMP (1 Caltrans 2003). The BMP fact sheets in Appendices A and B summarize available design, construction, performance, and cost information for BMPs considered for further testing or approval.

*Department-Approved Treatment BMPs*

Biofiltration (strips and swales)
Infiltration basins
Detention basins
Traction sand traps
Dry weather flow diversion

The Department collects information for treatment BMPs not currently approved in the SWMP. To introduce products to the Department, manufacturers and suppliers must contact the New Product Coordinator at (916) 227-7185. Fact sheets are prepared for identified technologies and added to this report. The Department reviews the fact sheets to determine if a BMP warrants further research, which may include full scale pilot testing.

The Department's ongoing review of new technologies consists of evaluating the latest innovations in storm water treatment and control, including technologies used by municipal or Department of Transportation (DOT) storm water management programs. BMPs approved by the Department are excluded from this report, except for modifications to approved BMPs that require further study before approval.

## 1.1 REPORT ORGANIZATION

The remainder of the Treatment BMP New Technology Report is divided into two sections and three appendices.

- Section Two describes how the Department identifies and evaluates new technologies, and lists new technologies that are being evaluated in the pilot-testing program.
- Section Three provides references.
- Appendix A describes the format and information included in the fact sheets.
- Appendix B includes fact sheets that summarize unapproved technologies not yet tested by the Department. Technology fact sheets from previous years remain in Appendix B to allow annual updating as information becomes available.
- Appendix C provides fact sheets for unapproved BMPs that were or are being pilot tested by the Department.

# 2.0 IDENTIFYING NEW TECHNOLOGY

New BMP technology is identified by reviewing the literature on existing practices. The Department, with input from universities, consultants, regulators, third parties, and manufacturers, continually reviews BMP information reported in the literature. Manufacturers' exhibits at professional conferences also provide an opportunity to identify new technologies and products. After identification, BMPs are listed in this report.

## 2.1 FACT SHEETS

After identification, BMP fact sheets are developed using a standard format to facilitate comparison among BMP types. Each fact sheet is divided into a standard series of topics and presents summary information to evaluate the potential applicability of BMPs to the Department, including: design parameters, operations, maintenance, treatment effectiveness, costs, advantages and constraints. These topics are discussed in Appendix A. Completed BMP fact sheets are presented in Appendix B and Appendix C. New fact sheets added since the last annual report are noted on the first pages of Appendices B and C.

## 2.2 PILOTS

BMPs with potential application to the Department, as summarized in the fact sheets, may require further reconnaissance studies, small-scale, and/or full-scale pilot testing. The Department currently is conducting several pilot studies throughout the state. Fact sheets for BMPs undergoing full-scale pilot studies are presented in Appendix C. Technologies undergoing small-scale or bench scale pilot testing do not have fact sheets in Appendix C because sufficient information is not available for full-scale application by the Department. Table 2-1 presents a summary of the Department's past and current BMP pilots. Current pilots are those in any phase of pilot testing, from project scoping to final report publication. The Storm Water Monitoring and BMP Development Status Report (SW-RT-04-069.04.01) describes current pilot studies in more detail.

TABLE 2-1. CURRENT STORM WATER BMP PILOTS

| Study | Dist | RWQCB | Location | Status as of January 2003 | Final Report Reference No. | Professional Paper Ref. No. |
|---|---|---|---|---|---|---|
| Infiltration Basins (2) | 7 | Los Angeles | I-605/SR-91 | An infiltration basin was sited and constructed in this region. Three years of monitoring are complete. | Anticipated in Spring 2004. | 2,3,4,5,6 |
| | 11 | San Diego | I-5/La Costa Ave. | Infiltration basin was decommissioned after summer 2001. Site not conducive for infiltration. | | |
| Continuous Deflection Separators (4) | 7 | Pacoima | I-210/East Orcas Ave. | Performance monitoring complete. Final report presenting results is under preparation. Vector monitoring continues. | Anticipated in Spring 2004. | 2,4,5,6 |
| | | | I-210/East of Filmore St. | | | |
| | 11 | San Diego | SR-56 | Two years water quality monitoring complete. Monitoring to continue in following three wet seasons. | Anticipated in 2009. | |
| | | | SR-56 | | | |
| Detention Basins-Conventional (5) | 7 | Los Angeles | I-5/I-605 | Three years of monitoring complete. | Anticipated in Spring 2004. | 2,4,5,6,7 |
| | | | I-605/SR91 | | | |
| | 11 | San Diego | I-5/SR-56 | | | |
| | | | SR-78/I-5 | | | |
| | | | I-5/Manchester Ave. | | | |
| Detention Basins - bypass (4) | 12 | San Diego, Santa Ana | SR-73 | Monitoring started in 03/04. | Anticipated in 2008. | |
| Detention Basins - overflow (4) | 12 | Santa Ana | SR-73 | Monitoring started in 03/04. | | |
| Detention Basins - semi-batch (4) | 12 | San Diego | SR-73 | Construction to be complete by Spring 2004. | | |
| Detention Basins – floating skimmer (4) | 12 | San Diego | SR-73 | Monitoring started in 03/04 for 3 of 4 basins. | | |
| Detention Basins - inlet (2) | 12 | San Diego | SR-73 | Monitoring started in 03/04. | | |
| Sand Traps (2) | 3 | Lahontan | Hwy 50 Echo Summit | Two years monitoring complete. | 8 | |
| | | | Hwy 50 at Lake Tahoe Airport | | | |



A001927

| Study | Dist | RWQCB | Location | Status as of January 2003 | Final Report Reference No. | Professional Paper Ref. No. |
|---|---|---|---|---|---|---|
| Sand Traps with Filter Fabric (4) | 3 | Lahontan | SR-267 within Tahoe Basin | Construction scheduled for summer 2004. | Anticipated 2008. | |
| Austin Filter with Alt Media (2) | 3 | Lahontan | Hwy 50 near Tahoe | Construction complete. | Anticipated 2008. | |
| Bioretention (3) | 4 | San Fran | I-80 Toll Plaza at Oakland | Under design. | Anticipated 2008. | |
| | 12 | Santa Ana | SR-73 | Under design. | | |
| | 4 | San Francisco Bay | Between I-80 and I-580 | Geotechnical work completed at site, aerial survey commencing of drainage area, design to begin after aerial survey. | Anticipated in 2006. | |
| Tahoe Small Scale Study | | | | | | |
| Alternative media filters | 3 | Lahontan | Meyers Maintenance Station | The systems are in fourth year monitoring season (03/04). | Anticipated 2005. | |
| Sand filters | 3 | Lahontan | Meyers Maintenance Station | Three years monitoring complete. | 9 | |
| Chemical addition | 3 | Lahontan | Meyers Maintenance Station | The systems are in fourth year monitoring season (03/04). | Anticipated 2005. | |
| Austin Sand Filters (8) | 7 | Los Angeles | Paxton Park and Ride | Construction complete, no water quality monitoring, | n/a | 2,4,5,6,10 |
| | | | Eastern Regional Maintenance Station | Three years of monitoring complete. | Anticipated Spring 2004. | |
| | | | Foothill Maint Station | | | |
| | | | Termination Park/Ride | | | |
| | 11 | San Diego | La Costa Park & Ride | | | |
| | | | SR-78/I-5 Park & Ride | | | |
| | 2 | Central Valley | I-5 near Mountain Gate | Two seasons of monitoring complete. Monitoring to continue through the 03/04 wet season. | Anticipated 2006. | 11 |
| | | | Mt. Shasta Maintenance Station | One season of monitoring complete. Monitoring to begin in the 03/04 wet season. | | |
| Delaware Filters (1) | 11 | San Diego | Escondido Maintenance Station | Three years of monitoring complete. | Anticipated Spring 2004. | 2,4,5,6,10 |

| Study | Dist | RWQCB | Location | Status as of January 2003 | Final Report Reference No. | Professional Paper Ref. No. |
|---|---|---|---|---|---|---|
| StormFilter™ (1) | 11 | San Diego | Kearny Mesa Maintenance Station | Three years of monitoring complete. Vector monitoring is ongoing. | Anticipated 2006. | 2,4,5,6 |
| Compost StormFilter™ (CSF) (3) | 12 | San Diego | SR-73 -- various locations | The systems completed their second monitoring season (02/03). Vector monitoring is ongoing. | 12 | |
| Multi-Chamber Treatment Train (3) | 7 | Los Angeles | Metro Maintenance Station | Construction complete. No water quality monitoring. | n/a | |
| | | | Via Verde Park and Ride | Three years of monitoring complete. Vector monitoring is ongoing. | Anticipated Spring 2004. | 2,4,5,6 |
| | | | Lakewood Park and Ride | Three years of monitoring complete. Vector monitoring is ongoing. | | |
| Oil/Water Separator (1) | 7 | Los Angeles | Alameda Maintenance Station | Three years of monitoring complete. | Anticipated Spring 2004. | 2,4,5,6,13 |
| Bio Strip (1) | 7 | Los Angeles | Altadena Maintenance Station (a) | Three years of monitoring complete. | Anticipated Spring 2004. | 2,4,5,6 |
| Infiltration Trench (1) | | | Altadena Maintenance Station (b) | Three years of monitoring complete. | Anticipated Spring 2004. | 2,3,4,5,6 |
| Bio Strip (1) | | | I-605/SR-91 Interchange | Three years of monitoring complete. | Anticipated Spring 2004. | 2,4,5,6 |
| Bio Strip (1) | 11 | San Diego | Carlsbad Maintenance Station | Three years of monitoring complete. | Anticipated Spring 2004. | 2,4,5,6 |
| Infiltration Trench (1) | | | Carlsbad Maintenance Station | Three years of monitoring complete. | Anticipated Spring 2004. | 2,3,4,5,6 |
| Roadside Vegetated Treatment Sites (RVTS) – Strips (8) | 2 | Central Valley | SR-299 EB PM 26.0 | Two years of monitoring complete. | 14 | 15,16 |
| | | | I-5 SB PM 1.5 | | | |
| | 3 | | I-5 NB PM 13.5 | | | |
| | 4 | San Francisco | US-101 NB PM 15.0 | | | |
| | 8 | Santa Ana | SR-60 EB PM 14.0 | | | |

| Study | Dist | RWQCB | Location | Status as of January 2003 | Final Report Reference No. | Professional Paper Ref. No. |
|---|---|---|---|---|---|---|
| | 11 | San Diego | I-5 NB PM 70.4 | | | |
| | 12 | Santa Ana | SR-91 EB PM 15.0 | | | |
| | | | I-405 NB PM 2.5 | | | |
| Drain Inlet Insert (6) | 7 | Los Angeles | Foothill Maint Station (a) | StreamGuard® installed. Three years of monitoring complete. | Anticipated Spring 2004. | 2,4,5,6,13 |
| | | | Foothill Maint Station (b) | FossilFilter® installed. Three years of monitoring complete. | | |
| | | | Las Flores Maint Station (a) | StreamGuard® installed. Three years of monitoring complete. | | |
| | | | Las Flores Maint Station (b) | FossilFilter® installed. Three years of monitoring complete. | | |
| | | | Rosemead Maint Station (a) | StreamGuard® installed. Three years of monitoring complete. | | |
| | | | Rosemead Maint Station (b) | FossilFilter® installed. Three years of monitoring complete. | | |
| Bio-Swales (6) | 7 | Los Angeles | Cerritos Maint Station | Three years of monitoring complete. | Anticipated Spring 2004. | 2,4,5,6 |
| | | | I-5/I-605 | Three years of monitoring complete. | | |
| | | | I-605/Carson & Del Amo | Three years of monitoring complete. | | |
| | | | I-605/SR-91 Interchange | Three years of monitoring complete. | | |
| | 11 | San Diego | Melrose Dr./SR-78 | Three years of monitoring complete. | | |
| | | | I-5/Palomar Airport | Three years of monitoring complete. | | |
| Wet Basin (1) | 11 | San Diego | I-5/La Costa | Three years of monitoring complete. Final report presenting results is under preparation. | Anticipated Spring 2004. | 2,4,5,6,17,18, |
| Constructed Wetlands (1) | 12 | Santa Ana or San Diego | One Locations along SR-73 | One wet basin to be monitored "as-is" | Anticipated in 2006. | |
| Storm Filter (Perlite/Zeolite) (1) | 11 | San Diego | Kearney Mesa Maintenance Station | Three years of monitoring complete. Vector monitoring is ongoing. | Anticipated Spring 2004. | 2,4,5,6 |
| Linear Radial Device, configuration 2 (2) | 7 | Los Angeles | I-5/Garber | Study is complete. | 19 | |
| | | | I-210/Glenada | | | |

| Study | Dist | RWQCB | Location | Status as of January 2003 | Final Report Reference No. | Professional Paper Ref. No. |
|---|---|---|---|---|---|---|
| configuration 1 (1) | | | I-10/Rosemead | Study is complete. | 19 | |
| GSRD: Inclined Screen, configuration 1 (1) | 7 | Los Angeles | SR-170/Burbank | Study is complete. | 19 | |
| Gross Solids Removal Device (GSRD): Inclined Screen Device configuration 2 (2) | 7 | Los Angeles | US-101/Gaviota | Study is complete. | 19 | |
| | | | I-210/Orcas | | | |
| GSRD: Inclined Screen Device, configuration 3 (2) | 7 | Los Angeles | I-10/Halm | Study is complete. | 20 | |
| | 12 | Santa Ana | SR-73 | GSRD on basin 1180R: Construction complete. | Anticipated in 2006. | |
| GSRD: Inclined Screen, configuration 4 (1) | 7 | Los Angeles | I-210/Christy | One year monitoring complete. | Anticipated in 2006. | |
| GSRD: Baffle Box (2) | 7 | Los Angeles | I-210/Christy (being replaced) | Study is complete. Installation replaced with Inclined screen configuration #4. | 19 | |
| | | | I-405/Leadwell (being replaced) | Study is complete. Installation replaced with V-screen configuration #1. | | |
| GSRD: V-Screen, configuration 1 (2) | 7 | Los Angeles | I-405/Leadwell | Under construction. | Anticipated in 2006. | |
| | 12 | Santa Ana | SR-73 | GSRD on basin 1085L: Construction complete. Operation began Spring 2003 | | |

| Study | Dist | RWQCB | Location | Status as of January 2003 | Final Report Reference No. | Professional Paper Ref. No. |
|---|---|---|---|---|---|---|
| GSRD: V-Screen, configuration 2 (2) | 7 | Los Angeles | SR-91/Ardmore | One year monitoring complete. | Anticipated in 2006. | |
| | 12 | Santa Ana | SR-73 | GSRD on basin 630L: PS&E package is under Headquarters Office of Engineers review. Estimated date of completion of construction spring 2005. | Anticipated in 2006. | |
| GSRD: Litter Inlet Deflector (3) | 7 | Los Angeles | SR-60/Garfield | Study is complete. | 21 | |
| | | | SR-60/Garfield | | | |
| | | | SR-60/Wilcox | | | |

A001932

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# APPENDIX A: BMP FACT SHEET DESCRIPTION AND FORMAT

Appendix A describes the standard format used for fact sheets to facilitate comparison among the BMP types. Each fact sheet is divided into a standard series of discussion topics, which are discussed below.

## A.1 BMP DESCRIPTION

A description of the BMP is presented at the top of each fact sheet. The description provides a summary of the configuration of the BMP and a general overview of the treatment process, how the BMP operates, and considerations that need to be addressed to promote maximum treatment effectiveness and functionality.

## A.2 CONSTITUENT REMOVAL

The relative degree each BMP is able to remove selected groups of constituents from storm water runoff is provided in the fact sheets. The groups of constituents examined were selected based on the likelihood of occurrence in the Department's runoff at levels that would require treatment consideration. The constituent groups, removal efficiency, and confidence levels used in each fact sheet are discussed below.

### A.2.1 Constituent Groups

Estimates of the technology's performance removal abilities are made for each of the following constituent groups:

- Sediment (Total Suspended Solids [TSS])
- Nutrients
- Pesticides
- Total Metals
- Dissolved Metal
- Microbiological
- Litter
- Biochemical Oxygen Demand (BOD)
- Total Dissolved Solids (TDS)

### A.2.2 Constituent Group Removal Efficiency

The fact sheets report relative removal efficiencies for each of the nine general categories of constituents. Constituent removal percentages were derived from a review of the literature.

Removal efficiencies were assessed in terms of being high, medium or low. Constituent removal was quantified by first calculating the average removal percentage for all constituents within a given category. The overall assessment was then defined using the following criteria:

- *High*: average removal percentage was equal to or greater than 75 percent
- *Medium*: average removal percentage was between 40 and 75 percent
- *Low*: average removal percentage was less than or equal to 40 percent

The fact sheets provide notes with additional information regarding how the removal assessment was assigned to a given BMP.

### A.2.3 Level of Confidence

The level of confidence in the constituent removal data found in the literature depended on the type and quality of the data. Assessing constituent removal from storm water BMPs is not precise; water quality monitoring studies have demonstrated the wide variability in water quality concentrations in storm water runoff. To ensure that data are of the highest quality, storm event monitoring protocols require that samples be collected according to standard procedures, such as the *Guidance Manual: Stormwater Monitoring Protocols* (22 Caltrans 2000) or equivalent procedures. The level of confidence was assessed in terms of being high, medium or low. The criteria applied for defining the confidence level were:

- *High*: The information came from either the Department's research study or a study that met the Department's quality assurance and quality control monitoring protocols.
- *Medium*: Constituent removal rates were established from the results of a scientific monitoring study or studies conducted independently of equipment manufacturers, and:
  - the BMP technology has a documented history of application for treating storm water; or
  - the treatment process was a "known" technology for treating other types of wastewater discharges; or
  - the BMP technology provided "no discharge" to surface waters under design conditions; constituent removal was assumed to be 100 percent removal although it was recognized that certain large storm events would not receive treatment.
- *Low*: The BMP monitoring program used to quantify the removal percentages and the monitoring protocols applied could not be substantiated.

## A.3 DEPARTMENT SWMP CATEGORY

Each fact sheet has a section for listing one of the three general categories of BMPs identified in the Statewide SWMP that best describes the BMP being considered. These categories are as follows.

- Category I BMPs: Technology-based pollution prevention BMPs to meet the maximum extent practicable (MEP) requirements for designing and maintaining roadways and related facilities.

- Group A: The BMPs applicable to all maintenance operations.
- Group B: The BMPs used in the design of new facilities or major renovations of existing facilities.

- Category II BMPs: Controls to meet Best Conventional pollutant control Technology/Best Available Technology economically achivable (BCT/BAT) requirements for construction projects.
- Category III BMPs: Treatment BMPs to meet MEP requirements.

Currently this report only focuses on Category III BMPs.

## A.4 KEY DESIGN ELEMENTS

This section identifies important design considerations that have been highlighted by vendors or discovered through testing. Ancillary facilities assumed to be used in conjunction with the new technology are also listed in this section. An example would be including a detention basin downstream of a chemical treatment technology to capture flocculated particles.

## A.5 SCHEMATIC

If appropriate, a schematic figure is provided to depict a typical design plan or cross-section with the major components identified.

## A.6 CAPITAL, OPERATIONAL, AND MAINTENANCE COSTS

Assessments pertaining to the costs of building, operating and maintaining each BMP are also provided on each fact sheet. To provide the Department with as much information as possible for their evaluations, two pieces of information are provided on BMP costs:

- Level of confidence in the available data
- General assessment of the BMP's overall costs

### A.6.1 Level of Confidence

The level of confidence in the costs to build and operate a BMP depends on the type and quantity of information found in the literature. Use of cost information developed for municipal storm water programs was not considered to be directly relevant to the Department's facilities. The right-of-way costs and construction costs of major highway transportation projects are typically much greater than the typical suburban street or arterial road that might be constructed by a municipal public works Department. Furthermore, operations and maintenance costs of facilities along major freeways is typically much more expensive than similar municipal facilities because of limited access and the need for traffic control. The level of confidence was assessed in terms



A001937

of being high, medium or low. The criteria applied for defining the confidence level of the cost estimates were:

- *High:* Unit cost information was available from a facility designed and constructed by the Department or a similar state transportation department.
- *Medium*: Cost information was available from several similar facilities constructed under municipal storm water programs.
- *Low*: No cost information was available from a similar BMP facility that could be independently verified. Construction costs were extrapolated from available pricing information.

### A.6.2 Cost Estimate Assessment

The cost effectiveness for each BMP was assessed in terms of its equivalent uniform annual cost (EUAC) relative to a detention basin. A four-quadrant system was used as a tool to rate each BMP (ie ). One of the four quadrants was colored based on the rating key.

| | |
|---|---|
| Benefit ↑<br>Cost ↓ | Benefit ↑<br>Cost ↑ |
| Benefit ↓<br>Cost ↓ | Benefit ↓<br>Cost ↑ |

Figure A-1. Rating key for cost effectiveness.

The cost estimates were defined by first calculating the typical range of costs for constructing or operating BMPs on a per acre basis. The acres represented the drainage area served by the BMPs. Operation and maintenance costs were then added based on the BMPs design life. The EUAC for a particular BMP was estimated and then compared to that of a detention basin. If the EUAC was higher than a detention basin, then it was marked as a higher cost using the quadrant rating key.

The benefit of the BMP was evaluated relative to the performance of a typical detention basin. If the constituent removal was greater than that of a detention basin, then the BMP was marked as having a greater benefit.

## A.7 ISSUES AND CONCERNS

This section presents issues and concerns to be considered when evaluating the appropriateness of a BMP for any of the Department's facilities. This information is divided into two categories: maintenance and project development. Within each category is a standard set of topics. The same topics are included in every fact sheet to facilitate comparisons between BMPs.

### A.7.1 Maintenance

- *Requirements:* Summarizes routine maintenance tasks required to keep the BMP functional.
- *Nuisance Controls:* Identifies whether the BMP has the potential to create odors, breed mosquitoes, or attract pests.
- *Traffic Safety:* Identifies the level of potential traffic control during BMP servicing.

- *Staffing/Equipment:* Identifies the level of staff and training required to perform the maintenance. Identifies specialty equipment.

### A.7.2 Project Development

- *Right-of-Way Requirements:* Identifies relative space requirements to install the BMP.
- *Siting Constraints:* Identifies siting considerations and limitations, such as soil types, slope of the land, distance from existing infrastructure or other natural features, and regulatory requirements.
- *Design Complexity:* Identifies major components and equipment requirements, and operational controls or limits.
- *Retrofit Potential:* Identifies the potential for retrofitting existing Department facilities.

## A.8 BMP SPECIFIC ADVANTAGES AND CONSTRAINTS

This section lists additional advantages and constraints of the BMP that were not covered in the previous sections. Information presented may include impacts from hydrologic characteristics and weather conditions in California, experiences from actual installations, and expansion of particular points discussed in previous sections of the fact sheet.

## A.9 SOURCES

The fact sheets also include sources of information where appropriate (e.g., for proprietary technologies, vendor contact information is provided).

# APPENDIX B: NEW TECHNOLOGY FACT SHEETS

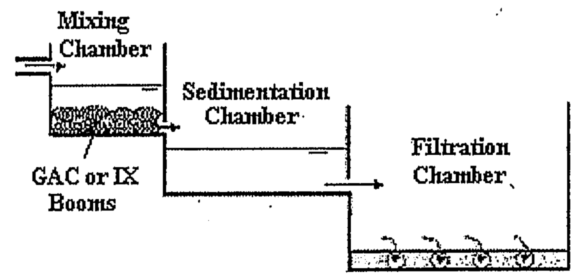
Appendix B presents fact sheets for new technologies that are not approved or rejected, and have not been pilot tested by the Department. Technology evaluations in the attached fact sheets are ongoing, and the assessment of these technologies may be revised in future reports. The evaluations that appear were derived from a review of information that was frequently limited to manufacturer's claims. Treatment BMP technologies are presented in the following order:

| Technology Type | Page | Available Storm Water Products |
|---|---|---|
| Adsorption/Ion Exchange – GAC or IX Media Added to Sedimentation Basin Influent | B-3 | n/a |
| Adsorption/Ion Exchange – GAC Sandwich Filter and Blanket | B-5 | n/a |
| Adsorption/Ion Exchange – Granular Activated Carbon Columns | B-7 | n/a |
| Adsorption/Ion Exchange – Ion Exchange Column | B-9 | n/a |
| Aeration (NEW FACT SHEET) | B-11 | MICROGEN™, Aqua Master |
| Chemical Treatment – Alum | B-13 | n/a |
| Chemical Treatment – Polyacrylimide | B-15 | n/a. |
| Detention Basin Outlet Improvements – Filters | B-17 | n/a |
| Detention Below Grade Storage (NEW FACT SHEET) | B-19 | DoubleTrap™, StormTrap™, Advanced Drainage System, Contech, Lane-Enterprises |
| Disinfection – Chlorination/Hypochlorite | B-21 | n/a |
| Disinfection - Ozone | B-23 | Bioxide® |
| Disinfection – Ultraviolet | B-25 | n/a |
| Drain Inlet Inserts – Fabric | B-27 | CatchAll, Drain Diaper™, Drain Gate™, Drain Guard™, DrainPac™, Drain Web™, Geotextile Catch Basin Insert™, Ultra-Drain Guards™ |
| Drain Inlet Inserts – Flow-Through Baskets | B-29 | AquaGaurd, Curb Inlet Basket, Ecosol RSF 100/GSP, Flo-Gaurd, Inceptor, Stream Saver Catch Basin Inserts, Stream Saver Bio-Oil Filter Insert, Verti-Pro Vertical Catch Basin Protection |
| Drain Inlet Inserts – Flow-Through Boxes | B-31 | AquaShield™ SD-100, CLR Filter, Grate Inlet Skimmer Box, Grate Protector 1000 & Grate Protector 2000, HydroKleen, SIFT Filter, StormKlenz, Ultra-Urban Filter |
| Drain Inlet Inserts – Media Filters | B-33 | Drop-In-Drain-Interceptor, Multi-Cell Filter, Raynfiltr™, SeaLife Saver™, StormFilter® |
| Drain Inlet Inserts – Passive Skimmers | B-35 | OARS Passive Skimmer, StreamGuard |
| Drain Inlet Inserts – Trickle Down Trays | B-37 | Adjustable Skimmer, CaptureFlow, Enviro-Drain® |
| Filters – Cartridge | B-39 | Aqua-Logic, CDS, StormFilter |
| Filters – Upflow, Compressible Media | B-41 | n/a |
| Filtration – Disc | B-43 | arkal-filter |

| Technology Type | Page | Available Storm Water Products |
|---|---|---|
| Filtration – Earthen Construction Modified Austin Sand Filter | B-45 | Non-proprietary design |
| Filtration – Integrated Filter and Detention Basin (NEW FACT SHEET) | B-47 | Aqua-Filter™ |
| Filtration – Pressure Filters | B-49 | n/a |
| Filtration – Self Backwashing Filters | B-51 | n/a |
| Infiltration - Trenches with Alternative Backfill | B-53 | Rainstore[3] |
| Infiltration - Below Grade Storage (NEW FACT SHEET) | B-55 | Cultec Contactor, Cultec HVLV™, StormChamber™ |
| Litter and Debris Removal – "Y" Mesh Litter Bags | deleted | "Y" mesh litter bag fact sheet deleted because the concept is similar to GSRD's fact sheets in Appendix C. |
| Litter and Debris Removal – Breakaway Bags | B-57 | Net Tech G.P.I. |
| Litter and Debris Removal – Hydrodynamic Separators | B-59 | Aqua-Swirl, Stormceptor, Storm Separator, StormVault, Stormgate Separator, Vortechs™ |
| Litter and Debris Removal – StormScreen™ (NEW FACT SHEET) | B-61 | StormScreen™ |
| Sedimentation – Grit/Water Separators | B-63 | n/a |
| Sedimentation – Plate and Tube Settlers (note: similar to MCTT in Appendix C-34) | B-65 | n/a |
| Sedimentation – StormTreat Wetland Systems | B-67 | StormTreat™ |
| Water Quality Inlets (NEW FACT SHEET) | B-69 | Aqua-filter™, Aquashield, BaySaver®, ~~Downstream-Defender™~~, ~~EcoStorm®, SNOUT~~, Stormceptor™, Stormgate™, Stormgate Seperator™, Stormfilter™, Catchbasin Stormfilter™, Vortechnics™, V2B1™ |

***Description:***

Influent storm water could be mixed with granular activated carbon (GAC), ion exchange (IX) resin or both at the inlet of an extended detention basin (EDB) or a sedimentation chamber preceding a sand filter. A mixing tank with centrifugal mixing pumps can be installed at the inlet flow distribution system of a sedimentation basin. As the storm water enters the mixing chamber tank, it comes in contact with GAC and IX. After mixing, the storm water flows to the sedimentation basin. The GAC and IX is in suspension with the storm water until it settles with other solids in the sedimentation tank. As an alternative, the extended detention pond influent storm water could flow over a bag or sack filled with GAC or IX resin, or both. These sacks could be placed in detention pond inlets or other structures.




***Key Design Elements:***

1. Media type and dosing rate.
2. Media feed and storage systems.

<u>Ancillary Facilities</u>

Sedimentation and/or filtration facilities downstream.

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ● | ○ |
| *Total Metals* | ● | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No performance data encountered in literature.
- Removal efficiency approximated for a combination of IX and GAC
- Suspended solids and other constituents attached to the solids settle out in the pond. Heavy metals that are not dissolved but attached to particles might be removed with the settled solids.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Maintenance same as Austin Sand Filter except for replacement of spent GAC/IX powder. The replacement frequency of the GAC/IX powder would depend on storm water flow and constituent concentrations. The replacement will be easier for the option using a bag than for the option using powder. If centrifugal mixing pumps are used, they will also have to be maintained.
- *Nuisance Control:* None identified.
- *Traffic Control*: Unlikely.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris, as well as to reduce GAC/IX.

***Project Development:***

- *Right-of-Way Requirements*: Moderate
- *Siting Constraints*: Power required if the centrifugal pumps are used.
- *Retrofit Potential*: Space required for influent chamber to mix GAC/IX.
- *Construction:* Requires existing filter.

***Advantages:***

- This BMP will remove additional constituents that aren't removed in an EDB or filter.

***Constraints:***

- The GAC/IX powder will accumulate in the sedimentation chamber unless the design is such that the influent flows over a GAC/IX bag.

***Sources:***

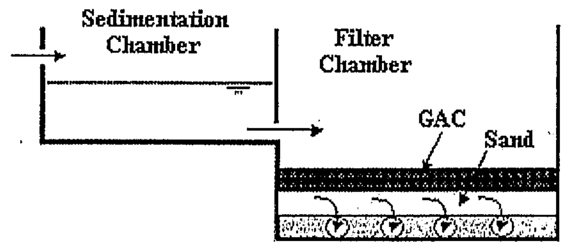
- Mercado, Shery or Jimmy Lam. GAC Stormwater Application. Calgon Carbon Corporation.
- http://www.calgoncarbon.com, April 2000.

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

To help remove organics from storm water, GAC has been proposed to be added to the treatment train of existing or proposed sand filters. A GAC layer could supplement the current sand media filter and would act as both a filtering media and adsorption layer. This option would require a detention pond upstream of the filter to provide sufficient pretreatment. One approach to consider is the GAC Sandwich Filter from Calgon Carbon Corporation (patent-pending), which removes a broad spectrum of pesticides and herbicides. This vendor claims to improve the effectiveness of slow sand filters by using a layer of GAC between two layers of sand. The system retains the advantages of traditional slow sand filtration while incorporating GAC's ability to remove organic compounds. Existing slow sand filters can be used for retrofit applications, which eliminates the need for a major capital investment and substantially reduces the time required to install GAC facilities.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ● | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ◒ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Nitrate and nitrite levels may actually increase due to nitrification.
- Performance data from Lake Angel Detention Pond in Orange County (University of Central Florida and State DOT, June 1991).

***Caltrans SWMP Category:***

Category III

***Key Design Elements:***

1. Adsorption media type and depth.

<u>Ancillary Facilities</u>

Upstream sedimentation facilities required.

Normally the GAC layer would be used in conjunction with a sand filter.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- Requirements: Routine maintenance may include periodic sediment and debris removal as well as spent GAC disposal/regeneration. Layered media may complicate maintenance.
- Nuisance Control: Standing water will occur if media filter is clogged.
- Traffic Control: Unlikely.
- Staffing/Equipment: For routine maintenance, requires staff and equipment to remove sediment, debris and periodically replace carbon.

***Project Development:***

- Right-of-Way Requirements: Same as Austin filter.
- Siting Constraints: Same as Austin filter.
- Retrofit Potential: Designed to be used with existing sand filters.
- Construction: Same as Austin filter.

***Advantages:***

- The GAC layer will act as both an adsorption layer and a filtering media. This option will provide removal of some organic constituents.

***Constraints:***

- Frequent clogging and short bedlife.
- Bacterial growth.
- Spent GAC may be a hazardous waste.

***Sources:***

- Mercado, Shery or Jimmy Lam. GAC Stormwater Application. Calgon Carbon Corporation. http://wwwcalgoncarbon.com, April 2000.

***Literature Sources of Performance Demonstrations:***

- GAC has already been used as a media filter to treat storm water during a study in Florida (University of Central Florida and State Department of Transportation, June 1991). This study describes the use of GAC filer beds in series to reduce the potential concentration of total trihalomethane at the Lake Angel Detention Pond in Orange County. The pond accepted runoff from an interstate highway and a commercial area.

***Description:***

Granulated Activated Carbon (GAC) adsorption is typically used to remove volatile organic compounds (VOCs) in water for potable uses. In addition to a removal efficiency greater than 99% for VOCs, it is also effective for treatment of synthetic organic chemicals. With GAC treatment, contaminated water passes through a column of GAC where organic compounds are removed by adsorption onto the carbon granule surface. Once the carbon can no longer adsorb pollutants from the water, it must be regenerated or replaced with fresh new carbon. Two types of designs are commonly employed for GAC: the pressurized contactor unit and the gravity-flow unit (which is similar to the gravity media filter). For storm water application, a GAC canister could be placed at the outlet of an extended detention basin (EDB), and the basin effluent would either be pumped through the canister or allowed to flow through it by gravity. The GAC system can be designed to operate either by gravity or pressure. Performance of the GAC canister at a sedimentation pond outlet will depend highly on the performance of the pretreatment. The sedimentation pond will also provide flow equalization to the GAC canisters.

***Constituent Removal:***

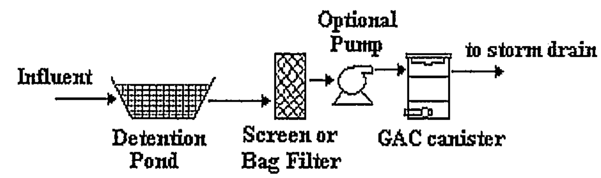
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ● | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

Notes:

- No performance data encountered in field demonstrations or in literature.

***Caltrans SWMP Category:***

Category III




***Key Design Elements:***

1. Absorption media type and depth
2. Container and hydraulic system

<u>Ancillary Facilities</u>

As with other granular media devices, sedimentation facilities should be provided upstream.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◳ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A001946

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: The mechanical equipment needs to be maintained. Spent GAC will have to be replaced or regenerated periodically. The GAC will need to be inspected.
- *Nuisance Control:* N/A.
- *Traffic Control*: N/A.
- *Staffing/Equipment:* Staff and equipment needed to replace media.

***Project Development:***

- *Right-of-Way Requirements*: Small footprint relative to sedimentation basin.
- *Siting Constraints*: Restricted to sites where nearby power or gravity flow is available.
- *Retrofit Potential*: May be added to existing EDBs.
- *Construction:* Requires pump or placement of GAC unit to accommodate gravity flow.

***Advantages:***

- Compact system at the EDB outlet.
- An effective way of removing pesticides.
- Effluent quality does not vary with pollutant concentration; only the bed life varies.
- ~~A reliable treatment process.~~

***Constraints:***

- Spent GAC has the potential of being considered a hazardous material and will need to be disposed of properly. Hauling costs may be excessive.
- The carbon must be shipped off-site for regeneration or disposal by a licensed company. One option would be to dispose of the spent GAC and replace it with new GAC. Regeneration of the GAC onsite is considered to be technically unfeasible and cost prohibitive. Another is to replace regenerated GAC cylinders and regenerate spent cylinders at an off-site location, which is commonly done by small-scale commercial and industrial users.
- GAC may promote considerable microbial growth on the carbon surface.
- Disinfection prior to GAC adsorption is not viable since the GAC removes disinfectants.
- Potential clogging of the GAC if pretreatment does not remove enough suspended solids, oil and grease.

***Sources:***

- Evans, Max. Mailed Correspondence. Oil or Gas Recovery from Parking Areas. Culligan Water, May 2000.
- Macpherson, John. Phone Conversation. GAC Quilted Blanket Filter. The IT Group, (425) 486-5515 ext. 232. April 2000.
- McMillen, Brent. Faxed document. Activated Carbon Contaminants and Costs. CPL Carbon Link Corporation, April 2000.
- Nitchman, Craig. Faxed Document. Carbon Usage Rate. Calgon Carbon Corporation, April 2000.
- Wilburn, Tom. Phone Conversation. GAC Quilted Blanket Filter Production. D. R. Shannon Company, (800) 255-1032. April 2000.
- Mercado, Shery or Jimmy Lam. GAC Stormwater Application. Calgon Carbon Corporation. http://www.calgoncarbon.com, April 2000.
- Jaubert, Michael. GAC Cost Estimates. Waterlink Barnebey Sutcliffe: Pur Air Division http://www.waterlink.com, April 2000.
- Mercado, Shery and Jimmy Lam. Activated Charcoal Cloth. Calgon Carbon Corporation. http://www.calgoncarbon.com/product/charcoalcloth.htm, April 2000.

***Literature Sources of Performance Demonstrations:***

- Wanielista, M. P., et al. Evaluation of the Stormwater Treatment Facility at the Lake Angel Detention Pond, Orange County, Florida. Florida State Department of Transportation and University of Central Florida, Gainesville. June 1991.

***Description:***

Ion exchange (IX) is a sorption process whereby a medium such as a resin removes one ion from a solution and replaces it with another. Resins are comprised of fixed ionic groups that are balanced by counter-ions of opposite charge to maintain electroneutrality. These counter-ions exchange with the ions in solution. As water passes through the resin bed in a storm water treatment system, contaminant ions in the water are exchanged with ions on the resin surface, thus removing the contaminant ions from the water and concentrating them on the resin. The resin is frequently regenerated to remove the contaminant from the resin surface and replenish the resin with the original exchange ion. A sedimentation basin and possibly a media filter will be needed in front of the resin bed to remove particles and prevent clogging of the IX resin. A media filter may also be necessary after the sedimentation basin and in front of the IX resin. The IX resin could either be placed in pressure vessels or in a canister at the pond outlet.

***Constituent Removal:***

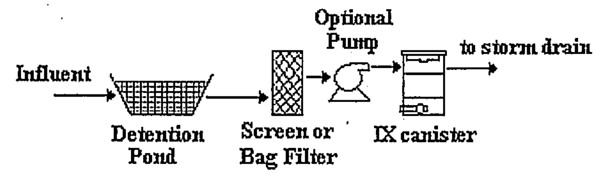
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ◒ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ● | ○ |
| *Dissolved Metals* | ● | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ◒ | ○ |

*Notes:*

- No performance data encountered in field demonstrations or in literature.

***Caltrans SWMP Category:***

Category III




***Key Design Elements:***

1. Ion exchange resin type, size, and bed depth.
2. Hydraulic system for moving water through resin bed.

<u>Ancillary Facilities</u>

Sedimentation and possible filtration upstream of the IX unit.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◳ | ● |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A001948

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Resin must be periodically inspected. Spent resin or regenerant brines must be removed and disposed of properly. Measures must be taken to make sure that the resins do not dry out during dry season. Mechanical equipment must be maintained. Because of the constraints, on-site regeneration is not considered feasible. The IX resin must be shipped off-site for regeneration or disposal by a licensed company.
- *Nuisance Control:* N/A
- *Traffic Control:* If located along a shoulder or median, maintenance activities will require traffic controls.
- *Staffing/Equipment:* Staff and equipment required to change out-spent resin.

***Project Development:***

- *Right-of-Way Requirements:* Small footprint.
- *Siting Constraints*: Restricted to sites where nearby power or gravity flow is available. Power is required if the system chosen is pressurized.
- *Retrofit Potential:* Potential greater for existing detention ponds.
- *Construction:* None.

***Advantages:***

- They provide a compact system at the EDB outlet.
- Effluent quality does not vary with pollutant concentration; only the bed life varies.
- As long as the effluent is monitored. appropriately, the adsorption capacity can be easily assessed to determine when the IX unit should be replaced.

***Constraints:***

- Exhausted IX has potential to be considered a hazardous material and will need to be disposed of properly.
- Hauling costs may be excessive.
- IX resins could dry out if not kept wet.
- Potential clogging of the resin if pretreatment does not remove enough suspended solids, oil and grease.
- The requirement for flow equalization.

***Sources:***

- Monat, J. Synergies Between Ultrafiltration & Ion Exchange. http://www.kochmembrane.com/technical_info/separation.htm. April 2000.

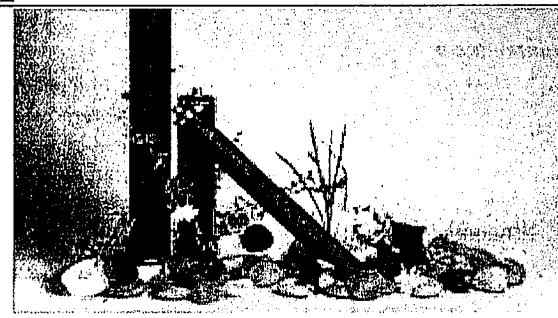
***Literature Sources of Performance Demonstrations:***

- Clifford, D.A., Department of Civil and Environmental Engineering, University of Houston, Texas, Water Quality and Treatment: A Handbook of Community Water Supplies 4th edition, 1990.
- Montgomery, James M, Consulting Engineers, Inc. Water Treatment Principles and Design, 1985.

***Description:***

The MICROGEN™ Stormwater Aeration System consists of a flexible suction hose or flexible pipe, a micro-bubble generator (pump, nozzle and S-tube with pressurized air return), and a flexible discharge hose or pipe. Micro-bubble generator is self-priming and able to pump solids to 2.5in diameter, so direct suction from storm water ponds or lakes is possible without filtration.

The MICROGEN™ Stormwater Aeration System quickly raises Dissolved Oxygen levels in storm water, pond or lakes, and estuaries after a rainstorm.



***Key Design Elements:***

1. Microgen™ produces bubbles with an average of 10 microns in diameter. This bubble is tens of thousands times smaller than the average bubble size produced by a venture ejector, fine bubble membrane or ceramic diffuser, brush aerator or fountain

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ○ | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Oxygen tanks can be mounted on a trailer with a single or multiple micro-bubble generators and a diesel generator, in order to diffuse pure oxygen rather than ambient air into storm water.
- The life expectancy of the Microgen™ system is 15 years.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◲ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Unknown
- *Nuisance Control:* Ponds that have permanent standing water need mosquito controls within exiting basins.
- *Traffic Control*: Unlikely.
- *Staffing/Equipment:* Unknown

***Project Development:***

- *Right-of-Way Requirements*: Ponds that have permanent standing water need mosquito controls within exiting basins.
- *Siting Constraints*: Ponds that have permanent standing water need mosquito controls within exiting basins.
- *Retrofit Potential*: Ponds that have permanent standing water need mosquito controls within exiting basins.
- *Construction:* Unknown

***Advantages:***

- The MICROGEN™ Stormwater Aeration System can be mobile or stationary.
- The MICROGEN™ system avoids the need for continuous electrical power which a brush aerator or fountain would need.
- Dissolved oxygen levels achievable with the MICROGEN™ system are significantly higher than would be possible with other aeration devices.

***Constraints:***

- Because of high nitrogen content in ambient air, the tiny bubble size, and long detention time, there is a significant risk, when using ambient air, to supersaturating the discharge water with nitrogen. This can be harmful to fish and their eggs. Therefore, a gas depressurization chamber on the discharge is required if ambient intake air is used. However, pure oxygen tanks or a pure oxygen generator can be used without this requirement.

***Sources:***

- Aqua Master, www.aquamasterfountains.com
- Tom Frankel, Stamford Scientific International, INC.
- www.stamfordscientific.com

***Literature Sources of Performance Demonstrations:***

- None identified.

# BMP Fact Sheet
# Chemical Treatment – Alum



***Description:***

Adding chemical coagulants to storm water influent is one way to remove more sediment and associated contaminants and nutrients in an Extended Detention Basin (EDB) without physically modifying the basin. Several coagulants have recently been evaluated for this application such as alum ($Al_2(SO4)_3 18H_2O$). The aluminum hydroxide precipitate, $Al(OH)_3$, forms a floc that attracts and absorbs colloidal particles, thus clarifying the treatment water. Removal of additional dissolved phosphorus occurs. Alum can be injected into major storm sewer lines on a flow-weighted basis during rain events. When added to runoff, alum forms non-toxic precipitates that combine with phosphorus, suspended solids and heavy metals, causing them to be rapidly removed from the treated water. In a typical alum storm water treatment system, the coagulant is injected into the storm water by a variable-speed chemical metering pump on a flow-weighted basis so the same dose is added regardless of the storm sewer discharge rate.

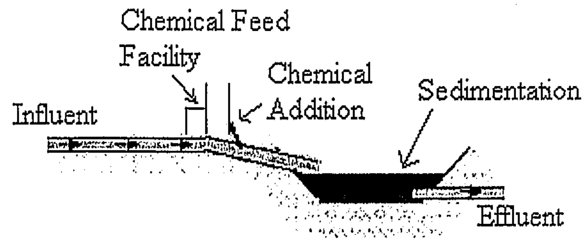
Since $Al^{+3}$ can be toxic to aquatic life, floc formation takes approximately 45 to 60 seconds and should be complete before treated storm water is discharged to receiving water. Alum injection locations must be carefully selected to allow at least 60 seconds of travel time after alum is added to the storm water and before discharge to the watershed.

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ● | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

***Caltrans SWMP Category:***

Category III




***Key Design Elements:***

1. Chemical dose.
2. Chemical feed and storage facilities.
3. Mixing Facilities.

Ancillary Facilities

Detention basin must be provided downstream to capture flocculated particles.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◳ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Mechanical equipment must be inspected and maintained on a regular basis. Sludge must be removed periodically.
- *Nuisance Control:* Vector control is an issue for detention basins.
- *Traffic Control*: Not commonly sited on the shoulder.
- *Staffing/Equipment:* Crews must be trained to maintain chemical addition system.

***Project Development:***

- *Right-of-Way Requirements*: Small footprint for chemical addition system.
- *Siting Constraints*: The site for this system must include access to electricity and be large enough for a central housing unit and storage tank.
- *Retrofit Potential*: May allow smaller detention basins where right-of-way is constrained.
- *Construction:* Access to the chemical storage facility will be needed for deliveries. Need enough head for mixing.

***Advantages:***

- The observed accumulation rate of alum floc in sediments of receiving waters is low due to floc consolidation over time and incorporation of alum floc into existing sediment.
- Alum treatment achieves high nutrient, heavy metal and fecal coliform removals.
- Dry alum sludge has chemical characteristics suitable for general land application or in agricultural sites.
- Construction costs for alum storm water treatment feed systems are largely independent of the drainage area to be treated and depend primarily upon the number of outfalls to be retrofitted.

***Constraints:***

- The pH must be maintained within a range of 5.5 to 7.5 to prevent formation of $Al^{+3}$, which has toxic effects on aquatic life.
- Sludge removal frequency and method will have to be studied.
- Alum forms voluminous metal hydroxides that are very difficult to dewater.
- Safety issues related to the chemical storage facility need to be considered.
- Appropriate mixing must be provided at the point of chemical addition.
- Optimum alum dose may vary with each storm.

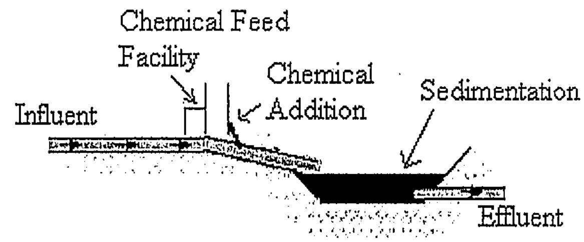
***Sources:*** None.

***Literature Sources of Performance Demonstrations:***


- Harper, H. H., et al. Alum Treatment of Stormwater: The First Ten Years Environmental Research & Design. 1997.
- Harper, H. H., et al. Alum Treatment of Stormwater Runoff: An Innovative BMP for Urban Runoff Problems. Environmental Research & Design, Inc. 1996.
- Harper, H. H., et al. "An Assessment of An In-Line Alum Injection Facility Used To Treat Stormwater Runoff in Pinellas County, Florida." Sixth Biennial Stormwater Research and Watershed Management Conference. September 14, 1999.
- Harper, H. H., et al. "The Evaluation & Design of an Alum Stormwater Treatment System to Improve Water Quality in Lake Maggiore in St. Petersburg, Florida." Fifth Biennial Storm water Research Conference. Nov 5 to 7, 1997.
- Harper, H. H., et al. "Removal of Microbial Indicators from Stormwater Using Sand Filtration, Wet Detention, & Alum Treatment Best Management Practices." Sixth Biennial Stormwater Research and Watershed Management Conference. September 14, 1999.
- Harper, H. H, " Long-Term Performance Evaluation of the Alum Stormwater Treatment System at Lake Ella, Florida." Final Report Submitted to the Florida Department of Environmental Regulation, Project WM339. December 1990.
- Price, F. A. & D. R. Yonge. Enhancing Containment Removal in Stormwater Detention Basins by Coagulation. Washington State University: Department of Civil and Environmental Engineering.
- Yonge, D. & F. Price. Stormwater Contaminant Removal by Chemicals: Enhancing Contaminant Removal in Stormwater Detention Basins by Coagulation. Research Project T9234-11. Washington State Department of Transportation (WSDOT). April 1995.

***Description:***

Adding chemical coagulants to storm water influent is one way to remove more sediment and associated contaminants and nutrients in an Extended Detention Basin (EDB) without physically modifying the basin. Several coagulants have recently been evaluated for this application such as polyacrylamide (PAM). PAM is one of several water-soluble coagulants that have demonstrated proficiency at reducing soil erosion when added at low concentrations to irrigation water. This reduction is accomplished by improving the stability of soil aggregates and flocculating suspended solids. When added to irrigation water, PAM removes most sediments, phosphorus, and pesticides from the resultant return flow. It also reduces the return flow BOD and increases infiltration, which reduces runoff water quantity. PAM could be used in a gel log or composite block placed in a basket or nylon mesh bag.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ◒ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No performance data encountered in field demonstrations.

***Key Design Elements:***

1. Chemical dose.
2. Delivery and storage system.
3. Mixing facilities.

Ancillary Facilities

Detention basin must be provided downstream to capture flocculated particles.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ● |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Mechanical equipment must be inspected and maintained on a regular basis. Sludge might need to be removed frequently. After each storm the sedimentation basin and the dosing systems should be inspected. The sedimentation basin would need to be cleaned when necessary. The dosing system should be recharged with PAM or PAM/$CaCO_3$ composite mixture when there is no residual gel.
- *Nuisance Control:* N/A.
- *Traffic Control*: Rarely located along a shoulder or median.
- *Staffing/Equipment:* Staff and equipment necessary to replenish PAM supply.

***Project Development:***

- *Right of Way Requirements:* Small footprint.
- *Siting Constraints*: None identified.
- *Retrofit Potential:* High potential to improve existing EDBs without physically modifying the basin.
- *Construction:* Access to the chemical storage facility will be needed for deliveries. Need enough head for mixing.

***Advantages:***

- Effective dose for anionic PAM is 3 to 50 times less than inorganic flocculants such as alum and ferric chlorides.
- Treating storm water with PAM does not require power or mechanical dosing equipment.
- Anionic PAM produces a large, stable floc, which settles much more rapidly than floc generated from voluminous metal hydroxides that are very difficult to dewater.
- PAM works over a very wide range of pH values, while inoragnic flocculants are pH-sensitive and must be adjusted to be effective. Inorganic flocculants consume alkalinity and lower system pH, while PAM has a negligible effect on system pH.
- When collected, pond sediments may be used as road fill or taken to disposal sites where excavated (clean) soils are usually deposited. These options assume that the concentrations of metals and other contaminants associated with sediments are low enough to be disposed of in these conditions.

***Constraints:***

- PAM dissolves very slowly before reaching full hydration and activation. Polymer activation is also a critical step that requires appropriate mixing. PAM must be added to storm water where turbulence is high enough to simulate a rapid-mix system.
- Aqueous PAM concentrations are limited to about 3% active ingredient because viscosity increases so rapidly.
- An odorless, free-flowing crystalline called acrylamide (AMD) is a chemical intermediate in the production and synthesis of PAM. AMD is regulated under National Primary Drinking Water Regulations, CFR 141.32(e)(23). To ensure compliance, it will be necessary to estimate AMD concentrations in the pond effluent and in the groundwater at sites where infiltration occurs.

***Sources:***

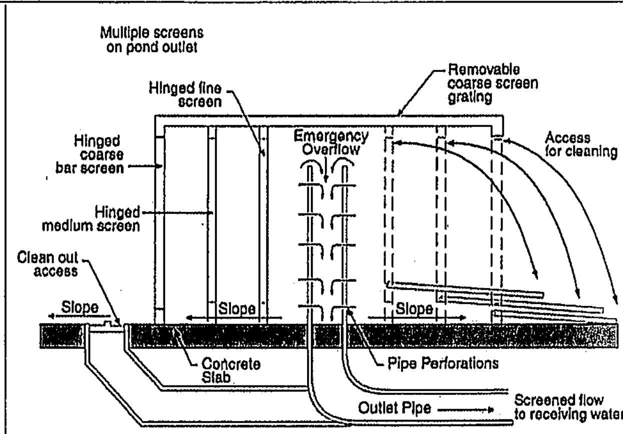
- PAM Research Project Washington State Department of Transportation (WSDOT). http://www.wsdot.wa.gov/eesc/environmental/pam.htm. April 2000.

***Literature Sources of Performance Demonstrations:***

- McElhiney M. & Osterli P. An Integrated Approach for Water Quality: The PAM Connection, West Stanislaus HUA, CA , Managing Irrigation-Induced Erosion and Infiltration with Polyacrylamide. University of Idaho Miscellaneous Publication No.101-96, 1996.
- Solka R.E & Lentz R.D. A PAM Primer: A brief history of PAM-related issues, Managing Irrigation-Induced Erosion and Infiltration with Polyacrylamide. University of Idaho Miscellaneous Publication No.101-96, 1996.
- Washington State Department Of Transportation (WSDOT). "Polyacrylamide (PAM) for Soil Erosion & Flocculation of Stormwater Detention Ponds at Highway Construction Sites." WSDOT High Runoff Manual, Section 4.4: WSDOT Experimental BMP-Quality Assurance/ Quality Control Plan. WAC 173-270-030.6.a.

**Description:**

The improved screening outlet BMP consists of placing a three-screen system before or around the effluent discharge location in a sedimentation pond. Debris that does not settle out will be retained or removed from the pond effluent. The outlet consists of a perforated vertical pipe with an open end. If inflow greatly exceeds outflow and the pond water level rises, the excess water can spill over into the open end of the pipe. The three screens consist of an exterior coarse bar screen, an intermediary medium-sized screen, and an interior fine screen. The system is designed to catch debris on the screen before effluent is discharged from the sedimentation basin. The first screen filters larger and coarser materials such as trash; the second stops medium-sized solids and debris; the third may remove some suspended solids. Use of filter fabric at a pond outlet is not recommended because it will clog too rapidly. The three screens are designed in a box-like arrangement with the sides of the box hinged at the bottom to allow the screen "wall" to be lowered for cleaning. The multiple-screen box has a built-in emergency overflow arrangement consisting of pipe perforations and the open end of the vertical outlet pipe. If inflow significantly exceeds outflow and the pond water level rises, the water will spill over and flow into the open end of the pipe when the water level reaches the top of the vertical pipe. The system includes a cleanout connection for rodding or use of a "sewer snake" to remove blockages or buildup in the outlet pipe.




**Section View**

*Notes:*

- Suspended solids and other constituents attached to the solids settle out in the pond. Heavy metals that are not dissolved but attached to particles might be removed with the settled solids.
- No performance data encountered in literature

**Key Design Parameters:**

1. Hydraulic design of perforated pipe outlet.
2. Screen sizes and mountings.

Ancillary Facilities

Extended detention basin

**Constituent Removal:**

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

**Equivalent Uniform Annual Costs:**

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▗ | ○ |

● High ◒ Medium ○ Low

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

**Caltrans SWMP Category:**

Category III

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Routine maintenance may include periodic debris removal.
- *Nuisance Control:* None associated with screens themselves.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove debris by spraying the screens in reverse flow.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively small.
- *Siting Constraints*: Requires adequate space at pond outlet for screen installation.
- *Retrofit Potential*: Screens are to be placed at effluent of existing sedimentation ponds.
- *Construction:* No issues identified.

***Advantages:***

- The improved screening outlet, like the original screen, would prevent clogging of the basin outlet as well as provide additional pollutant removal to the detention basin effluent.

***Constraints:***

- Clogging of the screens is common.

***Sources:***

- None available.

***Literature Sources of Performance Demonstrations:***

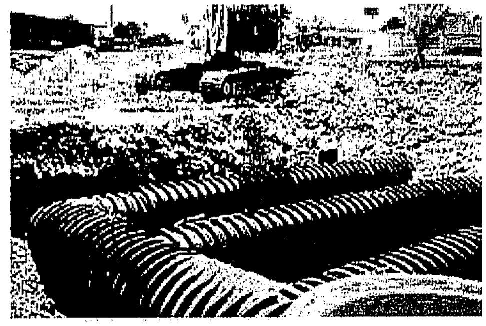
- Barrett, M.E., Malina, J.F., Jr., and Charbeneau, R.J., An Evaluation of the Performance of Geotextiles for Temporary Sediment Control, Water Environment Research, Vol. 70, No. 3, pp. 23-90. 1998.

# BMP Fact Sheet
# Detention - Below Grade Storage



***Description:***

Below grade storage are storm water detention systems using subsurface piping. Detained water can be reused or drained to the storm sewer or surface drainage.



***Constituent Removal:***

| ***Constituent Group*** | ***Removal Efficiency*** | ***Level-of-Confidence*** |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

***Key Design Elements:***

1. Cover requirements
2. Storage capacity
3. Class V injection well determination if designed to infiltrate

***Equivalent Uniform Annual Costs:***

| | ***Cost Effectiveness*** | ***Level-of-Confidence*** |
|---|---|---|
| *EUAC* | | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

*Notes:*

•

***Caltrans SWMP Category:***

Category III



A001958

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Unknown
- *Nuisance Control:* Required to completely drain.
- *Traffic Control*: Unknown
- *Staffing/Equipment:* Likely vactor equipment with the ability to clean horizontal lines. Equipment and training needed for confined space entry.

***Project Development:***

- *Right-of-Way Requirements*: Large area requirements, but area above grade can be used if constructed properly.
- *Siting Constraints*: A minimum cover requirement in a non-traffic installation site is 12" (top of pipe to the top of grade). If traffic is present with a flexible pavement the minimum cover is 12" (top of pipe to the bottom of bituminous) for a pipe up to 36" in diameter, and 24" (top of pipe to the bottom of bituminous) for a pipe of 42"-60" in diameter. If traffic is present with a rigid pavement the minimum cover is 36" (top of pipe to top of pavement) for a pipe up to 36" in diameter, and 24" (top of pipe to top of pavement) for a pipe of 42"-60" in diameter.
- *Retrofit Potential*: Requires extensive excavation and backfill.
- *Construction:* Backfill requirements state that all retention and detention systems shall be installed in accordance with ASTM D 2321. Acceptable backfill material for the pipe embedment zone shall be class I and II as predicated in ASTM D 2321. Filter fabric is recommended around the entire installation to prevent migration of fines with retention systems.

***Advantages:***

- Subsurface retention/detention systems use available land efficiently while introducing low maintenance costs and posing little or no aesthetic problem.

***Constraints:***

- Difficult to clean out due to the fact that it is buried.
- Standing water may create mosquito habitat.

***Sources:***

- Advanced Drainage Systems, Inc., www.ads-pipe.com
- Contech Construction Products Inc. www.contech-cpi.com
- Lane-Enterprises, www.lane-enterprises.com
- StormTrap™, DoubleTrap™, www.stormtrap.com

***Literature Sources of Performance Demonstrations:***

- None available

***Description:***

This BMP consists of chemical disinfection of storm water using hypochlorous acid solution. The product of concentration (C) and contact time (t) may be adjusted to achieve various levels of disinfection as defined by the U.S. EPA. This process has proven successful for many years at inactivating pathogens and other microbial contaminants in drinking water and wastewater. The hypochlorous solution is to be injected at the end of the pipe before the baffled contact chamber or existing sedimentation basin. A chemical storage tank and chemical feed system capable of adjusting feed based on pipe flow is required. Hypochlorous acid dosing sufficient to achieve the desired Ct value is necessary. A contact chamber will be designed to achieve desired Ct value at high flows. Chlorine residual will be monitored. Dechlorination may be needed prior to discharge to receiving waters.

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ● | ○ |
| *Litter* | ○ | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

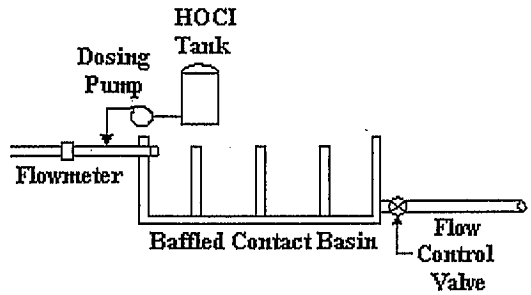
*Notes:*

- No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness
- Some organics may be converted to other (possibly more harmful) products.

***Caltrans SWMP Category:***

Category III

**Hypochlorite Disinfection Schematic**




***Key Design Elements:***

1. Chlorine dose and contact time (Ct).
2. Chemical feed and storage facilities.
3. Mixing facilities.

Ancillary Facilities

Pretreatment to remove particles is required to achieve reliable disinfection. This will normally require sedimentation and filtration facilities upstream. Contact time must be provided in a contact basin of sedimentation basin downstream. Dechlorination system.

***Equivalent Uniform Annual Costs:***

| | *Cost Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ◒ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A001960

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Mechanical equipment must be maintained.
- *Nuisance Control:* None identified.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* Trained staff is required for mechanical equipment maintenance. Requires flow measurement device designed for a large range of flow conditions.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements will depend on size of contact chamber needed to accommodate design flow.
- *Siting Constraints*: Restricted to sites with available nearby power.
- *Retrofit Potential*: Has potential to be used with existing sedimentation basins.
- *Construction*: Substantial excavation is needed.

***Advantages:***

- Specific use guidelines available and proven effectiveness on microbial contaminants.
- Insect vectors not an issue with chlorinated water.

***Constraints:***

- Harmful to receiving water biota.
- Formation of disinfection by-products (DBPs).
- Pre-treatment (e.g., removal of suspended solids) required in most cases.
- Requires special handling procedures and chemical storage tank on site.
- Substantial excavation is needed.
- May require special permitting and discharge water quality monitoring.
- May result in unnatural looking conditions in earthen basins.

***Sources:***

- www.jajagroup.com
- www.ionics.com

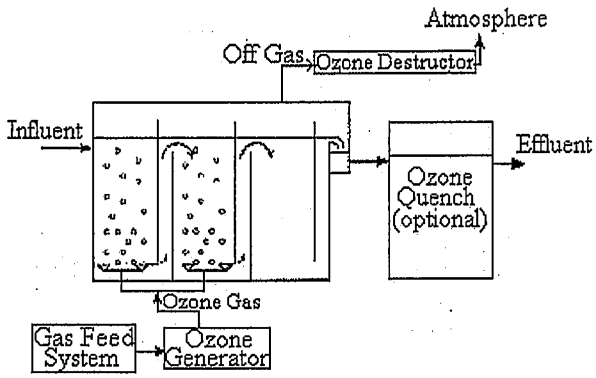
***Literature Sources of Performance Demonstrations:***

- None available.

***Description:***

Ozone is used in water treatment for disinfection and oxidation. An ozone treatment system has four basic components: a gas feed system, an ozone generator, an ozone contactor, and an off-gas destruction system. The gas feed system provides a clean, dry source of oxygen to the generator. The ozone contactor transfers the ozone-rich gas into the water to be treated, and provides contact time for disinfection (or other reactions). The final process step, off-gas destruction, is required as ozone is toxic in the concentration present in the off-gas. A quench chamber to remove ozone residual in solution may also be added to the treatment train.

The ozone feed system uses air, high purity oxygen, or a mixture of the two. Ozone systems are most applicable for continuous flow. For wet weather intermittent flow, a water sensor will be needed to start the ozone generator, but the first flush of the runoff would not be treated unless an equalization/storage basin is provided.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ● | ◒ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- The bacterial loads in the water upon leaving the contact chamber (City of Malibu, California Bioxide Technology) have been reduced to allowable U.S. EPA "recreational use" limits.
- Constituent removal assumed to at least be as good as EDB because it is assumed to be used in conjunction with and EDB.

***Key Design Elements:***

1. Ozone dose and contact time (Ct).
2. Gas feed and ozone production equipment.
3. Contact facilities.
4. Quench tank.

<u>Ancillary Facilities</u>

Pretreatment to remove particles is required to achieve reliable disinfection. This will normally require sedimentation and filtration facilities upstream. Contact time must be provided in a contact basin of sedimentation basin downstream.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III



A001962

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Generators should be checked daily when in operation. Manual start-up of the ozone generator is preferable since it needs to be purged before each start-up. Filters and desiccant in air preparation systems should be changed periodically.
- *Nuisance Control*: None.
- *Traffic Control*: No issues identified.
- *Staffing/Equipment*: The ozone system operation is to be performed by an operator with a water treatment background. Maintenance on the generators requires skilled technicians. This work can also be done by the equipment manufacturer if trained maintenance staff is not available.

***Project Development:***

- *Right-of-Way Requirements:* Relatively small footprint.
- *Siting Constraints*: Restricted to sites with available nearby power.
- *Retrofit Potential*: Most suited for maintenance stations.
- *Construction:* The ozone diffusers can easily be damaged by debris and sediments. The pre-treatment step will have to remove most of the sediments as well as the oil and grease. Accumulation of sediments in the contact chamber should be avoided.

***Advantages:***

- Ozone is a strong disinfectant and has a limited number of by-products.
- Low doses are required to complete disinfection.
- The process does not provide residual ozone concentration in the treated effluent. This will then minimize the impact on the receiving watershed.
- Even though ozone systems are complex, using highly technical instruments, the process is highly automated and very reliable.

***Constraints:***

- The ozone must be produced on site because it cannot be stored.
- Ozonation technology has a very high energy requirement.
- Some ozonation by-products may be harmful to the receiving water.
- In the presence of many compounds commonly encountered in water treatment, ozone decomposition forms hydroxyl free radicals.
- Ozone escaping to atmosphere may contribute to air pollution problems.

***Sources:***


- EPA Guidance Manual, Alternative Disinfectants and Oxidants, April 1999.
- Bioxide Corporation, Vanguard Stormwater Treatment System, http://www.bioxide.com/water.htm.
- PCI-Wedeco Environmental Technologies, Inc. One Fairfield Crescent, West Caldwell, NJ 07006.

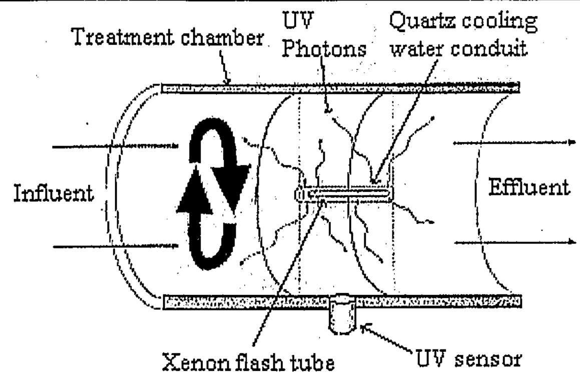

***Literature Sources of Performance Demonstrations:***

- The City of Malibu, California, approved the use of Bioxide's technology to treat their runoff before it reaches the lagoon near the beach for a "dry-flow" run.

***Description:***

Ultraviolet (UV) light disinfects water by altering the genetic material (DNA) in the cells so bacteria, viruses and other microorganisms can no longer reproduce or infect. In UV disinfection systems, the light is produced by germicidal lamps (200 to 300 nanometers) enclosed in a pressure vessel or submerged in a water channel. As the water flows past the UV lamps, the microorganisms are exposed to a lethal dose of UV energy. The UV dose is the product of the light intensity and contact time.

The UV disinfection treatment is an in-line device downstream of another treatment process. Potential applications could be: As an in-line pipe after a litter/coarse material removal device such as a vortex separator; downstream of a BMP such as a multiple chamber treatment train (MCTT); sedimentation basin or media filter.




***Caltrans SWMP Category:***

Category III

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ● | ○ |
| *Litter* | ○ | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Efficiency does not include required pretreatment.
- Removal efficiency depends on the UV dose applied to storm water.
- Factors affecting disinfection efficiency by UV light include: turbidity or suspended solids in the water, light-absorbing characteristics of the water, flow distribution across the UV lamps, contact time of water with UV light.
- Presence of some compounds in the storm water may reduce UV efficiency such as: dissolved or suspended matter may shield microorganisms from UV radiation, high turbidity of surface water can impact disinfection efficiency. Some chemical substances can decrease UV transmission. Color also reduces transmission within a UV contactor.

***Key Design Elements:***

1. Light intensity and contact time.
2. Hydraulic system for moving water past lamps.
3. Facilities for cleaning lamps.

<u>Ancillary Facilities</u>

Pretreatment to remove particles is required to achieve reliable disinfection. This will normally require sedimentation and filtration facilities upstream.

***Equivalent Uniform Annual Costs:***

| | *Cost Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◲ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Each lamp must be cleaned periodically – typically every two weeks for wastewater discharges, but probably less frequently for intermittent storm water discharges. Pumps must be maintained.
- *Nuisance Control:* None identified.
- *Traffic Control*: None identified.
- *Staffing/Equipment:* Highly trained staff is required for mechanical equipment maintenance.

***Project Development:***

- *Right-of-Way Requirements*: May be compact if pretreatment is not required.
- *Siting Constraints*: Restricted to sites with available nearby power. Access is required.
- *Retrofit Potential*: Moderate potential.
- *Construction:* Significant start-up and testing requirements.

***Advantages:***

- Natural process that disinfects without chemicals.
- Low maintenance requirements.
- Automated operations and controls.
- Compact system, small footprint.
- Suitable for retrofit to existing facilities.
- No impact on other processes following UV treatment.
- UV disinfection can meet water quality standards that have stringent requirements for total and fecal coliform (from 2 to 200 MPN/100ml) without generating disinfection by-products (DBPs) or handling chemicals.

***Constraints:***

- No chemical residual.
- Pretreatment requirement may be substantial. Clumping microorganism and turbidity can impact disinfection by harboring pathogens in the aggregates.
- Specific design parameters vary for individual waters (UV transmittance).
- Under certain conditions, some organisms are capable of repairing damaged DNA and reverting back to an active state to reproduce again (photoreactivation). This can be minimized by shielding the process stream or limiting the exposure of disinfected water to sunlight immediately following disinfection.
- Organic and inorganic fouling usually occurs on UV lamp sleeves. Inorganic fouling, which is related to the high temperature of the lamp, is the most difficult to clean because inorganics such as iron and manganese bind to the quartz sleeve.

***Sources:***

- PCI-Wedeco Environmental Technologies, Inc. One Fairfield Crescent, West Caldwell, NJ 07006

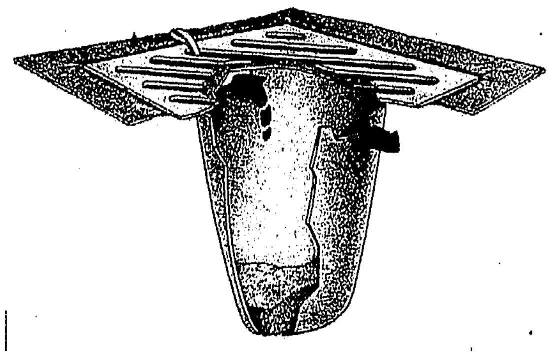
***Literature Sources of Performance Demonstrations:***


- Barrett, M. E. & J. F. Malina Jr. Stormwater Disinfection Research Work Plan. Center for Research in Water Resources: University of Texas, Austin. June 1999.
- EPA Guidance Manual, Alternative Disinfectants and Oxidants. April 1999.

# BMP Fact Sheet
## Drain Inlet Inserts – Fabric


***Description:***

Fabric inserts consist of a fabric filter sock installed under the storm grate to catch oil, grease, sediment, litter, and debris. The devices are simple, inexpensive, and easy to install and replace. They are ideal on construction sites, industrial facilities, and parking lots. The fabric sock must be sized to the storm grate. The fabric material and shape is dependent upon the types of contaminants present at the site.



***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ◒ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No performance data encountered in field demonstrations or in literature.

***Key Design Elements:***

1. Proprietary devices.
2. Hydraulic capacity and pollutant storage capacity.
3. Provision for overflow or bypass to avoid flooding when the insert is full or clogged.

Ancillary Facilities

None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▖ | ○ |

***Caltrans SWMP Category:***

Category III

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

*Maintenance:*

- Requirements: The inserts need to be checked regularly during the rainy season to prevent clogging. The socks may fall into the basin if too fully loaded. The socks will become heavier as they fill with contaminants, making them more difficult to remove. Care should be taken when removing the insert for replacement/cleaning so that the contaminants do not fall into the drain.
- Nuisance Control: None identified.
- Traffic Control: If located along a shoulder or median, maintenance activities may require traffic control.
- Staffing/Equipment: It may be a challenge for one person to lift up the storm grate and remove a full sock beneath it.

***Project Development:***

- Right-of-Way Requirements: Same as drop inlets.
- Siting Constraints: Requires a storm water inlet.
- Retrofit Potential: Easy to add to any inlet.
- Construction: No issues identified.

***Advantages:***

- The device can be easily retrofitted, is simple to install and maintain, and it is reusable. Some designs have a Pop-Up Capacity Indicator that alerts maintenance personnel that the sock needs to be replaced or emptied.

***Constraints:***

- If the socks become too filled with contaminants, they may be difficult to lift out of the drain to clean/replace.
- Excess debris may affect drain inlet capacity.

***Sources:***

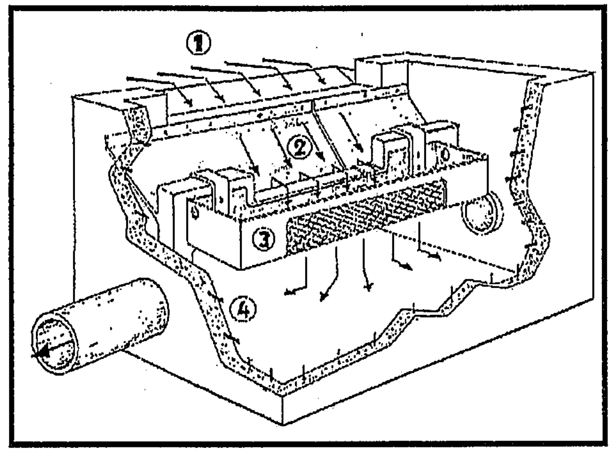
- Catch-All, Marathon Materials, www.marathonmaterials.com
- Drain Diaper (Petro-Marine, Inc.), http://www.petromarinecompany.com/petro-marine/noname.html
- DrainPacTM (PacTec, Inc.).
- Drain Guard, (Gullywasher), www.gullywasher.com
- Drain Web, (Gullywasher), www.gullywasher.com
- Drain Gate, (Gullywasher), www.gullywasher.com
- Geotextile Catch Basin Insert (Gullywasher), http://www.gullywasher.com/geoso.html
- Ultra-Drain Guards (UltraTech International), http://www.stormwater-products.com/
- www.usabluebook.com

***Literature Sources of Performance Demonstrations:***

- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/ultradrainguard.html

***Description:***

Flow-Through Baskets are wire catchbaskets that are installed in storm drains. Their main function is to catch sediment, litter, and organic debris. They are relatively easy to install, durable, and require low maintenance. Flow-through baskets can be installed at any curb inlet, including those located at construction sites and park-and-ride areas. The flow-through baskets can be simply designed for various capacities and can contain a variety of mesh size openings. For larger capacities, more space is required. The size of the debris must be estimated accurately so that the wire mesh can be sized accordingly. The amount of debris will affect how large to make the basket, so more or less space will be required to fit the device.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ◒ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- AquaShieldTM SD-100: Chattanooga, TN Stormwater Management Division accepts device based on a report from the Analytical Industrial Research Laboratories, Inc. dated September 24, 1977 and the U.S. Department of the Navy, Department of Commerce, and Best Manufacturing Practices Center of Excellence (BMPCOE) determines that it meets industry submitted practice requirements; DrainPacTM: Soper, Spencer, Encinitas Installs New Storm Drain Filters, North County Times, January 6, 2000.
- DrainPacTM: Bourelle, Andy, Tahoe Keys Installs DrainPacsTM, *Tahoe Tribune,* November 5, 1999; Grate Inlet Skimmer Box: Happel, Tom, Reedy Creek Report 3, December 23, 1999; many field tests have been performed, but not officially published.

***Caltrans SWMP Category:***

Category III

***Key Design Elements:***

1. Proprietary devices.
2. Hydraulic capacity and pollutant storage capacity.
3. Provision for overflow or bypass to avoid flooding when the insert is full or clogged.

Ancillary Facilities

None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▖ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A001968

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Needs to be frequently inspected and cleaned if needed. If there is heavy rainfall, more maintenance is required. If the baskets get too full, they may be difficult to clean.
- *Nuisance Control:* None identified.
- *Traffic Control*: If located along a shoulder or median, maintenance activities may require traffic control.
- *Staffing/Equipment:* There are several methods to clean: manually retrieve basket, manually use specially designed basket liners, or vacuum. The gross pollutants do not need to be handled during cleaning. The filter screens can be easily removed. There is no risk with confined space entry regulations, and there is no risk to public safety and health.

***Project Development:***

- *Right-of-Way Requirements*: Minimal requirements.
- *Siting Constraints*: Requires a storm water inlet.
- *Retrofit Potential*: Easy to add to any inlet.
- *Construction:* No issues identified.

***Advantages:***

- There is a range of sizes that can be retrofitted to storm drain requirements. They are easy to install and clean. Maintenance can be simple and quick. Adsorption booms can be attached.

***Constraints:***

- If there is heavy rainfall, more maintenance is required.
- If the baskets get too full, they may be difficult to clean.
- Debris and litter may quickly exceed drain inlet insert capacity.
- Depending on how large the basket will be, more land will have to be excavated, so there cannot be pipes, lines, etc. at the location.
- Possibility of clogging and causing local flooding.

***Sources:***

- Curb Inlet Basket (CIB) (Suntree Technologies, Inc.), http://www.suntreetech.com/catalog1/page6.html
- Ecosol RSF 100/GSP (Ecosol), http://www.ecosol.com.au/
- Fossil Filter™ Flo-Gaurd High Capacity Insert System (KriStar Enterprises), http://kristar.com/level2/products/hicap.html
- Stream Saver Catch Basin Inserts (Zymark, Inc.),
- Stream Saver Bio-Oil Filter Insert (Zymark, Inc.),
- Verti-Pro Vertical Catch Basin Protection (Alpine Stormwater Mgt. Co.)
- Wire Catch Basin Inserts for Litter, Oil & Sediment Control (Gullywasher) http://www.gullywasher.com

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

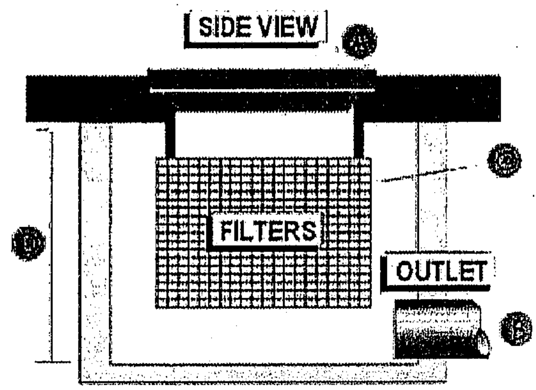
Flow-through boxes are a type of technology that catch sediment, debris, and organic litter in internal baskets or bags and remove contaminants by filtration media (sorbent). Filtration can vary to suit the source of contaminants. Wastewater flows by gravity (or can be pumped into a mobile unit) into the primary sediment removal stage to capture and extract unwanted debris and suspended solids. The wastewater then moves through a series of filters. The devices can be used by industrial, commercial, governmental, institutional and multi-family facilities, especially in vehicle parking lots, corporation yards, service stations, etc. These devices require regular maintenance for proper performance.

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ◒ |
| *Nutrients* | ◒ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ● | ◒ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ● | ◒ |
| *TDS* | ○ | ○ |

*Notes:*

- AquaShieldTM SD-100: Chattanooga, TN Stormwater Management Division accepts device based on a report from the Analytical Industrial Research Laboratories, Inc. dated September 24, 1977 and the U.S. Department of the Navy, Department of Commerce, and Best Manufacturing Practices Center of Excellence (BMPCOE) determines that it meets industry submitted practice requirements; DrainPacTM: Soper, Spencer, Encinitas Installs New Storm Drain Filters, North County Times, January 6, 2000.
- DrainPacTM: Bourelle, Andy, Tahoe Keys Installs DrainPacsTM, *Tahoe Tribune,* November 5, 1999; Grate Inlet Skimmer Box: Happel, Tom, Reedy Creek Report 3, December 23, 1999; many field tests have been performed, but not officially published.




***Caltrans SWMP Category:***

Category III

***Key Design Elements:***

1. Provision for overflow or bypass to avoid flooding when the insert is full or clogged.

Ancillary Facilities

None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A001970

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: The adsorption media must be removed and disposed of properly and frequently. It is a good idea to broom sweep around the area of the inlet. Trapped, solids, debris, and foreign matter must be removed to prevent restrictions and blockage. A high holding capacity will require less maintenance. Fastening devices should be regularly inspected. Proof of maintenance may be required due to past abuses in installed storm water treatment devices.
- *Nuisance Control:* Can pool water if clogged.
- *Traffic Control*: If located along a shoulder or median, maintenance activities may require traffic control.
- *Staffing/Equipment:* Some manufacturers provide maintenance services. The larger size generally requires removal of sediment from the device with a vacuum truck.

***Project Development:***

- *Right-of-Way Requirements*: Same as drop inlets.
- *Siting Constraints*: Requires a storm water inlet.
- *Retrofit Potential*: May be added to most inlets.
- *Construction:* It may be difficult to install device (drill, fasten, etc.) if storm drain area is small. Seal around filter housing to prevent water from bypassing filter. A watertight assembly of the product is important.

***Advantages:***

- The devices can be installed relatively easily in new and existing facilities without much structural modification.
- There are options to install fine sediment screens.
- The filtration media type and amount can be varied.
- Normal storm water flow is not usually restricted.
- Some devices are constructed to allow for easy NPDES sampling. Other devices have a "trap" for floatables.
- Installation can be permanent or temporary.
- Baffle configurations can also be installed in the system.
- Servicing the device does not typically take long (under 15 minutes).

***Constraints:***

- The adsorption media has to be removed and disposed of properly periodically during the storm season.
- If media become saturated, pollutants will pass through freely.
- May be difficult to clean filter baskets/bags.
- Clogged filter baskets will hinder flow and possibly flood roadway.
- Efficiency is proportional to maintenance.
- May have to install standpipe in existing drain inlet or replace a basin that is too small.

***Sources:***

- AquaShieldTM SD-100 (Remedial Solutions, Inc.) http://wwwremedialsolutions.com/aqua_shield/ index.html
- BMP Filter "CB" Series (StormWater Compliance International).
- CLR Filter (Stormwater Systems, Inc.).
- Grate Inlet Skimmer Box (Suntree Technologies, Inc.) http://suntreetech.com
- Grate Protector 1000 & Grate Protector 2000 (Suntree Technologies, Inc.) http://suntreetech.com
- Hydrocartidges Storm Drain Filtration System (Advanced Aquatic Products Int'l, Inc.).
- HydroKleen (Hydro Compliance Management, Inc.).
- Oil and Sediment Trap for Catch Basins (Gullywasher).
- SIFT Filter (REM Environmental Marketing), StormKlenz (Best Management Technologies).
- Trench Drain Systems (Gullywasher), http://www.gullywasher.com
- Ultra-Urban Filter (AbTech Industries).

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***
Media Filters use filter media exclusively in various configurations to trap contaminants found in storm water runoff. The system is easy to install, cost effective and easy to maintain. It can be used in parking lots and service bays. The device must be sized to fit the drain inlet. System sizing should be either volume-based or flow-based. The proper filter must be used to effectively remove contaminants.

***Constituent Removal:***

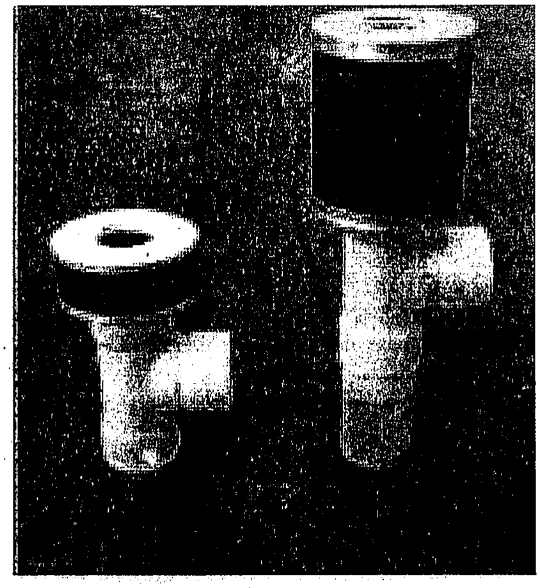
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ◓ | ◓ |
| *Nutrients* | ● | ○ |
| *Pesticides* | ● | ○ |
| *Total Metals* | ◓ | ◓ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ○ | ○ |
| *BOD* | ◓ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No performance data encountered in field demonstrations or in literature.

***Caltrans SWMP Category:***

Category III



Tee Section Filters for Manholes

***Key Design Elements:***

1. Proprietary devices.
2. Media type and depth.
3. Hydraulic capacity and pollutant storage capacity.
4. Provision for overflow or bypass to avoid flooding when the insert is full or clogged.

Ancillary Facilities
None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▖ | ○ |

| ● | ◓ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- _Requirements_: Filters must be regularly inspected and changed periodically depending on the storm season events. May require closed-space entry.
- _Nuisance Control_: Water can pool if clogged.
- _Traffic Control_: Commonly located along a shoulder or median, maintenance activities will require traffic control.
- _Staffing/Equipment_: Not available.

***Project Development:***

- _Right of Way Requirements_: Same as drop inlets.
- _Siting Constraints_: Requires a storm water inlet.
- _Retrofit Potential_: Easy to add to most inlets.
- _Construction:_ Confined space situations may be an issue.

***Advantages:***

- The system is easy to install.
- The device can be installed in parallel to increase treatment capacity.
- Water can pass through freely (if void of solids).
- Some filter cartridges can be recharged.
- Filter media can easily be site-specific.
- Some devices are delivered precast.

***Constraints:***

- Media Filters do not remove and catch debris, litter, etc, effectively, if at all. Solids traps must be installed for this purpose or else collected from the bottom during low flow.
- Media should be kept dry between storm events to extend life.
- Potential for clogging and flooding road.

***Sources:***

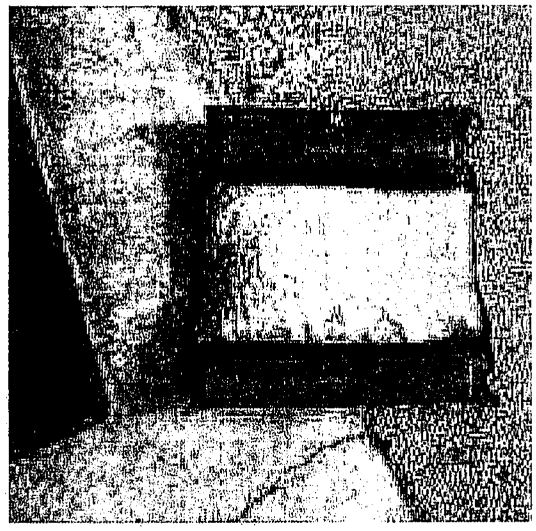
- Drop-In-Drain-Interceptor (Robert's Design Incorporated).
- Multi-Cell Filter (Best Management Technologies).
- Radial Filter Cartridge Filtration System (Gullywasher) http://www.gullywasher.com/radial08.html
- Raynfiltr™, Enviromental Filtration, Inc.
- Removable Baffle Stormwater Treatment System (Gullywasher) http://www.gullywasher.com/baffle1.html
- StormFilter® (StormWater Management, Inc.) http://www.stormwatermgt.com/products/stormfilters.html
- Tee Section Filters for Manholes (Gullywasher) http://www.gullywasher.com/tee1.html

***Literature Sources of Performance Documentation:***

- None identified.

***Description:***

Passive Skimmers float directly on the water surface and absorb floating hydrocarbons. The hydrocarbons are transformed into manageable solid waste. It is an inexpensive and simple method of capturing hydrocarbons. Passive Skimmers generally float in storm water catch basins, sumps, vaults, holding tanks, and oil/water separators. The skimmers must be able to withstand turbulent environments. The absorbent material should be specific to the contaminants at a location.



***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ○ | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- This device removes floatables.
- OARS Passive Skimmer: Co-polymer meets the non-leaching criteria developed by Washington state's King County Surface Water Management Division (Oil Leachate Test for Adsorbent Filter Media, April 1995) for products used in nonpoint source pollution control; Passive Skimmer: helps comply with NPDES, 40 CFR 122.26 (1999).
- OARS Passive Skimmer: successfully passed the EPA Method 1311/TCLP (Toxicity Characteristic Leaching Procedure) Test for volatile and semi-volatile organics and the 8 RCRA metals

***Caltrans SWMP Category:***

Category III

***Key Design Elements:***

1. Proprietary devices.
2. Adsorbent material.
3. Provision for overflow or bypass to avoid flooding when the insert is clogged.

<u>Ancillary Facilities</u>

None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- Requirements: Must be regularly inspected. Maintenance consists of pulling the skimmer out and replacing it.
- Nuisance Control: None identified.
- Traffic Control: Commonly located along a shoulder or median, maintenance activities will require traffic control.
- Staffing/Equipment: Minimal training required.

***Project Development:***

- Right of Way Requirements: Same as drop inlets.
- Siting Constraints: Requires a storm water inlet.
- Retrofit Potential: Easy to add to any inlet.
- Construction: Simple installation.

***Advantages:***

- Skimmers are cost effective.
- They "lock up" absorbed hydrocarbons and will not leak or leach, so they can remain in place for long periods.
- They continually absorb.
- Maintenance is quick and easy.
- Requires no structural modifications to existing drainage structures or oil/water separators.

***Constraints:***

- Some skimmers may contribute to sediment clogging.
- Skimmers only trap hydrocarbons, and do not contribute to sediment control.
- If a skimmer has adsorbed to its maximum capacity, hydrocarbons will not be captured until the device is replaced.

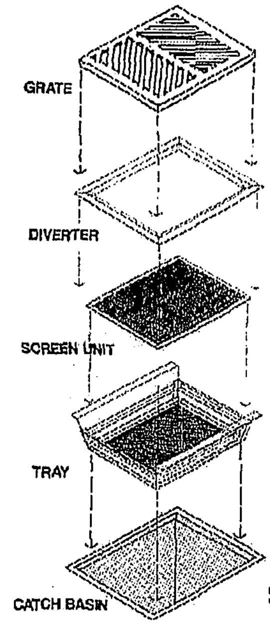
***Sources:***

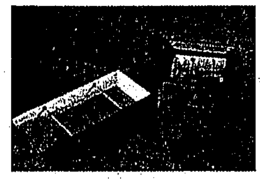
- OARS Passive Skimmer (AbTech Industries) http://www.abtechindustries.com/Passive%20skimmer.html
- Passive Skimmer (UltraTech International)
- http://www.stormwater-products.com/

***Literature Sources of Performance Documentation:***

- None identified.

***Description:***
Trickle Down Trays consist of levels of trays that have different purposes in treating storm water. Usually, contaminated water enters through a grate and is diverted to the first tray, which removes sediments, litter, and organic debris. Next, the water trickles down to a second tray that contains an absorbing media to remove hydrocarbons. Additional trays can be added to serve different purposes, such as activated carbon that can absorb fertilizers and pesticides. These systems are versatile and can be used in parking lots, streets, driveways, industrial facilities, and municipalities. Several trays could be designed to meet a variety of decontamination needs. Various mesh sizes will determine flow rate, maintenance, and rate of pollutant removal. It must be made of durable material to withstand potentially harsh conditions.



***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ◒ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ◒ | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- See: Enviro-Drain[R], Inc.: Savelle, Jon, Catching Water Pollutants at the Source, *Journal Environment*, September 15, 1998.

***Key Design Elements:***

1. Proprietary devices.
2. Media type and depth.
3. Hydraulic capacity and pollutant storage capacity.
4. Provision for overflow or bypass to avoid flooding when the insert is full or clogged.

Ancillary Facilities
None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▖ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Must be regularly inspected and replaced. A multi-tray unit would be heavy when wet and with sediment.
- *Nuisance Control:* None identified.
- *Traffic Control*: Commonly located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* Minimal training required.

***Project Development:***

- *Right-of-Way Requirements*: Same as drop inlets.
- *Siting Constraints*: Requires a storm water inlet.
- *Retrofit Potential*: Easy to add to most inlets.
- *Construction:* No construction necessary.

***Advantages:***

- Trickle Down Trays can be tailored to suit the needs specific to a site.
- Many of the filters used are recyclable.

***Constraints:***

- Efficiency is proportional to maintenance.
- Litter can hinder flow and cause flooding.

***Sources:***

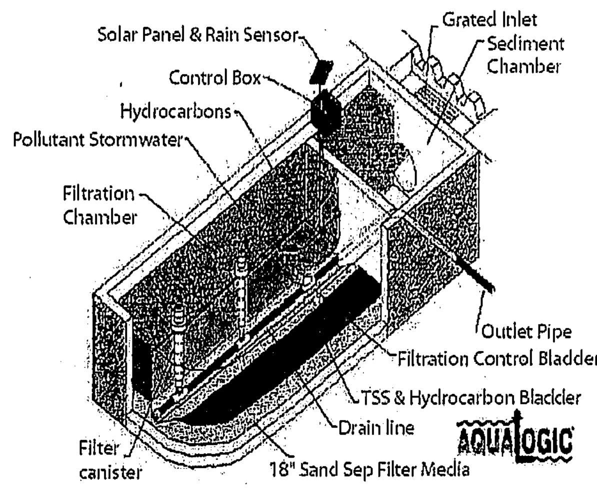
- Adjustable Skimmer Tray (Suntree Technologies, Inc.) http://www.suntreetech.com/page6.html
- CaptureFlow™, www.carsonind.com
- Enviro-Drain® (Enviro-Drain, Inc.) http://www.enviro-drain.com/

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

Cartridge filters use canisters to hold media or fabric through which water is filtered. The AquaLogic is an example of a cartridge filter. The AquaLogic system consists of two chambers: a sedimentation chamber and a filtration chamber where cloth filter cartridges are placed. The AquaLogic system is entirely automated and self-sufficient, utilizing rain sensors, solar panels, batteries and an inflatable bladder. The pneumatic bladder located in the sedimentation chamber outlet drain is inflated when sensors detect rain. The bladder prevents the storm water from flowing into the filtration chamber right away and provides a set sedimentation time. When the pre-set sedimentation time is reached, the bladder deflates and the storm water is fed by natural hydraulic gradient flow into the cloth-wound media cartridge filters. The design volume for the sedimentation basin should be increased to account for reduction in storage volume due to deposition of solids. Stormwater Management also has a cartridge filter described in Appendix C-40.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Removes up to 95% total suspended solids and 78% total petroleum hydrocarbons.
- The AquaLogic is approved by the Texas Natural Resource Conservation Commission (TNRCC) and the San Antonio Water Systems (SAWS).

***Key Design Elements:***

1. Proprietary design.
2. Power requirements

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◳ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑<br>Cost ↓ | Benefit ↑<br>Cost ↑ |
| Benefit ↓<br>Cost ↓ | Benefit ↓<br>Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III



A001978

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Potential high maintenance of the cartridge filter. Inspecting the facility after each storm and removing litter and sediment and all spent filter cartridges, repairing or replacing inoperative controls, valve or filter canister, and cleaning the filter cartridges and canister if necessary.
- *Nuisance Control* None identified.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* Crews must be trained to repair or replace any cartridge filter or part associated with the facility.

***Project Development:***

- *Right- of-Way Requirements*: Requires space and access.
- *Siting Constraints*: Must have sufficient hydraulic head.
- *Retrofit Potential*: Caltrans ROW space is typically limited, particularly in highly urbanized areas.
- *Construction:* None identified.

**Advantages:**

- Control of sedimentation time will improve water quality. No AC power requirement. Multiple-use capabilities: Parking spaces can be built on top of the system. Smaller footprint than for conventional sedimentation/gravity sand filter.

***Constraints:***

- Removal of fine sediment in cartridge filters is not as effective as in granular media filters.

***Sources:***

- Keblin, M.V., et al. The Effectiveness of Permanent Highway Runoff Controls: Sedimentation/Filtration Systems Center for Research in Water Resource. 1997.
- Roy, John R. AquaLogic Stormwater Abatement Filter System. SWAF, Inc- P.O. Box 701745, San Antonio, Texas 78270, Tel: (210) 602 8121. April 2000.
- StormFilter, Stormwater Management, www.stormwaterinc.com
- http://www.aqualogic.com/

***Literature Sources of Performance Demonstrations:***

- None available.

# BMP Fact Sheet

## Filter – Upflow, Compressible Media 

**Description:**

A Compressible Media Upflow Filter, one of such designed by Schriber Wastewater Treatment Technologies, is referred to as a Fuzzy Filter. A Fuzzy Filter is a packaged high-rate filter using fiber spheres in an upflow design. The Fuzzy Filter consists of extremely lightweight, synthetic fiber spheres that are 85% porous, which allow the filter to remove pollutants at high levels with minimal headloss. Filtration and water quality rates vary depending on the amount of compressed force applied to the filter media by a movable plate at the top of the media. The filter media bed is cleaned by lifting the plate off the bed, (which allows the bed to expand), then scouring the bed with air and water backwash. The wash water is passed from the filter to either a sewer line or a drying basin. The media is then recompressed by the filter plate forcing water through the media filter and flushing free any residual solids. After an allotted time, the cleaned effluent is allowed to exit to Fuzzy Filter System. A Fuzzy Filter could replace the sand filter chamber in the Austin filter design. The water from the sedimentation chamber would be directly pumped into the Fuzzy Filter package unit.

**Constituent Removal:**

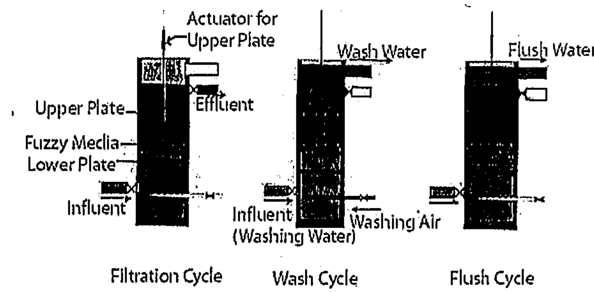
| Constituent Group | Removal Efficiency | Level-of-Confidence |
|---|---|---|
| Total Suspended Solids | ● | ○ |
| Nutrients | ○ | ○ |
| Pesticides | ◒ | ○ |
| Total Metals | ◒ | ○ |
| Dissolved Metals | ○ | ○ |
| Microbiological | ◒ | ○ |
| Litter | ● | ○ |
| BOD | ◒ | ○ |
| TDS | ○ | ○ |

Notes:

- No performance data encountered in literature.

**Caltrans SWMP Category:**

Category III




**Key Design Elements:**

1. Proprietary design.

Ancillary Facilities

Sedimentation facilities required upstream.

Backwash water storage and disposal facilities.

**Equivalent Uniform Annual Costs:**

| | Cost Effectiveness | Level-of-Confidence |
|---|---|---|
| EUAC | ▝ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

**Issues and Concerns:**

**Maintenance:**

- Requirements: Removing plate bed, backwash with air and water, recompress media.
- Nuisance Control: None identified.
- Traffic Control: If located along a shoulder or median, maintenance activities will require traffic control.
- Staffing/Equipment: Residual handling, mechanical equipment breakdown.

**Project Development:**

- Right-of Way-Requirements: Requires a smaller footprint than a sand filter.
- Siting Constraints: Requires connection to sewer lateral or drying bed for backwash water waste stream. Requires connection to a water supply for backwashing or backwash water tank and pump.
- Retrofit Potential: Caltrans ROW space is typically limited particularly in highly urbanized areas.
- Construction: Traffic control may be required for retrofits if in close proximity to roadway.

**Advantages:**

- The main advantage of the Fuzzy Filter over a traditional sand filter is that this package unit requires a smaller footprint. Other advantages are: high flow rate, lower backwash water usage than sand filter and lower headloss than conventional sand filter.
- Backwashing cycle allows cleaning sediment from the filter media rather than excavating a portion of the media at the end of the season as required for slow sand gravity filters. Installation of filters possible where there is insufficient head for gravity filtration.

**Constraints:**

- Restricted to sites with available nearby power and possibly a sewer connection.

**Sources:**

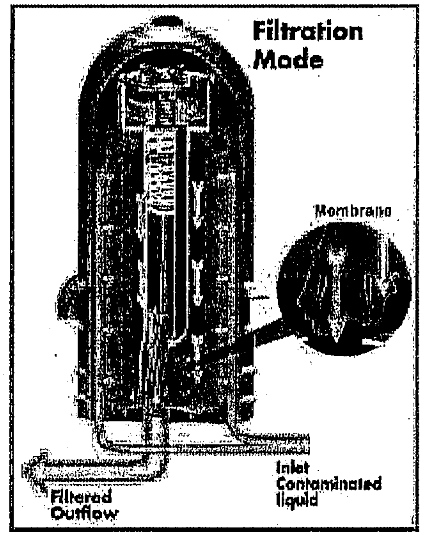
- Schreiber Wastewater Treatment Technologies.

**Literature Sources of Performance Demonstrations:**

- Caliskaner O., Tchobanoglous G., Evaluation of the Fuzzy Filter for the Filtration of Secondary Effluent, Department of Civil and Environmental Engineering, University of California, Davis. September 1996.
- Fuzzy Filter: High Rate Filtration System. Schreiber Wastewater Treatment Technologies, http://www.schreiberwater.com/eqfuzzy.htm April 2000.
- Shepard, John. Cost Estimate. Fuzzy Filter: Compressible Media Filter Data. April 2000.

***Description:***

A Disc Filtration device, one of such designed by Arkal Filtration Systems/Zeta Technologies, is referred to as a Spin Klin. The Spin Klin self-backwashing disc filter was designed for filtration of solids from irrigation water, but may be applicable on pressurized pipes downstream of storm water sedimentation basins. The filter consists of a spring-loaded spine that holds a number of stacked, diagonally-grooved polypropylene discs enclosed in a corrosion and pressure-resistant housing. The stacked discs create a filtration element with a statistically significant series of valleys and traps. During filtration, the discs are compressed by the spring and the differential pressure of the water, which flows from the peripheral end to the core of the element. Backwashing involves release of the compression spring and high-pressure flow of clean water through nozzles at the center of the spine. The discs spin free and solids are efficiently flushed out through the drain. Modular batteries allow for easy expansion of system in various space-saving configurations.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No long-term water quality monitoring studies have been discovered in literature to evaluate treatment effectiveness.
- No performance data encountered in literature.

***Caltrans SWMP Category:***

Category III

***Key Design Elements:***

<u>Ancillary Facilities</u>
Sedimentation facilities required upstream.
Backwash water storage and disposal facilities.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A001982

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Power needed. Mechanical equipment maintenance.
- *Nuisance Control:* None identified.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* Crews would need to be trained to maintain equipment.

***Project Development:***

- *Right-of-Way Requirements*: Not Available.
- *Siting Constraints*: None identified.
- *Retrofit Potential*: Caltrans ROW space is typically limited particularly in highly urbanized areas.
- *Construction:* Needs pressurized pipe. Batteries of filters are heavy and would require equipment to move.

***Advantages:***

- Micron-precise filtration of solids. Claimed by the manufacturer to retain large amount of solids for long filtration cycles (Note: solids in irrigation water may differ from those of settled storm water). Low maintenance self-backwashing design. Self-contained.

***Constraints:***

- Removes only solids-associated contaminants. Limited application. Designed for installation on pressurized pipes. Not designed to remove larger solids so upstream sedimentation would be needed. May not be suitable for use at side of freeway.

***Sources:***

- Arkal Filtration Systems, Kibbutz Bet Zera, Jordan Valley, Israel. Tel: (972)-4-6775140; Fax: (972)-4-6775476; E-mail: filters@ arkal.com http://www.arkal-filters.com/

***Literature Sources of Performance Demonstrations:***

- None identified.

# BMP Fact Sheet
## Filtration – Earthen Construction
## Modified Austin Sand Filter



***Description:***

This idea consists of combining the sedimentation and filtration processes in one basin. This design concept is to improve the contaminant removal capabilities of an infiltration pond or Extended Detention Basin (EDB) by covering an unlined detention basin bottom with a filter media and filter fabric and possibly topping it with an adsorption layer such as GAC, IX resin, or both. The bottom of the basin would function like a filter and an adsorber if GAC or GAC/IX is used. Buried perforated pipes would be installed below the adsorption layer to convey filtered water away for disposal. The adsorption layer is separated from the filter media by a nylon or metal sieve and covered with a filter fabric to prevent clogging. Adsorbent "pillows or booms" are added to the top of the sedimentation basin to provide additional oil and grease removal.

***Constituent Removal:***

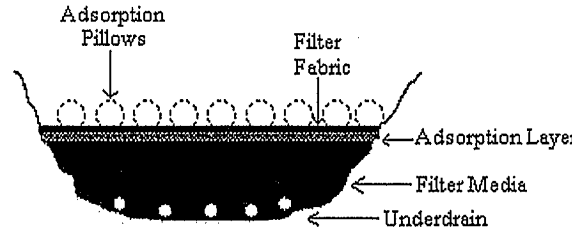
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

Notes:

- No performance data encountered in field demonstrations or in literature.

***Caltrans SWMP Category:***

- Category III




***Key Design Elements:***

1. Detention basin volume.
2. Filter area.
3. Media type and depth.
4. Filtered water collection system.

Ancillary Facilities

None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ○ |

● High ◒ Medium ○ Low

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Periodic regeneration or disposal of GAC, IX and sand is required. Potential clogging of the filter fabric is the main concern of this alternative. The filter fabric should be inspected regularly and replaced if necessary. Sediments deposited onto the media filter (or when the filter is clogged) will need to be removed and the media replaced.
- *Nuisance Control:* Clogged filters can produce standing water and provide breeding habitat for mosquitoes.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high.
- *Siting Constraints*: Adequate space required for relatively large footprint device.
- *Retrofit Potential*: Unlined detention basins can be retrofitted.
- *Construction:* Retrofits of existing detention basins will impact operations at the affected facility.

***Advantages:***

- Combining sedimentation/filtration and perhaps eventually infiltration in a single basin will improve effluent quality while still using the same footprint as an EDB.

***Constraints:***

- IX resin beads must be kept at a minimum humidity level. It is not clear at this point how this issue should be addressed.
- The clogging rate of the filters unknown.

***Sources:***

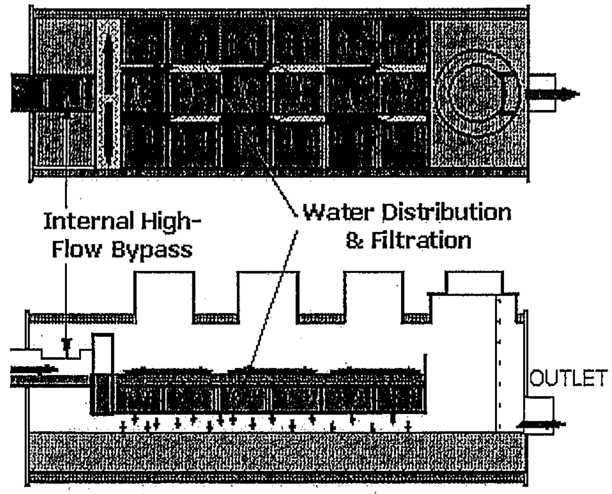
- None available.

***Literature Sources of Performance Demonstrations:***

- No information available.

***Description:***

This idea consists of combining the sedimentation and filtration processes in one vault. This design concept is to improve the contaminant removal capabilities of vault type BMPs (Water Quality Inlets and Hydro-dynamic Separators) The Aqua-Filter™ system is designed with a filter bed suspended in a vault. Water flows through the media and drains down into the vault. It appears the Aqua-Filter™ holds a permanent pool of water in the vault.




**Filtration Chamber**

AquaShield

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ◒ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ◒ | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- AquaShield manufacturer recommends Swirl Concentrator for upstream pre-treatment.

***Key Design Elements:***

1. Detention basin volume.
2. Filter area.
3. Media type and depth.
4. Filtered water collection system.

<u>Ancillary Facilities</u>
None.

***Caltrans SWMP Category:***

- Category III

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◲ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A001986

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Periodic regeneration or disposal of filter media is required. Potential clogging of the filter fabric is the main concern of this alternative. The filter fabric should be inspected regularly and replaced if necessary. Sediments deposited onto the media filter (or when the filter is clogged) will need to be removed and the media replaced.
- *Nuisance Control*: Standing water in the vault can provide breeding habitat for mosquitoes.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment*: For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high.
- *Siting Constraints*: Adequate space required for relatively large footprint device.
- *Retrofit Potential*: Unlined detention basins can be retrofitted.
- *Construction*: Retrofits of existing detention basins will impact operations at the affected facility.

***Advantages:***

- Combining sedimentation/filtration in a single vault will improve effluent quality while using a smaller footprint as a DB.

***Constraints:***

- IX resin beads must be kept at a minimum humidity level. It is not clear at this point how this issue should be addressed.
- The clogging rate of the filters is unknown.

***Sources:***

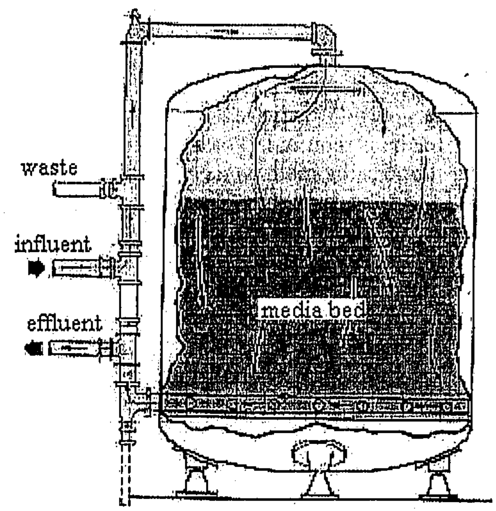
- Aqua-Filter™ Stormwater Filtration System
- Aquashield, Inc. www.aquashieldinc.com

***Literature Sources of Performance Demonstrations:***

- www.epa.gov/region1/assistance/ceitts/stormwater/techs/aquafiltersys.html

***Description:***

Media filters purify water primarily by physical filtration of undissolved pollutants as the fluid passes through sand or granular media. Pressure filter systems use pressure provided by an external pump to force water through the filter. Solids collect at the top of the sand media as the storm water passes through the media bed. The treated effluent exits the bottom of the filter and is discharged to a receiving water. Pressure filters also require backwashing, a process that requires water to be forced through the media bed by an external pump. The backwash wastewater containing sediments trapped during filtration can be discharged to a sanitary sewer or a drying bed for disposal. This alternative is a combination of a storage basin, automatic pool vacuum cleaner, basket strainer and pressure filter. Screened storm water fills the empty detention tank; then the automatic cleaner, strainer and filter treat the runoff passes through a coarse screening for litter and trash removal.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ◒ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No demonstration of performance in literature available.

***Key Design Elements:***

1. Filtration rate.
2. Media type and depth.
3. Facilities for containing media and passing water through the filter bed.

Ancillary Facilities

Sedimentation facilities required upstream. Backwash water storage and disposal facilities.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ◒ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

*Maintenance:*

- Requirements: Residual handling. Mechanical equipment must be maintained.
- Nuisance Control: None identified.
- Traffic Control: None identified.
- Staffing/Equipment: Crews will need to be trained to maintain equipment.

***Project Development:***

- Right-of Way-Requirements: Not Available.
- Siting Constraints: Restricted to sites with available nearby power and possibly a sewer connection.
- Retrofit Potential: Similar to detention basin. Access is required.
- Construction: None identified.

***Advantages:***

- The use of pressure, rather than gravity, to force water through a media bed allows a smaller footprint. Backwashing cycle reduces maintenance by cleaning sediment from the filter media as opposed to excavating a portion of the media at the end of the season as required for slow sand gravity filters. The pressure filter media will not need to be replaced as often as a gravity filter media, which must have its surface scraped to remove surface deposits. Pressure filter technology uses pumps, which allow more siting flexibility than gravity filtration.

***Constraints:***

- Connection to sewer or drying bed for backwash waste water is needed. Connection to a potable water supply or backwash water tank for backwashing is needed. Electric power supply for pump is required. Potentially higher capital costs due to pump and pressure tank. More maintenance is needed for a pressure filter than for a gravity filter because of the use of mechanical equipment. Best suited for maintenance stations and park-and-ride facilities in urban settings.

*Sources:*

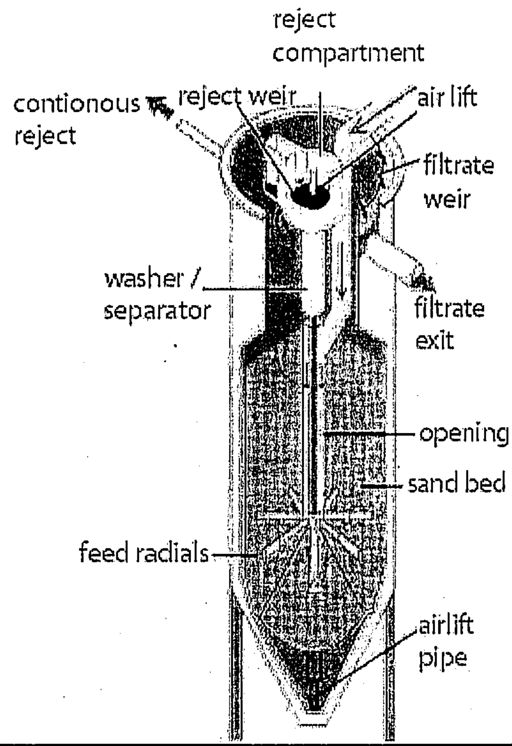
- Bachhuber, J. A. Pressurized Filtration System for Treatment of Urban Stormwater Pollution. Earth Tech. Inc. 1999.
- Pressure Filtration. Infilco Degremont, Inc.
- Arkal, Filtration Systems, Arkal Media Filter
- http://www.infilcodegremont.com/
- www.arkal-filters.com/agriculture/arg_meida.html

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

Self-backwashing sand filter systems treat water primarily by physically filtering pollutants as water passes upward through the sand media. Solids collide with sand particles and flocculate with other solids as they flow through the media. The filtrate flows up and out of the top of the filter. The sand bed and the accumulated solids, are drawn down into an airlift pipe. The sand and solids are then transported by the airlift from the bottom of the bed to a washer/separator with a central reject compartment at the top of the device. As the sand falls through a washer consisting of several concentric stages, a small amount of the filtered water passes upward, washing away the solids while allowing the heavier, coarser sand to fall to the top of the filter bed. In this way sand is constantly circulated and cleaned. A constant wash/rejection stream of backwash water exits near the top of the filter (potentially returned to EDB). The main components of this package unit are stainless steel tanks, an air control panel and a standard or double bed filtration. For large flow application, a concrete basin design consisting of multiple modules within individual cells can be used.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No demonstration of performance in literature available.

***Key Design Elements:***

1. Effective overflow rate (for sizing the sedimentation chamber).
2. Size and mounting of plates or tubes.
3. Sludge collection and removal facilities.

Ancillary Facilities

Necessarily installed in a sedimentation basin that may or may not precede a filter.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

| | | |
|---|---|---|
| ● High | ◒ Medium | ○ Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- Requirements: Residual handling. Must maintain complex mechanical equipment.
- Nuisance Control: Not identified.
- Traffic Control: If located along a shoulder or median, maintenance activities will require traffic control.
- Staffing/Equipment: Mechanical equipment maintenance. Special training required.

***Project Development:***

- Right-of-Way Requirements: No concerns identified.
- Siting Constraints: Restricted to sites with available nearby power and possibly a sewer connection. The system is relatively tall.
- Retrofit Potential: Units are compact, but have multiple utility requirements.
- Construction: Propriety device.

***Advantages:***

- The main advantage of the self-backwashing filter over a traditional sand filter is that the bed filter is continuously cleaned. Continuous backwashing allows cleaning of the sediment from the filter without excavating a portion of the media at the end of the season as required for slow sand gravity filters. No shutdowns required for backwashing, and no separate backwash water source or storage is needed. Internal airlift reduces wear and maintenance requirement. Lower electricity consumption than a pressure filter. Use of pressure, rather than gravity, to force water through media bed allows for a smaller footprint. Allows installation of filters where there is insufficient head for gravity filtration.

***Constraints:***

- The power requirement is the primary operational constraint for the self-backwashing filter. Most suited for maintenance facilities.
- Proprietary technology.
- Height of the unit.
- Requires connection to sewer lateral or drying bed for backwash water waste stream (potentially directed to EDB).

***Sources:***

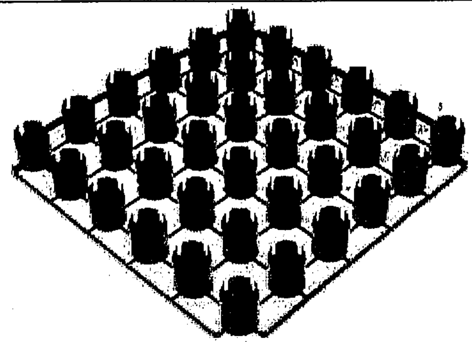
- Counterflow Sand Filter, Huber Technologies.
- http://www.huber.de/produktee/cfsfe.htm April 2000.

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

Infiltration trenches are typically excavated and backfilled with rock to create a temporary underground storage reservoir for localized storm runoff. Captured flows stored in the trench gradually infiltrate to the surrounding soil substrate. Pollutant removal is achieved primarily through adsorption, straining and microbial decomposition in the surrounding soil. Trenches would capture storm water runoff from the storm drain outfall. Pretreatment of the runoff would be necessary to remove litter, debris and sediments that would rapidly clog the trench. Several detention and infiltration basin technologies are available, including Rainstore3 from Invisible Structures, Inc., High Capacity Infiltrator Chamber from Infiltrator Systems, Inc., and StormChamber from HydroLogic Solutions, Inc. Infiltration trenches have been used successfully in some locations in the United States. However, siting and operational considerations may limit their use as an urban water quality BMP. They include: the need for a soil substrate with relatively high infiltration rates; the high incidence of clogging for this technology, especially when pollutant loads from construction are allowed to enter the facility; the potential threat to local groundwater; and the expense of remediation for a clogged trench.



For trench layout see Fact Sheet C-28
Source: www.invisiblestructures.com

***Key Design Elements:***

1. Sizing based on infiltration rate.

<u>Ancillary Facilities</u>
Pretreatment to remove particles is required to avoid clogging the infiltration surface. This will normally require sedimentation and filtration facilities upstream.

2. Class V injection well determination.

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ◒ |
| *Nutrients* | ● | ◒ |
| *Pesticides* | ● | ◒ |
| *Total Metals* | ● | ◒ |
| *Dissolved Metals* | ● | ◒ |
| *Microbiological* | ● | ◒ |
| *Litter* | ● | ◒ |
| *BOD* | ● | ◒ |
| *TDS* | ● | ◒ |

*Notes:*

- Removal efficiency for infiltration is assumed to be 100% for the design water quality volume since no water is discharged to surface waters.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *Construction* | ▝ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Group III



A001992

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Safety measures are required if the trench is in the ROW.
- *Nuisance Control:* Standing water present in the trench can introduce a breeding ground for mosquitoes and other vectors. Slight odors might be present.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment. Routine maintenance is also required on the infiltration trench to determine whether clogging has occurred.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high depending on the trench desired and pretreatment implemented.
- *Siting Constraints*: Restricted to sites with appropriate soil characteristics and low water table.
- *Retrofit Potential*: Potential where adequate space is available and soil substrata have a high infiltration rate.
- *Construction:* Unexpected soil characteristics or water table location. Possible contamination of groundwater; water percolation may disrupt roadway foundation or fill slope stability.

***Advantages:***

- These BMPs prevent the design surface runoff from reaching receiving water (i.e., they are "no surface discharge BMPs").
- They are not limited to a length-to-width ratio and can be fitted along the road in the freeway right-of-way; and layout and design are based on available space and drainage surface area.
- Infiltration trenches offer lesser chance for mosquito breeding and vector propagation. As an underground BMP, trenches have few negative visual aesthetic impacts. They do not require power, making them good candidates for retrofitting in the freeway right-of-way. Few or no mechanical devices would be needed, depending on the pretreatment device selected.

***Constraints:***

- Vulnerable to clogging, especially when improper construction sequencing or inadequate pretreatment allows high sediment loads to enter the trenches.
- Rehabilitation cost per unit of treated water volume is high. Infiltration trenches require reconstruction every 10 years (U.S. Department of Transportation, 1996). If well designed, they should not require much maintenance between reconstruction.
- Many soil and bedrock types are unsuitable for infiltration basin technologies due to low porosity and permeability, especially in areas with hydrologic soil groups C or D.
- Cannot be placed in areas with locally high water tables. They may cause groundwater contamination if chemicals or fuel are spilled on the highway. They may not be appropriate above sensitive aquifers unless they have an effective, reliable pretreatment system to prevent groundwater contamination. They require proper construction practices to avoid excessive compaction of the substrate.
- Over time, infiltration of polluted storm water may lead to accumulation of dissolved salts and toxics that may harm vegetation and pollute groundwater (Schueler, 1987).
- Significant space is required, mainly because fill rock typically occupies 60 to 65% of the trench volume.

***Sources:***

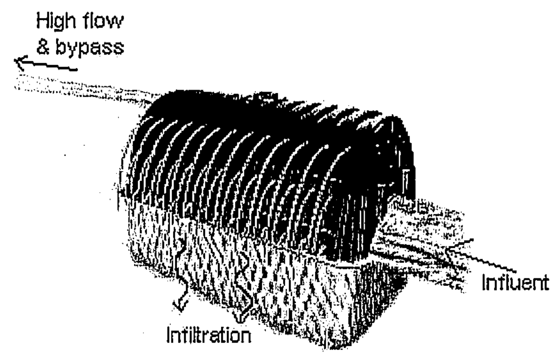
- Rainstore3 Invisible Structures, Inc. http://www.invisiblestructures.com. May 2000.
- Harris, Kathy. Infiltrator Systems, Inc. High Capacity Infiltrator Chamber. http://www.infiltratorsystems.com. June 2000.

***Literature Sources of Performance Demonstrations:***

- ASCE, Manual and Report on Engineering Practice No. 87. 1998.
- Loomis & Moore, et al. Draft Integrated Solutions Development Study Watersheds Master Plan, Prepared for the City of Austin Watershed Protection Dept. 1998.
- Robert Bein, William Frost and Associates, Scoping Study, Retrofit Pilot Program, Caltrans District 11. February 1998.
- Sansalone, J. J., et al. "Infiltration Device as a Best Management Practice for Immobilizing Heavy Metals in Urban Highway Runoff."

***Description:***

The Cultec Contactor™ and Recharger™ plastic leaching systems are examples of subsurface storm water management. Sometimes they replace conventional pipe systems and retention ponds. Design vary according to the manufacturer. The storm water or effluent is then absorbed onto the filter fabric covering and is leached into the surrounding backfill or directly absorbed into the soil or broken syane base.
Infiltration BMPs with below grade storage use a variety of structures to capture storm water and allow it to infiltrate into the surrounding backfill and soil. High flow bypasses can be incorparated for overflow conditions. Cultec chambers provide available open bottom interface.



Source: www.cultec.com

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Chambers can be placed in either trench or bed configurations by utilizing the patented interlocking rib connection.

***Key Design Elements:***

- Distance to groundwater
- Permeability of soils.
- Class V injection well determination

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

● High ◒ Medium ○ Low

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- *Requirements*:
- *Nuisance Control:* None identified, if water infiltrates with 72 hours.
- *Traffic Control*: Unknown
- *Staffing/Equipment:* Likely vactor equipment with the ability to clean horizontal lines. Equipment and training needed for confined space entry.

***Project Development:***

- *Right-of-Way Requirements*: Large area requirements, but area above grade can be used if constructed properly.
- *Siting Constraints*: Permeable soils, adequate separation groundwater
- *Retrofit Potential*: maybe during reconstruction of parking storage areas
- *Construction:* care needed to prevent soil compaction.

***Advantages:***

- Total drainage interface averages more than 60% higher than conventional PVC pipe and stone system of comparable size.
- Recharger, known for its high performance, quality and cost effective design, manufacturer claims more than 1,000 times the infiltrative capability of large-diameter pipe.

***Constraints:***

- Must be placed on permeable soil.
- Must avoid high groundwater
- Must avoid areas prone to spills of groundwater contaminents.
- Must addres EPA class V injection well regulations

***Sources:***

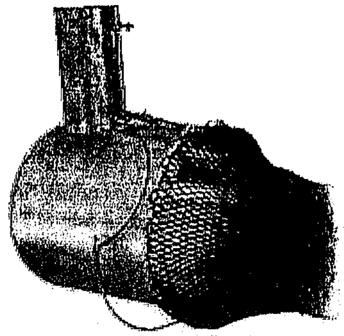
- Cultec, Inc., www.cultec.com
- StormChamber™, HydroLogic Solutions www.hydrologicsolutions.com
- http://www.epa.gov/safewater/uic/pdfs/fact_class5_stormwater.pdf "When Are Storm Water Discharges regulated As Class V Wells?"
- www.invisiblestructures.com/RS3/rainstore.htm

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

A breakaway litter bag installed at the storm water outfall is designed to capture litter. When the bag fills up, it is pushed off the pipe and ties off automatically. Can be used as a stand-alone litter removal device or as inlet to an extended detention basin.



Source: www.nettech.com.au

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes*:

- The Breakaway litter bags are not assumed to provide storm water pollutant removal.
- No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness

***Key Design Elements:***

1. Proprietary device.
2. Bag capacity.

Ancillary Facilities

None.

***Caltrans SWMP Category:***

Category III

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◲ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A001996

***Issues and Concerns:***

***Maintenance:***

- _Requirements_: Requires access road for maintenance. Frequent inspections may be required to check on the nets.
- _Nuisance Control_: Odors might be of concern without proper maintenance. Standing water may create a breeding ground for mosquitoes or other vectors.
- _Traffic Safety_: During routine maintenance traffic control will be necessary.
- _Staffing/Equipment_: For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- _Right-of-Way Requirements_: Requires access road for maintenance.
- _Siting Constraints_: Little or no site development needed to implement.
- _Retrofit Potential_: This design can be retrofitted to existing storm water outfalls or designed into new installations. The litter bag design can also be adapted to various flow and litter loading rates.
- _Construction:_ Patented devices are required but various manufacturers are available.

***Advantages:***

- Requires minor site work
- Low maintenance cost
- Low construction cost
- Ability to retrofit onto storm water outfalls, pipe culverts and channels of any shape
- Human contact with the litter is minimized or eliminated

***Constraints:***

- Breakaway litter bags are proprietary patented devices.
- Regular and possibly frequent maintenance/ inspections are required
- Possibility of mosquito breeding and litter decomposition.

***Sources:***

- http://www.nettech.com.au

***Literature Sources of Performance Documentations:***

- None identified.

# BMP Fact Sheet
# Litter And Debris Removal-Hydrodynamic Separators



***Description:***

These litter and debris removal devices are flow-through structures with a settling or separation unit to remove litter, sediments and other pollutants; separation is accomplished using the energy of the water by means of swirl action or indirect filtration. For in-line Vortechs Systems without a bypass, sizing criteria are based on providing one square foot of grit chamber surface area for each 100 gpm of peak design storm flow rate (i.e., 10-year storm). Other examples are listed under "sources."

***Constituent Removal:***

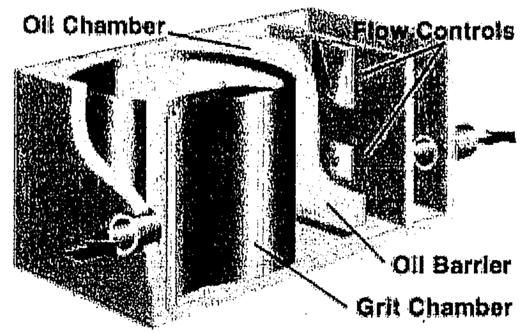
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No performance data encountered in literature.
- No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness.

***Caltrans SWMP Category:***

Category III




Vortechs™ Storm Water Treatment System

***Key Design Elements:***

1. Detention time.
2. Aeration system.
3. Grit removal facilities.

Ancillary Facilities

None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▖ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Initially the site needs to be monitored 3 or 4 times a year in order to determine accurately the required cleaning frequency.
- *Nuisance Control:* N/A.
- *Traffic Control*: Rarely located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and test for hazardous waste.

***Project Development:***

- *Right-of-Way Requirements*: May involve relocation of underground utility lines crossing the device. Space requirement is variable.
- *Siting Constraints*: May be used in-line or as a bypass and requires limited space to implement.
- *Retrofit Potential*: Will require a bypass system for high flow rates.
- *Construction:* Need to verify location of existing underground utilities at the site, also may require traffic control during construction

***Advantages:***

- Small footprint, all underground, and no additional ROW or easement required.

***Constraints:***

- May require periodic and frequent maintenance.

***Sources:***

- Vortechnics, Inc.
- http://www.vortechnics.com/vortechs/vorspec.html
- CDS Techbnologies
- http://www.cdstech.com
- Hil Technologies
- Stormceptor, Inc.
- Environment 21 Inc.
- Grande Novac and Associates Inc.

***Literature Sources of Performance Demonstrations:***

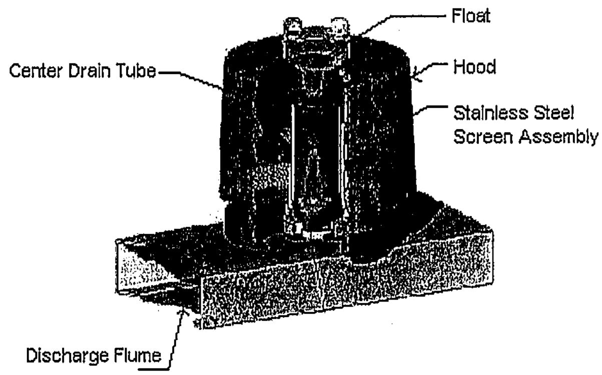
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/vortechs.html
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/stormceptor.html

# BMP Fact Sheet
# Litter And Debris Removal – StormScreen



## Description:

The StormScreen™ is a passive, high-flow screening system used for removal of trash and debris and some TSS from stormwater runoff. The system revolves around the float-actuated, siphonic, radial flow StormScreen cartridge. The stormScreen utilizies a patented self-cleaning mechanism that prevents binding of the screen surface. The cartridge will continue to operate at 225gpm even at 80% or more occusion to the screen surface. This system also incorporates a high flow bypass for peak flow diversion. StormScreen can be installed into small, prefabricated catch basins or incorporated into large, cast-in-place facilities that treat hundreds of cubic feet per second (cfs).




Cylinder installation similar to StormFilter (see StormFilter C-38)

## *Constituent Removal:*

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- StormWater™'s Drain-Down™ system can be incorporated with StormScreen.
- StormScreen and StormFilter systems can be used in combination for larger sites with a high flow rate or volume that need to be treated or a large amount of trash and debris that needs to be captured.

## Key Design Elements:

StormScreen™ is sized to treat the peak flow from the design storm. The peak flow is determined based on the watershed area and design storm magnitude. StormScreen™ canisters are designed to treat 0.5 cfs (225gpm) each.

## Equivalent Uniform Annual Costs:

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

## Caltrans SWMP Category:

Category III



A002000

## Issues and Concerns:

### Maintenance:

- *Requirements*: Maintenance expected to be similar to the other litter and debris removal BMP's.
- *Nuisance Control:* None identified.
- *Traffic Control*: Unlikely, if properly located away from traveled way.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

### *Project Development:*

- *Right-of-Way Requirements*: Requires access for maintaince.
- *Siting Constraints*: Minimum system head loss of 0.6096m, (2ft).
- *Retrofit Potential*: It can be applied in confined urban areas and areas with limited space since it is an underground vault.
- *Construction:* Modular units available.

### *Advantages:*

- Multiple stainless steel screens; protective hood covers; siphon-actuated self cleaning mechanism; minimal excavation depth; optional dewatering system for reducing BOD, vector incubation, etc.; easily replaced screens.

### *Constraints:*

- Although the screen is able to remove particles greater than the pore size (2.4mm) the system relies on finer sediments attaching to larger sediment for removal. Recommended use for gross pollutant removal, absorbents may need to accompany for additional petroleum hydrocarbon removal.

### *Sources:*

- Will Haris, Senior Regional Manager, StormWater Management INC.
- www.stormwaterinc.com

### *Literature Sources of Performance Demonstrations:*

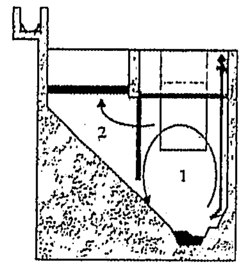
- None identified.

# BMP Fact Sheet
# Sedimentation-
# Grit/Water Separators



***Description:***

Air is introduced into a grit chamber by bubble diffusers in a "roll pattern," causing the grit to settle to the bottom. The settled grit particles are then removed via a grit pump through a traveling bridge type mechanical removal system. The channel basin is sized to yield approximately a 5-minute detention time, with a length-to-width ratio of approximately 10:1. The grease is removed in an adjacent vault by air flotation.




1. Grit Removal Section by hydraulic roll
2. Grease Removal Section by air flotation

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ◒ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No known stormwater applications.
- No performance data encountered in field demonstrations or in literature.
- No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness.

***Key Design Elements:***

1. Detention time.
2. Aeration system.
3. Grit removal facilities.
4. Power requirements

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

***Caltrans SWMP Category:***

Category III

| ● High | ◒ Medium | ○ Low |
|---|---|---|

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Grit removal and disposal that requires mechanical equipment.
- *Nuisance Control*: Unknown
- *Traffic Control*: Unknown
- *Staffing/Equipment*: Supervision by operator.

***Project Development:***

- *Right of Way Requirements*: Space requirements for the grit chamber are relatively low compared to EDB. May involve relocation of underground utility lines crossing the device.
- *Siting Constraints*: Power source must be available.
- *Retrofit Potential*: Will require a bypass system for increased flow rates.
- *Construction:* Need to verify location of existing underground utilities at the site.

***Advantages:***

- Removes litter, grit, and suspended solids very efficiently.

***Constraints:***

- Requires electricity to operate and needs regular monitoring.
- Requires supervision

***Sources:***

- Schreiber Corporation, Degremont S.A.
- http://www.schreiberwater.com
- http://www.infilcodegremont.com/densadeg.htm

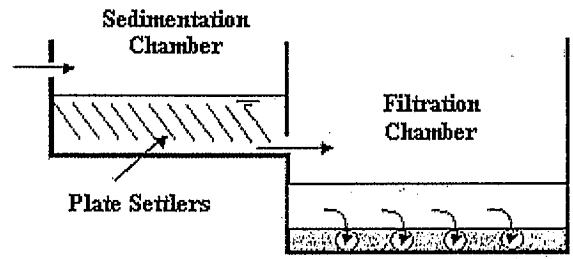
***Literature Sources of Performance Demonstrations:***

- No information encountered.

# BMP Fact Sheet
## Sedimentation Plate and Tube Settlers 

***Description:***

Improving sedimentation in the first chamber of an Austin filter or in a concrete detention basin can be achieved by installing plate or tube settlers in this chamber. Sedimentation of aqueous suspensions is accelerated by decreasing the distance particles must fall prior to removal. This can be achieved by making the basin shallower, but this is limited by practical aspects. One approach is to provide parallel plates or inclined tubes that permit solids to reach the bottom after only short distances of settling.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Removal efficiencies assumed plate and tube settlers used in conjunction with an EDB.
- No performance data encountered in field demonstrations.
- The tube or plate settlers will enhance the sedimentation of fine particles.
- The Multi-Chambered Treatment Train (MCTT) developed by the University of Alabama-Birmingham includes a sedimentation chamber with tube settlers.

***Key Design Elements:***

1. Effective overflow rate (for sizing the sedimentation chamber).
2. Size and mounting of plates or tubes.
3. Sludge collection and removal facilities.

Ancillary Facilities

Necessary installed in a sedimentation basin that may or may not precede a filter.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ■ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- Requirements: Cleaning and maintenance of the plate or tube settlers may require removing the plate settler structure. Litter may get trapped in the tube settler structure.
- *Nuisance Control:* Same as Austin filter.
- *Traffic Control*: Rarely located along a shoulder or median.
- *Staffing/Equipment:* Information not available.

***Project Development:***

- *Right-of-Way Requirements*: Same as Austin filter.
- *Siting Constraints*: Most suitable for maintenance stations and park-and-ride lots.
- *Retrofit Potential*: Can be installed in existing Austin sand filter.
- *Construction:* Information not available.

***Advantages:***

- Same as Austin Filter.

***Constraints:***

- Susceptible to clogging.
- Maintenance is more difficult than an open basin.

***Sources:***

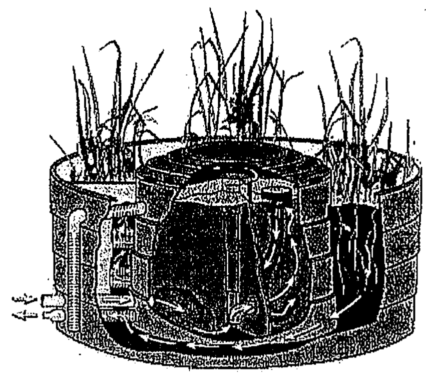
- None.

***Literature Sources of Performance Demonstrations:***


- Harper, H. H., et al. "Performance Evaluation of Dry Detention Stormwater Management Systems." Sixth Biennial Stormwater Research Watershed Management Conference. September 1999.
- High-Rate Sedimentation, WWF Plan Project Number 4.19. EPA Urban Watershed Management Branch. http://www.epa.gov/ednnrmrl/projects/control/high.htm. April 2000.
- Keblin, Michael, et al. Effectiveness of Permanent Highway Runoff Controls: Sedimentation/Filtration Systems. October 1997.
- Meinholtz, T. L., et al. Screening/Floatation Treatment of Combined Sewer Outflows, Volume II: Full-Scale Operation Racine, Wisconsin. EPA-600/2-79-106a. Aug 1979.
- Pitt, R., et al. Stormwater Treatment at Critical Areas, Vol. 1: The Multi-Chambered Treatment Train. Cincinnati: US EPA. 1997.
- Robert Bein, William Frost and Associates, Scoping Study, Retrofit Pilot Program, Caltrans District 11. February 1998.
- James M. Montgomery Consulting Engineers, Inc, Water Treatment Principles and Design. 1985.
- United States Department of Transportation, Federal Highway Administration, Office of Environmental Planning: Evaluation and Management of Highway Runoff Water Quality, Washington, DC. June 1996.

***Description:***

The StormTreat™ System (STS) consists of a series of sedimentation chambers and constructed wetlands. These wetlands are contained within a modular, 2.9-meter (9.5) ft diameter recycled-polyethylene tank that is roughly four feet in height. Unlike most constructed wetlands systems, STS conveys the storm water directly into the subsurface of the wetland and through the root zone. Pollutants are then removed through filtration, adsorption, and biochemical reactions. Storm water is retained in the wetlands for five to ten days prior to discharge.



1. Modular, 2.9-meter (9.5-foot) diameter recycled-polyethylene tank containing a series of sedimentation chambers and constructed wetlands.
2. Flow is conveyed from the final sedimentation chamber through four, slotted PVC outlet pipes, each 10-cm (4 inches) in diameter, into the wetland.
3. Mature vegetation in the outer ring should have roots that extend into the permanent 15-cm (6 inches) of water in the bottom of the tank.
4. Effluent from the wetland is discharged through a 5-cm (2-inch) diameter pipe that is controlled by a valve.

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ◒ |
| *Nutrients* | ● | ◒ |
| *Pesticides* | ● | ◒ |
| *Total Metals* | ● | ◒ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ● | ◒ |
| *Litter* | ○ | ○ |
| *BOD* | ◒ | ◒ |
| *TDS* | ◒ | ○ |

*Notes:*

- Data collected over a two-year period by clients, analyzed by state-certified labs and verified by the Commonwealth of Massachusetts.
- Thirty-three samples were collected over eight independent storm events during both winter and summer conditions.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ◒ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Key Design Elements:***

***Issues and Concerns:***



A002006

***Maintenance:***

- *Requirements*: Annual inspections and replacement of grit filter bag and sediment pumping once every three to five years using standard septic system pumper.
- *Nuisance Control:* None identified.
- *Traffic Control*: Unlikely.
- *Staffing/Equipment:* For routine maintenance, requires staff to remove grit filter bag and septic haulers to pump sediment from the tank.

***Project Development:***

- *Right-of-Way Requirements*: Moderate
- *Siting Constraints*: The systems size and modular configuration make it adaptable to a wide range of site constraints and watershed sizes. The system can be used to treat runoff from highways, parking lots, airports, marinas, and commercial, industrial, and residential areas. The STS system is not designed to be used directly in wastewater streams.
- *Retrofit Potential*: Generally 1-2 units are required for each acre of impervious surface.
- *Construction:*

***Advantages:***

- Protects groundwater by removing pollutants prior to infiltration.
- The spill contamination feature can capture an upstream release and lessen the spill impact on the environment.

***Constraints:***

- Is a relatively new BMP and remains to be thoroughly tested in different geographical locations.

***Sources:***

- United States Environmental Protection Agency.
- StormTreat™ Systems, Inc., 1998

***Literature Sources of Performance Demonstrations:***

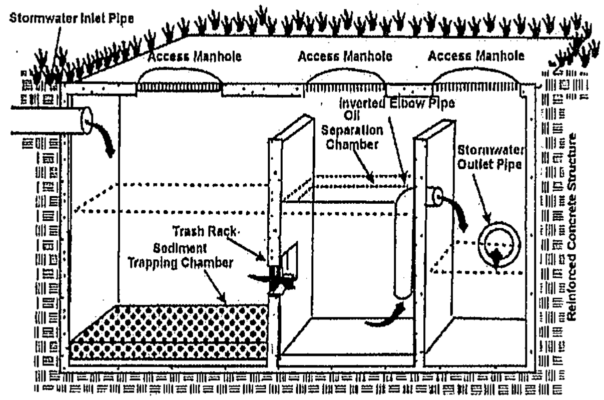
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/stormtreat.html

# BMP Fact Sheet
# Water Quality Inlets



***Description:***

"Water quality inlets (WQIs), also commonly called oil/grit separators, consist of a series of chambers the promote sedimentation of coarse materials and separation of free oil from storm water. Most WQIs also contain screens to help retain larger or floating debris, and many of the newer designs also include a coalexcing unit that helps to promote oil/water separation. WQIs typically capture only the first portion of runoff for treatment and are generally used for pretreatment before discharging to other best management practices (BMPs)." (source:EPA Storm Water Technology Fact Sheet, "Water Quality Inlets")




**Profile of a typical Water Quality Inlet**

(source: Berg, 1991)

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ◒ | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- WQIs can be purchased as pre-manufactured units or constructed on site.
- Suppliers of pre-manufactured units can also provide modifications of the typical design for special conditions.

***Caltrans SWMP Category:***

Category III

***Key Design Elements:***

1. Peak Flow
2. Offline vs. Online
3. Water quality design flow
4. Residence time (BMP sizing vs. Water quality flow rate)

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▗ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: The WQIs are designed to retain captured pollution over multiple rain events. WQIs should be inspected, floatables should be removed, and the sediment removed when the units are 50% to 85% full.
- *Nuisance Control:* Vector inspections are required since many units hold a permanent pool of water.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove floatables and debris. Vactor truck is the most common method of cleaning.

***Project Development:***

- *Right-of-Way Requirements*: Depending on the size and configuration of the equipment required for BMP construction, adequate space may not be available.
- *Siting Constraints*: WQIs should be sited where there is adequate access for maintenance of the facility. A vactor truck is the normal maintenance method.
- *Design Complexity*: Proprietary devices.
- *Retrofit Potential*: Relatively smaller size increase retrofit potential.
- *Construction:* BMP sites within freeway right-of-way are often located in areas with limited available lay-down space. Depending on the size and configuration of the equipment required for BMP construction, adequate space may not be available.

***Advantages:***

- WQIs can trap trash, debris, oil and grease, and other floatables.
- WQIs are typically smaller than basin type BMPs.

***Constraints:***

- WQIs have limited ability to separate dissolved or emulsified oil from runoff.
- WQIs are also not very effective at removing pollutants such as nutrients or metals.
- Standing water may create mosquito habitat.

***Sources:***

- Aqua-filter™ Stormwater Filtration System
- Aquashield, Inc. www.aquashieldinc.com
- Baysaver®, Inc., 1998. *Baysaver® Separation System Technical and Design Manual.* www.baysaver.com
- Downstream Defender™
- EcoStorm, Royal Enviromental Systems, Inc. www.royalenterprises.net
- SNOUT Oil-Debris Separator
- Stormceptor™
- Storm Water Technology Fact Sheet Water Quality Inlets www.epa.gov/owm/mtb/wtrqlty.pdf
- Stormwater™ Management Inc.
  - -Stormgate™
  - -Stormgate Seperator™
  - -Stormfilter™
  - -Catchbasin Stormfilter™
- Vortechnics™ http://www.vortechnics.com
- V2B1™ Stormwater Treatment System

***Literature Sources of Performance Demonstrations:***

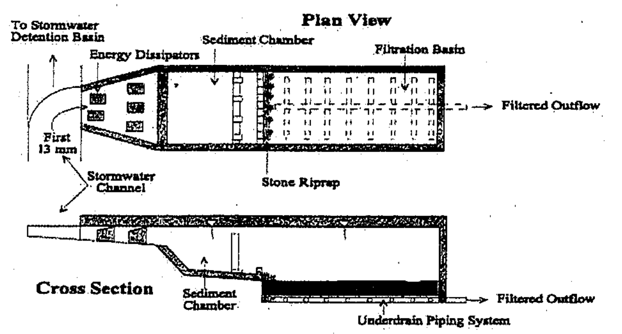
- www.epa.gov/region1/assistance/ceitts/stormwater/techs/aquafiltersys.html
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/downstreamdefender.html
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/baysaver.html
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/stormceptor.html
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/snout.html
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/stormfilter.html
- http://www.epa.gov/region1/assistance/ceitts/stormwater/techs/v2b1.html

# APPENDIX C: PILOT FACT SHEETS

Appendix C presents fact sheets for the full-scale BMPs listed in Section 2.2, Table 2-1 that are currently undergoing pilot testing, but are not yet approved by the Department. Technology evaluations in the attached fact sheets are ongoing, and the assessment of these technologies may be revised in future reports. The evaluations that appear were derived from a review of information that was frequently limited to manufacturer's claims. Unapproved treatment BMP technologies under full-scale pilot testing are presented in the following order:

***Description:***

The Austin sand filter includes a sedimentation basin and a sand media filter. The sedimentation basin captures and detains the design water quality runoff volume (typically for 24 hrs.) prior to discharge to the filter chamber. The sedimentation basin removes floatable debris and coarse suspended solids and prevents premature clogging of the filter media surface. Sedimentation chamber effluent discharges to the sand filtration basin typically through a perforated riser. In the sand filter, the water passes through an 18" sand layer, a geotextile layer, and 6" of gravel. Pollutant removal is achieved primarily by physical filtration of pollutants through the filtration media and settling of solids in the sedimentation basin.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ● |
| *Nutrients* | ○ | ● |
| *Pesticides* | ○ | ● |
| *Total Metals* | ◒ | ● |
| *Dissolved Metals* | ○ | ● |
| *Microbiological* | ● | ● |
| *Litter* | ● | ● |
| *BOD* | ○ | ● |
| *TDS* | ○ | ● |

*Notes:*

- Nitrate concentrations increase by 35%.
- Filters are self-contained devices that can function on an intermittent basis.
- Data obtained from Caltrans Retrofit Pilot Program. Five Austin sand filters were constructed and monitored.

***Caltrans SWMP Category:***

Category III

***Key Design Parameters:***

1. Design volume for the sedimentation basin should be increased to account for reduction in storage volume due to deposition of solids.
2. Orifice plate on the outlet riser should be sized so that the sedimentation basin drains from a full basin condition in 24 hours.
3. The underdrain piping should consist of a main collector pipe and two or more lateral branch pipes with a minimum slope of 1%.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ● |

Five Austin sand filters were constructed for retrofit and monitored. An average of 45 field hours/year were spent on O&M for each sand filter. Caltrans Cost Summary report CTSW-RT-01-003

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: A maintenance ramp should be incorporated to allow equipment into the sedimentation basin and filter basin for routine cleaning sediment and debris.
- *Nuisance Control:* The spreader ditch in the filtration chamber holds water and can provide breeding habitat for mosquitoes. The spreader ditch may be omitted from the traditional design if another energy dissipation method is provided in front of the riser outlet to the filter bed.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high for sedimentation basin and sand filter.
- *Siting Constraints*: Should not be sited where runoff from bare soil or construction activities will be allowed to enter the filter. Excessive amounts of sediment will cause premature clogging of the filter.
- *Design Complexity*: Sand filters should be sited where enough vertical clearance (head) is provided, about 1.5 meters. Detailed geotechnical investigation prior to construction is recommended.
- *Retrofit Potential*: Retrofit of sand filters at maintenance stations and park-and-ride lots impacts the operation of the facility during construction.
- *Construction:* Sand specified should be a standard locally available well-washed sand mix that generally meets the design requirements for permeability. Excavation problems may be magnified due to the large, deep design of the sedimentation basin and sand filter, the need to intercept existing storm drains, and the desire to minimize footprint area. Field conditions such as structurally unsuitable soils, buried manmade objects and existing utility lines may be encountered.

***Advantages:***

- The Austin sand filters have good constituent removal for suspended solids, total metals, and bacteria. They can provide consistent pollutant removal when properly maintained.
- They can treat runoff from drainage areas up to 20 hectares.
- They can reduce the potential for groundwater contamination if they are designed with an impermeable basin liner.
- They can be added to retrofit highly developed existing sites.

***Constraints:***

- Sand filters can be relatively expensive to construct and maintain.
- Limited pollutant removal for nutrients.
- If sufficient head is not available, the use of pumps may be required, which result in higher costs and more frequent maintenance.

***Sources:***

- M. Barrett, University of Texas at Austin
- http://www.epa.gov/owm/mtb/sandfltr.pdf
- http://enviro.nfesc.navy.mil/p2library/cgi-bin/p2h_datasheet.cfm?itemID=230
- http://webcentral.bts.gov/ntl/DOCS/RUNOFF.html

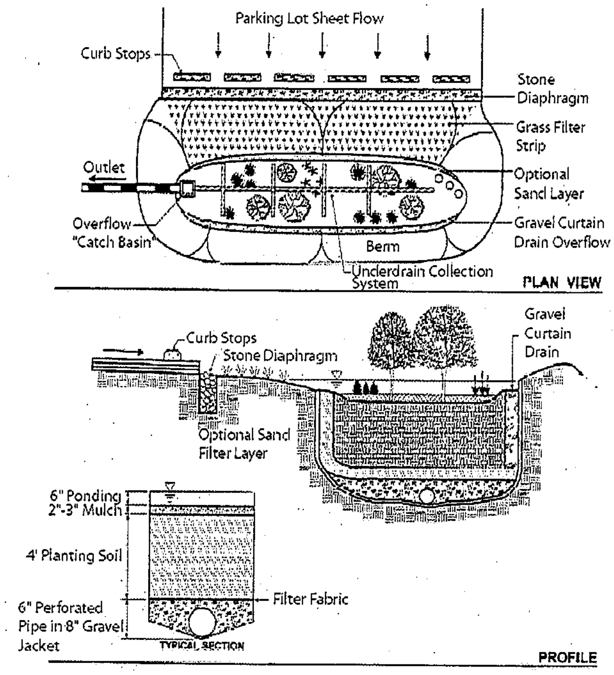
***Literature Sources of Performance Demonstrations:***

- The US Department of Transportation "Evaluation and Management of Highway Runoff Water Quality" Young et al. 1996 – contains info. on siting, design, and performance.
- Glick, Roger Chang, George C., and Barrett, Michael E., Monitoring and evaluation of stormwater quality control basins, in Watershed Management: Moving from Theory to Implementation, Denver, CO, May 3-6, 1998, pp. 369-376.

# BMP Fact Sheet
## Bioretention

***Description:***

Bioretention facilities are designed to capture and retain the storm water quality volume in a shallow, offline, vegetated retention area. They are typically used to treat small (0.25 to 1.0 acre), highly impervious surfaces such as park-and-ride facilities and maintenance yards. Bioretention facilities are intended to promote infiltration, evaporation and evapotranspiration of the water quality volume. Bioretention basins are smaller and less obtrusive than infiltration basins. Bioretention basins may have an underdrain connected to the storm drain if native soils are not sufficiently permeable. Careful landscaping and planting can provide a positive aesthetic appeal. Runoff should enter the facility in a sheet-flow manner across a grassed buffer to minimize introduction of sediment into the retention basin. Maximum ponding depths should be chosen in conjunction with measured infiltration/transportation rates to ensure that the facility will be dry within 72 hours to prevent mosquito propagation. The footprint is about 10 percent of the contributory drainage area (depending on required capture volume). Biorentention is well-suited for use around maintenance stations and park-and-ride facilities where a vegetated buffer area may provide screening and an aesthetic element is desirable to adjacent property owners. It may also prove to be appropriate for highway rest areas or rural areas.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ◒ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ● | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ● | ○ |
| *Litter* | ● | ○ |
| *BOD* | ● | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No performance data encountered in field demonstrations or in literature.

***Key Design Elements:***

1. Size (based on infiltration rate).
2. Vegetation.
3. Underground drain system if groundwater pollution is a concern.
4. Ponding depth.
5. Surface area
6. Depth and type of soil
7. Planting plan

Ancillary Facilities

None.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ○ |

***Caltrans SWMP Category:***

Category III

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A002013

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Regular vegetation management is required.
- *Nuisance Control:* The bioretention facility can promote mosquito breeding and sheltering of endangered species.
- *Traffic Control*: No concerns identified.
- *Staffing/Equipment:* For routine maintenance, staff is required to conduct regular vegetation management to advance the bioretention process.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high to accommodate shallow water quality storage depths.
- *Siting Constraints*: Restricted to large sites with appropriate soil characteristics and low water table. Bioretention facilities are limited to sites with adequate adjacent undeveloped land.
- *Retrofit Potential*: Feasible if right-of-way is available for facility.
- *Construction:* Vegetation establishment period is required.

***Advantages:***

- Pollutant removal effectiveness is typically high, accomplished primarily by sedimentation in the primary storage facility; physical filtration of particulates through the soil profile; and dissolved constituents uptake in the vegetative root zone by the soil-resident microbial community. It can provide a highly aesthetic vegetated appearance while providing multi-purpose benefits such as water quality protection.

***Constraints:***

- May not be appropriate along highways where safety considerations preclude use of large trees or plantings that obscure sight lines. In areas with prolonged dry periods, maintenance of trees, shrubs and grass between rainfalls may require irrigation. Bioretention is limited to sites with adequate adjacent undeveloped land because it requires a large footprint to accommodate shallow water quality storage depths. As with any infiltration facility, clogging can cause water ponding and associated nuisance and vector problems. Use of planting soil to fill the basin may increase costs compared to infiltration basins. It takes time for bioretention facilities to become established while vegetation develops
- Current designs are functional only during dry weather.
- Possible contamination of groundwater can be associated with the bioretention facility.

***Sources:***

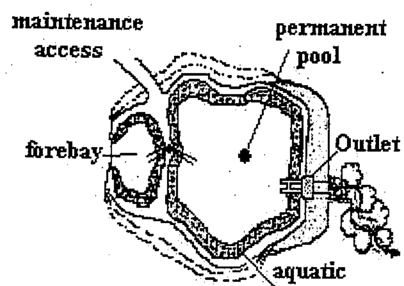

- Loomis & Moore et al 1998. Draft Integrated Solutions Development Study Watersheds Master Plan, Prepared for the City of Austin Watershed Protection Dept.
- Maryland Dept of the Environment and Center for Watershed Protection 2000. Maryland Storm water Design Manual, Volumes I & II.
- Schueler, T. R. et al. Draft Maryland Storm water Design Manual, Maryland Department of the Environment in Cooperation with the Maryland Department of Natural Resources Coastal Zone Management Program. 1998.
- CWP, 1996. Design of Stormwater Filtering Systems Center for Watershed Protection. December 1996


***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

Constructed wetlands attempt to replicate some of the conditions in natural wetlands. Constructed wetlands for stormwater treatment typically are shallow (less than 2 meters) ponds with a variety of wetland plant species. The ponds often incorporate forebays to localize sediment accumulation, shallow zones to encourage filtration by plant material, and deeper zones to allow further sedimentation. The water quality benefits of treatment in natural or constructed wetlands include nutrient cycling and removal, and reduction in suspended solids (TSS), total dissolved solids (TDS), trace metals, and BOD.




Source: Schueler, 1991

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ◒ | ◒ |
| *Nutrients* | ◒ | ◒ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ◒ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ◒ | ◒ |
| *BOD* | ◒ | ◒ |
| *TDS* | ◒ | ◒ |

*Notes:*

- None identified

***Key Design Elements:***

1. Sediment forebays are recommended to decrease the velocity and sediment loading to the wetland. The forebay should contain at least 10 percent of the wetlands treatment volume and should be 4 to 6 feet deep.
2. The wetland design should include a buffer to separate the wetland from surrounding land.
3. Above ground berms or high marsh wedges should be placed at 50 foot intervals.
4. A four-to-six foot deep micropool should be included in the design to prevent the outlet from clogging.
5. Site must have adequate water flow and appropriate underlying soils.

***Caltrans SWMP Category:***

Category III

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◳ | ◒ |

| | | |
|---|---|---|
| ● High | ◒ Medium | ○ Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A002015

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Active management of the hydrology and vegetation during the first few years or growing seasons is necessary.
- *Nuisance Control:* The constructed wetland facility can promote mosquito breeding and sheltering of endangered species.
- *Traffic Control*: No concerns identified
- *Staffing/Equipment:* For routine maintenance, staff if required to conduct regular vegetation management and inspections for sediment accumulation and removal, if necessary.

***Project Development:***

- *Right-of-Way Requirements*: Moderate
- *Siting Constraints*: The system's size and modular configuration make it adaptable to a wide range of site conditions and watershed sizes. The system can be used to treat runoff from highways, parking lots, airports, marinas, and commercial, industrial, and residential areas.
- *Retrofit Potential*: Generally 1-2 units are required for each acre of impervious surface.

***Advantages:***

- Improvements in downstream water quality
- Settlement of particulate pollutants
- Reduction of oxygen-demanding substances and bacteria from urban runoff
- Enhancement of vegetation diversity and wildlife habitat in urban areas

***Constraints:***

- May be difficult to maintain vegetation under a variety of flow conditions
- Relatively high construction costs in comparison to other BMP's

***Sources:***

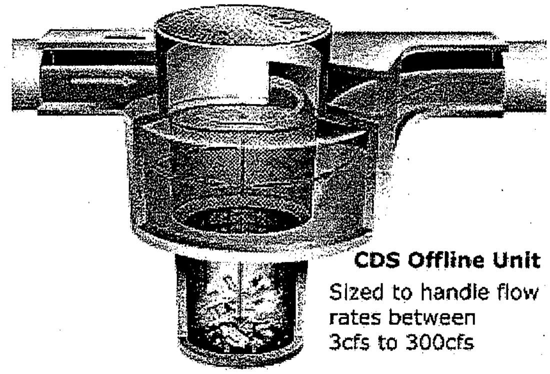
- None identified

***Literature Sources of Performance Demonstrations:***


- Schueler, T.R., "Design of Stormwater Pond Systems". Metropolitan Washington Council of Governments, Washington, DC.
- Schueler T. et al., 1992. "A Current Assessment of Urban Best Management Practices.
- Techniques for Reducing Non-Point Source Pollution in the Coastal Zone". 126pp.
- Schueler, T.R., F.J. Galli, L. Herson, P. Kumble and D.Shepp, 1991. "Developing Effective BMP Systems for Urban Watersheds". Urban Non-Point Workshops, New Orleans, Louisiana. January 27-29, 1991.
- Schueler, Thomas R., 1987. "Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP's. July.
- Strecker, E.W; J.M. Kersnar; and E.D. Driscoll, 1992. "The Use of Wetlands for Controlling Stormwater Pollution; Final Report", Prepared for Region 5 Water Division, Wetlands and Watershed Section, Watershed Management Unit, USEPA, Chicago, IL. Prepared by Woodward Clyde Consultants, Portland OR. 66 pp.plus appendix.
- Washington State Department of Ecology, 2000. "Stormwater Management Manual for Western Washington, Volume V, Runoff Treatment BMP's. 251 pp. August.
- Kadlec and Knight, 1996, "Treatment Wetlands", Lewis Publishers, NY, NY.

***Description:***

Continuous Deflective Separation (CDS™) units are placed downstream of drain inlets to capture sediment, trash, and debris (gross pollutants). The units create a vortex of water that allows the water to escape through a screen while contaminants are contained in the unit sump. The vortex action of the water tends to keep the screen clear from trash and debris. A storm by-pass weir is incorporated to allow excess flows to bypass the system, rather than entering the CDS™ unit. This is to prevent the unit from flooding or losing its captured material.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- No information on chemistry data is available from the Caltrans BMP retrofit pilot program. Manufacturer reports 2400 micron screen can remove:
  - 100% of particles 425 um or greater
  - 96 % of particles 300-425 um
  - 76 % of particles 150-300 um
  - 42 % of particles 75-150 um
- 4700 micron screen can remove:
  - 100% of particles 2,350 um or greater
  - 93 % of particles 1,551-2,350 um
  - 50 % of particles 940-1,551um
- Two CDS™ units are currently being tested as part of the Caltrans BMP retrofit pilot program. Performance evaluation is currently not available.
- There have been about 160 installations of CDS units in Australia and the Untied States.
- Five studies have been performed on CDS™ units. These studies focused on characteristics of litter and sediments rather than efficiency.

***Caltrans SWMP Category:***

Category III

***Key Design Parameters:***

Storm water units that will treat a 1 to 300 CFS flow range. Contact manufacturer for customization of units to meet site specific needs for flow capacities and sump sizes. Flow must be subcritical entering the unit. Sites with continuous dry weather flow are not recommended.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▖ | ● |

Information from Caltrans Cost Summary report CTSW-RT-01-003. Manufacturer can supply cost data for unit only. An average of 63 field hours per year were spent on operation and maintenance of each CDS™ during the Caltrans BMP retrofit pilot program.

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: The CDS™ units are designed to retain captured pollution over multiple rain events. The CDS™ unit should be inspected, floatables should be removed, and the sump cleaned when the sump is above 85% full. There are three methods for cleaning out a CDS™ unit - vactor truck, removable basket, and underflow pump.
- *Nuisance Control:* Vector inspections are required since the unit holds a permanent pool of water.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove floatables and debris.

***Project Development:***

- *Right-of-Way Requirements*: Depending on the size and configuration of the equipment required for BMP construction, adequate space may not be available.
- *Siting Constraints*: CDS™ units should be sited where there is adequate access for maintenance of the facility. A vactor truck is the normal maintenance method.
- *Design Complexity*: Proprietary device.
- *Retrofit Potential*: Two retrofits accomplished in Caltrans pilot study.
- *Construction:* BMP sites within freeway right-of-way are often located in areas with limited available lay-down space. Depending on the size and configuration of the equipment required for BMP construction, adequate space may not be available.

***Advantages:***

- Storm water can be treated at the end of pipe, and therefore storm water treatment devices are not needed at each storm drain inlet. The unit is non-mechanical, non-electrical, reducing maintenance issues related to mechanical and electrical devices. Relatively limited head is needed to operate the device (0.5 ft).

***Constraints:***

- Unit is developed for the removal of gross pollutants only.
- Permanent pool of water is maintained, creating a breeding opportunity for mosquitoes.

***Sources:***

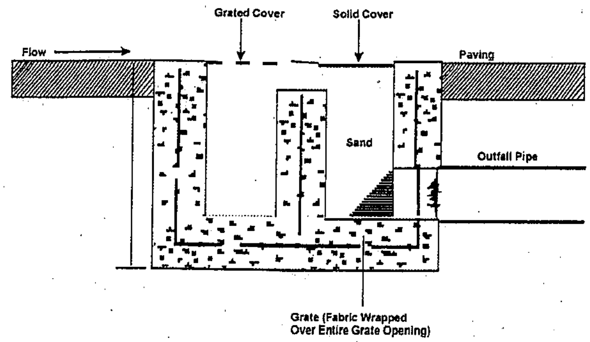
- US Head Office - West Coast
  CDS Technologies
  16360 South Monterey Road, Suite 250
  Morgan Hill, CA 95037
  Toll Free: 888 535 7559
  Phone: 408 779 6363
  Fax: 408 782 0721
  email: cds@cdstech.com
- http://www.CDStech.com.au/articles/StenstromReport.pdf
- http://www.CDStech.com.au/articles/Coarse&Medium-FineSedimentRemoval.pdf
- http://www.stormwater-resources.com/Library/065BCDSFinal.pdf

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

Delaware sand filters are often located at the curbside edge of a paved area or parking lot and include two parallel concrete chambers, a sedimentation chamber, and a sand media filter chamber. The sedimentation chamber holds a permanent pool of water. The sedimentation basin removes the coarse suspended solids and prevents premature clogging of the filter media surface. The sedimentation effluent discharges over a weir into the sand filter chamber where water is filtered through a 12- to 18-inch sand filter, geotextile layer, and 6 inches of gravel. Delaware sand filters are on-line facilities; they process all runoff leaving the site up to the point where the overflow limit is reached.
Delaware sand filters can be applied to confined urban areas and areas where space is limited. Parking lots are a common application for the Delaware sand filters.



Source: Shaver, 1991

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ● |
| *Nutrients* | ○ | ● |
| *Pesticides* | ○ | ● |
| *Total Metals* | ● | ● |
| *Dissolved Metals* | ○ | ● |
| *Microbiological* | ● | ● |
| *Litter* | ● | ● |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Nitrate concentrations increase by 78%.
- High dissolved Zn removal efficiency.
- A Delaware sand filter was sited as part of the Caltrans BMP Retrofit Pilot Program. Although Delaware sand filters are not thought to be effective for removing dissolved constituent, some removal was observed.

***Caltrans SWMP Category:***

- Category III

***Key Design Parameters:***

The Delaware unit should be designed and installed according to the guidelines described by Young et al. (1996). It should be noted that if a Delaware filter is designed according to these guidelines, there is only storage in the unit for 5 mm of runoff (0.2 inches); consequently, if it is desired to treat a larger water quality volume, the unit must act as a flow-through device. The filter is sized using unit values for the sedimentation chamber volume and filter bed area per acre of tributary area treated.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ● |

Information from Caltrans Cost Summary report CTSW-RT-01-003. An average of 20 field hours per year were spent on operation and maintenance of the Delaware sand filter during the Caltrans BMP retrofit pilot program.

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A002019

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Maintenance for smaller, underground filters is usually best done manually. Normal maintenance requirements include disposal of accumulated trash and replacement of the upper few inches of dirty sand when the filter drain time exceeds that stipulated in design.
- *Nuisance Control:* The spreader ditch in the filtration chamber holds water and can provide a breeding site for mosquitoes. The spreader ditch may be omitted from the traditional design if another energy dissipation method is provided in front of the riser outlet to the filter bed.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high for sedimentation basin and sand filter.
- *Siting Constraints*: Delaware sand filters should not be sited where runoff from bare soil or construction activities will be allowed to enter the filter. Excessive amounts of sediment will cause premature clogging of the filter.
- *Design Complexity*: Sand filters should be sited where enough vertical clearance (head) is provided, about 1.5 meters. Detailed geotechnical investigation prior to construction is recommended.
- *Retrofit Potential*: Retrofit of sand filters at maintenance stations and park-and-ride lots impacts the operation of the facility during construction.
- *Construction:* Sand specified should be a standard locally available sand mix that generally meets the design requirements for permeability. Field conditions, such as structurally unsuitable soils, buried manmade objects, and existing utility lines may be encountered.

***Advantages:***

- Delaware sand filters can be installed underground in urban settings and be kept out of sight, or open for large drainage areas. They are similar in performance to the Austin design with the principal advantage being the preservation of the surface use.
- Waste media from the filters does not appear to be toxic and is likely to be environmentally safe for landfill disposal.
- The filters can reduce the potential for groundwater contamination if they are designed with an impermeable basin liner.

***Constraints:***

- Delaware sand filters are relatively expensive to construct.
- Sand filters have only limited pollutant removal capability for nutrients.
- The sedimentation basin holds a permanent pool of water and has the potential to provide breeding opportunities for mosquitoes.

***Sources:***

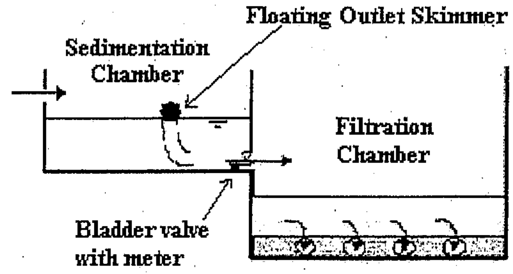
- The Web site, http://www.epa.gov/owm/mtb/sandfltr.pdf has information on design, performance, operation, maintenance, and costs of sand filters.
- Other Web sites with information on performance include:
- http://enviro.nfesc.navy.mil/p2library/
- cgi-bin/p2h_datasheet.cfm?itemID=230
- http://webcentral.bts.gov/ntl/DOCS/RUNOFF.html

***Literature Sources of Performance Demonstrations:***

- The US Department of Transportation "Evaluation and Management of Highway Runoff Water Quality" Young et al. 1996 contains information on the siting, design, and performance of Delaware sand filters.

***Description:***

The Improved Extended Detention Basin (EDB) Outlet drains water from the top of the basin to improve the sedimentation efficiency by assuring that settled particles are not accidentally sucked into the discharge. The sedimentation process could be improved by adding an outflow device composed of a skimmer, drainage hose and float to the current BMP design of the Austin Filter for the EDB outlet or to the outlet of a stand-alone EDB. Alternatively, a valve with an inflated bladder can be used to increase detention time. The pneumatic bladder located in the sedimentation chamber outlet drain is inflated when sensors detect rain to provide a set sedimentation time. The tank will be drained or "decanted" from the surface in order to allow more time for the sedimentation process. With the improved sedimentation process, less sediment will be collected on the media filter, reducing maintenance and extending the life of the sand filter.




***Key Design Elements:***

1. Hydraulic capacity.
2. Means of removing water when skimmer is at its lowest position.
3. Power and controls system for operating outlet bladder or valve.

Ancillary Facilities

Extended detention basin.

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ○ |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ◒ | ○ |
| *Total Metals* | ◒ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ◒ | ○ |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ○ | ○ |

Notes:

- Nitrate and nitrite levels may actually increase due to nitrification.
- No performance data encountered in field demonstrations or in literature.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Mechanical skimmer or bladder will require inspection and periodic replacement.
- *Nuisance Control:* None beyond normal detention basin.
- *Traffic Control*: None identified.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to inspect and maintain outlet.

***Project Development:***

- *Right-of-Way Requirements*: Equivalent to detention basin.
- *Siting Constraints*: None identified. Equivalent to detention basin.
- *Retrofit Potential*: Retrofit of EDBs at park-and-ride lots impact the operation of the facility during construction.
- *Construction:* Equivalent to detention basin.

***Advantages:***

- Savings from less frequent filter cleanings since cleaning a sedimentation basin is less difficult and expensive than cleaning a filter basin.
- Potentially increased removal of suspended solids.

***Constraints:***

- Unless the skimmer can drain all the water from the detention pond, a secondary outlet should be provided at the bottom of the basin to avoid water stagnation and the potential for mosquito propagation.
- Maintenance costs for sedimentation basins will be increased slightly since more sediments will accumulate in the sedimentation basin.
- May require draining the basin if the outlet fails.

***Sources:***

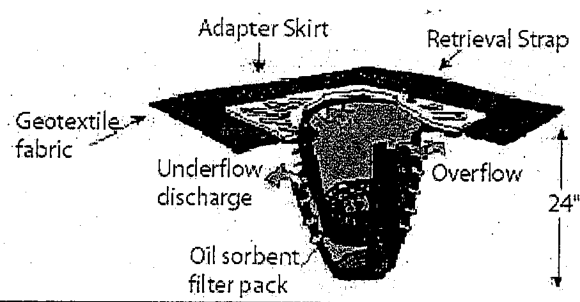
- http://www.epa.gov/ednnrmrl/projects/control/high.htm. April 2000.

***Literature Sources of Performance Demonstrations:***

- Harper, H. H., et al. "Performance Evaluation of Dry Detention Stormwater Management Systems." Sixth Biennial Stormwater Research Watershed Management Conference. September 1999.
- Keblin, Michael, et al. Effectiveness of Permanent Highway Runoff Controls: Sedimentation/Filtration Systems. October 1997.
- Meinholtz, T. L., et al. Screening/Floatation Treatment of Combined Sewer Outflows, Volume II: Full-Scale Operation Racine, Wisconsin. EPA-600/2-79-106a. Aug 1979.
- Pitt, R., et al. Stormwater Treatment at Critical Areas, Vol. 1: The Multi-Chambered Treatment Train. Cincinnati: US EPA. 1997.
- Robert Bein, William Frost and Associates, Scoping Study, Retrofit Pilot Program, Caltrans District 11. February 1998.
- Roy, John R. Corporate information packet. AquaLogic Stormwater Abatement Filter System. SWAF Inc. April 2000.
- United States Department of Transportation, Federal Highway Administration, Office of Environmental Planning: Evaluation and Management of Highway Runoff Water Quality, Washington, DC. June 1996.

***Description:***

StreamGuard™ is placed in the inlet to a storm drain where storm water flows through the insert, and the geotextile fabric absorbs oil and retains sediment and gross pollutants. The body of the unit fills with storm water and sediment, and gross pollutants are collected in the bottom of the insert. Floating oil and grease are absorbed by the filter pack contained in a poly-net bag fixed within the unit.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ● |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ● |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ○ | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Three StreamGuard™ DIIs were sited, constructed, and monitored as part of the Caltrans BMP retrofit pilot program.

***Key Design Parameters:***

StreamGuard™ should be installed into the inlet of the storm drain according to the manufacturer's recommendations. A tight seal is necessary between the frame of the drain inlet and the insert. The insert should have a high-flow bypass to prevent resuspension and washout.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ● |

Information from Caltrans Cost Summary report CTSW-RT-01-003. An average of 17 field hours were spent operating and maintaining each StreamGuard™ in the 1999/2000 season.

***Caltrans SWMP Category:***

Category III

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Sediment should be removed when accumulation is more than 6 inches. StreamGuard™ should be inspected for trash and debris that could interfere with the normal functioning of the inlets. The StreamGuard™ adsorbent should be replaced when significant oil and grease are present on the absorbent polymer. The media should be replaced annually.
- *Nuisance Control*: None
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Minimal space requirements for drain inlet insert.
- *Siting Constraints*: Drain Inlet Inserts should be installed where they can be easily accessible for maintenance.
- *Design Complexity*: Proprietary device.
- *Retrofit Potential*: DIIs located in maintenance stations will impact facilities, normal operations and may cause a loss of the available space normally used for parking vehicles or storing equipment and materials.
- *Construction:* The DIIs are designed to be part of the existing or new drainage system. Installation must include ensuring a tight fit between the device and the drain inlet lip.

***Advantages:***

- StreamGuard™ DIIs are relatively inexpensive to install, and are easily retrofitted to existing drain inlets.

***Constraints:***

- Constituent removal is relatively small. No treatment is provided for nutrient removal.

***Sources:***

- Foss Environmental
  PO Box 80327
  Seattle, Washington 98108 USA
  Tel (800) 909-3677 fax (888) 234-3677
  e-mail fossenv@fossenv.com
- StreamGuard™ is a proprietary device. Information provided by manufacturer can be found on their website at http://www.fossenv.com/

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

FossilFilter™ inserts are proprietary devices that contain filter media (Amorphous Alumina Silicate) just under the grates of the storm water system's catch basins. The water runoff flows into the inlet, through the filter where the target contaminants are removed, and then into the drainage system. It can be implemented anywhere free oil and grease (the primary target constituent) is considered a problem.

***Constituent Removal:***

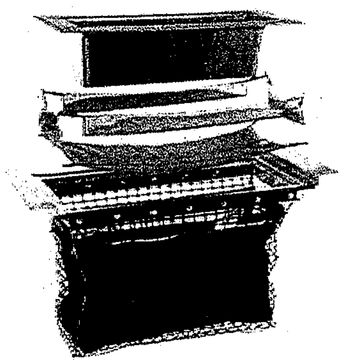
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ● |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ● |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ● | ● |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Three FossilFilter™ DIIs were sited, constructed, and monitored as part of the Caltrans BMP retrofit pilot program.

***Caltrans SWMP Category:***

Category III



***Key Design Parameters:***

FossilFilter™ should be installed into the inlet of the storm drain according to the manufacturer's recommendations. A tight seal is necessary between the frame of the drain inlet and the insert. The insert should have a high-flow bypass to prevent resuspension and washout. The media should not be able to escape the unit. Even sheet flow to all sites of the inlet is optimal. Concentrated flow (as in a swale) creates a jet entering the inlet which can result in by-pass. The design loading rate is 12 gpm per foot of filter.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ● |

Information from Caltrans Cost Summary report CTSW-RT-01-003. An average of 29 field hours were spent operating and maintaining each FossilFilter™ DII in the 1999/2000 season.

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑<br>Cost ↓ | Benefit ↑<br>Cost ↑ |
| Benefit ↓<br>Cost ↓ | Benefit ↓<br>Cost ↑ |

*Rating Key for Cost Effectiveness*



A002025

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: FossilFilter™ should be inspected for trash and debris that could interfere with the normal functioning of the inlets, or debris that tends to accumulate on top of the trays, deflecting runoff water. The FossilFilter™ adsorbent should be replaced when significant oil and grease are present on the absorbent granules. The media should be replaced annually.
- Nuisance Control: None
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment*: For routine maintenance, requires staff to remove debris.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are very small.
- *Siting Constraints*: Drain Inlet Inserts should accessible as needed for maintenance.
- *Design Complexity*: Proprietary device.
- *Retrofit Potential*: Easily retrofitted to existing drain inlets.
- *Construction:* The DIIs are designed to be part of a new or existing drainage system. The edge where the device tray meets the inlet wall must be sealed to prevent runoff from by-passing the tray. DIIs located in maintenance stations will impact facilities' normal operations and may cause a loss of the available space normally used for parking vehicles or storing equipment and materials.

***Advantages:***

- FossilFilter™ are relatively inexpensive to install.
- Easily retrofitted to existing drain inlets.

***Constraints:***

- No treatment is provided for nutrient removal.
- Maintenance is dispersed rather than centralized at the storm drain outlet.
- They are not suitable for locations such as freeway shoulders where maintenance access is compromised.

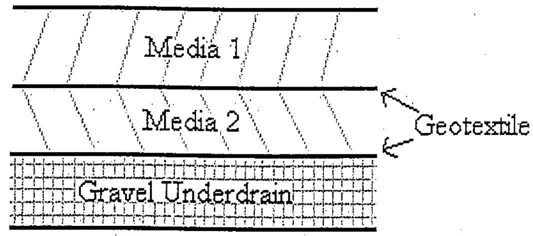
***Sources:***

- KriStar Enterprises, Inc.
  P.O. Box 7352
  Santa Rosa, CA 95407-0352
  (800) 579-8819 FAX: (707) 524-8186
- FossilFilter™ is a proprietary device. Information provided by manufacturer can be found on their website at http://www.kristar.com/

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***
The Dual Media Austin Filter is similar to an Austin Sand Filter. In the filter, the water passes through two media layers, a geotextile layer, and 6" of gravel. Particulate removal is achieved primarily by physical filtration of pollutants through the filtration media and settling of solids in the sedimentation basin. Dissolved pollutants are absorbed to the media. The second media typically has properties conducive to absorption. The arrangement tested by Caltrans consists of 0.4m (12") of Activated Alumina overlain by 0.2m (0.6") of sand. The sand on top will clog first. Replacement of clogged sand will be less expensive than if the entire filter where activated alumina.




see Austin Sand Filter fact sheet (C-2) for overall schematic.

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ● |
| *Nutrients* | ◒ | ◒ |
| *Pesticides* | ○ | ◒ |
| *Total Metals* | ◒ | ● |
| *Dissolved Metals* | ○ | ● |
| *Microbiological* | ● | ● |
| *Litter* | ● | ● |
| *BOD* | ○ | ● |
| *TDS* | ○ | ● |

*Notes:*

- Data obtained from Caltrans Retrofit Pilot Program for five Austin sand filters and based on the small-scale Tahoe pilot studies.

***Caltrans SWMP Category:***

Category III

***Key Design Parameters:***

1. Design volume for the sedimentation basin should be increased to account for reduction in storage volume due to deposition of solids.
2. Orifice plate on the outlet riser should be sized so that the sedimentation basin drains from a full basin condition in 24 hours.
3. The underdrain piping should consist of a main collector pipe and two or more lateral branch pipes with a minimum slope of 1%.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ● |

Five Austin sand filters were constructed for retrofit and monitored. An average of 45 field hours/year was spent on O&M for each sand filter. Caltrans Cost Summary report CTSW-RT-01-003

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: A maintenance ramp should be incorporated to allow equipment into the sedimentation basin and filter basin for routine cleaning sediment and debris.
- *Nuisance Control:* The spreader ditch in the filtration chamber holds water and can provide breeding habitat for mosquitoes. The spreader ditch may be omitted from the traditional design if another energy dissipation method is provided in front of the riser outlet to the filter bed.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high for sedimentation basin and sand filter.
- *Siting Constraints*: Should not be sited where runoff from bare soil or construction activities will be allowed to enter the filter. Excessive amounts of sediment will cause premature clogging of the filter.
- *Design Complexity*: Sand filters should be sited where enough vertical clearance (head) is provided, about 1.5 meters. Detailed geotechnical investigation prior to construction is recommended.
- *Retrofit Potential*: Retrofit of sand filters at maintenance stations and park-and-ride lots impacts the operation of the facility during construction.
- *Construction:* Sand specified should be a standard locally available well-washed sand mix that generally meets the design requirements for permeability. Excavation problems may be magnified due to the large, deep design of the sedimentation basin and sand filter, the need to intercept existing storm drains, and the desire to minimize footprint area. Field conditions such as structurally unsuitable soils, buried manmade objects and existing utility lines may be encountered.

***Advantages:***

- The Austin filters have good constituent removal for suspended solids, total metals, and bacteria. They can provide consistent pollutant removal when properly maintained.
- They can treat runoff from drainage areas up to 20 hectares.
- They can reduce the potential for groundwater contamination if they are designed with an impermeable basin liner.
- They can be added to retrofit highly developed existing sites.

***Constraints:***

- Sand filters can be relatively expensive to construct and maintain.
- Limited pollutant removal for nutrients.
- If sufficient head is not available, the use of pumps may be required, which result in higher costs and more frequent maintenance.

***Sources:***

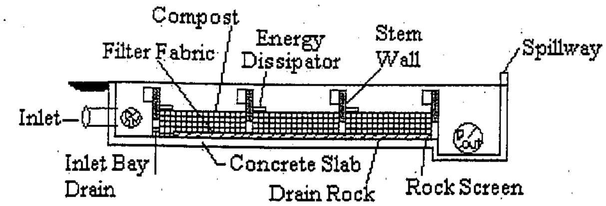
- M. Barrett, University of Texas at Austin
- http://www.epa.gov/owm/mtb/sandfltr.pdf
- http://enviro.nfesc.navy.mil/p2library/cgi-bin/p2h_datasheet.cfm?itemID=230
- http://webcentral.bts.gov/ntl/DOCS/RUNOFF.html

***Literature Sources of Performance Demonstrations:***

- The US Department of Transportation "Evaluation and Management of Highway Runoff Water Quality" Young et al. 1996 – contains info. on siting, design, and performance.
- Glick, Roger Chang, George C., and Barrett, Michael E., Monitoring and evaluation of stormwater quality control basins, in Watershed Management: Moving from Theory to Implementation, Denver, CO, May 3-6, 1998, pp. 369-376.

***Description:***

This filter is conceptually similar to the Austin Sand Filter (see page C-3, Appendix C), but uses a composted leaf filter media instead. Stormwater Management, Inc. is no longer manufacturing systems with this media. The filter is open to the atmosphere and requires a sedimentation basin upstream. The media is typically housed in a large below-grade vault. In some designs the vault is sectioned off by removable weirs, and under high flow conditions the storm water will overflow the first filter section to be treated in the subsequent ones. The filter media is reported to remove sediment, oil, particulate and dissolved metals, and a variety of organic contaminants. The assumption is that these systems will have enhanced removal for many pollutant compounds due to the increased cation exchange capacity of organic matter over sand. This technology is designed for use at the storm water pipe outlet. Alternative configurations, such as cylindrical filter modules, have been used in attempts to save space and reduce filter clogging.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ● |
| *Nutrients* | ○ | ● |
| *Pesticides* | ○ | ● |
| *Total Metals* | ○ | ● |
| *Dissolved Metals* | ○ | ● |
| *Microbiological* | ○ | ● |
| *Litter* | ● | ◒ |
| *BOD* | ○ | ◒ |
| *TDS* | ○ | ● |

***Key Design Elements:***

1. Proprietary design.

Ancillary Facilities

Sedimentation facilities required upstream of filter.

***Equivalent Uniform Annual Costs:***

| | *Cost Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◲ | ● |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

- Category III

***Issues and Concerns:***

***Maintenance:***

- _Requirements_: Sediment accumulation in filters and vegetation growth may occur. Nutrient concentrations (especially nitrates and phosphate) have been shown to increase. Media clogging issues may increase maintenance.
- _Nuisance Control:_ Standing water may provide a breeding place for mosquitoes and other vectors.
- _Traffic Control_: If located along a shoulder or median, maintenance activities will require traffic control.

***Project Development:***

- _Right-of-Way Requirements:_ Unknown.
- _Siting Constraints_: Safety barrier surrounding open basin. Open basins may not be suitable close to freeways.
- _Retrofit Potential_: Caltrans ROW space is typically limited particularly in highly urbanized areas.
- _Construction:_ Traffic control required for retrofits due to close proximity to roadway.

***Advantages:***

- Sedimentation shown to occur. May reduce concentrations of many metals, turbidity, suspended solids, BOD, and ammonia.

***Constraints:***

- Open basins may not be suitable close to freeways.
- Nutrient leaching.

***Sources:***

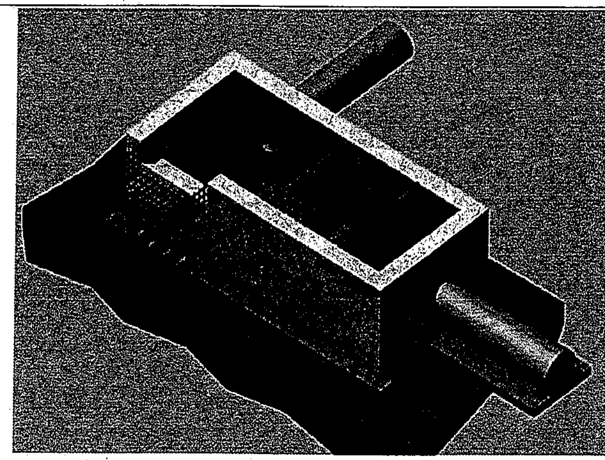
- Jim Lenhardt, Stormwater Management Inc.
- www.stormwatermgt.com

***Literature Sources of Performance Demonstrations:***

- Compost Storm Water Filter System Monitoring Report , State Route 73 CSTW-RT-03-036 http://www.dot.ca.gov/hq/env/stormwater/special/newsetup/index.htm

***Description:***

The Baffle Box Gross Solids Removal Device (GSRD) is a non-proprietary device whose primary function is to remove gross solids (litter and vegetative material) from storm water runoff. The Baffle Box applies a two-chamber concept: the first chamber utilizes an underflow wire to trap floatable gross solids; and the second chamber utilizes a bar rack to screen out any material that passes through from the first chamber.



***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | | |
| *Nutrients* | | |
| *Pesticides* | | |
| *Total Metals* | | |
| *Dissolved Metals* | | |
| *Microbiological* | | |
| *Litter* | ● | ● |
| *BOD* | | |
| *TDS* | | |

*Notes:*

- Litter and vegetative material are the target constituents for the device.
- No long-term water quality monitoring studies have been conducted to evaluate the treatment effectiveness of the Baffle Box on other water quality constituents.

***Key Design Parameters:***

1. Hydraulic Head
2. Annual Estimated Gross Solids Loading Rate

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ◪ | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Caltrans SWMP Category:***

Category III

***Issues and Concerns:***

***Maintenance:***

- *Requirements:* Periodic inspections required to ensure that the device is functional. Routine maintenance may include sediment/debris removal.
- *Nuisance Control:* Design should eliminate standing water that may provide breeding habitat for vectors.
- *Traffic Safety*: Traffic control may be required during maintenance.
- *Staffing/Equipment:* Routine maintenance requires staff and equipment to clear the bar rack if it becomes clogged and remove accumulated sediment.

***Project Development:***

- *Right-of-Way Requirements*: Requires access for maintenance.
- *Siting Constraints*: Must provide sufficient hydraulic head to operate by gravity.
- *Design Complexity*: Baffle boxes should be sized to hold gross solids to be deposited during a 1-year period and pass the design flow (e.g., 25-year flow).
- *Retrofit Potential*: Can be installed in existing right-of-way, but access is required.
- *Construction:* Traffic control may be required for retrofits due to close proximity to roadway.

***Advantages:***

- Baffle box is a "small footprint device" that can be installed in existing right of way.
- Based on pilot studies, when regular maintenance is supplied, the device removes nearly all the gross solids from storm water runoff.

***Constraints:***

- Based on pilot studies, regular maintenance is required to keep the device functioning properly.

***Sources:***

- Suntree Technologies Inc.
- http://bafflebox.com
- California Department of Transportation

***Literature Sources of Performance Demonstrations:***

- California Department of Transportation, Phase I Gross Solids Removal Devices Pilot Study: 2000-2002, Final Report.

**Description:**

The Inclined Screen (IS) Gross Solids Removal Devices (GSRDs) are non-proprietary devices whose primary function is to remove gross solids (litter and vegetative material) from storm water runoff. Currently, there are four configurations of IS GSRDs:

*Configuration #1*. This IS GSRD utilizes a 3 mm spaced parabolic wedge-wire screen. The device is configured with an influent trough to allow some solids to settle. See picture to the right.

*Configuration #2*. This IS GSRD utilizes 5 mm spaced parabolic bars. The device is configured with an influent trough to allow some solids to settle. Configuration #2 is not pictured.

*Configuration #3*. This IS GSRD utilizes the same screen as Configuration #1. However, Configuration #3 has been designed to be cleaned by a front-end loader instead of a Vactor Truck. Configuration #3 is not pictured.

*Configuration #4*. This IS GSRD is similar to the Configuration #1 except that the screen is not parabolic and the influent trough has been removed from the design. Configuration #4 is not pictured.

**Constituent Removal:**

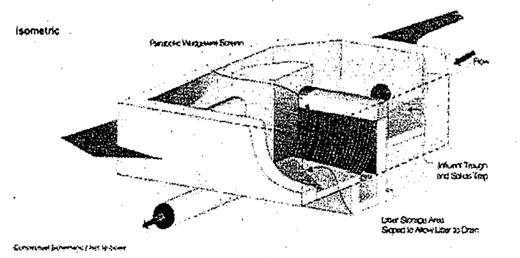
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | | |
| *Nutrients* | | |
| *Pesticides* | | |
| *Total Metals* | | |
| *Dissolved Metals* | | |
| *Microbiological* | | |
| *Litter* | ● | ● |
| *BOD* | | |
| *TDS* | | |

*Notes:*

- Litter and vegetative material are the target constituents for the device.
- No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness of the IS GSRDs on other water quality constituents.

***Caltrans SWMP Category:***

Category III




Inclined Bar Rack Separator

***Key Design Parameters:***

1. Hydraulic Head
2. Annual Estimated Gross Solids Loading Rate

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- _Requirements_: Periodic inspections required to ensure that the device is functional. Routine maintenance may include sediment/debris removal.
- _Nuisance Control:_ Design should eliminate standing water that may provide breeding habitat for vectors.
- _Traffic Control_: Traffic control may be required during maintenance.
- _Staffing/Equipment_ Routine maintenance requires staff and equipment to clear the screen module if it becomes clogged and remove accumulated sediment.

***Project Development:***

- _Right of Way Requirements_: Requires access for maintenance.
- _Siting Constraints_: Must provide sufficient hydraulic head to operate by gravity.
- _Design Complexity_: IS GSRDs should be sized to hold gross solids to be deposited during a 1-year period and pass the design flow (e.g., 25-year flow).
- _Retrofit Potential_: Can be installed in existing right-of-way, but access is required.
- _Construction:_ Traffic control may be required for retrofits due to close proximity to roadway.

***Advantages:***

- The IS GSRDs are a "small footprint device" that can be installed in existing right of way.
- Based on pilot studies, the devices remove nearly all the gross solids from storm water runoff with minimal maintenance requirements.

***Constraints:***

- Hydraulic head requirement.

***Sources:***

- California Department of Transportation

***Literature Sources of Performance Demonstrations:***

- California Department of Transportation, Phase I Gross Solids Removal Devices Pilot Study: 2000-2002, Final Report.
- California Department of Transportation, Phase II Gross Solids Removal Devices Pilot Study: 2001-2003, Final Report.
- California Department of Transportation, Phase III Gross Solids Removal Devices Pilot Study: 2002-2003, Interim Report.

# BMP Fact Sheet
# GSRD Linear Radial



***Description:***

The Linear Radial (LR) Gross Removal Devices (GSRDs) are non-proprietary devices whose primary function is to remove gross solids (litter and vegetative material) from storm water runoff. Currently, there are three configurations of LRDs:

*Configuration #1*. This LR GSRD utilizes a modular well casing with 5 mm x 64 mm louvers to serve as the screen. The LR GSRD is placed on a 2-percent slope. See picture to the right.

*Configuration #2*. This LR GSRD utilizes a modular 5 mm x 5 mm rigid mesh screen housing. Inside the rigid mesh screen are nylon mesh bags (5 mm mesh) that capture gross solids. Configuration #2 is not pictured.

*Configuration #3*. This LR GSRD is identical Configuration #1 except that it has been placed on an approximately 40-percent slope. Configuration #3 is not pictured.

***Constituent Removal:***

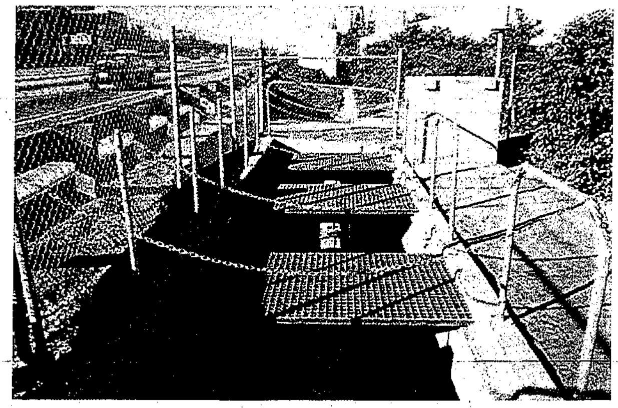
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | | |
| *Nutrients* | | |
| *Pesticides* | | |
| *Total Metals* | | |
| *Dissolved Metals* | | |
| *Microbiological* | | |
| *Litter* | ● | ● |
| *BOD* | | |
| *TDS* | | |

*Notes:*

- Litter and vegetative material are the target constituents for the device.
- No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness of the LR GSRDs on other water quality constituents.

***Caltrans SWMP Category:***

Category III



***Key Design Parameters:***

1. Annual Estimated Gross Solids Loading Rate

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A002035

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Periodic inspections required to ensure that the device is functional. Routine maintenance may include sediment/debris removal.
- *Nuisance Control:* Design should eliminate standing water that may provide breeding habitat for vectors.
- *Traffic Control*: Traffic control may be required during maintenance.
- *Staffing/Equipment:* Routine maintenance requires staff and equipment to clear the screen module if it becomes clogged and remove accumulated sediment.

***Project Development:***

- *Right-of-Way Requirements*: Requires access for maintenance.
- *Siting Constraints*: Must provide sufficient area to accommodate the length of LR GSRD required.
- *Design Complexity*: LR GSRDs should be sized to hold gross solids to be deposited during a 1-year period and pass the design flow (e.g., 25-year flow).
- *Retrofit Potential*: Can be installed in existing right-of-way, but access is required.
- *Construction:* Traffic control may be required for retrofits due to close proximity to roadway.

***Advantages:***

- The LR GSRDs are a "small footprint device" that can be installed in existing right of way.
- Based on pilot studies, the devices remove nearly all the gross solids from storm water runoff with minimal maintenance requirements.

***Constraints:***

- Surface area requirement.

***Sources:***

- Roscoe Moss Company
- http://www.roscoemoss.com/gsrd.html
- email info@roscoemoss.com
- California Department of Transportation

***Literature Sources of Performance Demonstrations:***

- California Department of Transportation, Phase I Gross Solids Removal Devices Pilot Study: 2000-2002, Final Report.

**Description:**

Standard Caltrans inlet and grate is replaced with a curb inlet and flap gate.

**Constituent Removal:**

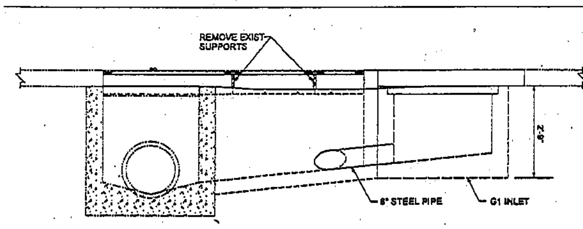
| Constituent Group | Removal Efficiency | Level-of-Confidence |
|---|---|---|
| Total Suspended Solids | ○ | ○ |
| Nutrients | ○ | ○ |
| Pesticides | ○ | ○ |
| Total Metals | ○ | ○ |
| Dissolved Metals | ○ | ○ |
| Microbiological | ○ | ○ |
| Litter | ◒ | ◒ |
| BOD | ○ | ○ |
| TDS | ○ | ○ |

Notes:

- No performance data encountered in literature
- Field evaluation of prototype is currently being conducted on Highway 60 in the Los Angeles area.

**Caltrans SWMP Category:**

Category III




**Key Design Parameters:**

Curbed roadway is required.

**Equivalent Uniform Annual Costs:**

| | Cost Effectiveness | Level-of-Confidence |
|---|---|---|
| EUAC | ▖ | ◒ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

Rating Key for Constituent Removal and Level-of-Confidence

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

Rating Key for Cost Effectiveness



A002037

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Flab gate requires periodic clean-out.
- Nuisance Control: None identified.
- *Traffic Safety*: None identified.
- *Staffing/Equipment:* Staff and equipment required to maintain flap gate and clean-out system.

***Project Development:***

- Right-of-Way Requirements: Small-footprint.
- *Siting Constraints*: Curbed roadway is required.
- *Retrofit Potential*: May be implemented on curbed roadways.
- *Construction:* None identified.

***Advantages:***

- Keeps dry-weather deposition out of storm water conveyance system and allows most gross pollutants to be collected by the street sweeper. Most effective in arid or semi-arid climates.

***Constraints:***

- Larger items can enter the LID than the standard inlet grate during storms.
- Flap gate may require maintenance and system clean out.

***Sources:***

- URS, 1615 Murray Canyon Road, Suite 1000, San Diego, CA 92108 619•294•9400
  - David Marx (davis_marx@urscorp.com)
  - Kim Walter (kim_walter@urscorp.com)

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

The V-Screens (VS) Gross Solids Removal Devices (GSRDs) are non-proprietary devices whose primary function is to remove gross solids (litter and vegetative material) from storm water runoff. Currently, there are two configurations of VS GSRDs:

*Configuration #1*. This VS GSRD utilizes a forward sloping V-shaped 5 mm wedge-wire screen. The screen is sloped forward so that the top of the screen is downstream from the bottom of the screen. Configuration #1 is not pictured.

*Configuration #2*. This VS GSRD utilizes a reverse sloping V-shaped 5 mm wedge-wire screen. The screen is sloped backward (or reverse) so that the bottom of the screen is downstream from the top of the screen. See picture to the right.

***Constituent Removal:***

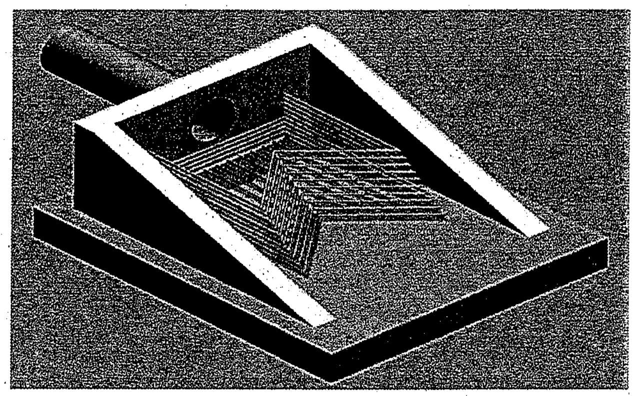
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | | |
| *Nutrients* | | |
| *Pesticides* | | |
| *Total Metals* | | |
| *Dissolved Metals* | | |
| *Microbiological* | | |
| *Litter* | ● | ● |
| *BOD* | | |
| *TDS* | | |

Notes:

- Litter and vegetative material are the target constituents for the device.
- No long-term water quality monitoring studies have been conducted to evaluate treatment effectiveness of the VS GSRDs on other water quality constituents.

***Caltrans SWMP Category:***

Category III



***Key Design Parameters:***

1. Hydraulic Head
2. Annual Estimated Gross Solids Loading Rate

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ○ |

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Periodic inspections required to ensure that the device is functional. Routine maintenance may include sediment/debris removal.
- *Nuisance Control:* Design should eliminate standing water that may provide breeding habitat for vectors.
- *Traffic Control*: Traffic control may be required during maintenance.
- *Staffing/Equipment:* Routine maintenance requires staff and equipment to clear the screen module if it becomes clogged and remove accumulated sediment.

***Project Development:***

- *Right-of-Way Requirements*: Requires access for maintenance.
- *Siting Constraints*: Must provide sufficient hydraulic head to operate by gravity.
- *Design Complexity*: VS GSRDs should be sized to hold gross solids to be deposited during a 1-year period and pass the design flow (e.g., 25-year flow).
- *Retrofit Potential*: Can be installed in existing right-of-way, but access is required.
- *Construction:* Traffic control may be required for retrofits due to close proximity to roadway.

***Advantages:***

- The IS GSRDs are a "small footprint device" that can be installed in existing right of way.
- Based on pilot studies, the devices remove nearly all the gross solids from storm water runoff with minimal maintenance requirements.

***Constraints:***

- Hydraulic head requirement.

***Sources:***

- California Department of Transportation

***Literature Sources of Performance Demonstrations:***

- California Department of Transportation, Phase III Gross Solids Removal Devices Pilot Study: 2002-2003, Interim Report.

***Description:***

An infiltration trench is typically a long and narrow excavation that is lined with filter fabric and backfilled with stone aggregate or gravel to form an underground basin. Runoff is diverted to the trench and infiltrates into the soil. Pollutants are filtered out of the runoff as it infiltrates the surrounding soils. Infiltration trenches are best sited in areas where soils meet the minimum infiltration rate. Regulators may caution against installation in highly industrial areas or areas where highly soluble constituents may be discharged to the trench.

***Constituent Removal:***

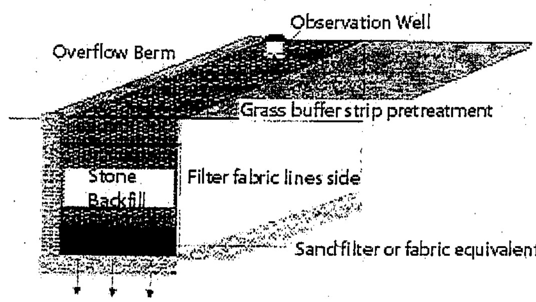
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ● |
| *Nutrients* | ● | ● |
| *Pesticides* | ● | ● |
| *Total Metals* | ● | ● |
| *Dissolved Metals* | ● | ● |
| *Microbiological* | ● | ● |
| *Litter* | ● | ● |
| *BOD* | ● | ● |
| *TDS* | ● | ● |

*Notes:*

- Constituent removal is considered 100% for the design water quality volume since the entire water quality volume is infiltrated and no water is discharged to surface waters. However, groundwater contamination can occur from soluble constituents that may not be retained in the soil matrix.
- Two infiltration trenches were sited, constructed, and monitored as part of the Caltrans BMP retrofit pilot program.

***Caltrans SWMP Category:***

Category III




***Key Design Parameters:***
An infiltration rate of at least 14 mm/hr is desired. This infiltration rate would be found in soils with low silt and clay content. The groundwater separation should be a minimum of 3.0 m. Trenches should be designed to drain within 72 hours to prevent potential vector problems. A large bottom surface area is desired because it allows an increased infiltration rate and reduces the amount of clogging. Use of a biofiltration strip as pretreatment to remove floatables and sediment from runoff before entering the infiltration trench is recommended. The trench volume should be determined by assuming the Water Quality Volume (WQV) will fill the void space based on the computed porosity of the rock matrix. Backfill material for the trench should be 1-in to 3-in rock or equivalent locally available material.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ● |

Costs include the construction of a pretreatment biofiltration strip. Cost information is from Caltrans Cost Summary report CTSW-RT-01-003. An average of 13 field hours were spent operating and maintaining each infiltration trench in the 1999/2000 season.

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A002041

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Maintenance requirements include regular inspections to confirm trench is draining within 72 hours. Trash and debris should be removed from the site on a regular basis. Sediment accumulation should be inspected and, if visible on top of the trench, the top layer of trench, silt, filter fabric, and stone should be removed. The stone should be washed and fabric and stone reinstalled in trench.
- *Nuisance Control*: Inspect for standing water at the end of the wet season. No additional nuisance control necessary if drained properly.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high for infiltration trenches.
- *Siting Constraints*: Infiltration trenches should not be sited within 30 meters of building or bridge foundations. Infiltration trenches sited within 30 meters would require detailed site structural and geotechnical investigation. Infiltration trenches are suitable for drainage areas up to 4 hectares. Trenches work best at sites with a upgradient drainage area slope of less then 5%. Trenches should be sited where infiltration rates are at least 14mm/hr and there is at least 3.0 meters separation between trench invert and the groundwater. Trenches are not recommended in industrial land use areas or in locations were soluble constituents may impact ground water quality.
- *Retrofit Potential*: Where space and sufficient water table depth permits.
- *Construction:* During excavation for trench construction, light equipment should be used to avoid compaction of the soil. Field conditions, such as structurally unsuitable soils, and existing utilities lines may be encountered, and detailed geotechnical investigation prior to construction is recommended. Retrofit of infiltration trenches at maintenance stations impacts the operation of the facility during construction. A geotechnical engineer must be present during the excavation to ensure that there are no anomalies encountered in the soil lithology that would inhibit infiltration. During design, sufficient borings are required to determine the presence of unsuitable materials. Stabilize the entire area draining to the facility before construction begins. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction. Stabilize the entire contributing drainage area before allowing any runoff to enter once construction is complete.

***Advantages:***

- Due to the infiltration of the entire water quality volume, the constituent removal is considered 100%. Infiltration trenches take up little land area and are not highly visible.

***Constraints:***

- Infiltration trenches must have soils with a high enough permeability rate and suitable groundwater separation.
- If not properly maintained they will prematurely clog.
- Pretreatment is required to reduce the amount of influent sediment.
- Major maintenance (removal and replacement of the rock matrix) is relatively costly.

***Sources:***

- http://www.epa.gov/owm/mtb/infltrenc.pdf
- http://h2osparc.wq.ncsu.edu/river/industrial/industri.html#cm
- http://www.stormwater-resources.com/Library/116BBMP%20Guide.PDF

***Literature Sources of Performance Demonstrations:***

- Schueler, T.R., 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs, Department of Environmental Programs, Metropolitan Washington Council of Governments, Washington, DC.
- Young, G.K., et al. 1996, Evaluation and Management of Highway Runoff Water Quality, Publication No. FHWA-PD-96-032, U.S. Department of Transportation, Federal Highway Administration, Office of Environment and Planning.

***Description:***

Multi-Chambered Treatment Trains (MCTTs) use three treatment mechanisms. The first chamber is a catch basin used to remove large, grit-sized material. The second chamber is a settling chamber that removes settleable solids with plate separators and oil and grease with sorbent pads. The third chamber is a sand/peat filter. These devices were originally designed to reduce toxicity in the runoff from critical storm water source areas and can be implemented where toxicity in runoff is an identified problem.

***Constituent Removal:***

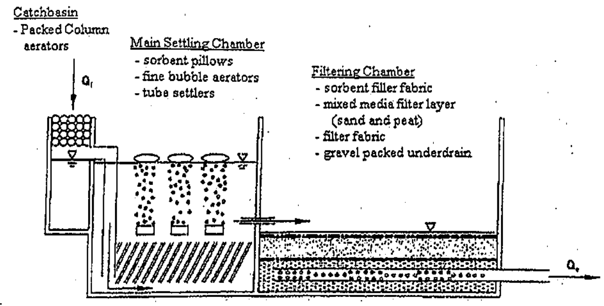
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ● |
| *Nutrients* | ○ | ● |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ● |
| *Dissolved Metals* | ○ | ● |
| *Microbiological* | ● | ● |
| *Litter* | ● | ● |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- Nitrate concentrations increase by 62%.
- High dissolved Zn removal.
- Two MCTTs were sited, constructed, and monitored as part of the Caltrans' BMP retrofit pilot program. An analysis of the influent and effluent water quality data for the filters indicated that there was no significant difference among the sites for the constituents monitored; therefore, the data for all sites were treated as if they came from a single site.

***Caltrans SWMP Category:***

Category III




***Key Design Parameters:***

MCTTs are designed as 3-stage devices. The first stage consists of a catch basin with a sump and packed column aerators. The volume of the catch basin is determined based on the desired maintenance frequency of the sump with the variables of discharge and influent TSS.

The second stage is the main settling chamber. The design volume is highly dependent on local rainfall characteristics. A computer model is used to analyze rainfall data from a given area with the chamber design variables of settling depth and detention time (typically 72 hrs). Gravity draining or pumps can be used to transfer runoff from the main settling chamber to the filtration chamber.

The filtration chamber consists of 450-mm filter media layer consisting of a 50/50 mixture of sand and peat moss. The layer is separated from a gravel-packed underdrain by a layer of filter fabric. The filter area is determined from the recommended solids loading rate of the peat/sand mixture of 5000 g TSS/m2/year. Gravity draining or pumps can be used to return the filtered runoff to the drainage system.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ● |

Information obtained from Caltrans Cost Summary report CTSW-RT-01-003 An average of 120 field hours per year were spent on operation and maintenance of each MCTT during the Caltrans BMP retrofit pilot program.

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



A002043

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: MCTTs requiring the use of pumps require additional maintenance for the pumps and associated electrical circuits. Minor structural repairs of cracks that form in the structure may be required. Major maintenance activities are hampered by the lack of adequate access to the settling and filter chambers.
- *Nuisance Control:* The MCTTs maintain a permanent pool of water below the tops of the tube settlers; this pool of water provides a breeding site for mosquitoes.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are relatively high for MCTTs.
- *Siting Constraints*: MCTTs should be sited where there is a small, impervious contributing watershed. They should not be sited where runoff from bare soil or construction activities will be allowed to enter the filter. MCTTs should be sited where enough vertical clearance (head) is provided, about 2 meters.
- *Design Complexity*: The sand is a special gradation requiring additional time and expense.
- *Retrofit Potential*: The hydraulic head requirement reduces the potential number of sites that could be retrofitted without the use of pumps.
- *Construction:* Material availability for the filter, excavation for the device/unknown field conditions, and interface with existing activities at the site are the primary issues to be addressed in the construction of MCTTs. The tube settler system is a special-order item with a significant lead-time. Unsuitable soil and unmapped utilities may be encountered since significant excavation is required. Construction within park-and-ride facilities have limited work area, and coordination with normal facility operations is required.

***Advantages:***

- The MCTTs have constituent removal for suspended solids, metals, and bacteria similar to that for an Austin Sand Filter. They can provide consistent pollutant removal when properly maintained. The target area for use of MCTTs are vehicle service facilities, parking areas, paved storage areas, and fueling stations with drainage areas up to 1 hectare.

***Constraints:***

- MCTTs are significantly more expensive to construct than gravity-drained Austin Sand Filters, which provide comparable performance.
- A permanent pool of water is maintained in the MCTT, which increases vector concerns.
- The presence of tube settlers in the sedimentation basin impedes maintenance activities.

***Sources:***

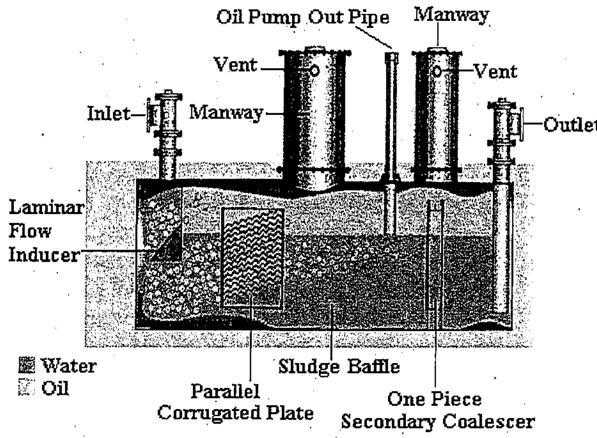
- Design guidelines for MCTTs and performance evaluation are presented in the report entitled, Stormwater Treatment at Critical Areas, Volume 1: The Multi-Chambered Treatment Train (MCTT), by Robert Pitt, et. al., dated October 1997, EPA/600/X-97/XXX.

***Literature Sources of Performance Demonstrations:***

- Design guidelines for MCTTs and performance evaluation are presented in the report entitled, Stormwater Treatment at Critical Areas, Volume 1: The Multi-Chambered Treatment Train (MCTT), by Robert Pitt, et. al., dated October 1997, EPA/600/X-97/XXX.

***Description:***

Oil/Water Separators are designed to remove free oil and grease from storm water runoff. Oil droplets collide and coalesce to become larger globules that are captured in the separator. Oil/Water separators are typically manufactured units. They consist of a baffled vault containing several inclined corrugated plates stacked and bundled together. The plates are equally spaced and reduce the vertical distance oil droplet must rise to separate from the storm water. With current technology and design, coalescing plate separator type oil/water separators are capable of reducing effluent concentrations of free oil and grease to 10 - 15 mg/L, and should be used where concentrations of oil and grease are high.




***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ○ | ● |
| *Nutrients* | ○ | ○ |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ○ | ○ |
| *Dissolved Metals* | ○ | ○ |
| *Microbiological* | ○ | ○ |
| *Litter* | ○ | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ○ | ○ |

*Notes:*

- One oil/water separator was sited as part of the Caltrans BMP Retrofit Pilot Program. Concentration reductions presented are those found in the study.

***Key Design Parameters:***

To design the coalescing plate separator the "effective separation area" required for the plate media needs to be determined given a design flow. The specific vault sizing will then depend on the manufacturer's plate media design. The specific design, analysis, configuration, and specifications for coalescing plates are empirically based and variable. Refer to manufacturer recommendations. An oil/water separator typically consists of three compartments divided by baffles: a forebay, an oil separation cell, and an afterbay. Sediments are trapped and collected in the forebay. The oil separation cell is used to capture and hold oil. The afterbay allows a relatively oil-free exit cell before the outlet.

***Caltrans SWMP Category:***

Category III

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ● |

Information from Caltrans Cost Summary report CTSW-RT-01-003. Twenty-seven field hours were spent operating and maintaining the oil/water separator in the 1999/2000 season.

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*



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***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Oil/Water separators require regular inspection. The separator plates require cleaning when sufficient oil and grease have accumulated and their effectiveness is reduced. Inspection and cleaning should follow manufacturers recommendations. Accumulated sediment should be removed frequently to prevent resuspension. Sediment removal also removes the oil and grease since these pollutants bind to the sediment.
- *Nuisance Control*: None
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* For routine maintenance, requires staff and equipment to remove sediment and debris.

***Project Development:***

- *Right-of-Way Requirements*: Must have room for excavation equipment to operate.
- *Siting Constraints*: Oil/water separators should be sited where higher concentrations of free oil and grease are found in the storm water.
- *Design Complexity*: Separators should precede all other stormwater treatment. Appropriate removal covers must be provided that allows access for observation and maintenance. Any pump mechanism should be installed downstream of the separator to prevent oil emulsification.
- *Retrofit Potential*: Most sites investigated as part of the Caltrans BMP retrofit pilot program had initial concentrations of oil lower than those that could be treated by an oil/water separator device.
- *Construction:* Oil/water separators constructed at maintenance stations impact the stations during construction. The facilities will lose some space and coordination with maintenance station supervisor is required. Underground utilities may also be present.

***Advantages:***

- Oil/water separators are installed underground so they are not an aesthetic problem. Where high concentrations of free oil are present they can provide significant reduction.

***Constraints:***

- Accumulated sediment must be removed or cleaned out frequently to prevent resuspension.
- The concentrations of free oil and grease typically found in storm water runoff are generally too low to benefit from treatment by this device.
- Significant excavation is required for construction.

***Sources:***

- Highland Tank
  One Highland Road
  Stoystown, PA 15563
  814-893-5701
  FAX 814-893-6126

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

StormFilter™ is a flow-through system consisting of a vault with canisters filled with filter media. The media traps particulate and adsorbs pollutants such as suspended solids, oil and grease, some metals, nutrients and organics. Various media can be specified (depending on the constituent of concern) including perlite, composted leaf media, zeolite, fabric inserts, GAC, and iron-infused media.

***Constituent Removal:***

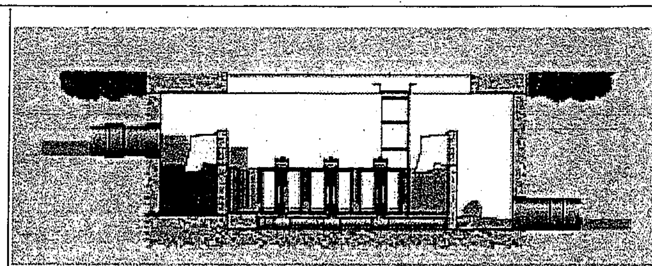
| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ◒ | ● |
| *Nutrients* | ○ | ● |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ◒ | ● |
| *Dissolved Metals* | ◒ | ● |
| *Microbiological* | ○ | ● |
| *Litter* | ● | ○ |
| *BOD* | ○ | ○ |
| *TDS* | ◒ | ○ |

*Notes:*

- A StormFilter™ was sited as part of the Caltrans BMP retrofit pilot program. The canisters contained a mixture of perlite and zeolite.

***Caltrans SWMP Category:***

Category III



***Key Design Parameters:***

StormFilter™ is sized to treat the peak flow from the design storm. The peak flow is determined based on the watershed area and design storm magnitude. StormFilter™ canisters are designed to treat 0.033 cfs each or 30 media canisters per c.f.s. of storm water runoff.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | | ● |

Cost information obtained from Caltrans Cost Summary report CTSW-RT-01-003. An average of 30 field hours per year was spent on operation and maintenance of the StormFilter™ during the Caltrans BMP retrofit pilot program.

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Vaults should be free of trash and debris. Periodic maintenance is required to remove sediment that accumulates in the vaults.
- *Nuisance Control:* A permanent pool of water is held in the pretreatment vault that provides breeding habitat for mosquitoes.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* The use of heavy equipment is needed to remove media canisters and to clean out pretreatment vault.

***Project Development:***

- *Right of Way Requirements*: The StormFilter™ requires access adjacent to the sediment and media vault.
- *Siting Constraints*: Runoff from bare soil or construction activities should not be allowed to enter the filter.
- *Design Complexity*: Sufficient hydraulic head is needed to operate the filter, about 0.7-m. StormFilter is a proprietary system.
- *Retrofit Potential*: It can be applied in confined urban areas and areas with limited space since it is an underground vault.
- *Construction:* Stormwater Management, Inc. (SMI) provides media cartridge filters in pre-cast vaults as a package system. During the design and construction phase, it may be difficult to obtain the specific design details on the vaults and appurtenances required to prepare the construction drawings and specifications.
- Detailed geotechnical investigation is recommended for all sites.
- There are often easements to utility service providers, coordination with utility service providers is required due to excavation for vaults.
- The BMPs are designed to be part of the existing or new drainage system.

***Advantages:***

- StormFilter™ has moderate constituent removal for suspended solids, nutrients, and metals. It can be applied in confined urban areas and areas with limited space since it is an underground vault.

***Constraints:***

- StormFilter™ can be expensive to construct.
- A permanent pool of water is held in the pretreatment vault that provides breeding opportunities for mosquitoes.
- Major maintenance may be costly due to the large number of filter canisters required (72 canisters for a 1.5 acre drainage area).

***Sources:***

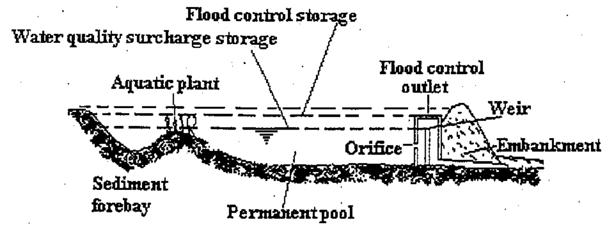
- Stormwater Management Inc.
  2035 NE Columbia Blvd.
  Portland, OR 97211
  800-548-4667
- EPA website includes information on design and performance of StormFilter™
  http://www.epa.gov/region01/steward/ceit/tech_cos/sto.html
- StormFilter™ is a proprietary system, check the manufacturers website for information on the product. www.stormwatermgt.com.

***Literature Sources of Performance Demonstrations:***

- None identified.

***Description:***

A wet basin holds a permanent pool of water designed to detain and treat a runoff water quality volume. The basins support plant species, which may provide constituent removal by biological processes. In addition, the vegetation may help reduce erosion of the sides slopes and help trap sediments. Sedimentation processes also occur in the basin. The basins are usually deep enough to prevent resuspension of particles. Wet basins should be sited where a permanent pool of water can be maintained from a dry weather flow source.




(modified from Urbonas And STAHRE, 1993)

***Constituent Removal:***

| *Constituent Group* | *Removal Efficiency* | *Level-of-Confidence* |
|---|---|---|
| *Total Suspended Solids* | ● | ● |
| *Nutrients* | ◒ | ● |
| *Pesticides* | ○ | ○ |
| *Total Metals* | ● | ● |
| *Dissolved Metals* | ◒ | ● |
| *Microbiological* | ● | ● |
| *Litter* | ● | ○ |
| *BOD* | ◒ | ○ |
| *TDS* | ● | ○ |

*Notes:*

- Nitrate storm water concentrations increase by 132%, however dry weather flow reductions caused a net annual removal of total nitrogen.
- 94% removal efficiency for dissolved Pb.
- A wet basin was sited as part of the Caltrans BMP Retrofit Pilot Program. Constituent reduction found during this study is comparable to those reductions found in other studies.

***Caltrans SWMP Category:***

Category III

***Key Design Parameters:***

Wet basins should be sized to hold the permanent pool and the water quality volume required. In addition, a 10% increase should be provided for solid deposition storage. The water quality volume above the permanent pool should drain within 24-48 hours. The basin should have a minimum length to width ratio of 1:1 and a preferred ratio of 3:1. The maximum depth of 2.4 meters and average depth of 1-2 meters. The volume of the permanent pool should be one to three times the water quality volume. Basin side slopes should be 3:1 or flatter.

Wet basin should include a sediment forebay and a main pool. The sediment forebay should be sized to be 15-25% of the permanent pool volume and at least 1 meter deep, separated from the main pool by a earthen berm, gabion, or loose riprap wall. The berm should have a 1.5-meter top width and an elevation 1-foot lower than the design water surface. Vegetation should be planted around the perimeter of the basin. For ponds designed as offline facilities, a splitter structure should be used.

***Equivalent Uniform Annual Costs:***

| | *Cost Effectiveness* | *Level-of-Confidence* |
|---|---|---|
| *EUAC* | ▝ | ● |

Cost information obtained from Caltrans Cost Summary report CTSW-RT-01-003. An average of 500 field hours per year was spent on operation and maintenance of the La Costa wet basin during the Caltrans BMP retrofit pilot program. This included 440 hours spent on harvesting of the vegetation and other vegetation management.

| ● | ◒ | ○ |
|---|---|---|
| High | Medium | Low |

*Rating Key for Constituent Removal and Level-of-Confidence*

| | |
|---|---|
| Benefit ↑ Cost ↓ | Benefit ↑ Cost ↑ |
| Benefit ↓ Cost ↓ | Benefit ↓ Cost ↑ |

*Rating Key for Cost Effectiveness*

***Issues and Concerns:***

***Maintenance:***

- *Requirements*: Inspections should be conducted to ensure that the structure operates as intended. The embankment should be checked for subsidence, erosion, leakage, cracking, and tree growth. Debris and litter should be removed from the basin to prevent clogging of the outlet. Sediment accumulation in the basin will reduce the storage capacity and removal performance of the basin. Sediment should be removed when it accumulates to 10% of the basin volume. Wet basin plant material should be harvested on an annual basis.
- *Nuisance Control:* Wet basins provide a pool of water and dense vegetation that is ideal for mosquito breeding. The basins should be stocked with mosquito fish to control the population.
- *Traffic Control*: If located along a shoulder or median, maintenance activities will require traffic control.
- *Staffing/Equipment:* Requires staff and equipment for routine maintenance.

***Project Development:***

- *Right-of-Way Requirements*: Space requirements are high for wet basins.
- *Siting Constraints*: Wet basins are best sited for highways in residential or commercial areas with a combined drainage area greater than 8 ha. Significant off-site drainage with year round base flow is needed. A wet basin usually has an area of 1 to 3 percent of the contributing drainage area. Since the basin required a permanent pool of water, the soil should have a low infiltration rate or be lined with a clay of geotextile liner.
- *Design Complexity*: Wet basins should be sited where a permanent pool of water can be maintained from a dry weather flow source.
- *Retrofit Potential*: Best for highways in residential or commercial areas to accommodate space requirements.
- *Construction:* Excavated soil surface should be suitable to support plant life. If a pond liner is used, it must be carefully constructed to avoid punctures.

***Advantages:***

- Wet basins have good removal efficiencies providing storm water quality benefits.
- They can also have recreational and aesthetic benefits.

***Constraints:***

- Wet basins must be properly maintained to prevent stratification and anoxic conditions, which would allow resuspension of solids and release of nutrients and metals.
- A permanent pool of water must be maintained and therefore may have limitations on siting.
- There are potential problems associated with mosquitoes and the device may become a regulated wetland if not consistently maintained per an established schedule.
- They require more area than an extended detention basin.

***Sources:***

- http://www.epa.gov/owm/mtb/wetdtnpn.pdf
- http://h2osparc.wq.ncsu.edu/wetland/aqlife/urbstorm.html#cm

***Literature Sources of Performance Demonstrations:***

- Information on design and performance of wet basins can be found in the following references:


- King County, 1996, Surface Water Design Manual (Draft), King County Surface Water Management Division, Washington.
- Schueler, T.R., 1987, Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs, Department of Environmental Programs, Metropolitan Washington Council of Governments, Washington, DC.
- Urbonas, B.R., et al., 1992, Urban Storm Drainage Criteria Manual, Volume 3 – Best Management Practices, Stormwater Quality, Urban Drainage and Flood Control District, Denver, CO.

CALIFORNIA STORMWATER QUALITY ASSOCIATION

# Industrial and Commercial Handbook

The Industrial and Commercial Handbook provides general guidance for selecting and implementing Best Management Practices (BMPs) to reduce the discharge of pollutants in runoff from industrial facilities and selected commercial businesses to waters of the state.

Click here to view the 2004 Errata Pages.

Get Acrobat Reader You will need *Acrobat Reader* to view and print these files.

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Click on the links below to view the individual handbook sections or click here to **view the entire Handbook. Size: 4,674 KB**.
**Due to large document size, expect lengthy download time.**
Note: The handbooks are formated to print double-sided.

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TABLE OF CONTENTS

*California Stormwater Quality Association*
*PO Box 2105*
*Menlo Park, CA 94026*

# Section 1
# Introduction

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

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

## 1.1 Handbook Purpose and Scope

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

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

### 1.1.1 Users of the Handbook

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

## 1.1.2 Organization of the Handbook

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

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

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

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

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

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

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

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

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

**Appendix C**
**Sample SWPPP**
*This appendix contains a sample SWPPP.*

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



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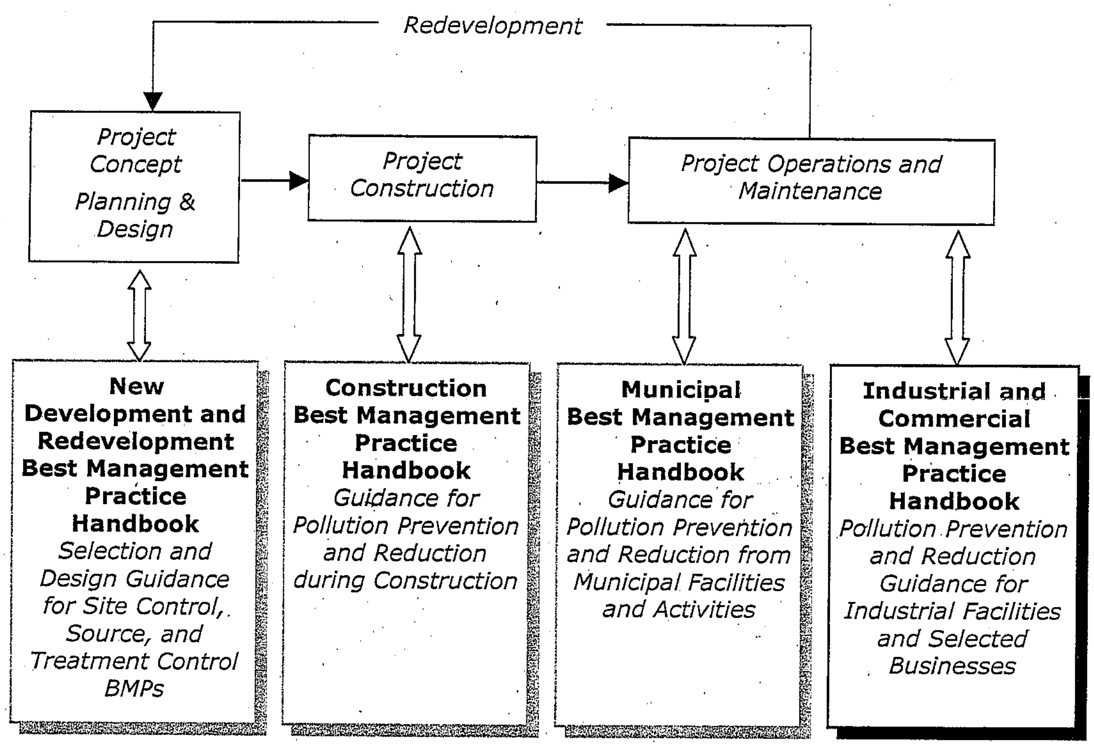
### 1.1.3 Relationship to other Handbooks

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

***Project Lifecycle***




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

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

## 1.2 Stormwater Pollutants and Impacts on Water Quality

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

## 1.3 Regulatory Requirements

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

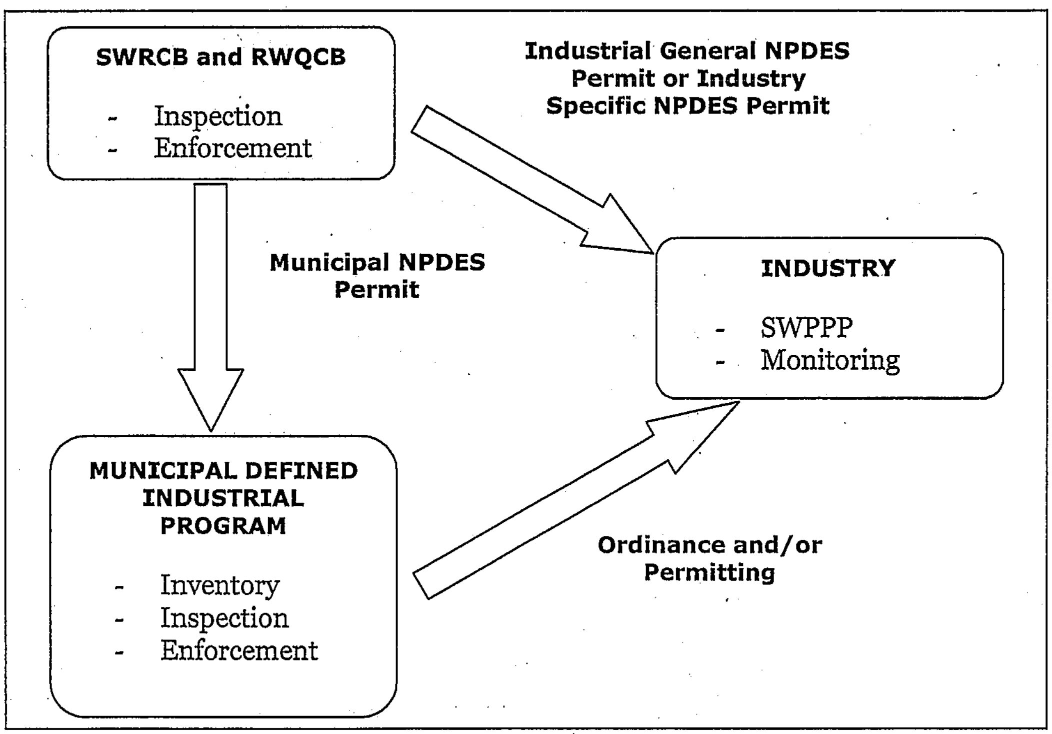



**Figure 1-1**
**California Regulatory Framework Associated with Industrial Stormwater**



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**Table 1-1 Pollutant Impacts on Water Quality**

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

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

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

### 1.3.1 Federal NPDES Program

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

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

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

### 1.3.2 State NPDES Program

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

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

The General Permit generally requires facility operators to:

1. Eliminate unauthorized non-stormwater discharges.

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

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

### 1.3.3 Municipal NPDES Program

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

## 1.4 Definitions

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

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

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

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

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

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

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

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

## 1.5 References and Resources

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF). 1999. Standard Methods for the Examination of Water and Wastewater 20th Edition.

General Industrial Storm Water Permit, State Water Resources Control Board (SWRCB), 1997.

Guidance Manual for Developing a Storm Water Pollution Plan for Industrial Facilities. Washington State Department of Ecology. Revised April, 1998, Publication No. WQ-R-93-015. On-line: http://www.ecy.wa.gov/pubs/93015.pdf

Metzger, M.E., D.F. Messer, C.L. Beitia, C.M. Myers, and V.L. Kramer. 2002. The dark side of storm Water runoff management: disease vectors associated with structural BMPs. Storm Water 3(2): 24-39.

Storm Water Management for Industrial Activities, Developing Pollution Prevention Plans and Best Management Practices. United States Environmental Protection Agency. 1992. On-line: http://www.ntis.gov

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

# Section 2
# Stormwater Pollution Prevention Planning for Industrial and Commercial Facilities

## 2.1 Introduction

The development of a stormwater pollution prevention plan is critical in a business' efforts to reduce pollutants in its stormwater discharges. Information is presented in this section to assist industrial owners and operators in developing a Stormwater Pollution Prevention Plan (SWPPP). The information provided is consistent with the State Industrial General Permit (General Permit) Board Order 97-03-DWQ. While the primary focus of this handbook is on industries covered by the General Permit, there are numerous commercial businesses that impact stormwater quality. Guidance is provided in Section 2.4 to assist selected commercial businesses in their efforts to reduce pollutants in stormwater discharges.

All facility operators subject to the General Permit must prepare, retain on site, and implement a SWPPP. The SWPPP has two major objectives:

1. To help identify the sources of pollution that affect the quality of industrial stormwater discharges and authorized non-stormwater discharges

2. To describe and ensure the implementation of BMPs to reduce or prevent pollutants in industrial stormwater discharges and authorized non-stormwater discharges

The process to develop and implement a Stormwater Pollution Prevention Plan is provided in this section.

### 2.1.1 Who Must Prepare a SWPPP?

The facilities covered by the General Permit and therefore required to prepare a SWPPP include the following:

- Facilities subject to stormwater effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards
- Manufacturing facilities
- Oil and gas/mining facilities
- Hazardous waste treatment, storage, or disposal facilities
- Landfills, land application sites, and open dumps
- Recycling facilities
- Steam electric power generating facilities



A002061

- Transportation facilities
- Sewage or wastewater treatment works
- Manufacturing facilities where industrial materials, equipment, or activities are exposed to stormwater

The specific facilities included in each of the above categories are provided in Appendix B.

In California, the decision whether a facility is required to obtain coverage under the General Permit is determined by what activity takes place on the site. It is the industrial activities at the facility site (and subsequent SIC code classification) that determine whether coverage under the General Permit is required, not the primary business of the facility owner. For example, a school district must obtain coverage under the General Permit for its bus maintenance facility, even though the primary business of the district is education.

Many businesses in California that are not included in Appendix B currently have or may be required to have an NPDES permit for stormwater. These permits are issued because the businesses either belonged to a category for which federal regulations were previously established, or because the respective Regional Water Quality Control Board (RWQCB) identified a problem. RWQCBs have the authority to require an NPDES permit of any facility that is discharging stormwater, not just those identified in Appendix B.

To assist the business owners and operators in deciding whether their facilities are subjected to the General Permit, refer to Figure 2-1.

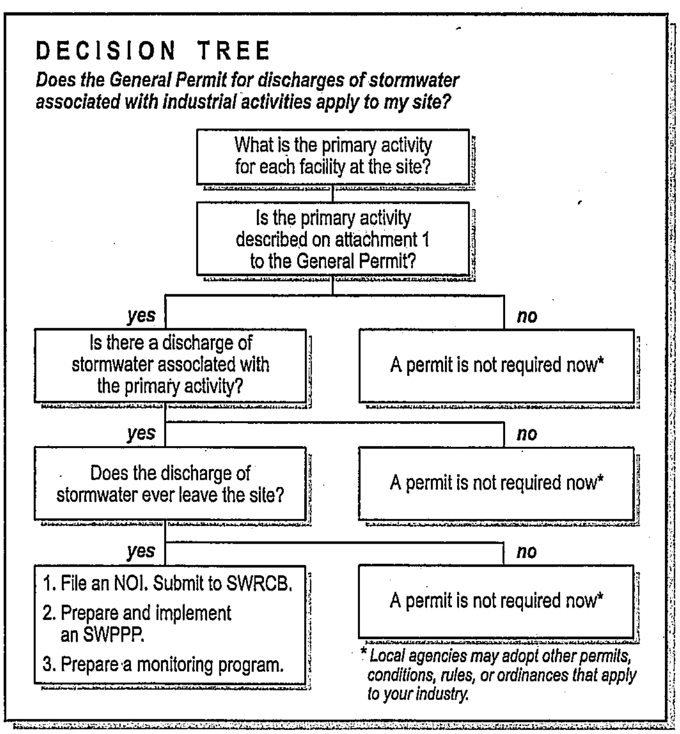


**Figure 2-1**
**Decision Tree**

### 2.1.2 Who Is Not Required to Prepare a SWPPP?

There are several categories of businesses and activities that are explicitly excluded from the requirement to develop a SWPPP under the commercial and industrial category, as these businesses are not required to obtain coverage under the General Permit. These are:

- Facilities which have other NPDES permits containing stormwater provisions
- Facilities determined ineligible by Regional Water Quality Control Boards
- Facilities which do not discharge stormwater to waters of the United States (including facilities that discharge stormwater to municipal sanitary sewers and facilities that do not discharge stormwater to surface waters or separate storm sewers
- Most silvicultural activities
- Mining and oil and gas facilities that have not released stormwater resulting in a discharge of a reportable quantity (RQ).
- Facilities on Indian lands

The RWQCB may require particular facilities to obtain an individual NPDES stormwater permit in which case it is likely that the permit will specify the preparation of a formal SWPPP. Local jurisdictions may also require that a business that falls outside the SIC list in Appendix B prepare a stormwater pollution control plan (SWPCP) following the process presented in this Section. Additional information on a SWPCP is presented in Section 2.4.

## 2.2 SWPPP Overview

An overview of the process to develop a SWPPP consists of six phases, as shown in Table 2-1. Each phase is briefly described in Table 2-1, and presented in detail in the following section. Those elements in Table 2-1 that are italicized are required elements of a SWPPP. Those not italicized are recommended SWPPP elements. An example SWPPP is provided in Appendix C.

## 2.3 Preparation of the SWPPP

Each of the elements corresponding to the first five phases of the SWPPP development and implementation process outlined above is described in detail in this section. Phase six is discussed in Section 5.



A002063

**Table 2-1 The Six Phases of SWPPP Development**

| Phase | Descriptions |
|---|---|
| 1. PLANNING AND ORGANIZATION (see Section 2.3.1)<br>*A) Form Pollution Prevention Team*<br>*B) Review other plans*<br>*C) Review other requirements* | The first step involves identifying the SWPPP Leader, forming a Pollution Prevention Team (PPT), and gathering and reviewing other existing documents and regulations. |
| 2. ASSESSMENT PHASE (see Section 2.3.2)<br>*D) Develop a site map*<br>*E) Describe industrial activities*<br>*F) Inventory significant materials and chemicals*<br>*G) List past significant spills and leaks*<br>*H) Identify non-stormwater discharges*<br>*I) Identify existing BMPs*<br>*J) Assess potential pollution sources*<br>*K) Complete an Assessment Summary* | The SWPPP Leader with the assistance of the PPT conducts an assessment of the facility. Worksheets for conducting an assessment are provided at the end of this Section. |
| 3. BEST MANAGEMENT PRACTICES IDENTIFICATION PHASE (see Section 2.3.3 and Sections 3 and 4)<br>*A) Identify erosion and sediment control BMPs*<br>*B) Identify BMPs for non-stormwater discharges*<br>*C) Identify non-structural, source control BMPs*<br>*D) Consider structural, source control BMPs*<br>*E) Consider treatment control BMPs*<br>*F) Prepare BMP list and prioritize*<br>*G) Prepare a Monitoring Plan*<br>*H) Prepare an Implementation Plan* | BMPs are selected to deal with the identified sources of stormwater pollution. Emphasis is placed on source control BMPs with the adoption of treatment control BMPs only if clearly needed. The SWPPP must include BMPs to prevent or reduce contact of stormwater and non-stormwater discharges with pollutants. |
| 4. ASSEMBLY PHASE (see Section 2.3.4)<br>*A) Obtain required signatures*<br>*B) Select plan location*<br>*C) Assemble document* | This phase includes assembly of information obtained in the prior phases (e.g., site map, BMPs, worksheets, etc.). |
| 5. IMPLEMENTATION PHASE<br>*A) Conduct Training*<br>*B) Implement the BMPs*<br>*C) Terminate non-allowable non-storm discharges* | The SWPPP is implemented and its effectiveness evaluated. |
| 6. MONITORING AND REPORTING (see Section 5)<br>*A) Conduct monitoring program*<br>*B) Conduct record keeping and reporting*<br>*C) Conduct annual site evaluation*<br>– *Review monitoring information*<br>– *Evaluate the BMPs*<br>– *Review and revise the SWPPP as necessary* | The required monitoring is conducted. Of particular importance is that adjustments be made in the SWPPP to update information on the nature of the activities at the site (e.g., change in outside manufacturing processes) insofar as they affect stormwater quality, and to redress observed inadequacies of the BMPs. |

## 2.3.1 Phase 1 - Planning and Organization Phase

**PHASE 1 - Planning & Organization:**

- Form Pollution Prevention Team
- Review other plans
- Review other requirements

The development of ȧ SWPPP is not intended to be a complicated and expensive process, and the staff of the company should look to doing as much of the SWPPP as possible. Technical consultants are available and can be a valuable asset. However, facility personnel should first become aware of the permit requirements, demonstrate site awareness as it relates to the SWPPP, and be familiar with the BMPs that will be implemented. By taking this approach, facility personnel will be able to identify specific technical assistance more appropriate for a technical consultant. Regardless, the following elements are completed:

### Form Pollution Prevention Team

The SWPPP must identify a specific individual or individuals within the facility organization as members of the Pollution Prevention Team (PPT). There are numerous ways to organize the PPT but most important is the need to designate a lead person responsible for spearheading the effort. For small facilities, stormwater PPTs may consist of just one individual. The size and composition of the team should be appropriate to the complexity of the facility. The team should consist of representatives from all departments, at all levels, that will have a role in implementing the SWPPP. The role of each member should be specified. The PPT may have personnel that overlap with related pollution control responsibilities such as a spill prevention and response team. The PPT is responsible for:

- Developing the SWPPP
- Assisting the facility manager in SWPPP implementation and revision
- Conducting the monitoring activities

The SWPPP must clearly identify the responsibilities, duties, and activities of each PPT member and should contain a statement of management's policy and responsibilities for implementing the SWPPP, the responsibilities of each division, the members of the PPT, and the lead contact.

### Review Other Plans

Review Appendix A for specifications on the content of the SWPPP. Items of particular significance include:

- Site map(s) and narrative description of the facility relevant to the potential for stormwater pollution
- List of pollutants that may come in contact with stormwater
- Existing sampling data and existing and proposed BMPs



A002065

### Review Other Requirements

This may include gathering background information and identifying related environmental management plans and regulations. The PPT should assemble the information and currently available data to be used in the Assessment Phase. This may include:

- Drawings of the facility's drainage system indicating locations of inlets, pipes, ditches and outlets and the area served by each portion of the system.
- Stormwater quality data previously collected
- Requirements of the RWQCB regarding the surface water body into which the facility discharges

It would be prudent for the PPT to identify at this time other local, state, and federal requirements that impact, complement, or are inconsistent with the requirements of the SWPPP. The PPT should consider in the Assessment Phase how these various plans affect, integrate with, or conflict with the SWPPP.

## 2.3.2 Phase 2 - Assessment Phase

The PPT leader should use the PPT to assess the facility. Including the team throughout the development of the SWPPP makes it more likely that they will understand, support, and therefore implement the SWPPP.

The recommended approach is to identify key activities or activity areas that are likely sources of pollutants. A series of worksheets have been developed to assist with completion of this phase. Worksheets 1-8 are provided in Section 2.5 at the end of this section. Examples of completed worksheets are included at the end of Appendix C.

**PHASE 2 - Assessment:**

- Develop a site map
- Describe industrial activities (use Worksheet 1)
- Inventory significant materials and chemicals (use Worksheets 2 & 3)
- List past significant spills and leaks (use Worksheet 4)
- Identify non-stormwater discharges (use Worksheets 5 & 6)
- Identify existing BMPs (use Worksheet 7)
- Assess potential pollution sources (use Worksheet 8)
- Complete an Assessment Summary

### Develop a Site Map

The SWPPP must include a site map, provided on an 8-½ x 11 inch or larger sheet with notes, legends, and other data as appropriate to ensure that the site map is clear and understandable. If necessary, multiple site maps may be used. The map is to include the following information:

- The facility boundaries
- The outline of all stormwater drainage areas
- Portions of the drainage area impacted by run-on from surrounding areas



A002066

- Direction of flow of each drainage area
- On-site surface water bodies
- Areas of soil erosion
- Nearby water bodies (such as rivers, lakes, ponds)
- Municipal storm drain inlets where the facility's stormwater discharges
- Stormwater collection and conveyance system, associated points of discharge, and the flow direction
- Structural control measures that affect stormwater discharges
- Locations of all catch basins
- Location of authorized non-stormwater discharges to the storm drain
- Outline of all impervious areas of the facility
- Locations where materials are directly exposed to precipitation
- Locations where significant spills or leaks have occurred
- Areas of industrial activities
- Monitoring locations

A base map of the facility identifies the location of buildings and key surface facilities. The stormwater conveyance systems with the location of the discharge outfall(s) and the drainage boundary to each outfall must be shown on the base map. Some fieldwork will likely be necessary to identify these features.

Note buildings and or activities that may be sources of non-stormwater discharges to the stormwater system: process wastewater; non-contact cooling water; wash water; irrigation water; and sanitary wastewater. These possibilities may be inferred from such things as the age of each facility building with older buildings more likely to have inappropriate connections. Remodeling may have resulted in inadvertent connections of non-storm lines to the storm drains.

It is recommended that a Preliminary Site Map be prepared at the outset of the Assessment Phase that describes the general physical layout of the business site (e.g., storm conveyance systems), and all information that is readily available in the minds of the PPT. This Preliminary Site Map is then confirmed and enhanced during the tour of the facility.

## Describe Industrial Activities

The SWPPP must include a narrative description of the facility's industrial activities, associated potential pollutant sources, and potential pollutants that could be discharged in stormwater discharges or authorized non-stormwater discharges. Worksheet 1 provides an activities assessment checklist to aid in identifying industrial activities. Table 2-2 outlines the pollutants potentially associated with common industrial activities.

**Table 2-2 Potential Pollutants from Industrial Activities**

| Activity-or-Facility Type | Potential Pollutants | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sediments | Nutrients | Metals | Organics and Toxicants[1] | Floatable Materials | Oxygen-Demanding Substances | Oil and Grease | Bacteria | Pesticides |
| Vehicle & Equipment Fueling | | | X | X | | | X | | |
| Vehicle & Equipment Washing and Steam Cleaning | X | X | X | X | | X | X | | |
| Vehicle & Equipment Maintenance and Repair | | | X | X | | | X | | |
| Outdoor Loading & Unloading of Materials | X | X | X | X | X | X | X | | |
| Outdoor Container Storage of Liquids | | X | X | X | | X | X | | X |
| Outdoor Process Equipment Operations and Maintenance | X | | X | X | | | X | | |
| Outdoor Storage of Raw Materials, Products, and Byproducts | X | X | X | X | X | X | X | | |
| Waste Handling & Disposal | | | X | X | X | X | X | X | |
| Contaminated or Erodible Surface Areas | X | X | X | X | X | X | X | X | |
| Building and Grounds Maintenance | X | X | X | | X | X | | X | X |
| Building Repair, Remodeling, and Construction | X | | X | | X | X | | | |
| Parking/Storage Area Maintenance | | | X | X | X | | X | | |

1. This includes all toxic pollutants other than pesticides.

## Inventory Significant Materials and Chemicals

How materials are stored and handled bears on the potential for water pollution. Knowledge of the type and location of materials provides insight into the pollutants likely to be present. Completing Worksheets 2 and 3 may be useful in this regard. Worksheet 2 lists all materials whereas Worksheet 3 lists only those significant materials that are regularly exposed to stormwater. "Significant materials" in this instance includes materials that have the potential to be released with stormwater discharges, which includes but is not limited to the following: raw materials; fuels; solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substance designed under Section 101(14) of CERLCA; any chemical the facility is required to report pursuant to Section 313 of Title III or SARA; fertilizers, pesticides, and waste products such as ashes, slag, and sludge.

For each material on the list, describe the following:

- Locations where the material is being stored, received, shipped, and handled
- Receiving and loading procedures
- Spill or leak prevention and response procedures
- Typical quantities and frequency
- Areas protected by containment structures and the corresponding containment capacity must also be described

## List Past Significant Spills and Leaks

The SWPPP must include a history of significant spills since April 17, 1994. Worksheet 4 may be useful for this requirement. The word "significant" in this instance relates to quantity, specifically the volume, concentrations, or mass of a pollutant in stormwater discharge that can cause or threaten to cause pollution, contamination, or nuisance, that adversely impact human health or the environment, and cause or contribute to a violation of any applicable water quality standards for the receiving water. List releases of oil or hazardous substances in excess of reportable quantities and include the following information:

- Type, characteristics, and approximate quantity of the material spilled or leaked
- Cleanup or remedial actions that have occurred or are planned
- Approximate remaining quantity of materials that may be exposed to stormwater or non-stormwater discharges
- Preventative measures taken to ensure spills or leaks do not reoccur
- Superfund Amendments and Reauthorization Act (SARA) Title III, Section 313 facilities must describe releases of "water priority" chemicals to land or water that have occurred during the three years prior to permit issuance

Although only significant spills are required to be included in the SWPPP, identifying areas where smaller spills occur frequently is also useful. Note on the site map the areas where repeated spills have occurred, or where the risk of spill is particularly significant.

## Identify Non-stormwater Discharges

Facility operators must investigate the facility to identify all potential non-stormwater discharges and their sources. As part of this investigation, all drains (inlets and outlets) must be evaluated to identify whether they connect to the storm drain system. All non-stormwater discharges must be described. This must include the source, quantity, frequency, and characteristics of the non-stormwater discharges and associated drainage area. Some non-stormwater discharges, including the following, are allowed as long as they meet particular conditions in the General Permit (see Appendix A, Section D Special Conditions):

- Fire hydrant flushing
- Potable water sources, including potable water related to the operation, maintenance, or testing of potable water systems
- Drinking fountain water
- Atmospheric condensates including refrigeration, air conditioning, and compressor condensate
- Irrigation drainage
- Landscape watering
- Springs
- Ground water
- Foundation or footing drainage
- Sea water infiltration where the sea waters are discharged back into the sea water source

Even when non-storm discharges are allowed, BMPs are typically employed to reduce the pollutants they contain. It is also important to note that the allowable non-stormwater discharges may differ among Regional Boards; therefore, the allowable non-stormwater discharges may vary for businesses with individual stormwater permits.

The non-stormwater discharges to the drainage system can be identified using Worksheets 5 and 6. Section 3 (Source Control Fact Sheet SC10) provides a detailed procedure for identifying non-stormwater discharges. The General Permit requires that a corrective process must begin immediately. It is recommended that unallowable discharges be terminated before the SWPPP is completed. If this is not possible, the specific actions or BMPs proposed to terminate these discharges must be included in the SWPPP.

This process must be certified. The certification should include identification of potential non-stormwater discharges, a description of the results of any tests for such discharges, the testing method used and the date, and the site drainage points that were directly observed during the test. Worksheet 5 may be used for the certification.

If certification is not feasible because you do not have access to some point in the drainage system or because you are in the process of eliminating the discharge, you must notify the RWQCB of the situation. You must notify the RWQCB of any potential sources of non-stormwater discharges for which you could not perform the necessary testing and why. Notification to the RWQCB should also include a responsive time schedule to complete elimination. Discharges that are essential to industrial operations, but that cannot be eliminated should be noted. For "essential" discharges you may request and the RWQCB will consider additional conditions or controls for these discharges. See Appendix A for the specific requirements. Worksheet 6 may help in this regard.

### Identify Existing BMPs

Those businesses already covered under the General Permit or that have obtained an individual permit should already have a SWPPP and therefore BMPs should already be implemented. However, even businesses that are preparing their first SWPPP will likely have BMPs already in place. These may include pavement sweeping, cleaning of drain inlet sumps, covered waste storage bins, and spill prevention and cleanup procedures. Worksheet 7 provides a checklist of BMPs that may be helpful in determining existing BMPs at a facility. Note these BMPs in relationship to the site activities and potential pollution sources. There may be other BMPs that were installed for reasons unrelated to stormwater control. Examples are berming, covered materials storage, and designated wash areas. You may have implemented these out of a desire for good housekeeping or financial savings, or because of other regulations such as the fire code.

### Assess Potential Pollution Sources

The SWPPP must include a narrative assessment of all industrial activities and potential pollutant sources to determine which areas of the facility are likely sources of pollutants in stormwater and non-stormwater discharges, and which pollutants are likely to be present in stormwater and non-stormwater discharges. Worksheet 8 may help with this task. Worksheet 8 also includes corresponding columns to list the selected BMPs that occur in the BMP Identification Phase, in Section 2.3.3. An example of a completed Worksheet 8 is provided in Appendix C.

Facility owners and operators must consider and evaluate various factors when performing this assessment such as current stormwater BMPs; quantities of significant materials handled, produced, stored, or disposed of; likelihood of exposure to stormwater or authorized non-stormwater discharges; history of spill or leaks; and run-on from outside sources. Facility owners and operators must summarize the areas of the facility that are likely sources of pollutants and the corresponding pollutants that are likely to be present in stormwater discharges and authorized non-stormwater discharges.

- Describe all industrial activities that generate dust or particulates that may be deposited within the facility's boundaries and identify their discharge locations; the characteristics of dust and particulate pollutants; the approximate quantity of dust and particulate pollutants that may be deposited within the facility boundaries; and a description of the primary areas of the facility where dust and particulate pollutants would settle.

- Describe the locations where soil erosion may occur as a result of industrial activity, stormwater discharges associated with industrial activity, or authorized non-stormwater discharges.

- Summarize existing stormwater quality data. Prepare a list of contaminants that have a reasonable potential to be present in the stormwater discharge in significant quantities, and an estimate of the annual quantities of these contaminants in stormwater discharges.



A002071

- Conduct more detailed field studies if necessary. Complex facilities may require extensive fieldwork to locate the drainage systems and outfalls. Some analysis of storm samples including flow measurements may be desirable to obtain a better understanding of the situation.

- Consider the potential and relative significance of each activity to cause stormwater pollution. This will be judgmental, based on the relative percentage of area covered by each activity, the nature of the activity, and the types of pollutants.

### Complete an Assessment Summary

Compile all of the above information for review and comment by the PPT. This summary will serve as the basis for the BMP Identification Phase. You should have sufficient information to determine which areas and activities may be contributors to stormwater pollution, and which BMPs are most suitable. Prioritization of BMP implementation may also be apparent at this time.

## 2.3.3 Phase 3 - BMP Identification Phase

The third phase in the preparation of the SWPPP is to identify the BMPs. The General Permit requires that the description of the BMPs identify the BMPs as (1) existing BMPs, (2) existing BMPs to be revised and implemented, or (3) new BMPs to be implemented. The description is to include a discussion on the effectiveness of each BMP to reduce or prevent pollutants in stormwater discharges and authorized non-stormwater discharges, and a summary of all BMPs implemented for each pollutant source. This information should be summarized similar to Worksheet 8.

**PHASE 3 – BMP Identification:**

- Identify erosion and sediment control BMPs
- Identify BMPs for non-stormwater discharges
- Identify source control BMPs
- Consider treatment control BMPs
- Prepare BMP list and prioritize
- Prepare the monitoring plan
- Prepare the implementation plan

### Types of BMPs

Before covering the steps included in this phase, a general description of BMPs is provided. BMPs are measures to prevent or mitigate pollution. They include a broad class of measures, many of which may already be used for reasons unrelated to stormwater pollution. BMPs are commonly defined two ways: whether they are Non-Structural or Structural (as in the General Industrial Permit), and whether they are Source Control or Treatment Control ( as used in this Handbook).

- **Non-Structural BMPs** - Generally consist of processes, prohibitions, procedures, schedule of activities, etc., that prevent pollutants associated with industrial activity from entering stormwater. They are generally low cost and low technology in nature.

- **Structural BMPs** - Some prevent the pollutants from reaching stormwater, such as a roof cover. Others treat or remove pollutants in stormwater, such as detention basins.

- **Source Control BMPs** - (Section 3) - Prevent contact between stormwater and the pollution source and can be structural or non-structural. Examples of source control non-structural and structural BMPs include using alternative less toxic chemicals and covering an activity area that is a pollutant source. Source control BMPs are preferred over treatment control BMPs because they are generally 100% effective if implemented properly and are usually, but not always less costly than treatment control BMPs.

- **Treatment Control BMPs** - (Section 4) Treat the stormwater to remove pollutant(s) and are structural by their basic nature. Treatment control BMPs are not 100% effective, even if maintained and operated properly. There is also uncertainty as to the effectiveness and reliability of treatment control BMPs.

## Identify Erosion and Sediment Control BMPs

If your site assessment has identified bare areas (areas not covered by pavement, buildings or vegetation), it is necessary to identify BMPs that reduce sediment generation. The New Development-Redevelopment Handbook and Construction Handbook provide information on erosion and sediment control BMPs.

## Identify BMPs for Non-stormwater Discharges

The General Permit prohibits, with exceptions (Section 2.3.3) non-stormwater discharges to the storm drainage system. They either must be terminated or you must obtain a separate permit allowing for the discharge. As non-stormwater discharges are likely to be significant contributors of pollutants, they should be given prompt attention (see Source Control Fact Sheet SC10). If possible, they should be terminated before the completion of the SWPPP. However, some may require a considerable investment, requiring more time to reach full termination. If this is the case, the specific BMPs that will be implemented to terminate the discharges are to be included in the SWPPP. If certain non-stormwater discharges are allowed, it is still necessary to implement BMPs that reduce the pollutants in these discharges.

## Identify Source Control BMPs (see Section 3)

The axiom of "80% of the problem can be solved with 20% of the effort" probably is true for most industries. Low or modest cost BMPs, many of which may already be in place, will usually provide satisfactory protection. There is no minimum BMP requirement specified in the General Permit. The permit requires that consideration be given first to Non-Structural Source Control BMPs. The following categories of non-structural, source control BMPs presented below should be considered:

- Good housekeeping
- Preventive maintenance
- Spill prevention and response
- Material handling and storage
- Waste handling and recycling



A002073

- Employee training
- Inspections
- Record keeping and internal reporting
- Quality assurance

It may be concluded at the end of the above effort that the low- and modest-cost BMPs may not be sufficient to reduce pollutants to an acceptable level. Given that this decision is judgmental, particularly in the absence of stormwater monitoring pollutant data, the PPT Leader has two options:

1. Complete the analysis at this point, only including the BMPs identified in the above effort. The SWPPP is implemented and, if the results are found through monitoring to be insufficient, the SWPPP is revisited and revised accordingly.
2. Identify the more costly BMPs at this time, but do not implement immediately. Rather, implement and evaluate the low- and modest-cost BMPs. Again, if they are found to be insufficient, the more costly BMPs are implemented.

General categories of structural source control BMPs include but are not limited to:

- Installing berms or simple curbing to divert runoff water from around the activity area to reduce the amount of polluted stormwater leaving the area.
- Implementing overhead coverage: This includes structures that provide horizontal coverage of materials, chemicals, and pollutant sources from contact with stormwater and authorized non-stormwater discharges.
- Using secondary containment structures: This generally includes containment structures around storage tanks and other areas for the purpose of collecting any leaks or spills.
- Moving an outdoor operation indoors.
- Designating equipment wash areas.

To ensure that these BMPs are properly implemented, you should also include employee training, inspection, record keeping, and quality control as part of your source control BMPs.

## Consider Treatment Control BMPs (see Section 4)

A Treatment Control BMP is included only if the source control BMPs are insufficient to meet numeric effluent limits required either by current federal regulations for certain industries (Appendix A) or in special situations identified by the local RWQCB.

Consider treatment control BMPs if:

- Elaborate source control BMPs are needed, in which case a Treatment Control BMP may be more cost-effective

- You are required to meet a numeric effluent limit that cannot be met with source control BMPs

- There is a pollutant of particular concern that can only be controlled with a treatment control BMP

Evaluate the following possibilities:

- If you have several separate drainage systems, consider placing the pollutant generating activities into one system so that you have to install only one treatment device.

- Place a treatment device in the immediate vicinity of the activity, rather than at the far end of the drainage system. This will reduce the size of the unit.

- If you have a wastewater treatment system, consider diverting the sources of particular concern to the sewer treatment plant. This may require permits or approvals from the agency providing sewer service.

- For activities that cover a small area but are potentially significant polluters, such as equipment washing, consider using an offsite commercial washing facility or covering the area and directing the wash water to a sanitary sewer. Consultation with the local sewer district is necessary.

After completing the above analysis, consider again covering the activity of concern. Even if it may be somewhat more expensive than treatment, covering has the advantage of being 100% effective. For certain industries, covering may avoid the need for coverage under the General Permit.

### Prepare BMP List and Prioritize

The final step is to "wrap-up" the list of BMPs, clearly showing the BMPs identified for each activity and by location within the site. Decide which BMPs to implement first. Make sure the BMP list meets the minimum requirements specified in the General Permit. Here is a final checklist of considerations:

- Have you identified the specific solutions to terminating unauthorized non-stormwater discharges and BMPs for those that are allowed?

- Have you identified low and nominal-cost BMPs that cover all of the activities you checked in Worksheet 1?

- Have you developed a strategy to deal with those activities that will still be significant sources of pollution for which more expensive BMPs are needed?

- Are you required to comply with numeric effluent limits, and if so, have you identified the specific BMPs to fulfill this obligation?

- Have you prepared a training program to provide the proper background to the employees who will implement the BMPs?

- Have you selected BMPs that are least likely to harbor or breed vectors such as mosquitoes? Have you considered vector suppression in your maintenance plan? If not, have you consulted with the local vector control agency about preventative maintenance and regular vector monitoring and abatement?

- Do you have a commitment and schedule for implementation of the BMPs, maintenance, inspection, and ongoing evaluation?

## Prepare the Monitoring Plan (see Section 5)

One of the important final steps in the preparation of the SWPPP is to develop a program to monitor how well the BMPs are being implemented, and how well they are reducing the amount of pollutants leaving your site in the stormwater. The General Permit requires that such a program be a component of the SWPPP. The program objectives are to:

- Monitor the quality of the stormwater discharge

- Aid in implementation of the SWPPP

- Measure BMP effectiveness

To meet these objectives the monitoring effort has these elements:

- Visual observations

- Stormwater monitoring

- Monitoring of authorized non-stormwater discharges

Each facility must either conduct an individual monitoring plan or participate in a group sampling program. A group monitoring program may be developed either by an entity representing a group of similar facilities or by a local stormwater agency that holds its own NPDES permit. According to the General Permit, the monitoring plan is to contain the rationale and description of the visual observation methods, location, and frequency; and the analytical methods and corresponding method detection limits used to detect constituents. A more complete description of the monitoring program is found in Section 5.

## Prepare the Implementation Plan

Phase 5 (discussed below) and Phase 6 (Section 5) outline detailed suggestions on how to implement and evaluate the relative success of the SWPPP. The General Permit specifies the following:

- Designate the personnel responsible for carrying out the SWPPP.
- Identify the time period (day or week as necessary) to conduct the annual Comprehensive Site Compliance Evaluation.
- Describe how records of the inspections, follow-up actions, and implementation of the BMPs will be prepared and kept.
- Develop a training program to train staff so they understand the SWPPP.

## 2.3.4 Phase 4 - Assemble the SWPPP

The final phase, before Implementation, is to assemble the SWPPP. Completing the SWPPP requires several actions.

**PHASE 4 – BMP Identification:**
- Obtain required signatures
- Select plan location
- Assemble the document

### Obtain Required Signatures

The SWPPP is to include the signature and title of the person responsible for the SWPPP, the dates of its initial preparation and each amendment (see Appendix A, Section C).

### Select Plan Location

An official copy of the SWPPP is to be located at the facility, not offsite. However, if an office is not located at the facility (e.g., landfill), then the SWPPP should be kept at the appropriate administrative office. The SWPPP is primarily for use by the Pollution Prevention Team, not the RWQCB or the public. Therefore, locating the SWPPP offsite would negate its purpose. However, a copy of the SWPPP must be submitted to the RWQCB on request or be available for review should a representative of the RWQCB or local municipality come on-site. The SWPPPs are considered to be available to the public pursuant to Section 308(b) of the Clean Water Act, and therefore are available to the public at the RWQCB office when SWPPPs have been submitted to the RWQCB.

### Assemble the Document

Assemble the site map, narrative descriptions, and worksheets into a 3-ring binder or bound document. Include the Monitoring Plan and the Implementation Plan.

## 2.3.5 Phase 5 – Implement the SWPPP

Finally, implement the SWPPP by training personnel, implementing BMPs, and terminating non-allowable non-stormwater discharges. The SWPPP should be conducted according to the implementation plan developed in Phase 3.

**PHASE 5 – Implementation:**
- Conduct Training
- Implement the BMPs
- Terminate non-allowable non-storm discharges

Facilities must identify and provide for adequate resources (personnel and capital) to properly implement



A002077

the SWPPP.

### Conduct Training

Training is in itself a BMP and is important for personnel who are responsible for:

- Implementing activities identified in the SWPPP
- Conducting inspections, sampling, and visual observations
- Managing stormwater

Training should address topics such as spill response, good housekeeping, material handling procedures, and actions necessary to implement all BMPs identified in the SWPPP. The SWPPP should identify periodic dates for such training. Records should be maintained of all training sessions held.

### Implement the BMPs

The BMPs identified in Phase 3 are implemented during this phase. A schedule for implementation of the BMPs, maintenance, inspection, and ongoing evaluation should be developed and followed. It is important that BMPs be maintained, particularly treatment control BMPs, but other BMPs also require attention such as spill containment materials, drip pans, etc.

### Terminate Non-allowable Non-storm Discharges

One of the major elements of the SWPPP is elimination of unauthorized non-stormwater discharges to a facility's storm drain system. Unauthorized non-stormwater discharges can be generated from several of the activities that may take place at industrial facilities (e.g., washing of vehicles, equipment, buildings, or pavement; improper disposal of materials; spilled or leaked materials). BMPs to control spills, leakage, and dumping should be implemented to address non-storm discharges.

## 2.3.6 Phase 6 – Monitoring, Reporting, and Program Evaluation

It is important, as well as required by the General Permit, that frequent inspections occur to check if BMPs are being implemented, and to evaluate their relative effectiveness. Section 5 provides guidance on Phase 6, which involves conducting the monitoring program, review of monitoring information, evaluation of BMPs, record keeping and reporting, and review and revision of the SWPPP.

# 2.4 Commercial Businesses

As noted previously the State Industrial General Permit is applicable to a wide range of specified industries (see Section 2.1). However, there are a number of commercial businesses that, although not covered by the General Permit, may impact stormwater quality. The oversight of these businesses will vary according to local jurisdiction requirements. Some jurisdictions may require the business to develop a stormwater pollution control plan (SWPCP), which is a less formal plan than the State General Permit defined SWPPP. The contents of these plans may vary with each local jurisdiction but all will basically address the following items:

- Identification of pollutant-generating activities
- Selection and implementation of BMPs to address these activities
- Review and modification of the plan to ensure effective implementation

While some jurisdictions may require the development of a written document, other jurisdictions may choose to provide education material to the businesses. To assist these businesses and the jurisdictions overseeing these businesses, specific stormwater pollution control guide sheets have been prepared (see Appendix D). These guide sheets may be used as reference material either as a business prepares a SWPCP or as a jurisdiction prepares outreach material. The guide sheets incorporate the source control BMPs presented in Section 3 into a business specific pollution control plan. The businesses selected for inclusion represent some of the more common business types in any community and tend to have a higher potential to impact stormwater quality based on the products they use and their activities. These businesses are listed in Table 2-3:

| **Table 2-3 Business Categories and Subcategories** |
|---|
| Animal Care and Handling Facilities |
| Automotive Service Facilities |
| Auto Recycling |
| Body Repair |
| Maintenance |
| Service Stations |
| Food Service Facilities |
| Marinas, Boatyards, and Ports |
| Mobil Cleaning |
| Transportation-related |
| Food Service-related |
| Surface Cleaning |
| Amenities |
| Carpets & Upholstery |
| Swimming Pools & Spas |
| Water Softeners |
| Landscape Maintenance |

More details on the business guide sheets are provided in Section 3.

## 2.5 SWPPP Worksheets

Blank copies of worksheets 1-8 for the Assessment Phase of the SWPPP follow.



A002079

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## WORKSHEET #1
## ACTIVITIES ASSESSMENT CHECKLIST

| Name of Reviewer: | Date: | | |
|---|---|---|---|
| ACTIVITIES - Check each activity present at site | EFFECTIVENESS | | |
| | HIGH | MOD. | LOW |
| ☐ Non-storm water discharges to drains. Describe BMPs in place: | | | |
| ☐ Spill Prevention, Control and Cleanup. Describe BMPs in place: | | | |
| ☐ Vehicle and equipment fueling. Describe BMPs in place: | | | |
| ☐ Vehicle and equipment washing and steam cleaning. Describe BMPs in place: | | | |
| ☐ Vehicle and equipment maintenance and repair. Describe BMPs in place: | | | |
| ☐ Outdoors loading/unloading of liquid materials. Describe BMPs in place: | | | |
| ☐ Outdoor container storage of liquids. Describe BMPs in place: | | | |
| ☐ Outdoor process equipment operations and maintenance. Describe BMPs in place: | | | |
| ☐ Outdoor storage of raw materials, products and byproducts. Describe BMPs in place: | | | |
| ☐ Waste handling and disposal. Describe BMPs in place: | | | |
| ☐ Contaminated or erodible surface areas. Describe BMPs in place: | | | |
| ☐ Building and grounds maintenance. Describe BMPs in place: | | | |
| ☐ Building repair, remodeling, and construction. Describe BMPs in place: | | | |
| ☐ Parking/Storage Area Maintenance. Describe BMPs in place: | | | |

# MATERIAL INVENTORY

(Adopt from EPA, 1992)

Worksheet No. 2
Completed By:
Title:
Date :

Instructions: List all materials used, stored, or produced onsite. Assess and evaluate these materials for their potential to contribute pollutants to storm water runoff. Also complete Worksheet 3 if the material has been exposed during the last three years.

| Material | Purpose/Location | Quantity (units) | | Quantity Exposed in Last 3 Years * | Likelihood of contact with storm water. | Past significant Spill or Leak ** | |
|---|---|---|---|---|---|---|---|
| | | Used | Produced | | | Yes | No |
| | | | | | | | |
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* Explain on separate sheet if quantity was more than the "minimum?"

** Explain items checked yes on a separate sheet.

## MATERIAL INVENTORY

Worksheet No. 3
Completed By:
Title:
Date :

Instructions: Based on your material inventory, describe the significant materials that were exposed to storm water during the past three years and/or are currently exposed. For the definition of "significant materials" see Appendix B of the manual.

| Description of Exposed Significant Material | Period of Exposure | Quantity Exposed (Units) | Location (as indicated on the site map) | Method of Storage or Disposal (e.g., pile, drum, tank | Description of Material Management Practices (e.g., pile covered, drum sealed) |
|---|---|---|---|---|---|
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# SPILLS INVENTORY

(Adopt from EPA, 1992)

Worksheet No. 4
Completed By:
Title:
Date:

Instructions: Record below all significant spills and significant leaks of toxic or hazardous pollutants that have occurred at the facility in the three years prior to the effective date of the permit.

Definitions: Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities.

1st Year Prior

| Date (month/day/year) | Check Box | | Location (as indicated on site map) | Description | | | | Response Procedure | Preventive Measures Taken |
|---|---|---|---|---|---|---|---|---|---|
| | Spill | Leak | | Type of Material | Quantity | Source, If Known | Reason | | |
| | | | | | | | | | |
| | | | | | | | | | |

2nd Year Prior

| Date (month/day/year) | Check Box | | Location (as indicated on site map) | Description | | | | Response Procedure | Preventive Measures Taken |
|---|---|---|---|---|---|---|---|---|---|
| | Spill | Leak | | Type of Material | Quantity | Source, If Known | Reason | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

3rd Year Prior

| Date (month/day/year) | Check Box | | Location (as indicated on site map) | Description | | | | Response Procedure | Preventive Measures Taken |
|---|---|---|---|---|---|---|---|---|---|
| | Spill | Leak | | Type of Material | Quantity | Source, If Known | Reason | | |
| | | | | | | | | | |
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A002084

## NON-STORM WATER DISCHARGE ASSESSMENT AND CERTIFICATION

(Source: EPA, 1992)

**Worksheet No. 5**
**Completed by:** ______
**Title:** ______
**Date:** ______

| Date of Test or Evaluation | Outfall Directly Observed During the Test (identify as indicated on the site map) | Method Used to Test or Evaluate Discharge | Describe Results from Test for the Presence of Non-Storm Water Discharge | Identify Potential Significant Sources | Name of Person Who Conducted the Test or Evaluation |
|---|---|---|---|---|---|
| | | | | | |
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**CERTIFICATION**

I, ______ (responsible corporate official), certify under penalty of law that this document and all attachments were prepared unde 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, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

| | |
|---|---|
| A. **Name & Official Title (type or print)** | B. **Area Code and Telephone No.** |
| C. **Signature** | D. **Date Signed** |

A002085

## NON-STORM WATER DISCHARGE ASSESSMENT AND FAILURE TO CERTIFY NOTIFICATION

(Source: EPA, 1992)

**Worksheet No. 6**
**Completed by:** ____________________
**Title:** ____________________
**Date:** ____________________

Directions: If you cannot feasibly test or evaluate an outfall due to one of the following reasons, fill in the table below with the appropriate information and sign this form to certify the accuracy of the included information.

List all outfalls not tested or evaluated, describe any potential sources of non-storm water pollution from listed outfalls, and state the reason(s) why certification is not possible. Use the key from your site map to identify each outfall.

Important Notice: A copy of this notification must be signed and submitted to the RWQCB within 180 days of the effective date of this permit.

| Identify Outfall Not Tested/Evaluated | Description of Why Certification Is Infeasible | Description of Potential Sources of Non-Storm Water Pollution |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

### CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly 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, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations, and that such notification has been made to the RWQCB within 180 days of ___________ (date permit was issued), the effective date of this permit.

| | |
|---|---|
| **A. Name & Official Title (type or print)** | **B. Area Code and Telephone No.** |
| **C. Signature** | **D. Date Signed** |

A002086

## WORKSHEET No. 7
## CHECKLIST FOR CONSIDERATION OF MINIMUM BMPs

Check which one of the following describe your facility.

| Name of Reviewer: | Date: |
|---|---|

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☐ | Are outside areas kept neat and clean? |
| ☐ | ☐ | ☐ | Is the facility orderly and neat? |
| ☐ | ☐ | ☐ | Is the process debris removed regularly? |
| ☐ | ☐ | ☐ | Is the area clear of excessive dust from industrial operations? |
| ☐ | ☐ | ☐ | Is there no evidence of leaks and drips from equipment and machinery? |
| ☐ | ☐ | ☐ | Are employees regularly informed of the importance of good housekeeping? |
| ☐ | ☐ | ☐ | Are catch basins, storm conveyance pipes, and storm water treatment facilities cleaned at the appropriate intervals (see Chapter 5)? |
| ☐ | ☐ | ☐ | Are good housekeeping procedures and reminders posted in appropriate locations? |
| ☐ | ☐ | ☐ | Are vehicle maintenance activities kept indoors and do not tend to "creep" out the front door of the maintenance shop? |
| ☐ | ☐ | ☐ | Are containers for chemical substances and for temporary storage of wastes labeled? |
| ☐ | ☐ | ☐ | Is vehicle and equipment washing done in a designated area so that the wash water can be discharged to the sanitary or process wastewater sewer? |
| ☐ | ☐ | ☐ | Are regular housekeeping practices carried out? |
| ☐ | ☐ | ☐ | Is there a spill prevention and response team? |
| ☐ | ☐ | ☐ | Are appropriate spill containment and cleanup materials kept on-site and in convenient locations? |
| ☐ | ☐ | ☐ | Are cleanup procedures for spills followed regularly and correctly? |
| ☐ | ☐ | ☐ | Are used absorbent materials removed and disposed of in a timely manner? |
| ☐ | ☐ | ☐ | Are personnel regularly trained in the use of spill control materials? |
| ☐ | ☐ | ☐ | Is exposed piping and process equipment regularly inspected and/or tested to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters? |
| ☐ | ☐ | ☐ | Are drainage ditches or the areas around the outfall(s) free of erosion? |
| ☐ | ☐ | ☐ | Are unpaved outdoor areas protected from water or wind erosion? |

Any items checked "No" require consideration in the selection of BMPs.
N/A = Not Applicable.

# WORKSHEET 8
## ASSESSMENT OF POTENTIAL POLLUTION SOURCES AND CORRESPONDING BMPS

| Area | Activity | Pollutant Source | Pollutant | Best Management Practices |
|---|---|---|---|---|
| | | | | |
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# Section 3
# Source Control BMPs

## 3.1 Introduction

This section provides a description of specific source control Best Management Practices (BMPs) for common industrial and commercial activities that may pollute stormwater. In this Handbook, Source Control BMPs are structured around the concept of "activities" as experience has shown that with few exceptions one or more of these activities will satisfactorily describe all industrial/commercial facilities. Source Control BMP fact sheets are therefore organized in Section 3 by activity. For certain commercial businesses, separate guide sheets have been developed and incorporate source control BMPs. These guide sheets are describe in the Section and presented in Appendix D.

## 3.2 Source Control BMPs

Source control BMPs are listed in Table 3-1 and fact sheets for each are provided in Section 3.5.

## 3.3 Source Control BMP Fact Sheet Format

A BMP fact sheet is a short document that gives all the information about a particular BMP. Typically each fact sheet contains the information outlined in Figure 3-1. The fact sheets also contain side bar presentations with information on BMP objectives and targeted constituents.

**Industrial Activity Description of the BMP**

Approach

- Pollution Prevention
- Suggested Protocols (including equipment needs)
- Training
- Spill Response and Prevention
- Other Considerations (Limitations and Regulations)

Requirements

- Costs (including capital and operation & maintenance)
- Maintenance (including administrative and staffing)

Supplemental Information

- Further Detail of the BMP
- Examples

References and Resources

**Figure 3-1**
**Contents of Source Control BMP Fact Sheet**

**Table 3-1 Source Control BMPs**

| | |
|---|---|
| **Non-Stormwater Management** | |
| SC-10 | Non-Stormwater Discharges |
| SC-11 | Spill Prevention, Control and Cleanup |
| **Vehicle and Equipment Management** | |
| SC-20 | Vehicle and Equipment Fueling |
| SC-21 | Vehicle and Equipment Cleaning |
| SC-22 | Vehicle and Equipment Repair |
| **Material and Waste Management** | |
| SC-30 | Outdoor Loading/Unloading |
| SC-31 | Outdoor Liquid Container Storage |
| SC-32 | Outdoor Equipment Operations |
| SC-33 | Outdoor Storage of Raw Materials |
| SC-34 | Waste Handling and Disposal |
| SC-35 | Safer Alternative Products |
| **Building and Grounds Management** | |
| SC-40 | Contaminated or Erodible Areas |
| SC-41 | Building & Grounds Maintenance |
| SC-42 | Building Repair and Construction |
| SC-43 | Parking/Storage Area Maintenance |
| SC-44 | Drainage System Maintenance |



A002089

# 3.4 Business Category Stormwater Pollution Control Guide Sheets

## 3.4.1 Introduction

This section describes "guide sheets" for the specific categories and subcategories of businesses shown in Table 3-2.

These categories represent some of the more common businesses types in any community and those businesses that tend to have a higher potential to pollute stormwater based on the products they use and their activities. Most of the business categories discussed in this section are not required to obtain coverage under state and federal stormwater regulations, with the exception of auto recycling facilities, and marinas and boatyards. For more information on BMPs for these two business categories as well as other categories permitted under the federal regulations, see the USEPA Multi-Sector General Permit for Industrial Activities (http://cfpub.epa.gov/npdes/stormwater/msgp.cfm?program_id=6).

## 3.4.2 Use of Guide Sheets

The guide sheets are provided in Appendix D. Guide sheets are business-based as opposed to the activity-based like the source control fact sheets. The guide sheets basically address a collection of activities typically associated with a certain type of business. BMPs are identified for these activities and are consistent with the ones found in Section 3. The guide sheet provides a single source of information to the business regarding stormwater pollution prevention.

The guide sheets are organized as shown in Figure 3-2.

## 3.4.3 Guide Sheet Limitations

Although the intent is to provide as much information in one place as possible, for some business categories there is much more information available than can be included in this handbook. The references section of each guide sheet is intended to minimize this potential limitation. The guide sheets do not provide design details or maintenance requirements for treatment

| Table 3-2 Business Categories and Subcategories |
|---|
| Animal Care and Handling Facilities |
| Automotive Service Facilities |
|     Auto Recycling |
|     Body Repair |
|     Maintenance |
|     Service Stations |
| Food Service Facilities |
| Marinas, Boatyards, and Ports |
| Mobil Cleaning |
|     Transportation-related |
|     Food Service-related |
|     Surface Cleaning |
|     Amenities |
|         Carpets & Upholstery |
|         Swimming Pools & Spas |
|         Water Softeners |
| Landscape Maintenance |

**Business Category Name**
**Description of the Business Category**

**Pollutant Sources** – Describes the most common pollutants and their sources

**Approach** – Explains the overall approach to pollutant control

**Source Control BMPs** – Lists controls that help keep pollutants out of stormwater

**Treatment Control BMPs** - Lists controls that help remove pollutants from stormwater

**More Information** – Provides references to: 1) materials with more specific information than is included in these guide sheets or 2) other formats – posters and videos – that may complement these guide sheets

**References** – Other information and resources

**Figure 3-2**
**Example Guide Sheet**



A002090

controls. This information is provided in the New Development and Redevelopment Handbook, and Section 4 of this handbook, respectively.

## 3.5 BMP Fact Sheets

Source control BMPs for common industrial and commercial activities follow. The BMP fact sheets are individually page numbered and are suitable for photocopying and inclusion in SWPPPs. Fresh copies of the fact sheets can be individually downloaded from the California Stormwater BMP Handbook web site at "www.cabmphandbooks.com".

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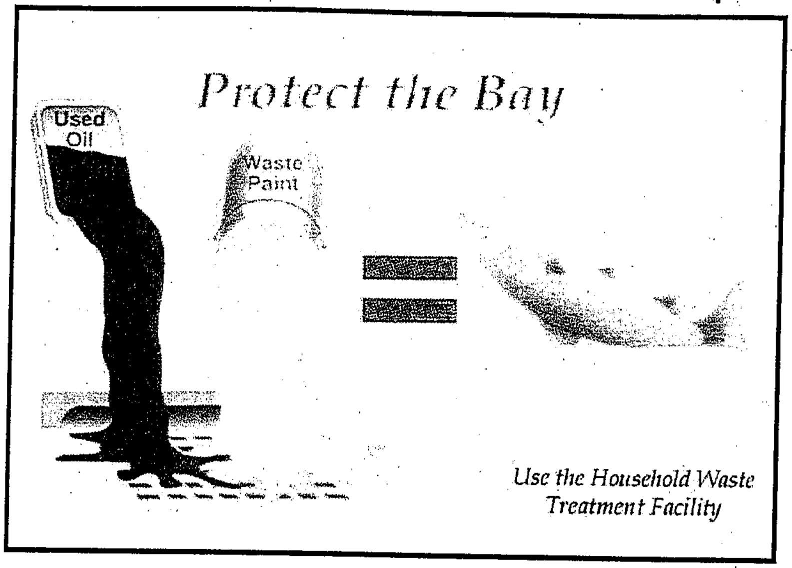
# Non-Stormwater Discharges SC-10




### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | ✓ |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

## Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

CASQA California Stormwater Quality Association



A002093

### *Pollution Prevention*

- Ensure that used oil, used antifreeze, and hazardous chemical recycling programs are being implemented. Encourage litter control.

### *Suggested Protocols*

*Recommended Complaint Investigation Equipment*

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms
  - Educational materials

*General*

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. These are often not responded to as effectively as they need to be.
- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled or demarcated next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- See SC44 Stormwater Drainage System Maintenance for additional information.

*Illicit Connections*

- Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Isolate problem areas and plug illicit discharge points.
- Locate and evaluate all discharges to the industrial storm drain system.

*Visual Inspection and Inventory*

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for a day or two following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

*Review Infield Piping*

- A review of the "as-built" piping schematic is a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

*Smoke Testing*

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.
- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

*Dye Testing*

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

*TV Inspection of Drainage System*

- TV Cameras can be employed to visually identify illicit connections to the industrial storm drainage system.

*Illegal Dumping*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Landscaping and beautification efforts of hot spots may also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.
- See fact sheet SC11 Spill Prevention, Control, and Cleanup.

*Inspection*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of non-stormwater discharges.
- Pro-actively conduct investigations of high priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for pro-active investigations.

*Reporting*

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Document and report annually the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

***Training***

- Training of technical staff in identifying and documenting illegal dumping incidents is required.
- Consider posting the quick reference table near storm drains to reinforce training.
- Train employees to identify non-stormwater discharges and report discharges to the appropriate departments.

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Determine and implement appropriate outreach efforts to reduce non-permissible non-stormwater discharges.
- Conduct spill response drills annually (if no events occurred to evaluate your plan) in cooperation with other industries.
- When a responsible party is identified, educate the party on the impacts of his or her actions.

***Spill Response and Prevention***
- See SC11 Spill Prevention Control and Cleanup.

***Other Considerations***
- Many facilities do not have accurate, up-to-date schematic drawings.

## Requirements

***Costs (including capital and operation & maintenance)***
- The primary cost is for staff time and depends on how aggressively a program is implemented.
- Cost for containment and disposal is borne by the discharger.
- Illicit connections can be difficult to locate especially if there is groundwater infiltration.
- Indoor floor drains may require re-plumbing if cross-connections to storm drains are detected.

***Maintenance (including administrative and staffing)***
- Illegal dumping and illicit connection violations requires technical staff to detect and investigate them.

## Supplemental Information

***Further Detail of the BMP***

*Illegal Dumping*
- Substances illegally dumped on streets and into the storm drain systems and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes cause stormwater and receiving water quality problems as well as clog the storm drain system itself.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots



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- Types and quantities (in some cases) of wastes
- Patterns in time of occurrence (time of day/night, month, or year)
- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges to the stormwater collection system may include any water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

*Permit Requirements*

- Facilities subject to stormwater permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The State's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

*Performance Evaluation*

- Review annually internal investigation results; assess whether goals were met and what changes or improvements are necessary.
- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.

## References and Resources

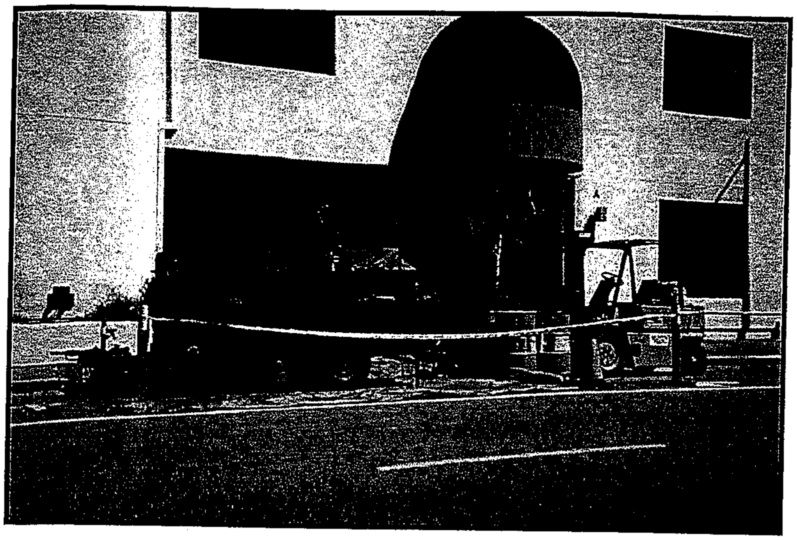
California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/



### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Approach

### *Pollution Prevention*

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

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- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

■ Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

***Suggested Protocols (including equipment needs)***
*Spill Prevention*

■ Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

■ If consistent illegal dumping is observed at the facility:
  - Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

■ Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

■ If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

■ Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*



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- Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

*Spill Control and Cleanup Activities*

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

*Reporting*

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

### *Training*

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.
- Train employees to recognize and report illegal dumping incidents.

### *Other Considerations (Limitations and Regulations)*

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure (SPCC) Plan (Health & Safety Code Chapter 6.67).
- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.
- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

## Requirements

### *Costs (including capital and operation & maintenance)*

- Will vary depending on the size of the facility and the necessary controls.
- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

### *Maintenance (including administrative and staffing)*

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

## Supplemental Information

### *Further Detail of the BMP*

*Reporting*

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

*Aboveground Tank Leak and Spill Control*

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

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tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

*Vehicle Leak and Spill Control*

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

*Vehicle and Equipment Maintenance*

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

*Vehicle and Equipment Fueling*

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off" of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

*Industrial Spill Prevention Response*

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas



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- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

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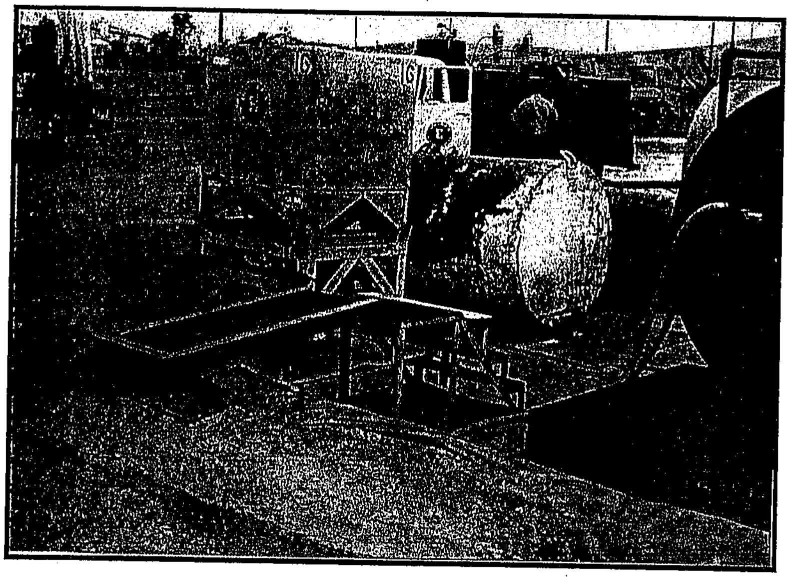
# Vehicle & Equipment Fueling SC-20



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

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## Description

Spills and leaks that occur during vehicle and equipment fueling can contribute hydrocarbons, oil and grease, as well as heavy metals to stormwater runoff. Implementing the following management practices can help prevent fuel spills and leaks.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *Pollution Prevention*

- Use properly maintained off-site fueling stations whenever possible. These businesses are better equipped to handle fuel and spills properly.
- Educate employees about pollution prevention measures and goals.
- Focus pollution prevention activities on containment of spills and leaks, most of which may occur during liquid transfers.

### *Suggested Protocols*

*General*

- "Spot clean" leaks and drips routinely. Leaks are not cleaned up until the absorbent is picked up and disposed of properly.



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- Manage materials and waste to reduce adverse impacts on stormwater quality.
- Label drains within the facility boundary, by paint/stencil (or equivalent), to indicate whether they flow to an oil/water separator, directly to the sewer, or to a storm drain. Labels are not necessary for plumbing fixtures directly connected to the sanitary sewer.
- Post signs to remind employees and customers not to top off the fuel tank when filling and signs that ban customers and employees from changing engine oil or other fluids at that location.
- Report leaking vehicles to fleet maintenance.
- Install inlet catch basin equipped with a small sedimentation basin or grit chamber to remove large particles from stormwater in highly impervious areas.
- Ensure the following safeguards are in place:
  - Overflow protection devices on tank systems to warn the operator to automatically shutdown transfer pumps when the tank reaches full capacity.
  - Protective guards around tanks and piping to prevent vehicle or forklift damage.
  - Clear tagging or labeling of all valves to reduce human error.

*Fuel Dispensing Areas*

- Maintain clean fuel-dispensing areas using dry cleanup methods such as sweeping for removal of litter and debris, or use of rags and absorbents for leaks and spills.
- If you periodically clean by washing, place a temporary plug in the downstream drain and pump out the accumulated water. Properly dispose the water. Note: permission from the local sewering agency must be obtained before discharging wash water to the sanitary sewer.
- Fit underground storage tanks with spill containment and overfill prevention systems meeting the requirements of Section 2635(b) of Title 23 of the California Code of Regulations.
- Fit fuel dispensing nozzles with "hold-open latches" (automatic shutoffs) except where prohibited by local fire departments.
- Post signs at the fuel dispenser or fuel island warning vehicle owners/operators against "topping off" of vehicle fuel tanks.
- Design fueling area to prevent stormwater runoff and spills.
- Cover fueling area with an overhanging roof structure or canopy so that precipitation cannot come in contact with the fueling area and use a perimeter drain or slope pavement inward with drainage to sump; pave area with concrete rather than asphalt.
- Where covering is not feasible and the fuel island is surrounded by pavement, apply a suitable sealant that protects the asphalt from spilled fuels.

- Install vapor recovery nozzles to help control drips as well as air pollution.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Cover storm drains in the vicinity during transfer.

*Outdoor Waste Receptacle Area*

- Spot clean leaks and drips routinely to prevent runoff of spillage.
- Minimize the possibility of stormwater pollution from outside waste receptacles by doing at least one of the following:
  - Use only watertight waste receptacle(s) and keep the lid(s) closed.
  - Grade and pave the waste receptacle area to prevent run-on of stormwater.
  - Install a roof over the waste receptacle area.
  - Install a low containment berm around the waste receptacle area.
  - Use and maintain drip pans under waste receptacles.
- Post "no littering" signs.

*Air/Water Supply Area*

- Minimize the possibility of stormwater pollution from air/water supply areas by doing at least one of the following:
  - Spot clean leaks and drips routinely to prevent runoff of spillage.
  - Grade and pave the air/water supply area to prevent run-on of stormwater.
  - Install a roof over the air/water supply area.
  - Install a low containment berm around the air/water supply area.

*Inspection*

- Aboveground Tank Leak and Spill Control:
  - Check for external corrosion and structural failure.
  - Check for spills and overfills due to operator error.
  - Check for failure of piping system.
  - Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.
  - Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.

- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Periodically, integrity testing should be conducted by a qualified professional.

- Inspect and clean, if necessary, storm drain inlets and catch basins within the facility boundary before October 1 each year.

*Training*

- Train all employees upon hiring and annually thereafter on proper methods for handling and disposing of waste. Make sure that all employees understand stormwater discharge prohibitions, wastewater discharge requirements, and these best management practices.
- Train employees on proper fueling and cleanup procedures.
- Use a training log or similar method to document training.
- Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.

*Spill Response and Prevention*

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Store portable absorbent booms (long flexible shafts or barriers made of absorbent material) in unbermed fueling areas.
- Report spills promptly.
- If a dead-end sump is not used to collect spills, install an oil/water separator.

*Other Considerations*

- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.

## Requirements

*Costs*

- The retrofitting of existing fueling areas to minimize stormwater exposure or spill runoff can be expensive. Good design must occur during the initial installation.
- Extruded curb along the "upstream" side of the fueling area to prevent stormwater run-on is of modest cost.

*Maintenance*

- Clean oil/water separators at appropriate intervals.

- Keep ample supplies of spill cleanup materials on-site.
- Inspect fueling areas and storage tanks on a regular schedule.

## Supplemental Information

### *Design Considerations*

*Designing New Installations*

The elements listed below should be included in the design and construction of new or substantially remodeled facilities.

*Fuel Dispensing Areas*

- Fuel dispensing areas must be paved with Portland cement concrete (or, equivalent smooth impervious surface), with a 2 to 4% slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of stormwater to the extent practicable. The fuel dispensing area is defined as extending 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less. The paving around the fuel dispensing area may exceed the minimum dimensions of the "fuel dispensing area" stated above.
- The fuel dispensing area must be covered, and the cover's minimum dimensions must be equal to or greater than the area within the grade break or the fuel dispensing area, as defined above. The cover must not drain onto the fuel dispensing area.
- If necessary, install and maintain an oil control device in the appropriate catch basin(s) to treat runoff from the fueling area.

*Outdoor Waste Receptacle Area*

- Grade and pave the outdoor waste receptacle area to prevent run-on of stormwater to the extent practicable.

*Air/Water Supply Area*

- Grade and pave the air/water supply area to prevent run-on of stormwater to the extent practicable.

*Designated Fueling Area*

- If your facility has large numbers of mobile equipment working throughout the site and you currently fuel them with a mobile fuel truck, consider establishing a designated fueling area. With the exception of tracked equipment such as bulldozers and perhaps small forklifts, most vehicles should be able to travel to a designated area with little lost time. Place temporary "caps" over nearby catch basins or manhole covers so that if a spill occurs it is prevented from entering the storm drain.

### *Examples*

The Spill Prevention Control and Countermeasure (SPCC) Plan, which is required by law for some facilities, is an effective program to reduce the number of accidental spills and minimize contamination of stormwater runoff.



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The City of Palo Alto has an effective program for commercial vehicle service facilities. Many of the program's elements, including specific BMP guidance and lists of equipment suppliers, are also applicable to industrial facilities.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Best Management Practice Guide for Retail Gasoline Outlets, California Stormwater Quality Task Force. 1997.



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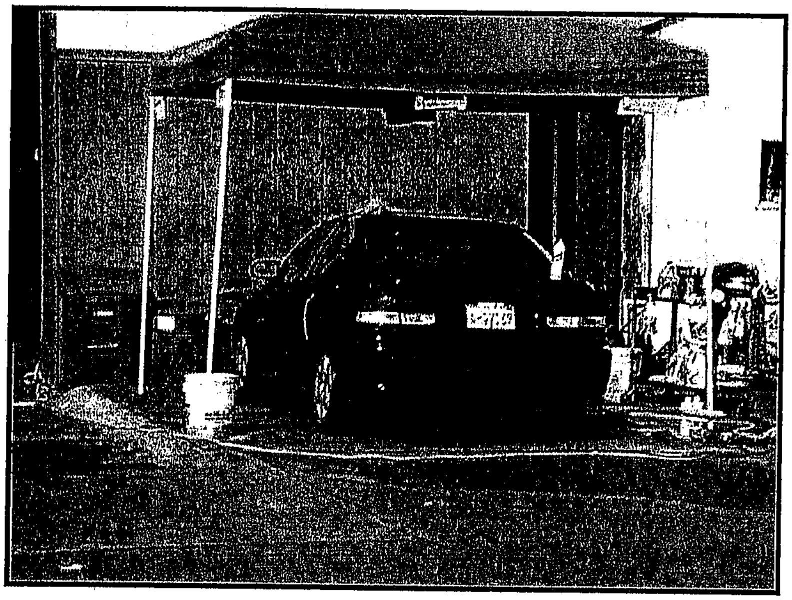

Photo Credit: Geoff Brosseau

**Objectives**

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

**Targeted Constituents**

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Description

Wash water from vehicle and equipment cleaning activities performed outdoors or in areas where wash water flows onto the ground can contribute toxic hydrocarbons and other organic compounds, oils and greases, nutrients, phosphates, heavy metals, and suspended solids to stormwater runoff. Use of the procedures outlined below can prevent or reduce the discharge of pollutants to stormwater during vehicle and equipment cleaning.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives

### *Pollution Prevention*

- If possible, use properly maintained off-site commercial washing and steam cleaning businesses whenever possible. These businesses are better equipped to handle and properly dispose of the wash waters.
- Good housekeeping practices can minimize the risk of contamination from wash water discharges.

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A002116

***Suggested Protocols***

*General*

- Use biodegradable, phosphate-free detergents for washing vehicles as appropriate.
- Mark the area clearly as a wash area.
- Post signs stating that only washing is allowed in wash area.
- Provide trash container in wash area.
- Map on-site storm drain locations to avoid discharges to the storm drain system.
- Emphasize the connection between the storm drain system and runoff, help reinforce that car washing activities affect local water quality through storm drain stenciling programs.

*Vehicle and Equipment Cleaning*

- Have all vehicle washing done in areas designed to collect and hold the wash and rinse water or effluent generated. Recycle, collect or treat wash water effluent prior to discharge to the sanitary sewer system.
- If washing/cleaning must occur on-site, consider washing vehicle equipment inside the building or on an impervious surface to control the targeted constituents by directing them to the sanitary sewer.
- If washing must occur on-site and outdoor:
  - Use designated paved wash areas. Designated wash areas must be well marked with signs indicating where and how washing must be done. This area must be covered or bermed to collect the wash water and graded to direct the wash water to a treatment or disposal facility.
  - Do not conduct oil changes and other engine maintenance in the designated washing area. Perform these activities in a place designated for oil change and maintenance activities.
  - Cover the wash area when not in use to prevent contact with rain water.
- Install sumps or drain lines to collect wash water for treatment.
- Use hoses with nozzles that automatically turn off when left unattended.
- Do not permit steam cleaning wash water to enter the storm drain.
- Pressure and steam clean off-site to avoid generating runoff with high pollutant concentrations. If done on-site, no pressure cleaning and steam cleaning should be done in areas designated as wellhead protection areas for public water supply.

*Disposal*

- Consider filtering and recycling wash water.
- Discharge equipment wash water to the sanitary sewer, a holding tank, or a process treatment system, regardless of the washing method used.
- Collect all wash water from vehicle cleaning operations and (1) discharge to a sanitary sewer, holding tank, or process treatment system or (2) run through an enclosed recycling system.
- Collect and treat wash water at the facility and either recycle or discharge to the sanitary sewer system or collect and dispose of as an industrial waste.
- Discharge wash water to sanitary sewer after contacting local sewer authority to find out if pretreatment is required.

***Training***

- Train employees on proper cleaning and wash water disposal procedures and conduct "refresher" courses on a regular basis.
- Train staff on proper maintenance measures for the wash area.
- Train employees and contractors on proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

***Spill Response and Prevention***

- Keep the Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment, and trained personnel ready at all times to deal immediately with major spills.
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.

***Other Considerations (Limitations and Regulations)***

- Some municipalities may require pretreatment and monitoring of wash water discharges to the sanitary sewer.
- Steam cleaning can generate significant pollutant concentrations requiring that careful consideration be given to the environmental impacts and compliance issues related to steam cleaning.
- Most car washing best management practices are inexpensive, and rely more on good housekeeping practices (where vehicles are washed, planning for the collection of wash water) than on expensive technology. However, the construction of a specialized area for vehicle washing can be expensive. Also, for facilities that cannot recycle their wash water, the cost of pre-treating wash water through either structural practices or planning for

collection and hauling of contaminated water to sewage treatment plants can be cost-prohibitive.

## Requirements

### *Costs*

- Capital costs vary as follows depending on measures implemented:
  - Low cost ($2000-5,000) for berm construction
  - Medium cost ($10,000-30,000) for plumbing modifications (including re-routing discharge to sanitary sewer and installing simple sump)
  - High cost ($60,000-200,000) for on-site treatment and recycling
- O&M costs increase with increasing capital investment.

### *Maintenance*

- Perform berm repair and patching.
- Sweep washing areas frequently to remove solid debris.
- Inspect and maintain sumps, oil/water separators, and on-site treatment/recycling units.

## Supplemental Information

### *Design Considerations*

*Designated Cleaning Areas*

- Washing operations outside should be conducted in a designated wash area having the following characteristics:
  - Paved with Portland cement concrete
  - Covered and bermed to prevent contact with stormwater and contain wash water
  - Sloped for wash water collections
  - Discharges wash water to the sanitary or recycle treatment process waste sewer, or to a dead-end sump
  - Equipped with an oil/water separator if necessary

### *Examples*

The City of Palo Alto has an effective program for commercial vehicle service facilities. Many of the program's elements, including specific BMP guidance and lists of equipment suppliers, are applicable to industrial vehicle service facilities.

The U.S. Postal Service in West Sacramento has a new vehicle wash system that collects, filters, and recycles wash water.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

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Photo Credit: Geoff Brosseau

**Objectives**

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

Vehicle or equipment maintenance and repair are potentially significant sources of stormwater pollution, due to use of harmful materials and wastes during maintenance and repair processes. Engine repair and service (e.g., parts cleaning), replacement of fluids (e.g., oil change), and out door equipment storage and parking (leaking vehicles) can impact water quality if stormwater runoff from areas with these activities becomes polluted by a variety of contaminants. Implementation of the following activities will prevent or reduce the discharge of pollutants to stormwater from vehicle and equipment maintenance and repair activities.

**Targeted Constituents**

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Approach

- Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

***Pollution Prevention***

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.

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A002122

- Minimize use of solvents. Clean parts without using solvents whenever possible, or use water-based solvents for cleaning.
- Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.

***Suggested Protocols***

*General*

- Move maintenance and repair activities indoors whenever feasible.
- Store idle equipment under cover
- Use a vehicle maintenance area designed to prevent stormwater pollution - minimize contact of stormwater with outside operations through berming and appropriate drainage routing.
- Avoid hosing down your work areas. If work areas are washed, collect and direct wash water to sanitary sewer. Use dry sweeping if possible.
- Paint signs on storm drain inlets to indicate that they are not to receive liquid or solid wastes.
- Post signs at sinks to remind employees not to pour wastes down drains.
- Clean yard storm drain inlets(s) regularly and especially after large storms.
- Do not pour materials down storm drains.
- Cover the work area to limit exposure to rain.
- Place curbs around the immediate boundaries of process equipment.
- Build a shed or temporary roof over areas where parked cars await repair or salvage, especially wrecked vehicles. Build a roof over vehicles kept for parts.

*Material and Waste Handling*

- Designate a special area to drain and replace motor oil, coolant, and other fluids, where there are no connections to the storm drain or the sanitary sewer, and drips and spills can be easily cleaned up.
- Drain all fluids immediately from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g., larger pans are needed to contain antifreeze, which may gush from some vehicles).
- Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- Do not put used or leftover cleaning solutions, solvents, and automotive fluids and in the sanitary sewer.
- Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.

- Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.

- Place oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal since municipalities prohibit or discourage disposal of these items in solid waste facilities. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters. Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater.

- Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling or household hazardous waste facilities.

*Maintenance and Repair Activities*

- Provide a designated area for vehicle maintenance.

- Keep equipment clean; don't allow excessive build-up of oil and grease.

- Use a tarp, ground cloth, or drip pans beneath the vehicle or equipment to capture all spills and drips if temporary work is being conducted outside. Collected drips and spills must be disposed, reused, or recycled properly.

- Perform all vehicle fluid removal or changing inside or under cover if possible to prevent the run-on of stormwater and the runoff of spills:

  - Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, or remove other parts. Use a drip pan under any vehicle that might leak while working on it to keep splatters or drips off the shop floor.

  - Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.

  - Keep drip pans or containers under vehicles or equipment that may drip during repairs.

  - Do not change motor oil or perform equipment maintenance in non-appropriate areas.

- Drain oil and other fluids first if the vehicle or equipment is to be stored outdoors.

- Monitor parked vehicles closely for leaks. Pans should be placed under any leaks to collect the fluids for proper disposal or recycling.

- Use one of the following for lubricating vehicle-trailer coupling:

  - Adhesive lubricant

  - Plastic plates

  - Fifth wheels with plastic inserts

  - On-Board lubricating system

*Parts Cleaning*

- Mechanics should clean vehicle parts without using liquid cleaners wherever possible to reduce waste.
- Steam cleaning and pressure washing may be used instead of solvent parts cleaning. The wastewater generated from steam cleaning must be discharged to an on-site oil water separator that is connected to a sanitary sewer or blind sump. Non-caustic detergents should be used instead of caustic cleaning agents, detergent-based or water-based cleaning systems in place of organic solvent degreasers, and non-chlorinated solvent in place of chlorinated organic solvents for parts cleaning. Refer to SC21 for more information on steam cleaning.

*Inspection*

- Inspect vehicles and equipment for leaks regularly and repair immediately.
- Make sure incoming vehicles are checked for leaking oil and fluids. Do not allow leaking vehicles or equipment on-site.

***Training***

- Train employees and contractors in the proper handling and disposal of engine fluids and waste materials.
- Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures (You can use reusable cloth rags to clean up small drips and spills instead of disposables; these can be washed by a permitted industrial laundry. Do not clean them at home or at a coin-operated laundry business). Employees should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Use a training log or similar method to document training.

***Spill Response and Prevention***

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place an adequate stockpile of spill cleanup materials where it will be readily accessible.
- Clean leaks, drips, and other spills with as little water as possible. Use rags for small spills, a damp mop for general cleanup, and dry absorbent material for larger spills. Use the following three-step method for cleaning floors:
  - Clean spills with rags or other absorbent materials
  - Sweep floor using dry absorbent material
  - Mop the floor. Mop water may be discharged to the sanitary sewer via a toilet or sink.
- Remove the adsorbent materials promptly and dispose of properly when using adsorbent materials on small spills.



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### *Other Considerations (Limitations and Regulations)*

- Space and time limitations may preclude all work from being conducted indoors.
- It may not be possible to contain and clean up spills from vehicles/equipment brought on-site after working hours.
- Drain pans (usually 1 ft. x 1 ft.) are generally too small to contain antifreeze, so drip pans (3 ft. x 3 ft.) may have to be purchased or fabricated.
- Dry floor cleaning methods may not be sufficient for some spills. Use three-step method instead.
- Identification of engine leaks may require some use of solvents.
- Installation of structural treatment practices for pretreatment of wastewater discharges can be expensive.
- Prices for recycled materials and fluids may be higher than those of non-recycled materials.
- Some facilities may be limited by a lack of providers of recycled materials, and by the absence of businesses to provide services such as hazardous waste removal, structural treatment practice maintenance, or solvent equipment and solvent recycling.

## Requirements

### *Costs*

- Costs should be low, but will vary depending on the size of the facility.

### *Maintenance*

- For facilities responsible for pre-treating their wastewater prior to discharging, the proper functioning of structural treatment practices is an important maintenance consideration. Routine cleanout of oil and grease is required for the devices to maintain their effectiveness, usually at least once a month. During periods of heavy rainfall, cleanout is required more often to ensure pollutants are not washed through the trap. Sediment removal is also required on a regular basis to keep the device working efficiently.
- It is important to sweep the maintenance area weekly, if it is paved, to collect loose particles, and wipe up spills with rags and other absorbent material immediately. Do not hose down the area to a storm drain.

## Supplemental Information

### *Further Detail of the BMP*

*Waste Reduction*

Parts are often cleaned using solvents such as trichloroethylene, 1,1,1-trichloroethane or methylene chloride. Many of these cleaners are harmful and must be disposed of as a hazardous waste. Cleaning without using liquid cleaners (e.g., wire brush) whenever possible reduces waste. Prevent spills and drips of solvents and cleansers to the shop floor. Do all liquid cleaning at a centralized station so the solvents and residues stay in one area. Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents.

- Clean parts without using liquid cleaners whenever possible to reduce waste.
- Prevent spills and drips of solvents and cleansers to the shop floor.
- Do all liquid cleaning at a centralized station so the solvents and residues stay in one area.
- Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

*Recycling*

Separating wastes allows for easier recycling and may reduce treatment costs. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents (e.g., 1,1,1-trichloroethane) separate from non-chlorinated solvents (e.g., kerosene and mineral spirits).

Many products made of recycled (i.e., refined or purified) materials are available. Engine oil, transmission fluid, antifreeze, and hydraulic fluid are available in recycled form. Buying recycled products supports the market for recycled materials.

- Recycling is always preferable to disposal of unwanted materials.
- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.
- Label and track the recycling of waste material (e.g., used oil, spent solvents, batteries).
- Purchase recycled products to support the market for recycled materials.

*Vehicle-Trailer Lubrication*

Fifth-wheel bearings on trucks require routine lubrication. Typically chassis grease is applied to the fifth-wheel bearing at rates that result in grease dripping off of the bearing into the environment. To address this concern the following options are available:

- Use adhesive lubricant. Follow manufacturer's label regarding the use of adhesive lubricant for truck fifth-wheels. Typically this means applying no more than 6 oz. of grease. No visible extrusion of lubricant from the fifth-wheel bearing when truck and trailer are connected should be present.
- Use plastic plates oil on fifth-wheels with plastic inserts.
- Use on-board truck or on-board trailer lubrication system. If these systems apply lube thinner than National Grease Lubrication Institute #2, equipment for collection of used lubricant is needed to prevent excess lubricant from dripping off the truck.

*Safer Alternatives*
If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

- Use non-caustic detergents instead of caustic cleaning for parts cleaning.
- Use detergent-based or water-based cleaning systems in place of organic solvent degreasers. Wash water may require treatment before it can be discharged to the sewer.
- Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
- Choose cleaning agents that can be recycled.

***Examples***
- Pick N Pull Auto Dismantlers in Rancho Cordova drains all fluids from automobiles before they enter the yard.
- Ecology Auto Wrecking in Rialto is surrounded by a steel plate/concrete fence and has a completely paved lot that is graded to a central low point. Collected stormwater is channeled through an underground drainage system of clarifiers and then stored in a 60,000 gallon UST before being processed through a filter system. In addition, the work area is covered, ventilated and has an additional sump. Vehicle fluids are drained in this area and segregated for recycling.
- All Auto Parts, Fontana, has a complete water recycling system in a 10,000 square foot concrete slab surrounded by a curb that contains all the runoff and sends it to the recycling system. All receiving, dismantling, and shipping occur on the slab.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/E

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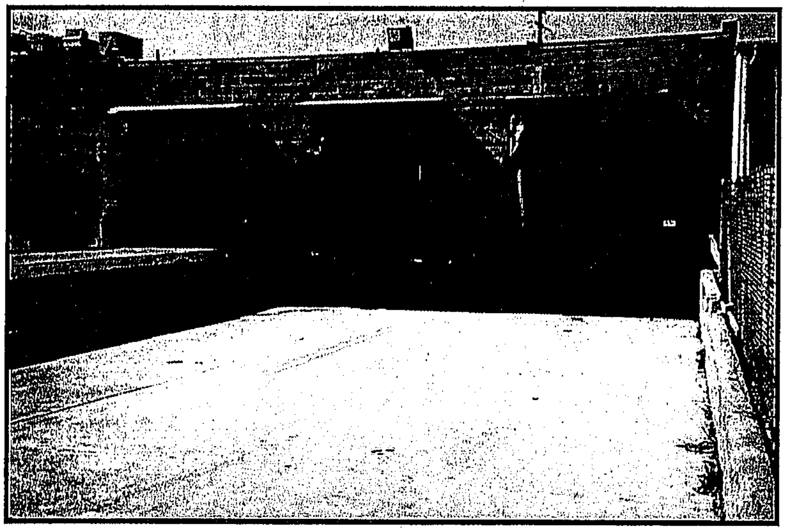
# Outdoor Loading/Unloading SC-30



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

## Targeted Constituents

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

***Pollution Prevention***

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

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***Suggested Protocols***

*Loading and Unloading – General Guidelines*

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

*Inspection*

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

***Training***

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.



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*Spill Response and Prevention*

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

*Other Considerations (Limitations and Regulations)*

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

## Requirements

*Costs*

Costs should be low except when covering a large loading/unloading area.

*Maintenance*

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

## Supplemental Information

*Further Detail of the BMP*

*Special Circumstances for Indoor Loading/Unloading of Materials*

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.



A002132

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

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The Storm Water Managers Resource Center http://www.stormwatercenter.net/



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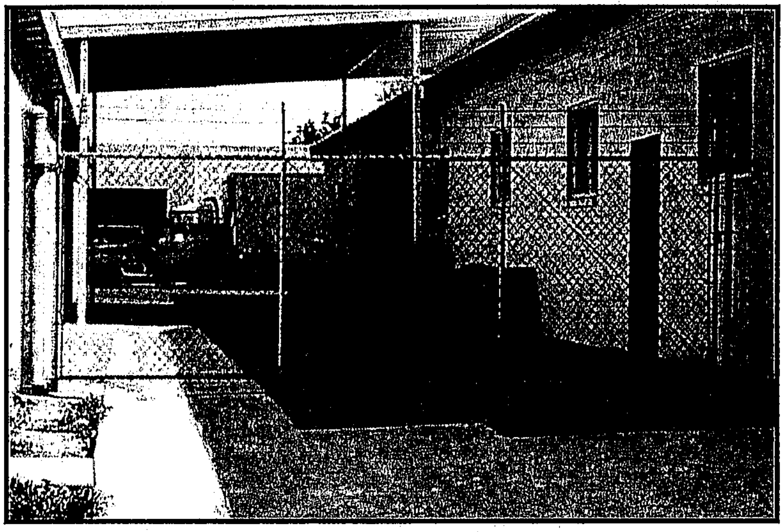

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

## Description

Accidental releases of materials from above ground liquid storage tanks, drums, and dumpsters present the potential for contaminating stormwaters with many different pollutants. Tanks may store many potential stormwater runoff pollutants, such as gasoline, aviation gas, diesel fuel, kerosene, oils, greases, lubricants and other distilled, blended and refined products derived from crude petroleum. Materials spilled, leaked, or lost from storage tanks may accumulate in soils or on other surfaces and be carried away by rainfall runoff. These source controls apply to containers located outside of a building used to temporarily store liquid materials and include installing safeguards against accidental releases, installing secondary containment, conducting regular inspections, and training employees in standard operating procedures and spill cleanup techniques.

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Approach

### *Pollution Prevention*

- Educate employees about pollution prevention measures and goals.

- Keep an accurate, up-to-date inventory of the materials delivered and stored on-site.

- Try to keep chemicals in their original containers, and keep them well labeled.

### *Suggested Protocols*

*General*

- Develop an operations plan that describes procedures for loading and/or unloading. Refer to SC-30 – Outdoor

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Loading/Unloading of Materials for more detailed BMP information pertaining to loading and unloading of liquids.

- Protect materials from rainfall, run-on, runoff, and wind dispersal:
  - Cover the storage area with a roof.
  - Minimize stormwater run-on by enclosing the area or building a berm around it.
  - Use a "doghouse" structure for storage of liquid containers.
  - Use covered dumpsters for waste product containers.
- Employ safeguards against accidental releases:
  - Provide overflow protection devices to warn operator or automatic shut down transfer pumps.
  - Provide protection guards (bollards) around tanks and piping to prevent damage from a vehicle or forklift.
  - Provide clear tagging or labeling, and restrict access to valves to reduce human error.
- Berm or surround tank or container with secondary containment system, including dikes, liners, vaults, or double walled tanks.
- Be aware and ready to address the fact that some municipalities require secondary containment areas to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.
- Contact the appropriate regulatory agency regarding environmental compliance for facilities with "spill ponds" designed to intercept, treat, and/or divert spills.
- Have registered and specifically trained professional engineers identify and correct potential problems such as loose fittings, poor welding, and improper or poorly fitted gaskets for newly installed tank systems.

*Storage Areas*

- Provide storage tank piping located below product level with a shut-off valve at the tank; ideally this valve should be an automatic shear valve with the shut-off located inside the tank.
- Provide barriers such as posts or guardrails, where tanks are exposed, to prevent collision damage with vehicles.
- Provide secure storage to prevent vandalism-caused contamination.
- Place tight-fitting lids on all containers.
- Enclose or cover the containers where they are stored.



A002135

- Raise the containers off the ground by use of pallet or similar method, with provisions for spill control.

- Contain the material in such a manner that if the container leaks or spills, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters or groundwater.

- Place drip pans or absorbent materials beneath all mounted container taps, and at all potential drip and spill locations during filling and unloading of containers. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.

- Ensure that any underground or aboveground storage tanks are designed and managed in accordance with applicable regulations, identified as a potential pollution source, and have secondary containment such as a berm or dike with an impervious surface.

*Inspection*

- Provide regular inspections:

  - Inspect storage areas regularly for leaks or spills.

  - Conduct routine inspections and check for external corrosion of material containers. Also check for structural failure, spills and overfills due to operator error, failure of piping system.

  - Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

  - Visually inspect new tank or container installations for loose fittings, poor welding, and improper or poorly fitted gaskets.

  - Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.

  - Replace containers that are leaking, corroded, or otherwise deteriorating with ones in good condition. If the liquid chemicals are corrosive, containers made of compatible materials must be used instead of metal drums.

  - New or secondary containers must be labeled with the product name and hazards.

***Training***

- Train employee (e.g., fork lift operators) and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

- Train employees in proper storage measures.

- Use a training log or similar method to document training.

### *Spill Response and Prevention*

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment, and trained personnel ready at all times to deal immediately with major spills.
- Collect all spilled liquids and properly dispose of them.
- Have employees trained in emergency spill cleanup procedures present when dangerous waste, liquid chemicals, or other wastes are delivered.
- Prevent operator errors by using engineering safeguards and thus reducing accidental releases of pollutants.
- Store and maintain appropriate spill cleanup materials in a location near the tank storage area and known to all.

### *Other Considerations*

- Storage sheds often must meet building and fire code requirements.
- The local fire district must be consulted for limitations on clearance of roof covers over containers used to store flammable materials.
- All specific standards set by Federal and State laws concerning the storage of oil and hazardous materials must be met.
- Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code.
- Storage of oil and hazardous materials must meet specific Federal and State standards including:
  - Spill Prevention Control and Countermeasure Plan (SPCC) Plan
  - Secondary containment
  - Integrity and leak detection monitoring
  - Emergency preparedness plans

## Requirements

### *Costs*

Costs will vary depending on the size of the facility and the necessary controls, such as berms or safeguards against accidental controls.

### *Maintenance*

- Conduct weekly inspection.
- Sweep and clean the storage area regularly if it is paved, do not hose down the area to a storm drain.



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## Supplemental Information

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

***Further Detail of the BMP***

*Aboveground Tank Leak and Spill Control*

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be paved with Portland cement concrete, free of cracks and gaps, and impervious in order to contain leaks and spills,
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10% of the volume of all of the containers or 110% of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator

Maintenance is critical to preventing leaks and spills. Conduct routine weekly inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa



A002138

- Inspect new tank or container installation visually for loose fittings, poor welding, and improper or poorly fitted gaskets.

- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.

- Frequently release accumulated stormwater during the wet season.

- Have periodic integrity testing conducted by a qualified professional.

*Container Management*

- To limit the possibility of stormwater pollution, containers used to store dangerous waste or other liquids should be kept inside the building unless this is impractical due to site constraints. If the containers are placed outside, the following procedures should be employed:

  - Dumpsters used to store items awaiting transfer to a landfill should be placed in a lean-to structure or otherwise covered. Dumpsters shall be kept in good condition without corrosion or leaky seams.

  - Garbage dumpsters shall be replaced if they are deteriorating to the point where leakage is occurring. Dumpsters should be kept undercover to prevent the entry of stormwater. Employees should be made aware of the importance of keeping the dumpsters covered and free from leaks.

  - Waste container drums should be kept in an area such as a service bay. If drums are kept outside, they must be stored in a lean-to type structure, shed or walk-in container to keep rainfall from reaching the drums.

*Dikes*

One of the best protective measures against contamination of stormwater is diking. Containment dikes are berms or retaining walls that are designed to hold spills. Diking is an effective pollution prevention measure for above ground storage tanks and railcar or tank truck loading and unloading areas. The dike surrounds the area of concern and holds the spill, keeping spill materials separated from the stormwater side of the dike area. Diking can be used in any industrial or municipal facility, but it is most commonly used for controlling large spills or releases from liquid storage areas and liquid transfer areas.

- For single-wall tanks, containment dikes should be large enough to hold the contents of the storage tank for the facility plus rain water.

- For trucks, diked areas should be capable of holding an amount equal to the volume of the tank truck compartment. Diked construction material should be strong enough to safely hold spilled materials.

- Dike materials can consist of earth, concrete, synthetic materials, metal, or other impervious materials.

- Strong acids or bases may react with metal containers, concrete, and some plastics.



A002139

- Where strong acids or bases or stored, alternative dike materials should be considered. More active organic chemicals may need certain special liners for dikes.

- Dikes may also be designed with impermeable materials to increase containment capabilities.

- Dikes should be inspected during or after significant storms or spills to check for washouts or overflows.

- Regular checks of containment dikes to insure the dikes are capable of holding spills should be conducted.

- Inability of a structure to retain stormwater, dike erosion, soggy areas, or changes in vegetation indicate problems with dike structures. Damaged areas should be patched and stabilized immediately.

- Earthen dikes may require special maintenance of vegetation such as mulching and irrigation.

*Curbing*

Curbing is a barrier that surrounds an area of concern. Curbing is similar to containment diking in the way that it prevents spills and leaks from being released into the environment. Curbing is usually small scaled and does not contain large spills like diking. Curbing is common at many facilities in small areas where handling and transfer of liquid materials occur. Curbing can redirect contaminated stormwater away from the storage area. It is useful in areas where liquid materials are transferred from one container to another. Asphalt is a common material used for curbing; however, curbing materials can include earth, concrete, synthetic materials, metal, or other impenetrable materials.

- Spilled materials should be removed immediately from curbed areas to allow space for future spills.

- Curbs should have manually-controlled pump systems rather than common drainage systems for collection of spilled materials.

- The curbed area should be inspected regularly to clear clogging debris.

- Maintenance should also be conducted frequently to prevent overflow of any spilled materials as curbed areas are designed only for smaller spills.

- Curbing has the following advantages:

  - Excellent run-on control

  - Inexpensive

  - Ease of installment

  - Provides option to recycle materials spilled in curb areas

  - Common industry practice

# SC-31 Outdoor Liquid Container Storage

### *Examples*

The "doghouse" design has been used to store small liquid containers. The roof and flooring design prevent contact with direct rain or runoff. The doghouse has two solid structural walls and two canvas covered walls. The flooring is wire mesh about secondary containment. The unit has been used successfully at Lockheed Missile and Space Company in Sunnyvale.

## References and Resources


California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

# Outdoor Equipment Operations SC-32

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

## Targeted Constituents

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Description

Outside process equipment operations and maintenance can contaminate stormwater runoff. Activities, such as grinding, painting, coating, sanding, degreasing or parts cleaning, landfills and waste piles, solid waste treatment and disposal, are examples of process operations that can lead to contamination of stormwater runoff. Source controls for outdoor process equipment operations and maintenance include reducing the amount of waste created, enclosing or covering all or some of the equipment, installing secondary containment, and training employees.

## Approach

### *Pollution Prevention*

- Perform the activity during dry periods.
- Use non-toxic chemicals for maintenance and minimize or eliminate the use of solvents.

### *Suggested Protocols*

- Consider enclosing the activity in a building and connecting the floor drains to the sanitary sewer.
- Cover the work area with a permanent roof if possible.
- Minimize contact of stormwater with outside process equipment operations through berming and drainage routing (run-on prevention). If possible, connect process equipment area to public sewer or facility wastewater treatment system. Some municipalities require that secondary containment areas be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.
- Dry clean the work area regularly.

### *Training*

- Train employees to perform the activity during dry periods only or substituting benign materials for more toxic ones.
- Train employee and contractors in proper techniques for spill containment and cleanup. Employees should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

### *Spill Response and Prevention*

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.

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A002142

- Have employees trained in emergency spill cleanup procedures present when dangerous waste, liquid chemicals, or other wastes are delivered.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Prevent operator errors by using engineering safe guards and thus reducing accidental releases of pollutant.
- Inspect storage areas regularly for leaks or spills. Also check for structural failure, spills and overfills due to operator error, and/or failure of piping system.

### *Other Considerations*

- Providing cover may be expensive.
- Space limitations may preclude enclosing some equipment.
- Storage sheds often must meet building and fire code requirements.

## Requirements

### *Costs*

Costs vary depending on the complexity of the operation and the amount of control necessary for stormwater pollution control.

### *Maintenance*

- Conduct routine preventive maintenance, including checking process equipment for leaks.
- Clean the storm drain system regularly.

## Supplemental Information

### *Further Detail of the BMP*

*Hydraulic/Treatment Modifications*

If stormwater becomes polluted, it should be captured and treated. If you do not have your own process wastewater treatment system, consider discharging to the public sewer system. Use of the public sewer might be allowed under the following conditions:

- If the activity area is very small (less than a few hundred square feet), the local sewer authority may be willing to allow the area to remain uncovered with the drain connected to the public sewer.
- It may be possible under unusual circumstances to connect a much larger area to the public sewer, as long as the rate of stormwater discharges does not exceed the capacity of the wastewater treatment plant. The stormwater could be stored during the storm and then transferred to the public sewer when the normal flow is low, such as at night.

Industries that generate large volumes of process wastewater typically have their own treatment system and corresponding permit. These industries have the discretion to use their wastewater treatment system to treat stormwater within the constraints of their permit requirements for process treatment. It may also be possible for the industry to discharge the stormwater directly to an effluent outfall without treatment as long as the total loading of the discharged process



A002143

water and stormwater does not exceed the loading had a stormwater treatment device been used. This could be achieved by reducing the loading from the process wastewater treatment system. Check with your Regional Water Quality Control Board or local sewering agency, as this option would be subject to permit constraints and potentially regular monitoring.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

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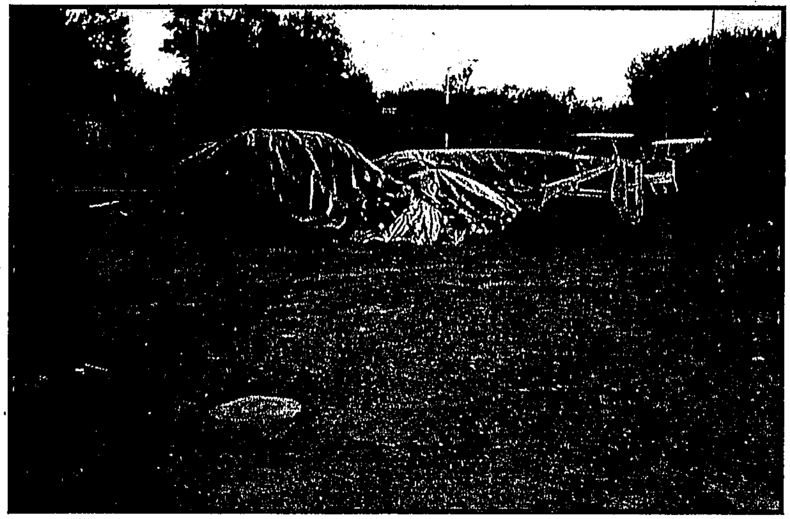

**Objectives**

- Cover
- Contain
- Educate
- Reduce/Minimize

## Description

Raw materials, by-products, finished products, containers, and material storage areas exposed to rain and/or runoff can pollute stormwater. Stormwater can become contaminated when materials wash off or dissolve into water or are added to runoff by spills and leaks. Improper storage of these materials can result in accidental spills and the release of materials. To prevent or reduce the discharge of pollutants to stormwater from material delivery and storage, pollution prevention and source control measures must be implemented, such as minimizing the storage of hazardous materials on-site, enclosing or covering materials, storing materials in a designated area, installing secondary containment, conducting regular inspections, preventing stormwater run-on and runoff, and training employees and subcontractors.

**Targeted Constituents**

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *Pollution Prevention*

- Emphasize employee education for successful BMP implementation.
- Minimize inventory of raw materials.
- Keep an accurate, up-to-date inventory of the materials delivered and stored on-site.

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A002146

- Try to keep chemicals in their original containers and keep them well labeled.

***Suggested Protocols***

*General*

- Store all materials inside. If this is not feasible, then all outside storage areas should be covered with a roof and bermed or enclosed to prevent stormwater contact. At the very minimum, a temporary waterproof covering made of polyethylene, polypropylene or hypalon should be used over all materials stored outside.
- Cover and contain the stockpiles of raw materials to prevent stormwater from running into the covered piles. The covers must be in place at all times when work with the stockpiles is not occurring. (Applicable to small stockpiles only).
- Implement erosion control practices at the perimeter of your site and at any catch basins to prevent erosion of the stockpiled material off-site, if the stockpiles are so large that they cannot feasibly be covered and contained.
- Keep liquids in a designated area on a paved impervious surface within a secondary containment.
- Keep outdoor storage containers in good condition.
- Minimize stormwater run-on by enclosing the area or building a berm around it.
- Keep storage areas clean and dry.
- Slope paved areas should be sloped in a manner that minimize pooling of water on the site, particularly with materials that may leach pollutants into stormwater and/or groundwater, such as compost, logs, and wood chips. A minimum slope of 1.5% is recommended.
- Secure drums stored in an area where unauthorized persons may gain access to prevent accidental spillage, pilferage, or any unauthorized use.
- Cover wood products treated with chromated copper arsenate, ammonical copper zinc arsenate, creosote, or pentachlorophenol with tarps or store indoors.

*Raw Material Containment*

- Curbing should be placed along the perimeter of the area to prevent the run-on of uncontaminated stormwater from adjacent areas as well as runoff of stormwater from the stockpile areas.
- Tanks should be bermed or surrounded by a secondary containment system.
- The area inside the curb should slope to a drain. Liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

*Inspection*

- Conduct regular inspections of storage areas so that leaks and spills are detected as soon as possible.

- Check berms, curbing, containment for repair and patching.

### *Training*

- Train employees well in proper material storage.

- Train employees and contractors in proper techniques for spill containment and cleanup.

### *Spill Response and Prevention*

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.

- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.

- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.

### *Other Considerations*

- Storage sheds often must meet building and fire code requirements. Storage of reactive, ignitable, or flammable liquids must comply with the Uniform Fire Code and the National Electric Code.

- Space limitations may preclude storing some materials indoors.

- Some municipalities require that secondary containment areas (regardless of size) be connected to the sanitary sewer, prohibiting any hard connections to the storm drain. Storage sheds often must meet building and fire code requirements.

- The local fire district must be consulted for limitations on clearance of roof covers over containers used to store flammable materials.

## Requirements

### *Costs*

Costs will vary depending on the size of the facility and the necessary controls. They should be low except where large areas may have to be covered.

### *Maintenance*

- Accurate and up-to-date inventories should be kept of all stored materials.

- Berms and curbs may require periodic repair and patching.

- Parking lots or other surfaces near bulk materials storage areas should be swept periodically to remove debris blown or washed from storage areas.

- Sweep paved storage areas regularly for collection and disposal of loose solid materials, do not hose down the area to a storm drain or conveyance ditch.

- Keep outdoor storage areas in good condition (e.g., repair roofs, floors, etc., to limit releases to runoff).

## Supplemental Information

***Further Detail of the BMP***

*Raw Material Containment*

Paved areas should be sloped in a manner that minimizes pooling of water on the site, particularly with materials that may leach pollutants into stormwater and/or groundwater, such as compost, logs, and wood chips. A minimum slope of 1.5% is recommended.

- Curbing should be placed along the perimeter of the area to prevent the run-on of uncontaminated stormwater from adjacent areas as well as runoff of stormwater from stockpile areas.
- The storm drainage system should be designed to minimize use of catch basins in the interior of the area as they tend to rapidly fill with manufacturing material.
- The area should be sloped to drain stormwater to the perimeter where it can be collected or to internal drainage alleyways where material is not stockpiled.
- If the raw material, by-product, or product is a liquid, more information for outside storage of liquids can be found under SC31, Outdoor Liquid Container Storage.

## Supplemental Information

***Examples***

The "doghouse" design has been used to store small liquid containers. The roof and flooring design prevent contact with direct rain or runoff. The doghouse has two solid structural walls and two canvas covered walls. The flooring is wire mesh about secondary containment. The unit has been used successively at Lockheed Missile and Space Company in Sunnyvale.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | |
| Metals | ✓ |
| Bacteria | ✓ |
| Oil and Grease | ✓ |
| Organics | ✓ |

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## Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

## Approach

### *Pollution Prevention*

- Accomplish reduction in the amount of waste generated using the following source controls:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.



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***Suggested Protocols***

*General*

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.

- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.

- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.

- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.

- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.

- Transfer waste from damaged containers into safe containers.

- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

*Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.

- Provide a sufficient number of litter receptacles for the facility.

- Clean out and cover litter receptacles frequently to prevent spillage.

*Waste Collection*

- Keep waste collection areas clean.

- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.

- Secure solid waste containers; containers must be closed tightly when not in use.

- Do not fill waste containers with washout water or any other liquid.

- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

*Good Housekeeping*

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

*Chemical/Hazardous Wastes*

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

*Run-on/Runoff Prevention*

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

*Inspection*

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.



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- Repair leaking equipment including valves, lines, seals, or pumps promptly.

***Training***
- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

***Spill Response and Prevention***
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

***Other Considerations (Limitations and Regulations)***
Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

## Requirements

***Costs***
Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

***Maintenance***
- None except for maintaining equipment for material tracking program.

## Supplemental Information

***Further Detail of the BMP***
*Land Treatment System*
Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

***Examples***

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

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# Safer Alternative Products SC-35

## Description

Promote the use of less harmful products and products that contain little or no TMDL pollutants. Alternatives exist for most product classes including chemical fertilizers, pesticides, cleaning solutions, janitorial chemicals, automotive and paint products, and consumables (batteries, fluorescent lamps).

## Approach

Pattern a new program after the many established programs around the state and country. Integrate this best management practice as much as possible with existing programs at your facility.

Develop a comprehensive program based on:

- The "Precautionary Principle," which is an alternative to the "Risk Assessment" model that says it's acceptable to use a potentially harmful product until physical evidence of its harmful effects are established and deemed too costly from an environmental or public health perspective. For instance, a risk assessment approach might say it's acceptable to use a pesticide until there is direct proof of an environmental impact. The Precautionary Principle approach is used to evaluate whether a given product is safe, whether it is really necessary, and whether alternative products would perform just as well.

- Environmentally Preferable Purchasing Program to minimize the purchase of products containing hazardous ingredients used in the facility's custodial services, fleet maintenance, and facility maintenance in favor of using alternate products that pose less risk to employees and to the environment.

- Integrated Pest Management (IPM) or Less-Toxic Pesticide Program, which uses a pest management approach that minimizes the use of toxic chemicals and gets rid of pests by methods that pose a lower risk to employees, the public, and the environment.

- Energy Efficiency Program including no-cost and low-cost energy conservation and efficiency actions that can reduce both energy consumption and electricity bills, along with long-term energy efficiency investments.

Consider the following mechanisms for developing and implementing a comprehensive program:

- Policies

### Objectives

- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

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A002156

- Procedures
  - Standard operating procedures (SOPs)
  - Purchasing guidelines and procedures
  - Bid packages (services and supplies)
- Materials
  - Preferred or approved product and supplier lists
  - Product and supplier evaluation criteria
  - Training sessions and manuals
  - Fact sheets for employees

Implement this BMP in conjunction with the Vehicle and Equipment Management fact sheets (SC20 – SC22) and SC41, Building and Grounds Maintenance.

*Training*

- Employees who handle potentially harmful materials in the use of safer alternatives.
- Purchasing departments should be encouraged to procure less hazardous materials and products that contain little or no harmful substances or TMDL pollutants.

*Regulations*

This BMP has no regulatory requirements. Existing regulations already encourage facilities to reduce the use of hazardous materials through incentives such as reduced:

- Specialized equipment storage and handling requirements,
- Storm water runoff sampling requirements,
- Training and licensing requirements, and
- Record keeping and reporting requirements.

*Equipment*

- There are no major equipment requirements to this BMP.

*Limitations*

- Alternative products may not be available, suitable, or effective in every case.

## Requirements

*Cost Considerations*

- The primary cost is for staff time to: 1) develop new policies and procedures and 2) educate purchasing departments and employees who handle potentially harmful materials about the availability, procurement, and use of safer alternatives.



A002157

- Some alternative products may be slightly more expensive than conventional products.

## Supplemental Information

Employees and contractors / service providers can both be educated about safer alternatives by using information developed by a number of organizations including the references and resources listed below.

The following discussion provides some general information on safer alternatives. More specific information on particular hazardous materials and the available alternatives may be found in the references and resources listed below.

- Automotive products – Less toxic alternatives are not available for many automotive products, especially engine fluids. But there are alternatives to grease lubricants, car polishes, degreasers, and windshield washer solution. Rerefined motor oil is also available.
- Vehicle/Trailer lubrication – Fifth wheel bearings on trucks require routine lubrication. Adhesive lubricants are available to replace typical chassis grease.
- Cleaners – Vegetables-based or citrus-based soaps are available to replace petroleum-based soaps/detergents.
- Paint products – Water-based paints, wood preservatives, stains, and finishes are available.
- Pesticides – Specific alternative products or methods exist to control most insects, fungi, and weeds.
- Chemical Fertilizers – Compost and soil amendments are natural alternatives.
- Consumables – Manufacturers have either reduced or are in the process of reducing the amount of heavy metals in consumables such as batteries and fluorescent lamps. All fluorescent lamps contain mercury, however low-mercury containing lamps are now available from most hardware and lighting stores. Fluorescent lamps are also more energy efficient than the average incandescent lamp.
- Janitorial chemicals – Even biodegradable soap can harm fish and wildlife before it biodegrades. Biodegradable does not mean non-toxic. Safer products and procedures are available for floor stripping and cleaning, as well as carpet, glass, metal, and restroom cleaning and disinfecting.

### *Examples*

There are a number of business and trade associations, and communities with effective programs. Some of the more prominent are listed below in the references and resources section.

## References and Resources

Note: Many of these references provide alternative products for materials that typically are used inside and disposed to the sanitary sewer as well as alternatives to products that usually end up in the storm drain.

***General Sustainable Practices and Pollution Prevention Including Pollutant-Specific Information***

California Department of Toxic Substances Control (www.dtsc.ca.gov)

California Integrated Waste Management Board (www.ciwmb.ca.gov)

City of Santa Monica (www.santa-monica.org/environment)

City of Palo Alto (www.city.palo-alto.ca.us/cleanbay)

City and County of San Francisco, Department of the Environment (www.ci.sf.ca.us/sfenvironment)

Earth 911 (www.earth911.org/master.asp)

Environmental Finance Center Region IX (www.greenstart.org/efc9)

Flex Your Power (www.flexyourpower.ca.gov)

GreenBiz.com (www.greenbiz.com)

Green Business Program (www.abag.org/bayarea/enviro/gbus/gb.html)

Pacific Industrial and Business Association (www.piba.org)

Sacramento Clean Water Business Partners (www.sacstormwater.org)

USEPA BMP fact sheet – Alternative products (http://cfpub.epa.gov/npdes/stormwater/menuofbmps/poll_2.cfm)

USEPA Region IX Pollution Prevention Program (www.epa.gov/region09/p2)

Western Regional Pollution Prevention Network (www.westp2net.org)

***Metals (mercury, copper)***

National Electrical Manufacturers Association - Environment, Health and Safety (www.nema.org)

Sustainable Conservation (www.suscon.org)

Auto Recycling Project

Brake Pad Partnership

***Pesticides and Chemical Fertilizers***

Bio-Integral Resource Center (www.birc.org)

California Department of Pesticide Regulation (www.cdpr.ca.gov)

University of California Statewide IPM Program (www.ipm.ucdavis.edu/default.html)

*Dioxins*

Bay Area Dioxins Project (http://dioxin.abag.ca.gov/)

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# Contaminated or Erodible Areas SC-40

## Description

Areas within an industrial site that are bare of vegetation or are subject to activities that promote the suppression of vegetation are often subject to erosion. In addition, they may or may not be contaminated from past or current activities. If the area is temporarily bare because of construction, see SC-42, Building Repair, Remodeling, and Construction. Sites with excessive erosion or the potential for excessive erosion should consider employing the soil erosion BMPs identified in the Construction BMP Handbook. Note that this fact sheet addresses soils that are not so contaminated as to exceed hazardous waste criteria (see Title 22 California Code of Regulations for Hazardous Waste Criteria).

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *Pollution Prevention*

Preserve natural vegetation whenever possible. See also EC-2, Preservation of Existing Vegetation, in the Construction BMP Handbook.

### *Suggested Protocols*

- Preserve natural vegetation.
- Analyze soil conditions.
- Re-vegetate when necessary.
- Remove contaminated soil.
- Utilize chemical stabilization when needed. See also EC-5, Soil Binders, and EC-13, Polyacrylamide, in the Construction BMP Handbook.
- Use geosynthetic membranes to control erosion if feasible. See also EC-7, Geotextiles and Mats, in the Construction BMP Handbook.

### *Training*

Training is not a significant element of this best management practice.

### Targeted Constituents

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | ✓ |
| Oil and Grease | ✓ |
| Organics | ✓ |

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A002162

*Other Considerations*

- Disadvantages of preserving natural vegetation or revegetation include:
  - Requires substantial planning to preserve and maintain the existing vegetation
  - May not be cost-effective with high land costs
  - Lack of rainfall, inadequate irrigation and/or poor soils may limit the success of re-vegetated areas
- Disadvantages of chemical stabilization include:
  - Creation of impervious surfaces
  - May cause harmful effects on water quality
  - Is usually more expensive than vegetative cover

## Requirements

*Costs*

Except for preservation of natural vegetation, each of the above solutions can be quite expensive depending upon the size of the area.

*Maintenance*

Maintenance should be minimal, except possibly if irrigation of vegetation is necessary.

## Supplemental Information

*Preserving Vegetation to Minimize Erosion*

Preserving stabilized areas minimizes erosion potential, protects water quality, and provides aesthetic benefits. The most effective way to control erosion is to preserve existing vegetation. Preservation of natural vegetation provides a natural buffer zone and an opportunity for infiltration of stormwater and capture of pollutants in the soil matrix. This practice can be used as a permanent source control measure.

Vegetation preservation should be incorporated into the site. Preservation requires good site management to minimize the impact of construction when construction is underway and exposure of soils after construction. Proper maintenance is important to ensure healthy vegetation that can control erosion. Different species, soil types, and climatic conditions will require different maintenance activities such as mulching, fertilizing, liming, irrigation, pruning and weed and pest control. Maintenance should be performed regularly especially during construction phases.

The preferred approach is to leave as much native vegetation on-site as possible, thereby reducing or eliminating any erosion problem. However, assuming the site already has contaminated or erodible surface areas, there are four possible courses of action which can be taken:

- The area can be revegetated if it is not in use and therefore not subject to damage from site activities. In as much as the area is already devoid of vegetation, special measures are likely



A002163

necessary. Lack of vegetation may be due to the lack of water and/or poor soils. The latter can perhaps be solved with fertilization, or the ground may simply be too compacted from prior use. Improving soil conditions may be sufficient to support the recovery of vegetation. Use process wastewater for irrigation if possible. Finally, see the Construction BMP Handbook for further procedures on establishing vegetation.

- Chemical stabilization can be used as an alternate method in areas where temporary seeding practices cannot be used because of season or climate. It can provide immediate, effective, and inexpensive erosion control. Application rates and procedures recommended by the manufacturer should be followed as closely as possible to prevent the products from forming ponds and creating large areas where moisture cannot penetrate the soil. See also EC-5, Soil Binders, and EC-13, Polyacrylamide, in the Construction BMP Handbook for more information. Advantages of chemical stabilization include:

  - Applied easily to the surface
  - Stabilizes areas effectively
  - Provides immediate protection to soils that are in danger of erosion

- Contaminated soils can be removed, however this is a last resort and quite expensive. The level and extent of the contamination must be determined. This determination and removal must comply with State and Federal regulations, permits must be acquired and fees paid.

- Geosynthetics may be used. Geosynthetics include those materials that are designed as an impermeable barrier to contain or control large amounts of liquid or solid matter. Geosynthetics have been developed primarily for use in landfills and surface impoundments, and the technology is well established. There are two general types of geosynthetics: geomembranes (impermeable) and geotextiles (permeable). Geomembranes are composed of one of three types of impermeable materials: elastomers (rubbers), thermoplasics (plastics), or a combination of these two types of materials. See also EC-7, Geotextiles and Mats, in the Construction BMP Handbook for more information. The advantages of these materials include:

  - A variety of compounds are available
  - Sheeting is produced in a factory environment
  - Polymeric membranes are flexible
  - Installation is simple

  Disadvantages include:

  - Chemical resistance must be determined for each application
  - Seaming systems may be a weak link in the system
  - Many materials are subject to attack from biotic, mechanical, or environmental sources

Geotextiles are uncoated synthetic textile products that are not watertight. They are composed of a variety of materials, most commonly polypropylene and polyester. Geotextiles serve five basic functions:

- Filtration
- Drainage
- Separation
- Reinforcement
- Armoring

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/


## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | ✓ |
| Trash | |
| Metals | ✓ |
| Bacteria | ✓ |
| Oil and Grease | |
| Organics | |

## Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *Pollution Prevention*

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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A002166

- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

***Suggested Protocols***

*Pressure Washing of Buildings, Rooftops, and Other Large Objects*

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

*Landscaping Activities*

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

*Building Repair, Remodeling, and Construction*

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.

- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

*Mowing, Trimming, and Planting*

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures when soils are exposed.

- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.

- Use hand weeding where practical.

*Fertilizer and Pesticide Management*

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.

- Do not use pesticides if rain is expected.

- Do not mix or prepare pesticides for application near storm drains.

- Use the minimum amount needed for the job.

- Calibrate fertilizer distributors to avoid excessive application.

- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.

- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.

- Irrigate slowly to prevent runoff and then only as much as is needed.

- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

*Inspection*

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

***Training***

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

***Spill Response and Prevention***

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

***Other Considerations***

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

## Requirements

***Costs***

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

***Maintenance***

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

## Supplemental Information

### *Further Detail of the BMP*

*Fire Sprinkler Line Flushing*

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

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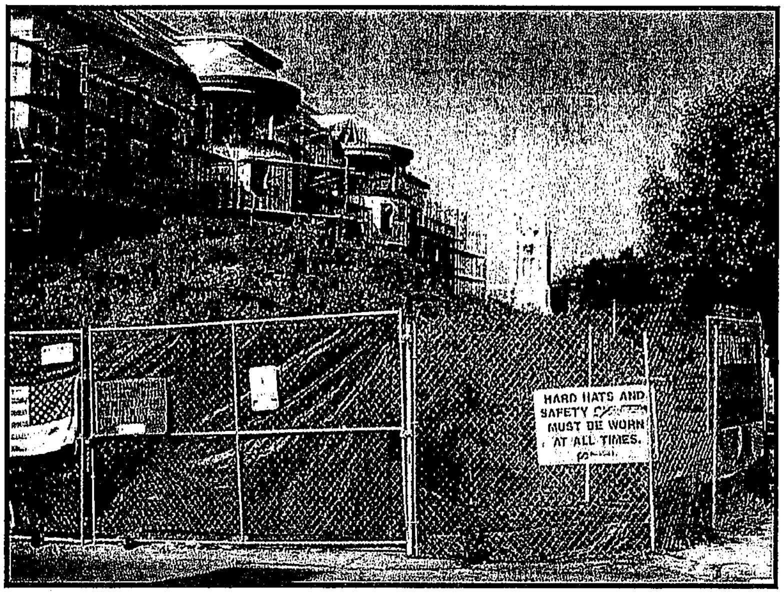

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Recycle

### Targeted Constituents

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | |
| Trash | ✓ |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Description

Modifications are common particularly at large industrial sites. The activity may vary from minor and normal building repair to major remodeling, or the construction of new facilities. These activities can generate pollutants including solvents, paints, paint and varnish removers, finishing residues, spent thinners, soap cleaners, kerosene, asphalt and concrete materials, adhesive residues, and old asbestos installation. Protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants to stormwater from building repair, remodeling, and construction by using soil erosion controls, enclosing or covering building material storage areas, using good housekeeping practices, using safer alternative products, and training employees.

## Approach

### *Pollution Prevention*

- Recycle residual paints, solvents, lumber, and other materials to the maximum extent practical.
- Buy recycled products to the maximum extent practical.
- Inform on-site contractors of company policy on these matters and include appropriate provisions in their contract to ensure certain proper housekeeping and disposal practices are implemented.

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A002172

- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids.

***Suggested Protocols***

*Repair & Remodeling*

- Follow BMPs identified in Construction BMP Handbook.
- Maintain good housekeeping practices while work is underway.
- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Cover materials of particular concern that must be left outside, particularly during the rainy season.
- Do not dump waste liquids down the storm drain.
- Dispose of wash water, sweepings, and sediments properly.
- Store materials properly that are normally used in repair and remodeling such as paints and solvents.
- Sweep out the gutter or wash the gutter and trap the particles at the outlet of the downspout if when repairing roofs, small particles have accumulated in the gutter. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, place a temporary plug at the first convenient point in the storm drain and pump out the water with a vactor truck, and clean the catch basin sump where you placed the plug.
- Properly store and dispose waste materials generated from construction activities. See Construction BMP Handbook.
- Clean the storm drain system in the immediate vicinity of the construction activity after it is completed.

*Painting*

- Enclose painting operations consistent with local air quality regulations and OSHA.
- Local air pollution regulations may, in many areas of the state, specify painting procedures which if properly carried out are usually sufficient to protect water quality.
- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint containers.
- Mix paint indoors before using so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100% effective.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.



A002173

- Do not transfer or load paint near storm drain inlets.
- Plug nearby storm drain inlets prior to starting painting and remove plugs when job is complete when there is significant risk of a spill reaching storm drains.
- Cover nearby storm drain inlets prior to starting work if sand blasting is used to remove paint.
- Use a ground cloth to collect the chips if painting requires scraping or sand blasting of the existing surface. Dispose the residue properly.
- Cover or enclose painting operations properly to avoid drift.
- Clean the application equipment in a sink that is connected to the sanitary sewer if using water based paints.
- Capture all cleanup-water and dispose of properly.
- Dispose of paints containing lead or tributyl tin and considered a hazardous waste properly.
- Store leftover paints if they are to be kept for the next job properly, or dispose properly.
- Recycle paint when possible. Dispose of paint at an appropriate household hazardous waste facility.

### *Training*

Proper education of off-site contractors is often overlooked. The conscientious efforts of well trained employees can be lost by unknowing off-site contractors, so make sure they are well informed about what they are expected to do.

### *Spill Response and Prevention*

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Clean up spills immediately.
- Excavate and remove the contaminated (stained) soil if a spill occurs on dirt.

### *Limitations*

- This BMP is for minor construction only. The State's General Construction Activity Stormwater Permit has more requirements for larger projects. The companion "Construction Best Management Practice Handbook" contains specific guidance and best management practices for larger-scale projects.
- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Be certain that actions to help stormwater quality are consistent with Cal- and Fed-OSHA and air quality regulations.

## Requirements

### *Costs*

These BMPs are generally low to modest in cost.

### *Maintenance*

N/A

## Supplemental Information

### *Further Detail of the BMP*

*Soil/Erosion Control*

If the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques. See the Construction Best Management Practice Handbook. If old buildings are being torn down and not replaced in the near future, stabilize the site using measures described in SC-40 Contaminated or Erodible Areas.

If a building is to be placed over an open area with a storm drainage system, make sure the storm inlets within the building are covered or removed, or the storm line is connected to the sanitary sewer. If because of the remodeling a new drainage system is to be installed or the existing system is to be modified, consider installing catch basins as they serve as effective "in-line" treatment devices. See Treatment Control Fact Sheet TC-20 Wet Pond/Basin in Section 5 of the New Development and Redevelopment Handbook regarding design criteria. Include in the catch basin a "turn-down" elbow or similar device to trap floatables.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

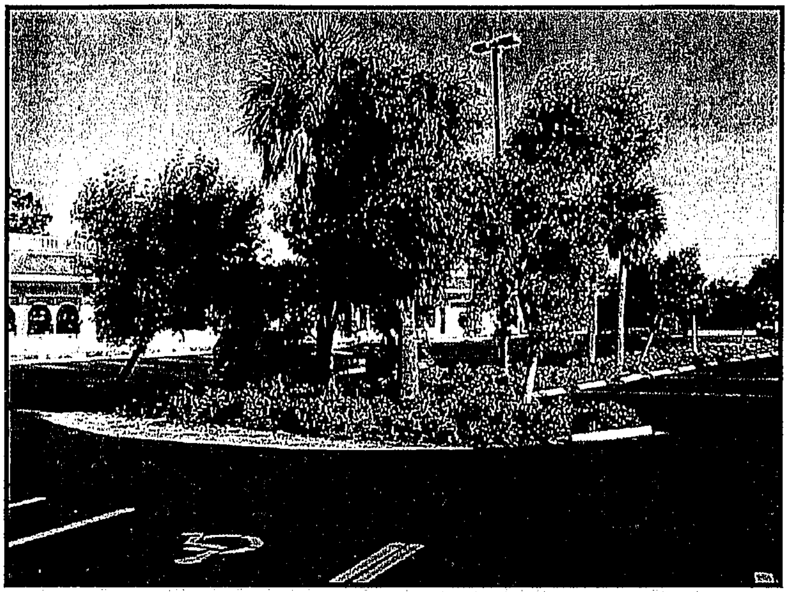
Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

# Parking/Storage Area Maintenance SC-43



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | |
| Trash | ✓ |
| Metals | ✓ |
| Bacteria | |
| Oil and Grease | ✓ |
| Organics | ✓ |

## Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

## Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *Pollution Prevention*

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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A002176

# SC-43 Parking/Storage Area Maintenance

***Suggested Protocols***

*General*

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

*Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

*Surface Cleaning*

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.



A002177

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

*Surface Repair*

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

*Inspection*

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

***Training***

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

***Spill Response and Prevention***

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

***Other Considerations***

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

# SC-43 Parking/Storage Area Maintenance

## Requirements

### *Costs*

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

### *Maintenance*

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

## Supplemental Information

### *Further Detail of the BMP*

*Surface Repair*

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

## References and Resources


California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

## Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

### Targeted Constituents

| | |
|---|---|
| Sediment | ✓ |
| Nutrients | |
| Trash | ✓ |
| Metals | |
| Bacteria | ✓ |
| Oil and Grease | |
| Organics | |

## Approach

### *Pollution Prevention*

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

### *Suggested Protocols*

*Catch Basins/Inlet Structures*

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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A002180

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

*Storm Drain Conveyance System*

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

*Pump Stations*

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

*Open Channel*

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

*Illicit Connections and Discharges*

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

*Illegal Dumping*

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

***Training***

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).



A002182

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

*Spill Response and Prevention*

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

*Other Considerations (Limitations and Regulations)*

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

## Requirements

*Costs*

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
  - Purchase and installation of signs.
  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
  - Purchase of landfill space to dispose of illegally-dumped items and material.



A002183

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

### *Maintenance*

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

## Supplemental Information

### *Further Detail of the BMP*

*Storm Drain Flushing*

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

## References and Resources


California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm




A002185

# Section 4
# Treatment Control BMPs

## 4.1 Introduction

This section discusses the inspection and maintenance requirements for treatment control BMPs for stormwater runoff. The specific design requirements, performance specifications, and limitations of each of these BMPs are discussed in detail in the New Development and Redevelopment BMP Handbook. Inspection and maintenance requirements are necessary to verify that each treatment control BMP performs efficiently throughout its design life. Although specific inspection and maintenance frequencies are presented in the following fact sheets, these are only suggested and should be adapted to each site situation to best accommodate environmental, economic, and local regulatory concerns.

**Table 4-1 Maintenance Fact Sheets for Public Domain Treatment Control BMPs**

| | |
|---|---|
| TC-10 | Infiltration Trench |
| TC-11 | Infiltration Basin |
| TC-12 | Retention/Irrigation |
| TC-20 | Wet Pond |
| TC-21 | Constructed Wetland |
| TC-22 | Extended Detention Basin |
| TC-30 | Vegetated Swale |
| TC-31 | Vegetated Buffer Strip |
| TC-32 | Bioretention |
| TC-40 | Media Filter |
| TC-50 | Water Quality Inlet |
| TC-60 | Multiple Systems |

For the purpose of this Handbook, treatment control BMPs have been classified according to whether they are public domain or proprietary controls. Public domain controls, as the name implies, are controls that are available to the general public, while proprietary controls are typically patented devices and are purchased from a vendor.

## 4.2 Public Domain BMPs

The public domain treatment controls discussed in this section are listed in Table 4-1. Maintenance fact sheets for each BMP are provided in Section 4.5.

## 4.3 Manufactured (Proprietary) Treatment Control Devices

Numerous proprietary treatment control devices are available as well. Manufacturers typically have recommended inspection schedules and maintenance requirements for each device. If your industry utilizes proprietary treatment control devices for stormwater runoff, a maintenance agreement and detailed maintenance plan should be developed to ensure that that they are well maintained and operate according to design specifications. For many manufactured devices industry owners can contract with the manufacturer or representative to provide maintenance

**Table 4-2 Maintenance Fact Sheets for Manufactured (Proprietary) Treatment Control BMPs**

| | |
|---|---|
| MP-20 | Wetland |
| MP-40 | Media Filter |
| MP-50 | Wet Vault |
| MP-51 | Vortex Separator |
| MP-52 | Drain Inlet |

services. Table 4-2 shows a list of available manufactured stormwater treatment control devices. Maintenance fact sheets for each BMP are provided in Section 4.5.

## 4.4 Maintenance BMP Fact Sheet Format

A maintenance BMP fact sheet is a short document that gives all the information about inspecting and maintaining a particular BMP including suggested frequencies for inspection and maintenance activities. Typically, each fact sheet contains the information outlined in Figure 4-1.

**TC-xx and MP-xx**
**Example Maintenance Fact Sheet**

General Description

Inspection/Maintenance Considerations

Inspection Activities

Maintenance Activities

Additional Information

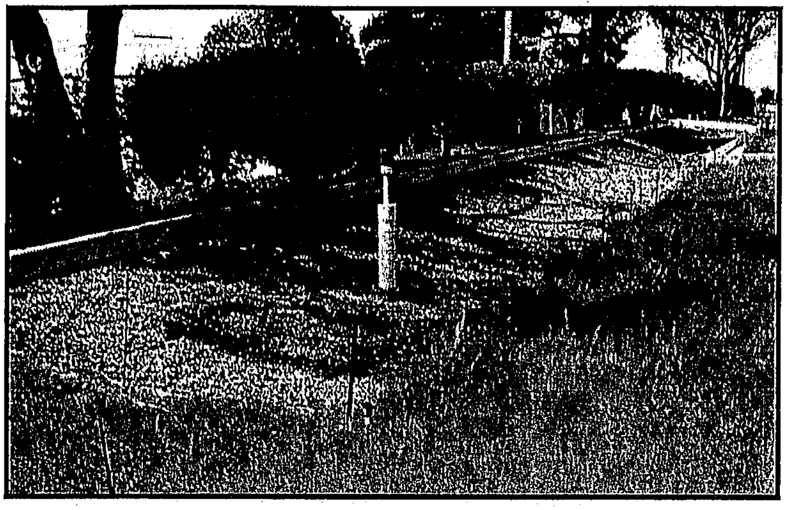
References

**Figure 4-1**
**Example Fact Sheet**

The fact sheets also contain side bar presentations with information on BMP maintenance concerns, objectives and goals; targeted constituents; and removal effectiveness if known.

## 4.5 Maintenance BMP Fact Sheets

Maintenance fact sheets for public domain and manufactured treatment controls follow. The BMP fact sheets are individually page numbered and are suitable for photocopying and inclusion in SWPPPs. Fresh copies of the fact sheets can be individually downloaded from the California Stormwater BMP Handbook web site at "www.cabmphandbooks.com". As noted previously, the reader should refer to the New Development and Redevelopment BMP Handbook for details regarding BMP design, performance, and installation. In addition to the references at the end of each fact sheet, the 1993 version of the California Stormwater BMP Handbook was used as a general reference and starting point for the preparation of the maintenance fact sheets that follow.



## Maintenance Concerns, Objectives, and Goals

- Accumulation of Metals
- Clogged Soil Outlet Structures
- Vegetation/Landscape Maintenance

## General Description

An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Pretreatment using buffer strips, swales, or detention basins is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective.

## Inspection/Maintenance Considerations

Frequency of clogging is dependant on effectiveness of pretreatment, such as vegetated buffer strips, at removing sediments. See appropriate maintenance factsheets for associated pretreatment. If the trench clogs, it may be necessary to remove and replace all or part of the filter fabric and possibly the coarse aggregate. Clogged infiltration trenches with surface standing water can become a nuisance due to mosquito breeding. Maintenance efforts associated with infiltration trenches should include frequent inspections to ensure that water infiltrates into the subsurface completely at a recommended infiltration rate of 72 hours or less to prevent creating mosquito and other vector habitats. Most of the maintenance should be concentrated on the pretreatment practices, such as buffer strips and swales upstream of the trench to ensure that sediment does not reach the infiltration trench. Regular inspection should determine if the sediment removal structures require routine maintenance. Infiltration trenches should not be put into operation until the upstream tributary area is stabilized.

## Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ■ |
| ✓ | Trash | ■ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ■ |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after every major storm for the first few months to ensure proper functioning. Drain times should be observed to confirm that designed drain times has been achieved. | After construction |
| ■ Inspect facility for signs of wetness or damage to structures, signs of petroleum hydrocarbon contamination, standing water, trash and debris, sediment accumulation, slope stability, standing water, and material buildup.<br>■ Check for standing water or, if available, check observation wells following 3 days of dry weather to ensure proper drain time.<br>■ Inspect pretreatment devices and diversion structures for damage, sediment buildup, and structural damage. | Semi-annual and after extreme events |
| ■ Trenches with filter fabric should be inspected for sediment deposits by removing a small section of the top layer. If inspection indicates that the trench is partially or completely clogged, it should be restored to its design condition. | Annual |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Repair undercut and eroded areas at inflow and outflow structures.<br>■ Remove sediment, debris, and oil/grease from pretreatment devices and overflow structures. | Standard maintenance (as needed) |
| ■ Remove trash, debris, grass clippings, trees, and other large vegetation from the trench perimeter and dispose of properly.<br>■ Mow and trim vegetation to prevent establishment of woody vegetation, and for aesthetic and vector reasons. | Semi-annual, more often as needed |
| ■ Clean out sediment traps, forebays, inlet/outlet structures, overflow spillway, and trenches if necessary.<br>■ Remove grass clippings, leaves, and accumulated sediment from the surface of the trench. Replace first layer of aggregate and filter fabric if clogging appears only to be at the surface.<br>■ Clean trench when loss of infiltrative capacity is observed. If drawdown time is observed to have increased significantly over the design drawdown time, removal of sediment may be necessary. This is an expensive maintenance activity and the need for it can be minimized through prevention of upstream erosion. | Annual |
| ■ If bypass capability is available, it may be possible to regain the infiltration rate in the short term by providing an extended dry period.<br>■ Seed or sod to restore ground cover. | 5-year maintenance |
| ■ Total rehabilitation of the trench should be conducted to maintain storage capacity within 2/3 of the design treatment volume and 72-hour exfiltration rate limit.<br>■ Trench walls should be excavated to expose clean soil.<br>■ All of the stone aggregate and filter fabric or media must be removed. Accumulated sediment should be stripped from the trench bottom. At this point the bottom may be scarified or tilled to help induce infiltration. New fabric and clean stone aggregate should be refilled. | Upon failure |

## Additional Information

Infiltration practices have historically had a high rate of failure compared to other stormwater management practices. One study conducted in Prince George's County, Maryland (Galli, 1992), revealed that less than half of the infiltration trenches investigated (of about 50) were still functioning properly, and less than one-third still functioned properly after 5 years. Many of these practices, however, did not incorporate advanced pretreatment. By carefully selecting the location and improving the design features of infiltration practices, their performance should improve.

It is absolutely critical that settleable particles and floatable organic materials be removed from runoff water before it enters the infiltration trench. The trench will clog and become nonfunctional if excessive particulate matter is allowed to enter the trench.

Cold climate considerations – see http://www.cwp.org/cold-climates.htm

## References

EPA, Stormwater Technology Fact Sheet - Infiltration Trench. EPA 832-F-99-019. September, 1999.

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

Michigan Department of Environmental Quality. Infiltration Trench Factsheet. Available at: http://www.deq.state.mi.us/documents/deq-swq-nps-it.pdf

Montgomery County Department of Environmental Protection. Maintaining Urban Stormwater Facilities - A Guidebook for Common Ownership Communities. Available at: http://www.montgomerycountymd.gov/mc/services/dep/Stormwater/maintain.htm

Stormwater Managers Resource Center, Manual Builder. Available at: http://www.stormwatercenter.net/intro_manual.htm

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

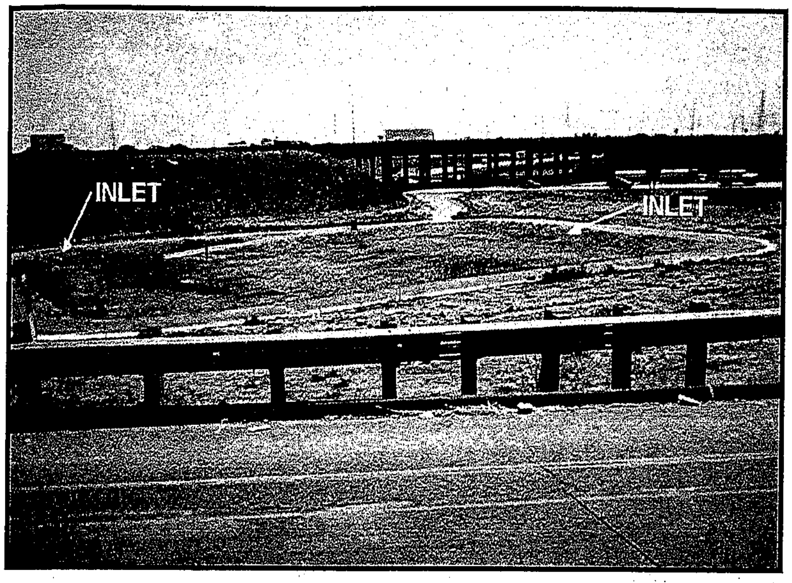
U.S. Department of Agriculture, Natural Resources Conservation Service. Illinois Urban Manual: A Technical Manual Designed for Urban Ecosystem Protection and Enhancement, 1995.

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

# Infiltration Basin

# TC-11




### Maintenance Concerns, Objectives, and Goals

- Vector Control
- Clogged soil or outlet structures
- Vegetation/Landscape Maintenance
- Groundwater contamination
- Accumulation of metals
- Aesthetics

### Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ■ |
| ✓ | Trash | ■ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ■ |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ■ |

**Legend** ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

## General Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

## Inspection/Maintenance Considerations

Infiltration basins perform better in well-drained permeable soils. Infiltration basins in areas of low permeability can clog within a couple years, and require more frequent inspections and maintenance. The use and regular maintenance of pretreatment BMPs will significantly minimize maintenance requirements for the basin. Spill response procedures and controls should be implemented to prevent spills from reaching the infiltration system.

Scarification or other disturbance should only be performed when there are actual signs of clogging or significant loss of infiltrative capacity, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a light tractor. This BMP may require groundwater monitoring. Basins cannot be put into operation until the upstream tributary area is stabilized.

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Clogged infiltration basins with surface standing water can become a breeding area for mosquitoes and midges. Maintenance efforts associated with infiltration basins should include frequent inspections to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Observe drain time for a storm after completion or modification of the facility to confirm that the desired drain time has been obtained.<br>■ Newly established vegetation should be inspected several times to determine if any landscape maintenance (reseeding, irrigation, etc.) is necessary. | Post construction |
| ■ Inspect for the following issues: differential accumulation of sediment, signs of wetness or damage to structures, erosion of the basin floor, dead or dying grass on the bottom, condition of riprap, drain time, signs of petroleum hydrocarbon contamination, standing water, trash and debris, sediment accumulation, slope stability, pretreatment device condition | Semi-annual and after extreme events |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Factors responsible for clogging should be repaired immediately.<br>■ Weed once monthly during the first two growing seasons. | Post construction |
| ■ Stabilize eroded banks.<br>■ Repair undercut and eroded areas at inflow and outflow structures.<br>■ Maintain access to the basin for regular maintenance activities.<br>■ Mow as appropriate for vegetative cover species.<br>■ Monitor health of vegetation and replace as necessary.<br>■ Control mosquitoes as necessary.<br>■ Remove litter and debris from infiltration basin area as required. | Standard maintenance (as needed) |
| ■ Mow and remove grass clippings, litter, and debris.<br>■ Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.<br>■ Replant eroded or barren spots to prevent erosion and accumulation of sediment. | Semi-annual |
| ■ Scrape bottom and remove sediment when accumulated sediment reduces original infiltration rate by 25-50%. Restore original cross-section and infiltration rate. Properly dispose of sediment.<br>■ Seed or sod to restore ground cover.<br>■ Disc or otherwise aerate bottom.<br>■ Dethatch basin bottom. | 3-5 year maintenance |



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## Additional Information

In most cases, sediment from an infiltration basin does not contain toxins at levels posing a hazardous concern. Studies to date indicate that pond sediments are generally below toxicity limits and can be safely landfilled or disposed onsite. Onsite sediment disposal is always preferable (if local authorities permit) as long as the sediments are deposited away from the shoreline to prevent their reentry into the pond and away from recreation areas, where they could possibly be ingested by young children. Sediments should be tested for toxicants in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed. Sediments containing high levels of pollutants should be disposed of properly.

Light equipment, which will not compact the underlying soil, should be used to remove the top layer of sediment. The remaining soil should be tilled and revegetated as soon as possible.

Sediment removal within the basin should be performed when the sediment is dry enough so that it is cracked and readily separates from the basin floor. This also prevents smearing of the basin floor.

## References

King County, Stormwater Pollution Control Manual – Best Management Practices for Businesses. July, 1995 Available at: ftp://dnr metrokc.gov/wlr/dss/spcm/SPCM.HTM

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

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# Retention/Irrigation TC-12

## General Description

Retention/irrigation refers to the capture of stormwater runoff in a holding pond and subsequent use of the captured volume for irrigation of landscape or natural pervious areas. This technology is very effective as a stormwater quality practice in that, for the captured water quality volume, it provides virtually no discharge to receiving waters and high stormwater constituent removal efficiencies. This technology mimics natural undeveloped watershed conditions wherein the vast majority of the rainfall volume during smaller rainfall events is infiltrated through the soil profile. Their main advantage over other infiltration technologies is the use of an irrigation system to spread the runoff over a larger area for infiltration. This allows them to be used in areas with low permeability soils.

Capture of stormwater can be accomplished in almost any kind of runoff storage facility, ranging from dry, concrete-lined ponds to those with vegetated basins and permanent pools. The pump and wet well should be automated with a rainfall sensor to provide irrigation only during periods when required infiltration rates can be realized. Generally, a spray irrigation system is required to provide an adequate flow rate for distributing the water quality volume (LCRA, 1998). Collection of roof runoff for subsequent use (rainwater harvesting) also qualifies as a retention/irrigation practice.

## Inspection/Maintenance Considerations

Pollutant removal rates are estimated to be nearly 100% for all pollutants in the captured and irrigated stormwater volume. However, relatively frequent inspection and maintenance is necessary to verify proper operation of these facilities.

### Maintenance Concerns, Objectives, and Goals

- Sediment Accumulation
- Mechanical malfunction
- Vector Control

### Targeted Constituents

| | Constituent | Effectiveness |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ■ |
| ✓ | Trash | ■ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ■ |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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A002195

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ The irrigation system should be inspected and tested (or observed while in operation) to verify proper operation multiple times annually. Two of these inspections should occur during or immediately following wet weather. Any leaks, broken spray heads, or other malfunctions with the irrigation system should be repaired immediately. | Frequently (3-6 times per year) |

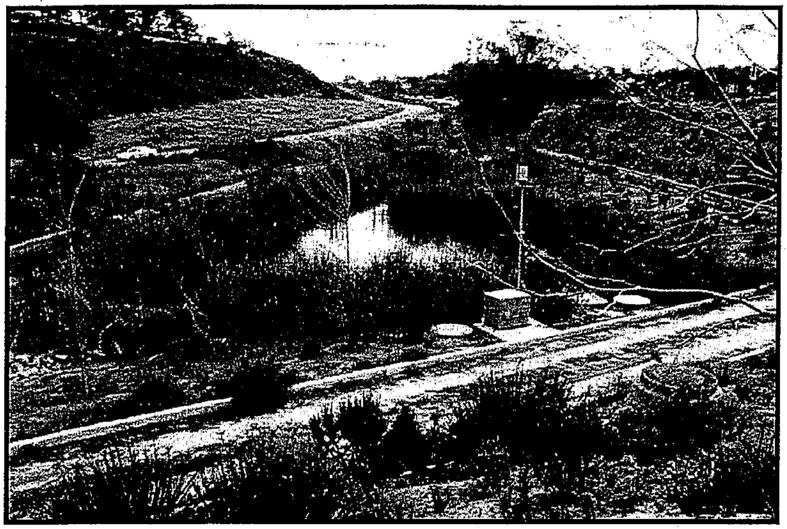
| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ The upper stage, side slopes, and embankment of a retention basin must be mowed regularly to discourage woody growth and control weeds. | Frequently |
| ■ Remove sediment from inlet structure/sediment forebay, and from around the sump area at least 2 times annually or when depth reaches 3 inches. When sediment in other areas of the basin fills the volume allocated for sediment accumulation, all sediment should be removed and disposed of properly.<br>■ Grass areas in and around basins must be mowed at least twice annually to limit vegetation height to 18 inches. More frequent mowing to maintain aesthetic appeal may be necessary in landscaped areas. When mowing is performed, a mulching mower should be used, or grass clippings should be caught and removed.<br>■ Debris and litter will accumulate near the basin pump and should be removed during regular mowing operations and inspections. Particular attention should be paid to floating debris that can eventually clog the irrigation system. | Semi-annual |
| ■ The pond side slopes and embankment may periodically suffer from slumping and erosion, although this should not occur often if the soils are properly compacted during construction. Regrading and revegetation may be required to correct the problems. | Infrequently |



A002196

# Wet Pond





## Maintenance Concerns, Objectives, and Goals

- Vegetation/Landscape Maintenance
- Endangered Species Habitat Creation
- Pollutant Removal Efficiency
- Clogging of the Outlet
- Invasive/exotic Plant Species
- Vector Control

## General Description

Wet ponds (a.k.a. stormwater ponds, retention ponds, wet extended detention ponds) are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from constructed wetlands primarily in having a greater average depth. Ponds treat incoming stormwater runoff by settling and biological uptake. The primary removal mechanism is settling as stormwater runoff resides in this pool, but pollutant uptake, particularly of nutrients, also occurs to some degree through biological activity in the pond. Wet ponds are among the most widely used stormwater practices. While there are several different versions of the wet pond design, the most common modification is the extended detention wet pond, where storage is provided above the permanent pool in order to detain stormwater runoff and promote settling. The schematic diagram is of an on-line pond that includes detention for larger events, but this is not required in all areas of the state.

## Inspection/Maintenance Considerations

In order to maintain the pond's design capacity, sediment must be removed occasionally and adequate resources must be committed to properly maintain peripheral aquatic vegetation, control vector production, and to maintain effective pool volume. Wet ponds can become a nuisance due to mosquito and midge breeding unless carefully designed and maintained. A proactive and routine preventative maintenance plan (which can vary according to location) is crucial to minimizing vector habitat. A vegetated buffer should be preserved around the pond to protect the banks from erosion and provide some pollutant removal before runoff enters the pond by overland flow.

## Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ▲ |
| ✓ | Trash | ■ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ■ |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ■ |

**Legend** ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after several storm events to confirm that the drainage system functions, and bank stability and vegetation growth are sufficient. | Post construction |
| ■ Inspect for invasive vegetation, trash and debris, clogging of inlet/outlet structures, excessive erosion, sediment buildup in basin or outlet, cracking or settling of the dam, bank stability, tree growth on dam or embankment, vigor and density of the grass turf on the basin side slopes and floor, differential settlement, leakage, subsidence, damage to the emergency spillway, mechanical component condition, and graffiti. | Semi-annual, after significant storms, or more frequent as needed |
| ■ Inspect condition of inlet and outlet structures, pipes, sediment forebays, basin, and upstream and downstream channel conditions. Monitor drain times, and check for algal growth, signs of pollution such as oil sheens, discolored water, or unpleasant odors, and signs of flooding. | Annual inspection |
| ■ During inspections, note changes to the wet pond or the contributing watershed as these may affect basin performance. | |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Introduce mosquito fish, *Gambusia* spp., (where permitted by the Department of Fish and Game or other agency regulations) to enhance natural mosquito and midge control and regularly maintain emergent and shoreline vegetation to provide access for vector inspectors and facilitate vector control if needed. | Post construction |
| ■ Perform mosquito control, if necessary.<br>■ Remove sediment from outlet structure. Dispose of properly.<br>■ Remove accumulated trash and debris in the basin, inlet/outlet structures, side slopes, and collection system as required.<br>■ Repair undercut areas and erosion to banks and basin. | Semi annual, after significant storm events |
| ■ Maintain protected vegetated buffer around pond. Mow side slopes and maintain vegetation in and around basin to prevent any erosion or aesthetic problems. Minimize use of fertilizers and pesticides. Reseed if necessary.<br>■ Manage and harvest wetland plants.<br>■ Structural repair or replacement, as needed. | Annual maintenance (if needed) |
| ■ Remove sediment from the forebay and regrade when the accumulated sediment volume exceeds 10-20% of the forebay volume. Clean in early spring so vegetation damaged during cleaning has time to re-establish. | 5- to 7-year maintenance |
| ■ Remove sediment when the permanent pool volume has become reduced significantly (sediment accumulation exceeds 25% of design depth), resuspension is observed, or the pond becomes eutrophic. | >5 year maintenance |

## Additional Information

In most cases, sediment from wet ponds do not contain toxins at levels posing a hazardous concern. Studies to date indicate that pond sediments are generally below toxicity limits and can be safely landfilled or disposed onsite. Onsite sediment disposal is always preferable (if local authorities permit) as long as the sediments are deposited away from the shoreline to prevent their reentry into the pond and away from recreation areas, where they could possibly be ingested by young children.



A002198

Sediments should be tested for toxicants in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed. Sediments containing high levels of pollutants should be disposed of properly.

For the best water quality benefit, the pond should hold water for at least 24 hours. It should drain down to the permanent water level within 72 hours of a storm event to avoid conditions which might increase water temperatures, deplete oxygen, promote vector growth, and/or cause odors.

## References

King County, Stormwater Pollution Control Manual – Best Management Practices for Businesses. July, 1995 Available at: ftp://dnr.metrokc.gov/wlr/dss/spcm/SPCM.HTM

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

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

Montgomery County Department of Environmental Protection. Maintaining Urban Stormwater Facilities - A Guidebook for Common Ownership Communities. Available at: http://www.montgomerycountymd.gov/mc/services/dep/Stormwater/maintain.htm

North Carolina Department of Environment and Natural Resources, Division of Water Quality. Maintaining Wet Detention Ponds Factsheet. Available at: http://h2o.enr.state.nc.us/su/PDF_Files/Land_of_Sky_factsheets/FactSheet_7.pdf

Oregon Association of Clean Water Agencies, Oregon Municipal Stormwater Toolbox for Maintenance Practices, June 1998. Available at: http://www.oracwa.org/Pages/toolbox.htm

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

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.



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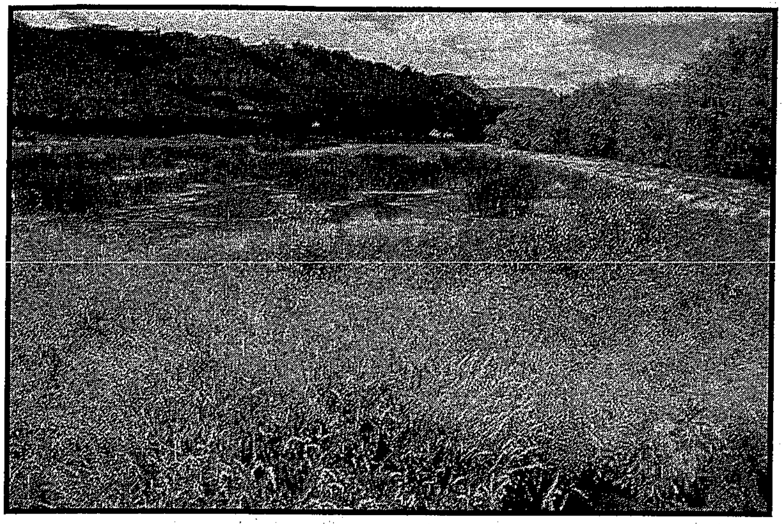
# Constructed Wetland





**Maintenance Concerns, Objectives, and Goals**

- Vector/Pest Control
- Sediment and Trash Removal
- Vegetation/Landscape Maintenance
- Invasive Species Management
- Bank Erosion
- Nutrient Release During Winter
- Clogging of the Outlet

## General Description

Constructed wetlands are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from wet ponds primarily in being shallower and having greater vegetation coverage.

A distinction should be made between using a constructed wetland for storm water management and diverting storm water into a natural wetland. The latter practice is not recommended and in all circumstances, natural wetlands should be protected from the adverse effects of development, including impacts from increased storm water runoff. This is especially important because natural wetlands provide storm water and flood control benefits on a regional scale.

Wetlands are among the most effective stormwater practices in terms of pollutant removal and they also offer aesthetic value. As stormwater runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake within the wetland. Flow through the root systems forces the vegetation to remove nutrients and dissolved pollutants from the stormwater.

**Targeted Constituents**

| | | |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ▲ |
| ✓ | Trash | ■ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ■ |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ■ |

**Legend** ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

## Inspection/Maintenance Considerations

Wetlands need a continuous base flow to maintain aquatic plants. Salts and scum can accumulate in wetlands and, unless properly designed and managed, can be flushed out during larger storms. Wetlands can also release nutrients during the non-growing season. Wetlands can become a breeding area for mosquitoes and midges unless carefully designed and maintained. A proactive and routine preventative maintenance plan (which can vary according to location) is crucial to minimizing vector habitat.

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To maximize wetland removal of pollutants, the vegetation must be harvested frequently. Harvesting is particularly important with respect to the removal of phosphorus and metals, less so nitrogen. Harvesting should occur by mid-summer before the plants begin to transfer phosphorus from the aboveground foliage to subsurface roots, or begin to lose metals that desorb during plant die off. While not stated by the manufacturer, it is also desirable that every few years the entire plant mass including roots be harvested. This is because the belowground biomass constitutes a significant reservoir (possibly half) of the nutrients and metals that are removed from the stormwater by plant (Minton, 2002).

If pretreatment is provided then maintenance consideration must be given to the build up of debris and floatables.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after several storm events for bank stability, vegetation growth, drainage system functioning, and structural damage. | After construction |
| ■ Inspect for invasive vegetation, differential settlement, cracking; erosion, leakage, or tree growth on the embankment; the condition of the riprap in the inlet, outlet, and pilot channels; sediment accumulation in the basin; clogging of outlet; and the vigor and density of the vegetation on the basin side slopes and floor. Correct observed problems as necessary. | Semi-annual inspection |
| ■ Inspect for damage to the embankment and inlet/outlet structures. Repair as necessary.<br>■ Note signs of hydrocarbon buildup such as floating oil on water surface.<br>■ Monitor for sediment accumulation in the facility and forebay.<br>■ Examine inlet and outlet devices to ensure they are free of debris and are operational. | Annual inspection |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Replace wetland vegetation to maintain at least 50% surface area coverage in wetland plants after the second growing season. | One-time |
| ■ Repair undercut areas, erosion to banks, and bottom as required.<br>■ Where permitted by the Department of Fish and Game or other agency regulations, stock constructed wetlands regularly with mosquito fish (*Gambusia* spp.) to enhance natural mosquito and midge control | As needed maintenance |
| ■ Clean and remove debris from inlet and outlet structures.<br>■ Mow side slopes and remove grass clippings.<br>■ Remove litter and debris from banks, basin bottom, trash racks, outlet structures, and valves as required. | Frequent (3-4 times/year) maintenance |
| ■ Supplement wetland plants if a significant portion have not established (at least 50% of the surface area).<br>■ Remove nuisance plant species. | Annual maintenance (if needed) |
| ■ Clean forebay to avoid accumulation in main wetland area to minimize when the main wetland area needs to be cleaned. | 5- to 7-year maintenance |
| ■ Harvest plant species if vegetation becomes too thick causing flow backup and flooding. More frequent plant harvesting may be required by local vector control agencies. | 5- to 7-year maintenance (or more frequently as required) |
| ■ Monitor sediment accumulations, and remove sediment when the accumulated sediment volume exceeds 10-20% of the basin volume, plants are "choked" with sediment, or the wetland becomes eutrophic. It is suggested that the main area be cleaned one half at a time with at least one growing season in between cleanings. This will help to preserve the vegetation and enable the wetland to recover more quickly from the cleaning. | As needed maintenance (20- to 50-years) |



A002203

## Additional Information

The following observations should be made during the inspections:

- Type and distribution of dominant wetland plants in the marsh
- The presence and distribution of planted wetland species
- The presence and distribution of invasive wetland species
- Signs that invasive species are replacing the planted wetland species
- Percentage of unvegetated standing water (excluding the deep water cells which are not suitable for emergent plant growth)
- The maximum elevation and the vegetative condition in this zone, if the design elevation of the normal pool is being maintained for wetlands with extended zones
- Stability of the original depth zones and the microtopographic features, accumulation of sediment in the forebay and micropool, and survival rate of plants in the wetland buffer.

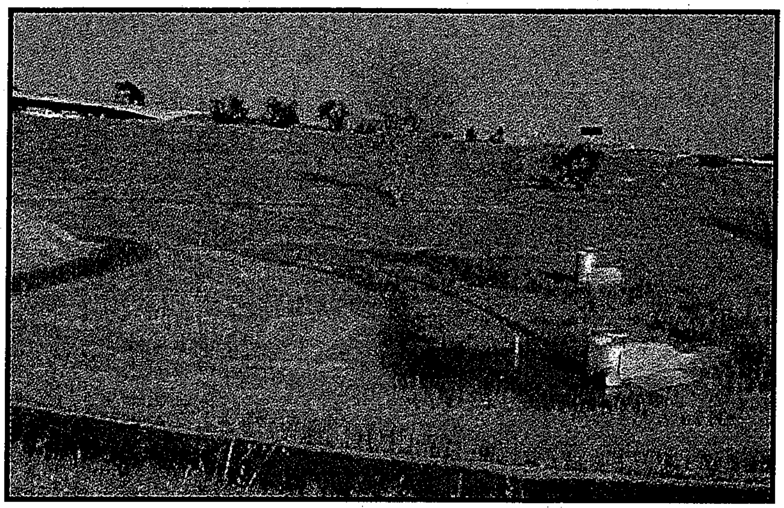
## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

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

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.



**Maintenance Concerns, Objectives, and Goals**

- Vector/Pest Control
- Sediment and Trash Removal
- Vegetation/Landscape Maintenance
- Re-suspension of settled material
- Clogging of the Outlet

## General Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 72 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

## Inspection/Maintenance Considerations

Inspections should be conducted semi-annually and after significant storm events to identify potential problems early. Most maintenance efforts will need to be directed toward vegetation management and vector control, which may focus on basic housekeeping practices such as removal of debris accumulations and vegetation management to ensure that the basin dewaters completely (recommended 72 hour residence time or less) to prevent creating mosquito and other vector habitats.

**Targeted Constituents**

| | | |
|---|---|---|
| ✓ | Sediment | ▲ |
| ✓ | Nutrients | ● |
| ✓ | Trash | ■ |
| ✓ | Metals | ▲ |
| ✓ | Bacteria | ▲ |
| ✓ | Oil and Grease | ▲ |
| ✓ | Organics | ▲ |

**Legend** *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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A002205

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after several storm events for bank stability, vegetation growth, and to determine if the desired residence time has been achieved.<br>■ Inspect outlet structure for evidence of clogging or outflow release velocities that are greater than design flow. | Post construction |
| ■ Inspect for the following issues: differential settlement, cracking; erosion of pond banks or bottom, leakage, or tree growth on the embankment; the condition of the riprap in the inlet, clogging of outlet and pilot channels; standing water, slope stability, presence of burrows; sediment accumulation in the basin, forebay, and outlet structures; trash and debris, and the vigor and density of the grass turf on the basin side slopes and floor. | Semi-annual, after significant storms, or more frequent |
| ■ Inspect for the following issues: subsidence, damage to the emergency spillway; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel, accumulated sediment volume, and semi-annual inspection items. | Annual |
| ■ During inspections, changes to the extended storage pond or the contributing watershed should be noted, as these may affect basin performance. | Annual inspection |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ If necessary, modify the outlet orifice to achieve design values if inspection indicates modifications are necessary.<br>■ Repair undercut or eroded areas.<br>■ Mow side slopes.<br>■ Manage pesticide and nutrients.<br>■ Remove litter and debris.<br>■ Control mosquitoes as necessary. | As needed |
| ■ Remove accumulated trash and debris from the basin, around the riser pipe, side slopes, embankment, emergency spillway, and outflow trash racks. The frequency of this activity may be altered to meet specific site conditions.<br>■ Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons. | Semi-annual, or more frequent, as needed |
| ■ Seed or sod to restore dead or damaged ground cover.<br>■ Repair erosion to banks and bottom as required. | Annual maintenance (as needed) |
| ■ Supplement wetland plants if a significant portion have not been established (at least 50% of the surface area).<br>■ Remove nuisance plant species. | Annual maintenance (if needed) |
| ■ Remove sediment from the forebay to reduce frequency of main basin cleaning. | 3- to 5-year maintenance |
| ■ Monitor sediment accumulation and remove accumulated sediment and regrade about every 10 years or when the accumulated sediment volume exceeds 10-20% of the basin volume, or when accumulation reaches 6 inches or if resuspension is observed. Clean in early spring so vegetation damaged during cleaning has time to re-establish. | Every 10-25 years |



A002206

## Additional Information

In most cases, sediment from extended detention basin does not contain toxins at levels posing a hazardous concern. Studies to date indicate that pond sediments are likely to meet toxicity limits and can be safely landfilled or disposed of onsite. Onsite sediment disposal is always preferable (if local authorities permit it) as long as the sediments are deposited away from the shoreline to prevent their re-entry into the pond.

Sediments should be tested for toxin in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed.

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

# Vegetated Swale 

**Maintenance Concerns, Objectives, and Goals**

- Channelization
- Vegetation/Landscape Maintenance
- Vector Control
- Aesthetics
- Hydraulic and Removal Efficacy

## General Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems. Therefore, swales are best suited for residential, industrial, and commercial areas with low flow and smaller populations.

## Inspection/Maintenance Considerations

It is important to consider that a thick vegetative cover is needed for vegetated swales to function properly. Usually, swales require little more than normal landscape maintenance activities such as irrigation and mowing to maintain pollutant removal efficiency. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g., debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained. The application of fertilizers and pesticides should be minimized.

**Targeted Constituents**

| | | |
|---|---|---|
| ✓ | Sediment | ▲ |
| ✓ | Nutrients | ● |
| ✓ | Trash | ● |
| ✓ | Metals | ▲ |
| ✓ | Bacteria | ● |
| ✓ | Oil and Grease | ▲ |
| ✓ | Organics | ▲ |

**Legend** *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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A002208

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after seeding and after first major storms for any damages. | Post construction |
| ■ Inspect for signs of erosion, damage to vegetation, channelization of flow, debris and litter, and areas of sediment accumulation. Perform inspections at the beginning and end of the wet season. Additional inspections after periods of heavy runoff are desirable. | Semi-annual |
| ■ Inspect level spreader for clogging, grass along side slopes for erosion and formation of rills or gullies, and sand/soil bed for erosion problems. | Annual |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Mow grass to maintain a height of 3–4 inches, for safety, aesthetic, or other purposes. Litter should always be removed prior to mowing. Clippings should be composted.<br>■ Irrigate swale during dry season (April through October) or when necessary to maintain the vegetation.<br>■ Provide weed control, if necessary to control invasive species. | As needed (frequent, seasonally) |
| ■ Remove litter, branches, rocks blockages, and other debris and dispose of properly.<br>■ Maintain inlet flow spreader (if applicable).<br>■ Repair any damaged areas within a channel identified during inspections. Erosion rills or gullies should be corrected as needed. Bare areas should be replanted as necessary. | Semi-annual |
| ■ Declog the pea gravel diaphragm, if necessary.<br>■ Correct erosion problems in the sand/soil bed of dry swales.<br>■ Plant an alternative grass species if the original grass cover has not been successfully established. Reseed and apply mulch to damaged areas. | Annual (as needed) |
| ■ Remove all accumulated sediment that may obstruct flow through the swale. Sediment accumulating near culverts and in channels should be removed when it builds up to 3 in. at any spot, or covers vegetation, or once it has accumulated to 10% of the original design volume. Replace the grass areas damaged in the process.<br>■ Rototill or cultivate the surface of the sand/soil bed of dry swales if the swale does not draw down within 48 hours. | As needed (infrequent) |



A002209

## Additional Information

Recent research (Colwell et al., 2000) indicates that grass height and mowing frequency have little impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

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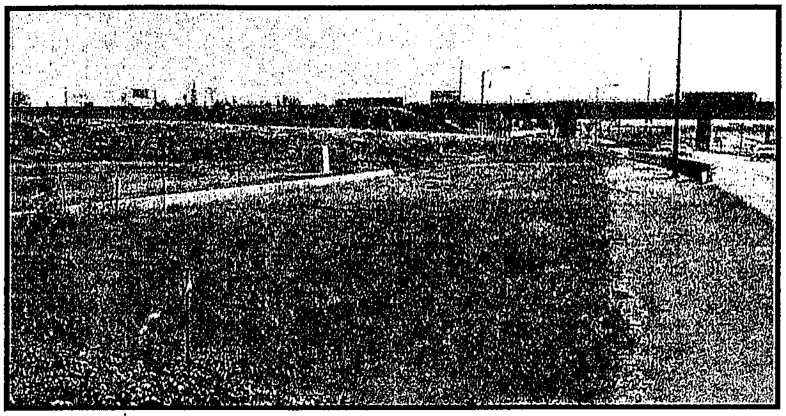

### Maintenance Concerns, Objectives, and Goals

- Clogged Soil or Outlet Structures
- Invasive Species Management
- Vegetation/Landscape Maintenance
- Erosion
- Channelization of Flow
- Aesthetics

### Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ● |
| ✓ | Trash | ▲ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ● |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ▲ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

## General Description

Grassed buffer strips (vegetated filter strips, filter strips, and grassed filters) are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and allowing sediment and other pollutants to settle and by providing some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice and have more recently evolved into an urban practice. With proper design and maintenance, filter strips can provide relatively high pollutant removal. In addition, the public views them as landscaped amenities and not as stormwater infrastructure. Consequently, there is little resistance to their use.

## Inspection/Maintenance Considerations

Vegetated buffer strips require frequent landscape maintenance. In many cases, vegetated buffer strips initially require intense maintenance, but less maintenance is needed over time. In many cases, maintenance tasks can be completed by a landscaping contractor. Maintenance requirements typically include grass or shrub-growing activities such as irrigation, mowing, trimming, removal of invasive species, and replanting when necessary. Buffer strips require more tending as the volume of sediment increases. Vegetated buffer strips can become a nuisance due to mosquito breeding in level spreaders (unless designed to dewater completely in 72 hours or less) and/or if proper drainage slopes are not maintained.

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Once the vegetated buffer strip is established, inspect at least three times per year. Repair all damage immediately.<br>■ Inspect buffer strips after seeding and repair as needed. | Post construction |
| ■ Inspect buffer strip and repair all damage immediately.<br>■ Inspect soil and repair eroded areas. | After major storms |
| ■ Inspect for erosion or damage to vegetation, preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the strips are ready for winter. However, additional inspection after periods of heavy runoff is desirable.<br>■ Inspect pea-gravel diaphragm/level spreader for clogging and effectiveness and remove built-up sediment.<br>■ Inspect for rolls and gullies. Immediately fill with topsoil, install erosion control blanket and seed or sod.<br>■ Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket.<br>■ Check for debris and litter, and areas of sediment accumulation. | Semi-annual |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Water plants daily for 2 weeks after construction. | Post construction |
| ■ Mow regularly to maintain vegetation height between 2 - 4 inches, and to promote thick, dense vegetative growth. Cut only when soil is dry to prevent tracking damage to vegetation, soil compaction and flow concentrations. Clippings are to be removed immediately after mowing.<br>■ Remove all litter, branches, rocks, or other debris. Damaged areas of the filter strip should be repaired immediately by reseeding and applying mulch.<br>■ Regularly maintain inlet flow spreader.<br>■ Irrigate during dry season (April through October) when necessary to maintain the vegetation. | Frequently, as needed |
| ■ Remulch void areas.<br>■ Treat diseased trees and shrubs, remove dead vegetation. | Semi-annual |
| ■ Remove sediment and replant in areas of buildup. Sediment accumulating near culverts and in channels should be removed when it builds up to 3 in. at any spot, or covers vegetation.<br>■ Limit fertilizer applications based on plant vigor and soil test results.<br>■ Rework or replant buffer strip if concentrated flow erodes a channel through the strip. | Annual |

## Additional Information

Recent research (Colwell et al., 2000) indicates that grass height and mowing frequency have little impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp files.cfm

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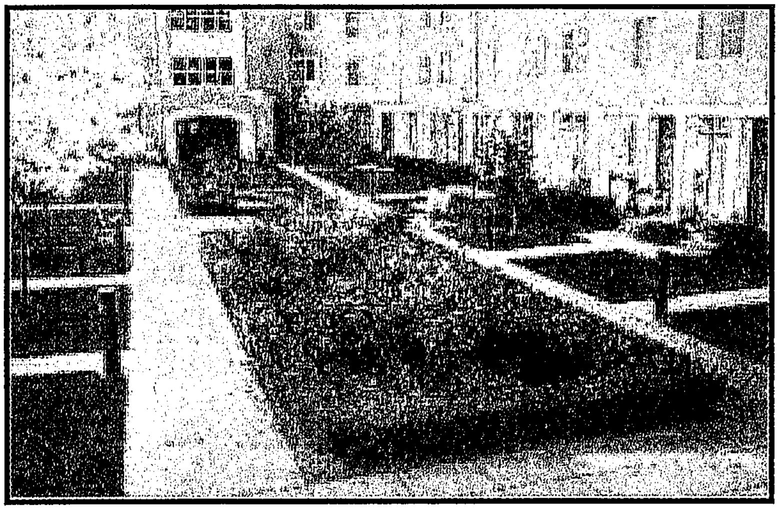

## Maintenance Concerns, Objectives, and Goals

- Clogged Soil or Outlet Structures
- Invasive Species
- Vegetation/Landscape Maintenance
- Erosion
- Channelization of Flow
- Aesthetics

## General Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through a sand bed and is subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

## Inspection/Maintenance Considerations

Bioretention requires frequent landscaping maintenance, including measures to ensure that the area is functioning properly, as well as maintenance of the landscaping on the practice. In many cases, bioretention areas initially require intense maintenance, but less maintenance is needed over time. In many cases, maintenance tasks can be completed by a landscaping contractor, who may already be hired at the site. In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

## Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ▲ |
| ✓ | Trash | ■ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ■ |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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A002216

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect soil and repair eroded areas. | Monthly |
| ■ Inspect for erosion or damage to vegetation, preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the strips are ready for winter. However, additional inspection after periods of heavy runoff is desirable. | Semi-annual inspection |
| ■ Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket.<br>■ Check for debris and litter, and areas of sediment accumulation.<br>■ Inspect health of trees and shrubs. | |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Water plants daily for 2 weeks. | At project completion |
| ■ Remove litter and debris. | Monthly |
| ■ Remove sediment.<br>■ Remulch void areas.<br>■ Treat diseased trees and shrubs.<br>■ Mow turf areas.<br>■ Repair erosion at inflow points.<br>■ Repair outflow structures.<br>■ Unclog underdrain.<br>■ Regulate soil pH regulation. | As needed |
| ■ Remove and replace dead and diseased vegetation. | Semi-annual |
| ■ Add mulch.<br>■ Replace tree stakes and wires. | Annual |
| ■ Mulch should be replaced every 2 to 3 years or when bare spots appear. Remulch prior to the wet season. | Every 2-3 years, or as needed |

## Additional Information

Landscaping is critical to the function and aesthetic value of bioretention areas. It is preferable to plant the area with native vegetation, or plants that provide habitat value, where possible. Another important design feature is to select species that can withstand the hydrologic regime they will experience. At the bottom of the bioretention facility, plants that tolerate both wet and dry conditions are preferable. At the edges, which will remain primarily dry, upland species will be the most resilient. It is best to select a combination of trees, shrubs, and herbaceous materials.

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

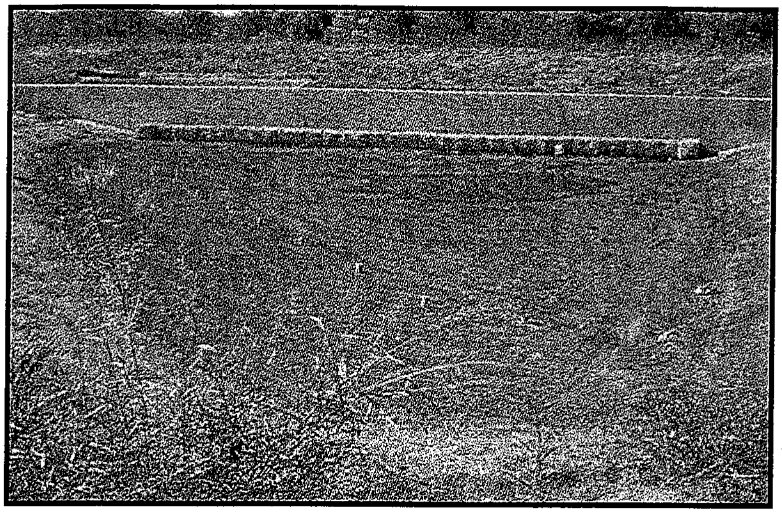
Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast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

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

# Media Filter





## Maintenance Concerns, Objectives, and Goals

- Pollutant Breakthrough
- Clogged of Sand Media
- Trash and Debris Accumulation

## General Description

Stormwater media filters are usually two-chambered including a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as stormwater flows through the filtering media in the second chamber. There are a number of design variations including the Austin sand filter, Delaware sand filter, and multi-chambered treatment train (MCTT).

## Inspection/Maintenance Considerations

Media filters may exhibit decreased effectiveness after a few years of operation, depending on the activities occurring in the drainage area. Media filters clog easily when subjected to high sediment loads. Sediment reducing pretreatment practices, such as vegetated buffer strips or vegetated swales, placed upstream of the filter should be maintained properly to reduce sediment loads into filter. Media filters can become a nuisance due to mosquito or midge breeding if not properly designed and maintained. Installations should dewater completely (recommended 72 hour or less residence time) to prevent creating mosquito and other vector habitats. Maintenance efforts will need to focus on basic housekeeping practices such as removal of debris accumulations and vegetation management (in filter media) to prevent clogs and/or pods of standing water. To minimize the potential for clogging, frequent maintenance and inspection practices are required. Waste sand, gravel, filter cloth, or filter media must be disposed of properly and in accordance with all applicable laws.

## Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ● |
| ✓ | Trash | ■ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ▲ |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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A002219

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ During the first year of operation, inspect chambers quarterly to ensure that the system is functioning properly.<br>■ Inspect sand filters after every major storm in the first few months after construction to ensure that the system is functioning properly. | Post construction |
| ■ Ensure that filter surface, inlets, and outlets are clear of debris.<br>■ Ensure that the contributing area is stabilized and mowed, with clippings removed.<br>■ Check to ensure that the filter surface is not clogging.<br>■ Ensure that activities in the drainage area minimize oil/grease and sediment entry to the system.<br>■ Inspect the facility once during the wet season after a large rain event to determine whether the facility is draining completely within 72 hr. | Quarterly, and after major storms |
| ■ Inspect for standing water, sediment, trash and debris, structural damage, and to identify potential problems. | Semi-annual |
| ■ Check to see that the filter bed is clean of sediments and the sediment chamber contains no more than six inches of sediment.<br>■ Make sure that there is no evidence of deterioration of concrete structures.<br>■ Inspect grates (if used).<br>■ Inspect inlets, outlets, and overflow spillway to ensure good condition and no evidence of erosion.<br>■ Ensure that flow is not bypassing the facility.<br>■ Ensure that no noticeable odors are detected outside the facility. | Annual |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Remove trash and debris from the sedimentation basin (Austin design), the riser pipe, and the filter bed as needed.<br>■ Prevent grass clippings from washing into the filter.<br>■ Remove trash from inlet grates to maintain the inflow capacity of the media filter.<br>■ Upstream vegetation should be maintained as needed. | Frequently (as needed) |
| ■ Clean filter surface semiannually; or more often if watershed is excessively erosive.<br>■ Replace sorbent pillows (Multi-Chamber Treatment Train only). | Semi-annual |
| ■ Repair or replace any damaged structural parts.<br>■ Stabilize any eroded areas. | Annual |
| ■ Remove accumulated sediment in the sedimentation chamber every 10 years or when the sediment occupies 10-20% of the basin volume or accumulates to a depth of six inches, whichever is less.<br>■ Remove top 2 in. of media filter and landfill if facility drain time exceeds 72 hr. Restore media depth to 18 in. when overall media depth drops to 12 in.). | As needed |

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

# Water Quality Inlet TC-50

## General Description

Water quality inlets (WQIs), also commonly called trapping catch basins, oil/grit separators or oil/water separators, consist of one or more chambers that promote sedimentation of coarse materials and separation of free oil (as opposed to emulsified or dissolved oil) from stormwater. Some WQIs also contain screens to help retain larger or floating debris, and many of the newer designs also include a coalescing unit that helps promote oil/water separation.

These devices are appropriate for capturing hydrocarbon spills, but provide very marginal sediment removal and are not very effective for treatment of stormwater runoff. WQIs typically capture only the first portion of runoff for treatment and are generally used for pretreatment before discharging to other best management practices (BMPs).

## Inspection/Maintenance Considerations

High sediment loads can interfere with the ability of the WQI to effectively separate oil and grease from the runoff. During periods of high flow, sediment can be resuspended and released from the WQI into surface waters. Maintenance of WQIs can be easily neglected because they are underground. Establishment of a maintenance schedule is helpful for ensuring proper maintenance occurs. The required maintenance effort will be site-specific due to variations in sediment and hydrocarbon loading. Since WQI residuals contain hydrocarbon by-products, they may require disposal as hazardous waste. Many WQI owners coordinate with waste haulers to collect and dispose of these residuals.

### Maintenance Concerns, Objectives, and Goals

- ■ High Sediment Loads
- ■ Hazardous Waste
- ■ Vector Control

### Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ● |
| ✓ | Nutrients | ● |
| ✓ | Trash | ▲ |
| ✓ | Metals | ● |
| ✓ | Bacteria | ● |
| ✓ | Oil and Grease | ▲ |
| ✓ | Organics | ● |

**Legend** *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after every storm event to determine if maintenance is required. | Monthly during the wet season, or after significant rain events |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Clean out and dispose of accumulated oil, grease, and sediments. Remove accumulated trash and debris. The clean out and disposal techniques should be environmentally acceptable and in accordance with local regulations. | Annual, before the wet season, or more frequent as needed |

## Additional Information

Since WQIs can be relatively deep, they may be designated as confined spaces. Caution should be exercised to comply with confined space entry safety regulations if it is required.

## References

http://www.co.pierce.wa.us/pc/services/home/environ/water/swm/sppman/bmpt1.htm

## General Description

A multiple treatment system uses two or more BMPs in series. Some examples of multiple systems include: settling basin combined with a sand filter; settling basin or biofilter combined with an infiltration basin or trench; extended detention zone on a wet pond.

## Inspection/Maintenance Considerations

Each of the separate treatment processes will require maintenance as described in the previous fact sheets. For example, multiple system comprises of a biofilter combined with an infiltration basin would require the inspection and maintenance considerations outlined on the fact sheet for each process.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Refer to individual treatment control factsheets | As needed |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Refer to individual treatment control factsheets | As needed |

### Maintenance Concerns, Objectives, and Goals

May include some of the following:

- Accumulation of Metals
- Aesthetics
- Channelization of Flow
- Clogged Outlet Structures
- Endangered Species Habitat Creation
- Erosion
- Groundwater Contamination
- Hazardous Waste
- Hydraulic and Removal Efficiency
- Invasive/exotic Plant Species
- Mechanical Malfunction
- Pollutant Breakthrough
- Re-suspension of settled material
- Sediment and Trash Removal
- Sedimentation
- Vector/Pest Control
- Vegetation harvesting
- Vegetation/Landscape Maintenance

### Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ■ |
| ✓ | Nutrients | ● |
| ✓ | Trash | ■ |
| ✓ | Metals | ■ |
| ✓ | Bacteria | ▲ |
| ✓ | Oil and Grease | ■ |
| ✓ | Organics | ■ |

**Legend** ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

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A002224

## General Description

A manufactured wetland is similar to public domain stormwater wetlands. In a manufactured wetland, gravel substrate and subsurface flow of the stormwater through the root systems force the vegetation to remove nutrients and dissolved pollutants from the stormwater.

Only one company currently manufactures a pre-engineered wetland: It consists of a standard module, about 9.5 feet in diameter and 4 feet in height. The module is constructed of recycled polyethylene. The number of units is varied to meet the design volume of the site.

## Inspection/Maintenance Considerations

To maximize wetland removal of pollutants, the vegetation must be harvested frequently. Harvesting is particularly important with respect to the removal of phosphorus and metals, less so nitrogen. Harvesting should occur by mid-summer before the plants begin to transfer phosphorus from the aboveground foliage to subsurface roots, or begin to lose metals that desorb during plant die off. While not stated by the manufacturer, it is also desirable that every few years the entire plant mass including roots be harvested. This is because the belowground biomass constitutes a significant reservoir (possibly half) of the nutrients and metals that are removed from the stormwater by plants (Minton, 2002).

If pretreatment is provided then maintenance consideration must be given to the build up of debris and floatables.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect during the dry season to determine if irrigation of plants is necessary. | As needed |
| ■ Inspect to verify that invasive species of wetland plants is not occurring. | Annual |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Clean the center well. | As needed |
| ■ Remove vegetation near end of each growth season to capture the nutrients and pollutants removed by the wetland vegetation. | Annual |

### Maintenance Concerns, Objectives, and Goals

- Vegetation/Landscape Maintenance
- Endangered Species Habitat Creation
- Pollutant Removal Efficiency
- Clogging of the Outlet
- Invasive/exotic Plant Species
- Vector Control

### Targeted Constituents

✓ Sediment
✓ Nutrients
✓ Trash
✓ Metals
✓ Bacteria
✓ Oil and Grease
✓ Organics

***Removal Effectiveness***

See New Development and Redevelopment Handbook-Section 5.

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# Media Filter



## General Description

Stormwater media filters are usually two-chambered including a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as stormwater flows through the filtering media in the second chamber.

There are currently three manufacturers of stormwater filter systems. Two are similar in that they use cartridges of a standard size. The cartridges are placed in vaults; the number of cartridges a function of the design flow rate. The water flows laterally (horizontally) into the cartridge to a centerwell, then downward to an underdrain system. The third product is a flatbed filter, similar in appearance to sand filters.

## Inspection/Maintenance Considerations

Media filters may exhibit decreased effectiveness after a few years of operation, depending on the activities occurring in the drainage area. Media filters clog easily when subjected to high sediment loads. Sediment reducing pretreatment practices, such as vegetated buffer strips or vegetated swales, placed upstream of the filter should be maintained properly to reduce sediment loads into filter. Media filters can become a nuisance due to mosquito or midge breeding if not properly designed and maintained. Installations should dewater completely (recommended 72 hour or less residence time) to prevent creating mosquito and other vector habitats. Maintenance efforts will need to focus on basic housekeeping practices such as removal of debris accumulations and vegetation management (in filter media) to prevent clogs and/or pods of standing water. To minimize the potential for clogging, frequent maintenance and inspection practices are required. Waste sand, gravel, filter cloth, or filter media must be disposed of properly and in accordance with all applicable laws.

### Maintenance Concerns, Objectives, and Goals

- Pollutant Breakthrough
- Clogged of Sand Media
- Trash and Debris Accumulation

### Targeted Constituents

✓ Sediment
✓ Nutrients
✓ Trash
✓ Metals
Bacteria
✓ Oil and Grease
✓ Organics

***Removal Effectiveness***

See New Development and Redevelopment Handbook-Section 5.

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ During the first year of operation, inspect chambers quarterly to ensure that the system is functioning properly.<br>■ Inspect sand filters after every major storm in the first few months after construction to ensure that the system is functioning properly. | Post construction |
| ■ Ensure that filter surface, inlets, and outlets are clear of debris.<br>■ Ensure that the contributing area is stabilized and mowed, with clippings removed.<br>■ Check to ensure that the filter surface is not clogging.<br>■ Ensure that activities in the drainage area minimize oil/grease and sediment entry to the system.<br>■ Inspect the facility once during the wet season after a large rain event to determine whether the facility is draining completely within 72 hr. | Quarterly, and after major storms |
| ■ Inspect for standing water, sediment, trash and debris, structural damage, and to identify potential problems. | Semi-annual |
| ■ Check to see that the filter bed is clean of sediments and the sediment chamber contains no more than six inches of sediment.<br>■ Make sure that there is no evidence of deterioration of concrete structures.<br>■ Inspect grates (if used).<br>■ Inspect inlets, outlets, and overflow spillway to ensure good condition and no evidence of erosion.<br>■ Ensure that flow is not bypassing the facility.<br>■ Ensure that no noticeable odors are detected outside the facility. | Annual |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Remove trash and debris from the sedimentation basin (Austin design), the riser pipe, and the filter bed as needed.<br>■ Prevent grass clippings from washing into the filter.<br>■ Remove trash from inlet grates to maintain the inflow capacity of the media filter.<br>■ Upstream vegetation should be maintained as needed. | Frequently (as needed) |
| ■ Clean filter surface semiannually; or more often if watershed is excessively erosive.<br>■ Replace sorbent pillows (Multi-Chamber Treatment Train only). | Semi-annual |
| ■ Repair or replace any damaged structural parts.<br>■ Stabilize any eroded areas. | Annual |
| ■ Remove accumulated sediment in the sedimentation chamber every 10 years or when the sediment occupies 10-20% of the basin volume or accumulates to a depth of six inches, whichever is less.<br>■ Remove top 2 in. of media filter and landfill if facility drain time exceeds 72 hr. Restore media depth to 18 in. when overall media depth drops to 12 in.). | As needed |

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

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# Wet Vault



## General Description

A wet vault is a vault with a permanent water pool, generally 3 to 5 feet deep. The vault may also have a constricted outlet that causes a temporary rise of the water level (i.e., extended detention) during each storm. This live volume generally drains within 12 to 48 hours after the end of each storm.

## Inspection/Maintenance Considerations

Maintenance of wet vaults requires special equipment. Each manufacturer provides storage capacities with respect to sediments and floatables, with recommendations on the frequency of cleaning as a function of the percentage of the volume in the unit that has been filled by these materials. There is concern about mosquito breeding in standing water. A loss of dissolved pollutants may occur as accumulated organic matter (e.g., leaves) decomposes in the units. If regular maintenance is not performed, accumulated sediment may cause noxious gases to form.

It is important to recognize that as storage of accumulated sediment occurs directly in the operating area of the wet vault, treatment efficiency will decline over time given the reduction in treatment volume. Whether this is significant depends on the design capacity. Some manufactured wet vaults have relatively little sediment storage and therefore must be cleaned frequently (e.g., annually) while others have sufficient capacity to reduce cleaning frequency. Vault maintenance procedures must meet OSHA confined space entry requirements.

Sediment should be tested for toxicants in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed.

### Maintenance Concerns, Objectives, and Goals

- Sediment Removal
- Vector Control

### Targeted Constituents

✓ Sediment
✓ Nutrients
✓ Trash
✓ Metals
Bacteria
✓ Oil and Grease
✓ Organics

***Removal Effectiveness***

See New Development and Redevelopment Handbook-Section 5.

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect the unit twice during the first wet season of operation, setting the cleaning frequency accordingly. | Post construction |
| ■ Inspect for floating debris, sediment buildup, and accumulated petroleum products. | Annual |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Remove sediment that has accumulated in the vault after construction in the drainage area is complete. | Post construction |
| ■ The recommended frequency of cleaning differs with the manufacturer, ranging from one to two years.<br>■ Maintenance consists of the removal of accumulated material with an eductor truck. It may be necessary to remove and dispose the floatables separately due to the presence of petroleum product. Annual maintenance is typical. | Annual, or per manufacturers recommendations |
| ■ Remove floating debris and accumulated petroleum products as needed. Floating oil should be removed from wet vaults that are used as oil/water separators when oil accumulation exceeds one inch. | Annual, or more frequent as needed |

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

# Vortex Separator　MP-51

## General Description

Vortex separators: (alternatively, swirl concentrators) are gravity separators, and in principle are essentially wet vaults. The difference from wet vaults, however, is that the vortex separator is round, rather than rectangular, and the water moves in a centrifugal fashion before exiting. By having the water move in a circular fashion, rather than a straight line as is the case with a standard wet vault, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space. Vortex separators were originally developed for combined sewer overflows (CSOs), where it is used primarily to remove coarse inorganic solids. Vortex separation has been adapted to stormwater treatment by several manufacturers.

## Inspection/Maintenance Considerations

As some of the systems have standing water that remains between storms, there is concern about mosquito breeding. Also, a loss of dissolved pollutants may occur as accumulated organic matter (e.g., leaves) decomposes in the units.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect for accumulated sediment/debris. | As needed |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Remove of accumulated material with an eductor truck. It may be necessary to remove and dispose the floatables separately due to the presence of petroleum product. | Annual, or more frequent as needed |

### Maintenance Concerns, Objectives, and Goals

- Sediment/Debris Removal
- Vector Control

### Targeted Constituents

| | | |
|---|---|---|
| ✓ | Sediment | ▲ |
| ✓ | Nutrients | ● |
| ✓ | Trash | |
| ✓ | Metals | ● |
| | Bacteria | |
| ✓ | Oil and Grease | |
| ✓ | Organics | |

Legend *(Removal Effectiveness)*

● Low　■ High

▲ Medium

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A002233

# Drain Insert



## General Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

## Inspection/Maintenance Considerations

Washout problems increase with rain intensity. Susceptibility of accumulated sediments to be re-suspended at low flow rates, can be corrected with an energy dissipater between gate and treatment areas.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect for sediment buildup and proper functioning. | At the beginning of the wet season and after significant storms |
| ■ Verify that stormwater enters the unit and does not leak around the perimeter. | After construction. |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Remove sediment as needed. | At the beginning of the wet season and as necessary |

### Maintenance Concerns, Objectives, and Goals

- Sediment Removal

### Targeted Constituents

- ✓ Sediment
- ✓ Nutrients
- ✓ Trash
- ✓ Metals
- Bacteria
- ✓ Oil and Grease
- ✓ Organics

*Removal Effectiveness*

See New Development and Redevelopment Handbook-Section 5.

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A002234

# Section 5
# Monitoring, Reporting, and Program Evaluation

Conducting a monitoring program, reviewing the monitoring information, evaluating BMPs, and record keeping and reporting are all important elements of the implementation phase of the SWPPP. The success of the SWPPP depends upon the thorough implementation of the monitoring plan and evaluation of the effectiveness of the plan elements once they have been implemented.

**Monitoring, Reporting, and Evaluation Elements**

- Conduct monitoring program
- Conduct record keeping and reporting
- Conduct annual site evaluation
  - Review monitoring information
  - Evaluate BMPs
  - Review and revise the SWPPP as necessary

## 5.1 Conduct Monitoring Program

The General Permit requires that a monitoring program be a component of the SWPPP. The program has the following objectives:

- To monitor the quality of the stormwater discharge
- To aid in SWPPP implementation
- To measure the BMP effectiveness

To meet these objectives the monitoring effort has these elements:

- Training
- Visual observations
- Stormwater monitoring
- Authorized non-stormwater discharges

### 5.1.1 Training

Familiarity with the requirements of the stormwater monitoring plan and competence in the techniques and protocols specified in the plan are essential to ensure that stormwater samples are collected in a manner that meets the goals of the plan, while protecting the health and safety of the monitoring team members. It is recommended that all stormwater monitoring personnel receive training prior to conducting any stormwater monitoring activities. Stormwater monitoring training should include the following basic elements:

- Review of the Monitoring Plan and Health and Safety Plan

- Classroom training session
- Field training and sampling simulation (dry run)
- Annual refresher training

## 5.1.2 Visual Observations

Visual observations of both stormwater and non-stormwater discharges should be made at all facilities to document the presence of any discolorations, odors, floating and suspended material, oil and grease, etc., and to identify the source of any pollutants and non-stormwater flows. Visual observations should be made under the leadership of the SWPPP Leader, with appropriate members of the Pollution Prevention Team, according to the following schedule:

- All drainage areas within the facility should be checked for the presence of unauthorized non-stormwater discharges on a quarterly basis, during daylight hours, on days with no stormwater discharges.
- All authorized non-stormwater discharges and their sources should be observed quarterly during daylight hours, on days with no stormwater discharges.
- One storm event per month during the wet season (October 1-May 30) should be visually observed during the first hour of discharge at all discharge locations. These observations are only required of stormwater discharges that occur during daylight hours that are preceded by at least three working days without stormwater discharges and that occur during scheduled facility operating hours.

The results of the visual observations should be recorded and include: the date of the observation, locations observed, observations, response taken to eliminate unauthorized non-stormwater discharges, and actions taken to reduce or prevent pollutants from contacting non-stormwater or stormwater discharges. Results are included in the Annual Report.

## 5.1.3 Stormwater Monitoring

Each facility should either conduct an individual monitoring plan or participate in a group-sampling program. A group-monitoring program may be developed either by an entity representing a group of similar facilities or by a local stormwater agency that holds its own NPDES permit. According to the General Permit, the monitoring plan is to contain the rationale and description of the visual observation methods, location, and frequency; and the analytical methods and corresponding method detection limits used to detect constituents.

Selection of sites for industrial stormwater monitoring will depend on many factors including the following:

### Representativeness

It is important to select sites that are representative of typical site operations.

- Runoff from the facility should combine to form a definable runoff stream.



A002236

- The runoff stream should represent the full range of activities at the facility.
- Runoff from the facility should not combine with runoff from other sources.
- Adequate flow volume must be available for sample collection.

### Personal Safety

Development of a health and safety plan is recommended. Site selection should insure monitoring personnel from the following potential hazards:

- Traffic
- Uneven or slippery footing surface
- Poor night visibility (lighting)

### Site Access

Ease of monitoring site access for monitoring personnel and vehicles parking is essential. Also, for sites that require installation of sample collection or flow metering equipment, adequate equipment access for maintenance and monitoring activities must be available.

### Equipment Security

Permanently installed monitoring equipment must be located at a site that will minimize potential vandalism and other possible damage.

### Adequate Flow Volume

Monitoring sites should be configured such that adequate flow volume is present for sample collection. Hydraulic conditions should be well mixed and free flowing.

### Utility Access

If automated monitoring equipment is required, electrical power should be readily available at selected monitoring sites. Additionally, telephone service may be required for off-site station controlling and data transfer.

Stormwater samples should be collected during the first hour of discharge from (1) the first storm event of the wet season, and (2) at least one other storm event in the wet season. If the first event is missed, sampling of two events during the wet season is still required. Furthermore, a justification for failing to sample the first event should be provided in the Annual Report. Sample collection is only required of stormwater discharges that occur during scheduled facility operating hours and that are preceded by at least three working days without stormwater discharge. Sample collection is not required if dangerous weather conditions are present (e.g., flooding, electrical storm, etc.), when stormwater discharges begin after scheduled facility operating hours or when stormwater discharges are not preceded by three working days without discharge. When the required samples are not collected due to these exceptions, an explanation must be provided in the Annual Report. Visual observations and sample collection may be conducted more than one hour after discharge begins if it is determined that the monitoring objectives will be better satisfied. If this occurs, an explanation should be provided in the Annual Report.

Specific sampling and analysis requirements include the following:

- All sampling and sample preservation should be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater".
- All monitoring instruments and equipment should be calibrated and maintained in accordance with manufacturers' specifications to ensure accurate measurements.
- All laboratory analyses should be conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified by the RWQCB.
- Analyze samples for total suspended solids (TSS), pH, specific conductance, and total organic carbon (TOC). Oil and grease (O&G) may be substituted for TOC.
- Analyze toxic chemicals and other pollutants that are likely to be present in stormwater discharges. Any of these pollutants that are not detected in significant quantities after two consecutive sampling events may be eliminated from future sampling analysis until the pollutant is likely to be present again. (According to the definitions section of the General Permit, "significant quantities" is defined as the volume, concentration, or mass of a pollutant that can cause or threaten to cause pollution, contamination, or nuisance; adversely impact human health or the environment; and/or cause or contribute to a violation of any applicable water quality standards for the receiving water.)
- Other analytical parameters should be included based on the facility's standard industrial classification (see Table D of the General Permit).

**Rules to Follow to Reduce Potential Sample Contamination**

1. No smoking.
2. Never sample near a running vehicle. Do not park vehicles in immediate sample collection area (even non-running vehicles)
3. Always wear clean, powder-free nitrile gloves when handling composite bottles, lids, sterile grab sample bottles, tubing, or strainers.
4. Never touch the inside surface of a sample bottle or lid, even with gloved hands.
5. Never touch the exposed end of a sampling tube.
6. Never allow the inner surface of a sample bottle, lid, or sampling tube to be contacted by any material other than the sample water.
7. Never allow any object or material to fall into or contact the collected sample water.
8. Avoid allowing rain water to drip from rain gear or other surfaces into sample bottles.
9. Do not eat or drink during sample collection.
10. Do not breathe, sneeze or cough in the direction of an open sample bottle.

In addition to the requirements above, which are outlined in the General Permit, the following procedures are recommended to maximize the ability of sampling personnel to collect samples reliably and with minimal sample contamination.

- Before stormwater samples are collected, personnel must ensure the safety of such activities at each sampling location.
- Select the appropriate sample bottles and equipment for each parameter to be measured. As general guidelines, all sampling equipment and sample bottles used for trace metals determination should be nonmetallic and free from any material that may contain metals. Only high-density plastic or Teflon containers should be used for metals analytical sample storage bottles. All sampling equipment and sample bottles used for trace organics determination should be glass or Teflon. Nutrients and most "conventional" parameters may be sampled using plastic or glass bottles.
- Employ "clean" sampling techniques to minimize potential sources of sample contamination, particularly from trace pollutants. Experience has shown that when clean sampling techniques are used, detected concentrations of constituents tend to be lower.

## 5.2 Conduct Record Keeping and Reporting

Records of all stormwater monitoring information, inspections and visual observations, certifications, corrective actions and follow-up activities, and copies of all reports should be retained for a period of at least five years. These records should include:

- The date, place, and time of site inspections, sampling, visual observations, and measurements
- The individual(s) who performed the site inspections, sampling, visual observations, and measurements
- Flow measurements or estimates (as required by Section B.6 of the General Permit)
- The date and approximate time of analyses
- The individual who performed the analyses
- Analytical results, method detection limits, and the analytical techniques or methods used
- Quality assurance and quality control records and results
- Non-stormwater discharge inspections and visual observations and stormwater discharge visual observation records
- Visual observations and sample collection exception records
- All calibration and maintenance records of onsite instruments used

- All sampling and analysis exemption and reduction certifications and supporting documentation
- The records of any corrective actions and follow-up activities that resulted from the visual observations

It is also recommended that information regarding the rain event be collected. A nearby recording gage should be identified and used to document the start and stop times and date of precipitation event. Some industries may want to consider installing a recording gage at the monitoring site.

Photographs can be useful. Also keep a record of maintenance activities or any other BMPs that are of an "action" nature. It is easy to demonstrate that a BMP that involves a physical change, such as berming or covering, has been accomplished. But actions that relate to good housekeeping can only be demonstrated by record keeping. Keeping a record of catch basin cleaning, for example, also provides insight into how soon it takes for the catch basin sump to refill.

An Annual Report including the items listed below should be submitted by July 1 of each year to the Executive Officer of the appropriate RWQCB.

- Summary of visual observations and sampling results
- Evaluation of the visual observations and sampling and analysis results
- Documentation that the BMPs in the SWPPP are being implemented and properly maintained as necessary
- Laboratory reports (including detection limits for each analytical parameter)
- The Annual Comprehensive Site Compliance Evaluation Report (as described below)
- Documentation, including the justification, of any deviations from the General Permit requirements (if not already included in the Evaluation Report)
- Records
- Detection limits for each analytical parameter

## 5.3 Conduct Annual Site Evaluation

All facilities should conduct an annual comprehensive site compliance evaluation. It may be helpful to involve the Pollution Prevention Team (PPT) in this effort (see Section 2). The SWPPP should be revised within 90 days of the evaluation based on the evaluation and the revisions implemented. Evaluations should include the following:

- A review of the results of visual inspections of potential pollutant sources for evidence of, or the potential for, pollutants entering the drainage system



A002240

- A review of visual observation records, inspection records, and sampling and analysis results
- A review and evaluation of each BMP to determine whether it is adequate, properly implemented, and maintained
- A review of site activities to ascertain if change has occurred, and if so, whether new or modified BMPs are needed
- A review of the list of significant materials to ascertain if the list has changed, and if so, whether new or modified BMPs are needed
- A review of spills that have occurred over the past 12 months, with a determination of cause(s) and possible solutions, including modified or new BMPs
- A determination of whether each BMP must be modified, replaced, and whether additional BMPs are needed
- An evaluation report

# Section 6
# Glossary and List of Acronyms
## 6.1 Glossary

***303(d) Listed:*** Waterbodies listed as impaired as per Section 303(d) of the 1972 Clean Water Act.

***Best Management Practices (BMPs):*** Includes schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent, eliminate, or reduce the pollution of waters of the receiving waters. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

***Catch Basin (Also known as Inlet):*** Box-like underground concrete structure with openings in curbs and gutters designed to collect runoff from streets and pavement.

***Clean Water Act (CWA):*** (33 U.S.C. 1251 et seq.) requirements of the NPDES program are defined under Sections 307, 402, 318 and 405 of the CWA.

***Construction Activity:*** Includes clearing, grading, excavation, and contractor activities that result in soil disturbance.

***Construction General Permit:*** A National Pollutant Discharge Elimination System (NPDES) permit issued by the State Water Resources Control Board for the discharge of stormwater associated with construction activity from soil disturbance of five acres or more. Threshold lowered to one acre beginning October 10, 2003. Construction General Permit No. CAS000002.

***Denuded:*** Land stripped of vegetation or land that has had its vegetation worn down due to the impacts from the elements or humans.

***Detention:*** The capture and subsequent release of stormwater runoff from the site at a slower rate than it is collected the difference being held in temporary storage.

***Discharge:*** A release or flow of stormwater or other substance from a conveyance system or storage container. Broader – includes release to storm drains, etc.

***Effluent Limits:*** Limitations on amounts of pollutants that may be contained in a discharge. Can be expressed in a number of ways including as a concentration, as a concentration over a time period (e.g., 30-day average must be less than 20 mg/l), or as a total mass per time unit, or as a narrative limit.

***Erosion:*** The wearing away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, new development, redevelopment, road building, or timber-cutting.



A002242

***Facility:*** Is a collection of industrial processes discharging stormwater associated with industrial activity within the property boundary or operational unit.

***Grading:*** The cutting or filling of the land surface to a desired slope or elevation.

***Hazardous Waste:*** A waste or combination of wastes that, because of its quantity, concentration, or physical, chemical or infectious characteristics, may either cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity or toxicity) or appears on special EPA or state lists. Regulated under the federal Resource Conservation and Recovery Act and the California Health and Safety Code.

***Illicit Discharges:*** Any discharge to a municipal separate storm sewer that is not in compliance with applicable laws and regulations as discussed in this document.

***Industrial General Permit:*** A National Pollutant Discharge Elimination System (NPDES) Permit (No. CAS000001) issued by the State Water Resources Control Board for discharge of stormwater associated with industrial activity. Board Order 97-03-DWQ.

***Inlet:*** An entrance into a ditch, storm drain, or other waterway.

***Integrated Pest Management (IPM):*** An ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism.

***Municipal Separate Storm Sewer System (MS4):*** A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) designed or used for collecting or conveying storm water; (ii) which is not a combined sewer; and (iii) which is not part of a Publicly Owned Treatment Works (POTW) as defined at Title 40 of the Code of Federal Regulations (CFR) 122.2. A "Small MS4" is defined as and MS4 that is not a permitted MS4 under the Phase I regulations. This definition of a Small MS4 applies to MS4 operated within cities and counties as well as governmental facilities that have system of storm sewers.

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

***Nonpoint Source Pollution:*** Pollution that does not come from a point source. Nonpoint source pollution originates from aerial diffuse sources that are mostly related to land use.

***Notice of Intent (NOI):*** A formal notice to SWRCB submitted by the owner of an industrial site or construction site that said owner seeks coverage under a General Permit for discharges associated with industrial and construction activities. The NOI provides information on the

owner, location, type of project, and certifies that the owner will comply with the conditions of the construction General Permit.

***Notice of Termination (NOT):*** Formal notice to SWRCB submitted by owner/ developer that a construction project is complete.

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

***Outfall:*** The end point where storm drains discharge water into a waterway.

***Point Source:*** Any discernible, confined, and discrete conveyance from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff.

***Pollutant:*** Generally, any substance introduced into the environment that adversely affects the usefulness of a resource.

***Pollution Prevention (P2):*** Practices and actions that reduce or eliminate the generation of pollutants.

***Precipitation:*** Any form of rain or snow.

***Pretreatment:*** Treatment of waste stream before it is discharged to a collection system.

***Reclaim (water reclamation):*** Planned use of treated effluent that would otherwise be discharged without being put to direct use.

***Retention:*** The storage of stormwater to prevent it from leaving the development site.

***Reuse (water reuse):*** (see Reclaim)

***Runoff:*** Water originating from rainfall, melted snow, and other sources (e.g., sprinkler irrigation) that flows over the land surface to drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands.

***Run-on:*** Off site stormwater surface flow or other surface flow which enters your site.

***Scour:*** The erosive and digging action in a watercourse caused by flowing water.

***Secondary Containment:*** Structures, usually dikes or berms, surrounding tanks or other storage containers and designed to catch spilled materials from the storage containers.

***Sedimentation:*** The process of depositing soil particles, clays, sands, or other sediments that were picked up by runoff.

***Sediments:*** Soil, sand, and minerals washed from land into water, usually after rain, that collect in reservoirs, rivers, and harbors, destroying fish nesting areas and clouding the water, thus preventing sunlight from reaching aquatic plants. Farming, mining, and building activities without proper implementation of BMPs will expose sediment materials, allowing them to be washed off the land after rainfalls.

***Significant Materials:*** Includes, but not limited to, raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designed under Section 101(14) of CERLCA; any chemical the facility is required to report pursuant to Section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with stormwater discharges.

***Significant Quantities:*** The volume, concentrations, or mass of a pollutant in stormwater discharge that can cause or threaten to cause pollution, contamination, or nuisance that adversely impact human health or the environment and cause or contribute to a violation of any applicable water quality standards for receiving water.

***Source Control BMPs:*** Operational practices that reduce potential pollutants at the source.

***Source Reduction (also source control):*** The technique of stopping and/ or reducing pollutants at their point of generation so that they do not come into contact with stormwater.

***Storm Drains:*** Above- and below-ground structures for transporting stormwater to streams or outfalls for flood control purposes.

***Stormwater:*** Defined as urban runoff and snowmelt runoff consisting only of those discharges, which originate from precipitation events. Stormwater is that portion of precipitation that flows across a surface to the storm drain system or receiving waters.

***Stormwater Discharge Associated with Industrial Activity:*** Discharge from any conveyance which is used for collecting and conveying stormwater from an area that is directly related to manufacturing, processing, or raw materials storage activities at an industrial plant.

***Stormwater Pollution Control Plan (SWPCP):*** A less formal plan than the SWPPP that addresses the implementation of BMPs at facilities/businesses not covered by a general permit but that have the potential to discharge pollutants.

***Stormwater Pollution Prevention Plan (SWPPP):*** A written plan that documents the series of phases and activities that, first, characterizes your site, and then prompts you to select and carry out actions which prevent the pollution of stormwater discharges.

***Treatment Control BMPs:*** Treatment methods to remove pollutants from stormwater.

***Toxicity:*** Adverse responses of organisms to chemicals or physical agents ranging from mortality to physiological responses such as impaired reproduction or growth anomalies.

***Turbidity:*** Describes the ability of light to pass through water. The cloudy appearance of water caused by suspended and colloidal matter (particles).

## 6.2 Acronyms

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| AC | Asphalt Concrete |
| ADL | Aerially Deposited Lead |
| AIMP | Impervious Area |
| AINF | Infiltration Area |
| ANSI | American National Standards Institute |
| APHA | American Public Health Association |
| APWA | American Public Works Association |
| ARS | Agricultural Research Service |
| AQMD | Air Quality Management District |
| ASTM | American Society for Testing Materials |
| AWWA | American Water Works Association |
| BAT | Best Available Technology (economically available) |
| BCT | Best Conventional Technology (pollution control) |
| BFP | Bonded Fiber Matrix |
| BMPs | Best Management Practices |
| BOD | Biological Oxygen Demand |
| CA | Contractor Activities |
| CAL-EPA | California Environmental Protection Agency |
| CAL-OSHA | California Division of Occupational Safety and Health Administration |
| CASQA | California Stormwater Quality Association |
| CCR | California Code of Regulations |

| | |
|---|---|
| CCS | Cellular Confinement System |
| CEQA | California Environmental Quality Act |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| CFR | Code of Federal Register |
| CMA | Congestion Management Program |
| COE | U.S. Army Corps of Engineers |
| CPI | Coalescing Plate Interceptor |
| CWA | Clean Water Act (Federal Water Pollution Control Act of 1972 as amended in 1987) |
| DCIA | Directly Connected Impervious Area |
| DTSC | California Department of Toxic Substances Control |
| EEC | Effect Effluent Concentration |
| EIR | Environmental Impact Report |
| EMC | Event Mean Concentration |
| EOS | Equivalent Opening Size |
| ESA | Environmentally Sensitive Area |
| ESC | Erosion and Sedimentation Control |
| FEMA | Federal Emergency Management Agency |
| FHWA | Federal Highway Administration |
| GIS | Geographical Information System |
| Hazmat | Hazardous Material |
| HSG | Hydrologic Soil Groups |
| IPM | Integrated Pest Management |
| JURMP | Jurisdictional Urban Runoff Management Program |
| MEP | Maximum Extent Practicable |

| | |
|---|---|
| MS4 | Municipal Separate Storm Sewer System |
| MSDS | Material Safety Data Sheet |
| MSHA | Mine Safety and Health Administration |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanographic and Atmospheric Administration |
| NOI | Notice of Intent |
| NPDES | National Pollution Discharge Elimination System |
| NPS | Nonpoint Source |
| NRC | National Response Center |
| NRCS | Natural Resources Conservation Service |
| NSF | National Science Foundation |
| NURP | National Urban Runoff Program |
| O&G | Oil and Grease |
| O&M | Operations and Maintenance |
| OSDS | On-site Disposal System |
| OSHA | Occupational Safety and Health Administration |
| P2 | Pollution Prevention |
| PAHs | Polyaromatic Hydrocarbons |
| PAM | Polyacrylamide |
| PCBs | Polychlorinated Biphenyls |
| PCC | Portland Concrete Cement |
| PPT | Pollution Prevention Team |
| POTW | Publicly Owned Treatment Works |
| PSD | Particle Size Distribution |
| RCRA | Resource Conservation and Recovery Act |

| | |
|---|---|
| RWQCB | Regional Water Quality Control Board |
| SAP | Sampling and Analysis Plan |
| SARA | Superfund Amendments and Reauthorization Act |
| SIC | Standard Industrial Classification |
| SPCC | Spill Prevention Control and Countermeasure |
| SUSMP | Standard Urban Stormwater Mitigation Plan |
| SWMP | Stormwater Management Program |
| SWPCP | Stormwater Pollution Control Plan |
| SWPPP | Stormwater Pollution Prevention Plan |
| SWRCB | State Water Resource Control Board |
| TMDL | Total Maximum Daily Load |
| TOC | Total Organic Carbon |
| TSS | Total Suspended Solids |
| UFC | Uniform Fire Code |
| USACE | United States Army Corps of Engineers |
| USDA | United States Department of Agriculture |
| USDOT | United States Department of Transportation |
| USEPA | United States Environmental Protection Agency |
| WEF | Water Environment Federation |

# Appendix A
# General Permit

# State Water Resources Control Board

**Division of Water Quality**
1001 I Street • Sacramento, California 95814 • (916) 341-5538
Mailing Address: P.O. Box 1977 • Sacramento, California • 95812-1977
FAX (916) 341-5543 • Internet Address: http://www.swrcb.ca.gov

**Winston H. Hickox**
*Secretary for Environmental Protection*

**Gray Davis**
*Governor*

To: STORM WATER DISCHARGER

SUBJECT: CHECKLIST FOR SUBMITTING A NOTICE OF INTENT

In order for the State Water Resources Control Board to expeditiously process your Notice of Intent (NOI), the following items must be submitted to either of the addresses indicated below:

1._______ NOI (please keep a copy for your files) with all applicable sections completed and original signature of the facility operator;

2._______ Check made out to the "State Water Resources Control Board" with the appropriate fee. The regular fee is **$700.00**. Dairy farms pay a one time fee of $2000.00; and

3._______ Site Map of the facility (see NOI instructions). DO NOT SEND BLUEPRINTS

U.S. Postal Service Address

State Water Resources Control Board
Division of Water Quality
Attn: Storm Water Section
P.O. Box 1977
Sacramento, CA 95812-1977

Overnight Mailing Address

State Water Resources Control Board
Division Of Water Quality
Attn: Storm Water, 15th Floor
1001 I Street
Sacramento, CA 95814

NOIs are processed in the order they are received. A NOI receipt letter will be mailed to the facility operator within approximately two weeks. Incomplete NOI submittals will be returned to the facility operator within the same timeframe and will specify the reason(s) for return. If you need a receipt letter by a specific date (for example, to provide to a local agency), we advise that you submit your NOI thirty (30) days prior to the date the receipt letter is needed.

Please do not call us to verify your NOI status. A copy of your NOI receipt letter will be available on our web page within twenty-four (24) hours of processing. Go to: http://esmr.swrcb.ca.gov:7778/dwq/IndReceiptLetter.asp to retrieve an electronic copy of your NOI receipt letter. If you have any questions regarding this matter, please contact us at (916) 341-5538.

# TABLE OF CONTENTS
FOR

STATE WATER RESOURCES CONTROL BOARD (STATE WATER BOARD)
WATER QUALITY ORDER NO. 97-03-DWQ
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT NO. CAS000001 (GENERAL PERMIT)

WASTE DISCHARGE REQUIREMENTS (WDRS)
FOR
DISCHARGES OF STORM WATER ASSOCIATED WITH INDUSTRIAL ACTIVITIES
EXCLUDING CONSTRUCTION ACTIVITIES

# FACT SHEET
FOR

STATE WATER RESOURCES CONTROL BOARD (STATE WATER BOARD)
WATER QUALITY ORDER NO. 97-03-DWQ
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT NO. CAS000001 (GENERAL PERMIT)

WASTE DISCHARGE REQUIREMENTS (WDRS)
FOR
DISCHARGES OF STORM WATER ASSOCIATED WITH INDUSTRIAL ACTIVITIES
EXCLUDING CONSTRUCTION ACTIVITIES

## BACKGROUND

In 1972, the Federal Water Pollution Control Act (also referred to as the Clean Water Act [CWA]) was amended to provide that the discharge of pollutants to waters of the United States from any point source is effectively prohibited unless the discharge is in compliance with an NPDES permit. The 1987 amendments to the CWA added Section 402(p) that establishes a framework for regulating municipal and industrial storm water discharges under the NPDES Program. On November 16, 1990, the U.S. Environmental Protection Agency (U.S. EPA) published final regulations that establish application requirements for storm water permits. The regulations require that storm water associated with industrial activity (storm water) that discharges either directly to surface waters or indirectly through municipal separate storm sewers must be regulated by an NPDES permit.

U.S. EPA developed a four-tier permit issuance strategy for storm water discharges associated with industrial activity as follows:

Tier I, Baseline Permitting--One or more general permits will be developed to initially cover the majority of storm water discharges associated with industrial activity.

Tier II, Watershed Permitting--Facilities within watersheds shown to be adversely impacted by storm water discharges associated with industrial activity will be targeted for individual or watershed-specific general permits.

Tier III, Industry-Specific Permitting--Specific industry categories will be targeted for individual or Industry-specific general permits.

Tier IV, Facility-Specific Permitting--A variety of factors will be used to target specific facilities for individual permits.

The regulations allow authorized states to issue general permits or individual permits to regulate storm water discharges.

Consistent with Tier I, Baseline Permitting, of the U.S. EPA permitting strategy, the State Water Board issued a statewide General Permit on November 19, 1991 that applied to all storm water discharges requiring a permit except construction activity. The monitoring requirements of this General Permit were amended September 17, 1992. A separate statewide general permit has been issued for construction activity.

To obtain authorization for continued and future storm water discharge under this General Permit, each facility operator must submit a Notice of Intent (NOI). This approach is consistent with the four-tier permitting strategy described in Federal regulations, i.e., Tier 1, Baseline Permitting. Tier 1, Baseline Permitting, enables the State to begin reducing pollutants in industrial storm water in the most efficient manner possible.

This General Permit generally requires facility operators to:

1. Eliminate unauthorized non-storm water discharges;
2. Develop and implement a storm water pollution prevention plan (SWPPP); and
3. Perform monitoring of storm water discharges and authorized non-storm water discharges.

## TYPES OF STORM WATER DISCHARGES COVERED BY THIS GENERAL PERMIT

This General Permit is intended to cover all new or existing storm water discharges and authorized non-storm water discharges from facilities required by Federal regulations to obtain a permit including those (1) facilities previously covered by the San Francisco Bay Regional Water Quality Control Board Order No. 92-011 (as amended by Order No. 92-116), (2) facilities designated by the Regional Water Quality Control Boards (Regional Water Boards), (3) facilities whose operators seek coverage under this General Permit, (4) and facilities required by future U.S. EPA storm water regulations.

The General Permit is intended to cover all facilities described in Attachment 1, whether the facility is primary or is auxiliary to the facility operator's function. For example, although a school district's primary function is education, a facility that it operates for vehicle maintenance of school buses is a transportation facility that is covered by this General Permit.

The definition of "storm water associated with industrial activity" is provided in Attachment 4, Definition 9, of this General Permit. Facilities that discharge storm water associated with industrial activity requiring a General Permit are listed by category in 40 Code of Federal Regulations (CFR) Section 122.26(b)(14) (Federal Register, Volume 55 on

Pages 48065-66) and in Attachment 1 of this General Permit. The facilities can be publicly or privately owned. General descriptions of these categories are:

1. Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards (40 CFR Subchapter N);

2. Manufacturing facilities;

3. Mining/oil and gas facilities;

4. Hazardous waste treatment, storage, or disposal facilities;

5. Landfills, land application sites, and open dumps that receive industrial waste;

6. Recycling facilities such as metal scrap yards, battery reclaimers, salvage yards, automobile yards;

7. Steam electric generating facilities;

8. Transportation facilities that conduct any type of vehicle maintenance such as fueling, cleaning, repairing, etc.;

9. Sewage treatment plants;

10. Construction activity (covered by a separate general permit); and

11. Certain facilities (often referred to as "light industry") where industrial materials, equipment, or activities are exposed to storm water.

For the most part, these facilities are identified in the Federal regulations by a Standard Industrial Classification (SIC).

<u>Category 1 Dischargers</u>

The following categories of facilities currently have storm water effluent limitation guidelines for at least one of their subcategories. They are cement manufacturing (40 CFR Part 411); feedlots (40 CFR Part 412); fertilizer manufacturing (40 CFR Part 418); petroleum refining (40 CFR Part 419); phosphate manufacturing (40 CFR Part 422); steam electric power generation (40 CFR Part 423); coal mining (40 CFR Part 434); mineral mining and processing (40 CFR Part 436); ore mining and dressing (40 CFR Part 440); and asphalt emulsion (40 CFR Part 443). A facility operator whose facility falls into one of these general categories should examine the effluent guidelines to determine if the facility is categorized in one of the subcategories that have storm water effluent guidelines. If a facility is classified as one of those subcategories, that facility is subject to the standards listed in the CFR for that category and is subject to this General Permit. This General Permit contains additional requirements (see Section B.6.) for facilities with storm water effluent limitations guidelines.

Category 5 Dischargers

Inactive or closed landfills, land application sites, and open dumps that have received industrial wastes (Category 5) may be subject to this General Permit unless the storm water discharges from the sites are already regulated by an NPDES permit issued by the appropriate Regional Water Board. Facility operators of closed landfills that are regulated by waste discharge requirements (WDRs) may be required to comply with this General Permit. In some cases, it may be appropriate for closed landfills to be covered by the State Water Board's General Permit during closure activities. The Construction Activities General Permit should cover new landfill construction. Facility operators should contact their Regional Water Board to determine the appropriate permit coverage.

Category 10 Dischargers

Facility operators of Category 10 (light industry) facilities are not subject to this General Permit if they can certify that the following minimum conditions at their facilities are met:

1. All prohibited non-storm water discharges have been eliminated or otherwise permitted.

2. All areas of past exposure have been inspected and cleaned, as appropriate.

3. All materials related to industrial activity (including waste materials) are not exposed to storm water or authorized non-storm water discharges.

4. All industrial activities and industrial equipment are not exposed to storm water or authorized non-storm water discharges.

5. There is no exposure of materials associated with industrial activity through other direct or indirect pathways such as particulates from stacks and exhaust systems.

6. There is periodic re-evaluation of the facility to ensure Conditions 1, 3, 4, and 5 are continuously met.

Currently, facility operators that can certify that the above conditions are met are not required to notify the State Water

Board or Regional Water Board. These facility operators are advised to retain such certification documentation on site.

The Ninth Circuit Court of Appeals invalidated the exemption granted by U.S. EPA for storm water discharges from facilities in Category 11 that do not have exposure and remanded the regulation to U.S. EPA for further action. The State Water Board, at this time, is not requiring storm water discharges from facilities in Category 11 that do not have exposure to be covered by this General Permit. Instead, the State Water Board will await future U.S. EPA or court action clarifying the types of storm water discharges that must be permitted. If necessary, the State Water Board will reopen the General Permit to accommodate such a clarification.

Section 1068 of the Intermodal Surface Transportation Act of 1991 exempts municipal agencies serving populations of less than 100,000 from Phase I permit requirements for most facilities they operate (uncontrolled sanitary landfills, power plants, and airports are still required to be permitted in Phase I). Phase II of the Permit Program scheduled to begin August 7, 2001 will cover the facilities that are exempt from Phase I permit requirements.

**TYPES OF DISCHARGES NOT COVERED BY THIS GENERAL PERMIT**

1. CONSTRUCTION ACTIVITY: Discharges from construction activity of five acres or more, including clearing, grading, and excavation. A separate general permit was adopted on August 20, 1992 for this industrial category.

2. FACILITIES WHICH HAVE NPDES PERMITS CONTAINING STORM WATER PROVISIONS: Some storm water discharges may be regulated by other individual or general NPDES permits issued by the State Water Board or the Regional Water Boards. This General Permit shall not regulate these discharges. When the individual or general NPDES permits for such discharges expire, the State Water Board or Regional Water Board may authorize coverage under this General Permit or another general NPDES permit, or may issue a new individual NPDES permit consistent with the Federal and State storm water regulations. Interested parties may petition the State Water Board or appropriate Regional Water Board to issue individual or General NPDES Permits. General Permits may be issued for a particular industrial group or watershed area.

3. FACILITIES DETERMINED INELIGIBLE BY REGIONAL WATER BOARDS: Regional Water Boards may determine that discharges from a facility or groups of facilities, otherwise eligible for coverage under this General Permit, have potential water quality impacts that may not be appropriately addressed by

this General Permit. In such cases, a Regional Water Board may require such discharges to be covered by an individual or general NPDES permit. Interested persons may petition the appropriate Regional Water Board to issue individual NPDES permits. The applicability of this General Permit to such discharges will be terminated upon adoption of an individual NPDES permit or a different general NPDES permit.

4. FACILITIES WHICH DO NOT DISCHARGE STORM WATER TO WATERS OF THE UNITED STATES: The discharges from the following facilities are not required to be permitted:

   a. FACILITIES THAT DISCHARGE STORM WATER TO MUNICIPAL SANITARY SEWER SYSTEMS: Facilities that discharge storm water to municipal sanitary sewer systems or combined sewer systems are not required by Federal regulations to be covered by an NPDES storm water permit or to submit an NOI to comply with this General Permit. (It should be noted that many municipalities have sewer use ordinances that prohibit storm drain connections to their sanitary sewers.)

   b. FACILITIES THAT DO NOT DISCHARGE STORM WATER TO SURFACE WATERS OR SEPARATE STORM SEWERS: Storm water that is captured and treated and/or disposed of with the facility's NPDES permitted process wastewater and storm water that is disposed of to evaporation ponds, percolation ponds, or combined sewer systems are not required to obtain a storm water permit. To avoid liability, the facility operator should be certain that no discharge of storm water to surface waters would occur under any circumstances.

5. MOST SILVICULTURAL ACTIVITIES: Storm water discharges from most silvicultural activities such as thinning, harvesting operations, surface drainage, or road construction and maintenance are exempt from this permit. Log sorting or log storage facilities that fall within SIC 2411 are required to be permitted.

6. MINING AND OIL AND GAS FACILITIES: Oil and gas facilities that have not released storm water resulting in a discharge of a reportable quantity (RQ) for which notification is or was required pursuant to 40 CFR Parts 110, 117, and 302 at any time after November 19, 1987 are not required to be permitted unless the industrial storm water discharge contributed to a violation of a water quality standard. Mining facilities that discharge storm water that does not come into contact with any overburden, raw materials, intermediate product, finished product, by-product, or waste product located at the facility are not required to be permitted. These facilities must be permitted if they have a new release of storm water resulting in a discharge of an RQ.

7. FACILITIES ON INDIAN LANDS: the U.S. EPA will regulate Discharges from facilities on Indian lands.

## NOTIFICATION REQUIREMENTS

Storm water discharges from facilities described in the section titled "Types of Storm Water Discharges Covered by This General Permit" must be covered by an NPDES permit. An NOI must be submitted by the facility operator for each individual facility to obtain coverage. Certification of the NOI signifies that the facility operator intends to comply with the provisions of the General Permit. Facility operators who have filed NOIs for the State Water Board Order No. 91-013-DWQ (as amended by Order No. 92-12-DWQ) or San Francisco Bay Regional Water Board Order No. 92-011 (as amended by Order No. 92-116) will be sent an abbreviated NOI soon after adopting this General Permit that must be completed and returned within 45 days of receipt. Where operations have discontinued and significant materials remain on site (such as at closed landfills), the landowner may be responsible for filing an NOI and complying with this General Permit. A landowner may also file an NOI for a facility if the landowner, rather than the facility operator(s), is responsible for compliance with this General Permit.

A facility operator that does not submit an NOI for a facility must submit an application for an individual NPDES permit. U.S. EPA's regulations [40 CFR 122.21 (a)] exclude facility operators covered by a general permit from requirements to submit an individual permit application unless required by the Regional Water Board. The NOI requirements of this General Permit are intended to establish a mechanism which can be used to establish a clear accounting of the number of facility operators complying with the General Permit, their identities, the nature of operations at the facilities, and location.

All facility operators filing an NOI after the adoption of this General Permit must comply with this General Permit. Existing facility operators who have filed NOIs prior to the adoption of this General Permit shall continue to complete the requirements of the previous General Permit through June 30, 1997 including submitting annual reports to the Regional Water Boards by July 1, 1997. Group Leaders are required to submit a 1996-97 Group Evaluation Report by August 1, 1997.

## DESCRIPTION OF GENERAL PERMIT CONDITIONS

Prohibitions

This General Permit authorizes storm water and authorized non-storm water discharges from facilities that are required to be covered by a storm water permit. This General Permit prohibits discharges of material other than storm water (non-storm water discharges) that are not authorized by the General Permit and discharges containing hazardous substances in storm water in excess of reportable quantities established at 40 CFR 117.3 and 40 CFR 302.4. Authorized non-storm water discharges are addressed in the Special Conditions of the General Permit.

Effluent Limitations

NPDES Permits for storm water discharges must meet all applicable provisions of Sections 301 and 402 of the CWA. These provisions require control of pollutant discharges using best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT) to prevent and reduce pollutants and any more stringent controls necessary to meet water quality standards.

U.S. EPA regulations (40 CFR Subchapter N) establish effluent limitation guidelines for storm water discharges from facilities in ten industrial categories. For these facilities, compliance with the effluent limitation guidelines constitutes compliance with BAT and BCT for the specified pollutants and must be met to comply with this General Permit.

For storm water discharges from facilities not among the ten industrial categories listed in 40 CFR Subchapter N, it is not feasible at this time to establish numeric effluent limitations. The reasons why establishment of numeric effluent limitations is not feasible are discussed in detail in State Water Board Orders No. WQ 91-03 and WQ 91-04. Therefore, this General Permit allows the facility operator to implement best management practices (BMPs) to comply with the requirements of this General Permit. This approach is consistent with the U.S. EPA's August 1, 1996 "Interim Permitting Approach for Water Quality Based Effluent Limitations in Storm Water Permits".

Receiving Water Limitations

Storm water discharges shall not cause or contribute to a violation of an applicable water quality standard. The General Permit requires facility operators to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges through the development and implementation of BMPs which constitutes compliance with BAT and BCT and, in most cases, compliance with water quality standards. If receiving water quality standards are exceeded, facility operators are required to submit a written report providing additional BMPs that will be implemented to achieve water quality standards.

Storm Water Pollution Prevention Plans (SWPPPs)

All facility operators must prepare, retain on site, and implement an SWPPP. The SWPPP has two major objectives: (1) to help identify the sources of pollution that affect the quality of industrial storm water discharges and authorized non-storm water discharges, and (2) to describe and ensure the implementation of BMPs to reduce or prevent pollutants in industrial storm water discharges and authorized non-storm water discharges.

This General Permit requires development and implementation of an SWPPP emphasizing BMPs. This approach provides the flexibility necessary to establish appropriate BMPs for different types of industrial activities and pollutant sources. As this General Permit covers vastly different types of facilities, the State Water Board recognizes that there is no single best way of developing or organizing an SWPPP. The SWPPP requirements contain the essential elements that all facility operators must consider and address in the SWPPP. This General Permit's SWPPP requirements are more detailed than the previous general permit's SWPPP requirements, and the suggested order of the SWPPP elements have been rearranged (1) to correspond more closely with other storm water permits in effect throughout the country, and (2) to generally follow a more logical path. Facility operators that have already developed and implemented SWPPPs under previous general permits are required to review the SWPPP's requirements contained in this General Permit and then review their existing SWPPP for adequacy. If the existing SWPPP adequately identifies and assesses all potential sources of pollutants and describes the appropriate BMPs necessary to reduce or prevent pollutants, the facility operator is not required to revise the existing SWPPP.

One of the major elements of the SWPPP is the elimination of unauthorized non-storm water discharges to the facility's storm drain system. Unauthorized non-storm water discharges can be generated from a wide variety of potential pollutant sources. They include waters from the rinsing or washing of vehicles, equipment, buildings, or pavement; materials that have been improperly disposed of or dumped, and spilled; or leaked materials. Unauthorized non-storm water discharges can contribute a significant pollutant load to receiving waters. Measures to control spills, leakage, and dumping can often be addressed through BMPs. Unauthorized non-storm water discharges may enter the storm drain system via conveyances such as floor drains. All conveyances should be evaluated to determine whether they convey unauthorized non-storm water discharges to the storm drain system. Unauthorized non-storm water discharges (even when commingled with storm water) shall be eliminated or covered by a separate NPDES Permit.

There are many non-storm water discharges that, under certain conditions, should not contain pollutants associated with industrial activity (i.e., air conditioning condensate, potable water line testing, landscaping overflow, etc.). Item D, Special Conditions, provides the conditions where certain listed non-storm water discharges are authorized by this General Permit.

Monitoring Program

The General Permit requires development and implementation of a monitoring program. The objectives of the monitoring program are to (1) demonstrate compliance with the General Permit, (2) aid in the implementation of the SWPPP, and (3) measure the effectiveness of the BMPs in reducing or preventing pollutants in storm water discharges and authorized non-storm water discharges.

All facility operators (with the exception of inactive mining operations) are required to:

1. Perform visual observations of storm water discharges and authorized storm water discharges.

2. Collect and analyze samples of storm water discharges. Analysis must include pH, total suspended solids (TSS), total organic carbon (TOC), specific conductance, toxic chemicals, and other pollutants which are likely to be present in storm water discharges in significant quantities, and those parameters listed in Table D of this General Permit. The Table D parameters are those listed in the U.S. EPA Multi-Sector General Permit. Facility operators subject to Federal storm water effluent limitation guidelines in 40 CFR Subchapter N must also sample and analyze for any pollutant specified in the appropriate category of 40 CFR Subchapter N.

Facility operators are not required to collect samples or perform visual observations during adverse climatic conditions. Sample collection and visual observations are required only during scheduled facility operating hours. Visual observations are required only during daylight hours. Facility operators that are unable to collect any of the required samples or visual observations because of the above circumstances must provide documentation to the Regional Water Board in their annual report.

Facility operators may be exempt from performing sampling and analysis if they: (1) do not have areas of industrial activity exposed to storm water, (2) receive an exemption from a local agency which has jurisdiction over the storm sewer system, or (3) receive an exemption from the appropriate Regional Water Board. Facility operators must always perform sampling and analysis for any pollutant specified in storm water effluent limitation guidelines.

This General Permit contains a new procedure where facility operators, if they meet certain minimum conditions, may certify compliance with the General Permit and reduce the number of sampling events required to be sampled for the remaining term of the General Permit. Each Regional Water Board may develop instructions, guidance, and checklists to assist facility operators to complete sampling reduction requests.

Local agencies that wish to provide sampling and analysis exemptions or reductions to facility operators within their jurisdiction shall develop a certification program that clearly indicates the certification procedures and criteria used by the local agency. At a minimum, these programs should include site inspections, a review of the facility operator's SWPPP, and a review of other records such as monitoring data, receiving water data, etc. The certification program shall be approved by the local Regional Water Board before implementation.

Alternative Monitoring

Facility operators are required to develop a facility-specific monitoring program that satisfies both the minimum monitoring program requirements and the objectives of the monitoring program. Some facility operators have indicated that cost-effective alternative monitoring programs can be developed that provide equivalent or more accurate indicators of pollutants and/or BMP performance than a monitoring program based upon the minimum monitoring program requirements. An example of such an alternative monitoring program would be one that identifies sample locations at or near pollutant sources rather than sampling an entire drainage area where the storm water discharge has been diluted with storm water from areas with little or no industrial activity.

The State Water Board does not want to preclude facility operators from developing better, and perhaps more cost-effective, monitoring programs. This General Permit allows facility operators to submit alternative monitoring programs for approval by the Regional Water Board. For individual facilities, these proposals must be facility specific and demonstrate how the alternative monitoring program will result in an equivalent or more accurate indicator of pollutants and/or BMP effectiveness. Facility operators with similar industrial activities may also propose alternative monitoring programs for approval by the Regional Water Boards. These proposals must demonstrate how the alternative monitoring program will result in an equivalent or more accurate indicator of pollutants and/or BMP effectiveness for all of the participating facilities.

Facility operators shall continue to comply with the existing monitoring program requirements until receiving approval by the Regional Water Board.

Group Monitoring

Each facility operator may either perform sampling and analysis individually or participate in a group monitoring program. A group monitoring program may be developed either by a group leader representing a group of similar facilities or by a local agency which holds a storm water permit for a municipal separate storm sewer system for industrial facilities within its jurisdiction. The group leader or local agency responsible for the group monitoring program must schedule all participating facilities to sample two storm events over the life of this General Permit. Facility operators subject to Federal effluent limitations guidelines in 40 CFR Subchapter N must individually sample and analyze for pollutants listed in the appropriate Federal regulations.

Participants within a group may be located within the jurisdiction of more than one Regional Water Board. Multi-Regional Water Board groups must receive the approval of the State Water Board Executive Director (with the concurrence of the appropriate Regional Water Boards).

Each group leader or local agency responsible for group sampling must: (1) provide guidance or training so that the monitoring is done correctly, (2) recommend appropriate BMPs to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges from group participants, (3) evaluate and report the monitoring data to the State Water Board and/or the appropriate Regional Water Board(s), and (4) conduct two on-site inspections at each facility over the five year term of this General Permit to evaluate facility compliance and recommend BMPs to achieve compliance with this General Permit. The group leader or local agency may designate, hire, or train inspectors to conduct these inspections that are or are not directly affiliated with the group leader or local agency. It is the group leader's or local agency's responsibility to select inspectors that are capable of evaluating each facility's compliance with the General Permit and can recommend appropriate BMPs. All group monitoring plans are subject to State Water Board and/or Regional Water Board(s) review. Consistent with the four-tier permitting strategy described in the Federal regulations, the Regional Water Board(s) may evaluate the data and results from group monitoring to establish future permitting decisions. As appropriate, the State Water Board and/or the Regional Water Board(s) may terminate or require substantial amendment to the group monitoring plans. The State Water Board and/or the Regional Water Board(s) may terminate a facility's participation in group monitoring or require additional monitoring activities.

Retention of Records

The facility operator is required to retain records of all monitoring information, copies of all reports required by this General Permit, and records of all data used to complete the NOI for a period of five years from the date of measurement, report, or monitoring activity. This period may be extended by the State and/or Regional Water Boards. All records are public documents and must be provided to the Regional Water Boards on request.

Watershed Management

The State and Regional Water Boards are undertaking a focussed effort in watershed management throughout the State. In reissuing this General Permit, the State Water Board recognizes both the evolving nature of watershed management and the long-term desirability of structuring monitoring programs to support the Watershed Management Initiative. Therefore, the amended monitoring and reporting provisions provide flexibility for individual facility operators or groups of facility operators to propose and participate in, subject to Regional Water Board approval, watershed monitoring programs in lieu of some or all of the monitoring requirements contained in this General Permit.

Facility Operator Compliance Responsibilities

This General Permit has been written to encourage individual facility operators to develop their own SWPPP and monitoring programs. Many facility operators, however, choose to obtain compliance assistance either by hiring a consultant on an individual basis or by participating in a group monitoring plan. Regardless of how a facility operator chooses to pursue compliance, it is the facility operator that is responsible for compliance with this General Permit.

The State Water Board recognizes that industrial activities and operating conditions at many facilities change over time. In addition, new and more effective BMPs are being developed by various facility operators and by industrial groups. The SWPPP and monitoring program requirements include various inspections, reviews, and observations all of which recognize, encourage, and mandate an iterative self-evaluation process that is necessary to consistently comply with this General Permit. In general, facility operators that develop and implement SWPPPs that comply with this General Permit should not be penalized when discovering minor violations through this iterative self-evaluation process. The General Permit provides facility operators up to 90 days to revise and implement the SWPPP to correct such violations.

STATE WATER RESOURCES CONTROL BOARD (STATE WATER BOARD)
WATER QUALITY ORDER NO. 97-03-DWQ
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT NO. CAS000001 (GENERAL PERMIT)

WASTE DISCHARGE REQUIREMENTS (WDRS)
FOR
DISCHARGES OF STORM WATER ASSOCIATED WITH INDUSTRIAL ACTIVITIES
EXCLUDING CONSTRUCTION ACTIVITIES

The State Water Board finds that:

1. Federal regulations for storm water discharges were issued by the U.S. Environmental Protection Agency (U.S. EPA) on November 16, 1990 (40 Code of Federal Regulations [CFR] Parts 122, 123, and 124). The regulations require operators of specific categories of facilities where discharges of storm water associated with industrial activity (storm water) occur to obtain an NPDES permit and to implement Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) to reduce or prevent pollutants associated with industrial activity in storm water discharges and authorized non-storm discharges.

2. This General Permit shall regulate storm water discharges and authorized non-storm water discharges from specific categories of industrial facilities identified in Attachment 1, storm water discharges and authorized non-storm water discharges from facilities as designated by the Regional Water Quality Control Boards (Regional Water Boards), and storm water discharges and authorized non-storm water discharges from other facilities seeking General Permit coverage. This General Permit may also regulate storm water discharges and authorized non-storm water discharges from facilities as required by U.S. EPA regulations. This General Permit shall regulate storm water discharges and authorized non-storm water discharges previously regulated by San Francisco Bay Regional Water Board Order, No.92-11 (as amended by Order No. 92-116). This General Permit excludes storm water discharges and non-storm water discharges that are regulated by other individual or general NPDES permits, storm water discharges and non-storm water discharges from construction activities, and storm water discharges and non-storm water discharges excluded by the Regional Water Boards for coverage by this General Permit. Attachment 2 contains the addresses and telephone numbers of each Regional Water Board office.

3. To obtain coverage for storm water discharges and authorized non-storm water discharges pursuant to this General Permit, operators of facilities (facility operators) must submit a Notice of Intent (NOI), in accordance with the Attachment 3

instructions, and appropriate annual fee to the State Water Board. This includes facility operators that have participated in U.S. EPA's group application process.

4. This General Permit does not preempt or supersede the authority of local agencies to prohibit, restrict, or control storm water discharges and authorized non-storm water discharges to storm drain systems or other water-courses within their jurisdictions as allowed by State and Federal law.

5. If an individual NPDES permit is issued to a facility operator otherwise subject to this General Permit or an alternative NPDES general permit is subsequently adopted which covers storm water discharges and/or authorized non-storm water discharges regulated by this General Permit, the applicability of this General Permit to such discharges is automatically terminated on the effective date of the individual NPDES permit or the date of approval for coverage under the subsequent NPDES general permit.

6. Effluent limitations and toxic and effluent standards established in Sections 208(b), 301, 302, 303(d), 304, 306, 307, and 403 of the Federal Clean Water Act (CWA), as amended, are applicable to storm water discharges and authorized non-storm water discharges regulated by this General Permit.

7. This action to adopt an NPDES general permit is exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21100, et seq.) in accordance with Section 13389 of the California Water Code.

8. Federal regulations (40 CFR Subchapter N) establish effluent limitations guidelines for storm water discharges from some facilities in ten industrial categories.

9. For facilities which do not have established effluent limitation guidelines for storm water discharges in 40 CFR Subchapter N, it is not feasible at this time to establish numeric effluent limitations. This is due to the large number of discharges and the complex nature of storm water discharges. This is also consistent with the U.S. EPA's August 1, 1996 "Interim Permitting Approach for Water Quality Based Effluent Limitations in Storm Water Permits."

10. Facility operators are required to comply with the terms and conditions of this General Permit. Compliance with the terms and conditions of this General Permit constitutes compliance with BAT/BCT requirements and with requirements to achieve water quality standards. This includes the development and implementation of an effective Storm Water Pollution Prevention Plan (SWPPP) to reduce or prevent pollutants associated with industrial activity in storm water discharges and authorized non-storm water discharges.

11. Best Management Practices (BMPs) to reduce or prevent pollutants associated with industrial activity in storm water discharges and authorized non-storm water discharges are appropriate where numeric effluent limitations are infeasible, and the implementation of BMPs is adequate to achieve compliance with BAT/BCT and with water quality standards.

12. The State Water Board has adopted a Watershed Management Initiative that encourages watershed management throughout the State. This General Permit recognizes the Watershed Management Initiative by supporting the development of watershed monitoring programs authorized by the Regional Water Boards.

13. Following adoption of this General Permit, the Regional Water Boards shall enforce its provisions.

14. Following public notice in accordance with State and Federal laws and regulations, the State Water Board held a public hearing on November 12, 1996 and heard and considered all comments pertaining to this General Permit. A response to all significant comments has been prepared and is available for public review.

15. This Order is an NPDES General Permit in compliance with Section 402 of the CWA and shall take effect upon adoption by the State Water Board.

16. All terms that are defined in the CWA, U.S. EPA storm water regulations and the Porter-Cologne Water Quality Control Act will have the same definition in this General Permit unless otherwise stated.

IT IS HEREBY ORDERED that all facility operators required to be regulated by this General Permit shall comply with the following:

A. DISCHARGE PROHIBITIONS:

1. Except as allowed in Special Conditions (D.1.) of this General Permit, materials other than storm water (non-storm water discharges) that discharge either directly or indirectly to waters of the United States are prohibited. Prohibited non-storm water discharges must be either eliminated or permitted by a separate NPDES permit.

2. Storm water discharges and authorized non-storm water discharges shall not cause or threaten to cause pollution, contamination, or nuisance.

B. EFFLUENT LIMITATIONS:

1. Storm water discharges from facilities subject to storm water effluent limitation guidelines in Federal regulations (40 CFR

Subchapter N) shall not exceed the specified effluent limitations.

2. Storm water discharges and authorized non-storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of a reportable quantity listed in 40 CFR Part 117 and/or 40 CFR Part 302.

3. Facility operators covered by this General Permit must reduce or prevent pollutants associated with industrial activity in storm water discharges and authorized non-storm water discharges through implementation of BAT for toxic and non-conventional pollutants and BCT for conventional pollutants. Development and implementation of an SWPPP that complies with the requirements in Section A of the General Permit and that includes BMPs that achieve BAT/BCT constitutes compliance with this requirement.

C. RECEIVING WATER LIMITATIONS:

1. Storm water discharges and authorized non-storm water discharges to any surface or ground water shall not adversely impact human health or the environment.

2. Storm water discharges and authorized non-storm water discharges shall not cause or contribute to an exceedance of any applicable water quality standards contained in a Statewide Water Quality Control Plan or the applicable Regional Water Board's Basin Plan.

3. A facility operator will not be in violation of Receiving Water Limitation C.2. as long as the facility operator has implemented BMPs that achieve BAT/BCT and the following procedure is followed:

   a. The facility operator shall submit a report to the appropriate Regional Water Board that describes the BMPs that are currently being implemented and additional BMPs that will be implemented to prevent or reduce any pollutants that are causing or contributing to the exceedance of water quality standards. The report shall include an implementation schedule. The Regional Water Board may require modifications to the report.

   b. Following approval of the report described above by the Regional Water Board, the facility operator shall revise its SWPPP and monitoring program to incorporate the additional BMPs that have been and will be implemented, the implementation schedule, and any additional monitoring required.

4. A facility operator shall be in violation of this General Permit if he/she fails to do any of the following:

a. Submit the report described above within 60 days after either the facility operator or the Regional Water Board determines that discharges are causing or contributing to an exceedance of an applicable water quality standard;

b. Submit a report that is approved by the Regional Water Board; or

c. Revise its SWPPP and monitoring program as required by the approved report.

D. SPECIAL CONDITIONS

1. Non-Storm Water Discharges

a. The following non-storm water discharges are authorized by this General Permit provided that they satisfy the conditions specified in Paragraph b. below: fire hydrant flushing; potable water sources, including potable water related to the operation, maintenance, or testing of potable water systems; drinking fountain water; atmospheric condensates including refrigeration, air conditioning, and compressor condensate; irrigation drainage; landscape watering; springs; ground water; foundation or footing drainage; and sea water infiltration where the sea waters are discharged back into the sea water source.

b. The non-storm water discharges as provided in Paragraph a. above are authorized by this General Permit if all the following conditions are met:

i. The non-storm water discharges are in compliance with Regional Water Board requirements.

ii. The non-storm water discharges are in compliance with local agency ordinances and/or requirements.

iii. BMPs are specifically included in the SWPPP to (1) prevent or reduce the contact of non-storm water discharges with significant materials or equipment and (2) minimize, to the extent practicable, the flow or volume of non-storm water discharges.

iv. The non-storm water discharges do not contain significant quantities of pollutants.

v. The monitoring program includes quarterly visual observations of each non-storm water discharge and its sources to ensure that BMPs are being implemented and are effective.

vi. The non-storm water discharges are reported and described annually as part of the annual report.

c. The Regional Water Board or its designee may establish additional monitoring programs and reporting requirements for any non-storm water discharge authorized by this General Permit.

d. Discharges from firefighting activities are authorized by this General Permit and are not subject to the conditions of Paragraph b. above.

E. PROVISIONS

1. All facility operators seeking coverage by this General Permit must submit an NOI for each of the facilities they operate. Facility operators filing an NOI after the adoption of this General Permit shall use the NOI form and instructions (Attachment 3) attached to this General Permit. Existing facility operators who have filed an NOI pursuant to State Water Board Order No. 91-013-DWQ (as amended by Order No. 92-12-DWQ) or San Francisco Bay Regional Water Board Order No. 92-11 (as amended by Order No. 92-116) shall submit an abbreviated NOI form provided by the State Water Board. The abbreviated NOI form shall be submitted within 45 days of receipt.

2. Facility operators who have filed an NOI, pursuant to State Water Board Order No. 91-013-DWQ (as amended by Order No. 92-12-DWQ) or San Francisco Bay Regional Water Board Order No. 92-11 (as amended by Order No. 92-116), shall continue to implement their existing SWPPP and shall implement any necessary revisions to their SWPPP in accordance with Section A of this General Permit in a timely manner, but in no case later than August 1, 1997. Facility operators beginning industrial activities after adoption of this General Permit must develop and implement an SWPPP in accordance with Section A of this General Permit when the industrial activities begin.

3. Facility operators who have filed an NOI, pursuant to State Water Board Order No. 91-013-DWQ (as amended by Order No. 92-12-DWQ) or San Francisco Bay Regional Water Board Order No. 92-11 (as amended by Order No. 92-116), shall continue to implement their existing Monitoring Program and shall implement any necessary revisions to their Monitoring Program in accordance with Section B of the General Permit in a timely manner, but in no case later than August 1, 1997. Facility operators beginning industrial activities after adoption of this General Permit must develop and implement a Monitoring Program in

accordance with Section B of this General Permit when industrial activities begin.

4. Facility operators of feedlots as defined in 40 CFR Part 412 that are in full compliance with Section 2560 to Section 2565, Title 23, California Code of Regulations (Chapter 15) will be in compliance with all effluent limitations and prohibitions contained in this General Permit. Facility operators of feedlots that comply with Chapter 15, however, must perform monitoring in compliance with the requirements of Section B.4.d. and B.14. of this General Permit. Facility operators of feedlots must also comply with any Regional Water Board WDRs or NPDES general permit regulating their storm water discharges.

5. All facility operators must comply with lawful requirements of municipalities, counties, drainage districts, and other local agencies regarding storm water discharges and non-storm water discharges entering storm drain systems or other watercourses under their jurisdiction, including applicable requirements in municipal storm water management programs developed to comply with NPDES permits issued by the Regional Water Boards to local agencies.

6. All facility operators must comply with the standard provisions and reporting requirements for each facility covered by this General Permit contained in Section C, Standard Provisions.

7. Facility operators that operate facilities with co-located industrial activities (facilities that have industrial activities that meet more than one of the descriptions in Attachment 1) that are contiguous to one another are authorized to file a single NOI to comply with the General Permit. Storm water discharges and authorized non-storm water discharges from the co-located industrial activities are authorized if the SWPPP and Monitoring Program addresses each co-located industrial activity.

8. Upon reissuance of a successor NPDES general permit by the State Water Board, the facility operators subject to this reissued General Permit may be required to file an NOI.

9. Facility operators may request to terminate their coverage under this General Permit by filing a Notice of Termination (NOT) with the Regional Water Board. The NOT shall provide all documentation requested by the Regional Water Board. The facility operator will be notified when the NOT has been approved. Should the NOT be denied, facility operators are responsible for continued compliance with the requirements of this General Permit.

10. Facility operators who have filed an NOI, pursuant to State Water Board Order No. 91-013-DWQ (as amended by Order No. 92-12) or San Francisco Bay Regional Water Board Order No. 92-11 (as amended by Order No. 92-116) shall:

    a. Complete the 1996-97 activities required by those general permits. These include, but are not limited to, conducting any remaining visual observations, sample collection, annual site inspection, annual report submittal, and (for group monitoring leaders) Group Evaluation Reports; and

    b. Comply with the requirements of this General Permit no later than August 1, 1997.

11. If the Regional Water Board determines that a discharge may be causing or contributing to an exceedance of any applicable water quality standards contained in a Statewide Water Quality Control Plan or the applicable Regional Water Board's Basin Plan, the Regional Water Board may order the facility operator to comply with the requirements described in Receiving Water Limitation C.3. The facility operator shall comply with the requirements within the time schedule established by the Regional Water Board.

12. If the facility operator determines that its storm water discharges or authorized non-storm water discharges are causing or contributing to an exceedance of any applicable water quality standards, the facility operator shall comply with the requirements described in Receiving Water Limitation C.3.

13. State Water Board Order No. 91-013-DWQ (as amended by Order No. 92-12-DWQ) and San Francisco Bay Regional Water Board Order No. 91-011 (as amended by Order No. 92-116) are hereby rescinded.

F. REGIONAL WATER BOARD AUTHORITIES

1. Following adoption of this General Permit, Regional Water Boards shall:

    a. Implement the provisions of this General Permit, including, but not limited to, reviewing SWPPPs, reviewing annual reports, conducting compliance inspections, and taking enforcement actions.

    b. Issue other NPDES general permits or individual NPDES storm water permits as they deem appropriate to individual facility operators, facility operators of specific categories of industrial activities, or facility operators in a watershed or geographic area. Upon issuance of such NPDES permits by a Regional Water Board, the affected facility operator shall no longer be regulated by this General Permit. Any new NPDES permit issued by the Regional Water Board may contain different requirements than the requirements of this General Permit.

2. Regional Water Boards may provide guidance to facility operators on the SWPPP and the Monitoring Program and reporting implementation.

3. Regional Water Boards may require facility operators to conduct additional SWPPP and Monitoring Program and reporting activities necessary to achieve compliance with this General Permit.

4. Regional Water Boards may approve requests from facility operators whose facilities include co-located industrial activities that are not contiguous within the facilities (e.g., some military bases) to comply with this General Permit under a single NOI. Storm water discharges and authorized non-storm water discharges from the co-located industrial activities and from other sources within the facility that may generate significant quantities of pollutants are authorized provided the SWPPP and Monitoring Program addresses each co-located industrial activity and other sources that may generate significant quantities of pollutants.

CERTIFICATION

The undersigned, Administrative Assistant to the State Water Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on April 17, 1997.

AYE: John P. Caffrey
John W. Brown
James M. Stubchaer
Marc Del Piero
Mary Jane Forster

NO: None

ABSENT: None

ABSTAIN: None

Maureen Marché

Administrative Assistant to the Board

## SECTION A: STORM WATER POLLUTION PREVENTION PLAN REQUIREMENTS

1. *Implementation Schedule*

A storm water pollution prevention plan (SWPPP) shall be developed and implemented for each facility covered by this General Permit in accordance with the following schedule.

a. Facility operators beginning industrial activities before October 1, 1992 shall develop and implement the SWPPP no later than October 1, 1992. Facility operators beginning industrial activities after October 1, 1992 shall develop and implement the SWPPP when industrial activities begin.

b. Existing facility operators that submitted a Notice of Intent (NOI), pursuant to State Water Resources Control Board (State Water Board) Order No. 91-013-DWQ (as amended by Order No. 92-12) or San Francisco Bay Regional Water Quality Control Board (Regional Water Board) Order No. 92-11 (as amended by Order No. 92-116), shall continue to implement their existing SWPPP and shall implement any necessary revisions to their SWPPP in a timely manner, but in no case later than August 1, 1997.

2. *Objectives*

The SWPPP has two major objectives: (a) to identify and evaluate sources of pollutants associated with industrial activities that may affect the quality of storm water discharges and authorized non-storm water discharges from the facility; and (b) to identify and implement site-specific best management practices (BMPs) to reduce or prevent pollutants associated with industrial activities in storm water discharges and authorized non-storm water discharges. BMPs may include a variety of pollution prevention measures or other low-cost and pollution control measures. They are generally categorized as non-structural BMPs (activity schedules, prohibitions of practices, maintenance procedures, and other low-cost measures) and as structural BMPs (treatment measures, run-off controls, over-head coverage.) To achieve these objectives, facility operators should consider the five phase process for SWPPP development and implementation as shown in Table A.

The SWPPP requirements are designed to be sufficiently flexible to meet the needs of various facilities. SWPPP requirements that are not applicable to a facility should not be included in the SWPPP.

A facility's SWPPP is a written document that shall contain a compliance activity schedule, a description of industrial activities and pollutant sources, descriptions of BMPs, drawings, maps, and relevant copies or references of parts of other plans. The SWPPP shall be revised whenever appropriate and shall be readily available for review by facility employees or Regional Water Board inspectors.

3. *Planning and Organization*

a. *Pollution Prevention Team*

The SWPPP shall identify a specific individual or individuals and their positions within the facility organization as members of a storm water pollution prevention team responsible for developing the SWPPP, assisting the facility manager in SWPPP implementation and revision, and conducting all monitoring program activities required in Section B of this General Permit. The SWPPP shall clearly identify the General Permit related responsibilities, duties, and activities of each team member. For small facilities, storm water pollution prevention teams may consist of one individual where appropriate.

b. *Review Other Requirements and Existing Facility Plans*

The SWPPP may incorporate or reference the appropriate elements of other regulatory requirements. Facility operators should review all local, State, and Federal requirements that impact, complement, or are consistent with the requirements of this General Permit. Facility operators should identify any existing facility plans that contain storm water pollutant control measures or relate to the requirements of this General Permit. As examples, facility operators whose facilities are subject to Federal Spill Prevention Control and Countermeasures' requirements should already have instituted a plan to control spills of certain hazardous materials. Similarly, facility operators whose facilities are subject to air quality related permits and regulations may already have evaluated industrial activities that generate dust or particulates.

4. *Site Map*

The SWPPP shall include a site map. The site map shall be provided on an 8-½ x 11 inch or larger sheet and include notes, legends, and other data as appropriate to ensure that the site map is clear and understandable. If necessary, facility operators may provide the required information on multiple site maps.

**TABLE A**
**FIVE PHASES FOR DEVELOPING AND IMPLEMENTING INDUSTRIAL STORM WATER POLLUTION PREVENTION PLANS**

**PLANNING AND ORGANIZATION**

*Form Pollution Prevention Team
*Review other plans

↓

**ASSESSMENT PHASE**

*Develop a site map
*Identify potential pollutant sources
*Inventory of materials and chemicals
*List significant spills and leaks
*Identify non-storm water discharges
*Assess pollutant Risks

↓

**BEST MANAGEMENT PRACTICES IDENTIFICATION PHASE**

*Non-structural BMPs
*Structural BMPs
*Select activity and site-specific BMPs

↓

**IMPLEMENTATION PHASE**

*Train employees
*Implement BMPs
*Conduct recordkeeping and reporting

↓

**EVALUATION / MONITORING**

*Conduct annual site evaluation
*Review monitoring information
*Evaluate BMPs
*Review and revise SWPPP

The following information shall be included on the site map:

a. The facility boundaries; the outline of all storm water drainage areas within the facility boundaries; portions of the drainage area impacted by run-on from surrounding areas; and direction of flow of each drainage area, on-site surface water bodies, and areas of soil erosion. The map shall also identify nearby water bodies (such as rivers, lakes, and ponds) and municipal storm drain inlets where the facility's storm water discharges and authorized non-storm water discharges may be received.

b. The location of the storm water collection and conveyance system, associated points of discharge, and direction of flow. Include any structural control measures that affect storm water discharges, authorized non-storm water discharges, and run-on. Examples of structural control measures are catch basins, berms, detention ponds, secondary containment, oil/water separators, diversion barriers, etc.

c. An outline of all impervious areas of the facility, including paved areas, buildings, covered storage areas, or other roofed structures.

d. Locations where materials are directly exposed to precipitation and the locations where significant spills or leaks identified in Section A.6.a.iv. below have occurred.

e. Areas of industrial activity. This shall include the locations of all storage areas and storage tanks, shipping and receiving areas, fueling areas, vehicle and equipment storage/maintenance areas, material handling and processing areas, waste treatment and disposal areas, dust or particulate generating areas, cleaning and rinsing areas, and other areas of industrial activity which are potential pollutant sources.

5. *List of Significant Materials*

The SWPPP shall include a list of significant materials handled and stored at the site. For each material on the list, describe the locations where the material is being stored, received, shipped, and handled, as well as the typical quantities and frequency. Materials shall include raw materials, intermediate products, final or finished products, recycled materials, and waste or disposed materials.

6. *Description of Potential Pollutant Sources*

a. The SWPPP shall include a narrative description of the facility's industrial activities, as identified in Section A.4.e above, associated potential pollutant sources, and potential pollutants that could be discharged in storm water discharges or authorized non-storm water discharges. At a minimum, the following items related to a facility's industrial activities shall be considered:

i. Industrial Processes

Describe each industrial process, the type, characteristics, and quantity of significant materials used in or resulting from the process, and a description of the manufacturing, cleaning, rinsing, recycling, disposal, or other activities related to the process. Where applicable, areas protected by containment structures and the corresponding containment capacity shall be described.

ii. Material Handling and Storage Areas

Describe each handling and storage area, type, characteristics, and quantity of significant materials handled or stored, description of the shipping, receiving, and loading procedures, and the spill or leak prevention and response procedures. Where applicable, areas protected by containment structures and the corresponding containment capacity shall be described.

iii. Dust and Particulate Generating Activities

Describe all industrial activities that generate dust or particulates that may be deposited within the facility's boundaries and identify their discharge locations; the characteristics of dust and particulate pollutants; the approximate quantity of dust and particulate pollutants that may be deposited within the facility boundaries; and a description of the primary areas of the facility where dust and particulate pollutants would settle.

iv. Significant Spills and Leaks

Describe materials that have spilled or leaked in significant quantities in storm water discharges or non-storm water discharges since April 17, 1994. Include toxic chemicals (listed in 40 CFR, Part 302) that have been discharged to storm water as reported on U.S. Environmental Protection Agency (U.S. EPA) Form R, and oil and hazardous substances in excess of reportable quantities (see 40 Code of Federal Regulations [CFR], Parts 110, 117, and 302).

The description shall include the type, characteristics, and approximate quantity of the material spilled or leaked, the cleanup or remedial actions that have occurred or are planned, the approximate remaining quantity of materials that may be exposed to storm water or non-storm water discharges, and the preventative measures taken to ensure spill or leaks do not reoccur. Such list shall be updated as appropriate during the term of this General Permit.

v. Non-Storm Water Discharges

Facility operators shall investigate the facility to identify all non-storm water discharges and their sources. As part of this investigation, all drains (inlets and outlets) shall be evaluated to identify whether they connect to the storm drain system.

All non-storm water discharges shall be described. This shall include the source, quantity, frequency, and characteristics of the non-storm water discharges and associated drainage area.

Non-storm water discharges that contain significant quantities of pollutants or that do not meet the conditions provided in Special Conditions D. are prohibited by this General Permit (Examples of prohibited non-storm water discharges are contact and non-contact cooling water, boiler blowdown, rinse water, wash water, etc.). Non-storm water discharges that meet the conditions provided in Special Condition D. are authorized by this General Permit. The SWPPP must include BMPs to prevent or reduce contact of non-storm water discharges with significant materials or equipment.

vi. Soil Erosion

Describe the facility locations where soil erosion may occur as a result of industrial activity, storm water discharges associated with industrial activity, or authorized non-storm water discharges.

b. The SWPPP shall include a summary of all areas of industrial activities, potential pollutant sources, and potential pollutants. This information should be summarized similar to Table B. The last column of Table B, "Control Practices", should be completed in accordance with Section A.8. below.

7. *Assessment of Potential Pollutant Sources*

a. The SWPPP shall include a narrative assessment of all industrial activities and potential pollutant sources as described in A.6. above to determine:

i. Which areas of the facility are likely sources of pollutants in storm water discharges and authorized non-storm water discharges, and

ii. Which pollutants are likely to be present in storm water discharges and authorized non-storm water discharges. Facility operators shall consider and evaluate various factors when performing this assessment such as current storm water BMPs; quantities of significant materials handled, produced, stored, or disposed of; likelihood of exposure to storm water or authorized non-storm water discharges; history of spill or leaks; and run-on from outside sources.

b. Facility operators shall summarize the areas of the facility that are likely sources of pollutants and the corresponding pollutants that are likely to be present in storm water discharges and authorized non-storm water discharges.

Facility operators are required to develop and implement additional BMPs as appropriate and necessary to prevent or reduce pollutants associated with each pollutant source. The BMPs will be narratively described in Section 8 below.

*8. Storm Water Best Management Practices*

The SWPPP shall include a narrative description of the storm water BMPs to be implemented at the facility for each potential pollutant and its source identified in the site assessment phase (Sections A.6. and 7. above). The BMPs shall be developed and implemented to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. Each pollutant and its source may require one or more BMPs. Some BMPs may be implemented for multiple pollutants and their sources, while other BMPs will be implemented for a very specific pollutant and its source.

**TABLE B**
**EXAMPLE**
## ASSESSMENT OF POTENTIAL POLLUTION SOURCES AND CORRESPONDING BEST MANAGEMENT PRACTICES SUMMARY

| Area | Activity | Pollutant Source | Pollutant | Best Management Practices |
|---|---|---|---|---|
| Vehicle & Equipment Fueling | Fueling | Spills and leaks during delivery | fuel oil | - Use spill and overflow protection<br>- Minimize run-on of storm water into the fueling area<br>- Cover fueling area<br>- Use dry cleanup methods rather than hosing down area<br>- Implement proper spill prevention control program<br>- Implement adequate preventative maintenance program to preventive tank and line leaks<br>- Inspect fueling areas regularly to detect problems before they occur<br>- Train employees on proper fueling, cleanup, and spill response techniques. |
| | | Spills caused by topping off fuel tanks | fuel oil | |
| | | Hosing or washing down fuel area | fuel oil | |
| | | Leaking storage tanks | fuel oil | |
| | | Rainfall running off fueling area, and rainfall running onto and off fueling area | fuel oil | |

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The description of the BMPs shall identify the BMPs as (1) existing BMPs, (2) existing BMPs to be revised and implemented, or (3) new BMPs to be implemented. The description shall also include a discussion on the effectiveness of each BMP to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. The SWPPP shall provide a summary of all BMPs implemented for each pollutant source. This information should be summarized similar to Table B.

Facility operators shall consider the following BMPs for implementation at the facility:

a. Non-Structural BMPs

Non-structural BMPs generally consist of processes, prohibitions, procedures, schedule of activities, etc., that prevent pollutants associated with industrial activity from contacting with storm water discharges and authorized non-storm water discharges. They are considered low technology, cost-effective measures. Facility operators should consider all possible non-structural BMPs options before considering additional structural BMPs (see Section A.8.b. below). Below is a list of non-structural BMPs that should be considered:

i. Good Housekeeping

Good housekeeping generally consist of practical procedures to maintain a clean and orderly facility.

ii. Preventive Maintenance

Preventive maintenance includes the regular inspection and maintenance of structural storm water controls (catch basins, oil/water separators, etc.) as well as other facility equipment and systems.

iii. Spill Response

This includes spill clean-up procedures and necessary clean-up equipment based upon the quantities and locations of significant materials that may spill or leak.

iv. Material Handling and Storage

This includes all procedures to minimize the potential for spills and leaks and to minimize exposure of significant materials to storm water and authorized non-storm water discharges.

v. Employee Training

This includes training of personnel who are responsible for (1) implementing activities identified in the SWPPP, (2) conducting inspections, sampling, and visual observations, and (3) managing storm water. Training should address topics such as spill response, good housekeeping, and material handling procedures, and actions necessary to implement all BMPs identified in the SWPPP. The SWPPP shall identify periodic dates for such training. Records shall be maintained of all training sessions held.

vi. Waste Handling/Recycling

This includes the procedures or processes to handle, store, or dispose of waste materials or recyclable materials.

vii. Recordkeeping and Internal Reporting

This includes the procedures to ensure that all records of inspections, spills, maintenance activities, corrective actions, visual observations, etc., are developed, retained, and provided, as necessary, to the appropriate facility personnel.

viii. Erosion Control and Site Stabilization

This includes a description of all sediment and erosion control activities. This may include the planting and maintenance of vegetation, diversion of run-on and runoff, placement of sandbags, silt screens, or other sediment control devices, etc.

ix. Inspections

This includes, in addition to the preventative maintenance inspections identified above, an inspection schedule of all potential pollutant sources. Tracking and follow-up procedures shall be described to ensure adequate corrective actions are taken and SWPPPs are made.

x. Quality Assurance

This includes the procedures to ensure that all elements of the SWPPP and Monitoring Program are adequately conducted.

b. Structural BMPs

Where non-structural BMPs as identified in Section A.8.a. above are not effective, structural BMPs shall be considered. Structural BMPs generally consist of structural devices that reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. Below is a list of structural BMPs that should be considered:

i. Overhead Coverage

This includes structures that provide horizontal coverage of materials, chemicals, and pollutant sources from contact with storm water and authorized non-storm water discharges.

ii. Retention Ponds

This includes basins, ponds, surface impoundments, bermed areas, etc. that do not allow storm water to discharge from the facility.

iii. Control Devices

This includes berms or other devices that channel or route run-on and runoff away from pollutant sources.

iv. Secondary Containment Structures

This generally includes containment structures around storage tanks and other areas for the purpose of collecting any leaks or spills.

v. Treatment

This includes inlet controls, infiltration devices, oil/water separators, detention ponds, vegetative swales, etc. that reduce the pollutants in storm water discharges and authorized non-storm water discharges.

9. <u>Annual Comprehensive Site Compliance Evaluation</u>

The facility operator shall conduct one comprehensive site compliance evaluation (evaluation) in each reporting period (July 1-June 30). Evaluations shall be conducted within 8-16 months of each other. The SWPPP shall be revised, as appropriate, and the revisions implemented within 90 days of the evaluation. Evaluations shall include the following:

a. A review of all visual observation records, inspection records, and sampling and analysis results.

b. A visual inspection of all potential pollutant sources for evidence of, or the potential for, pollutants entering the drainage system.

c. A review and evaluation of all BMPs (both structural and non-structural) to determine whether the BMPs are adequate, properly implemented and maintained, or whether additional BMPs are needed. A visual inspection of equipment needed to implement the SWPPP, such as spill response equipment, shall be included.

d. An evaluation report that includes, (i) identification of personnel performing the evaluation, (ii) the date(s) of the evaluation, (iii) necessary SWPPP revisions, (iv) schedule, as required in Section A.10.e, for implementing SWPPP revisions, (v) any incidents of non-compliance and the corrective actions taken, and (vi) a certification that the facility operator is in compliance with this General Permit. If the above certification cannot be provided, explain in the evaluation report why the facility operator is not in compliance with this General Permit. The evaluation report shall be submitted as part of the annual report, retained for at least five years, and signed and certified in accordance with Standard Provisions 9. and 10. of Section C. of this General Permit.

10. *SWPPP General Requirements*

a. The SWPPP shall be retained on site and made available upon request of a representative of the Regional Water Board and/or local storm water management agency (local agency) which receives the storm water discharges.

b. The Regional Water Board and/or local agency may notify the facility operator when the SWPPP does not meet one or more of the minimum requirements of this Section. As requested by the Regional Water Board and/or local agency, the facility operator shall submit an SWPPP revision and implementation schedule that meets the minimum requirements of this section to the Regional Water Board and/or local agency that requested the SWPPP revisions. Within 14 days after implementing the required SWPPP revisions, the facility operator shall provide written certification to the Regional Water Board and/or local agency that the revisions have been implemented.

c. The SWPPP shall be revised, as appropriate, and implemented prior to changes in industrial activities which (i) may significantly increase the quantities of pollutants in storm water discharge, (ii) cause a new area of industrial activity at the facility to be exposed to storm water, or (iii) begin an industrial activity which would introduce a new pollutant source at the facility.

d. Other than as provided in Provisions B.11, B.12, and E.2 of the General Permit, the SWPPP shall be revised and implemented in a timely manner, but in no case more than 90 days after a facility operator determines that the SWPPP is in violation of any requirement(s) of this General Permit.

e. When any part of the SWPPP is infeasible to implement by the deadlines specified in Provision E.2 or Sections A.1, A.9, A.10.c, and A.10.d of this General Permit due to proposed significant structural changes, the facility operator shall submit a report to the Regional Water Board prior to the applicable deadline that (i) describes the portion of the SWPPP that is infeasible to implement by the deadline, (ii) provides justification for a time extension, (iii) provides a schedule for completing and implementing that portion of the SWPPP, and (iv) describes the BMPs that will be implemented in the interim period to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges. Such reports are subject to Regional Water Board approval and/or modifications. Facility operators shall provide written notification to the Regional Water Board within 14 days after the SWPPP revisions are implemented.

f. The SWPPP shall be provided, upon request, to the Regional Water Board. The SWPPP is considered a report that shall be available to the public by the Regional Water Board under Section 308(b) of the Clean Water Act.

## SECTION B. MONITORING PROGRAM AND REPORTING REQUIREMENTS

1. *Implementation Schedule*

Each facility operator shall develop a written monitoring program for each facility covered by this General Permit in accordance with the following schedule:

a. Facility operators beginning industrial activities before October 1, 1992 shall develop and implement a monitoring program no later than October 1, 1992. Facility operators beginning operations after October 1, 1992 shall develop and implement a monitoring program when the industrial activities begin.

b. Facility operators that submitted a Notice Of Intent (NOI) pursuant to State Water Resources Control Board (State Water Board) Order No. 91-013-DWQ (as amended by Order No. 92-12) or San Francisco Bay Regional Water Quality Control Board (Regional Water Board) Order No. 92-11 (as amended by Order No. 92-116), shall continue to implement their existing monitoring program and implement any necessary revisions to their monitoring program in a timely manner, but in no case later than August 1, 1997. These facility operators may use the monitoring results conducted in accordance with those expired general permits to satisfy the pollutant/parameter reduction requirements in Section B.5.c., Sampling and Analysis Exemptions and Reduction certifications in Section B.12., and Group Monitoring Sampling credits in B.15.k. For facilities beginning industrial activities after the adoption of this General Permit, the monitoring program shall be developed and implemented when the facility begins the industrial activities.

2. *Objectives*

The objectives of the monitoring program are to:

a. Ensure that storm water discharges are in compliance with the Discharge Prohibitions, Effluent Limitations, and Receiving Water Limitations specified in this General Permit.

b. Ensure practices at the facility to reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges are evaluated and revised to meet changing conditions.

c. Aid in the implementation and revision of the SWPPP required by Section A of this General Permit.

d. Measure the effectiveness of best management practices (BMPs) to prevent or reduce pollutants in storm water discharges and authorized non-storm water discharges. Much of the information necessary to develop the monitoring program, such as discharge locations, drainage areas, pollutant sources, etc., should be found in the Storm Water Pollution Prevention Plan (SWPPP). The facility's monitoring program shall be a written, site-specific document that shall be revised whenever appropriate and be readily available for review by employees or Regional Water Board inspectors.

3. *Non-storm Water Discharge Visual Observations*

a. Facility operators shall visually observe all drainage areas within their facilities for the presence of unauthorized non-storm water discharges;

b. Facility operators shall visually observe the facility's authorized non-storm water discharges and their sources;

c. The visual observations required above shall occur quarterly, during daylight hours, on days with no storm water discharges, and during scheduled facility operating hours[1]. Quarterly visual observations shall be conducted in each of the following periods: January-March, April-June, July-September, and October-December. Facility operators shall conduct quarterly visual observations within 6-18 weeks of each other.

d. Visual observations shall document the presence of any discolorations, stains, odors, floating materials, etc., as well as the source of any discharge. Records shall be maintained of the visual observation dates, locations observed, observations, and response taken to eliminate unauthorized non-storm water discharges and to reduce or prevent pollutants from contacting non-storm water discharges. The SWPPP shall be revised, as necessary, and implemented in accordance with Section A of this General Permit.

4. *Storm Water Discharge Visual Observations*

a. With the exception of those facilities described in Section B.4.d. below, facility operators shall visually

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[1] "Scheduled facility operating hours" are the time periods when the facility is staffed to conduct any function related to industrial activity, but excluding time periods where only routine maintenance, emergency response, security, and/or janitorial services are performed.

observe storm water discharges from one storm event per month during the wet season (October 1-May 30). These visual observations shall occur during the first hour of discharge and at all discharge locations. Visual observations of stored or contained storm water shall occur at the time of release.

b. Visual observations are only required of storm water discharges that occur during daylight hours that are preceded by at least three (3) working days[2] without storm water discharges and that occur during scheduled facility operating hours.

c. Visual observations shall document the presence of any floating and suspended material, oil and grease, discolorations, turbidity, odor, and source of any pollutants. Records shall be maintained of observation dates, locations observed, observations, and response taken to reduce or prevent pollutants in storm water discharges. The SWPPP shall be revised, as necessary, and implemented in accordance with Section A of this General Permit.

d. Feedlots (subject to Federal effluent limitations guidelines in 40 Code of Federal Regulations [CFR] Part 412) that are in compliance with Sections 2560 to 2565, Article 6, Chapter 15, Title 23, California Code of Regulations, and facility operators with storm water containment facilities shall conduct monthly inspections of their containment areas to detect leaks and ensure maintenance of adequate freeboard. Records shall be maintained of the inspection dates, observations, and any response taken to eliminate leaks and to maintain adequate freeboard.

5. *Sampling and Analysis*

a. Facility operators shall collect storm water samples during the first hour of discharge from (1) the first storm event of the wet season, and (2) at least one other storm event in the wet season. All storm water discharge locations shall be sampled. Sampling of stored or contained storm water shall occur at the time the stored or contained storm water is released. Facility operators that do not collect samples from the first storm event of the wet season are still required to collect samples from two other storm events of the wet season and shall explain in the Annual Report why the first storm event was not sampled.

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[2] Three (3) working days may be separated by non-working days such as weekends and holidays provided that no storm water discharges occur during the three (3) working days and the non-working days.

b. Sample collection is only required of storm water discharges that occur during scheduled facility operating hours and that are preceded by at least (3) three working days without storm water discharge.

c. The samples shall be analyzed for:

   i. Total suspended solids (TSS) pH, specific conductance, and total organic carbon (TOC). Oil and grease (O&G) may be substituted for TOC; and

   ii. Toxic chemicals and other pollutants that are likely to be present in storm water discharges in significant quantities. If these pollutants are not detected in significant quantities after two consecutive sampling events, the facility operator may eliminate the pollutant from future sample analysis until the pollutant is likely to be present again; and

   iii. Other analytical parameters as listed in Table D (located at the end of this Section). These parameters are dependent on the facility's standard industrial classification (SIC) code. Facility operators are not required to analyze a parameter listed in Table D when the parameter is not already required to be analyzed pursuant to Section B.5.c.i. and ii. or B.6 of this General Permit, and either of the two following conditions are met: (1) the parameter has not been detected in significant quantities from the last two consecutive sampling events, or (2) the parameter is not likely to be present in storm water discharges and authorized non-storm water discharges in significant quantities based upon the facility operator's evaluation of the facilities industrial activities, potential pollutant sources, and SWPPP. Facility operators that do not analyze for the applicable Table D parameters shall certify in the Annual Report that the above conditions have been satisfied.

   iv. Other parameters as required by the Regional Water Board.

6. *Facilities Subject to Federal Storm Water Effluent Limitation Guidelines*

Facility operators with facilities subject to Federal storm water effluent limitation guidelines, in addition to the requirements in Section B.5. above, must complete the following:

a. Collect and analyze two samples for any pollutant specified in the appropriate category of 40 CFR Subchapter N. The sampling and analysis exemptions and reductions described in Section B.12. of this General Permit do not apply to these pollutants.

b. Estimate or calculate the volume of storm water discharges from each drainage area;

c. Estimate or calculate the mass of each regulated pollutant as defined in the appropriate category of 40 CFR Subchapter N; and

d. Identify the individual(s) performing the estimates or calculations in accordance with Subsections b. and c. above.

7. *Sample Storm Water Discharge Locations*

a. Facility operators shall visually observe and collect samples of storm water discharges from all drainage areas that represent the quality and quantity of the facility's storm water discharges from the storm event.

b. If the facility's storm water discharges are commingled with run-on from surrounding areas, the facility operator should identify other visual observation and sample collection locations that have not been commingled by run-on and that represent the quality and quantity of the facility's storm water discharges from the storm event.

c. If visual observation and sample collection locations are difficult to observe or sample (e.g., sheet flow, submerged outfalls), facility operators shall identify and collect samples from other locations that represent the quality and quantity of the facility's storm water discharges from the storm event.

d. Facility operators that determine that the industrial activities and BMPs within two or more drainage areas are substantially identical may either (i) collect samples from a reduced number of substantially identical drainage areas, or (ii) collect samples from each substantially identical drainage area and analyze a combined sample from each substantially identical drainage area. Facility operators must document such a determination in the annual report.

8. *Visual Observation and Sample Collection Exceptions*

Facility operators are required to be prepared to collect samples and conduct visual observations at the beginning of the wet season (October 1) and throughout the wet season until the minimum requirements of Sections B.4. and B.5. are completed with the following exceptions:

a. A facility operator is not required to collect a sample and conduct visual observations in accordance with Section B.4 and Section B.5 due to dangerous weather conditions, such as flooding, electrical storm, etc., when storm water discharges begin after scheduled facility operating hours or when storm water discharges are not preceded by three working days without discharge. Visual observations are only required during daylight hours. Facility operators that do not collect the required samples or visual observations during a wet season due to these exceptions shall include an explanation in the Annual Report why the sampling or visual observations could not be conducted.

b. A facility operator may conduct visual observations and sample collection more than one hour after discharge begins if the facility operator determines that the objectives of this Section will be better satisfied. The facility operator shall include an explanation in the Annual Report why the visual observations and sample collection should be conducted after the first hour of discharge.

9. *Alternative Monitoring Procedures*

Facility operators may propose an alternative monitoring program that meets Section B.2 monitoring program objectives for approval by the Regional Water Board. Facility operators shall continue to comply with the monitoring requirements of this Section and may not implement an alternative monitoring plan until the alternative monitoring plan is approved by the Regional Water Board. Alternative monitoring plans are subject to modification by the Regional Water Boards.

10. *Monitoring Methods*

a. Facility operators shall explain how the facility's monitoring program will satisfy the monitoring program objectives of Section B.2. This shall include:

i. Rationale and description of the visual observation methods, location, and frequency.

ii. Rationale and description of the sampling methods, location, and frequency; and

iii. Identification of the analytical methods and corresponding method detection limits used to detect pollutants in storm water discharges. This shall include justification that the method detection limits are adequate to satisfy the objectives of the monitoring program.

b. All sampling and sample preservation shall be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association). All monitoring instruments and equipment (including a facility operator's own field instruments for measuring pH and Electro Conductivity) shall be calibrated and maintained in accordance with manufacturers' specifications to ensure accurate measurements. All laboratory analyses must be conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified in this General Permit or by the Regional Water Board. All metals shall be reported as total metals. With the exception of analysis conducted by facility operators, all laboratory analyses shall be conducted at a laboratory certified for such analyses by the State Department of Health Services. Facility operators may conduct their own sample analyses if the facility operator has sufficient capability (qualified employees, laboratory equipment, etc.) to adequately perform the test procedures.

11. *Inactive Mining Operations*
Inactive mining operations are defined in Attachment 1 of this General Permit. Where comprehensive site compliance evaluations, non-storm water discharge visual observations, storm water discharge visual observations, and storm water sampling are impracticable, facility operators of inactive mining operations may instead obtain certification once every three years by a Registered Professional Engineer that an SWPPP has been prepared for the facility and is being implemented in accordance with the requirements of this General Permit. By means of these certifications, the Registered Professional Engineer having examined the facility and being familiar with the provisions of this General Permit shall attest that the SWPPP has been prepared in accordance with good engineering practices. Facility operators of mining operations who cannot obtain a certification because of noncompliance must notify the appropriate Regional Water Board and, upon request, the local agency which receives the storm water discharge.

12. *Sampling and Analysis* Exemptions and Reductions

A facility operator who qualifies for sampling and analysis exemptions, as described below in Section B.12.a.i., or who qualifies for reduced sampling and analysis, as described below in Section B.12.b., must submit the appropriate certifications and required documentation to the Regional Water Boards prior to the wet season (October 1) and recertify as part of the Annual Report submittal. A facility operator that qualifies for either the Regional Water Board or local agency certification programs, as described below in Section B.12.a.ii. and iii., shall submit certification and documentation in accordance with the requirements of those programs. Facility operators who provide certifications in accordance with this Section are still required to comply with all other monitoring program and reporting requirements. Facility operators shall prepare and submit their certifications using forms and instructions provided by the State Water Board, Regional Water Board, or local agency or shall submit their information on a form that contains equivalent information. Facility operators whose facility no longer meets the certification conditions must notify the Regional Water Boards (and local agency) within 30 days and immediately comply with the Section B.5. sampling and analysis requirements. Should a Regional Water Board (or local agency) determine that a certification does not meet the conditions set forth below, facility operators must immediately comply with the Section B.5. sampling and analysis requirements.

a. Sampling and Analysis Exemptions

A facility operator is not required to collect and analyze samples in accordance with Section B.5. if the facility operator meets all of the conditions of one of the following certification programs:

i. No Exposure Certification (NEC)

This exemption is designed primarily for those facilities where all industrial activities are conducted inside buildings and where all materials stored and handled are not exposed to storm water. To qualify for this exemption, facility operators must certify that their facilities meet all of the following conditions:

(1) All prohibited non-storm water discharges have been eliminated or otherwise permitted.

(2) All authorized non-storm water discharges have been identified and addressed in the SWPPP.

(3) All areas of past exposure have been inspected and cleaned, as appropriate.

(4) All significant materials related to industrial activity (including waste materials) are not exposed to storm water or authorized non-storm water discharges.

(5) All industrial activities and industrial equipment are not exposed to storm water or authorized non-storm water discharges.

(6) There is no exposure of storm water to significant materials associated with industrial activity through other direct or indirect pathways such as from industrial activities that generate dust and particulates.

(7) There is periodic re-evaluation of the facility to ensure conditions (1), (2), (4), (5), and (6) above are continuously met. At a minimum, re-evaluation shall be conducted once a year.

ii. Regional Water Board Certification Programs

The Regional Water Board may grant an exemption to the Section B.5. Sampling and Analysis Requirements if it determines a facility operator has met the conditions set forth in a Regional Water Board certification program. Regional Water Board certification programs may include conditions to (1) exempt facility operators whose facilities infrequently discharge storm water to waters of the United States, and (2) exempt facility operators that demonstrate compliance with the terms and conditions of this General Permit.

iii. Local Agency Certifications

A local agency may develop a local agency certification program. Such programs must be approved by the Regional Water Board. An approved local agency program may either grant an exemption

from the Section B.5. Sampling and Analysis Requirements or reduce the frequency of sampling if it determines that a facility operator has demonstrated compliance with the terms and conditions of this General Permit.

b. Sampling and Analysis Reduction

i. A facility operator may reduce the number of sampling events required to be sampled for the remaining term of this General Permit if the facility operator provides certification that the following conditions have been met:

(1) The facility operator has collected and analyzed samples from a minimum of six storm events from all required drainage areas;

(2) All prohibited non-storm water discharges have been eliminated or otherwise permitted;

(3) The facility operator demonstrates compliance with the terms and conditions of the General Permit for the previous two years (i.e., completed Annual Reports, performed visual observations, implemented appropriate BMPs, etc.);

(4) The facility operator demonstrates that the facility's storm water discharges and authorized non-storm water discharges do not contain significant quantities of pollutants; and

(5) Conditions (2), (3), and (4) above are expected to remain in effect for a minimum of one year after filing the certification.

ii. Unless otherwise instructed by the Regional Water Board, facility operators shall collect and analyze samples from two additional storm events (or one additional storm event when certification filed for the wet season beginning October 1, 2001) during the remaining term of this General Permit in accordance with Table C below. Facility operators shall collect samples of the first storm event of the wet season. Facility operators that do not collect samples from the first storm event of the wet season shall collect samples from another storm event during the same wet season. Facility operators that do not collect a sample in a required wet season shall collect the sample from another storm event in the next wet season. Facility operators shall explain in the Annual Report why the first storm event of a wet season was not sampled or a sample was not taken from any storm event in accordance with the Table C schedule.

Table C
REDUCED MONITORING SAMPLING SCHEDULE

| Facility Operator Filing Sampling Reduction Certification By | Samples Shall be Collected and Analyzed in These Wet Seasons | |
|---|---|---|
| | Sample 1 | Sample 2 |
| Oct. 1, 1997 | Oct. 1, 1997-May 31, 1998 | Oct. 1, 1999-May 31, 2000 |
| Oct. 1, 1998 | Oct. 1, 1998-May 31, 1999 | Oct. 1, 2000-May 31, 2001 |
| Oct. 1, 1999 | Oct. 1, 1999-May 31, 2000 | Oct. 1, 2001-May 31, 2002 |
| Oct. 1, 2000 | Oct. 1, 2000-May 31, 2001 | Oct. 1, 2001-May 31, 2002 |
| Oct. 1, 2001 | Oct. 1, 2001-May 31, 2002 | - |

13. *Records*

Records of all storm water monitoring information and copies of all reports (including the Annual Reports) required by this General Permit shall be retained for a period of at least five years. These records shall include:

a. The date, place, and time of site inspections, sampling, visual observations, and/or measurements;

b. The individual(s) who performed the site inspections, sampling, visual observations, and or measurements;

c. Flow measurements or estimates (if required by Section B.6);

d. The date and approximate time of analyses;

e. The individual(s) who performed the analyses;

f. Analytical results, method detection limits, and the analytical techniques or methods used;

g. Quality assurance/quality control records and results;

h. Non-storm water discharge inspections and visual observations and storm water discharge visual observation records (see Sections B.3. and 4.);

i. Visual observation and sample collection exception records (see Section B.5.a, 7.d, 8, and 12.b.ii.);

j. All calibration and maintenance records of on-site instruments used;

k. All Sampling and Analysis Exemption and Reduction certifications and supporting documentation (see Section B.12);

l. The records of any corrective actions and follow-up activities that resulted from the visual observations.

14. *Annual Report*

All facility operators shall submit an Annual Report by July 1 of each year to the Executive Officer of the Regional Water Board responsible for the area in which the facility is located and to the local agency (if requested).

The report shall include a summary of visual observations and sampling results, an evaluation of the visual observation and sampling and analysis results, laboratory reports, the Annual Comprehensive Site Compliance Evaluation Report required in Section A.9., an explanation of why a facility did not implement any activities required by the General Permit (if not already included in the Evaluation Report), and records specified in Section B.13.i. The method detection limit of each analytical parameter shall be included. Analytical results that are less than the method detection limit shall be reported as "less than the method detection limit." The Annual Report shall be signed and certified in accordance with Standard Provisions 9. and 10. of Section C of this General Permit. Facility operators shall prepare and submit their Annual Reports using the annual report forms provided by the State Water Board or Regional Water Board or shall submit their information on a form that contains equivalent information.

15. *Group Monitoring*

Facility operators may participate in group monitoring as described below. A facility operator that participates in group monitoring shall develop and implement a written site-specific SWPPP and monitoring program in accordance with the General Permit and must satisfy any group monitoring requirements. Group monitoring shall be subject to the following requirements:

a. A group monitoring plan (GMP) shall be developed and implemented by a group leader representing a group of similar facility operators regulated by this General Permit or by a local agency which holds an NPDES permit (local agency permittee) for a municipal separate storm sewer system. GMPs with participants that discharge storm water within the boundaries of a single Regional Water Board shall be approved by that Regional Water Board. GMPs with participants that discharge storm water within the boundaries of multiple Regional Water Boards shall be approved by the State Water Board. The State Water Board and/or Regional Water Board(s) may disapprove a facility's participation in a GMP or require a GMP participant to conduct additional monitoring activities.

b. Each GMP participant shall collect and analyze samples from at least two storm events in accordance with Section B.5. over the five-year period of this General Permit. The two storm event minimum applies to new and existing members. The group leader or local agency permittee shall schedule sampling to meet the following conditions: (i) to evenly distribute the sample collection over the five-year term of this General Permit, and (ii) to collect samples from the two storm events at each participant's facility in different and non-consecutive wet seasons. New participants who join in Years 4 and 5 of this General Permit are not subject to Condition (ii) above. Group leaders shall explain in the annual Group Evaluation Report why any scheduled samples were not collected and reschedule the sampling so that all required samples are collected during the term of this General Permit.

c. The group leader or local agency permittee must have the appropriate resources to develop and implement the GMP. The group leader or local agency permittee must also have the authority to terminate any participant who is not complying with this General Permit and the GMP.

d. The group leader or local agency permittee is responsible for:

   i. Developing, implementing, and revising the GMP;

   ii. Developing and submitting an annual Group Evaluation Report to the State Water Board and/or Regional Water Board by August 1 of each year that includes:

      (1) An evaluation and summary of all group monitoring data,

      (2) An evaluation of the overall performance of the GMP participants in complying with this General Permit and the GMP,

(3) Recommended baseline and site-specific BMPs that should be considered by each participant based upon Items (1) and (2) above, and

(4) A copy of each evaluation report and recommended BMPs as required in Section B.15.d.v. below.

iii. Recommending appropriate BMPs to reduce or prevent pollutants associated with industrial activities in storm water discharges and authorized non-storm water discharges;

iv. Assisting each participant in completing their Annual Comprehensive Site Compliance Evaluation and Annual Report;

v. Conducting a minimum of two on-site inspections of each participant's facility (it is recommended that these inspections be scheduled during the Annual Comprehensive Site Compliance Evaluation) during the term of this General Permit to evaluate the participant's compliance with this General Permit and the GMP, and to recommend any additional BMPs necessary to achieve compliance with this General Permit. Participants that join in Years 4 and 5 shall be scheduled for one evaluation. A copy of the evaluation and recommended BMPs shall be provided to the participants;

vi. Submitting a GMP (or revisions, as necessary), to the appropriate Regional Water Board(s) and State Water Board no later than September 1, 1997 (or August 1 in subsequent years). Once approved, a group leader or local agency permittee shall submit a letter of intent by August 1 of each year to continue the approved GMP. The letter of intent must include a roster of participants, participant's Waste Discharge Identification number (WDID#), updated sampling schedules, and any other revisions to the GMP;

vii. Revising the GMP as instructed by the Regional Water Board or the State Water Board; and

viii. Providing the State Water Board and/or Regional Water Board with quarterly updates of any new or deleted participants and corresponding changes in the sampling and inspection schedule.

e. The GMP shall:

i. Identify the participants of the GMP by name, location, and WDID number;

ii. Include a narrative description summarizing the industrial activities of participants of the GMP and explain why the participants, as a whole, have sufficiently similar industrial activities and BMPs to be covered by a group monitoring plan;

iii. Include a list of typical potential pollutant sources associated with the group participant's facilities and recommended baseline BMPs to prevent or reduce pollutants associated with industrial activity in the storm water discharges and authorized non-storm water discharges;

iv. Provide a five-year sampling and inspection schedule in accordance with Subsections b. and d.v. above.

v. Identify the pollutants associated with industrial activity that shall be analyzed at each participant's facility in accordance with Section B.5. The selection of these pollutants shall be based upon an assessment of each facility's potential pollutant sources and likelihood that pollutants associated with industrial activity will be present in storm water discharges and authorized non-storm water discharges in significant quantities.

f. Sampling and analysis shall be conducted in accordance with the applicable requirements of this Section.

g. Unless otherwise instructed by the Regional Water Board or the State Water Board Executive Director, the GMPs shall be implemented at the beginning of the wet season (October 1).

h. All participants in an approved GMP that have not been selected to sample in a particular wet season are required to comply with all other monitoring program and reporting requirements of this Section including the submittal of an Annual Report by July 1 of each year to the appropriate Regional Water Board.

i. GMP participants subject to Federal storm water effluent limitation guidelines must perform the monitoring described in Section B.6. and submit the results of the monitoring to the appropriate Regional Water Board within the facility operator's Annual Report.

j. GMPs and Group Evaluation Reports should be prepared in accordance with State Water Board (or Regional Water Board) guidance.

k. GMP participants may receive Sampling and Analysis Reduction sampling credit in accordance with the following conditions:

i. Current or prior participants (group participants) of approved GMPs, who have not collected and analyzed samples from six storm events as required in Section B.7.b.i.(1), may substitute credit earned through participation in a GMP for up to four of the six required storm events. Credits for GMP participation shall be calculated as follows:

(1) Credit may only be earned in years of participation where the GMP participant was not scheduled to sample and the GMP was approved.

(2) One credit will be earned for each year of valid GMP participation.

(3) One additional credit may be earned for each year the overall GMP sample collection performance is greater than 75 percent.

ii. GMP participants substituting credit as calculated above shall provide proof of GMP participation and certification that all the conditions in Section B.12.b.i. have been met. GMP participants substituting credit in accordance with Section B.15.k.i.(3) shall also provide GMP sample collection performance documentation.

iii. GMP participants that qualify for Sampling and Analysis Reduction and have already sampled a storm event after October 1, 1997 shall only be required to sample one additional storm event during the remainder of this General Permit in accordance with the "Sample 2" schedule (or "Sample 1" schedule when certification filed for the wet season beginning October 1, 2001) in Table C of this Section.

n. Group leaders shall furnish, within 60 days of receiving a request from the State Water Board or Regional Water Board, any GMP information and documentation necessary to verify the Section B.15.k. sampling credits. Group leaders may also provide this information and documentation to the group participants.

16. *Watershed Monitoring Option*

Regional Water Boards may approve proposals to substitute watershed monitoring for some or all of the requirements of this Section if the Regional Water Board finds that the watershed monitoring will provide substantially similar monitoring information in evaluating facility operator compliance with the requirements of this General Permit.

TABLE D
ADDITIONAL ANALYTICAL PARAMETERS

| Subsector | SIC | Activity Represented | Parameters |
|---|---|---|---|
| **SECTOR A. TIMBER PRODUCTS** | | | |
| A1 | 2421 | General Sawmills and Planing Mills | COD;TSS;Zn |
| A2 | 2491 | Wood Preserving | As;Cu |
| A3 | 2411 | Log Storage and Handling | TSS |
| A4 | 2426 | Hardwood Dimension and Flooring Mills | COD;TSS |
| A4 | 2429 | Special Product Sawmills, Not Elsewhere Classified | COD;TSS |
| A4 | 243X | Millwork, Veneer, Plywood, and Structural Wood | COD;TSS |
| A4 | (except 2434--Wood Kitchen Cabinet Manufacturers) | | |
| A4 | 244X | Wood Containers | COD;TSS |
| A4 | 245X | Wood Buildings and Mobile Homes | COD;TSS |
| A4 | 2493 | Reconstituted Wood Products | COD;TSS |
| A4 | 2499 | Wood Products, Not Elsewhere Classified | |
| **SECTOR B. PAPER AND ALLIED PRODUCTS MANUFACTURING** | | | |
| B1 | 261X | Pulp Mills | |
| B2 | 262X | Paper Mills | |
| B3 | 263X | Paperboard Mills | COD |
| B4 | 265X | Paperboard Containers and Boxes | |
| B5 | 267X | Converted Paper and Paperboard Products, Except Containers and Boxes | |
| **SECTOR C. CHEMICAL AND ALLIED PRODUCTS MANUFACTURING** | | | |
| C1 | 281X | Industrial Inorganic Chemicals | Al;Fe;N+N |
| C2 | 282X | Plastics Materials and Synthetic Resins, Synthetic Rubber, Cellulosic, and Other Manmade Fibers Except Glass | Zn |
| C3 | 283X | Drugs | |
| C4 | 284X | Soaps, Detergents, and Cleaning Preparations; Perfumes, Cosmetics, and Other Toilet Preparations | N+N;Zn |
| C5 | 285X | Paints, Varnishes, Lacquers, Enamels, and Allied Products | |
| C6 | 286X | Industrial Organic Chemicals | |
| C7 | 287X | Nitrogenous and Phosphatic Basic Fertilizers, Mixed Fertilizer, Pesticides, and Other Agricultural Chemicals | Fe;N+N;Pb;Zn;P |
| C8 | 289X | Miscellaneous Chemical Products | |
| | 3952 | Inks and Paints, Including China Painting Enamels, India Ink, (limited to list) Drawing Ink, Platinum Paints for Burnt Wood or Leather Work, Paints for China Painting, Artist's Paints, and Artist's Watercolors | |
| **SECTOR D. ASPHALT PAVING/ROOFING MATERIALS MANUFACTURERS AND LUBRICANT MANUFACTURERS** | | | |
| D1 | 295X | Asphalt Paving and Roofing Materials | TSS |
| D2 | 2992 | Lubricating Oils and Greases | |

Parameter Names

| | | | | |
|---|---|---|---|---|
| Al - Aluminum | Cd - Cadmium | Cu - Copper | Mg - Magnesium | BOD - Biochemical Oxygen Demand |
| As - Arsenic | CN - Cyanide | Fe - Iron | Ag - Silver | N + N - Nitrate & Nitrite Nitrogen |
| $NH_3$- Ammonia | Hg - Mercury | P - Phosphorus | Se - Selenium | Pb - Lead |
| - Zinc | TSS -Total Suspended Solids | COD - Chemical Oxygen Demand | | |

| Subsector | SIC | Activity Represented | Paramete |
|---|---|---|---|

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**SECTOR E. GLASS, CLAY, CEMENT, CONCRETE, AND GYPSUM PRODUCT MANUFACTURING**

| | | | |
|---|---|---|---|
| E1 | 3211 | Flat Glass | |
| E1 | 322X | Glass and Glassware, Pressed or Blown | |
| E1 | 323X | Glass Products Made of Purchased Glass | |
| E2 | 3241 | Hydraulic Cement | |
| E3 | 325X | Structural Clay Products | Al |
| E3 | 326X | Pottery and Related Products | Al |
| E3 | 3297 | Non-Clay Refractories | Al |
| E4 | 327X | Concrete, Gypsum, and Plaster Products (Except Lime) (except 3274). | TSS;Fe |
| E4 | 3295 | Minerals and Earths, Ground, or Otherwise Treated | TSS;Fe |

**SECTOR F. PRIMARY METALS**

| | | | |
|---|---|---|---|
| F1 | 331X | Steel Works, Blast Furnaces, Rolling & Finishing Mill | Al;Zn |
| F2 | 332X | Iron and Steel Foundries | Al;TSS;Cu;Fe;Zn |
| F3 | 333X | Primary Smelting and Refining of Nonferrous Metals | |
| F4 | 334X | Secondary Smelting and Refining of Nonferrous Metals | |
| F5 | 335X | Rolling, Drawing, and Extruding of Nonferrous Metals | Cu;Zn |
| F6 | 336X | Nonferrous Foundries (Castings) | Cu;Zn |
| F7 | 339X | Miscellaneous Primary Metal Products | |

**SECTOR G. METAL MINING (ORE MINING AND DRESSING) EXCEPT INACTIVE METAL MINING ACTIVITIES ON FEDERAL LANDS WHERE AN OPERATOR CANNOT BE IDENTIFIED**

| | | | |
|---|---|---|---|
| G1 | 101X | Iron Ores | |
| G2 | 102X | Copper Ores | TSS;COD;N+N |
| G3 | 103X | Lead and Zinc Ores | |
| G4 | 104X | Gold and Silver Ores | |
| G5 | 106X | Ferroalloy Ores, Except Vanadium | |
| G6 | 108X | Metal Mining Services | |
| G7 | 109X | Miscellaneous Metal Ores | |

**SECTOR H. COAL MINES AND COAL MINING-RELATED FACILITIES**

| | | | |
|---|---|---|---|
| NA | 12XX | Coal Mines and Coal Mining-Related Facilities | TSS;Al;Fe |

**SECTOR I. COAL MINES AND COAL MINING-RELATED FACILITIES**

| | | | |
|---|---|---|---|
| I1 | 131X | Crude Petroleum and Natural Gas | |
| I2 | 132X | Natural Gas Liquids | |
| I3 | 138X | Oil and Gas Field Services | |

**SECTOR J. MINERAL MINING AND DRESSING EXCEPT INACTIVE MINERAL MINING ACTIVITIES OCCURRING ON FEDERAL LANDS WHERE AN OPERATOR CANNOT BE IDENTIFIED**

| | | | |
|---|---|---|---|
| J1 | 141X | Dimension Stone | TSS |
| J1 | 142X | Crushed and Broken Stone, Including Rip Rap | TSS |
| J1 | 148X | Nonmetallic Minerals, Except Fuels | TSS |
| J2 | 144X | Sand and Gravel | TSS;N+N |
| J3 | 145X | Clay, Ceramic, and Refractory Materials | |
| J4 | 147X | Chemical and Fertilizer Mineral Mining | |
| J4 | 149X | Miscellaneous Nonmetallic Minerals, Except Fuels | |

| Subsector | SIC | Activity Represented | Parameters |
|---|---|---|---|
| **SECTOR K. HAZARDOUS WASTE TREATMENT STORAGE OR DISPOSAL FACILITIES** | | | |
| NA | 4953 | Hazardous Waste Treatment Storage or Disposal | **$NH_3$;Mg;COD;As Cd;CN;Pb Hg;Se;Ag** |
| **SECTOR L. LANDFILLS AND LAND APPLICATION SITES** | | | |
| NA | 4953 | Landfills and Land Application Sites That Receive or Have Received Industrial Wastes, Except Inactive Landfills or Land Applications Sites Occurring on Federal Lands Where an Operator Cannot be Identified | **TSS;Fe** |
| **SECTOR M. AUTOMOBILE SALVAGE YARDS** | | | |
| NA | 5015 | Facilities Engaged in Dismantling or Wrecking Used Motor Vehicles for Parts Recycling or Resale and for Scrap | **TSS;Fe;Pb;Al** |
| **SECTOR N. SCRAP RECYCLING FACILITIES** | | | |
| NA | 5093 | Processing, Reclaiming, and Wholesale Distribution of Scrap and Waste Materials | **TSS;Fe;Pb Al;Cu;Zn;COD** |
| **SECTOR O. STEAM ELECTRIC GENERATING FACILITIES** | | | |
| NA | 4911 | Steam Electric Power Generating Facilities | **Fe** |
| **SECTOR P. LAND TRANSPORTATION FACILITIES THAT HAVE VEHICLE AND EQUIPMENT MAINTENANCE SHOPS AND/OR EQUIPMENT CLEANING OPERATIONS** | | | |
| P1 | 40XX | Railroad Transportation | |
| P2 | 41XX | Local and Highway Passenger Transportation | |
| P3 | 42XX | Motor Freight Transportation and Warehousing | |
| P4 | 43XX | United States Postal Service | |
| P5 | 5171 | Petroleum Bulk Stations and Terminals | |
| **SECTOR Q. WATER TRANSPORTATION FACILITIES THAT HAVE VEHICLE (VESSEL) & EQUIPMENT MAINTENANCE SHOPS AND/OR EQUIPMENT CLEANING OPERATIONS** | | | |
| NA | 44XX | Water Transportation | **Al;Fe;Pb;Zn** |
| **SECTOR R. SHIP AND BOAT BUILDING OR REPAIRING YARDS** | | | |
| NA | 373X | Ship and Boat Building or Repairing Yards | |
| **SECTOR S. AIR TRANSPORTATION FACILITIES** | | | |
| NA | 45XX | Air Transportation Facilities That Have Vehicle Maintenance Ships, Material Handing Facilities, Equipment Cleaning Operations, or Airport and/or Aircraft Deicing/Anti-icing Operations | **BOD;COD;$NH_3$;pH** |

| Subsector | SIC | Activity Represented | Parameters |
|---|---|---|---|
| **SECTOR T.** | **TREATMENT WORKS** | | |
| NA | 4952 | Treatment Works Treating Domestic Sewage or Any Other Sewage Sludge or Wastewater Treatment Device or System Used in the Storage, treatment, recycling, or Reclamation of Municipal or Domestic Sewage with a Design Flow of 1.0 MGD or More or Required to Have an Approved Pretreatment Program | |
| **SECTOR U.** | **FOOD AND KINDRED PRODUCTS** | | |
| U1 | 201X | Meat Products | |
| U2 | 202X | Dairy Products | |
| U3 | 203X | Canned, Frozen and Preserved Fruits, Vegetables and Food Specialties | |
| U4 | 204X | Grain Mill Products | **TSS** |
| U5 | 205X | Bakery Products | |
| U6 | 206X | Sugar and Confectionery Products | |
| U7 | 207X | Fats and Oils | **BOD;COD;TSS;N+N** |
| U8 | 208X | Beverages | |
| U9 | 209X | Miscellaneous Food Preparations and Kindred Products | |
| NA | 21XX | Tobacco Products | |
| **SECTOR V.** | **TEXTILE MILLS, APPAREL, AND OTHER FABRIC PRODUCT MANUFACTURING** | | |
| V1 | 22XX | Textile Mill Products | |
| V2 | 23XX | Apparel and Other Finished Products Made From Fabrics and Similar Materials | |
| **SECTOR W.** | **FURNITURE AND FIXTURES** | | |
| NA | 25XX | Furniture and Fixtures | |
| NA | 2434 | Wood Kitchen Cabinets | |
| **SECTOR X.** | **PRINTING AND PUBLISHING** | | |
| NA | 2732 | Book Printing | |
| NA | 2752 | Commercial Printing, Lithographic | |
| NA | 2754 | Commercial Printing, Gravure | |
| NA | 2759 | Commercial Printing, Nor Elsewhere Classified | |
| NA | 2796 | Platemaking and Related Services | |
| SECTOR Y. | RUBBER, MISCELLANEOUS PLASTIC PRODUCTS, AND MISC. MANUFACTURING INDUSTRIES | | |
| Y1 | 301X | Tires and Inner Tubes | **Zn** |
| Y1 | 302X | Rubber and Plastics Footwear | **Zn** |
| Y1 | 305X | Gaskets, Packing, and Sealing Devices and Rubber and Plastics Hose and Belting | **Zn** |
| Y1 | 306X | Fabricated Rubber Products, Not Elsewhere Classified | **Zn** |
| Y2 | 308X | Miscellaneous Plastics Products | |

| Subsector | SIC | Activity Represented | Parameters |
|---|---|---|---|
| Y2 | 393X | Musical Instruments | |
| Y2 | 394X | Dolls, Toys, Games, and Sporting and Athletic Goods | |
| Y2 | 395X | Pens, Pencils, and Other Artists' Materials | |
| Y2 | 396X | Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal | |
| Y2 | 399X | Miscellaneous Manufacturing Industries | |
| **SECTOR Z. LEATHER TANNING AND FINISHING** | | | |
| NA | 311X | Leather Tanning and Finishing | |
| NA | NA | Facilities that Make Fertilizer Solely From Leather Scraps and Leather Dust | |
| **SECTOR AA. FABRICATED METAL PRODUCTS** | | | |
| AA1 | 3429 | Hardware, Not Elsewhere Classified | **Zn;N+N;Fe;Al** |
| AA1 | 3441 | Fabricated Structural Metal | **Zn;N+N;Fe;Al** |
| AA1 | 3442 | Metal Doors, Sash, Frames, Molding, and Trim | **Zn;N+N;Fe;Al** |
| AA1 | 3443 | Fabricated Plate Work (Boiler Shops) | **Zn;N+N;Fe;Al** |
| AA1 | 3444 | Sheet Metal Work | **Zn;N+N;Fe;Al** |
| AA1 | 3451 | Screw Machine Products | **Zn;N+N;Fe;Al** |
| AA1 | 3452 | Bolts, Nuts, Screws, Rivets, and Washers | **Zn;N+N;Fe;Al** |
| A1 | 3462 | Iron and Steel Forgings | **Zn;N+N;Fe;** |
| AA1 | 3471 | Electroplating, Plating, Polishing, Anodizing, and Coloring | **Zn;N+N;Fe;** |
| AA1 | 3494 | Valves and Pipe Fittings, Not Elsewhere Classified | **Zn;N+N;Fe;Al** |
| AA1 | 3496 | Miscellaneous Fabricated Wire Products | **Zn;N+N;Fe;Al** |
| AA1 | 3499 | Fabricated Metal Products, Not Elsewhere Classified | **Zn;N+N;Fe;Al** |
| AA1 | 391X | Jewelry, Silverware, and Plated Ware | **Zn;N+N;Fe;Al** |
| AA2 | 3479 | Coating, Engraving, and Allied Services | **Zn;N+N** |
| **SECTOR AB. TRANSPORTATION EQUIPMENT, INDUSTRIAL OR COMMERCIAL MACHINERY** | | | |
| NA | 35XX | Industrial and Commercial Machinery (except 357X Computer and Office Equipment) | |
| NA | 37XX | Transportation Equipment (except 373X Ship and Boat Building and Repairing | |
| **SECTOR AC. ELECTRONIC, ELECTRICAL. PHOTOGRAPHIC, AND OPTICAL GOODS** | | | |
| NA | 36XX | Electronic and Other Electrical Equipment and Components, Except Computer Equipment | |
| NA | 38XX | Measuring, Analyzing, and Controlling Instruments; Photographic, Medical, and Optical Goods; Watches and Clocks | |
| NA | 357X | Computer and Office Equipment | |

Section C: STANDARD PROVISIONS

1. Duty to Comply

The facility operator must comply with all of the conditions of this General Permit. Any General Permit noncompliance constitutes a violation of the Clean Water Act (CWA) and the Porter-Cologne Water Quality Control Act and is grounds for (a) enforcement action for (b) General Permit termination, revocation and reissuance, or modification or (c) denial of a General Permit renewal application.

The facility operator shall comply with effluent standards or prohibitions established under Section 307(a) of the CWA for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if this General Permit has not yet been modified to incorporate the requirement.

2. General Permit Actions

This General Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the facility operator for a General Permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any General Permit condition.

If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the CWA for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this General Permit, this General Permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition, and the facility operator so notified.

3. Need to Halt or Reduce Activity not a Defense

It shall not be a defense for a facility operator in an enforcement action that it would have been necessary to halt or reduce the general permitted activity in order to maintain compliance with the conditions of this General Permit.

4. Duty to Mitigate

The facility operator shall take all responsible steps to minimize or prevent any discharge in violation of this General Permit which has a reasonable likelihood of adversely affecting human health or the environment.

5. Proper Operation and Maintenance

The facility operator at all times shall properly operate and maintain any facilities and systems of treatment and control (and related appurtenances) which are installed or used by the facility operator to achieve compliance with the conditions of this General Permit and with the requirements of storm water pollution prevention plans (SWPPPs). Proper operation and maintenance also include adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance may require the operation of backup or auxiliary facilities or similar systems installed by a facility operator when necessary to achieve compliance with the conditions of this General Permit.

6. Property Rights

This General Permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

7. Duty to Provide Information

The facility operator shall furnish the Regional Water Quality Control Board (Regional Water Board), State Water Resources Control Board (State Water Board), U.S. Environmental Protection Agency (U.S. EPA), or local storm water management agency, within a reasonable time specified by the agencies, any requested information to determine compliance with this General Permit. The facility operator shall also furnish, upon request, copies of records required to be kept by this General Permit.

8. Inspection and Entry

The facility operator shall allow the Regional Water Board, State Water Board, U.S. EPA, and local storm water management agency, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the facility operator's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this General Permit;

b. Have access to and copy at reasonable times any records that must be kept under the conditions of this General Permit;

c. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment) that are related to or may impact storm water discharge or authorized non-storm water discharge; and

d. Conduct monitoring activities at reasonable times for the purpose of ensuring General Permit compliance.

9. Signatory Requirements

a. All Notices of Intent (NOIs) submitted to the State Water Board shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (a) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or (b) the manager of the facility if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. The principal executive officer of a Federal agency includes the chief executive officer of the agency or the senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of U.S. EPA).

b. All reports, certifications, or other information required by the General Permit or requested by the Regional Water Board, State Water Board, U.S. EPA, or local storm water management agency shall be signed by a person described above or by a duly authorized representative. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described above and retained as part of the SWPPP.

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility or an individual or position having overall responsibility for named position.)

(3) If an authorization is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization must be attached to the SWPPP prior to submittal of any reports, certifications, or information signed by the authorized representative.

10. Certification

Any person signing documents under Provision 9. above shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure 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, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

11. Reporting Requirements

a. Planned changes: The facility operator shall give advance notice to the Regional Water Board and local storm water management agency of any planned physical alteration or additions to the general permitted facility. Notice is required under this provision only when the alteration or addition could significantly change the nature or increase the quantity of pollutants discharged.

b. Anticipated noncompliance: The facility operator will give advance notice to the Regional Water Board and local storm water management agency of any planned changes at the permitted facility which may result in noncompliance with General Permit requirements.

c. Compliance schedules: Reports of compliance or noncompliance with or any progress reports on interim and final requirements contained in any compliance schedule of this General Permit shall be submitted no later than 14 days following each scheduled date.

d. Noncompliance reporting: The facility operator shall report any noncompliance at the time monitoring reports are submitted. The written submission shall contain (1) a description of the noncompliance and its cause; (2) the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and (3) steps taken or planned to reduce and prevent recurrence of the noncompliance.

12. Oil and Hazardous Substance Liability

Nothing in this General Permit shall be construed to preclude the institution of any legal action or relieve the facility operator from any responsibilities, liabilities, or penalties to which the facility operator is or may be subject under Section 311 of the CWA.

13. Severability

The provisions of this General Permit are severable; and if any provision of this General Permit or the application of any provision of this General Permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this General Permit shall not be affected thereby.

14. Reopener Clause

This General Permit may be modified, revoked, and reissued, or terminated for cause due to promulgation of amended regulations, receipt of U.S. EPA guidance concerning regulated activities, judicial decision, or in accordance with 40 CFR 122.62, 122.63, 122.64, and 124.5. This General Permit may be reopened to modify the provisions regarding authorized non-storm water discharges specified in Section D. Special Conditions.

15. Penalties for Violations of General Permit Conditions.

a. Section 309 of the CWA provides significant penalties for any person who violates a General Permit condition implementing Sections 301, 302, 306, 307 308, 318, or 405 of the CWA, or any General Permit condition or limitation implementing any such section in a General Permit issued under Section 402. Any person who violates any General Permit condition of this General Permit is subject to a civil penalty not to exceed $25,000 per day of such violation, as well as any other appropriate sanction provided by Section 309 of the CWA.

b. The Porter-Cologne Water Quality Control Act also provides for civil and criminal penalties in some cases greater than those under the CWA.

16. Availability

A copy of this General Permit shall be maintained at the facility and be available at all times to the appropriate facility personnel and to Regional Water Board and local agency inspectors.

17. Transfers

This General Permit is not transferable from one facility operator to another facility operator nor may it be transferred from one location to another location. A new facility operator of an existing facility must submit an NOI in accordance with the requirements of this General Permit to be authorized to discharge under this General Permit.

18. Continuation of Expired General Permit

This General Permit continues in force and effect until a new general permit is issued or the State Water Board rescinds the General Permit. Facility operators authorized to discharge under the expiring general permit are required to file an NOI to be covered by the reissued General Permit.

19. Penalties for Falsification of Reports

Section 309(c)(4) of the CWA provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this General Permit, including reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than two years, or by both.

FACILITIES COVERED BY THIS GENERAL PERMIT

Industrial facilities include Federal, State, municipally owned, and private facilities from the following categories:

1. FACILITIES SUBJECT TO STORM WATER EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, OR TOXIC POLLUTANT EFFLUENT STANDARDS (40 Code of Federal Regulations (CFR) SUBCHAPTER N). Currently, categories of facilities subject to storm water effluent limitations guidelines are Cement Manufacturing (40 CFR Part 411), Feedlots (40 CFR Part 412), Fertilizer Manufacturing (40 CFR Part 418), Petroleum Refining (40 CFR Part 419), Phosphate Manufacturing (40 CFR Part 422), Steam Electric (40 CFR Part 423), Coal Mining (40 CFR Part 434), Mineral Mining and Processing (40 CFR Part 436), Ore Mining and Dressing (40 CFR Part 440), and Asphalt Emulsion (40 CFR Part 443).

2. MANUFACTURING FACILITIES: Standard Industrial Classifications (SICs) 24 (except 2434), 26 (except 265 and 267), 28 (except 283 and 285) 29, 311, 32 (except 323), 33, 3441, and 373.

3. OIL AND GAS/MINING FACILITIES: SICs 10 through 14 including active or inactive mining operations (except for areas of coal mining operations meeting the definition of a reclamation area under 40 CFR 434.11(l) because of performance bond issued to the facility by the appropriate Surface Mining Control and Reclamation Act (SMCRA) authority has been released, or except for area of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990); oil and gas exploration, production, processing, or treatment operations; or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, by-products, or waste products located on the site of such operations. Inactive mining operations are mined sites that are not being actively mined but which have an identifiable facility operator. Inactive mining sites do not include sites where mining claims are being maintained prior to disturbances associated with the extraction, beneficiation, or processing of mined material; or sites where minimal activities are undertaken for the sole purpose of maintaining a mining claim.

4. HAZARDOUS WASTE TREATMENT, STORAGE, OR DISPOSAL FACILITIES: Includes those operating under interim status or a general permit under Subtitle C of the Federal Resource, Conservation, and Recovery Act (RCRA).

5. LANDFILLS, LAND APPLICATION SITES, AND OPEN DUMPS: Sites that receive or have received industrial waste from any of

the facilities covered by this General Permit, sites subject to regulation under Subtitle D of RCRA, and sites that have accepted wastes from construction activities (construction activities include any clearing, grading, or excavation that results in disturbance of five acres or more).

6. RECYCLING FACILITIES: SICs 5015 and 5093. These codes include metal scrapyards, battery reclaimers, salvage yards, motor vehicle dismantlers and wreckers, and recycling facilities that are engaged in assembling, breaking up, sorting, and wholesale distribution of scrap and waste material such as bottles, wastepaper, textile wastes, oil waste, etc.

7. STEAM ELECTRIC POWER GENERATING FACILITIES: Includes any facility that generates steam for electric power through the combustion of coal, oil, wood, etc.

8. TRANSPORTATION FACILITIES: SICs 40, 41, 42 (except 4221-25), 43, 44, 45, and 5171 which have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations. Only those portions of the facility involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication) or other operations identified herein that are associated with industrial activity.

9. SEWAGE OR WASTEWATER TREATMENT WORKS: Facilities used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility with a design flow of one million gallons per day or more or required to have an approved pretreatment program under 40 CFR Part 403. Not included are farm lands, domestic gardens, or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with Section 405 of the Clean Water Act.

10. MANUFACTURING FACILITIES WHERE INDUSTRIAL MATERIALS, EQUIPMENT, OR ACTIVITIES ARE <u>EXPOSED</u> TO STORM WATER: SICs 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, and 4221-4225.

Attachment 2

*STORM WATER CONTACTS FOR*
*THE STATE AND REGIONAL WATER BOARDS*

See Storm Water Contacts at:
http://www.swrcb.ca.gov/stormwtr/contact.html

# NOTICE OF INTENT (NOI) INSTRUCTIONS

## TO COMPLY WITH STATE WATER RESOURCES CONTROL BOARD WATER QUALITY ORDER NO. 97-03-DWQ NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) GENERAL PERMIT NO. CAS000001

### Who Must Submit

The facility operator must submit an NOI for each industrial facility that is required by U.S. Environmental Protection Agency (U.S.EPA) regulations to obtain a storm water permit. The required industrial facilities are listed in Attachment 1 of the General Permit and are also listed in 40 Code of Federal Regulations Section 122.26(b)(14).

The facility operator is typically the owner of the business or operation where the industrial activities requiring a storm water permit occur. The facility operator is responsible for all permit related activities at the facility.

Where operations have discontinued and significant materials remain on site (such as at closed landfills), the landowner may be responsible for filing an NOI and complying with this General Permit. Landowners may also file an NOI for a facility if the landowner, rather than the facility operator, is responsible for compliance with this General Permit.

### How and Where to Apply

The completed NOI form, a site map, and appropriate fee must be mailed to the State Water Resources Control Board (State Water Board) at the following address:

State Water Resources Control Board
Division of Water Quality
P.O. Box 1977
Sacramento, CA 95812-1977
Attn: Storm Water Permitting Unit

**Please Note: Do not send the original or copies of the NOI submittal to the Regional Water Quality Control Board (Regional Water Board).** The original NOI will be forwarded to the Regional Water Board after processing.

**Do not send a copy of your Storm Water Pollution Prevention Plan (SWPPP) with your NOI submittal.** Your SWPPP is to be kept on site and made available for review upon request.

**When to Apply**

Facility operators of existing facilities must file an NOI in accordance with these instructions by March 30, 1992. Facility

operators of new facilities (those beginning operations after March 30, 1992) must file an NOI in accordance with these instructions at least 14 days prior to the beginning of operations.

Once the completed NOI, site map, and appropriate fee have been submitted to the State Water Board, your NOI will be processed and you will be issued a receipt letter with a Waste Discharge Identification (WDID) Number. Please refer to this number when you contact either the State or Regional Water Boards.

**Fees**

The annual fee is $700. Feedlots pay a one time fee of $2,000 fee. Checks should be made payable to: SWRCB

**Change of Information**

If the information provided on the NOI or site map changes, you should report the changes to the State Water Board using an NOI form. Section I of the line-by-line instructions includes information regarding changes to the NOI.

**Questions**

If you have any questions completing the NOI, please call the appropriate Regional Water Board (Attachment 2) or the State Water Board at (916) 341-5538.

## NOI LINE-BY-LINE INSTRUCTIONS

Please type or print your responses on the NOI. Please complete the NOI form in its entirety and sign the certification.

**Section I--NOI STATUS**

Check box "A" if this is a new NOI registration.

Check box "B" if you are reporting changes to the NOI (e.g., new contact person, phone number, mailing address). Include the facility WDID #. Highlight all the information that has been changed.

Please note that a change of information **does not** apply to a change of facility operator or a change in the location of the facility. These changes require a Notice of Termination (NOT) and submittal of a new NOI and annual fee. Contact the State Water Board or Regional Water Boards for more information on the NOT Form and instructions.

Regardless of whether you are submitting a new or revised NOI, you must complete the NOI in its entirety and the NOI must be signed.

**Section II--Facility Operator Information**

Part A: The facility operator is the legal entity that is responsible for all permit related compliance activities at the facility. In most cases, the facility operator is the owner of the business or operation where the industrial activity occurs. Give the legal name and the address of the person, firm, public organization, or any other entity that is responsible for complying with the General Permit.

Part B: Check the box that indicates the type of operation.

**Section III--Facility Site Information**

Part A: Enter the facility's official or legal name and provide the address. Facilities that do not have a street address must provide cross-streets or parcel numbers. <u>Do not include a P.O. Box address in Part A</u>.

Part B: Enter the mailing address of the facility if different than Part A. This address may be a P.O. Box.

The contact person should be the plant or site manager who is familiar with the facility and responsible for overseeing compliance of the General Permit requirements.

Part C: Enter the total size of the facility in either acres or square feet. Also include the percentage of the site that is impervious (areas that water cannot soak into the ground, such as concrete, asphalt, and rooftops).

Part D: Determine the Standard Industrial Classification (SIC) code which best identifies the industrial activity that is taking place at the facility. This information can be obtained by referring to the <u>Standard Industrial Classification Manual</u> prepared by the Federal Office of Management and Budget which is available at public libraries. The code you determine should identify the industrial activity that requires you to submit the NOI. (For example, if the business is high school education and the activity is school bus maintenance, the code you choose would be bus maintenance, not education.) Most facilities have only one code; however, additional spaces are provided for those facilities that have more than one activity.

Part E: Identify the title of the industrial activity that requires you to submit the NOI (e.g., the title of SIC Code 2421 is Sawmills and Planing Mills, General). If you cannot identify the title, provide a description of the regulated activity(s).

**Section IV--Address for Correspondence**

Correspondence relative to the permit will be mailed occasionally. Check the box which indicates where you would like such correspondence delivered. If you want correspondence sent to another contact person or address different than indicated in Section II or Section III then include the information on an extra sheet of paper.

**Section V--Billing Address Information**

To continue coverage under the General Permit, the annual fee must be paid. Use this section to indicate where the annual fee invoices should be mailed. Enter the billing address if different than the address given in Sections II or III.

**Section VI--Receiving Water Information**

Provide the name of the receiving water where storm water discharge flows from your facility. A description of each option is included below.

1. Directly to waters of the United States: Storm water discharges directly from the facility to a river, creek, lake, ocean, etc. Enter the name of the receiving water (e.g., Boulder Creek).

2. Indirectly to waters of the United States: Storm water discharges over adjacent properties or right-of-ways prior to discharging to waters of the United States. Enter the name of the closest receiving water (e.g., Clear Creek).

**Section VII--Implementation of Permit Requirements**

Parts A and B: Check the boxes that best describe the status of the Storm Water Pollution Prevention Plan (SWPPP) and the Monitoring Program.

Part C: Check yes or no to questions 1 through 4. If you answer no to any question, you need to assign a person to these tasks immediately.

As a permit holder you are required to have an SWPPP and Monitoring Program in place prior to the beginning of facility operations. Failure to do so is in direct violation of the General Permit. Do not send a copy of your SWPPP with your NOI submittal.

Please refer to Sections A and B of the General Permit for additional information regarding the SWPPP and Monitoring Program.

**Section VIII--Regulatory Status**

In some instances, the facility may be covered under another permit from the State Water Board. If there is a current NPDES or WDR permit for the facility, list the permit number in the space provided (e.g., NPDES Permit CA0000123, WDR No. 96-960). You will not be required to pay the annual fee for the General Permit if you are already paying a fee for an NPDES or WDR permit. If the facility is not covered under a State Water Board permit, then skip to Section IX.

**Section IX--Site Map**

Provide a "to scale" drawing of the facility and its immediate surroundings. Include as much detail about the site as possible. At a minimum, indicate buildings, material handling and storage areas, roads, names of adjacent streets, storm water discharge points, sample collection points, and a north arrow. Whenever possible limit the map to a standard size sheet of paper (8.5" x 11" or 11" x 17"). **Do not send blueprints** unless you are sending one page and it meets the size limits as defined above.

A location map may also be included, especially in cases where the facility is difficult to find, but are not to be submitted as a substitute for the site map. The location map can be created from local street maps and U.S. Geological Survey (USGS) quadrangle maps, etc.

A revised site map must be submitted whenever there is a significant change in the facility layout (e.g., new building, change in storage locations, boundary change, etc.).

**Section X--Certification**

This section should be read by the facility operator. The certification provides assurances that the NOI and site map were completed by the facility operator in an accurate and complete fashion and with the knowledge that penalties exist for providing false information. It also requires the Responsible Party to certify that the provisions in the General Permit will be complied with.

The NOI must be signed by:

**For a Corporation:** a responsible corporate officer (or authorized individual).

**For a Partnership or Sole Proprietorship:** a general partner or the proprietor, respectively.

**For a Municipality, State, or other non-Federal Public Agency:** either a principal executive officer or ranking elected official.

**For a Federal Agency:** either the chief or senior executive officer of the agency.

State of California
State Water Resources Control Board

# NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF THE
GENERAL PERMIT TO DISCHARGE STORM WATER
ASSOCIATED WITH **INDUSTRIAL ACTIVITY** (WQ ORDER No. 97-03-DWQ)
*(Excluding Construction Activities)*

## SECTION I. NOI STATUS (please check only one box)

A. [ ] New Permittee    B. [ ] Change of Information    WDID # |_|_|_|_|_|_|_|_|_|_|_|

## SECTION II. FACILITY OPERATOR INFORMATION (See instructions)

A. NAME:

Phone: |_|_|_|–|_|_|_|–|_|_|_|_|

Mailing Address:

City:

State:

Zip Code:

Contact Person:

B. OPERATOR TYPE:
*(check one)* 1.[ ] Private 2.[ ]City 3.[ ]County 4.[ ]State 5.[ ]Federal 6.[ ]Special District 7.[ ]Gov. Combo

## SECTION III. FACILITY SITE INFORMATION

A. FACILITY NAME

Phone: |_|_|_|–|_|_|_|–|_|_|_|_|

Facility Location:

County:

City:

State: C|A

Zip Code:

B. MAILING ADDRESS:

City:

State:

Zip Code:

Contact Person:

C. FACILITY INFORMATION ( check one)
Total Size of Site: Acres [ ] Sq. Ft. [ ]

Percent of Site Impervious (*including rooftops*) |_|_|_| %

D. SIC CODE(S) OF REGULATED ACTIVITY:

E. REGULATED ACTIVITY (*describe each SIC code*):

1.

2.

3.

**FOR STATE USE ONLY:**

A002325

## SECTION IV. ADDRESS FOR CORRESPONDENCE

|_| Facility Operator Mailing Address (Section II) |_| Facility Mailing Address (Section III, B.) |_| Both

## SECTION V. BILLING ADDRESS INFORMATION

SEND BILL TO: [ ]Facility Operator Mailing Address (Section II) [ ]Facility Mailing Address (Section III, B.) [ ]Other (*enter information below*)

| | |
|---|---|
| Name: | Phone: \|_\|_\|_\|--\|_\|_\|_\|--\|_\|_\|_\|_\| |
| Mailing Address: | |
| City: | State: Zip Code: |
| Contact Person: | |

## SECTION VI. RECEIVING WATER INFORMATION

Your facility's storm water discharges flow: (*check one*) [ ] Directly OR [ ] Indirectly to waters of the United States.

Name of receiving water: ______________________________
(river, lake, stream, ocean, etc.)

## SECTION VII. IMPLEMENTATION OF PERMIT REQUIREMENTS

A. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) (*check one*)
[ ] A SWPPP has been prepared for this facility and is available for review.
[ ] A SWPPP will be prepared and ready for review by (enter date): ____/____/____.

B. MONITORING PROGRAM (check one)
[ ] A Monitoring Program has been prepared for this facility and is available for review.
[ ] A Monitoring Program will be prepared and ready for review by (enter date): ____/____/____.

C. PERMIT COMPLIANCE RESPONSIBILITY
Has a person been assigned responsibility for:
1. Inspecting the facility throughout the year to identify any potential pollution problems? .......... ____YES ____NO
2. Collecting storm water samples and having them analyzed?.......... ____YES ____NO
3. Preparing and submitting an annual report by July 1 of each year? .......... ____YES ____NO
4. Eliminating discharges other than storm water (*such as equipment or vehicle wash-water*) into the storm drain? .......... ____YES ____NO

## SECTION VIII. REGULATORY STATUS (*Go to Section IX if not applicable*)

A. WASTE DISCHARGE REQUIREMENT ORDER NUMBER: |_|_|_|_|_|_|_| B. NPDES PERMIT CA |_|_|_|_|_|_|_|_|

## SECTION IX. SITE MAP

I HAVE ENCLOSED A SITE MAP YES[ ] A new NOI submitted without a site map will be rejected.

## SECTION X. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction and 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, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. In addition, I certify that the provisions of the permit, including the development and implementation of a Storm Water Pollution Prevention Plan and a Monitoring Program Plan, will be complied with."

Printed Name:

Signature: ______________________________ Date

Title:

**DEFINITIONS**

1. "Best Management Practices" ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment measures, operating procedures, and practices to control facility site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may include any type of pollution prevention and pollution control measure necessary to achieve compliance with this General Permit.

2. Clean Water Act (CWA) means the Federal Water Pollution Control Act enacted by Public Law 92-500 as amended by Public Laws 95-217, 95-576, 96-483, and 97-117; 33 USC. 1251 et seq.

3. "Facility" is a collection of industrial processes discharging storm water associated with industrial activity within the property boundary or operational unit.

4. "Non-Storm Water Discharge" means any discharge to storm sewer systems that is not composed entirely of storm water.

5. "Significant Materials" includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under Section 101(14) of Comprehensive Environmental Response, Compensation, and Liability Act (CERLCA); any chemical the facility is required to report pursuant to Section 313 of Title III of Superfund Amendments and Reauthorization Act (SARA); fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges.

6. "Significant Quantities" is the volume, concentrations, or mass of a pollutant that can cause or threaten to cause pollution, contamination, or nuisance; adversely impact human health or the environment; and/or cause or contribute to a violation of any applicable water quality standards for the receiving water.

7. "Significant Spills" includes, but is not limited to: releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the CWA (see 40 CFR 110.10 and 117.21) or Section 102 of CERCLA (see 40 CFR 302.4).

8. "Storm water" means storm water runoff, snow melt runoff, and storm water surface runoff and drainage. It excludes infiltration and runoff from agricultural land.

9. "Storm Water Associated with Industrial Activity" means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program. For the facilities identified in Categories 1 through 9 of Attachment 1 of this General Permit, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials; manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process wastewaters (as defined at 40 CFR Part 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water.

For the facilities identified in Category 10 of Attachment 1 of this General Permit, the term only includes storm water discharges from all areas listed in the previous sentence where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery <u>are exposed to storm water</u>.

Material handling activities include the: storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, finished product, by-product, or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are federally, State, or municipally owned or operated that meet the description of the facilities listed in this paragraph) include those facilities designated under 40 CFR 122.26(a)(1)(v).

Attachment 5

# ACRONYM LIST

| | |
|---|---|
| BAT | Best Available Technology Economically Achievable |
| BCT | Best Conventional Pollutant Control Technology |
| BMPs | Best Management Practices |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Federal Superfund) |
| CFR | Code of Federal Regulations |
| CWA | Clean Water Act |
| General Permit | General Industrial Activities Storm Water Permit |
| GMP | Group Monitoring Plan |
| NEC | No Exposure Certification |
| NOI | Notice of Intent |
| NOT | Notice of Termination |
| NPDES | National Pollutant Discharge Elimination System |
| O&G | Oil and Grease |
| RCRA | Resource, Conservation, and Recovery Act |
| Regional Water Board | Regional Water Quality Control Board |
| RQ | Reportable Quantity |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |
| SIC | Standard Industrial Classification |
| SMCRA | Surface Mining Control and Reclamation Act |
| SPCC | Spill Prevention Control and Countermeasures |
| State Water Board | State Water Resources Control Board |
| SWPPP | Storm Water Pollution Prevention Plan |
| TOC | Total Organic Carbon |
| TSS | Total Suspended Solids |
| U.S. EPA | U.S. Environmental Protection Agency |
| WDID | Waste Discharger Identification |
| WDRs | Waste Discharge Requirements |

# Appendix B
# Storm Water Discharges Associated With Industrial Activity

# Who is subject to Phase I the NPDES Storm Water Program and needs a Permit?

The term "Storm Water Discharges Associated with Industrial Activity", defined in federal regulations 40 CFR 122.26(b)(14)(i)-(xi), determined which industrial facilities are potentially subject to Phase I of the storm water program. If you are subject to the program you need to apply for a permit. The definition uses either SIC (Standard Industrial Classification) codes or narrative descriptions to characterize the activities. You are responsible for identifying your facility's SIC code. The definition's 11 categories ((i) - (xi)) are listed below. You should review these 11 categories and decide if your type of facility is described by any of them (either by SIC code or by narrative descriptions). Please note that categories iii, viii, and xi have special conditions, or exceptions (described below) which may make a facility NOT subject to the program, and therefore not required to apply, even though the facility's activity matches one of the SIC codes.

### category (i)

Facilities subject to storm water effluent limitations guideline, new source performance standards, or toxic pollutant effluent standards under 40 CFR subchapter N (except facilities with toxic pollutant effluent standards which are exempted under category (xi)). These types of facilities include the following :

<u>40 CFR Subchapter N</u>
405 Dairy products processing
406 Grain mills
407 Canned & preserved fruits & veg. processing *
408 Canned & preserved seafood processing
409 Beet, crystalline & liquid cane sugar refining
410 Textile mills
411 Cement manufacturing
412 Feedlots
414 Organic Chemicals plastics and synthetic fibers
415 Inorganic chemical manufacturing *
417 Soap and detergent manufacturing
418 Fertilizer manufacturing
419 Petroleum refining
420 Iron and steel manufacturing
421 Nonferrous metal manufacturing
422 Phosphate manufacturing *
423 Steam electric power
424 Ferroalloy manufacturing *
425 Leather tanning and finishing
426 Glass manufacturing *
427 Asbestos manufacturing
428 Rubber manufacturing
429 Timber products processing
430 Pulp, paper, and paperboard *
431 Builder's paper and board mills
432 Meat products
433 Metal finishing
434 Coal Mining *
436 Mineral mining & processing *
439 Pharmaceutical manufacturing *
440 Ore mining & dressing *
443 Paving and roofing materials
446 Paint formulating
447 Ink formulating
455 Pesticide Chemicals *
458 Carbon Black manufacturing
461 Battery manufacturing
463 Plastics molding and forming
464 Metal molding and casting
465 Coil coating
466 Porcelain enameling
467 Aluminum forming
468 Copper forming *
469 Electrical & electronic component
471 Nonferrous metal forming & powders
* some facilities in group do not have limits or standards, see 40 CFR subchapter N to verify.

### category (ii)

Facilities classified by the following SIC codes:

<u>SIC Code</u>
24 lumber and wood products (except 2434 wood kitchen cabinets, see (xi))
26 paper & allied products (except 265 paperboard containers, 267 converted paper, see (xi))
28 chemicals & allied products (except 283 drugs, see (xi))
29 petroleum & coal products
311 leather tanning & finishing
32 stone, clay & glass production (except 323 products of purchased glass, see (xi))
33 primary metal industry
3441 fabricated structural metal
373 ship and boat building and repair

### category (iii) Mineral Industry

Facilities classified as SIC codes 10-14 including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(1) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or areas of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990), and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations (inactive mining operations are mining sites that are not being actively mined, but which have an identifiable owner/operator; inactive mining sites do not include sites where mining claims are being maintained prior to disturbances associated with the extraction, benefication, or processing of mined materials, nor sites where minimal activities are undertaken for the sole purpose of maintaining a mining claim).

<u>SIC Code</u>
10 metal mining (metallic mineral/ores)
12 coal mining
13 oil and gas extraction
14 non-metallic minerals except fuels

Oil and gas operations that discharge contaminated storm water at any time between November 16, 1987 and October 1, 1992, and that are currently not authorized by an NPDES permit, must apply for a permit. Operators of oil and gas exploration, production, processing, or treatment operations or transmission facilities, that are not required to submit a permit application as of October 1, 1992 in accordance with 40 CFR 122.26(c)(1)(iii), but that after October 1, 1992 have a discharge of a reportable quantity of oil or a hazardous substance (in a storm water discharge) for which notification is required pursuant to either 40 CFR 110.6, 117.21, or 302.6, must apply for a permit.

### category (iv) Hazardous Waste

Hazardous waste treatment, storage, or disposal facilities including those that are operating under interim status or a permit under Subtitle C of RCRA.

### category (v) Landfills

Landfills, land application sites, and open dumps that receive or have received any industrial waste (waste that is received from any of the facilities described under categories (i) - (xi)) including those that are subject to regulations under Subtitle D of RCRA.

### category (vi)

Facilities involved in the recycling of materials, including metal scrap yards, battery reclaimers, salvage yards, and automobile junkyards, including but limited to those classified as SIC 5015 (used motor vehicle parts) and 5093 (scrap and waste materials).

### category (vii) Steam Electric Plants

Steam electric power generating facilities, including coal handling sites.

### category (viii) Transportation

Transportation facilities classified by the SIC codes listed below <u>which have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations</u>. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airport deicing operations, or which are otherwise identified under categories (i)-(vii) or (ix)-(xi) are associated with industrial activity, and need permit coverage.

<u>SIC Code</u>
40 railroad transportation
41 local and interurban passenger transit
42 trucking & warehousing (except 4221-25, see (xi))
43 US postal service
44 water transportation
45 transportation by air
5171 petroleum bulk stations and terminals

### category (ix) Treatment Works

Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 mgd or more, or required to have an approved pretreatment program under 40 CFR 403. Not included are farm lands, domestic gardens or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with section 405 of the Clean Water Act.

### category (x) Construction

Construction activity including clearing, grading and excavation activities except: operations that result in the disturbance of less than 5 acres of total land area which are not part of a larger common plan of development or sale.

*[The construction "operator" must apply for permit coverage under the General Storm Water Permit for Construction Activities. The "operator" is the party or parties that either individually or taken together meet the following two criteria: 1) they have operational control over the site specification; 2) they have the day-to-day operational control of those activities at the site necessary to ensure compliance. For a typical commercial construction site, the owner and general contractor must both apply. For a typical residential development, the developer and all builders must apply. Each builder must apply even if they individually disturb less than 5 acres if the overall development is 5 or more acres. Only one Pollution Prevention Plan is required per site even though there may be multiple parties.]*

### category (xi) Light industry

Facilities classified by the following SIC codes:

<u>SIC Code</u>
20 food and kindred product
21 tobacco products
22 textile mill products
23 apparel and other textile product
2434 wood kitchen cabinets
25 furniture and fixtures
265 paperboard containers and boxes
267 miscellaneous converted paper products
27 printing and publishing
283 drugs
285 paints and allied products
30 rubber and miscellaneous plastic
31 leather and products (except 311)
323 products of purchased glass
34 fabricated metal products (except 3441)
35 industrial machinery and equipment
36 electronic and other electric equipment
37 transportation equipment (except 373)
38 instruments and related products
39 miscellaneous manufacturing
4221 farm product storage
4222 refrigerated storage
4225 general warehouse and storage

(and which are not otherwise included in categories (ii) - (x)) with storm water discharges from all areas (except access roads and rail lines) where material handling equipment, or activities, raw materials, immediate products, final products, waste materials, by-products, or industrial machinery <u>are exposed to storm water</u>. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate produce, finished product, by-product, or waste product.

updated 9/4/97

# Appendix C
# Sample SWPPP

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Presented in the following pages is an example of a Storm Water Pollution Prevention Plan (SWPPP). The example was prepared following the procedures and worksheets presented in Section 2. The industrial facility is a cargo container business located in a marine port. The contents of this example follow the requirements of the State of California General Permit (Appendix A). However, your Regional Water Quality Control Board may request additional items as specified in your permit.

**STORM WATER POLLUTION PREVENTION PLAN**

**LOADUM STEVEDORE COMPANY**

**Sknits Bay Facility**

INDUSTRIAL HANDBOOK
TABLE OF CONTENTS

## CHAPTER 1 INTRODUCTION

Federal regulations, administered by the Ahctog Water Quality Board (AWQB), requires the Loadum Company facility at Sknits Bay to have a General Industrial Storm Water Permit (hereafter referred to as the "Permit"). The purpose of the regulations is to protect water quality by reducing the amount of pollutants in the storm water. These pollutants come from our outdoor activities, as well as atmospheric deposition over which we have no control. The permit covers the entire Facility except for the Administration Building and the adjoining employee parking lot. These activities are not included in the permit because they drain to their own drainage system. A copy of the Permit is at the back of this Storm Water Pollution Prevention Plan. The original is kept at Headquarters.

### 1.1 Purpose of the SWPPP

The regulations require us to prepare a Storm Water Pollution Prevention Plan (SWPPP). It describes the measures that we will take through November 19, 2003, as specified in our permit. This plan is to be kept on the premises at the office of the Environmental Coordinator.

### 1.2 BMP Implementation Committee

The Permit requires that the SWPPP identify personnel to oversee the implementation of any measures to reduce pollution (called Best Management Practices), to conduct monitoring activities, and to modify the SWPPP as necessary over time. We have formed a standing committee which participated in the preparation of this plan and will oversee its implementation. The committee will be lead by the Facility Environmental Coordinator plus the following: M&R Repair Manager, Container Yard Manager, Marine Manager, Safety Director (also the Spill Response Team Leader), Facilities Management, and a Union representative.

### 1.3 Implementation Schedule

All of what are called "management BMPs" (those that do not involve any major construction) are to be implemented by the end of FY 2003.

### 1.4 Protocol on Public Access to the SWPPP

Although this is a Company plan, meant for the use by our employees, it is a public document. Representatives of the AWQB who visit the Facility on occasion are allowed direct access to the plan when on site. Any request for a copy of the plan by the AWQB, or other government agency is to be forwarded to the Director of Environmental Affairs at the Headquarters Office.

### 1.5 Updating the SWPPP

The AWQB can require changes to the plan. We are not required to forward this plan automatically to the AWQB but only upon request. We are required to change the plan whenever a change in our activities occurs that may affect significantly the discharge of pollutants. We may also change the plan if we determine that there are more economical BMPs to reduce pollutants than the one's currently identified in the SWPPP. The Facility Environmental Coordinator is responsible for determining if the SWPPP is to be changed, and when done, by the involvement of the Committee.

# CHAPTER 2 SITE LOCATION AND GENERAL ENVIRONS

Although this is our plan to carryout the needed actions to reduce storm water pollution, this plan contains general background information that is of value to the public and the AWQB should they request a copy, and for Headquarters, given the large number of Company facilities.

## 2.1 General Nature of Facility Activities

The Facility's primary objective is the loading and unloading of cargo containers on seagoing ships. Some break bulk packing occurs. The loading equipment (container cranes, top pickers, tractors, container trailers and forklifts) and miscellaneous vehicles are maintained on site. This includes engine maintenance, lubrication, frame welding, miscellaneous painting, and washing. Highway tractors (trucks) are not maintained on site as they are not owned by the Company.

## 2.2 Map of General Environs

Map 1 shows the Facility and the immediately surrounding area. The site covers a total of 125 acres and is completely covered with pavement or buildings. All storm water discharges to Ignatia Bay either directly or via storm drains. There are no active or inactive wells on site. There are no streams or wetlands on the site.

## 2.3 Maps of Facility Layout

The location of buildings and major activity areas are shown on Map 1. There are four (4) buildings (A, B, C and the Crane Maintenance Shop) and several activities in the open as described below.

Building A is the Company administrative office and employee parking lot (not included in the permit).

Building B is for break bulk containerization; where various types of dry goods are packed in containers such as lumber, wire, and paper. However, this is a minor part of the operation. In excess of 99% of all cargo passing through the Facility comes to the site in containers. This area is not considered a "significant source" of pollutants (as defined in the Permit) and therefore is not discussed further in the SWPPP.

Building C is for maintenance and repair (M&R). Outside the building in the general M&R area are: the wash rack where containers and equipment are stream cleaned; the reefer area where reefer (refrigerated) containers are temporarily stored; the fueling station; and outside storage of various parts and fluids.

Container Trailer Storage Yard: Trailers are temporarily stored in this area and repaired.

Container yard: Containers awaiting loading are stacked or temporarily stored on trailers.

Dock apron: Loading/unloading of ships occurs in this area. The container cranes are located on tracks. Containers are loaded on to trailers that are pulled either by a dock tractor or a highway truck tractor.

Crane maintenance shop: Located next to the dock apron, where materials are kept that are needed to repair the container cranes.

## 2.4 Description of Storm Drainage System and Outfalls

The drainage pipes, outfalls, and the boundaries of the areas that drain to each outfall are shown on Map 2 (enclosed in the back cover pocket). Included in the drainage system are a large number of catch basins. These basins do provide a moderate level of treatment. The sumps are of sufficient depth to collect settleable pollutants. Each catch basin has a "turned down" elbow in the discharge line. This traps much of the floating debris and some petroleum products. We point this out because to be effective the catch basins need to be cleaned more frequently if they are to work.

# CHAPTER 3 DESCRIPTION OF POTENTIAL SOURCES OF POLLUTION

The locations of various activities that could be sources of pollution are shown on Map 3. Enclosed at the back of this report are various completed worksheets, including a summary of materials that could become contaminants such as used oil.

## 3.1 Maintenance and Repair (M&R) Area

With the exception of the container cranes located on the dock apron, maintenance of vehicles and equipment occurs in M & R Area. Because of height limitations maintenance of top picks occurs outside the building. The chiller units on reefer containers are serviced in the designated area. Servicing is done from a motorized platform that can elevate to the height of the reefer unit. Servicing involves replacement of coolant and lubricants. The platform is enclosed on three sides.

Worksheet 3, in the Appendix, lists the types and quantities of both fresh and used fluids located in M&R area. These materials are potential pollutants if not handling properly. They include motor oil, hydraulic/lube oil, degreasers (mineral spirits), cleaning solvent, spray paint cans, rust removers, antifreeze, cleaning detergents, and batteries.

On the west side of the shop is a space for gensets, where portable generators sets are stored and serviced including fueling with #2 diesel. The internal drains of the shop drain to an oil/water separator which in turn drains to the sanitary sewer.

Hydraulic/lube oil is purchased in *55* gallon drums and stored in the designated walkin containment box (on the south side of M&R shop). This container is watertight., has a containment floor, and is approved by the city fire department. Bulk motor oil is stored inside the shop as is fresh solvent. Solvent, used to clean parts and to clean the surfaces of equipment, is supplied by Safety-Kleen who also removes used solvent which is stored in containers provided by Safety-Kleen.

The used solvent container, as well as containers for other used fluids (except engine oil), are stored in a walk-in containment box (#2 on the south side of the shop). It has a containment floor and is approved by the fire department. Used engine oil is stored in a *500* gallon underground tank. The used oil is removed by a private contractor.

Used antifreeze is recycled after it is cleaned of contaminates. This is done inside the shop. Minor touchup painting occurs using spray cans.

Containers and equipment are steam cleaned at the location shown in Map 4. The water drains to a storm catch basin. The area is swept clean each day of surface debris.

The fueling station situated on the south side of the M&R shop is not enclosed. Service vehicles and small trucks use the fueling station. Top pickers and bulls are fueled throughout the site by a fueling truck (see below). There are two underground 5,000 gallon tanks: one for #2 diesel and one for unleaded gasoline. These tanks are to be replaced in FY 93 with new tanks that meet the current underground tank regulations.

Potential sources of pollution are:

- spills from the fueling of vehicles and equipment;
- spills when fuel is delivered;
- spills when fueling generator sets
- spills from servicing reefers
- spills when taking used fluids to the used fluids storage shed.
- materials discharged from steam cleaning area

### 3.2 Container Trailer Storage Yard

Container trailers are repaired and serviced outside, south of Building B. Repairs involve minor welding and spot painting (with spray cans). Servicing involves greasing and axle oil replacement. The only potential source of pollution is the changing of axle oil.

### 3.3 Container Yard

The container handling equipment (top picks, tractors, and forklifts) have hydraulic oil lines that can break, spilling oil, The maximum capacity is 75 gallons.

Hazardous Materials passing through the Facility are temporarily stored in designated areas as required by the fire department. Spills from a container can reach storm drains.

Fueling of top picks and forklifts occurs in the container yard. Spills could occur.

Yard transformers contain mineral oil, not PCBs, for insulation. Mineral oil could leak if the transformers are damaged.

### 3.4 Dock Apron

Container cranes are serviced at dock side. The cranes are electric. Therefore maintenance is limited to various lubricants and oils. The maximum capacity of oil tank is 30 gallons. No fueling occurs. Solvent stored at the Crane Maintenance shop is used to clean the metal surfaces of the crane. Spills of these materials during handling and transfer to the crane could occur.

Ship fueling occurs at dockside by truck. Spills could occur. Painting of the ship hull occurs infrequently and is limited to the deck. Hull painting does not occur. Consequently, loss to the bay is unlikely.

### 3.5 Crane Maintenance Shop

Small parts, grease, and tools are kept in this small shop located immediately adjacent to the dock apron. Fresh and used hydraulic oil and filters are kept at the M&R shop and not at the crane maintenance shop. Parts are not cleaned here except if it can done by a cloth. Solvent is used to clean (with a cloth) the surfaces of the cranes. Cleaning of parts by dunking is done at the M&R shop. As the cranes are electric there is no fueling.

### 3.6 Maintenance, Repair, Remodeling of Facility Buildings

This is discussed separately as it is the responsibility of Facilities Management. Any major repairs or additions to buildings are performed by off-site contractors who are responsible for their activities. Potential sources of pollution include spilled or dumped paint, and washing of materials down the drain.

### 3.7 Improper Connections to the Storm Drain

The line from the wash rack area is connected to the storm drain. Wash water is considered a process or waste water, not storm water, and needs to be discharged to the sanitary sewer.

## CHAPTER 4 POTENTIAL POLLUTANTS

### 4.1 Significant Materials that May Come in Contact with Storm Water

Worksheet 3 (Appendix) lists materials that may come in contact with storm water. Essentially all of these materials are related to the maintenance, repair, and fueling of vehicles and materials handling equipment.

### 4.2 Types of Pollutants by Potential Source

Table 1 is a table listing the types of pollutants that may be present in storm water from the Facility.

### 4.3 Existing Data on Quality of Storm Water from Site

There are no data on the quality of the storm water from the Facility site.

### 4.4 Estimate of Pollutant Loadings to Sknits Bay

Because of the episodic nature of many activities (such as painting) and the lack of storm water data we are unable to calculate with sufficient accuracy the probable loadings of the various pollutants in Table 1.

### 4.5 Spills of Significant Materials After April 17, 1994

It is required by the regulations that we list spills since the date indicated. There have been no such spills.

**TABLE I. LIST OF POLLUTANTS WITH A REASONABLE POTENTIAL TO BE PRESENT IN STORM WATER IN SIGNIFICANT QUANTITIES**

OilJ grease
PAll (polynuclear aromatic hydrocarbons)
Petroleum hydrocarbons
Zinc
Lead
Copper
Cadmium
Chromium
Total suspended solids
Small floatable debris (wood pieces)
Phenol
Benzene
Napthalene
Phosphorus
Nitrogen

### 4.6 Identification of Non-Storm Water Discharges

The Permit states that we are to investigate the facility to identify all potential non-storm water discharges and their sources. This will be conducted quarterly as part of the monitoring program.

## CHAPTER 5 STEPS TO REDUCE POLLUTION – BOTH OLD AND NEW

Table 2 summarizes existing and new BMPs, denoting which of the Permit categories (listed below) applies. Also indicated is the schedule of implementation and the department that is responsible for carrying out the BMP. Worksheet 7 "grades" the area for general housekeeping quality, indicating that in general we are doing a good job already.

### 5.1 What are Best Management Practices (BMPs)

The storm regulations state that we are to put in place Best Management Practices (BMPs) to reduce the contamination or potential for contamination of storm water. BMPs can be simple and low cost, such as sweeping the container yard, or expensive such as installing an oil/water separator. Many of the BMPs we are already doing: these are included in the SWPPP with new BMPs that need to be implemented.

We are required by the permit to identify BMPs in the following general areas:

1. Good housekeeping: - Refers to those things we do to keep the work areas clean.
2. Preventive maintenance: - Maintenance of our equipment in a way that anticipates problems that could occur, resulting in pollution. An example is routine replacement of hydraulic lines on the top picks.
3. Spill prevention and response: - Particular attention is to be devoted to minimizing spills, which is already covered by our Business Plan.
4. Storm water management practices: This refers to BMPs that involve construction such as installation of an oil/water separator, or containment sump.
5. Employee training: Our training program needs to include training as necessary for the various BMPs.
6. Inspections: We must at least annually inspect the facility to be certain that all of the BMPs are being implemented, decide if they are effective, and make changes as necessary. A record of these exceptions is to be kept.
7. Monitoring: During the wet season (October-April), we will collect and analyze runoff samples from two storms.

What follows is a description of BMPs that we already do and new ones that we need to do. The following discussion is organized by area of the Facility, with a few exceptions.

### 5.2 Assignments to Implement the BMPs

The department responsible for the various BMPs are shown in Table 2.

## 5.3 Maintenance and Repair (M & R) Area

Current BMPs: Minor spills are cleaned up promptly by M&R shop personnel. Spill absorbent materials of various types are stored in the brightly marked container at the northeast corner of the M&R shop. The used fluids and filters are placed in marked containers, properly stored as previously described, and are inventoried and removed by XYZ Environmental. The fresh and used materials storage areas are checked weekly by the M&R Manager. The shop floor is cleaned weekly using liquid detergent. These wash waters drain to a sanitary sewer. The wash rack area is swept clean of debris each day that washing occurs. When serviced, all vehicles and equipment are checked for faulty parts and hydraulic hose wear; these are replaced as potential problems are discovered. A solvent sink is used to clean parts.

New BMPs: The following will be implemented.

- When the two storage tanks are removed (FY 93) they will be replaced by one above ground tank for #2 diesel. Pickup trucks which are the only vehicles that use gasoline will be fueled off-site at a gas station.
- The above ground tank will be placed on a concrete pad sloped inward towards a drain that will connect to an oil/water separator which will discharge to the sanitary sewer. A valve will keep the line closed under fueling operations so that major spills can be contained within the pad. When fueling is not occurring the valve will be open to allow storm water to drain from the pad via the oil/water separator to the sanitary line.
- The wash rack area will also drain to this oil/water separator.
- The floor drains from the shop will be plumbed to the oil/water separator as required by a recent order of the city sewer department.
- Oil contaminated materials such as rags, pads, filters and absorbent materials are currently placed in covered dumpsters. Containment drums will be obtained and marked for these materials.
- When using a forklift to transport drums with fluid, the drums will be placed in a secondary containment device.
- The catch basins within the immediate vicinity of the M&R shop will be stenciled "dump no waste" so that we all remember that wastes are not be dumped.
- Whenever vehicles and equipment are in the shop for servicing all hydraulic lines are to be checked for wear. Whenever there are indications of wear of a nature as to possible cause failure, the lines are to be replaced.
- When servicing top picks, drip pans will be used to the maximum extent practical.
- Signs within the shop area will be examined and modified as appropriate.

### 5.4 Container Trailer Storage Yard

Current BMPs: The only relevant BMP is spill cleanup if axle lubricant oil is spilled. A brightly marked barrel of absorbent materials is located in the yard area. Used absorbent material is removed promptly so as to not be washed down to the storm drain.

New BMPs: None are needed.

### 5.5 Container yard

Current BMPs: The yard is swept by a contract sweeper once per month. Hand sweepers are used as needed in areas that cannot be reached by the mechanical sweeper. Spills are immediately cleaned with appropriate absorbent materials. These materials are located in the bright yellow bins placed at four locations around the yard. Major spills are handled by XYZ Environmental, under contract to the Company (as per the Company's Spill Prevention and Control Plan). When fueling top picks and forklifts the fuel truck operator is always present throughout the fueling operation. Spraying of stripes occurs during dry weather only. Spills of hazardous materials on site for transhipment (that is, not the Company's materials or wastes) and major spills during fueling operations are cleaned up by XYZ Environmental, as per the Company's Spill Prevention and Control Plan. The Facility has already implemented all practical measures to reduce hazardous wastes as per our Business Plan.

New BMPs: Currently the catch basins are not cleaned. Hence forth they are to be checked twice per year and cleaned whenever sediment reaches within 2 feet of the outlet pipe. This will not always be easy to do since containers and trailers are typically parked over many of the catch basins. However, to the maximum extent practical these catch basins will be checked and cleaned when accessible. XYZ Environmental's contract will be modified to include this work.

### 5.6 Dock Apron

Current BMPs: Vessel fueling is done as per Coast Guard requirements. This includes personnel at both ends of the operation in radio contact with each other, monitoring of tank levels, and closing of ship scuppers during fueling. As per our Spill Prevention and Cleanup Plan, XYZ Environmental responds to marine spills upon Company request. Agencies to notify in the event of spills is contained in the Company's Spill Prevention and Control Plan.

New BMPs: A container marked for oily rags, filters, etc will be obtained so that this material is no longer placed in the dumpster. It will be disposed in accordance with our hazardous waste plan. When fueling or hydraulic fluid is being added to the crane, the drain holes in the apron will be temporarily plugged with a removal plug to contain any significant spill that might occur.

### 5.7 Maintenance, Repair, Remodeling of Facility Buildings

Current BMPs: None specified

New BMPs: When Company employees are doing minor painting, drop cloths will be used. Contracts with outside contractors who do major work will contain suitable clauses regarding practices to diminish the risk of storm water contamination such as keeping the work area clean, use of drop cloths, and proper disposal of residual materials.

### 5.8 Employee Training

Current BMPs: Employees already receive training on spill cleanup and control, and safety measures which for the M&R staff includes proper handling of hazardous materials. Safety training also supports actions that will minimize the risk of storm water contamination.

New BMPs: Current training procedures will be modified to include awareness about storm water pollution, and the relationship between our activities and potential pollutants. This will occur once per year. All new employees will be provided this information during their normal orientation training.

# CHAPTER 6. MONITORING AND RECORD KEEPING

## 6.1 Checking on New BMP Implementation

An annual inspection is required which must be documented (see below and the Permit). This inspection will be carried out by the Facility Environmental Coordinator with the respective Managers assisting in their areas. Upon completion of the annual inspection the BMP Implementation Committee will meet to consider: how well the BMPs are working, progress with the more substantial BMPs, and changes to both the BMPs and the SWPPP.

The M&R Manager will conduct (as is done now) weekly inspections of the M&R area, and will use a checklist of BMPs to denote if they are in place, if there are problems, and if so, the solution. These checklists will be kept at the M&R office, with a copy forwarded to the Facility Environmental Coordinator.

## 6.2 Monitoring of Storm Water

During the wet season, the Facility Environmental Coordinator will assign and train field personnel to collect runoff samples from two storms; the first storm of the wet season and one additional storm. Grab samples will be collected from the last catch basin in the container yard prior to the bay discharge. AB Analytical Services will provide appropriate sampling equipment to provide for the analyses of pH, total suspended solids, specific conductance, and total organic carbon. Other potential pollutants likely to be present in storm water (as identified in Chapter 4) and associated with activities at our facility will be analyzed during 2 consecutive monitoring events. However, any of these pollutants that are not found in significant quantities will be eliminated from future monitoring until the pollutant is likely to be present again.

Once collected, all samples will be preserved properly and transported immediately to AB Analytical Services. Analytical results will be submitted to the Facility Environmental Coordinator and kept on file.

## 6.3 Record Keeping

Records of all storm water monitoring information, inspections and visual observations, certifications, corrective actions and follow-up activities, and copies of all reports will be keep and retained for a period of at least five years.

## 6.4 Comprehensive Site Compliance Evaluation

An evaluation report will be prepared annually to assist us in evaluating the need to revise this SWPPP. A review of all monitoring data collected (i.e. visual observation records, inspection records, sampling and analysis results), BMPs, significant materials used, activities, and spills that have occurred including their causes and possible solutions will be conducted in the preparation of the evaluation report. The SWPPP will be revised as appropriate based on the evaluation and the revisions will be implemented within 90 days of the evaluation.

**CHAPTER 7 CERTIFICATIONS AND SIGNATURES**

"1 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 ensure 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, the information submitted, is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

**BY:** ______________________________

______________________________
TITLE

______________________________
DATE

## WORKSHEET #1
## ACTIVITIES ASSESSMENT CHECKLIST

| Name of Reviewer: **L. SMOLTZ** | Date: **10/12/02** | | |
|---|---|---|---|
| ACTIVITIES - Check each activity present at site | EFFECTIVENESS | | |
| | HIGH | MOD. | LOW |
| ☐ Non-storm water discharges to drains. Describe BMPs in place: **WASH WATER FROM WASH RACK CONNECTED TO STORM DRAIN** | | | ✓ |
| ☐ Spill Prevention, Control and Cleanup. Describe BMPs in place: | | | |
| ☒ Vehicle and equipment fueling. Describe BMPs in place: **SPILL CLEAN UP MATERIALS AVAILABLE** | | ✓ | |
| ☒ Vehicle and equipment washing and steam cleaning. Describe BMPs in place: **SWEEP AREA EACH DAY** | | | ✓ |
| ☒ Vehicle and equipment maintenance and repair. Describe BMPs in place: **PROPER HAZARDOUS WASTE STORAGE, SOLVENT RECYCLED, PROPER STORAGE OR FRESH FLUIDS** | ✓ | | |
| ☒ Outdoor loading/unloading of materials. Describe BMPs in place: **LIQUIDS ARE STORED IN CONTAINERS** | ✓ | | |
| ☒ Outdoor container storage of liquids. Describe BMPs in place: **LIQUIDS ARE STORED IN CONTAINERS** | ✓ | | |
| ☐ Outdoor process equipment operations and maintenance. Describe BMPs in place: | | | |
| ☐ Outdoor storage of raw materials, products and byproducts. Describe BMPs in place: | | | |
| ☒ Waste handling and disposal. Describe BMPs in place: **M&R SHOP, SEE ABOVE** | | | |
| ☐ Contaminated or erodible surface areas. Describe BMPs in place: | | | |
| ☒ Building and grounds maintenance. Describe BMPs in place: **NONE IN PLACE** | | | |
| ☒ Building repair, remodeling, and construction. Describe BMPs in place: **NONE IN PLACE** | | | |
| ☐ Parking/Storage Area Maintenance. Describe BMPs in place: | | | |

# MATERIAL INVENTORY

(Adopt from EPA, 1992)

Worksheet No. 2
Completed By: ***L. Smoltz***
Title: ***Environmental Coordinator***
Date : ***10/15/02***

Instructions: List all materials used, stored, or produced onsite. Assess and evaluate these materials for their potential to contribute pollutants to storm water runoff. Also complete Worksheet 3 if the material has been exposed during the last three years.

| Material | Purpose/Location | Quantity (units) Used | Quantity (units) Produced | Quantity Exposed in Last 3 Years * | Likelihood of contact with storm water. | Past significant Spill or Leak ** Yes | Past significant Spill or Leak ** No |
|---|---|---|---|---|---|---|---|
| ***DIESEL #2*** | ***Fuel line- Building C, Yard*** | ***30,000 Gal.*** | ***0*** | ***Incidental Drippings*** | ***High*** | | ***X*** |
| ***HYDRAULIC OIL*** | ***Engines/Building C*** | ***1,000 Gal.*** | ***0*** | ***0*** | ***None*** | | ***X*** |
| ***ANTI-FREEZE*** | ***Engines/Building C*** | ***400 Gal.*** | ***0*** | ***0*** | ***None*** | | ***X*** |
| ***SOLVENTS*** | ***Engines/Building C*** | ***Recycled*** | ***0*** | ***0*** | ***None*** | | ***X*** |
| ***BUNKER OIL*** | ***Ships/Dockside*** | ***Unknown*** | ***0*** | ***50,000 Gal.*** | ***Low*** | ***X*** | |
| ***AXLE OIL*** | ***Chasses/Building C*** | ***400 Gal.*** | ***0*** | ***0*** | ***None*** | | ***X*** |
| ***BATTERIES*** | ***Engines/Building C*** | ***12*** | ***0*** | ***0*** | ***None*** | | ***X*** |
| ***USED ENGINE FLUIDS (ABOVE)*** | ***Engines/Building C*** | ***1,500 Gal.*** | | ***0*** | | | ***X*** |
| ***USED ENGINE PARTS/BATTERIES*** | ***Engines/Building C*** | ***Varies*** | | ***0*** | ***None*** | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| ***Note: All cargo is in containers or packaged inside Building B.*** | | | | | | | |

* Explain on separate sheet if quantity was more than the "minimum?"
** Explain items checked yes on a separate sheet.

A002349

## MATERIAL INVENTORY

Worksheet No. 3
Completed By: L. Smoltz
Title: *Environmental Coordinator*
Date : *10/15/02*

Instructions: Based on your material inventory, describe the significant materials that were exposed to storm water during the past three years and/or are currently exposed. For the definition of "significant materials" see Appendix B of the manual.

| Description of Exposed Significant Material | Period of Exposure | Quantity Exposed (Units) | Location (as indicated on the site map) | Method of Storage or Disposal (e.g., pile, drum, tank | Description of Material Management Practices (e.g., pile covered, drum sealed) |
|---|---|---|---|---|---|
| *DIESEL #2* | *WHEN FUELING* | *SMALL* | *BUILDING C, YARD* | *TRUCK* | *SPILL CLEAN MATERIALS* |
| *USED OIL ** | *WHEN TRANSFERRING* | *SMALL* | *BUILDING C* | *DRUM UNDER COVER* | *ENCLOSED STORAGE* |
| *USED ANTIFREEZE ** | *WHEN TRANSFERRING* | *SMALL* | *BUILDING C* | *DRUM UNDER COVER* | *ENCLOSED STORAGE* |
| *USED SOLVENT** | *WHEN TRANSFERRING* | *SMALL* | *BUILDING C* | *DRUM UNDER COVER* | *ENCLOSED STORAGE* |
| *HYDRAULIC OIL** | *WHEN TRANSFERRING* | *SMALL* | *BUILDING C* | *DRUM UNDER COVER* | *ENCLOSED STORAGE* |
| *BUNKER OIL* | *WHEN FUELING* | *SUBSTANTIAL* | *DOCK APRON* | *N/A* | *SPCC* |
| *AXLE OIL* | *SERVICING* | *SMALL* | *TRAILER YARD* | *DRUMS UNDER COVER* | *SPILL CLEAN-UP MATERIALS* |
| *WASH DEBRIS* | *WHEN WASHING* | *SIGNIFICANT* | *WASH RACK* | *DUMPSTER* | *SWEEP AREA* |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

* *Material stored under cover and only exposed to storm water during transferring operations.*

A002350

# SPILLS INVENTORY

(Adopt from EPA, 1992)

Worksheet No. 4
Completed By: *L. Smoltz*
Title: *Environmental Coordinator*
Date: *10/15/02*

Instructions: Record below all significant spills and significant leaks of toxic or hazardous pollutants that have occurred at the facility in the three years prior to the effective date of the permit.

Definitions: Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities.

1st Year Prior ***SPCC Implemented to control spill of bunker oil***

| Date (month/day/year) | Check Box | | Location (as indicated on site map) | Description | | | | Response Procedure | Preventive Measures Taken |
|---|---|---|---|---|---|---|---|---|---|
| | Spill | Leak | | Type of Material | Quantity | Source, If Known | Reason | | |
| | | | | | | | | | |
| | | | | | | | | | |

2nd Year Prior

| Date (month/day/year) | Check Box | | Location (as indicated on site map) | Description | | | | Response Procedure | Preventive Measures Taken |
|---|---|---|---|---|---|---|---|---|---|
| | Spill | Leak | | Type of Material | Quantity | Source, If Known | Reason | | |
| ***10/12/1992*** | ***X*** | | ***Dock Apron*** | ***Bunker Oil*** | ***20 gal.*** | ***Oil Tank*** | ***Ruptered Tank*** | ***Absorbents, Clean-up*** | ***Develop SPCC*** |
| | | | | | | | | | |
| | | | | | | | | | |

3rd Year Prior ***None Recorded***

| Date (month/day/year) | Check Box | | Location (as indicated on site map) | Description | | | | Response Procedure | Preventive Measures Taken |
|---|---|---|---|---|---|---|---|---|---|
| | Spill | Leak | | Type of Material | Quantity | Source, If Known | Reason | | |
| | | | | | | | | | |
| | | | | | | | | | |

A002351

## NON-STORM WATER DISCHARGE ASSESSMENT AND CERTIFICATION

(Source: EPA, 1992)

**Worksheet # 5**
**Completed by:** ______________________
**Title:** ______________________
**Date:** ______________________

| Date of Test or Evaluation | Outfall Directly Observed During the Test (identify as indicated on the site map) | Method Used to Test or Evaluate Discharge | Describe Results from Test for the Presence of Non-Storm Water Discharge | Identify Potential Significant Sources | Name of Person Who Conducted the Test or Evaluation |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

### CERTIFICATION

I, ______________________ (responsible corporate official), certify under penalty of law that this document and all attachments were prepared unde 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, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

| | |
|---|---|
| **A. Name & Official Title (type or print)** | **B. Area Code and Telephone No.** |
| **C. Signature** | **D. Date Signed** |

## NON-STORM WATER DISCHARGE ASSESSMENT AND FAILURE TO CERTIFY NOTIFICATION

(Source: EPA, 1992)

**Worksheet # 6**
**Completed by:** ____________
**Title:** ____________
**Date:** ____________

Directions: If you cannot feasibly test or evaluate an outfall due to one of the following reasons, fill in the table below with the appropriate information and sign this form to certify the accuracy of the included information.

List all outfalls not tested or evaluated, describe any potential sources of non-storm water pollution from listed outfalls, and state the reason(s) why certification is not possible. Use the key from your site map to identify each outfall.

Important Notice: A copy of this notification must be signed and submitted to the RWQCB within 180 days of the effective date of this permit.

| **Identify Outfall Not Tested/Evaluated** | **Description of Why Certification Is Infeasible** | **Description of Potential Sources of Non-Storm Water Pollution** |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

### CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly 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, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations, and that such notification has been made to the RWQCB within 180 days of ____________ (date permit was issued), the effective date of this permit.

| | |
|---|---|
| **A. Name & Official Title (type or print)** | **B. Area Code and Telephone No.** |
| **C. Signature** | **D. Date Signed** |

A002353

## CHECKLIST FOR CONSIDERATION OF MINIMUM BMPs

Check which one of the following describe your facility.

Name of Reviewer: **L. SMOLTZ AND COMMITTEE** Date: **10/15/02**

| Yes | No | N/A | |
|---|---|---|---|
| ☒ | ☐ | ☐ | Are outside areas kept neat and clean? |
| ☒ | ☐ | ☐ | Is the facility orderly and neat? |
| ☒ | ☐ | ☐ | Is the process debris removed regularly? |
| ☒ | ☐ | ☐ | Is the area clear of excessive dust from industrial operations? |
| ☐ | ☒ | ☐ | Is there no evidence of leaks and drips from equipment and machinery? **MINOR SPILLS NOTICED IN YARD, ABSORBENT MATERIAL USED.** |
| ☒ | ☐ | ☐ | Are employees regularly informed of the importance of good housekeeping? |
| ☐ | ☒ | ☐ | Are catch basins, storm conveyance pipes, and storm water treatment facilities cleaned at the appropriate intervals (see Chapter 5)? |
| ☐ | ☒ | ☐ | Are good housekeeping procedures and reminders posted in appropriate locations? |
| ☒ | ☐ | ☐ | Are vehicle maintenance activities kept indoors and do not tend to "creep" out the front door of the maintenance shop? **LARGE EQUIPMENT AND REEFERS SERVED OUTDOORS.** |
| ☒ | ☐ | ☐ | Are containers for chemical substances and for temporary storage of wastes labeled? |
| ☐ | ☒ | ☐ | Is vehicle and equipment washing done in a designated area so that the wash water can be discharged to the sanitary or process wastewater sewer? **YES, BUT NOT CONNECTED.** |
| ☒ | ☐ | ☐ | Are regular housekeeping practices carried out? |
| ☒ | ☐ | ☐ | Is there a spill prevention and response team? |
| ☒ | ☐ | ☐ | Are appropriate spill containment and cleanup materials kept on-site and in convenient locations? |
| ☒ | ☐ | ☐ | Are cleanup procedures for spills followed regularly and correctly? |
| ☒ | ☐ | ☐ | Are used absorbent materials removed and disposed of in a timely manner? |
| ☒ | ☐ | ☐ | Are personnel regularly trained in the use of spill control materials? |
| ☐ | ☐ | ☒ | Is exposed piping and process equipment regularly inspected and/or tested to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters? |
| ☐ | ☐ | ☒ | Are drainage ditches or the areas around the outfall(s) free of erosion? |
| ☐ | ☐ | ☒ | Are unpaved outdoor areas protected from water or wind erosion? |

Any items checked "No" require consideration in the selection of BMPs.

N/A = Not Applicable.

# Appendix D
# Business Category Storm Water Pollution Control Guide Sheets

# Animal Care and Handling Facilities

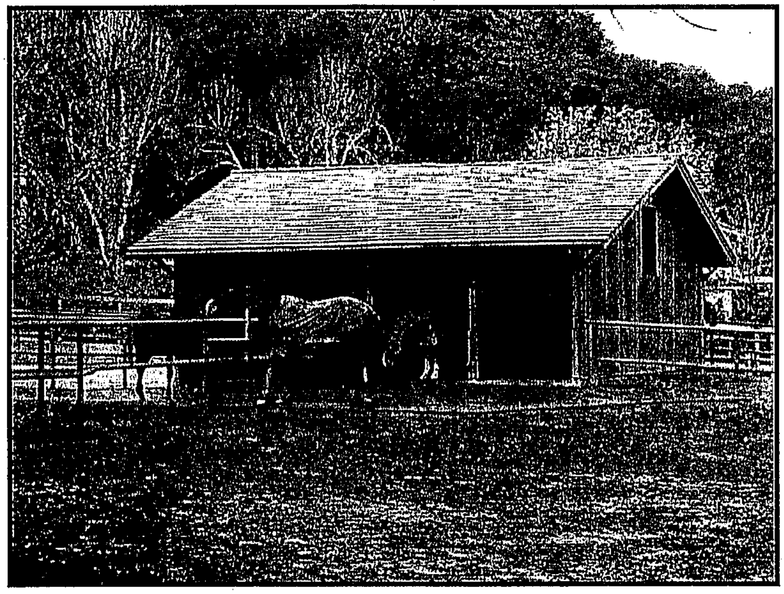

Photo Credit: Geoff Brosseau

## Description

This category covers two types of animal care and handling facilities:

Small animal facilities and facilities in urbanized areas including:

- Kennels
- Veterinarians
- Racetracks

Horse keeping facilities including:

- Boarding stables
- Equestrian centers
- Small farms
- Suburban horse owners

Typically these types of facilities will have access to pasture and be near or include waterways.

This category does not include concentrated animal feeding operations (CAFO) as defined by USEPA regulations.

## Pollutant Sources

The following are sources of pollutants:

- Animal washing
- Feeding / grazing
- Urine / feces and manure deposits
- Unpaved or non-vegetated areas

CASQA California Stormwater Quality Association



A002356

Pollutants can include:

- Coliform bacteria
- Nutrients
- Sediment

## Approach

Minimize exposure of rain and runoff to animal care and handling areas by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program.

## Source Control BMPs

The best management practices are listed by activity or area.

### Small Animal Facilities and Facilities in Urbanized Areas

- Regularly sweep and clean animal keeping areas to collect and properly dispose of droppings, uneaten food, and other potential stormwater pollutants.
- Do not hose down to storm drains or to receiving water those areas that contain potential stormwater pollutants.
- Do not allow any wash waters to be discharged to storm drains or to receiving water without proper treatment.
- If animals are kept in unpaved and uncovered areas, the ground must either have vegetative cover or some other type of ground cover such as mulch.
- If animals are not leashed or in cages, the area where animals are kept must be surrounded by a fence or other means that prevents animals from moving away from the controlled area where BMPs are used.

### Horse Keeping Facilities

Site Design

- Site barns, corrals, manure storage, and other high-use areas on higher ground when possible or on the portion of property that drains away from creeks and channels. Do not site facilities or pasture on land where the slope is 30% or more.
- Locate the following areas at least 50 feet away from creeks, intermittent streams, drains, domestic wells, septic tank or leach field sites:
- Animal washing
- Arenas and riding rings
- Stalls, paddocks, and turnouts
- Pasture and equestrian courses
- Land application of manure and compost
- Locate bins and stockpiles at least 150 feet away from creeks, intermittent streams, drains, domestic wells, and septic tank or leach field sites.
- Separate barnyards, paddocks, and manure storage areas from waterways with vegetated buffers or pasture to act as a natural filter.

- Keep "clean water clean." Use grassed ditches, berms, or subsurface drains and properly sized roof gutters and downspouts to divert clean runoff around barnyard manure and sediment.
- Divert contaminated runoff from manured areas away from waterways and to low-gradient vegetated buffers.
- Construct or repair trails, arenas, roads, parking areas, ditches, and culverts to drain water but not sediment.
- Use fencing to keep horses away from environmentally sensitive areas and protect stream banks. Keep fencing and gates in good repair at all times.

### Horse Access to Waterways

- Provide animals with other sources of water and shade.
- Design stream crossings to minimize erosion.
- Prevent trampling of streamside vegetation.

### Grazing Management

- Focus on protecting the pasture's soil and vegetative cover. Prevent bare areas from forming.
- Establish healthy and vigorous pastures with at least 3 inches of leafy material present.
- Subdivide grazing areas into three or more units of equal size, which can be grazed in rotation.
- Clip tall weeds and old grass to control weeds and stimulate grass growth.
- Rotate animals to clean pasture when grass is grazed down to 3-4 inches.
- Let pasture regrow to 8-10 inches before allowing regrazing.
- Manage grazing so that a cover of dry residual vegetation protects soil from the first rains.
- Keep animals away from wet fields when possible.
- During heavy rainfall, consider indoor feeding.
- Use manure and soiled bedding sparingly to fertilize pastures and croplands.
- Use turnout paddocks as "sacrifice areas" to preserve pastures.

### Horse Waste Management

- Clean up manure and soiled bedding regularly, especially during wet weather.
- After cleanup, during the arid summer, water the areas where horses frequently deposit manure to promote decomposition.
- Store horse waste in sturdy, insect-resistant, and seepage-free units that have an impervious surface bottom and a cover to prevent leaching and runoff, such as:
- Plastic garbage cans with lids
- Fly-tight wooden or concrete storage sheds
- Composters
- Pits or trenches lined with an impermeable layer

- Do not dump horse waste on the edge or directly into stream channels.
- Compost. Keep compost piles moist, and well aerated to promote decomposition.
- Give away composted material to local greenhouses, nurseries and botanical gardens.
- Transport manure to topsoil companies or composting centers.
- Fertilize pastures, cropland, and lawns with manure and soiled bedding. Do not apply fertilizer just before or during rainstorms.

Chemical Management

- Use Integrated Pest Management (IPM) or less-toxic methods for insect and weed control.
- Use chemical insecticides and herbicides as a last resort. Always properly store and dispose of chemical pesticides.
- Do not let horse wash water drain directly into waterways.

## Treatment Control BMPs

For information on inspecting and maintaining treatment controls, see Section 4 of this Handbook.

For information on designing treatment controls, see Section 5 of the New Development and Redevelopment Planning Handbook.

## More Information

Council of Bay Area Resource Conservation Districts, 1998. Horse Owners Guide to Water Quality Protection (http://www.baysavers.org/projects/equinefacilities.html).

National Marine Fisheries Service, Southwest Region, 2001. Guidelines for Salmonid Passage at Stream Crossings (http://swr.nmfs.noaa.gov/habitat.htm).

## References


City of Davis, undated. Best Management Practices: BMP Facts – Pesticide Management, Partners for a Clean Davis.

City of Los Angeles, 1996. Stormwater Best Management Practices (BMPs), Horse Owners & Equine Industry, Safe Environmental Habits and Procedures for: Boarding Stables, Equestrian Centers, Small Farms, Urban Horse Owners.

Council of Bay Area Resource Conservation Districts, 1998. Equine Facilities Assistance Program Fact Sheets. (http://www.baysavers.org/projects/equinefacilities.html)

Council of Bay Area Resource Conservation Districts, 1998. Horse Owners Guide to Water Quality Protection. (http://www.baysavers.org/projects/equinefacilities.html)

King County Surface Water Management Division, 1995. Stormwater Pollution Control Manual. Best Management Practices for Businesses. (http://dnr.metrokc.gov/wlr/dss/spcm.htm)

National Marine Fisheries Service, Southwest Region, 2001. Guidelines for Salmonid Passage at Stream Crossings (http://swr.nmfs.noaa.gov/habitat.htm).

Stanford Management Company, 1999. Recommended Best Management Practices for Management of Animal Waste, Compost and Sediment On Creeks.

USEPA, 1994. Pollution Control for Horse Stables and Backyard Livestock, Rural Nonpoint Source Management.

Washington State Department of Ecology, 2001. Stormwater Management Manual for Western Washington, Volume IV – Source Control BMPs. (http://www.ecy.wa.gov/programs/wq/stormwater/index.html)



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# Automotive Services – Auto Recycling

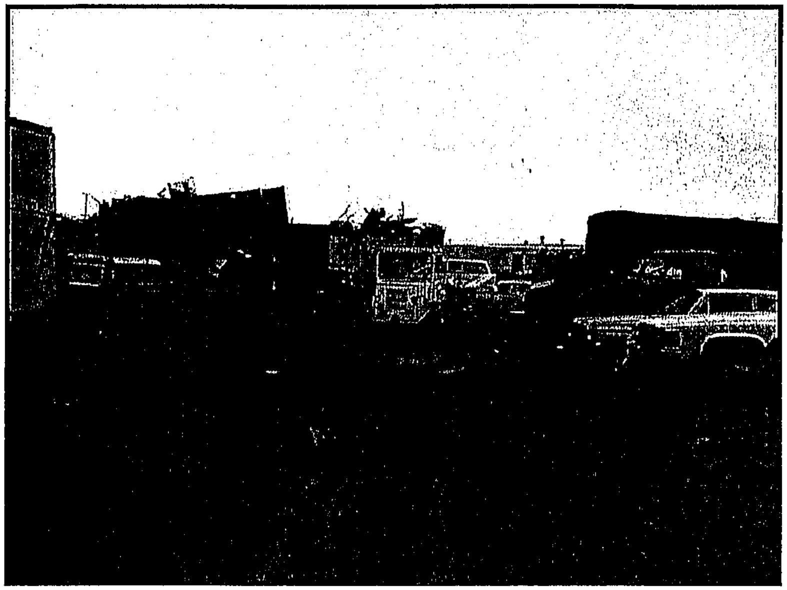

Photo Credit: Geoff Brosseau

## Description

This category includes facilities that impound, dismantle, and store and sell vehicles and vehicle parts. These facilities were required to obtain permit coverage under state and federal Phase I stormwater regulations. This guide sheet is intended to assist these facilities with permit compliance but does not supersede permit requirements. Activities include: draining fluids from vehicles, crushing and scrapping vehicle bodies, and recovering and recycling parts and vehicle fluids. Information specific to: body repair, maintenance, and service stations is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Draining fluids from vehicles
- Crushing and scrapping vehicle bodies
- Recovering and recycling parts and vehicle fluids
- Unpaved or non-vegetated areas

Pollutants can include:

- Mercury - switches for convenience lighting, antilock braking systems (ABS), active ride control systems, high intensity discharge (HID) headlamps, and background lighting in automotive displays
- Other heavy metals (aluminum, cadmium, chromium, copper, iron, lead, and zinc) – waste oil, hydraulic fluid, antifreeze, fuels, tires/wheels, body/paint, radiators, carburetors/engines/transmissions, mufflers, catalytic converters, batteries, air bags, and brake pads

CASQA California Stormwater Quality Association

- Oils and greases - waste oil, hydraulic fluid, fuels, and parts cleaners
- PAHs - waste oil, hydraulic fluid, fuels, parts cleaners, carburetors/engines/transmissions, and catalytic converters
- Toxic chemicals - antifreeze
- Sediment
- Trash

## Approach

Minimize exposure of rain and runoff to impound, dismantling, crushing, and storage areas by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees, as necessary.

## Source Control BMPs

The best management practices are listed by activity or area.

### Good Housekeeping

General Practices

- An in-coming vehicle inspection inventory program should include a check for fluid leaks and for unwanted material that could have been placed in the vehicles. Re-inspect work and storage areas for signs of leaking vehicles, parts, or equipment.
- Construct fences or other physical barriers to act as visual and noise barriers, help to control dust, help prevent theft, and control the direction of runoff.
- Maintain an organized inventory of materials used at the facility.
- Consider indoor storage of vehicles, parts, and equipment, and the use of berms and/or dikes to control stormwater runoff.

Employee and Customer Education

- Develop a stormwater management policy statement for your employees. Management can provide direction and support for pollution prevention by reviewing this policy with employees and keeping it posted.
- Ensure that employees are trained to follow these pollution prevention practices and to monitor customers to help ensure they prevent pollution as well. Train employees when they are hired, and annually after that. Emphasize that by following these practices they are helping to protect the local waterways.
- Ensure that non-English-speaking employees are also trained in these practices (for example, use a bilingual instructor, post signs, and provide written information in their own language).
- Have customers sign a form that makes them responsible for preventing spills. Provide them with drip pans when needed.
- Label storm drain inlets with a stormwater pollution prevention message.

Vehicle Dismantling Fluid Management

***Site Design***

- Confine the dismantling and storage of vehicles, parts, and equipment to designated areas that are paved, covered and bermed. Paving should be concrete or other less porous surface. Consider using an epoxy type of sealant. Berms can rounded like speed bumps, so that vehicles and forklifts can move over them.
- Consider constructing an impound/inventory area with non-porous surface for leaking vehicles prior to dismantling.
- Fluid Removal
- Remove fluids as soon as possible from vehicles brought into the facility for processing or dismantling. Use a funnel adapter to a "quarter barrel" whenever possible. Transfer the contents of drain pans or quarter barrels to the designated waste storage area as soon as possible.
- If fluids must be drained or oily parts removed in an unpaved area, use extra large drip pans.
- To prevent accidental spills do not leave drip pans outside, exposed to rainfall, or left unattended.
- Drain all parts of fluids prior to disposal.
- Drain fluids and remove parts as follows before customers can spill or disperse them:
- Engine oil - Should be drained and stored in labeled, doubled-walled, above ground tanks. Used oil can either be recycled for onsite use in a waste oil heater, or sent offsite for re-refining or fuel blending.
- Oil filters - Drain fluids and crush prior to disposal. A bearing press can be used for this purpose by placing a container under the press to collect the oil.
- Antifreeze - Should be reclaimed and reused or properly disposed of.
- Window washer fluid - Drain for reuse.
- Freon – Recover first.
- Fuel – Recover first.
- Batteries - Remove as soon as possible after vehicle enters the yard. Store good batteries inside for resale. Store dead batteries inside on pallets (if your floor is gravel or dirt, put a layer of absorbent material below the pallet) or in storage containers, or store dead batteries outside in a leak proof, covered container.
- Mercury-containing switches – Protect from shredding or crushing by removing from hood and trunk light assemblies and anti-lock brakes. Store in a covered container kept in a secure, dry area. Dispose of legally by having switches processed at a recycling facility that recovers mercury.
- Mufflers, tailpipes, and catalytic converters – Recover and protect from shredding.
- Gas tanks – Remove and drain.
- Jacks – Remove and prevent customers from using.
- Tires – Remove, store, recycle, and prevent water accumulation. Do not bury or landfill.



A002364

- Air bags – Deploy or recover per manufacturer guidelines.
- Burnt autos – Cover and remove as soon as possible.

***Storage***

- Store wastes in covered, bermed (contained) areas that have no drains. Waste containers should be constructed of materials that are impermeable to the liquids in the first container.
- Double-contain fluids to prevent accidental spills to the sewer system. Keep double containment clean and dry.
- Parts that might leak fluids, such as engines, transmissions, radiators, and batteries should be stored under cover, and on an impermeable surface.
- Keep vehicle hoods down when not in use. For vehicles without hoods, use covers such as tarps or sheet metal to keep rainfall out.
- Place absorbent in bottom of core bins to absorb fluids leaking from core parts.
- Keep used oil separate from part cleaning solvents, antifreeze, and fuel. Engine oil, transmission fluid, brake fluid, and power steering fluid can be combined and stored together.
- Label storage containers of all fluids and waste materials.
- Use canvas or sheets of plastic to temporarily cover storage areas
- Transmission and engine cores may be stored in plastic storage boxes with leak proof tops; lugger boxes without a solid bottoms and covered by a permanent roof; lugger boxes without a solid bottom stored under a permanent roof on a concrete pad with curbing; or an enclosed trailer with a steel floor to contain fluid runoff and a drain in the floor to properly remove waste fluids.

Parts Cleaning

- Perform all part cleaning operations indoors or cover and berm outside cleaning areas.
- Clean parts by using minimal amounts of solvents or detergents.
- Recycle and reuse cleaning fluids where practical.
- Spent cleaning solutions should be removed by a waste hauler or recycler.
- Use phosphate-free biodegradable detergents. Consider using detergent-based or water-based cleaning systems in place of organic solvent degreasers.

Vehicle Crushing Activities

- Provide a containment system – such as a concrete pad with berms – for vehicle crushers. Fluids and stormwater runoff from such bermed areas could be discharged into a sump, oil/water separator, sanitary sewer, or other appropriate drainage system that prevents stormwater pollution.
- Consider placing crushing and scrapping areas under cover.
- If a gravel/geotextile fabric foundation is provided under a crusher, install a fluid collection system to capture fluids that are released during the crushing operation.
- Capture crusher fluids to prevent spillage. Collect this mixture of fluids in a spill proof covered container, test the fluid, and dispose of it properly. It should not be allowed to



A002365

drain onto the ground. Keep the drain within the crusher clear so that the fluids do not collect and overflow from the crusher onto the ground.

### Preventive Maintenance

- Develop a preventive maintenance program that involves timely inspections and/or maintenance of the crusher and facility equipment and vehicles. The program may include:
- Service checklists and maintenance logs for each piece of equipment;
- Employee education and instruction material; and
- Review of manufacturer-recommended parts replacement and maintenance activities and frequencies.
- Keep the crusher and other equipment clean by frequently wiping off accumulated oil and grease that may be exposed to stormwater (except where needed for proper operation of the equipment) or that may hide equipment trouble spots.
- Conduct scheduled maintenance of facility equipment and vehicles in a covered or bermed area, where practicable.
- Schedule periodic inspections of equipment for leaks, spills and malfunctioning, worn, or corroded parts. Regularly inspect tanks, valves, hoses, and containers. Look for signs of wear or weakness.
- On secondary containment structures, regularly inspect the valve, seals around the outlet pipe, the outlet pipe itself, and the dike for cracks, damage, or leaks.
- When secondary containment reservoirs require pumping or release, a sample of collected water should be visually inspected or tested for pollutants. If pollutant levels are significant or there is contamination, pump the accumulated water into barrels or into a tanker truck and haul to a wastewater treatment facility.
- Repair or replace parts before they wear out.
- Repair malfunctioning equipment that is responsible for any leak or spill as soon as possible.
- Secure and lock above ground tank storage areas. Tanks, pumps, fittings, pipes, and containers should be inspected routinely for integrity and leaks.
- Perform maintenance activities indoors.
- Valves on secondary containment structures should be kept in the "off" position at all times, except when collected water is being removed.

### Spill Prevention and Response

#### Prevention

- Install safeguards (such as diking or berming) against accidental releases at dismantling and storage areas.
- Place waste fluid storage containers in a convenient and safe place to avoid having to move waste fluids long distances.
- Containers and tanks should be stored on a concrete or impermeable surface, and if feasible, under cover. All containers should be labeled according to content and hazard

characteristics. Keep drums containing chemicals away from sumps and drains. Maintain good integrity of all storage containers.

- Provide spill cleanup equipment at locations where spills are most likely to occur.
- Make available MSDS sheets and other safety materials that identify types of fluids that have the potential to spill, indicate whether these fluids are hazardous or toxic, list appropriate safety equipment to be worn, and specify correct materials and procedures to use to clean up the spill.
- Identify cleanup procedures, including the use of dry absorbent materials or other cleanup methods to collect, dispose of, or recycle spilled or leaked fluids. Maintain an adequate supply of dry absorbent material onsite. Properly dispose of used absorbent materials.
- Never pour liquids or dry materials down a storm drain.
- Place drip pans, plastic sheets, or canvas tarps beneath vehicles, parts, and equipment during maintenance and dismantling activities. If any parts are removed, they should be placed in a drip pan. Drip pans should not be left unattended.
- When refueling vehicles and equipment, park as close to the pump as possible. Keep fuel nozzle upright when not in use, and replace nozzle securely in the pump.
- Pave refueling area to prevent contamination of the soil if a spill occurs.
- Equip fuel pumps and tanks with overflow prevention and automatic shut-off devices.

Response

- Contain oil or other fluids spilled during parts removal.
- Control any spills that may occur around fueling areas.
- Observed spills and leaks should be captured and cleaned up as soon as possible using dry absorbents, drip pan, towel, mops, pads, and booms.
- Keep spilled fluids from entering drains by using drain mats or plugs. Seal or remove unused floor drains.
- Remove soils with spilled fluids to prevent rainwater from carrying pollutants to local waterways.

### Erosion and Sediment Control

- Implement appropriate vegetative, structural, or stabilization measures to limit soil erosion.
- Regularly sweep and clean paved surfaces to reduce sediment buildup. Sediment should be swept up and placed into a covered, watertight dumpster for proper disposal.
- Install filtering or diversion practices, such as filter fabric fences, sediment filter booms, earthen or gravel berms, curbing or equivalent measures.
- Install sediment traps, vegetative buffer strips, silt fencing or equivalent measures to remove sediment prior to discharge through an inlet or catch basin.
- Do not use vehicle fluids, oils, or fuels for dust control or weed control.
- Establish and maintain a vegetative cover in areas not used for vehicle salvage activities.

### Non-Stormwater Discharges

- Disconnect or seal off all existing floor drains and sinks that are connected to the storm drainage system.
- Wash vehicles and equipment in a contained area.
- Do not steam clean parts outside without proper wastewater containment.
- Do not discharge steam cleaned wastewater to a septic tank system because the oils may not be treated or removed in the system.
- Do not pour liquid waste or parts wash water down storm drain inlets.
- Do not hose down the shop floor if water would be conveyed to a storm drain.
- Clean up debris and trash on a regular basis.
- Keep storm drains in good working condition by clearing debris and sediment buildup at least once a year – best to do just before the start of the rainy season (August – September).

## Treatment Control BMPs

- Use vegetated swales and buffer strips, catch basin filters, and/or other similar measures to facilitate settling or filtering of pollutants in runoff.
- Construct grassed swales, berms, and diversions to direct water flow to a central point for better control and management.
- Properly maintain grassed swales by keeping swales free of debris and litter, maintaining vegetation and periodically removing accumulated sediment. Do not place material or waste in swales or in the runoff paths.
- Divert runoff away from material storage areas through such practices as dikes, berms, containment trenches, culverts, elevated concrete pads, and/or surface grading.
- Consider installing a detention pond. Monitor accumulation of sediments in the bottom of detention ponds. Remove accumulated metals and other materials from the bottom of detention ponds as needed.
- Considering installing oil-water separators to reduce the levels of petroleum-based oils in stormwater runoff. Test and clean out sediments and oily deposits that have accumulated in the oil-water separator. Sediments should be tested for metals and other pollutants that may be expected to be present.

For information on inspecting and maintaining treatment controls, see Section 4 of this handbook.

For information on designing treatment controls, see Section 5 of the New Development and Redevelopment Planning Handbook.

## More Information

Alliance of Auto Manufacturers, 2000. Getting Mercury Out of Cars (http://www.cleancarcampaign.org/switchremoval.shtml)

Automotive Recyclers Association, 1996. Storm Water Guidance Manual: Automotive Recycling Facilities (http://www.autorecyc.org/docs/bookstore/manuals.htm).

## References


Alliance of Auto Manufacturers, 2000. Getting Mercury Out of Cars (http://www.cleancarcampaign.org/switchremoval.shtml).

Automotive Recyclers Association, 1996. Storm Water Guidance Manual: Automotive Recycling Facilities (http://www.autorecyc.org/docs/bookstore/manuals.htm).

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# Automotive Service – Body Repair

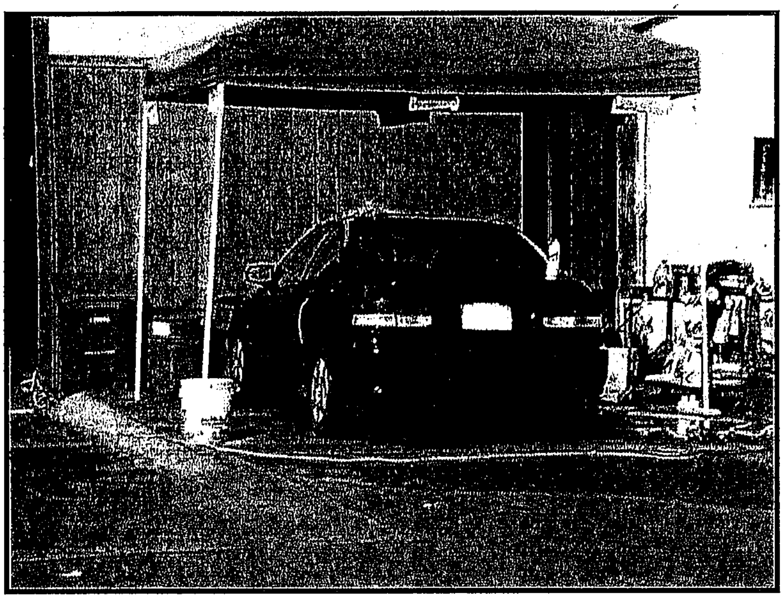

Photo Credit: Geoff Brosseau

## Description

This category includes facilities that conduct auto body repair and painting. Information specific to: auto dismantling, maintenance, and service stations is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Wet and dry sanding
- Painting
- Washing cars and other vehicles
- Cleaning floors
- Auto body repair products

Pollutants can include:

- Heavy metals (copper, lead, nickel, and especially zinc)
- Hydrocarbons (oil and grease, PAHs)
- Toxic chemicals (solvents, chlorinated compounds)
- Paints

## Approach

Minimize exposure of rain and runoff to auto body repair and painting areas by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training

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program. Provide employee education materials in the first language of employees, as necessary.

Auto body repair products, such as body filler, primers, paints, and sandpaper often contain significant amounts of zinc. The original paint on a customer's car may also contain high concentrations of zinc. The following practices should help reduce or eliminate the amount of zinc and other pollutants in wastewater discharges.

## Source Control BMPs

The best management practices are listed by activity or area.

### Sanding

Dry Sanding

- Conduct all sanding indoors.
- Sweep, vacuum, or use other dry cleanup methods routinely to pick up dust from dry sanding of primer, metal, or body filler. Make extra efforts to thoroughly sweep or vacuum dust prior to mopping.
- Use vacuum sanding equipment whenever possible in order to reduce the amount of airborne dust.

Wet Sanding

- Conduct all sanding indoors.
- Do not wet sand in a wash rack or in an area with a floor drain.
- If possible, reduce or eliminate need for a sanding bucket:
  - Use dent repair tools whenever practical for small dents.
  - Use vacuum sanding equipment whenever practical (for larger panels) in order to minimize the amount of wastewater.
  - Use spray bottle to squirt water onto the panel being sanded. This eliminates sanding bucket wastewater and also minimizes drips and spills.
- Place a pan under the car panel being sanded to catch drips. Pour the collected water back into the wet sanding bucket.
- Clean up drips with a rag, or let the drips dry and then sweep or vacuum up the dust.

Options for Handling a Wet Sanding Bucket

In addition to the potential for wet sanding to cause stormwater pollution, emptying the wet sanding bucket directly into a sink or other sanitary sewer drain is one of the primary causes of body shop wastewater discharge permit violations. Therefore, shops should seriously consider reducing or eliminating the need for a wet sanding bucket. However, if a sanding bucket must be used, there are three options for disposal of the contents:

***Option # 1: Settling***

Up to 80 percent of the zinc in the sanding bucket would settle out if the bucket is simply left to stand undisturbed for 24 - 48 hours. This is the simplest and least costly method of achieving significant zinc reductions – assuming the shop has space for the buckets to be put aside during the workday. Sanding bucket wastewater may also be poured into a settling unit (see next section) prior to discharge to a sump or to the sanitary sewer.

Step 1: Remove sponge and sandpaper from water. Wring out the sponge over the bucket.

Step 2: Settle out zinc particles in one of two ways:

a) Allow the wet sanding bucket to stand at least overnight – preferably longer – in a place where it will not be disturbed.

**or**

b) Pour contents of the wet sanding bucket into a settling unit.

Devise a system to let shop employees know how long the bucket has been settling, and that it is not to be disturbed.

Step 3: Separate water from sludge:

Carefully bail the clear water from the top of the bucket, or remove the clear water from the settling unit after it has been allowed to sit at least overnight. Avoid any agitation of sludge on the bottom. The clear water on top may be discharged to the sanitary sewer through a drain or permitted treatment system (such a sump or oil/water separator).

Step 4: Dispose of sludge:

Dispose of non-hazardous dried sludge in trash. Please note that the California Department of Toxic Substances Control places responsibility on each shop owner for providing that such waste is non-hazardous. If the sludge is hazardous, it must be disposed of appropriately. (Contact the DTSC for more information)

If the settling bucket is uncovered, make sure it's in secondary containment.

***Option #2: Discharge to a Permitted Treatment System***

A shop may elect to route contents of the wet sanding bucket through a treatment system or recycling unit prior to discharging to the sanitary sewer. An industrial waste discharge permit must be obtained in many jurisdictions for such a sewer discharge. In addition, the wastewater should first be allowed to settle overnight in the bucket or in a settling unit (see Option #1).

***Option #3: Offsite Disposal***

A shop may choose to collect and dispose of wet sanding wastewater offsite. This alternative may be attractive to those shops interested in reducing their waste streams or eliminating all wastewater discharges and becoming a "zero-discharger." There are two possible methods for offsite disposal of wet-sanding bucket waster water:

a) Disposal with other collected wastes

Depending upon the hauler, it may be possible to dispose of the wet-sanding wastewater with waste paint rinse water or waste antifreeze. Check with the local hauler to see if this is acceptable.

**or**

b) Disposal as a hazardous waste

Wet-sanding wastewater may be collected separately and hauled offsite for disposal as a hazardous waste, either by a licensed waste hauler or through a Very Small Quantity Generator (VSQG) hazardous waste collection program for small businesses.



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### Simple Settling Units for Wet Sanding and Mop Wastewater

Settling units may be used to remove zinc and other metals from wastewater, generated by activities such as wet sanding and mopping. Even shops with a sump or oil-water separator may find it beneficial to settle out wet sanding and mop wastewater prior to discharge to the separator and /or sanitary sewer. Settling units can range from simple, compact containers to complex treatment systems. Unless the shop has a high volume of wastewater from sanding or mopping, it may want to consider one of the simpler units – since complex treatment systems can be very expensive to purchase, install, and maintain. In fact, the shop may be able to make its own simple settling unit using an empty plastic 30-gallon drum, for example, and a little creativity.

### Selecting the Right Unit for the Shop

In choosing or designing a settling unit, several factors should be considered including:

- Potential volume of wastewater and the size of a container that will ensure adequate settling time. In order to determine the appropriate size, the volume of wastewater should be calculated – wet sanding and/or mop water – that is generated each day. The settling unit should be able to contain at least double or triple this daily volume.
- A method for removing the clear wastewater from the unit without disturbing the sludge on the bottom. A valve or spigot should be located no lower than half-way down the side of the unit.
- Strategy (method and frequency) for removing sludge from the bottom of the unit. Sludge should be removed on a regular basis, and never allowed to build up higher than ¼ of the container's height. Remove sludge only after draining off the clear wastewater on top. Sludge can either be removed from the bottom of the settling unit or scooped out by hand from the top. Removal may require a large opening with a secure cap (as sludge may clog a valve or spigot). Some shops use a container with a conical bottom to facilitate both settling and sludge removal.

In addition,

- Identify a location in the shop that is convenient but enough out of the way so that the settling unit will not be disturbed accidentally. The unit may be placed on the ground, or elevated.
- To settle wastewater for longer than overnight, consider a system comprised of several containers used in sequence.

***Multiple Settling Units, In Series***

A sequence of two or more settling containers is one way to increase settling time for the wastewater. For example, some shops construct their own tow-drum units. Wastewater is held in the first drum for 24 hours and allowed to settle; then the clear water on top is drained into the second drum for an additional 24 hours or more of settling prior to discharge to the sanitary sewer. (Be sure to follow sludge-removal precautions detailed in the previous section).

The decision to use a settling unit with a single container versus one with multiple containers may depend partly on the metals concentrations in the wastewater and the time required to allow the metals to settle out to acceptable levels. Also, there must be adequate space in the shop, in a convenient location, where the unit(s) will not be disturbed.

*Testing Settled Wastewater*

After installing a settling unit, be sure to have the settled wastewater tested at least twice to make sure the system allows for enough settling time. Overnight settling may be sufficient for some shops' wastewater, but others may require 48 or 72 hours of settling in order to comply with local discharge limits. An analytical lab should test the settled wastewater for zinc, nickel, and lead. The results should confirm whether or not enough there's settling time to ensure that the wastewater is acceptable for discharge.

### Washing Cars

After bodywork is completed, some sanding dust often remains on the vehicle. When the car is washed, the dust is rinsed off and discharged with the wash water. Therefore, vehicle wash water from an auto body shop is typically contaminated with zinc and/or other metals, and it should not be discharged to the storm drain under any circumstances, or to the sanitary sewer without treatment. There are two options for discharge of vehicle wash water:

Option #1:

Wash vehicles and discharge the wastewater to the sanitary sewer through a permitted treatment system or recycling unit. An industrial waste discharge permit must be obtained in many jurisdictions for such a sewer discharge.

Option #2:

Collect the wash water and dispose of it offsite.

- For either option, also:
- Remove dust from the vehicle prior to washing. Be sure to check areas where dust might collect, such as the doorjambs, hood, and trunk. Try to keep the amount of airborne dust to a minimum.
- Make sure wash water does not run into a street, gutter, or storm drain.

## Cleaning Floors

Sanding dust and wet-sanding drips often end up on the shop floor. If the shop floor is mopped and the mop water is discharged to the sanitary sewer, the mop water alone can cause a violation of local sanitary sewer discharge limits for zinc.

Instead of mopping, sweep the floors.

- If mopping must be done, follow this three-step procedure:
  1. Clean up all drips and spills with rags or other absorbent materials.
  2. Sweep or vacuum to pick up dust. (This should be a frequent routine.)
  3. Finally mop with a minimal amount of water. Do not let water run outside.
- Dispose of the mop water to the sanitary sewer through a drain or permitted treatment system. As an additional precaution, let the mop water settle overnight or longer (in a bucket or settling unit) prior to discharge.

### Primers, Paints, and Painting

Primers in particular may contain significant amounts of zinc. A review of the Material Safety Data Sheets (MSDS) of primers shows that certain primers contain as much as 40 percent zinc phosphate by volume. It doesn't take much of these primers reaching the sanitary sewer for a shop to exceed local sanitary sewer discharge limits for zinc.

- Conduct all painting indoors, preferably in a pant booth.
- Review the MSDS of the products used and look for the zinc concentrations listed. Use primers and paints with lower zinc content if they work equally well.
- Befriend your vendor. They can be an invaluable source of information about new and versatile (low metal) paints, technologies, and industry trends.
- When cleaning auto body parts before painting, minimize use of hose-off degreasers. Brush off dirt and use rags to wipe down parts. If an acid-based metal cleaner or cleaner/conditioner is used to treat bare metal and rinse water is recommended to stop the chemical reaction, use as little water as possible and wipe down the area with a rag or towel.
- Reduce waste by using low-volume paint mixing equipment and high-efficiency painting tools.
- Minimize waste paint and thinner by carefully calculating paint needs based on surface area and using the proper sprayer cup size.
- Clean spray guns in a self-contained cleaner. The gun-cleaning solution, whether solvent or aqueous-based, should be recycled or disposed of properly when it becomes too dirty to use. Never discharge gun-cleaning solution to the sewer or storm drain.
- Do not use water to control overspray or dust in the paint booth unless it is sure to evaporate in the booth (so the dust can be swept up), or this wastewater is collected. The water should be treated prior to discharge into the sewer system.

### Miscellaneous Tips

- When receiving damaged vehicles, inspect for leaks. Use drip pans if necessary.
- Conduct all body repair and painting work indoors.
- When cleaning wheels, avoid the use of acid-based wheel cleaners if soap and elbow grease will do.
- Never use spray-on, acid-based wheel cleaners in areas where rinse water may flow to a street, gutter, or storm drain. If acid-based products are used on a wash pad, the wash water may need additional treatment beyond oil/water separation to meet wastewater discharge limits.

## Treatment Control BMPs

For information on inspecting and maintaining treatment controls, see Section 4 of this handbook.

For information on designing treatment controls, see Section 5 of the New Development and Redevelopment Planning Handbook.

## More Information

Booklets, checklists, fact sheets, and pamphlets

Regional Water Quality Control Plant—Palo Alto, 1997. Water Pollution Prevention Practices for Auto Body Shops.

### Videos

Sacramento County Environmental Management Department / California Department of Toxic Substances Control, 1994. Pollution Prevention for Auto Body Shops.

## References

Bay Area Dischargers Association and Bay Area Storm Water Management Agencies Association, 1995. Your Shop Can Make A Difference!, What vehicle service shops can do to protect water quality in the Bay and Delta.

King County Surface Water Management Division, 1995. Storm Water Pollution Control Manual. Best Management Practices for Businesses. (http://dnr.metrokc.gov/wlr/dss/spcm.htm)

Regional Water Quality Control Plant—Palo Alto, 1997. Water Pollution Prevention Practices for Auto Body Shops.

# Automotive Service – Maintenance

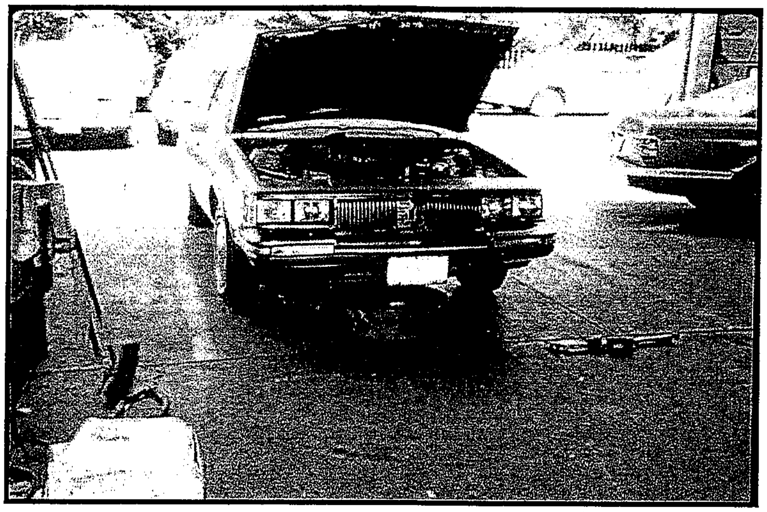

Photo Credit: Geoff Brosseau

## Description

This category includes facilities that conduct general maintenance and repair on vehicles including:

- General repair shops
- Radiator repair shops
- Car dealerships
- Car washes
- Fleet maintenance operations

Information specific to: auto dismantling, body repair, and service stations is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Changing oil and other fluids
- Cleaning engines and parts
- Flushing radiators
- Washing cars and other vehicles

Pollutants can include:

- Heavy metals (copper, lead, nickel, and zinc)
- Hydrocarbons (oil and grease, PAHs)
- Toxic chemicals (solvents, chlorinated compounds, glycols)
- Acids and alkalis

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## Approach

- Minimize exposure of maintenance areas to rain and runoff by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees, as necessary.

## Source Control BMPs

The best management practices are listed by activity or area.

### Changing Oil and Other Fluids

Waste oil, antifreeze, and other vehicle fluids contain toxic chemicals and heavy metals from wear and tear of engine parts.

- Whenever possible, change vehicle fluids indoors and only on floors constructed of non-porous materials. Avoid working over asphalt and dirt floors – surfaces that absorb vehicle fluids.
- If vehicle fluids must be removed outdoors, always use a drip pan. Prevent spills from reaching the street or storm drain by working over an absorbent mat and covering nearby storm drains, or working in a bermed area. If necessary, you can use absorbent socks to create a bermed area.
- When draining fluids into a drain pan, place a larger drip pan (e.g., 3' x 4') under the primary drain pan to catch any spilled fluids.
- Transfer fluids drained from vehicles to a designated waste storage area as soon as possible. Drain pans and other open containers of fluids should not be left unattended unless they are covered and within secondary containment.
- Store waste containers of antifreeze and oil within secondary containment. Antifreeze and waste oil should be stored separately and recycled, or disposed of as hazardous waste.
- Never pour vehicle fluids or other hazardous wastes into sinks, toilets, floor drains, outside storm drains, or in the garbage. These substances should be kept in designated storage areas until recycled or safe disposal.
- Drain fluids from leaking or wrecked vehicles as soon a possible, to avoid leaks and spills.
- Consider using a quarter barrel, vacuum pump, or drain pan with built-in pump to transfer fluids.

(See fact sheet SC-22 - Vehicle and Equipment Maintenance and Repair for other information)

### Cleaning Engines and Parts, and Flushing Radiators

Solvents are hazardous to employees and can ignite in sewers.

- Eliminate discharges from these operations to the sanitary sewer and storm drains. Use a licensed service to haul and recycle or dispose of wastes.
- Designate specific areas or service bays for engine, parts, or radiator cleaning. Do not wash or rinse parts outdoors.
- Use self-contained sinks and tanks when working with solvents. Keep sinks and tanks covered when not in use.

- Inspect degreasing solvent sinks regularly for leaks, and make necessary repairs immediately.
- Avoid soldering over drip tanks. Sweep up drippings and recycle or dispose as hazardous waste.
- Rinse and drain parts over the solvent sink or tank, so that solvents will not drip or spill onto the floor. Use drip boards or pans to catch excess solutions and divert them back to a sink or tank.
- Allow parts to dry over the hot tank. If rinsing is required, rinse over the tank as well.
- Collect and reuse parts cleaning solvents and water used in flushing and testing radiators. When reuse is no longer possible, these solutions may be hazardous wastes, and must be disposed of properly.
- Never discharge cleaning solutions used for engines or parts into the sewer system without adequate treatment. Most facilities have these solutions hauled offsite as hazardous waste because of the permits necessary for onsite treatment.
- Rinsewater may only be discharged to the sanitary sewer with adequate treatment and approval of the sewage treatment plant.
- Never discharge wastewater from steam cleaning, or engine/parts cleaning to a street, gutter, or storm drain.
- Sweep or use a vacuum to clean up dust and debris from scraping or bead blasting radiators.
- Consider using static tanks for rinsing to reduce the volume of discharged rinsewater.
- Consider using counter-current rinsing to reduce water usage and rinsewater discharges.

(See fact sheet SC-21 – Vehicle and Equipment Washing and Stream Cleaning and fact sheet SC-22 - Vehicle and Equipment Maintenance and Repair for other information)

### Washing Cars and Other Vehicles

Even biodegradable soaps can be toxic when they reach a creek or waterbody.

#### Regular Activity

- If car washing is a central activity of your business, the most desirable option is to treat and recycle the wash water.
- Designate a vehicle washing area and wash cars and trucks only in that area. This "wash pad" should be bermed or protected from storm drains and should drain to an oil/water separator before discharging to the sewer.
- Cover an outside wash pad or minimize the area of an uncovered pad to reduce the amount of rainwater reaching the sewer. Consult your local sewage treatment plant for guidance.
- Minimize the use of acid-based wheel cleaners. These products may require additional treatment (beyond oil/water separation) before discharge to the sewer.

#### Occasional Activity

- Even biodegradable soap is toxic to fish and wildlife. Whenever possible, take vehicles to a commercial car wash.

- If soap is used in washing, the wash water must be collected and discharged, preferably with treatment, to the sanitary sewer. This water cannot be discharged to a storm drain.
- Never rinse off spray-on acid-based wheel cleaners where rinsewater may flow to a street, gutter, or storm drain.

Washing New Vehicles

- If cleaning the exterior of new vehicles with water only, the discharged water may go to the storm drain directly.
- Always protect the storm drains from solvents, used to remove protective coatings from new cars. Discharges of these solvents to the sanitary sewer must receive adequate treatment and approval of the sewage treatment plant.

(See fact sheet SC-21 – Vehicle and Equipment Washing and Stream Cleaning for other information)

### Keeping a Clean Shop

Good housekeeping practices minimize liability, reduce costs, and make it easier to detect spills and potential problems.

- Use drip pans under leaking vehicles to capture fluids.
- Sweep or vacuum the shop floor frequently. Use mopping as an alternative to hosing down work areas.
- If mopping is used to clean shop floors:
  1. Spot clean any spilled oil or fluids using absorbents or rags.
  2. Use dry cleanup methods: Sweep the floor using absorbents.
  3. After steps 1 and 2 above (if mopping is still needed), mop and discharge mop water to the sanitary sewer.
- Do not pour mop water into the parking lot, street, gutter, or storm drain.
- Remove unnecessary hoses to discourage washing down floors and outside paved areas.
- Regularly sweep parking lots and areas around your facility instead of washing them down with water.
- Collect all metal filings, dust, and paint chips from grinding, shaving, and sanding, and dispose of the waste properly. Never discharge these wastes to the storm drain or sanitary sewer.
- Collect all dust from brake pads separately and dispose of the waste properly. Never discharge these wastes to the storm drain or sanitary sewer.
- Send rags to an industrial laundry.
- Inspect and clean if necessary, storm drain inlets and catch basins within the facility boundary before October 1 each year.
- Consider using an oleophilic mop (picks up oil and not water) to reduce the volume of waste liquids you collect and reduce your cost for disposal.

(See fact sheet SC-22 - Vehicle and Equipment Maintenance and Repair for other information)

### Storage

Appropriate storage protects your shop from hazardous spills. Consult your local hazardous waste agency for details.

- Store hazardous materials and wastes where they are protected from rain and in a way that prevents spills from reaching the sanitary sewer or storm drain.
- Keep lids on waste barrels and containers, and store them indoors or under cover to reduce exposure to rain.
- All hazardous wastes must be labeled according to hazardous waste regulations. Consult the Fire Department or your local hazardous waste agency for details.
- Keep wastes separate to increase your waste recycling/disposal options and to reduce your costs.
- Never mix waste oil with fuel, antifreeze, or chlorinated solvents. Consult your hazardous waste hauler for details.
- Double-contain all bulk fluids to prevent accidental discharges to the sewer and storm drain. Consult the Fire Department for details.
- Carefully transfer fluids from drip pans or collection devices to designated waste storage areas, as soon as possible.
- When receiving vehicles to be parted or scavenged, park them on a paved surface and immediately drain and collect gasoline and other fluids properly.
- Drain all fluids from components, such as engine blocks, which you may store for reuse or reclamation. Keep these components under cover and on a drip pan or sealed floor.
- Store new batteries securely to avoid breakage and acid spills during earthquakes. Shelving should be secured to the wall. Store used batteries indoors and in plastic trays to contain potential leaks. Recycle old batteries.

(See Material and Waste Management fact sheets – SC-30 series for other information)

### Spill Control

Spills cause safety hazards for employees and can spread if not cleaned up immediately.

- The best spill control is prevention.
- Maintain and keep current, as required by other regulations, a spill response plan and ensure that employees are trained on the elements of the plan.
- Minimize the distance between waste collection points and storage areas.
- Contain and cover all solid and liquid wastes – especially during transfer.
- Purchase and maintain the proper absorbent materials for containment and cleanup of different spills, and make sure they are easily accessible anywhere in the shop. Saturated absorbents generally must be disposed of as hazardous waste.
- "Spot clean" leaks and drips routinely. Leaks are not cleaned up until the absorbent is picked up and disposed of properly.
- Seal or remove floor drains to prevent accidental discharge to the sewer system.

(See fact sheet SC-11 - Spill Prevention, Control and Cleanup for other information)

### Outdoor Waste Receptacle Area

Existing Facilities

Spot clean leaks and drips routinely to prevent runoff of spillage.

Minimize the possibility of stormwater pollution from outside waste receptacles by doing at least one of the following:

- Use only watertight waste receptacle(s) and keep the lid(s) closed, or
- Grade and pave the waste receptacle area to prevent run-on of stormwater, or
- Install a roof over the waste receptacle area, or
- Install a low containment berm around the waste receptacle area, or
- Use and maintain drip pans under waste receptacles.

New or Substantially Remodeled Facilities

- The element listed below should be included in the design and construction of new or substantially remodeled facilities.
- Grade and pave the outdoor waste receptacle area to prevent run-on of stormwater to the extent practicable.
- Note: Substantially Remodeled Facilities - The facility is considered substantially remodeled if the area around the waste receptacle area is being regraded or repaved.

(See fact sheet SC-20 - Vehicle and Equipment Fueling for other information)

### Air/Water Supply Area

Existing Facilities

- Minimize the possibility of stormwater pollution from air/water supply areas by doing at least one of the following:
- Spot clean leaks and drips routinely to prevent runoff of spillage, or
- Grade and pave the air/water supply area to prevent run-on of stormwater, or
- Install a roof over the air/water supply area, or
- Install a low containment berm around the air/water supply area.

New or Substantially Remodeled Facilities

- The element listed below should be included in the design and construction of new or substantially remodeled facilities.
- Grade and pave the air/water supply area to prevent run-on of stormwater to the extent practicable.

Note: Substantially Remodeled Facilities - The facility is considered substantially remodeled if the area around the air/water supply area is being regraded or repaved.

(See fact sheet SC-20 - Vehicle and Equipment Fueling for other information)

### Recycling / Wastewater Treatment

Recycling and properly treating wastes protects the environment and saves you money.

- Recycle solvents, paints, oil filters, antifreeze, motor oil, batteries, and lubricants.

- Set up a system (separate, well-labeled containers in a convenient location) to make it easy for employees to separate wastes and to recycle.
- Choose wastewater treatment systems that are easy to maintain and repair.
- Properly maintain and service all pretreatment equipment, including sumps, separators, and grease traps to ensure proper functioning. Follow manufacturer's maintenance instructions and consider using a licensed service to conduct maintenance on a regular basis.
- Frequently inspect equipment for malfunctioning parts, leaks, and the accumulation of pollutants such as oil and grease. Since pretreatment equipment is supposed to remove pollutants, a lack of accumulation may be a sign of a malfunction.
- Retain only a licensed service to haul away and dispose of wastes.
- Consider installing self-contained, zero-discharge treatment systems that recycle wastewater.

(See fact sheet SC-22 Vehicle and Equipment Maintenance and Repair and fact sheet SC-34 – Waste Handling and Disposal for other information)

### Purchasing

Purchasing decisions have a direct and long-term impact on the products used and disposed of by your shop. Make pollution prevention easier and reduce costs and liability by controlling the types and amounts of products purchased.

- Ask your supplier for information on less toxic chemical cleaners and other products. There are alternatives to chlorinated solvents; chlorofluorocarbons; and 1,1,1, trichloroethane (TCA).
- Ask your supplier for information on the composition of brake pads. Recent studies have shown that brake dust washed off streets by rain may be the single biggest contributor of copper, a major pollutant, to waterways. Your awareness and understanding of this problem and the available alternatives will help us come up with solutions in the future.
- Minimize inventory by purchasing only as much product as you will need in the foreseeable future. This will reduce your storage space needs, inventory tracking costs, and liability for storing hazardous materials and waste.

### Education and Training

Your success in following these guidelines depends on an effective training program.

- Train all employees upon hiring – and annually thereafter – on personal safety, chemical management, and proper methods for handling and disposing of waste. Make sure that all employees understand stormwater discharge prohibitions, wastewater discharge requirements, and these best management practices. Use a training log or similar method to document training.
- Post instructional/informational signs around your shop for customers and employees. Put signs above all sinks prohibiting discharges of vehicle fluids and wastes. Put signs on faucets (hose bibbs) reminding employees and customers to conserve water and not to use water to clean up spills.
- Label drains within the facility boundary, by paint/stencil (or equivalent), to indicate whether they flow to an oil/water separator, directly to the sewer, or to a storm drain. Labels are not necessary for plumbing fixtures directly connected to the sanitary sewer.

## Treatment Control BMPs

For information on inspecting and maintaining treatment controls, see Section 4 of this handbook.

For information on designing treatment controls, see Section 5 of the New Development and Redevelopment Planning Handbook.

## More Information

### Booklets, Checklists, Fact Sheets, and Pamphlets

Bay Area Pollution Prevention Group, 1999. Switching to Water-based Solutions for Parts Cleaning.

USEPA, 1999. The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair (http://www.epa.gov/region09/p2/autofleet/).

USEPA, 1999. The Pollution Prevention Toolkit, Best Environmental Practices for Fleet Maintenance (http://www.epa.gov/region09/p2/autofleet/).

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Fresno Metropolitan Flood Control District, no date. Partners for Clean Stormwater.

Los Angeles County, 1995. Good Operating Practices – Auto Repair Industry.

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Department of Toxic Substances Control, no date. Best Environmental Practices for Auto Repair.

Mission College Television, no date. Hazardous Waste Management.

USEPA, 1999. Profit Through Prevention, Best Environmental Practices for Fleet Maintenance (http://www.epa.gov/region09/p2/autofleet/).

## References


Bay Area Dischargers Association and Bay Area Storm Water Management Agencies Association, 1995. Your Shop Can Make A Difference!, What vehicle service shops can do to protect water quality in the Bay and Delta.

Bay Area Pollution Prevention Group, 1999. Switching to Water-based Solutions for Parts Cleaning.

City of Santa Cruz, 1999. Vehicle Service Facilities: Best Management Practices – Section 1 of Best Management Practices Manual for the Storm Water Program.

Regional Water Quality Control Plant—Palo Alto, 1995. A Brief Look at Wastewater Treatment Equipment: Vehicle Service Facilities, Machine Shops, Other Small Shops.

USEPA, 1999. The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair (http://www.epa.gov/region09/p2/autofleet/).

USEPA, 1999. The Pollution Prevention Toolkit, Best Environmental Practices for Fleet Maintenance (http://www.epa.gov/region09/p2/autofleet/).

# Automotive Service – Service Stations

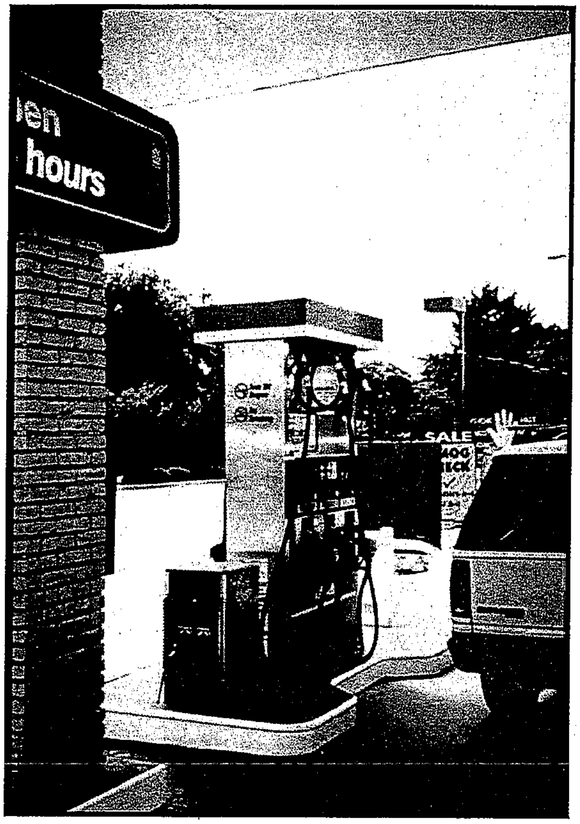


Photo Credit: Geoff Brosseau

## Description

This category includes facilities that provide vehicle fueling services, including self-serve facilities as well as those that provide a convenience store. Information specific to auto dismantling, body repair, and maintenance is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Fueling
- Spills
- Surface cleaning
- Air / water supply areas
- Dumpster and trash can areas

Pollutants can include:

- Heavy metals (copper, lead, nickel, and zinc)
- Hydrocarbons (oil and grease, PAHs)
- Toxic chemicals (benzene, toluene, xylene, MTBE)
- Detergents
- Food waste and trash

## Approach

Minimize exposure of rain and runoff to fueling areas by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees, as necessary.

Reprinted below are the best management practices and related information from the 1997 Best Management Practice Guide – Retail Gasoline Outlets. This guide represents the work of the California Stormwater Quality Task Force's (SWQTF) Retail Gasoline Outlet Work Group. The Work Group formed in May 1996 and met on a regular basis to review and discuss appropriate best management practices for fueling and other closely related activities likely to be found at retail fueling operations. Representatives from industry, municipalities, and regulatory agencies participated.

### Coverage

These best management practices cover three activities or areas:

- Fuel dispensing

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- Air/water supply
- Outdoor waste receptacles

Retail gasoline outlets will have every combination of these activities/areas onsite, including other activities not covered by this guide. For example, a facility may have a fuel dispensing area, air/water supply area, indoor service bay, but no outdoor waste receptacles. These BMPs cover the first two areas but not the indoor service bay. Best management practices for the indoor service bay may be found elsewhere. The inclusion of best management practices for air/water supply areas is not intended to suggest that air and/or water must be supplied by retail gasoline outlets in geographic areas not otherwise required to do so.

### Design

The design of this guide is purposely different from many BMP lists that are designed as a menu of BMPs from which the facility owner/operator, and the inspector, may choose some but not necessarily all BMPs. These BMP lists are designed so that if the activity/area is onsite, each numbered BMP listed below the activity should be implemented. For some BMPs, as described below, several implementation options are provided. The best management practices are meant to be implemented, monitored, and maintained on a year round basis. The guide also makes an important distinction between existing facilities and new or substantially remodeled facilities. A definition of new or substantially remodeled is also provided. The Work Group used these design elements to help clarify and unify expectations.

### Options

Several of the best management practices provide facility owners and operators options for compliance. For example, one best management practice is:

Minimize the possibility of stormwater pollution from outside waste receptacles by doing at least one of the following:

- Use only watertight waste receptacle(s) and keep the lid(s) closed
- Grade and pave the waste receptacle area to prevent run-on of stormwater
- Install a roof over the waste receptacle area
- Install a low containment berm around the waste receptacle area
- Use and maintain drip pans under waste receptacles

It is the intent of these BMPs that a) through e) are options. Effective implementation of at least one of these options, chosen by the facility owner/operator, should be deemed implementation of this best management practice.

## Source Control BMPs

The best management practices are listed by activity or area.

### Existing Facilities

#### Fuel Dispensing Areas

- Maintain fuel dispensing areas using dry cleanup methods such as sweeping for removal of litter and debris, or use of rags and absorbents for leaks and spills. Fueling areas should never be washed down unless the wash water is collected and disposed of properly.



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- Fit underground storage tanks with spill containment and overfill prevention systems meeting the requirements of Section 2635(b) of Title 23 of the California Code of Regulations.
- Fit fuel dispensing nozzles with "hold-open latches" (automatic shutoffs) except where prohibited by local fire departments.
- Post signs at the fuel dispenser or fuel island warning vehicle owners/operators against "topping off" of vehicle fuel tanks.

### Facility - General

- "Spot clean" leaks and drips routinely. Leaks are not cleaned up until the absorbent is picked up and disposed of properly.
- Maintain and keep current, as required by other regulations, a spill response plan and ensure that employees are trained on the elements of the plan.
- Manage materials and waste to reduce adverse impacts on stormwater quality.
- Train all employees upon hiring and annually thereafter on proper methods for handling and disposing of waste. Make sure that all employees understand stormwater discharge prohibitions, wastewater discharge requirements, and these best management practices. Use a training log or similar method to document training.
- Label drains within the facility boundary, by paint/stencil (or equivalent), to indicate whether they flow to an oil/water separator, directly to the sewer, or to a storm drain. Labels are not necessary for plumbing fixtures directly connected to the sanitary sewer.
- Inspect and clean if necessary, storm drain inlets and catch basins within the facility boundary before October 1 each year.

### Outdoor Waste Receptacle Area

- Spot clean leaks and drips routinely to prevent runoff of spillage.
- Minimize the possibility of stormwater pollution from outside waste receptacles by doing at least one of the following:
  - Use only watertight waste receptacle(s) and keep the lid(s) closed, or
  - Grade and pave the waste receptacle area to prevent run-on of stormwater, or
  - Install a roof over the waste receptacle area, or
  - Install a low containment berm around the waste receptacle area, or
  - Use and maintain drip pans under waste receptacles.

### Air/Water Supply Area

- Minimize the possibility of stormwater pollution from air/water supply areas by doing at least one of the following:
  - Spot clean leaks and drips routinely to prevent runoff of spillage, or
  - Grade and pave the air/water supply area to prevent run-on of stormwater, or
  - Install a roof over the air/water supply area, or
  - Install a low containment berm around the air/water supply area.



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### New or Substantially Remodeled Facilities

The elements listed below should be included in the design and construction of new or substantially remodeled facilities.

#### Fuel Dispensing Areas

- Fuel dispensing areas must be paved with portland cement concrete (or, equivalent smooth impervious surface), with a 2% to 4% slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of stormwater to the extent practicable. The fuel dispensing area is defined as extending 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less. The paving around the fuel dispensing area may exceed the minimum dimensions of the "fuel dispensing area" stated above. (Note: This best management practice is not specifically intended to apply to facilities that install a new canopy where no canopy existed.)
- The fuel dispensing areas must be covered, and the cover's minimum dimensions must be equal to or greater than the area within the grade break or the fuel dispensing area, as defined above. The cover must not drain onto the fuel dispensing area. (Note: This best management practice is not specifically intended to apply to facilities that:
  - Are located in geographic areas not subject to federal or state stormwater regulations
  - Do not discharge stormwater either directly to surface waters or indirectly, through municipal separate storm drain systems
  - Do not add fuel dispensers
  - Replace, relocate, or add fuel dispensers within the parameters described in the BMP
  - Increase their throughput of fuel dispensed without modifying their equipment
  - Make only cosmetic or facial appearance changes to their existing canopy)

#### Outdoor Waste Receptacle Area

- Grade and pave the outdoor waste receptacle area to prevent run-on of stormwater to the extent practicable.

#### Air/Water Supply Area

- Grade and pave the air/water supply area to prevent run-on of stormwater to the extent practicable.

### Substantially Remodeled Facilities

One of the following criteria must be met before a facility is deemed to be substantially remodeled and the design elements described above are required to be included in the new design and construction:

- The canopy cover over the fuel dispensing area is new or is being substantially replaced (not including cosmetic/facial appearance changes only) and the footing is structurally sufficient to support a cover of the minimum dimensions described above, or
- One or more fuel dispensers are relocated or added in such a way that the portland cement concrete (or, equivalent) paving and grade break or the canopy cover over the fuel dispensing area do not meet the minimum dimensions as defined above. Replacement of existing dispensers or underground storage tanks do not by itself, constitute a substantial remodel.

For the purposes of the waste receptacle area and air/water supply area BMPs only, the facility is considered substantially remodeled if the area around the waste receptacle area or air/water supply area is being regraded or repaved.

### Treatment Control BMPs

In 1996-97, the SWQTF Work Group considered other BMPs not listed here including:

- Oil/water separators
- Catch basin inserts

The evidence reviewed by the Work Group at that time indicated that the effectiveness and efficiency of these and other BMPs not listed was insufficient for them to pass peer review and therefore these BMPs could not be generally recommended for use statewide. Since 1997, a significant amount of research has been conducted across the country on treatment controls so the status of treatment control BMPs may have changed since that time. There may be situations in which these BMPs would be effective and efficient (as evidenced by research), and therefore appropriate.

For information on inspecting and maintaining treatment controls, see Section 4 of this handbook.

For information on designing treatment controls, see Section 5 of the New Development and Redevelopment Planning Handbook.

## More Information

### Booklets, Checklists, Fact Sheets, and Pamphlets

California Storm Water Quality Task Force, 1997. Best Management Practice Guide – Retail Gasoline Outlets.

### Posters

Los Angeles County, 1995. Good Gas Station Operating Practices.

## References

California Storm Water Quality Task Force (SWQTF), 1997. Best Management Practice Guide – Retail Gasoline Outlets.



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# Food Service Facilities

Photo Credit: Geoff Brosseau

## Description

This category includes:

- Restaurants
- Institutional cafeterias
- Grocery stores, bakeries, and delicatessens
- Any facility requiring a Health Department permit for food preparation

## Pollutant Sources

The following are sources of pollutants:

- Cleaning of equipment
- Grease handling and disposal
- Spills
- Surface cleaning
- Cooling and refrigeration equipment maintenance
- Landscaping and grounds maintenance
- Dumpster and loading dock area
- Parking lots
- Illicit connections to storm drain system

Pollutants can include:

- Organic materials (food wastes)
- Oil and grease

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- Toxic chemicals in cleaning products, disinfectants, and pesticides

## Approach

Minimize exposure of rain and runoff to outdoor cleaning and storage areas by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees.

## Source Control BMPs

The best management practices are listed by activity or area.

### Dumpster and Loading Dock Areas

- All solid and liquid wastes, such as tallow, must be stored and transferred in watertight covered containers.
- Keep litter from accumulating around loading docks by providing trash receptacles and encouraging employees to use them.
- Bag and seal food waste before putting it in the dumpster. Do not place uncontained liquids, or leaking containers or garbage bags into a dumpster.
- Keep dumpster lids closed to keep out rainwater and to prevent trash from spilling out.
- If the dumpster regularly overflows, get a bigger one or arrange for more frequent collection.
- Don't hose out dumpsters. Apply absorbent over any fluids spilled in dumpster. Absorbent will usually be knocked out when the dumpster is emptied.
- Have the dumpster leasing company repair or replace leaky dumpsters and compactors, and have them clean out dirty dumpsters.
- Have spill cleanup materials handy near the dumpster and loading dock areas.
- Post employee reminder signs such as "Keep lid closed" near tallow bins and dumpsters.
- Consider enclosing the dumpster in a roofed and bermed area to prevent exposure to rainwater, and draining the area to the sanitary sewer. Contact the local wastewater treatment plant or the county environmental health department for guidance.
- Keep dumpsters or the dumpster enclosure locked to prevent illegal dumping.
- For more information on cleaning dumpster areas see the Mobile Cleaning - Food Service Business-related business guide sheet in this series.

### Equipment and Outdoor Cleaning

- Make sure all discharges from cooling equipment go to the sanitary sewer and not the street, gutter, or storm drain.
- Clean floor mats, filters, and garbage cans in a mop sink, floor drain, or proper outside area connected to the sanitary sewer with an oil and water separator. Don't wash them in a parking lot, alley, sidewalk, or street.
- Consider installing anti-slip floors when you remodel.



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- Consider cleaning filters in the dishwasher. Contact the local wastewater treatment plant or the county environmental health department for guidance.
- Pour wash water into a janitorial or mop sink. Don't pour it out onto a parking lot, alley, sidewalk, or street.
- For outdoor cleaning, have employees or contractors follow the instructions in the following business guide sheet in this series:
  - Mobile Cleaning - Food Service Business-related
  - Mobile Cleaning – Surface cleaning

For more information in general on cleaning floor mats, equipment, exhaust filters, and outdoor surfaces see the Mobile Cleaning - Food Service Business-related business guide sheet in this series.

### Spill Cleanup

- Prepare a spill cleanup plan that includes:
  - Procedures for different types of spills
  - Schedule for initial and annual training of employees
  - Cleanup kits in well-marked, accessible areas
  - Designation of key employee who monitors cleanup
  - Posting the plan in the work area
- First, stop the spill at its source.
- Keep the spill from entering the street, gutter, or storm drain.
- Use dry methods for spill cleanup (sweeping, cat litter, etc.). Don't hose down spills.
- If wet cleaning (including high-temperature or high pressure washing) is required, dry clean first and then mop (or if it is absolutely necessary, wash) and collect the water. Dispose of water in sink or other indoor drain, not in the street, gutter, or storm drain.
- If a final rinse is necessary for health reasons, collect the rinsewater and dispose it to the sink or indoor floor drain. If outdoors, block the storm drain before applying water. Mop up or wet-vacuum water, and dispose it to a sink or indoor drain.
- Do not use bleach or disinfectants if there is a possibility that rinsewater could flow to a street, gutter, or storm drain.

For more information on cleaning outdoor surfaces see the Mobile Cleaning - Surface Cleaning business guide sheet in this series.

### Recycling and Disposal

- Separate wastes. Keep your recyclable wastes in separate containers according to the type of material. They are easier to recycle if separated.
- Recycle the following materials:
  - Food waste (non-greasy, non-animal food waste can be composted). Donate leftover, edible food whenever possible to local food banks.
  - Paper and cardboard

- Container glass, aluminum, and tin
- Pallets and drums

- Dispose of toxic waste properly. Toxic waste includes used cleaners, and rags (soaked with solvents, floor cleaners, and detergents).

### Grease Handling and Disposal

- Never pour oil, grease, or large quantities of oily liquids such as sauces or salad dressings or waste grease down a sink, floor drain, storm drain, or into a dumpster.
- Install screens and solid traps in sink and floor drains to catch larger solids. Clean these screens and traps frequently.
- Don't try to "dissolve" grease by adding hot water or emulsifying chemicals – it will only move the grease further down the building's sewer line and make it harder to remove later.
- Recycle grease and oil. Don't pour it into sinks, floor drains, or onto a parking lot or street. Look in the phone book for "Renderers" or call the local recycling or household hazardous waste information line.
- Use tallow bins or sealed containers with tamper-proof lids. Keep the exterior of the container clean. Check for leaks. Ask the recycler for a leak-free tallow bin and replace any leaky grease containers. If grease is stored outside, keep it under a roof, if possible.
- Do not contaminate the recyclable oils and grease in the tallow bin with the waste grease from the grease trap or grease interceptor.
- Inspect and clean all waste grease removal devices (grease trap or grease interceptor) often enough to keep them functioning properly and efficiently.
- For disposal of waste grease from the grease trap or grease interceptor, see "Grease Traps" or "Septic Tanks" in the phone book.

### Landscaping and Grounds Maintenance

- Never dispose of leftover pesticides in the gutter, street, or storm drain. Leftover pesticides must be either used up or disposed of as hazardous waste.
- Do not blow or rake leaves, grass, or garden clippings into the street, gutter, or storm drain.
- If pesticides are used, do not over apply or apply when rain is forecast.
- Do not use copper-based algicides in pools or fountains. Control algae with chlorine or other alternatives to copper-based products.

### Pest Control

Assign the task below to a "pest control captain." Check weekly to be sure they are done.

#### Food Sources

- Keep the kitchen free of food scraps.
- Take out garbage each night in a closed container.
- Refrigerate all food or store in pest-proof containers each night.
- Keep ventilation system working properly to keep greasy residue off walls.



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### Appliances

- Keep dishwasher area clean. Check the trap nightly.
- Where possible, elevate appliances at least 6 inches off the floor.
- Clean under appliances nightly.
- Steam clean or wash appliances weekly.
- Remember to clean under the counter, under the sink, and the refrigerator vent.

### Drains and Trash Cans

- Steam clean or scrub floor drains with a brush to help eliminate fruit flies.
- Keep dumpster area clean – inside and out.
- Wash garbage cans periodically.

### Supplies and Entry Points

- Check for pests before bringing supplies in to the kitchen. Roaches like corrugated boxes.
- Don't store boxes in the kitchen – take boxes away or store in a refrigerated area.
- Seal any gaps below doors.

When hiring a pest control service, look for a company that provides Integrated Pest Management (IPM) services. Work with them to:

### Reduce Habitat

- Inspect the entire establishment – inside and out.
- Suggest physical modifications that may help to eliminate pest behavior.
- Suggest changes in food storage or cleanup practices to eliminate food sources for pests.
- Place boric acid powder in wall voids.
- Seal cracks and crevices.
- Fill holes in the building's exterior.

### Monitor for Pests

- Use sticky traps to monitor how well the pest control program is working. Pests caught in the traps warn of a possible problem.

### Use Baits First

- Use baits for controlling pests. Remove bait when pests are gone, or else the bait may attract more pests.
- Use chemicals only as a last resort. If absolutely necessary, choose less-toxic chemicals, and ask the pest service to provide label information.
- Apply pesticides only if necessary, not on a regular schedule. Follow label directions. Do not apply pesticides around floor drains, sinks, or food.

### Purchasing

- Use non-disposable products. Serve food on ceramic dishware rather than paper, plastic or Styrofoam, and use cloth napkins rather than paper ones. If you must use disposable products, use paper instead of Styrofoam.

- Buy the least toxic products available.
  - Look for "non-toxic," "non-petroleum based," "free of ammonia, phosphates, dye, or perfume," or "readily biodegradable" on the label. Don't assume biodegradable products are safe. Biodegradable means the product will eventually break down, but it may harm the environment in the meantime.
  - Avoid chlorinated compounds, petroleum distillates, phenols, formaldehyde, and caustic or acidic products.
  - Use water-based products.
  - Look for and purchase "recycled" and "recyclable" containers. By doing so, you help ensure a use for the recyclable materials that people collect and recycle.

### Education and Training

Employees can help prevent pollution when urban runoff training is included in employee orientations and reviews. Train all employees upon hiring and annually thereafter. Use a training log to document employee training. Promote these BMPs:

- Storage containers should be regularly inspected and kept in good condition.
  - Place materials inside rigid, durable, water-tight and rodent-proof containers with tight fitting covers.
  - Store materials inside a building or build a covered area that is paved and designed to prevent runoff from entering storm drains.
  - Place temporary plastic sheeting over materials or containers and secure the cover with ties and weighted objects. (Not appropriate for storing liquids.)
- Post BMPs where employees and customers can see them.
- Remember the facility is liable for the behavior of contractors. Be sure all contractors hired to clean inside or outside are aware of and implement these BMPs.
- Explain BMPs to other food businesses through your business associations or chambers of commerce.
- Label storm drain inlets with a stormwater pollution prevention message.

## Treatment Control BMPs

For information on inspecting and maintaining treatment controls, see Section 4 of this handbook.

For information on designing treatment controls, see Section 5 of the Development and Redevelopment Handbook.

## More Information

### Booklets, Checklists, Fact Sheets, and Pamphlets

#### General Water Pollution Prevention

Bay Area Storm Water Management Agencies Association (BASMAA), 1996. Pollution from Surface Cleaning – Flat Work, Sidewalks, Plazas, Building exteriors, Parking areas, Drive-Thru.

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Contra Costa Clean Water Program, City of Concord, and Central Contra Costa Sanitary District, no date. Water Pollution Prevention Tips: Tips to protect water quality and keep your food service facility clean.

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County of Los Angeles, no date. Food and Related Facilities – Best Management Practices, Project Pollution Prevention.

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Los Angeles County, 1995. Good Cleaning Practices – Food & Restaurant Industry.

Santa Clara Valley Nonpoint Source Pollution Control Program, 1994. Good Cleaning Practices to Protect Our Creeks and Bay.

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City of Monterey and Monterey Bay National Marine Sanctuary, 2000. Make the Connection: BMPs for Restaurant Kitchen Staff on how to prevent storm drain pollution.

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Los Angeles County, 1995. Good Cleaning Practices – Food & Restaurant Industry.

Regional Water Quality Control Plant—Palo Alto, 1996. Be a part of the Team! Keep the Bay CLEAN! Water Quality Protection Guidelines for Food Handling Facilities.

Regional Water Quality Control Plant—Palo Alto, 1996. Food Service Facilities – Selecting and installing a grease removal device.

Santa Clara Valley Nonpoint Source Pollution Control Program, 1994. Good Cleaning Practices to Protect Our Creeks and Bay poster.

# Marinas, Boatyards, and Ports

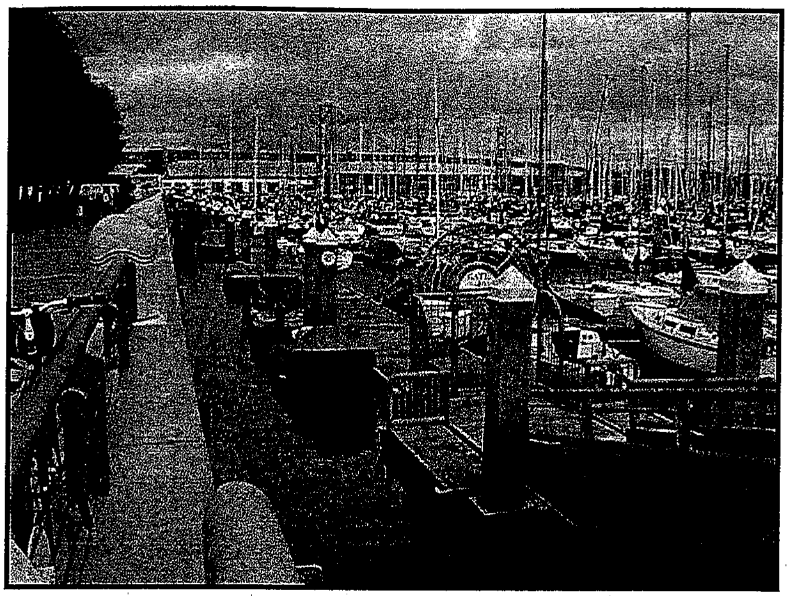

Photo Credit: Geoff Brosseau

## Description

This category includes marinas, boatyards, shipyards, and ports that provide services for boats and ships – both public and private – including fishing fleets, excursion boats, and private fishing boats. Most of these facilities were required to obtain permit coverage under state and federal Phase I stormwater regulations. This guide sheet is intended to assist these facilities with permit compliance but does not supersede permit requirements. Ports often have the added responsibility of helping regulators ensure that Port tenants adhere to the stormwater regulations. Although tenants of Port facilities are often involved in water-related activities, virtually any kind of business can be operating at a Port so the full gamut of pollutant-generating activities may be of concern. Activities of concern that are unique to this category are:

- Boat and ship painting, cleaning, fueling, maintenance, and breaking
- Vessel operations
- Waterfront or over-water areas management
- Fish handling

Other activities of concern include:

- Vehicle and equipment maintenance, fueling, and washing
- Material and waste handling, storage, and disposal
- Leaks and spills
- Outdoor process equipment operation
- Building and grounds maintenance
- Building construction, repair, and remodeling
- Parking and storage area maintenance

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## Pollutant Sources

The following sources of pollutants are unique to this category or present unique challenges in this situation:

- Boat and Ship Building, Maintenance, Fueling, Repair, and Breaking
  - Wet and dry sanding
  - Sand blasting
  - Painting
  - Boat cleaning
  - Fueling
  - Changing oil and other fluids
  - Cleaning engines and parts
  - Flushing radiators
  - Hull repair products
  - Spills
  - Scrapping operations
  - Dumpster and trash can areas
- Vessel Operations
  - Vessel sewage
  - Bilge water
  - Loading / unloading
  - Waterfront or over-water areas management
  - Dry-docks maintenance
  - Non-Dry-docks containment
  - Collection facilities and recycling
  - Pier deck and floor cleaning
  - Inspections
- Fish Handling

Potential pollutants from these unique activities include:

- Heavy metals (copper, lead, tin, and zinc) - spent abrasive grits, anti-corrosive compounds, paint chips, scrap metal, welding rods
- Hydrocarbons (fuels, oils and grease, PAHs)
- Toxic chemicals (solvents, ethylene glycol, cleaners / detergents, resins, glass fibers)
- PCBs (electrical equipment (e.g., transformers and capacitors), hydraulic fluids, flame retardants, lubricants, paints, dyes, sealants, and plasticizers)

- Asbestos (insulation)
- Trash
- Fish wastes

## Approach

Minimize exposure of rain and runoff to boat and ship building, maintenance, fueling, and repair areas as well as fish handling areas by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees, as necessary.

Pollutant-generating activities at these facilities require extra attention because many of the activities are conducted on boats and ships or on piers, docks, or wharfs directly over waterbodies. Apply good housekeeping, preventive maintenance, and cover and containment in and around work areas.

## Source Control BMPs

The best management practices are listed by activity or area. The focus of this guide sheet is BMPs for the unique areas and activities at marinas, boatyards, shipyards, and ports. Additional source controls for areas and activities that are not unique to these facilities can be found in the facts sheets in Section 3.

### Painting, Blasting, Sanding, and Stripping

Site Design and Management

- Conduct ship painting, blasting, sanding, or stripping in specifically designated areas designed to minimize releases.
- Pave work areas, preferably with concrete to allow easier removal of spills or wastes. Slope surface to allow capture of spills. Use catch basins with a valve that allow spills and releases to enter a dead-end sump. Use berms to minimize runon of stormwater.
- Create a paint / spray booth to prevent residue from being carried into surface waters and into the air. New portable ship paint booths are being tested and may be commercially available soon.

or

- Use temporary controls such as:
- Use wind-blocking tarps to prevent dust and overspray from escaping.
- Use shrouds between the vessel and pier/shore to prevent spillage into the water. Shrouds should be cleaned frequently to prevent material from being blown into the water.
- Use plywood and/or plastic sheeting to cover open areas between decks when sandblasting (scuppers, railings, freeing ports, ladders, and doorways).
- Use drip pans, drop cloths, tarpaulins, or other protective devices in all paint mixing and solvent operations unless carried out in impervious contained and covered areas.
- Prohibit uncontained spray painting, blasting or sanding activities over open water.



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- Prohibit outside spray painting, blasting, or sanding activities during windy conditions that render containment ineffective.

Collection, Cleanup, Storage, Recycling, and Disposal

- Use vacuum sanders that have dust-containment bags to remove paint from hulls and collect paint dust.
- Plug scuppers to contain dust and debris.
- Don't sand underwater or in a strong breeze.
- Wipe down small amounts of sanding dust with a damp rag.
- Clean up stripping wastes immediately to reduce potential releases from wind or stormwater.
- Collect spent abrasives regularly and store under cover to await proper disposal.
- Collect and properly dispose of wash water from washing painted boat hulls. Consider taking the boat to a local boat yard that is equipped to collect and treat wash water.
- Vacuum or sweep paved surfaces regularly.
- Do not hose down area.
- Dispose of empty solvent and paint containers properly.
- Dispose of lead-based paint residues in accordance with local, state, and federal guidelines.
- Do not pour out unused portions on the ground or down the storm drains. Use proper receptacles or disposal facilities for unused portions.
- Reuse blast material where possible.
- For boaters and tenants, provide:
  - Used paint disposal facilities
  - Paint stripping debris disposal area
- All paint and chemical strippers should be labeled and stored properly.
- Where necessary, regularly clean stormwater conveyances of deposits of abrasive blasting debris and paint chips, and dispose of waste properly.

Waste Minimization

- Minimize volume of paints and chemical strippers purchased and stored to minimize waste.
- Minimize amount of material subject to wind or rain.
- Mix materials away from the water.
- Reuse solvents and thinners.
- Use brush or roller painting, rather than spray painting, where possible.
- Use water-based paints and solvents, where possible.
- Switch to longer lasting, less-toxic antifouling paints where possible.
- Enforce the prohibition on the use of TBT-based paint.

- Support the use of environmentally compatible products.

Boat Cleaning

- Do not allow in-water boat cleaning and encourage:
  - Frequent cleaning of hulls to reduce buildup of hard growth
  - Use of phosphate-free soaps and detergents
  - Use of alternative anti-fouling paints
  - Use of "natural" cleansers instead of solvents
- No soaps or detergents of any kind should be used to wash the topsides of boats where the wash water will enter a waterbody.
- Discourage the use of detergents containing ammonia, sodium hypochlorite, chlorinated solvents, petroleum distillates, or lye.
- Detergents and cleaning compounds used for washing boats should be phosphate-free and biodegradable, and amounts used should be kept to a minimum.
- Do not allow in-the-water hull scraping or any process that occurs underwater to remove paint from the boat hull.

(See fact sheet SC21 – Vehicle and Equipment Washing and Steam Cleaning for other information not unique to this business type)

### Fueling

- Have an employee supervise the fuel dock.
- Use automatic shut-off nozzles and promote the use of "whistles" and fuel/air separators on air vents or tank stems of inboard fuel tanks to reduce the amount of fuel spilled into surface waters during fueling of boats.

(See fact sheet SC-20 – Vehicle and Equipment Fueling for other information not unique to this business type)

### Maintenance

Site design

- Minimize releases to surface water.
  - Provide space for onshore maintenance that is connected to oil/water separator or sanitary sewer.
  - Conduct hull repair and maintenance work in a drydock, whenever possible.
  - Cover work areas.
  - For new drydocks, provide full or moveable covers to prevent stormwater from entering work area.
- Provide adequate stormwater controls.
  - In uncovered drydocks, provide stormwater capture and pumping systems.
  - Pump stormwater to treatment system or sanitary sewer.
- For small vessels, provide and clearly mark designated work areas for outside boat repairs and maintenance. Do not permit work outside designated areas.

- If work must be performed on a vessel while it is in the water, a tarp should be placed above the water surface underneath the work area to collect drips, spills, and loose solids.
- Sweep maintenance yard areas, docks, and boat ramps weekly to collect oils, trash, paper, glass, and other loose debris. Do not hose down the area to the water or a storm drain.
- Provide covered containers for solid waste that is generated within the facility to prevent direct discharges of trash into receiving waters.

Maintenance Policies

- Decide what type and how much maintenance and cleaning (as a percent of boat surface area) will be permitted in slips. Require boaters and tenants to take larger projects to onshore or drydock facilities with proper equipment and pollution controls.
- Prohibit maintenance activities unless appropriate space is available.
- Require that engine parts be washed over a container or in a parts washer, not over water or ground. Dispose of wash water as a hazardous waste.
- Insert language into facility leases and contracts that requires tenants and contractors to use certain areas and techniques when conducting boat maintenance.
- Establish the rule – "Nothing is left on the dock, nothing goes in the water." If nothing is on the dock, nothing can be knocked or blown over or off of the dock.
- Educate boaters, tenants, employees, and contractors of these policies.

(See fact sheet SC-22 – Vehicle and Equipment Maintenance and Repair for other information not unique to this business type)

### Spill Prevention and Response

- Each facility should have adequate oil spill response equipment that is easily accessible and clearly marked.
- Each facility should develop and maintain an oil spill plan.
- Inform your local harbormaster and fire department about your oil spill recovery plan and equipment.
- In the event of an accidental discharge of oil or hazardous material into the water or onto a deck or pier with a potential for entry into the water, immediately notify the yard, port, or marina owner or manager.

If a spill occurs:

- Stop source of spill immediately and contain liquid.
- If the substance spills near or in the water, use containment booms, as appropriate. Do not use emulsifiers or dispersants.
- As appropriate, cover spill with absorbent material.
- If spill is in an enclosed area, keep the area ventilated.
- Properly dispose of used oil spill response supplies.

(See fact sheet SC-11 - Spill Prevention, Control and Cleanup for other information not unique to this business type)

**Ship Breaking**

Site design

- Minimize contact of rust or paint stripping debris with surface water.
  - Use drydock facilities whenever possible.
  - At a minimum, use dry-docks for final hull scrapping.
  - Provide shroud between ship and pier to minimize materials spilling into water.
- Cover work areas.
  - Outfit new dry-docks with cover.
  - Place tarp over work area where possible.
- Cover storage areas.
  - Provide covered storage for oily scrap materials.
  - Provide covered storage space for hazardous materials (e.g., PCBs, asbestos, lead-paint, TBT).
- Scrapping and storage areas should be paved where possible.
  - Provide stormwater runoff controls for scrapping and storage areas.
  - For new uncovered dry-docks, provide stormwater capture and pumping system.
  - Install oil/water separators to remove floatables.
  - Maintain oil/water separators.
  - Pump captured stormwater to sanitary sewer or treatment facility.
  - For uncovered scrap storage areas install oil/water separator to remove floatables and detention system to remove sediments and metal particles.
  - Provide berms/dikes around scrapping and storage areas to minimize runon of stormwater.

Scrapping Operations

- Cover work areas where possible.
- Provide tarps or solid covers, particularly in areas where fuels, lubricants, and other hazardous materials were used and stored.
- Remove fluids before starting scrapping process.
- Store fluids separately.
- Do not mix fuel, lubricants, and other chemicals together.
- Provide adequate spill response material at scrapping and storage areas.
- Clean up spills of fluids before scrapping.
- Clean up spills during scrapping process as they occur.
- Cover all fluids removed during scrapping operations.
- Cover oily scrap with tarp to eliminate stormwater runon.
- Encourage operators to keep equipment tuned up and in good working condition.



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- Leaks should be identified and repaired.
- Provide shroud between ship and pier/dock to prevent materials from spilling into surface water.
- Clean shroud frequently to prevent material from being blown into the water.
- Clean work areas frequently.
- Remove dust and spills on a daily basis and before hull is breached.
- Remove asbestos in accordance with local, state, and federal regulations.
- Remove and dispose of sand blast residue in accordance with local, state, and federal guidelines.
- Do not sand blast over open water.
- Provide cover over work area and shroud under work area.
- Remove PCB-containing materials in accordance with federal, state, and local guidelines.
- Provide skin and respiratory protection for affected workers.

### Vessel Operations

#### Sewage

- Install pumpout stations to receive sewage from onboard Marine Sanitation Devices (MSDs).
- Install a dump station, possibly located at the end of a pier, to receive sewage from portable or removable toilets (port-a-potty) typical on smaller boats.
- Ensure that pumpout facilities are available on weekend mornings and evenings when demand is high.
- Keep pumpout fees to a minimum to encourage use.
- Inspect pumpout stations routinely enough to ensure that the equipment is functioning properly. If it takes longer than 30-35 seconds to empty a 5-gallon bucket, the station needs servicing.
- Arrange maintenance contracts with contractors competent in the repair and servicing of pumpout facilities.
- Maintain a dedicated fund for the repair and maintenance of marina pumpout stations.
- Add language to slip leasing agreements mandating the use of pumpout facilities and specifying penalties for failure to comply.
- Enforce California's no discharge zone (no discharge of untreated sewage into any lake, river, reservoir, or coastal area) and federal "No Discharge Areas" (significant bays and harbors in California).
- Formally advise the local municipality that there is a pumpout facility available and provide pertinent information, such as times of operation and fees.
- Encourage the local harbormaster to enforce existing state and federal regulations pertaining to Marine Sanitation Devices and the illegal discharge of boat sewage.
- Educate boaters about the state and federal regulations, impacts of discharging untreated sewage, and the availability of pumpout stations.

- Encourage boaters to use marina restrooms, not boat heads.
- Consider requiring new liveaboard tenants to have adequate holding tanks, not just portable toilets.
- Provide signage marking pumpout station locations, hours of operation, and operation guidance.

Bilge Water

- Provide bilge pumpout stations connected to oil/water separator and sanitary sewer. Regularly inspect connecting hoses for leaks.
- Inform ship captains, boaters, tenants, and contractors that discharging bilge water contaminated with oil, fuel, or other regulated contaminants is illegal. Post location of the nearest bilge pumpout service, if the marina does not have one.
- Promote the use of oil-absorbing materials in the bilge areas of all boats with inboard engines. Encourage your tenants to examine these materials at least once a year, replace them as necessary, and recycle them if possible or dispose of them in accordance with petroleum disposal regulations.
- Keep low cost or no cost oil absorbent pads available for boaters and tenants to remove oil from bilge water. Dispose the pads as hazardous waste once they are saturated.
- Collect oil contaminated by water, fuel, or engine fluids for proper disposal. If the marina does not collect waste oil, post the location of the nearest collection facility.

Loading / Unloading Vessels

- Use covered containers for loading / unloading materials and products.
- Cover materials stored outside.
- Use temporary barriers during unloading from vessels to contain runoff from pier deck.

(See fact sheet SC-30 – Outdoor Loading / Unloading of Materials for other information not unique to this business type)

### Waterfront or Over-water Areas Management

Dry Dock Maintenance and Dry Docking

- Hang plastic barriers from flying bridge of the drydock, from bow or stern of vessel, or from temporary structures and place beneath hull and between drydock walls for containment.
- Weight bottom edge of containment tarps during light breeze.
- Cover open areas between decks when sandblasting (railings, scuppers, freeing ports, ladders, doorways, etc.).
- Sweep accessible areas of drydock to remove debris before flooding.
- Clean rest of drydock after vessel is removed and dock raised.
- Collect any wash water used and treat to remove solids and other potential pollutants.

Non-drydock Containment

- Hang tarps from boat, fixed, or floating platforms and place under boats to reduce wind-blown pollutants and collect waste.



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- Pave or tarp surfaces under marine railways and clean before incoming tide.
- Haul vessels beyond high tide zone before work starts or stop work during high tide.
- Place containment berms around fixed pieces of machinery that use oil and gas within the facility.

### Collection facilities and recycling

- Provide receptacles for recycling used oil and oil filters.
- Provide proper and easily accessible trash disposal facilities to marina patrons. Because of the tendency for windy conditions in nearshore areas, covered dumpsters or other covered receptacles are preferred.
- Provide facilities for the eventual recycling of appropriate materials, such as glass, aluminum, plastic, trash, newspapers, and batteries.
- Clearly mark receptacles to minimize disposal of hazardous waste such paints and solvents.
- Develop information packets for ship captains and boaters:
  - Identify solid waste facilities.
  - Prescribe acceptable waste handling procedures.
- Educate ship captains, boaters, employees, and contractors of the following requirements (MARPOL treaty):
  - No discharge of garbage (food wastes), plastics, trash (non-plastic), packaging, line, nets, or fish cleaning wastes within 3 nautical miles of United States coastline.
  - Boats over 26 feet must display MARPOL placard in a visible location
  - Boats over 40 feet must display the placard plus have a written waste management plan on board.
- Empty solid waste receptacles as often as necessary to keep up with disposal.

(See fact sheet SC-34 – Waste Handling and Disposal for other information not unique to this business type)

### Pier Deck and Floor Cleaning

- Monitor outdoor areas for dirt and debris.
- Clean regularly all accessible work, service, and storage areas to remove debris, spent sandblasting material, and any other potential stormwater pollutants.
- Do not dump or sweep debris and wastes into outdoor drains, between planking, or over the side of piers.
- Sweep and pickup rather than hosing down. If hosing is unavoidable dry sweep thoroughly first to collect potential pollutants prior to rinsing.
- Do not use soap or chemicals when rinsing down areas that drain into outdoor drains, between planking, or over the side of piers.
- Do not wash vehicles or equipment with soap or cleaners on pier decks or valleys that do not drain to the sewer system.
- Do not rinse fish wastes to outdoor drains or off the premises.

- Immediately repair or replace leaking connections, valves, pipes, hoses and equipment that causes the pollution of stormwater.
- Immediately clean up any spillage on dock, boat, or ship deck areas and dispose of the wastes properly.

(See business guide sheet – Mobile Cleaning - Surface Cleaning for other information not unique to this business type)

Inspections

- Conduct routine inspections of all work areas to ensure releases are minimized.
- Regularly inspect stormwater management devices such as traps and screens and remove captured spent abrasives, paint chips, and solids to ensure that these wastes do not get flushed into stormwater or receiving water.

Fish Handling

- Clean fish offshore where the fish are caught and dispose fish waste at sea.
- Dispose of unwanted bait at sea or freeze and use on the next trip.
- Establish designated fish cleaning stations at the marina and boat launching sites and require fishermen to only use these sites to clean fish.
- Ensure that fish cleaning areas have ample covered receptacles for waste and are hooked up to the sewer system. Clean the stations frequently and make sure the collected waste is disposed of regularly and properly.
- Compost fish waste when possible. Contact a local extension service for information on locally applicable composting procedures and equipment and where supplies can be purchased.

**Education**

- Provide information to marina tenants on collection and recycling programs for oil, oil-absorbing pads, and oil filters.
- Direct marina patrons to the proper disposal of all used hydrocarbon products through the use of signs, mailings, and other means.
- Insert language into facility contract that recommends tenants use fuel/air separators and oil absorption materials.
- Educate boaters, tenants, and employees about these best management practices.

## Treatment Control BMPs

- Direct deck drainage to a collection system sump for settling and/or additional treatment.
- For activities with high pollutant-generating potential, conduct the activity in a dedicated, self-contained area and direct the wastewater to the sanitary sewer (with the permission of the local wastewater authority).

For information on inspecting and maintaining treatment controls, see Section 4 of this handbook.

For information on designing treatment controls, see Section 5 of the New Development and Redevelopment Planning Handbook.

## More Information


### Facility Owners and Operators

American Association of Port Authorities, 1998. Environmental Management Handbook, Section 6: Environmental Management Practices fact sheets (http://www.aapa-ports.org/govrelations/env_mgmt_hb.htm).

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USEPA, Office of Wetlands, Oceans, & Watersheds, 1999. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Section 5, Management

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USEPA, 2000. Multi-Sector General Permit for Industrial Activities. (http://cfpub.epa.gov/npdes/stormwater/msgp.cfm?program_id=6).

Washington State Department of Ecology, 2001. Stormwater Management Manual for Western Washington, Volume IV – Source Control BMPs. (http://www.ecy.wa.gov/programs/wq/stormwater/index.html)

# Mobile Cleaning – Transportation Related

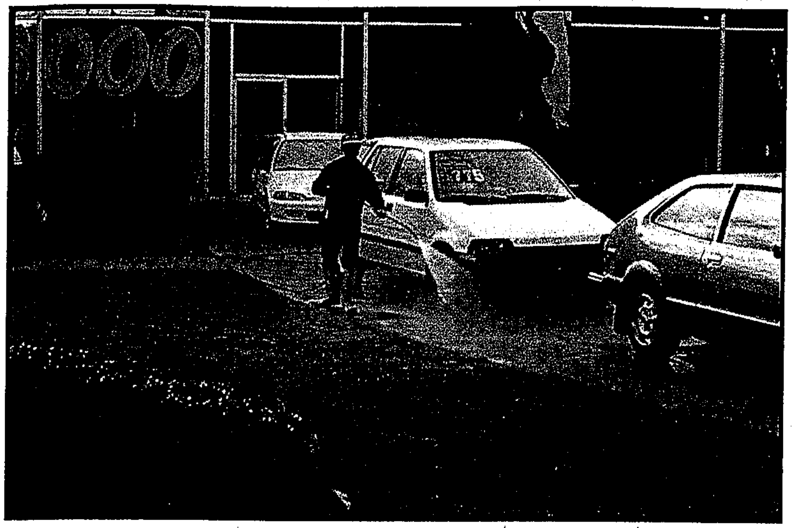

Photo Credit: Geoff Brosseau

## Description

This category includes businesses that both conduct their own mobile cleaning or "power washing" activities and those that are hired as contractors to conduct these activities. Mobile cleaning differs from other cleaning activities in that the cleaning is not conducted in a dedicated, fixed location with a wastewater capture and treatment system connected to the sanitary sewer system. This category includes mobile cleaning or power washing of transportation-related objects or areas:

- Mobile cleaning or power washing of vehicle exteriors
- Engine or equipment degreasing
- Acid cleaning of unpainted trucks or containers
- Auto detailing
- Car lot rinsing

Information specific to: food service business-related cleaning, surface cleaning, or cleaning of amenities is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Using harmful cleaning chemicals – including soaps as well as solvents
- Removing toxic materials such as oil, antifreeze, and grease
- Generating polluted wash water from cleaning activities

Pollutants can include:

- Heavy metals (copper, lead, nickel, and zinc)
- Hydrocarbons (oil and grease, PAHs)
- Toxic chemicals (solvents, chlorinated compounds, glycols)

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- Acids and alkalis

## Approach

The potential for generating stormwater pollution as part of these activities requires extra attention because by definition these activities are conducted outside with water (and sometimes chemicals) for the purpose of removing residues, dirt, and debris. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees, as necessary.

Use the following four-step approach:

1. Do dry cleanup before washing down
2. Wash without soaps and solvents
3. Keep polluted water out of storm drains
4. Dispose of wastewater correctly and legally

## Source Control BMPs

The best management practices are listed by activity or area.

### Exterior Fleet Washing

- Do not discharge wash water to storm drain
- Use wash pads to capture wash water
- Discharge to sanitary sewer

**or**

- Seal storm drain, collect, and discharge to sanitary sewer or if minimal discharge, discharge to unpaved area (with owner's permission) if it will contain all wastewater without runoff.

### Semi Trailers (food service business-related interior cleaning)

- Do not discharge wash water to storm drain.
- Sweep, collect, and dispose of debris.
- Use dry cleaning methods.
- Dispose of food residue as garbage or to sanitary sewer.
- Avoid hosing down trailer.
- Send wash water to sanitary sewer.

### Boat Cleaning (if paint chips are removed in preparation for painting)

- Discharge filtered wash water to sanitary sewer.
- Dispose of lead-based, copper-based, tributyltin, or PCB paint particles as hazardous waste.
- Other types of paint chips may be disposed of in a garbage can. Consult the local garbage company.

### Engine and Equipment Degreasing

- Do not discharge wash water to storm drain.

# Mobile Cleaning – Transportation Related

- Pretreatment is required before discharge to the sanitary sewer is allowed.
- Clean wash pads.
- Discuss with customer's facility operator first.

### Acid Cleaning of Unpainted Trucks or Containers

- Do not discharge wash water to storm drain.
- Neutralize runoff to a pH between 6 and 10.
- Discharge to sanitary sewer (once runoff is neutralized).

### Auto Detailing

- Small amounts of runoff may be allowed to evaporate on a paved surface.
- Plug the storm drain. Collect and discharge to sanitary sewer or if minimal discharge, discharge to unpaved area (with owner's permission) if it will contain all wastewater without runoff.
- Discharge remaining soapy wash water to sanitary sewer or distribute over a large dirt area (with owner's permission).

### Rinsing of New Cars for Dust Removal (no soap)

- May discharge to storm drain or unpaved area.
- Do not allow runoff to flow through oil deposits on streets.

## Treatment Control BMPs

The use of self-contained, mobile wastewater collection and treatment units may be appropriate and cost-effective for some mobile cleaning activities.

## More Information

Bay Area Pollution Prevention Group, 1995. Outdoor Cleaning - Where does the Water go? Guidelines for disposal of wash water from outdoor cleaning projects: Sidewalk/plaza/parking lot cleaning, Vehicle cleaning/detailing, Building exterior cleaning, Waterproofing, Equipment cleaning/degreasing.

Fairfield-Suisun Urban Runoff Management Program, 1999. Stormwater Pollution Prevention Practices for Mobile Cleaning Activities, Guidance for Mobile Washers Who Clean Buildings Exteriors, Flat Work, Sidewalks, Drive-Throughs, Plazas, Parking Areas or Who Perform Fleet Washing, Auto Detailing, Carpet Cleaning, or Food-Related Cleaning Activities.

San Francisco Bay Area CETA (Cleaning Equipment Trade Association), 1995. Mobile Cleaner Best Management Practices for Wastewater Runoff.

## References

Bay Area Pollution Prevention Group, 1995. Outdoor Cleaning - Where does the Water go? Guidelines for disposal of wash water from outdoor cleaning projects: Sidewalk/plaza/parking lot cleaning, Vehicle cleaning/detailing, Building exterior cleaning, Waterproofing, Equipment cleaning/degreasing.

City of Santa Rosa, 2001. A Clean Water Guide for the Cleaning Industry – Auto Detailer Guidelines.

Fairfield-Suisun Urban Runoff Management Program, 1999. Storm Water Pollution Prevention Practices for Mobile Cleaning Activities, Guidance for Mobile Washers Who Clean

Buildings Exteriors, Flat Work, Sidewalks, Drive-Thrus, Plazas, Parking Areas or Who Perform Fleet Washing, Auto Detailing, Carpet Cleaning, or Food-Related Cleaning Activities.

San Francisco Bay Area CETA (Cleaning Equipment Trade Association), 1995. Mobile Cleaner Best Management Practices for Wastewater Runoff.

Washington State Department of Ecology, 2001. Storm Water Management Manual for Western Washington, Volume IV – Source Control BMPs
http://www.ecy.wa.gov/programs/wq/stormwater/index.html

# Mobile Cleaning – Food Service Related

Photo Credit: Geoff Brosseau

## Description

This category includes businesses that both conduct their own mobile cleaning or "power washing" activities and those that are hired as contractors to conduct these activities. Mobile cleaning differs from other cleaning activities in that the cleaning is not conducted in a dedicated, fixed location with a wastewater capture and treatment system connected to the sanitary sewer system. This category includes mobile cleaning or power washing of food service business-related objects or areas:

- Restaurant alleys and dumpster areas
- Restaurant floor mats and exhaust filters (baffles)
- Kitchen oil and grease
- Grocery carts
- Lunch wagons and food carts

Information specific to: transportation-related cleaning, surface cleaning, or cleaning of amenities is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Using harmful cleaning chemicals – including soaps as well as solvents
- Removing food waste, trash, and oil and grease
- Generating polluted wash water from cleaning activities

Pollutants can include:

- Organic materials (food wastes)
- Oil and grease
- Toxic chemicals in cleaning products, disinfectants, and pesticides

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# Mobile Cleaning – Food Service Related

## Approach

The potential for generating stormwater pollution as part of these activities requires extra attention because by definition these activities are conducted outside with water (and sometimes chemicals) for the purpose of removing residues, dirt, and debris. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees, as necessary.

Use the following four-step approach:

1. Do dry cleanup before washing down
2. Wash without soaps and solvents
3. Keep polluted water out of storm drains
4. Dispose of wastewater correctly and legally

## Source Control BMPs

The best management practices are listed by activity or area.

### Restaurant Alleys and Dumpster Areas

- Do not discharge wash water to storm drain.
- Use dry cleaning methods only (use absorbents, sweep debris)

**or**

- After using dry cleaning methods, seal the storm drain. Wash area. Pump wash water to sanitary sewer. Use screens to collect wash water particles before entrance to sanitary sewer.

### Restaurant Floor Mats and Exhaust Filters (baffles)

- Do not discharge wash water to storm drain.
- Clean mats, etc. indoors and discharge to sanitary sewer or clean mats, etc. outside in bermed or sloped area which drains to sanitary sewer.

**or**

- Take mats and baffles to a public car wash that discharges wash water to the sanitary sewer.

### Kitchen Oil and Grease

- Do not pour into storm drain or sanitary sewer (sink, floor drain, etc.)
- Save in sealed containers such as tallow bin
- Separate recyclable fats from waste grease (from an interceptor or trap).
- See "Tallow," "Grease Traps," or "Septic" in yellow pages for recycling or disposal service or locations.

### Grocery Carts

- If soap is used, capture and filter the wastewater. Then pump it to the sanitary sewer.
- If soap is not used, capture and filter wash water. Then pump it to the storm drain or use a filter barrier (boom) to remove debris and send the wash water to the storm drain once the water is cool.



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# Mobile Cleaning – Food Service Related

### Lunch Wagons and Food Carts

- Do not discharge wash water to storm drain (except melted ice).
- Discharge to a commissary that can accept and discharge wastewater to the sanitary sewer.
- Clean on a properly equipped wash pad.

## Treatment Control BMPs

The use of self-contained, mobile wastewater collection/treatment units may be appropriate and cost-effective for some mobile cleaning activities.

## More Information

Bay Area Pollution Prevention Group, 1995. Outdoor Cleaning - Where does the Water go? Guidelines for disposal of wash water from outdoor cleaning projects: Sidewalk/plaza/parking lot cleaning, Vehicle cleaning/detailing, Building exterior cleaning, Waterproofing, Equipment cleaning/degreasing.

City of Santa Cruz, 2000. Food Service Facilities – Best Management Practices, Section 2 of Best Management Practices Manual for the Stormwater Program.

Fairfield-Suisun Urban Runoff Management Program, 1999. Stormwater Pollution Prevention Practices for Mobile Cleaning Activities, Guidance for Mobile Washers Who Clean Buildings Exteriors, Flat Work, Sidewalks, Drive-Thrus, Plazas, Parking Areas or Who Perform Fleet Washing, Auto Detailing, Carpet Cleaning, or Food-Related Cleaning Activities.

San Francisco Bay Area CETA (Cleaning Equipment Trade Association), 1995. Mobile Cleaner Best Management Practices for Wastewater Runoff.

## References


Bay Area Pollution Prevention Group, 1995. Outdoor Cleaning - Where does the Water go? Guidelines for disposal of wash water from outdoor cleaning projects: Sidewalk/plaza/parking lot cleaning, Vehicle cleaning/detailing, Building exterior cleaning, Waterproofing, Equipment cleaning/degreasing.

City of Santa Cruz, 2000. Food Service Facilities – Best Management Practices, Section 2 of Best Management Practices Manual for the Stormwater Program.

Fairfield-Suisun Urban Runoff Management Program, 1999. Stormwater Pollution Prevention Practices for Mobile Cleaning Activities, Guidance for Mobile Washers Who Clean Buildings Exteriors, Flat Work, Sidewalks, Drive-Throughs, Plazas, Parking Areas or Who Perform Fleet Washing, Auto Detailing, Carpet Cleaning, or Food-Related Cleaning Activities.

King County Surface Water Management Division, 1995. Stormwater Pollution Control Manual. Best Management Practices for Businesses. (http://dnr.metrokc.gov/wlr/dss/spcm.htm)

San Francisco Bay Area CETA (Cleaning Equipment Trade Association), 1995. Mobile Cleaner Best Management Practices for Wastewater Runoff.

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# Mobile Cleaning – Surface Cleaning

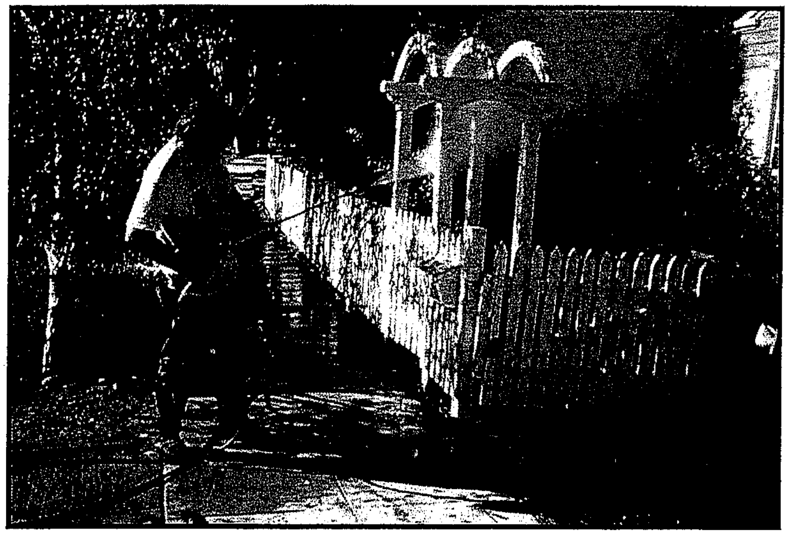

Photo Credit: Geoff Brosseau

## Description

This category includes businesses that both conduct their own mobile cleaning or "power washing" activities and those that are hired as contractors to conduct these activities. Mobile cleaning differs from other cleaning activities in that the cleaning is not conducted in a dedicated, fixed location with a wastewater capture and treatment system connected to the sanitary sewer system. This category includes mobile cleaning or power washing of flat surfaces:

- Sidewalks and plazas
- Parking areas, driveways, and drive-throughs
- Restaurant / food handling cleaning and storage areas
- Building exteriors, roofs, and decks
- Painted surfaces being cleaned to remove paint or graffiti
- Graffiti removal

Information specific to: transportation-related cleaning, food service business-related cleaning, or cleaning of amenities is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Using harmful cleaning chemicals – including soaps as well as solvents
- Removing toxic materials such as oil, antifreeze, and grease from parking lots, sidewalks, and other surfaces
- Generating polluted wash water from activities such as wet sand blasting of buildings to remove paint

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Pollutants can include:

- Heavy metals (copper, lead, and zinc)



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- Oils and greases
- Trash
- Sediment
- Toxic organic compounds

Highly polluted sites can generate hazardous waste including:

- Oil-saturated absorbents (but not oil-saturated rags, which can be cleaned at an industrial laundry)
- Wash water that contains lead paint chips
- Solvent cleaners

## Approach

The potential for generating stormwater pollution as part of these activities requires extra attention because by definition these activities are conducted outside with water (and sometimes chemicals) for the purpose of removing residues, dirt, and debris. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees, as necessary.

Use the following four-step approach:

1. Do dry cleanup before washing down
2. Wash without soaps and solvents
3. Keep polluted water out of storm drains
4. Dispose of wastewater correctly and legally



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# Mobile Cleaning – Surface Cleaning

## Source Control BMPs

The best management practices are listed by activity or area.

| Type of Surface | Cleaning Method | Proper Disposal |
|---|---|---|
| Sidewalks, plazas | Dry cleanup first, wash without soap. | Screen wash water, if needed, to catch debris then discharge to landscaping, or to a gutter, street, or storm drain. |
| *Sidewalks, plazas* | *Block the storm drain or contain runoff. Dry cleanup, then wash with soap.* | *Discharge to landscaping or collect water and pump to the sewer.* |
| Parking areas, driveways, drive-throughs | 1. Block the storm drain or contain runoff.<br>2. Use absorbents to pick up oil; then dry sweep.<br>3. Clean with or without soap. | Collect water and pump to the sewer. *Check the local wastewater authority's requirements for discharge.* |
| Restaurant/food handling dumpster areas, grease storage | Block the storm drain or contain runoff. Dry cleanup. | If you must use water after sweeping/using absorbents, collect water and pump to the sewer. *Check the local wastewater authority's requirements for discharge.* |
| Building surfaces, decks, etc., without loose paint | Use high-pressure water, no soap. | Screen wash water, if needed, to catch debris then discharge to landscaping, or to a gutter, street, or storm drain. |
| Unpainted building surfaces, wood decks, etc. | Block the storm drain or contain runoff. Use soap or acid wash to remove deposits, wood restorer, or other chemicals. | Make sure pH is between 6 and 10 then discharge to landscaping or collect wash water in a tank and pump to the sewer. *Check the local wastewater authority's requirements for discharge.* |
| Painted surfaces being cleaned to remove paint or graffiti | Block the storm drain or contain runoff. Use any cleaning method. | Collect wash water in a tank and pump to the sewer, or dispose as hazardous waste, as appropriate. *Call the local wastewater authority or the state Department of Toxic Substances Control (510–540–3732) for help in determining whether the paint contains toxic pollutants such as lead, mercury, or tri-butyl tin; or if the solvent cleaners you use are hazardous.* |
| Graffiti removal | Block the storm drain or contain runoff. Wet sand-blast. | Direct all runoff to a landscaped or unpaved area or follow instructions above for painted surfaces. |

## Treatment Control BMPs

The use of self-contained, mobile wastewater collection/treatment units may be appropriate and cost-effective for some mobile cleaning activities.

## More Information

Booklets, checklists, fact sheets, and pamphlets

Bay Area Pollution Prevention Group, 1995. Outdoor Cleaning - Where does the Water go? Guidelines for disposal of wash water from outdoor cleaning projects:

Sidewalk/plaza/parking lot cleaning, Vehicle cleaning/detailing, Building exterior cleaning, Waterproofing, Equipment cleaning/degreasing.

Bay Area Stormwater Management Agencies Association (BASMAA), 1996. Pollution from Surface Cleaning – Flat Work, Sidewalks, Plazas, Building exteriors, Parking areas, Drive-thrus.

Fairfield-Suisun Urban Runoff Management Program, 1999. Stormwater Pollution Prevention Practices for Mobile Cleaning Activities, Guidance for Mobile Washers Who Clean Buildings Exteriors, Flat Work, Sidewalks, Drive-Thrus, Plazas, Parking Areas or Who Perform Fleet Washing, Auto Detailing, Carpet Cleaning, or Food-Related Cleaning Activities.

San Francisco Bay Area CETA (Cleaning Equipment Trade Association), 1995. Mobile Cleaner Best Management Practices for Wastewater Runoff.

### Videos

BASMAA, 2000. We Do the Job Right! Preventing Pollution from Surface Cleaning (English and Spanish).

## References

Bay Area Pollution Prevention Group, 1995. Outdoor Cleaning - Where does the Water go? Guidelines for disposal of wash water from outdoor cleaning projects: Sidewalk/plaza/parking lot cleaning, Vehicle cleaning/detailing, Building exterior cleaning, Waterproofing, Equipment cleaning/degreasing.

Bay Area Stormwater Management Agencies Association (BASMAA), 1996. Pollution from Surface Cleaning – Flat Work, Sidewalks, Plazas, Building exteriors, Parking areas, Drive-thrus.

City of Santa Rosa, 2001. A Clean Water Guide for the Cleaning Industry – Surface Cleaner/Mobile Washer Guidelines.

Fairfield-Suisun Urban Runoff Management Program, 1999. Stormwater Pollution Prevention Practices for Mobile Cleaning Activities, Guidance for Mobile Washers Who Clean Buildings Exteriors, Flat Work, Sidewalks, Drive-Thrus, Plazas, Parking Areas or Who Perform Fleet Washing, Auto Detailing, Carpet Cleaning, or Food-Related Cleaning Activities.

King County Surface Water Management Division, 1995. Stormwater Pollution Control Manual. Best Management Practices for Businesses. (http://dnr.metrokc.gov/wlr/dss/spcm.htm)

San Francisco Bay Area CETA (Cleaning Equipment Trade Association), 1995. Mobile Cleaner Best Management Practices for Wastewater Runoff.

Washington State Department of Ecology, 2001. Stormwater Management Manual for Western Washington, Volume IV – Source Control BMPs. (http://www.ecy.wa.gov/programs/wq/stormwater/index.html)



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# Mobile Cleaning – Carpets & Upholstery

Photo Credit: Geoff Brosseau

## Description

This category includes businesses that both conduct their own mobile cleaning activities and those that are hired as contractors to conduct these activities. Mobile cleaning differs from other cleaning activities in that the cleaning is not conducted in a dedicated, fixed location with a wastewater capture and treatment system connected to the sanitary sewer system. This category includes cleaning of carpets and upholstery. Information specific to: other amenities, transportation-related cleaning, food service business-related cleaning, or surface cleaning is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Cleaning chemicals
- Carpet fibers

Pollutants can include:

- Toxic organic compounds

## Approach

Never discharge wash water or wastewater from these activities to the street, gutter, or near a storm drain.

## Source Control BMPs

The best management practices are listed by activity or area.

- Cleaning waste must be discharged to a sink, toilet, or other drain connected to the sanitary sewer system – never to a street, gutter, parking lot, or storm drain. Either:
- Empty the spent cleaning fluid tank into a utility sink or other indoor sewer connection at the service provider's home base

**or**

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A002425

- Arrange with the customer to discharge into a toilet or utility sink on their premises.
- Check the local wastewater authority's requirements for discharge.

These guidelines apply even to cleaning products labeled "nontoxic" and "biodegradable." "Nontoxic" means the product is not toxic to the user. "Biodegradable" means the product will eventually break down. Such products can harm wildlife if they enter a storm drain.

## Treatment Control BMPs

The use of self-contained, mobile wastewater collection/treatment units may be appropriate and cost-effective for some mobile cleaning activities.

## More Information

### Booklets, Checklists, Fact Sheets, and Pamphlets

Fairfield-Suisun Urban Runoff Management Program, 1999. Stormwater Pollution Prevention Practices for Mobile Cleaning Activities, Guidance for Mobile Washers Who Clean Buildings Exteriors, Flat Work, Sidewalks, Drive-Throughs, Plazas, Parking Areas or Who Perform Fleet Washing, Auto Detailing, Carpet Cleaning, or Food-Related Cleaning Activities.

## References

Bay Area Pollution Prevention Group, 1995. Pollution Prevention Tips for Carpet Cleaners.

City of Santa Rosa, 2001. A Clean Water Guide for the Cleaning Industry – Carpet Cleaner Guidelines.

City of Vacaville, 1993. Small Quantity Generator Program Mobile Sources – Carpet Cleaners.

Fairfield-Suisun Urban Runoff Management Program, 1999. Stormwater Pollution Prevention Practices for Mobile Cleaning Activities, Guidance for Mobile Washers Who Clean Buildings Exteriors, Flat Work, Sidewalks, Drive-Thrus, Plazas, Parking Areas or Who Perform Fleet Washing, Auto Detailing, Carpet Cleaning, or Food-Related Cleaning Activities.

King County Surface Water Management Division, 1995. Stormwater Pollution Control Manual. Best Management Practices for Businesses. (http://dnr.metrokc.gov/wlr/dss/spcm.htm)

Sacramento Stormwater Program, 2000. Clean Water Business Partner Program.



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# Mobile Cleaning – Swimming Pools & Spas

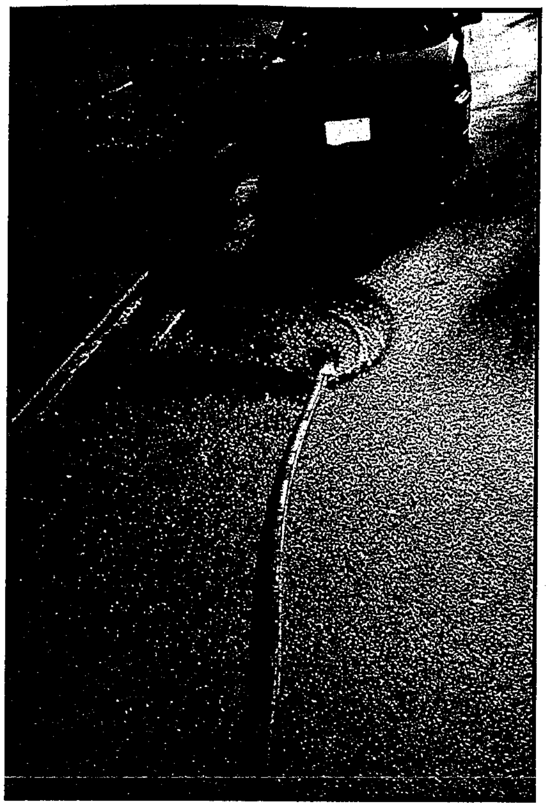

Photo Credit: Geoff Brosseau

## Description

This category includes businesses that both conduct their own mobile cleaning activities and those that are hired as contractors to conduct these activities. Mobile cleaning differs from other cleaning activities in that the cleaning is not conducted in a dedicated, fixed location with a wastewater capture and treatment system connected to the sanitary sewer system. This category includes cleaning swimming pools and spas. Information specific to: other amenities, transportation-related cleaning, food service business-related cleaning, or surface cleaning is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Filter cleaning
- Algae control
- Pool draining

Pollutants can include:

- Copper
- Chlorine

## Approach

Never discharge wash water or wastewater from these activities to the street, gutter, or near a storm drain.

## Source Control BMPs

The best management practices are listed by activity or area.

### Preventative Maintenance

- Prevent algae problems with regular cleaning, consistent adequate chlorine levels, and well-maintained water filtration and circulation systems.
- Manage pH and water hardness to minimize corrosion of copper pipes.

### Filter Cleaning

- Never clean a filter in the street or near a storm drain.
- Rinse cartridge filters onto a dirt area, and spade filter residue into soil.
- Backwash diatomaceous earth filters onto dirt. Dispose of spent diatomaceous earth in the garbage.

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- If there is not a suitable dirt area, call the local wastewater treatment plant for instructions on discharging filter backwash or rinsewater to the sanitary sewer.

### Algae Problems

- Resolve persistent problems without copper algicides. Use chlorine or other alternatives. For more information about non-copper algae prevention, consult a pool chemical supplier.

### Draining Pools

- Do not discharge pool, spa, or fountain water to the street, storm drain, or where water might flow to a creek or seasonal stream.
- It is almost always possible to discharge to a sanitary sewer cleanout. If assistance is needed in locating the cleanout, call the local wastewater treatment plant.
- When draining a pool to the sanitary sewer, prevent backflow by maintaining an "air gap" between the discharge line and the sewer line (do not seal the connection between the hose and sewer line).
- When it is time to drain a pool, spa, or fountain, be sure to call the local wastewater treatment plant for further guidance on flow rate restrictions, backflow prevention, and handling special cleaning waste (such as acid wash). Discharge flows should be kept to the low levels typically possible through a garden hose. Higher flow rates may be prohibited by local ordinance.

## Treatment Control BMPs

The use of self-contained, mobile wastewater collection/treatment units may be appropriate and cost-effective for some mobile cleaning activities.

## More Information

No additional information is available that provides: 1) more specific information than is included in these guide sheets or 2) information in other formats – posters and videos – that may complement these guide sheets.

## References


Regional Water Quality Control Plant—Palo Alto, undated. Keep Pool/Spa Water Out of Storm Drains, Streets, and Creeks.

Santa Clara Valley Urban Runoff Pollution Prevention Program, 2001. Landscaping, Gardening, and Pool Maintenance – Best Management Practices for the Construction Industry.

# Mobile Cleaning – Water Softeners

Photo Credit: Geoff Brosseau

## Description

This category includes businesses that both conduct their own mobile cleaning activities and those that are hired as contractors to conduct these activities. Mobile cleaning differs from other cleaning activities in that the cleaning is not conducted in a dedicated, fixed location with a wastewater capture and treatment system connected to the sanitary sewer system. This category includes servicing water softeners. Information specific to: other amenities, transportation-related cleaning, food service business-related cleaning, or surface cleaning is provided in other guide sheets.

## Pollutant Sources

The following are sources of pollutants:

- Regeneration

Pollutants can include:

- Brine containing calcium and magnesium

## Approach

Never discharge wash water or wastewater from these activities to the street, gutter, or near a storm drain.

Source Control BMPs: The best management practices are listed by activity or area.

- Brine from regeneration must be discharged to a sink, toilet, or other drain connected to the sanitary sewer system – never to a street, gutter, parking lot, or storm drain. Either:
  - Empty the brine into a utility sink or other indoor sewer connection at the service provider's home base

  **or**

  - Arrange with the customer to discharge into a toilet or utility sink on their premises.
- Check the local wastewater authority's requirements for discharge.

## Treatment Control BMPs

The use of self-contained, mobile wastewater collection and treatment units may be appropriate and cost-effective for some mobile cleaning activities.

## More Information

No additional information is available that provides: 1) more specific information than is included in these guide sheets or 2) information in other formats – posters and videos – that may complement these guide sheets.

## References


University of Nebraska—Lincoln, 1996. Water Treatment Equipment: Water Softeners, Institute of Agriculture and Natural Resources, Cooperative Extension. http://www.ianr.unl.edu/pubs/housing/


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# Landscape Maintenance

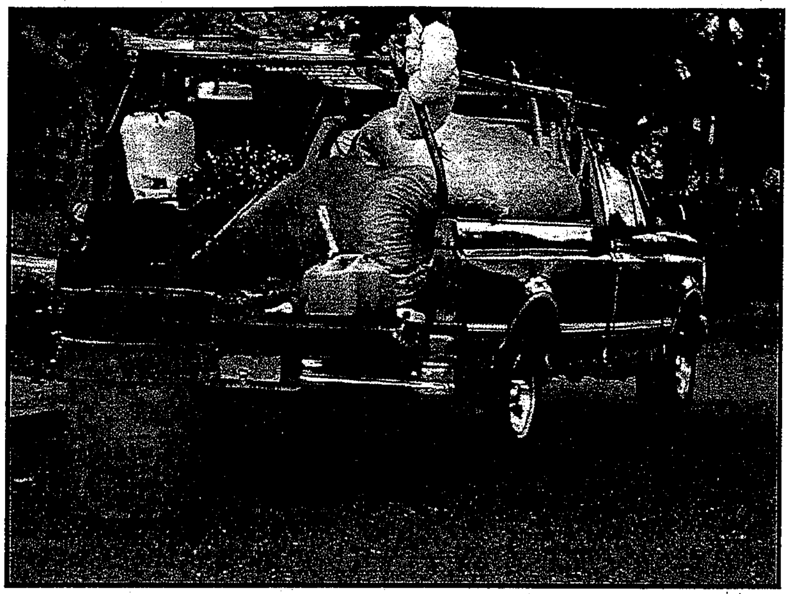

Photo Credit: Geoff Brosseau

## Description

This category includes businesses that provide landscaping and landscape maintenance/gardening services.

## Pollutant Sources

The following are sources of pollutants:

- Selecting plants or landscape design
- Installing new landscaping
- Maintaining landscapes
- Using pesticides and fertilizers
- Using gas-powered equipment
- Working near waterbodies

Pollutants can include:

- Nutrients (fertilizers, yard wastes)
- Pesticides
- Heavy metals (copper, lead, and zinc)
- Hydrocarbons (fuels, oils and grease)
- Sediments

## Approach

Minimize the potential for stormwater pollution and the need for resources/controls (water, pesticides, fertilizers) by creating and maintaining landscapes in a way that is compatible with the local soils, climate, and amount of rain and sun. Make stormwater

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pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees, as necessary.

## Source Control BMPs

The best management practices are listed by activity or area.

### Landscape Design

- Specify native, low maintenance, and insectary (attract beneficial insects) plants and landscape designs.
- Design zoned, water-efficient irrigation systems using technologies such drip irrigation, soaker hoses, or microspray systems.
- Do not landscape riparian areas, except to remove non-native plants and replace them with native riparian landscaping.
- Replant with native species where possible when landscaping or building an ornamental pond. Do not assume something is native because you have seen it in your area. Contact the local nursery for information or visit the California Exotic Pest Plant Council website (www.caleppc.org).

### Landscape Installation

- Protect stockpiles and landscaping materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Schedule grading and excavation projects during dry weather.
- Divert runoff from exposed soils or lower its velocity by leveling and terracing.
- Use temporary check dams or ditches to divert runoff away from storm drains.
- Protect storm drains with sandbags or other sediment controls.
- Revegetation is an excellent form of erosion control for any site. Keep soils covered with vegetation or temporary cover material (mulch) to control erosion.
- Check plant roots before buying a plant. Do not buy plants with roots are that kinked or circling around the container. Do not buy plants with soft, rotten, or deformed root crowns.
- Do not pile soil around the plant any higher than the root crown.

### Landscape Maintenance

#### Yard Waste

- Allow leaf drop to become part of the mulch layer in tree, shrub, and groundcover areas.
- Keep lawn mower blades sharp and grasscycle.
- Grasscycle – leave grass clippings on the lawn when mowing. Once cut, grass clippings first dehydrate, then decompose, quickly disappearing from view. Proper mowing is required for successful grasscycling. Cut grass when the surface is dry, and keep mower blades sharp. Follow the "1/3 Rule": mow the lawn often enough so that no more than 1/3 of the length of the grass blade is cut in any one mowing. Frequent mowing will produce short clippings that will not cover up the grass surface. The lawn may have to be cut every seven days when the lawn is growing fast but only every 7 to 14 days when the lawn is growing slowly.

- Do not leave clippings on pavement or sidewalks where they can wash off into the street, gutter, or storm drain.
- Collect lawn and garden clippings, pruning waste, and tree trimmings. Chip if necessary, and compost or take to the local municipal yard waste recycling/composting facility.
- In communities with curbside pick-up of yard waste, place clippings and pruning waste at the curb in approved bags or containers. No curbside pickup of yard waste is available for commercial properties.
- Do not blow or rake leaves or other yard waste into the street, or place yard waste in gutters or on dirt shoulders, unless it is being piled up for recycling (allowed by some municipalities). After pick-up, sweep up any leaves, litter, or residue in gutters or on street.

### Fertilizing and Pruning

- Perform soil analysis seasonally to determine actual fertilization need and application rates.
- Fertilize garden areas with a mulch of leaves, bark, or composted manure and/or garden waste.
- Apply chemical fertilizer only as needed, when plants can best use it, and when the potential for it being carried away by runoff is low. Make sure the fertilizer spreader is calibrated.
- Prune plants sparingly, if at all. A healthy plant – one that is native to the area and growing under the right conditions – should not need pruning, except when it is not in the right location (where safety or liability is a concern).

### Watering

- Use soil probes to determine soil moisture depth, overall moisture levels, and the need to adjust irrigation schedules.

### Pest and Weed Control

- Anyone who is in the business of landscape maintenance and performs pest control as part of providing that service must have a license from the state to apply pesticides. Contact the Department of Pesticide Regulation for more information.
- Become trained in and offer customers less-toxic pest control or Integrated Pest Management (IPM).
- The label on a pesticide container is a legal document. Use a pesticide only as instructed on the label.
- Store pesticides, fertilizers, and other chemicals indoors or in a shed or storage cabinet.
- Use pesticides sparingly, according to instructions on the label. Rinse empty containers, and use rinsewater as product.
- Dispose of rinsed, empty containers in the trash. Dispose of unused pesticides as hazardous waste.
- To control weeds, use drip irrigation and mulch. Hand-pull weeds including roots or cut down to ground. Repeat cutting before they flower, grow new leaves, or go to seed. Use herbicides containing pelargonic acid or herbicidal soap as a last resort.

### Handling Gasoline

- Use only containers approved by a nationally recognized testing lab, such as Underwriters Laboratories (UL). Keep the container tightly sealed. Containers should be fitted with a spout to allow pouring without spilling and to minimize the generation of vapors.
- Fill cautiously. Always use a funnel and/or spout to prevent spilling or splashing when fueling power mowers, blowers, and all other gas-powered equipment.
- Avoid spilling gasoline on the ground, especially near wells. If a spill occurs use kitty litter, saw dust, or an absorbent towel to soak up the spill, then dispose of it properly.
- Store carefully. Gasoline moves quickly through soil and into groundwater, therefore, store and use gasoline and fuel equipment as far away from your drinking water well as possible. Be certain to keep a closed cap on the gasoline container. Store at ground level, not on a shelf to minimize the danger of falling and spilling.
- Do not dispose of gasoline down the drain, into surface water, onto the ground, or in the trash. Contact the local municipality for directions on proper disposal of excess or old gasoline. Transport old gas in an approved gasoline container.

### Working Near Waterbodies

- Do not dump lawn clippings, other yard waste, or soil along creek banks or in creeks.
- Do not store stockpiles of materials (soil, mulch) along creek banks. These piles can erode over time into a creek.
- Do not spray pesticides or fertilizers by creeks.
- Do not over water near streams. The excess water may carry pesticides, fertilizers, sediments, and anything else in its path directly into the creek.
- Do not remove native vegetation along creek banks or remove large woody debris from creek banks or creeks. Instead, contact the local municipal planning department and Department of Fish & Game for guidance.

## Treatment Control BMPs

Not applicable.

## More Information

Bay Area Stormwater Management Agencies Association, 1999. Start at the Source – Design Guidance Manual for Stormwater Quality Protection. (http://www.basmaa.org).

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San Francisquito Watershed Council and San Mateo Countywide Stormwater Pollution Prevention Program, no date. Streamside Planting Guide for San Mateo and Santa Clara County Streams. (http://www.acterra.org/watershed/)

Santa Clara Valley Urban Runoff Pollution Prevention Program, 2001. Landscaping, Gardening, and Pool Maintenance – Best Management Practices for the Construction Industry.

The Alliance for Proper Gasoline Handling, 1999. Consumer Tips for Proper Gasoline Handling. (http://www.gas-care.org/consumer_tips.htm).

# Construction Handbook

The Construction Handbook provides general guidance for selecting and implementing Best Management Practices (BMPs) that will eliminate or reduce the discharge of pollutants from construction sites to waters of the state and developing and implementing stormwater pollution prevention plans (SWPPPs) that document the selection and implementation of BMPs for a particular construction project. SWPPP Template.

CALIFORNIA STORMWATER QUALITY ASSOCIATION

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**TABLE OF CONTENTS**

| | |
|---|---|
| | WM-9 Sanitary/Septic Waste Management |
| Section 5 | Glossary and List of Acronyms |
| 5.1 | Glossary |
| 5.2 | Acronyms |

**Appendices**

| | |
|---|---|
| Appendix A | General Permit |
| Appendix B | SWPPP Template |
| Appendix C | Construction Stormwater Sampling and Analysis Guidance (Handbook Reference) |

**Template:** To download the template, right click the link below, choose "Save Target As" and save to a drive at your site. You may then open the document in Microsoft Word and use it to build a SWPPP. If you are using MS Office 2000 and/or XP, you should have installed the latest Microsoft Office Patch (Service Release No. 3) to make sure that the template will work correctly.

Stormwater Pollution Prevention Plan
SWPPP ReadMeFirst
SWPPP Attachments (Zip File)

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*California Stormwater Quality Association*
*PO Box 2105*
*Menlo Park, CA 94026*

# Section 1
# Introduction

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

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

## 1.1 Handbook Purpose and Scope

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

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

### 1.1.1 Users of the Handbook

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

The target audience for this handbook includes: developers, including their planners and engineers; contractors, including their engineers, estimators, superintendents, foremen,



A002439

tradesmen, and subcontractors; municipal agencies, including their engineers, municipal inspectors, building inspectors, permit counter staff, code enforcement officers, and construction staff; Regulatory agencies, including permit staff and enforcement staff, and the general public with an interest in stormwater pollution control.

## 1.1.2 Organization of the Handbook

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

**California Stormwater BMP Handbook - Construction**

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

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

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

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

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

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

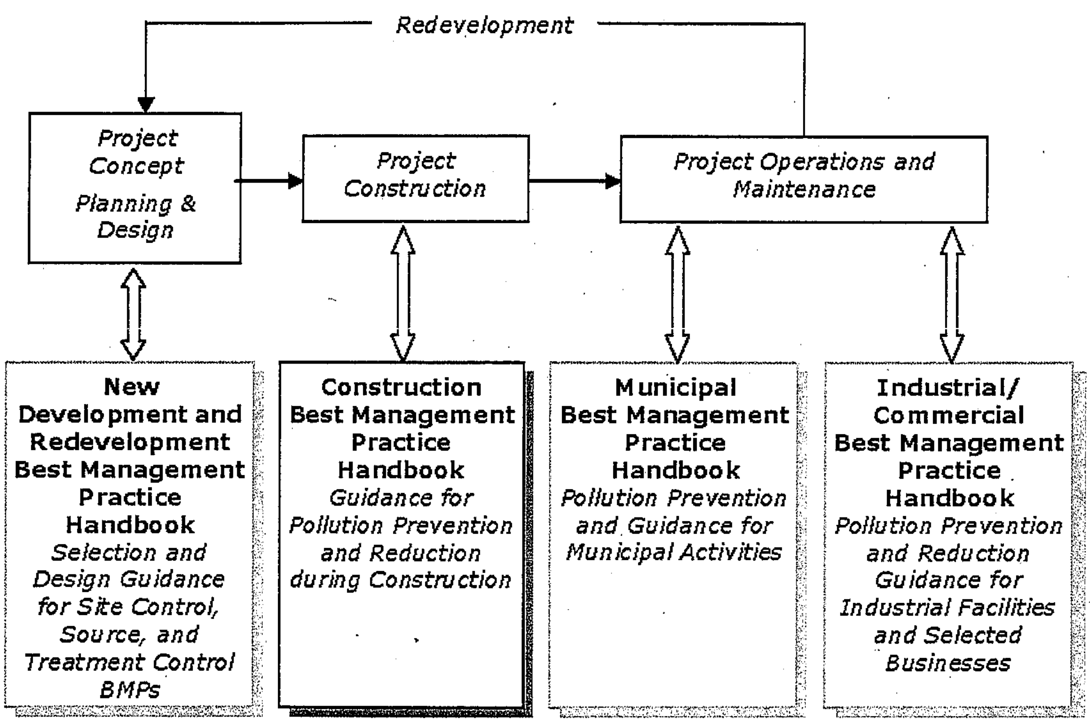
**Appendix B**
**SWPPP Template**
*This Appendix provides the SWPPP Template that was developed as an assistance tool for SWPPP preparation and review. The template contains elements required by the General Permit.*

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

### 1.1.3 Relationship to other Handbooks

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

***Project Lifecycle***




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



A002441

# 1.2 Construction Sites and their Impacts on Water Quality

## 1.2.1 Pollutants Associated with Construction Activities

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

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

**Table 1-1 Pollutant Impacts on Water Quality**

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



A002443

## 1.2.2 Erosion and Sedimentation

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

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

### Erosion from Rainfall Impact

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

### Sheet Erosion

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

### Rill and Gully Erosion

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

### Stream and Channel Erosion

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

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



A002444

- Replacing pervious natural ground with impervious cover such as buildings and pavement further increases runoff.
- Detention basins used to capture sediment extend the duration of flows leaving the site.

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

## Wind Erosion

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

**Table 1-2 Examples of Dust Sources at Construction Sites**

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

## 1.2.3 Other Pollutants

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

**Table 1-3 Other Construction Activity Pollutants**

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



A002446

## 1.2.4 Impacts of Erosion and Sedimentation, and Other Pollutants

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

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

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

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

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

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

- Irrigation of vegetative erosion control measures

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

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

# 1.3 Regulatory Programs

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

## 1.3.1 Federal NPDES Programs

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

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

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

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

## 1.3.2 State NPDES Programs

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

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

The primary objectives of the General Permit are to:

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

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

### Who must comply with the Construction General Permit?

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



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

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

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

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

## How to comply with Construction General Permit

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

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

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

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

  - An inspection and maintenance program for BMPs.

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

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

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

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

### 1.3.3 Municipal NPDES Programs

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

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

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

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

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

## 1.4 Definitions

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



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

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

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

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

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

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

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

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

# 1.5 References

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# Section 2
# Stormwater Pollution Prevention Plan

## 2.1 Introduction

This section describes the preparation and implementation of a stormwater pollution prevention plan (SWPPP) for a construction project. A SWPPP must be prepared before construction begins, ideally during the project planning and design phases. This is because much of the information required by the SWPPP is already part of the project design documentation, and because the design may need to be modified to incorporate controls during construction and post-construction. It may be completed at the end of the design phase or at the initiation of the construction phase prior to any activity with the potential to cause water pollution.

Implementation of the SWPPP begins when construction begins, typically before the initial clearing, grubbing, and grading operations, since these activities can usually increase erosion potential on the site. During construction, the SWPPP should be referred to frequently, and amended by the owner and contractors as changes occur in construction operations, which could have significant effects on the potential for discharge of pollutants.

## 2.2 Minimum Requirements

### 2.2.1 Sites Subject to General Permit Coverage

A construction project is subject to the General Permit[1] if it disturbs one acre or more of soil, or the project results in the disturbance of less than one acre but is part of a larger common plan of development or sale of one or more acres. Construction sites that result in soil disturbance of one acre or greater will require the preparation and implementation of a SWPPP meeting the requirements of the General Permit.

### 2.2.2 Other Sites

Construction projects with a disturbed area of less than one acre are not covered under the General Permit at this time and therefore are not required by the SWRQCB to develop a SWPPP. However, the local municipality or Regional Water Quality Control Board (RWQCB) may require the development of a SWPPP for all projects that require a grading permit or if it is determined that the project poses a significant water quality risk threat. The owner should contact local authorities to determine local requirements.

## 2.3 Assess Construction Site and Planned Activities

The planning phase is the source of much of the information needed for the SWPPP. The basis for stormwater pollution control decisions is also made at this phase via the normal review process with the local municipality. Information to be collected includes contractor activities, disturbed areas and erosion potential, and site history.

1 State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Stormwater Runoff Associated with Construction Activity (General Permit).

### 2.3.1 Contractor Activities

Information about contractor activities is required for the selection of proper BMPs. Details that should be recorded include:

- Equipment storage, cleaning and maintenance areas and activities
- Points of ingress and egress to the construction site
- Material loading, unloading, and storage practices and areas, including construction materials, building materials and waste materials.
- Materials, equipment, or vehicles that may come in contact with stormwater

### 2.3.2 Disturbed Areas and Erosion Potential

The physical condition of the site and adjacent areas should be reviewed. A project layout showing what is being constructed, limits of construction, project schedule, and existing features should be developed. Site characteristics including drainage patterns, soils, vegetation, surface water bodies, and steep or unstable slopes should be noted. A hydrology report, soils report, and a grading/drainage plan should be prepared. Physical conditions at the site will change as construction progresses. The SWPPP must be amended to address conditions as activities change at the site.

The hydrology reports should assess information such as drainage areas and patterns, rainfall information and expected run-on and runoff volumes and flow rates, etc. A soil report will identify soil constraints, design criteria, and soil stability. Both of these reports are used in the preparation of the preliminary grading and drainage plan. The grading and drainage plan should identify areas of cut and fill, slope during and after grading, protection of existing vegetation, and areas of soil disturbance. They also form the technical basis for selection of erosion and sediment control BMPs.

### 2.3.3 Site History

Existing site characteristics such as vegetation, environmental features, and areas of historic contamination (natural and/or industrial or agricultural) should also be recorded on the project layout. Soil laboratory analysis may be required should prior contamination be suspected. The selection and implementation of construction BMPs will be affected by what existing features need to be protected or mitigated during construction.

## 2.4 Identify and Select BMPs

The owner, the owner's design consultant, or the contractor; may select BMPs at the discretion of the owner. The contract between the owner and contractor should specify the responsibilities of the owner and contractor with regards to stormwater pollution control during construction. Owners must be aware that regardless of the contractual agreement between the owner and contractor with respect to BMP selection and SWPPP implementation, the owner is ultimately responsible for compliance with the General Permit.

A guide to selecting BMPs for construction activities is presented in the following sections. BMPs are generally selected in a three-step process:

- Define BMP Objectives
- Identify BMP category
- Select appropriate BMPs

## 2.4.1 Define BMPs Objectives

Selection and implementation of BMPs is based on the pollution risks associated with the construction activity. The pollution prevention objectives of BMPs are defined based on a review of information gathered during the assessment of the site and planned activities (Section 2.3). Once defined, BMP objectives are developed and BMPs selected. The BMP objectives for construction projects are as follows:

- Control of Erosion, and Discharge of Sediment:
  - Minimize Disturbed Areas: Only clear land which will be actively under construction in the near term (e.g., within the next 6-12 months), minimize new land disturbance during the rainy season, and avoid clearing and disturbing sensitive areas (e.g., steep slopes and natural watercourses) and other areas where site improvements will not be constructed.
  - Stabilize Disturbed Areas: Provide temporary stabilization of disturbed soils whenever active construction is not occurring on a portion of the site. Provide permanent stabilization during finish grade and landscape the site.
  - Protect Slopes and Channels: Safely convey runoff from the top of the slope and stabilize disturbed slopes as quickly as possible. Avoid disturbing natural channels. Stabilize temporary and permanent channel crossings as quickly as possible and ensure that increases in runoff velocity caused by the project do not erode the channel.
  - Control Site Perimeter: Delineate site perimeter to prevent disturbing areas outside the project limits. Divert upstream run-on safely around or through the construction project. Local codes usually state that such diversions must not cause downstream property damage, or be diverted into another watershed. Runoff from the project site should be free of excessive sediment and other constituents. Control tracking at points of ingress to and egress from the project site.
  - Retain Sediment: Retain sediment-laden waters from disturbed, active areas within the site.
- Manage Non-Stormwater Discharges and Materials:
  - Practice Good Housekeeping: Perform activities in a manner to keep potential pollutants from coming into contact with stormwater or being transported off site to eliminate or avoid exposure.



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- Contain Materials and Wastes: Store construction, building, and waste materials in designated areas, protected from rainfall and contact with stormwater runoff. Dispose of all construction waste in designated areas, and keep stormwater from flowing onto or off of these areas. Prevent spills and clean up spilled materials.

## 2.4.2 Identify BMP Categories

Once the BMP objectives are defined, identify the category of BMP best suited to meet each objective. The particular BMP selected from each category depends on specific site conditions, construction activities, and cost considerations.

There are six BMP categories available for selection. They are:

- Erosion Control (EC)
- Sediment Control (SE)
- Wind Erosion Control (WE)
- Tracking Control (TR)
- Non Stormwater Management (NS)
- Waste Management and Materials Pollution Control (WM)

BMPs for contractor activities are listed in the TR, NS, and WM categories. BMPs for erosion and sediment control are listed in the EC, SE, WE, and TR categories.

## 2.4.3 Select BMPs

### BMPs for Erosion and Sediment Control

BMPs for erosion and sediment control are selected to meet the BMP objectives based on specific site conditions, construction activities, and cost. Various BMPs may be needed at different times during construction since activities are constantly changing site conditions.

Selection of erosion control BMPs should be based on minimizing disturbed areas, stabilizing disturbed areas, and protecting slopes and channels. Selection of sediment control BMPs should be based on retaining sediment on-site and controlling the site perimeter. Erosion and sediment control BMPs are listed in the EC, SE, WE, and TR categories, which are presented in Section 3.

### BMPs for Contractor Activities

Certain contractor activities may cause pollution if not properly managed. BMPs should be selected based on the contractor activities information collected in the SWPPP. The materials and BMP objectives for contractor activities are practicing good housekeeping and containing materials and waste. BMPs for contractor activities are selected from the TR, NS and WM categories, which are presented in Sections 3 (TR) and 4 (NS, WM). Several considerations for selecting a BMP for contractor activities include:

- Is it expected to rain? Selection of a BMP is different for the rainy season versus the dry season. What activities can be postponed or re-scheduled until after the rains or performed during the dry season.
- How much water is being used? The more water used and wastewater generated, the more likely that pollutants transported by this water will reach the drainage system or be transported off site.
- What are the site conditions? BMPs may differ depending on whether the activity is conducted on a slope or flat ground near a drainage structure or watercourse. Conducting activities away from certain sensitive areas will reduce the cost and inconvenience of implementing BMPs.
- What about accidents? Controls for common activities should be established, and preparations should be made to allow for quick response to accidents or spills. In the event of a spill or exposure of construction compounds, what are the contingency plans for sampling the contaminated stormwater? Can the analysis be done in the field or should laboratory analysis be required? Are sample bottles available on-site, appropriate test strips, etc?

# 2.5 Stormwater Pollution Prevention Plans

## 2.5.1 SWPPP Preparation

The General Permit requires that the owner prepare a SWPPP for projects that will create one acre or more of soil disturbance. The General Permit also requires that the SWPPP applies to all areas that are directly related to the construction activity, including but not limited to staging areas, storage yards, material borrow areas, and access roads, etc. In some cases, the owner may enter into agreements with the contractor or stormwater quality professionals for preparation and implementation of the SWPPP. However, owners must be aware that regardless of the contractual agreement between the owner and contractor with respect to BMP selections and SWPPP implementation, the owner is ultimately responsible for compliance with the General Permit. It is highly recommended that the owner and contractor jointly review the SWPPP during its development or during a pre-construction conference.

The SWPPP is a document that addresses water pollution control during construction. The SWPPP must be prepared and available on the project site before the project owner, developer, or contractor begins any activity with the potential to cause water pollution. The SWPPP must be available on site at all times and must be implemented year-round throughout the duration of the construction project.

The SWPPP must be completed before any construction activity starts. No construction activity having the potential to cause water pollution shall be performed until the SWPPP has been completed, certified, and appropriate BMPs have been implemented. Construction activities that will not threaten water quality, such as traffic control, may proceed without a complete SWPPP if allowed by the local agency and the RWQCB.

The SWPPP should be directed at personnel on the construction project (e.g., supervisor, foreman, and inspectors). The SWPPP should provide specific guidance on actions to be taken by these personnel and should be presented in a format that accommodates day-to-day use (e.g., loose leaf, pullout sections, and checklists).

The SWPPP should provide a simple narrative and diagram that locates the construction site, identifies potential pollutant sources on site, and shows the location of the BMPs to be used to minimize erosion and sedimentation during construction. It should also describe measures which eliminate or reduce pollution of stormwater runoff by any chemicals and materials used during the construction process. The level of detail will vary with the intensity, size, and type of construction.

### 2.5.2 SWPPP Template

An electronic SWPPP template has been developed and is included in Appendix A of this handbook as an assistance tool. The template contains the elements required by the General Permit, but local agencies may develop their own SWPPP template or require an alternative format. It is important to note that a SWPPP does not need to match the template provided. The template SWPPP is provided as a guidance document that was developed to:

- Provide easy data entry during SWPPP preparation (instructions and examples can be viewed in the template while the SWPPP is being prepared)
- Provide consistency in SWPPP content and format, thus making the SWPPP review process more efficient

An electronic copy of the SWPPP template (Microsoft Word® 2000) can be downloaded from the California Stormwater BMP Handbook web site at "www.cabmphandbooks.com." Due to the SWPPP template objectives for consistency in SWPPP content and format, the SWPPP template's underlying structure cannot be modified by the user.

## 2.6 SWPPP Implementation

### 2.6.1 Staff Training

Training is imperative to the success of the BMPs identified in the SWPPP. Adequate training is required if these BMPs are to be installed and maintained properly. These BMPs will fail if not properly installed and maintained. Thus, only trained personnel should be assigned these responsibilities. A construction stormwater pollution prevention training program should be held for all construction personnel. A good program will include:

- SWPPP Preparation Training. This training is geared towards owners, engineers, contractors, and water quality professionals involved in preparation and certification of SWPPPs. The training must cover all aspects of construction site water pollution control, including, SWPPP documentation and BMP selection.
- SWPPP Implementation Training. This training is geared towards owners, contractors, superintendents, foremen, and key staff designated in the SWPPP as being responsible for

certifications, inspections, monitoring, and project oversight. The first training element must familiarize the individuals with the content and organization of the SWPPP, pollution control objectives, responsibilities for pollution control, BMPs, inspection procedures, and monitoring procedures. The second training element must focus on the SWPPP for the particular project site for which the individual is responsible, including site-specific responsibilities, BMPs, and other measures.

- BMP Implementation Training. This training is geared towards owners, contractors, superintendents, foremen, tradesmen, laborers, and for other staff that work on the construction site including subcontractors. The training should cover responsibilities for BMP implementation, how to implement BMPs, general good housekeeping, and protection of BMPs in place.

Construction water pollution control training typically includes off-site and on-site training. Off-site training is most appropriate for SWPPP Preparation training with instruction provided by trade associations, colleges, Regional Boards, County, or other water quality professionals. SWPPP Implementation training can be conducted through a combination of off-site training for the general subjects, and on-site training for a site specific SWPPP, with instruction provided by trade associations, colleges, Regional Boards, Counties, water quality professionals, and experienced owner and contractor superintendents. BMP implementation training is usually conducted on the project site with instruction provided by experienced owner and contractors' superintendents and foremen.

Subcontractor employees can impact water quality and potentially jeopardize compliance with the General Permit, thus subcontractor staff must also receive appropriate training. The owner may wish to contractually require that subcontractors employ trained staff.

### 2.6.2 Site Inspections

The General Permit requires inspections before and after a storm event, and once each 24-hour period during extended storm events, to identify BMP effectiveness and implement repairs or BMP changes as soon as feasible. At the onset of a construction project (e.g., clearing, grubbing, or earth movement) it may be more appropriate to perform inspection of the BMPs on a regular basis instead of just before and after a storm. This will allow sufficient time for any corrections or improvements to be made before the storm. An inspector should be identified in the SWPPP. Inspection can usually be performed as part of a regular oversight and inspection of the project site.

According to the General Permit, a tracking or follow-up procedure must follow an inspection that identifies deficiencies in the BMPs. The result of the inspection and assessment must be written. Include the date of the inspection, weather information, the person(s) who performed the inspection, observations, descriptions of inadequate BMPs, and the corrective actions that were taken, such as BMPs that were fixed or additional BMPs that were implemented. Inspection records must be retained for three years from the date they were generated. It is highly recommended that records be retained for at least three years following the date coverage is terminated under the General Permit; even longer retention of records is recommended where sites have been subject to enforcement actions or are involved in litigation regarding issues covered by the permit.

### 2.6.3 BMP Monitoring

The type of BMP monitoring depends on which BMP is implemented. In the case of contractor activity BMPs, the monitoring consists of visual inspection to ensure that the BMP was implemented and maintained according to the SWPPP. Such inspection would include:

- Looking for evidence of spills and resulting clean-up procedures (e.g., supplies of spill cleanup materials)
- Verifying adequacy of trash receptacles
- Verifying waste disposal practices (e.g., recycle vs. hazardous waste bins)
- Examining integrity and use of containment structures
- Verifying use of employee education programs for the various activities
- Noting the location of activity (e.g., outdoor vs. indoor, concrete vs. grass)
- BMPs for any chemicals or fuels not addressed in the SWPPP must be developed

In the case of erosion and sediment control BMPs, the monitoring program should consist of regular inspection to determine the following:

- Are erosion and sediment control BMPs installed properly? The SWPPP BMPs should include details or references to allow for the proper construction of structural or vegetative erosion and sediment control devices. The inspector should ensure that these systems are installed according to the SWPPP in the proper locations
- Are the BMPs effective? The effectiveness of the BMP would be based on the presence of sediment behind or within control devices, the presence of sediment downstream of the site, and signs of erosion in stabilized areas after a storm event.
- Have drainage patterns changed? If the site has undergone significant grading operations, resulting in a change of drainage patterns, adjustment to the BMPs will likely be required to address this change. The inspector shall determine the extent of changes to the drainage pattern and the necessity for additional or reconfigured BMPs.
- Are areas stabilized as quickly as possible after completion of construction activities in an area? Disturbed active and inactive construction areas (inactive construction areas may be defined as areas in which no construction activity will occur for a period of 30 days or longer) should be stabilized as soon as practical. If construction, climatological, or other site conditions do not allow stabilization, the SWPPP should define alternative approaches.

- Are the BMPs properly maintained? Maintenance of erosion and sediment control BMPs is critical. Erosion controls should be installed as soon as practical after an area becomes inactive, and before the onset of rain. The capacity of sediment controls must be restored prior to the next rain event.

### 2.6.4 BMP Maintenance

The inspector should inspect the site on a regular basis, during and after any storm generating runoff to determine maintenance requirements and general condition of the installed system. The local agency may also inspect the site on a routine basis to assess the maintenance performed on the systems. All maintenance related to a storm event should be completed within 48 hours of the storm event. The following maintenance tasks should be performed on a regular basis:

- Removal of sediment from barriers and sedimentation devices
- Replacement or repair of worn or damaged silt fence fabrics
- Replacement or repair of damaged structural controls
- Repair of damaged soil stabilization measures.
- Other control maintenance as defined in each BMP fact sheet.

### 2.6.5 Stormwater Pollution Control Documentation

Records of inspections, compliance certifications, and non-compliance reporting are to be retained for at least three years by the owner. It is suggested that records of incidents such as spills or other releases be kept. Analyzing a history of this information can provide insight into modifying the BMPs. Photographs should also be kept.

Also, keep a record of maintenance activities or any other BMPs that are of an action nature. Activity based BMPs such as Good Housekeeping must be documented in each inspection; often, this documentation is the only evidence that the BMPs have been implemented.

# Section 3
# Erosion and Sediment Control BMPs

## 3.1 Erosion Control

Erosion control is any source control practice that protects the soil surface and prevents soil particles from being detached by rainfall, flowing water, or wind. Erosion control is also referred to as soil stabilization. Erosion control consists of preparing the soil surface and implementing one or more of the BMPs shown in Table 3-1, to disturbed soil areas.

**Table 3-1 Erosion Control BMPs**

| BMP# | BMP Name |
|---|---|
| EC-1 | Scheduling |
| EC-2 | Preservation of Existing Vegetation |
| EC-3 | Hydraulic Mulch |
| EC-4 | Hydroseeding |
| EC-5 | Soil Binders |
| EC-6 | Straw Mulch |
| EC-7 | Geotextiles & Mats |
| EC-8 | Wood Mulching |
| EC-9 | Earth Dikes and Drainage Swales |
| EC-10 | Velocity Dissipation Devices |
| EC-11 | Slope Drains |
| EC-12 | Streambank Stabilization |
| EC-13 | Polyacrylamide |

All inactive soil-disturbed areas on the project site, and most active areas prior to the onset of rain, must be protected from erosion. Soil disturbed areas may include relatively flat areas as well as slopes. Typically, steep slopes and large exposed areas require the most robust erosion controls; flatter slopes and smaller areas still require protection, but less costly materials may be appropriate for these areas, allowing savings to be directed to the more robust BMPs for steep slopes and large exposed areas. To be effective, erosion control BMPs must be implemented at slopes and disturbed areas to protect them from concentrated flows.

Some erosion control BMPs can be used effectively to temporarily prevent erosion by concentrated flows. These BMPs, used alone or in combination, prevent erosion by intercepting, diverting, conveying, and discharging concentrated flows in a manner that prevents soil detachment and transport. Temporary concentrated flow conveyance controls may be required to direct run-on around or through the project in a non-erodible fashion. Temporary concentrated flow conveyance controls include the following BMPs:

- EC-9, Earth Dikes and Drainage Swales
- EC-10, Velocity Dissipation Devices
- EC-11, Slope Drains



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## 3.2 Sediment Control

Sediment control is any practice that traps soil particles after they have been detached and moved by rain, flowing water, or wind. Sediment control measures are usually passive systems that rely on filtering or settling the particles out of the water or wind that is transporting them.

Sediment control practices include the BMPs listed in Table 3-2.

| **Table 3-2** | **Temporary Sediment Control BMPs** |
|---|---|
| **BMP#** | **BMP Name** |
| SE-1 | Silt Fence |
| SE-2 | Sediment Basin |
| SE-3 | Sediment Trap |
| SE-4 | Check Dam |
| SE-5 | Fiber Rolls |
| SE-6 | Gravel Bag Berm |
| SE-7 | Street Sweeping and Vacuuming |
| SE-8 | Sandbag Barrier |
| SE-9 | Straw Bale Barrier |
| SE-10 | Storm Drain Inlet Protection |
| SE-11 | Chemical Treatment |

Sediment control BMPs include those practices that intercept and slow or detain the flow of stormwater to allow sediment to settle and be trapped. Sediment control practices can consist of installing linear sediment barriers (such as silt fence, sandbag barrier, and straw bale barrier); providing fiber rolls, gravel bag berms, or check dams to break up slope length or flow; or constructing a sediment trap or sediment basin. Linear sediment barriers are typically placed below the toe of exposed and erodible slopes, down-slope of exposed soil areas, around soil stockpiles, and at other appropriate locations along the site perimeter.

A few BMPs may control both sediment and erosion, for example, fiber rolls and sand bag barriers. The authors of this handbook have classified these BMPs as either erosion control (EC) or sediment control (SC) based on the authors opinion on the BMPs most common and effective use.

Sediment control BMPs are most effective when used in conjunction with erosion control BMPs. The combination of erosion control and sediment control is usually the most effective means to prevent sediment from leaving the project site and potentially entering storm drains or receiving waters. Under most conditions, the General Permit requires that the discharger implement an effective combination of erosion and sediment controls.

Under limited circumstances, sediment control, alone may be appropriate. For example, applying erosion control BMPs to an area where excavation, filling, compaction, or grading is currently under way may not be feasible when storms come unexpectedly. Use of sediment controls by establishing perimeter control on these areas may be appropriate and allowable under the General Permit provided the following conditions are met.

- Weather monitoring is under way.
- Inactive soil-disturbed areas have been protected with an effective combination of erosion and sediment controls.



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- An adequate supply of sediment control materials are stored on-site and there are sufficient forces of labor and equipment available to implement sediment controls on the active area prior to the onset of rain.

- The SWPPP adequately describes the methods to protect active areas.

## 3.3 Wind Erosion Control

Wind erosion control consists of applying water or other dust palliatives to prevent or alleviate dust nuisance. Wind erosion control best management practices (BMPs) are shown in Table 3-3.

**Table 3-3 Wind Erosion Control BMPs**

| BMP# | BMP Name |
|---|---|
| WE-1 | Wind Erosion Control |

Other BMPs that are sometimes applied to disturbed soil areas in order to control wind erosion are BMPs EC-2 through EC-7, shown in Section 3.1 of this Manual. Be advised that many of the dust palliatives may contain compounds that have an unknown effect on stormwater. A sampling and analysis protocol to test for stormwater contamination from exposure to such compounds is required in the SWPPP.

## 3.4 Tracking Control BMPs

Tracking control consists of preventing or reducing the tracking of sediment off-site by vehicles leaving the construction area. Tracking control best management practices (BMPs) are shown in Table 3-4.

**Table 3-4 Temporary Tracking Control BMPs**

| BMP # | BMP Name |
|---|---|
| TR-1 | Stabilized Construction Entrance/ Exit |
| TR-2 | Stabilized Construction Roadway |
| TR-3 | Entrance/Outlet Tire Wash |

Attention to control of tracking sediment off site is highly recommended, as dirty streets and roads near a construction site create a nuisance to the public and generate constituent complaints to elected officials and regulators. These complaints often result in immediate inspections and regulatory actions.

## 3.5 Erosion and Sediment Control BMP Fact Sheet Format

A BMP fact sheet is a short document that gives all the information about a particular BMP. Typically, each fact sheet contains the information outlined in Figure 3-1. Completed fact sheets for each of the above activities are provided in Section 3.6.

The fact sheets also contain side bar presentations with information on BMP objectives, targeted constituents, removal effectiveness, and potential alternatives.

**EC-xx Example Fact Sheet**

<u>Description and Purpose</u>

<u>Suitable Applications</u>

<u>Limitations</u>

<u>Implementation</u>

<u>Costs</u>

<u>Inspection and Maintenance</u>

<u>References</u>

**Figure 3-1**
**Example Fact Sheet**



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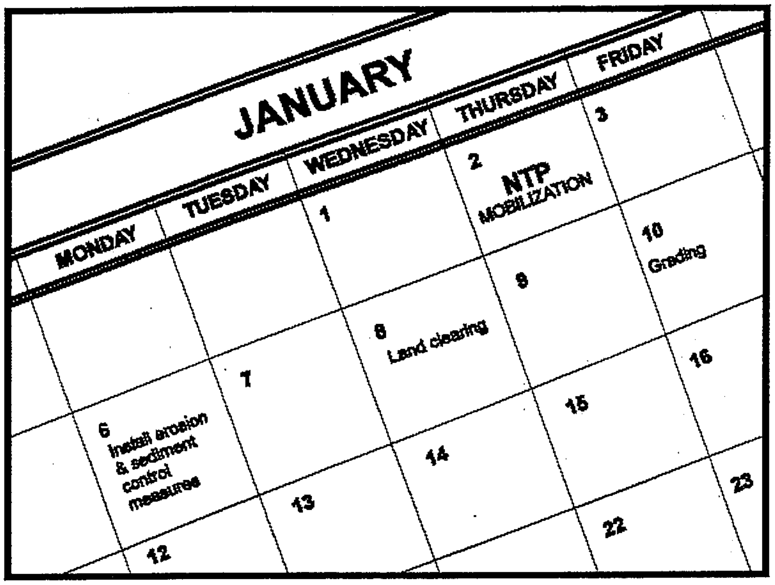
# 3.6 BMP Fact Sheets

BMP fact sheets for erosion, sediment, wind, and tracking controls follow. The BMP fact sheets are individually page numbered and are suitable for photocopying and inclusion in SWPPPs. Fresh copies of the fact sheets can be individually downloaded from the California Stormwater BMP Handbook web site at www.cabmphandbooks.com.

# Scheduling EC-1




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | ☒ |
| WE | Wind Erosion Control | ☒ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

### Description and Purpose

Scheduling is the development of a written plan that includes sequencing of construction activities and the implementation of BMPs such as erosion control and sediment control while taking local climate (rainfall, wind, etc.) into consideration. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

### Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project especially during rainy season. Use of other, more costly yet less effective, erosion and sediment control BMPs may often be reduced through proper construction sequencing.

### Limitations

- Environmental constraints such as nesting season prohibitions reduce the full capabilities of this BMP.

### Implementation

- Avoid rainy periods. Schedule major grading operations during dry months when practical. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means or to install sediment trapping devices.

- Plan the project and develop a schedule showing each phase of construction. Clearly show how the rainy season relates to soil disturbing and re-stabilization activities. Incorporate the construction schedule into the SWPPP.

- Include on the schedule, details on the rainy season implementation and deployment of:
  - Erosion control BMPs
  - Sediment control BMPs
  - Tracking control BMPs
  - Wind erosion control BMPs
  - Non-stormwater BMPs
  - Waste management and materials pollution control BMPs
- Include dates for activities that may require non-stormwater discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, pavement cleaning, etc.
- Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
  - Sequence trenching activities so that most open portions are closed before new trenching begins.
  - Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
  - Schedule establishment of permanent vegetation during appropriate planting time for specified vegetation.
- Non-active areas should be stabilized as soon as practical after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year round to deploy erosion control and sediment control BMPs. Erosion may be caused during dry seasons by un-seasonal rainfall, wind, and vehicle tracking. Keep the site stabilized year round, and retain and maintain rainy season sediment trapping devices in operational condition.
- Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

### Costs

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost effectiveness of scheduling techniques should be compared with the other less effective erosion and sedimentation controls to achieve a cost effective balance.

### Inspection and Maintenance

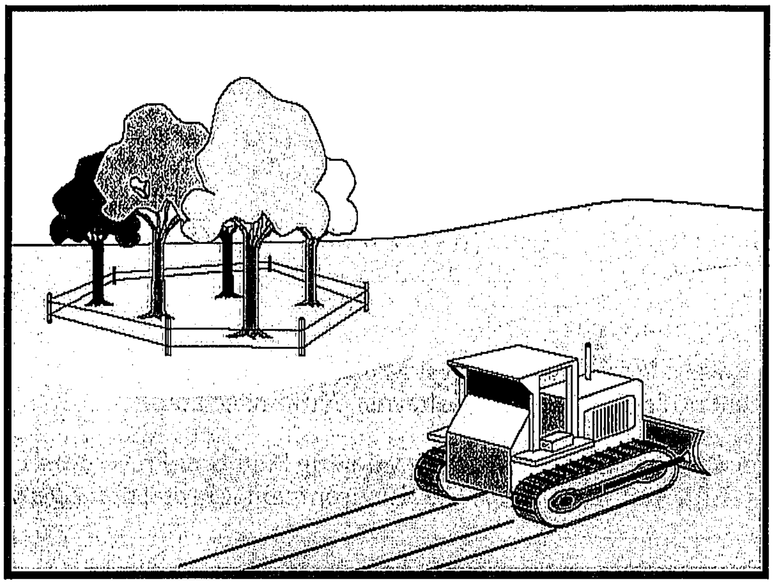
- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

### References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005), U.S. Environmental Protection Agency, Office of Water, September 1992.

# Preservation Of Existing Vegetation EC-2



**Objectives**

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

**Targeted Constituents**

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

**Potential Alternatives**

None

## Description and Purpose

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil from erosion.

## Suitable Applications

Preservation of existing vegetation is suitable for use on most projects. Large project sites often provide the greatest opportunity for use of this BMP. Suitable applications include the following:

- Areas within the site where no construction activity occurs, or occurs at a later date. This BMP is especially suitable to multi year projects where grading can be phased.
- Areas where natural vegetation exists and is designated for preservation. Such areas often include steep slopes, watercourse, and building sites in wooded areas.
- Areas where local, state, and federal government require preservation, such as vernal pools, wetlands, marshes, certain oak trees, etc. These areas are usually designated on the plans, or in the specifications, permits, or environmental documents.
- Where vegetation designated for ultimate removal can be temporarily preserved and be utilized for erosion control and sediment control.

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### Limitations

- Requires forward planning by the owner/developer, contractor, and design staff.
- Limited opportunities for use when project plans do not incorporate existing vegetation into the site design.
- For sites with diverse topography, it is often difficult and expensive to save existing trees while grading the site satisfactory for the planned development.

### Implementation

The best way to prevent erosion is to not disturb the land. In order to reduce the impacts of new development and redevelopment, projects may be designed to avoid disturbing land in sensitive areas of the site (e.g., natural watercourses, steep slopes), and to incorporate unique or desirable existing vegetation into the site's landscaping plan. Clearly marking and leaving a buffer area around these unique areas during construction will help to preserve these areas as well as take advantage of natural erosion prevention and sediment trapping.

Existing vegetation to be preserved on the site must be protected from mechanical and other injury while the land is being developed. The purpose of protecting existing vegetation is to ensure the survival of desirable vegetation for shade, beautification, and erosion control. Mature vegetation has extensive root systems that help to hold soil in place, thus reducing erosion. In addition, vegetation helps keep soil from drying rapidly and becoming susceptible to erosion. To effectively save existing vegetation, no disturbances of any kind should be allowed within a defined area around the vegetation. For trees, no construction activity should occur within the drip line of the tree.

#### *Timing*

- Provide for preservation of existing vegetation prior to the commencement of clearing and grubbing operations or other soil disturbing activities in areas where no construction activity is planned or will occur at a later date.

#### *Design and Layout*

- Mark areas to be preserved with temporary fencing. Include sufficient setback to protect roots.
  - Orange colored plastic mesh fencing works well.
  - Use appropriate fence posts and adequate post spacing and depth to completely support the fence in an upright position.
- Locate temporary roadways, stockpiles, and layout areas to avoid stands of trees, shrubs, and grass.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Maintain existing irrigation systems where feasible. Temporary irrigation may be required.
- Instruct employees and subcontractors to honor protective devices. Prohibit heavy equipment, vehicular traffic, or storage of construction materials within the protected area.

### Costs

There is little cost associated with preserving existing vegetation if properly planned during the project design, and these costs may be offset by aesthetic benefits that enhance property values. During construction, the cost for preserving existing vegetation will likely be less than the cost of applying erosion and sediment controls to the disturbed area. Replacing vegetation inadvertently destroyed during construction can be extremely expensive, sometimes in excess of $10,000 per tree.

### Inspection and Maintenance

During construction, the limits of disturbance should remain clearly marked at all times. Irrigation or maintenance of existing vegetation should be described in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below should be followed:

- Verify that protective measures remain in place. Restore damaged protection measures immediately.
- Serious tree injuries shall be attended to by an arborist.
- Damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Trench as far from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching or tunneling near or under trees to be retained, place tunnels at least 18 in. below the ground surface, and not below the tree center to minimize impact on the roots.
- Do not leave tree roots exposed to air. Cover exposed roots with soil as soon as possible. If soil covering is not practical, protect exposed roots with wet burlap or peat moss until the tunnel or trench is ready for backfill.
- Cleanly remove the ends of damaged roots with a smooth cut.
- Fill trenches and tunnels as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- If bark damage occurs, cut back all loosened bark into the undamaged area, with the cut tapered at the top and bottom and drainage provided at the base of the wood. Limit cutting the undamaged area as much as possible.
- Aerate soil that has been compacted over a trees root zone by punching holes 12 in. deep with an iron bar, and moving the bar back and forth until the soil is loosened. Place holes 18 in. apart throughout the area of compacted soil under the tree crown.
- Fertilization
  - Fertilize stressed or damaged broadleaf trees to aid recovery.
  - Fertilize trees in the late fall or early spring.

  - Apply fertilizer to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft to the trunk. Increase the fertilized area by one-fourth of the crown area for conifers that have extended root systems.

- Retain protective measures until all other construction activity is complete to avoid damage during site cleanup and stabilization.

### References

County of Sacramento Tree Preservation Ordinance, September 1981.

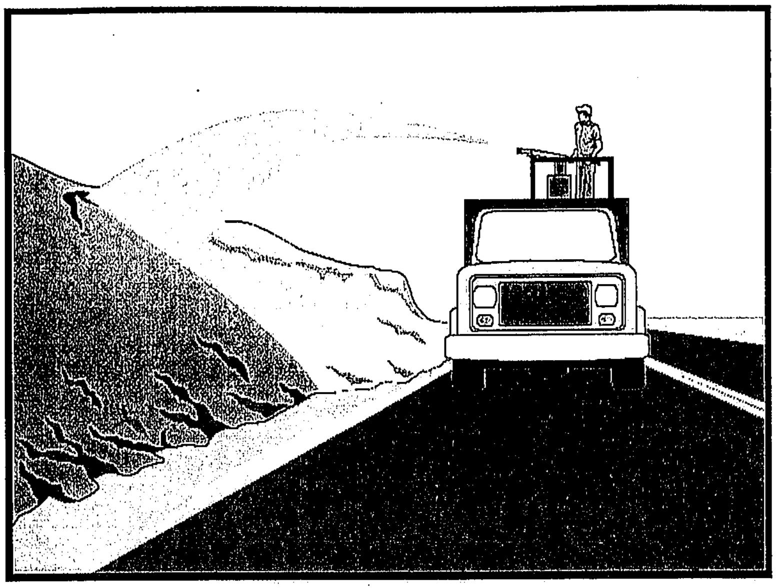
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

# Hydraulic Mulch





**Objectives**

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | ☒ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

**Targeted Constituents**

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

**Potential Alternatives**

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

## Description and Purpose

Hydraulic mulch consists of applying a mixture of shredded wood fiber or a hydraulic matrix, and a stabilizing emulsion or tackifier with hydro-mulching equipment, which temporarily protects exposed soil from erosion by raindrop impact or wind.

## Suitable Applications

Hydraulic mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity.

## Limitations

Wood fiber hydraulic mulches are generally short lived and need 24 hours to dry before rainfall occurs to be effective. May require a second application in order to remain effective for an entire rainy season.

## Implementation

- Prior to application, roughen embankment and fill areas by rolling with a crimping or punching type roller or by track walking. Track walking shall only be used where other methods are impractical.
- To be effective, hydraulic matrices require 24 hours to dry before rainfall occurs.
- Avoid mulch over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.

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- Paper based hydraulic mulches alone shall not be used for erosion control.

### *Hydraulic Mulches*
Wood fiber mulch can be applied alone or as a component of hydraulic matrices. Wood fiber applied alone is typically applied at the rate of 2,000 to 4,000 lb/acre. Wood fiber mulch is manufactured from wood or wood waste from lumber mills or from urban sources.

### *Hydraulic Matrices*
Hydraulic matrices include a mixture of wood fiber and acrylic polymer or other tackifier as binder. Apply as a liquid slurry using a hydraulic application machine (i.e., hydro seeder) at the following minimum rates, or as specified by the manufacturer to achieve complete coverage of the target area: 2,000 to 4,000 lb/acre wood fiber mulch, and 5 to 10% (by weight) of tackifier (acrylic copolymer, guar, psyllium, etc.)

### *Bonded Fiber Matrix*
Bonded fiber matrix (BFM) is a hydraulically applied system of fibers and adhesives that upon drying forms an erosion resistant blanket that promotes vegetation, and prevents soil erosion. BFMs are typically applied at rates from 3,000 lb/acre to 4,000 lb/acre based on the manufacturer's recommendation. A biodegradable BFM is composed of materials that are 100% biodegradable. The binder in the BFM should also be biodegradable and should not dissolve or disperse upon re-wetting. Typically, biodegradable BFMs should not be applied immediately before, during or immediately after rainfall if the soil is saturated. Depending on the product, BFMs typically require 12 to 24 hours to dry and become effective.

## Costs
Average cost for installation of wood fiber mulch is $900/acre. Average cost for installation of BFM is $5,500/acre.

## Inspection and Maintenance
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked.

## References
Controlling Erosion of Construction Sites Agricultural Information #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Soil Erosion by Water, Agriculture Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

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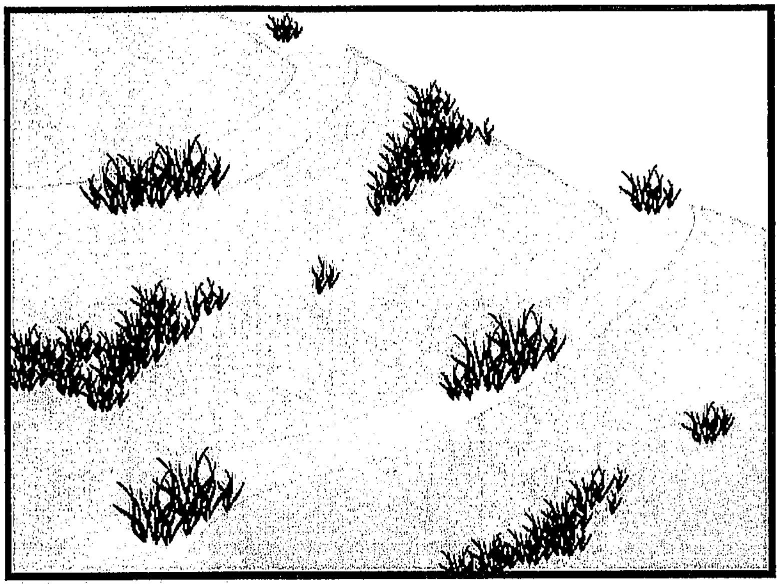

### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | ☒ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

EC-3 Hydraulic Mulch
EC-5 Soil Binders
EC-6 Straw Mulch
EC-7 Geotextiles and Mats
EC-8 Wood Mulching

## Description and Purpose

Hydroseeding typically consists of applying a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion with hydro-mulch equipment, to temporarily protect exposed soils from erosion by water and wind.

## Suitable Applications

Hydroseeding is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity.

## Limitations

- Hydroseeding may be used alone only when there is sufficient time in the season to ensure adequate vegetation establishment and coverage to provide adequate erosion control. Otherwise, hydroseeding must be used in conjunction with mulching (i.e., straw mulch).
- Steep slopes are difficult to protect with temporary seeding.
- Temporary seeding may not be appropriate in dry periods without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation is not appropriate for short term inactivity.

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### Implementation

In order to select appropriate hydroseeding mixtures, an evaluation of site conditions shall be performed with respect to:

- Soil conditions
- Site topography
- Season and climate
- Vegetation types
- Maintenance requirements
- Sensitive adjacent areas
- Water availability
- Plans for permanent vegetation

The local office of the U.S.D.A. Natural Resources Conservation Service (NRCS) is an excellent source of information on appropriate seed mixes.

The following steps shall be followed for implementation:

- Avoid use of hydroseeding in areas where the BMP would be incompatible with future earthwork activities and would have to be removed.
- Hydroseeding can be accomplished using a multiple step or one step process. The multiple step process ensures maximum direct contact of the seeds to soil. When the one step process is used to apply the mixture of fiber, seed, etc., the seed rate shall be increased to compensate for all seeds not having direct contact with the soil.
- Prior to application, roughen the area to be seeded with the furrows trending along the contours.
- Apply a straw mulch to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- All seeds shall be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. The container shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed shall be pellet inoculated. Inoculant sources shall be species specific and shall be applied at a rate of 2 lb of inoculant per 100 lb seed.
- Commercial fertilizer shall conform to the requirements of the California Food and Agricultural Code. Fertilizer shall be pelleted or granular form.
- Follow up applications shall be made as needed to cover weak spots and to maintain adequate soil protection.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.

### Costs

Average cost for installation and maintenance may vary from as low as $300 per acre for flat slopes and stable soils, to $1600 per acre for moderate to steep slopes and/or erosive soils.

| Hydroseeding | | Installed Cost per Acre |
|---|---|---|
| High Density | Ornamentals | $400 - $1600 |
| | Turf Species | $350 |
| | Bunch Grasses | $300 - $1300 |
| Fast Growing | Annual | $350 - $650 |
| | Perennial | $300 - $800 |
| Non-Competing | Native | $300 - $1600 |
| | Non-Native | $400 - $500 |
| Sterile | Cereal Grain | $500 |

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Where seeds fail to germinate, or they germinate and die, the area must be re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates.
- Irrigation systems, if applicable, should be inspected daily while in use to identify system malfunctions and line breaks. When line breaks are detected, the system must be shut down immediately and breaks repaired before the system is put back into operation.
- Irrigation systems shall be inspected for complete coverage and adjusted as needed to maintain complete coverage.

### References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

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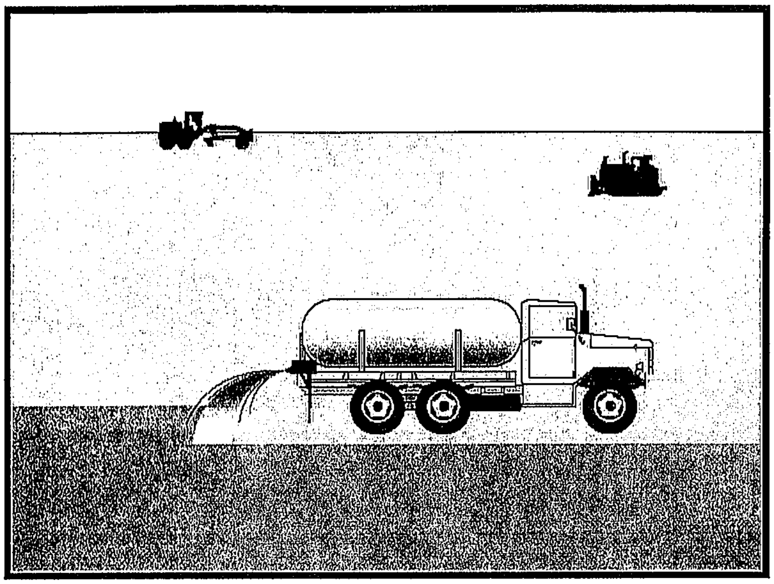

**Objectives**

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | ☒ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

**Targeted Constituents**

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

**Potential Alternatives**

EC-3 Hydraulic Mulch
EC-4 Hydroseeding
EC-6 Straw Mulch
EC-7 Geotextiles and Mats
EC-8 Wood Mulching

## Description and Purpose

Soil binders consist of applying and maintaining a soil stabilizer to exposed soil surfaces. Soil binders are materials applied to the soil surface to temporarily prevent water induced erosion of exposed soils on construction sites. Soil binders also prevent wind erosion.

## Suitable Applications

Soil binders are typically applied to disturbed areas requiring short term temporary protection. Because soil binders can often be incorporated into the work, they are a good alternative to mulches in areas where grading activities will soon resume. Soil binders are also suitable for use on stockpiles.

## Limitations

- Soil binders are temporary in nature and may need reapplication.
- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer. Curing time may be 24 hours or longer. Soil binders may need reapplication after a storm event.
- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.

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- Soil binders do not hold up to pedestrian or vehicular traffic across treated areas.
- Soil binders may not penetrate soil surfaces made up primarily of silt and clay, particularly when compacted.
- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.
- Soil binders may not cure if low temperatures occur within 24 hours of application.
- The water quality impacts of soil binders are relatively unknown and some may have water quality impacts due to their chemical makeup.
- A sampling and analysis plan must be incorporated into the SWPPP as soil binders could be a source of non-visible pollutants.

## Implementation

### *General Considerations*

- Regional soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and should not stain paved or painted surfaces. Soil binders should not pollute stormwater.
- Some soil binders may not be compatible with existing vegetation.
- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.

### *Selecting a Soil Binder*

Properties of common soil binders used for erosion control are provided on Table 1 at the end of this BMP. Use Table 1 to select an appropriate soil binder. Refer to WE-1, Wind Erosion Control, for dust control soil binders.

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders.
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- Frequency of application - The frequency of application can be affected by subgrade conditions, surface type, climate, and maintenance schedule. Frequent applications could



A002483

lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean up.

### *Plant-Material Based (Short Lived) Binders*

Guar: Guar is a non-toxic, biodegradable, natural galactomannan based hydrocolloid treated with dispersant agents for easy field mixing. It should be mixed with water at the rate of 11 to 15 lb per 1,000 gallons. Recommended minimum application rates are as follows:

**Application Rates for Guar Soil Stabilizer**

| Slope (H:V): | Flat | 4:1 | 3:1 | 2:1 | 1:1 |
|---|---|---|---|---|---|
| lb/acre: | 40 | 45 | 50 | 60 | 70 |

Psyllium: Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates should be from 80 to 200 lb/acre, with enough water in solution to allow for a uniform slurry flow.

Starch: Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lb/acre. Approximate drying time is 9 to 12 hours.

### *Plant-Material Based (Long Lived) Binders*

Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin should be a minimum of 26% of the total solids content. The soil stabilizer should be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and should be applied as follows:

- For clayey soil: 5 parts water to 1 part emulsion
- For sandy soil: 10 parts water to 1 part emulsion

Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

### *Polymeric Emulsion Blend Binders*

Acrylic Copolymers and Polymers: Polymeric soil stabilizers should consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound should be handled and mixed in a manner that will not cause foaming or should contain an anti-foaming agent. The polymeric emulsion should not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer should be readily miscible in water, non-injurious to seed or animal life, non-flammable, should provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and should not re-emulsify when cured. The applied compound should air cure within a maximum of 36 to 48 hours. Liquid copolymer should be diluted at a rate of 10 parts water to 1 part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.

Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with manufacturer's recommendations, and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.

Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient:

| Slope Gradient (H:V) | lb/acre |
|---|---|
| Flat to 5:1 | 3.0 – 5.0 |
| 5:1 to 3:1 | 5.0 – 10.0 |
| 2:2 to 1:1 | 10.0 – 20.0 |

Poly-Acrylamide and Copolymer of Acrylamide: Linear copolymer polyacrylamide is packaged as a dry flowable solid. When used as a stand alone stabilizer, it is diluted at a rate of 1lb/1,000 gal of water and applied at the rate of 5.0 lb/acre.

Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 lb/acre. Drying times are 0 to 4 hours.

### *Cementitious-Based Binders*

Gypsum: This is a formulated gypsum based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 lb/acre. Drying time is 4 to 8 hours.

### *Applying Soil Binders*

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps should be followed:

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.
- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.

- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.
- For liquid agents:
  - Crown or slope ground to avoid ponding.
  - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd$^2$ or according to manufacturer's recommendations.
  - Apply solution under pressure. Overlap solution 6 to 12 in.
  - Allow treated area to cure for the time recommended by the manufacturer; typically at least 24 hours.
  - Apply second treatment before first treatment becomes ineffective, using 50% application rate.
  - In low humidities, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd$^2$.

### Costs

Costs vary according to the soil stabilizer selected for implementation. The following are approximate costs:

| Soil Binder | Cost per Acre |
|---|---|
| Plant-Material Based (Short Lived) Binders | $400 |
| Plant-Material Based (Long Lived) Binders | $1,200 |
| Polymeric Emulsion Blend Binders | $400 (1) |
| Cementitious-Based Binders | $800 |

(1) $1,200 for Acrylic polymers and copolymers

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Reapply the selected soil binder as needed to maintain effectiveness.

**References**

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

| **Table 1 Properties of Soil Binders for Erosion Control** | | | | |
|---|---|---|---|---|
| **Evaluation Criteria** | **Binder Type** | | | |
| | **Plant Material Based (Short Lived)** | **Plant Material Based (Long Lived)** | **Polymeric Emulsion Blends** | **Cementitious-Based Binders** |
| Relative Cost | Low | Low | Low | Low |
| Resistance to Leaching | High | High | Low to Moderate | Moderate |
| Resistance to Abrasion | Moderate | Low | Moderate to High | Moderate to High |
| Longevity | Short to Medium | Medium | Medium to Long | Medium |
| Minimum Curing Time before Rain | 9 to 18 hours | 19 to 24 hours | 0 to 24 hours | 4 to 8 hours |
| Compatibility with Existing Vegetation | Good | Poor | Poor | Poor |
| Mode of Degradation | Biodegradable | Biodegradable | Photodegradable/ Chemically Degradable | Photodegradable/ Chemically Degradable |
| Labor Intensive | No | No | No | No |
| Specialized Application Equipment | Water Truck or Hydraulic Mulcher | Water Truck or Hydraulic Mulcher | Water Truck or Hydraulic Mulcher | Water Truck or Hydraulic Mulcher |
| Liquid/Powder | Powder | Liquid | Liquid/Powder | Powder |
| Surface Crusting | Yes, but dissolves on rewetting | Yes | Yes, but dissolves on rewetting | Yes |
| Clean Up | Water | Water | Water | Water |
| Erosion Control Application Rate | Varies (1) | Varies (1) | Varies (1) | 4,000 to 12,000 lbs/acre |

(1) See Implementation for specific rates.



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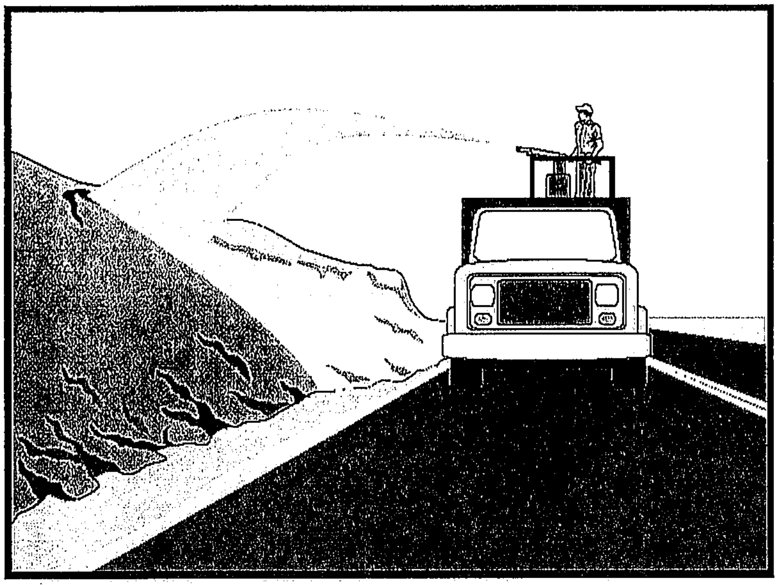
# Straw Mulch EC-6



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

## Description and Purpose

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or anchoring it with a tackifier stabilizing emulsion. Straw mulch protects the soil surface from the impact of rain drops, preventing soil particles from becoming dislodged.

## Suitable Applications

Straw mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established. Straw mulch is typically used for erosion control on disturbed areas until soils can be prepared for permanent vegetation. Straw mulch is also used in combination with temporary and/or permanent seeding strategies to enhance plant establishment.

## Limitations

- Availability of straw and straw blowing equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- There is a potential for introduction of weed seed and unwanted plant material.
- When straw blowers are used to apply straw mulch, the treatment areas must be within 150 ft of a road or surface capable of supporting trucks.
- Straw mulch applied by hand is more time intensive and potentially costly.

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- Wind may limit application of straw and blow straw into undesired locations.
- May have to be removed prior to permanent seeding or prior to further earthwork.
- "Punching" of straw does not work in sandy soils, necessitating the use of tackifiers.

### Implementation

- Straw shall be derived from wheat, rice, or barley. Where required by the plans, specifications, permits, or environmental documents, native grass straw shall be used.
- A tackifier is the preferred method for anchoring straw mulch to the soil on slopes.
- Crimping, punch roller-type rollers, or track walking may also be used to incorporate straw mulch into the soil on slopes. Track walking shall only be used where other methods are impractical.
- Avoid placing straw onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Straw mulch with tackifier shall not be applied during or immediately before rainfall.
- In San Diego, use of straw near wood framed home construction has been frowned on by the Fire Marshall.

### Application Procedures

- Apply straw at a minimum rate of 4,000 lb/acre, either by machine or by hand distribution.
- Roughen embankments and fill rills before placing the straw mulch by rolling with a crimping or punching type roller or by track walking.
- Evenly distribute straw mulch on the soil surface.
- Anchor straw mulch to the soil surface by "punching" it into the soil mechanically (incorporating). Alternatively, use a tackifier to adhere straw fibers.
- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions, and longevity.
  - On small areas, a spade or shovel can be used to punch in straw mulch.
  - On slopes with soils that are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife blade roller or a straight bladed coulter, known commercially as a "crimper".
  - On small areas and/or steep slopes, straw can also be held in place using plastic netting or jute. The netting shall be held in place using 11 gauge wire staples, geotextile pins or wooden stakes as described in EC-7, Geotextiles and Mats.
  - A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier shall be selected based on longevity and ability to hold the fibers in place. A tackifier is



A002491

typically applied at a rate of 125 lb/acre. In windy conditions, the rates are typically 180 lb/acre.

## Costs

Average annual cost for installation and maintenance (3-4 months useful life) is $2,500 per acre. Application by hand is more time intensive and potentially costly.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- The key consideration in inspection and maintenance is that the straw needs to last long enough to achieve erosion control objectives.
- Maintain an unbroken, temporary mulched ground cover while disturbed soil areas are inactive. Repair any damaged ground cover and re-mulch exposed areas.
- Reapplication of straw mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.

## References

Controlling Erosion of Construction Sites, Agricultural Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Soil Erosion by Water, Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

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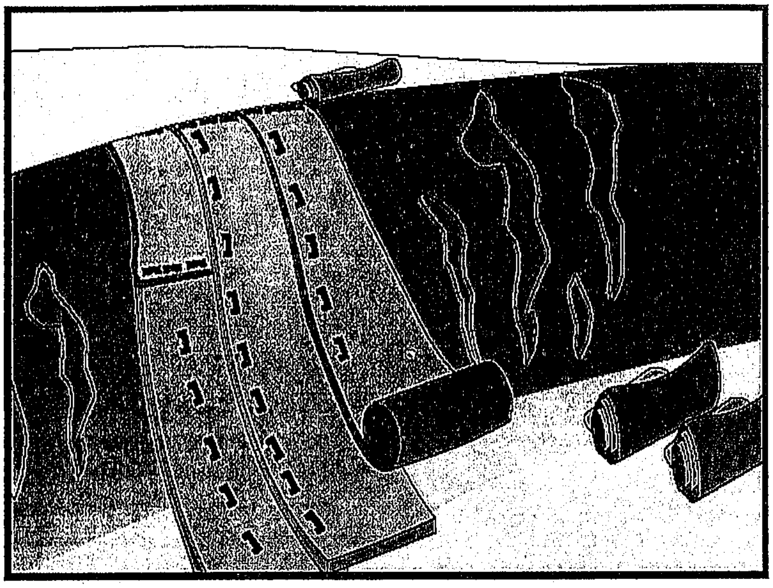

| Objectives | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | 3 |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

| Targeted Constituents | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

**Potential Alternatives**

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-8 Wood Mulching

## Description and Purpose

Mattings of natural materials are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, matting may be used to stabilize soils until vegetation is established.

## Suitable Applications

Mattings are commonly applied on short, steep slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks where moving water at velocities between 3 ft/s and 6 ft/s are likely to wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. Matting may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). Erosion control matting should be considered when the soils are fine grained and potentially erosive. These measures should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop
- Channels with flows exceeding 3.3 ft/s

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- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies of Environmentally Sensitive Areas (ESAs)

### Limitations

- Properly installed mattings provide excellent erosion control but do so at relatively high cost. This high cost typically limits the use of mattings to areas of concentrated channel flow and steep slopes.
- Mattings are more costly than other BMP practices, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- Installation is critical and requires experienced contractors. The contractor should install the matting material in such a manner that continuous contact between the material and the soil occurs.
- Geotextiles and Mats may delay seed germination, due to reduction in soil temperature.
- Blankets and mats are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers).
- Blankets and mats must be removed and disposed of prior to application of permanent soil stabilization measures.
- Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
- Plastic results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until alternative measures, such as seeding and mulching, may be installed.
- Geotextiles, mats, plastic covers, and erosion control covers have maximum flow rate limitations; consult the manufacturer for proper selection.
- Not suitable for areas that have heavy foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.

### Implementation

#### *Material Selection*

Organic matting materials have been found to be effective where re-vegetation will be provided by re-seeding. The choice of matting should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

The following natural and synthetic mattings are commonly used:

### *Geotextiles*

- Material should be a woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 $sec^{-1}$ in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.
- Geotextiles may be reused if they are suitable for the use intended.

### *Plastic Covers*

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil.
- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

### *Erosion Control Blankets/Mats*

- Biodegradable rolled erosion control products (RECPs) are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable.
  - **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. It is designed to be used in conjunction with vegetation and has longevity of approximately one year. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.
  - **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 $lb/yd^2$, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples

should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 $lb/yd^2$. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 $lb/yd^2$. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 $lb/yd^2$. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

- **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

### *Site Preparation*

- Proper site preparation is essential to ensure complete contact of the blanket or matting with the soil.

- Grade and shape the area of installation.

- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.

- Prepare seedbed by loosening 2 to 3 in. of topsoil.

### *Seeding*

Seed the area before blanket installation for erosion control and revegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket installation, all check slots and other areas disturbed during installation must be re-seeded. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. When using jute matting on a seeded area, apply approximately half the seed before laying the mat and the remainder after laying the mat. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

### *Check Slots*

Check slots are made of glass fiber strips, excelsior matting strips or tight folded jute matting blanket or strips for use on steep, highly erodible watercourses. The check slots are placed in narrow trenches 6 to 12 in. deep across the channel and left flush with the soil surface. They are to cover the full cross section of designed flow.

### *Laying and Securing Matting*

- Before laying the matting, all check slots should be installed and the friable seedbed made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.
- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

### *Anchoring*

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.
- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.
- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.
- Wire staples and metal stakes should be driven flush to the soil surface.

### *Installation on Slopes*

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket down slope in the direction of water flow.
- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft.

- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd$^2$. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd$^2$.

***Installation in Channels***

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.
- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.

- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

***Soil Filling (if specified for turf reinforcement)***

- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

***Temporary Soil Stabilization Removal***

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

## Costs

Relatively high compared to other BMPs. Biodegradable materials: \$0.50 - \$0.57/yd$^2$. Permanent materials: \$3.00 - \$4.50/yd$^2$. Staples: \$0.04 - \$0.05/staple. Approximate costs for installed materials are shown below:

| Rolled Erosion Control Products | | Installed Cost per Acre |
|---|---|---|
| Biodegradable | Jute Mesh | $6,500 |
| | Curled Wood Fiber | $10,500 |
| | Straw | $8,900 |
| | Wood Fiber | $8,900 |
| | Coconut Fiber | $13,000 |
| | Coconut Fiber Mesh | $31,200 |
| | Straw Coconut Fiber | $10,900 |
| Non-Biodegradable | Plastic Netting | $2,000 |
| | Plastic Mesh | $3,200 |
| | Synthetic Fiber with Netting | $34,800 |
| | Bonded Synthetic Fibers | $50,000 |
| | Combination with Biodegradable | $32,000 |

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

***Inspection and Maintenance***

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.



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- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.
- Check that disturbed areas are seeded.

## References

Guides for Erosion and Sediment Controls in California, USDA Soils Conservation Service, January 1991.

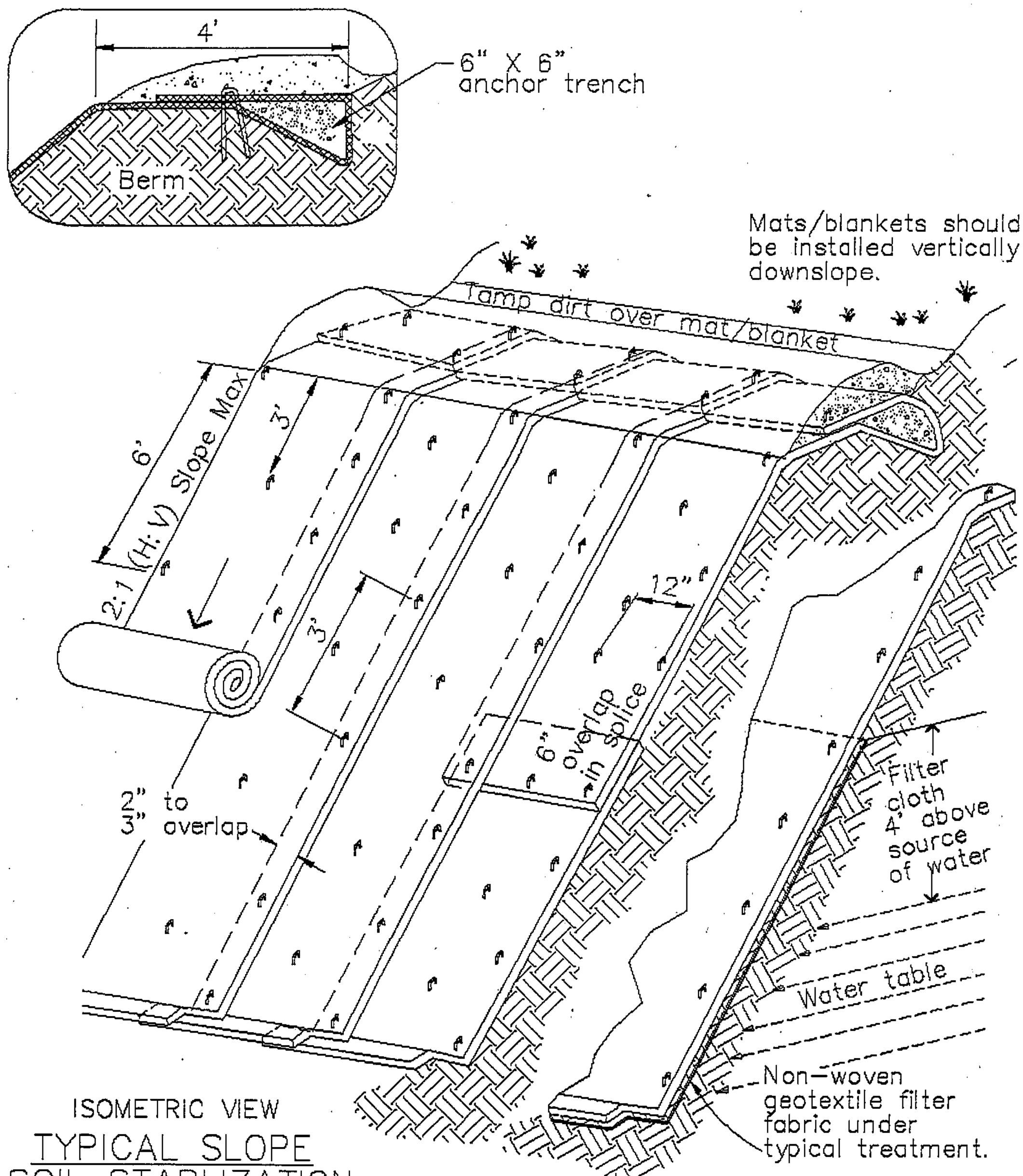
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.




ISOMETRIC VIEW

TYPICAL SLOPE SOIL STABLIZATION

NTS

WET SLOPE LINING

NTS

NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL



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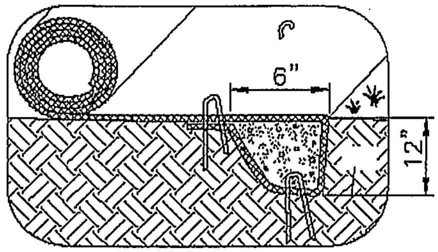
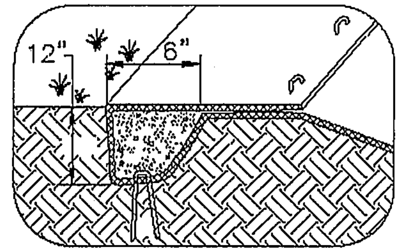



INITIAL CHANNEL ANCHOR TRENCH
NTS




TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
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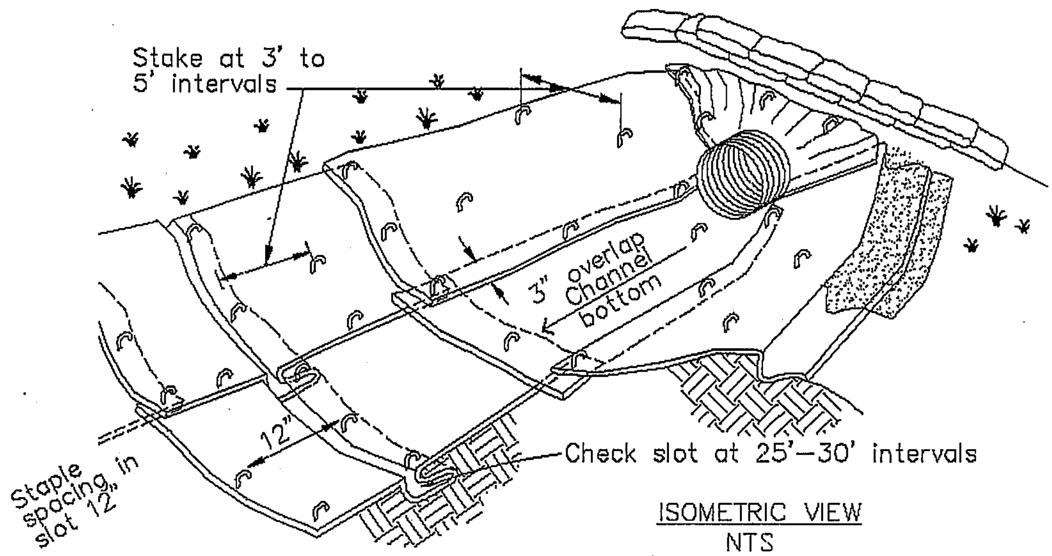


ISOMETRIC VIEW
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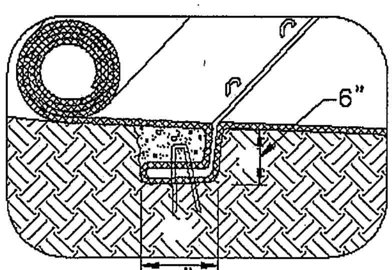


INTERMITTENT CHECK SLOT
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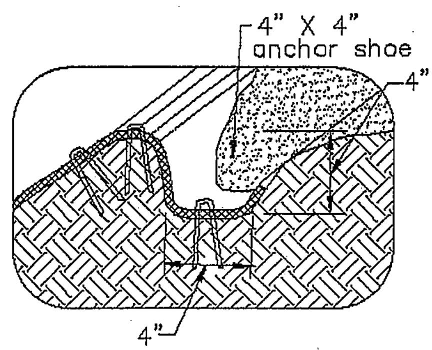


LONGITUDINAL ANCHOR TRENCH
NTS

NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL

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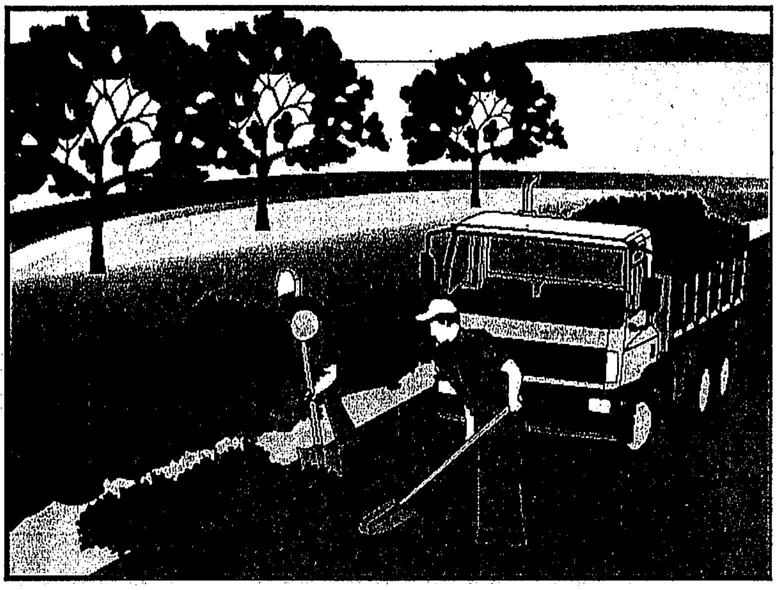

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | ☒ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

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## Description and Purpose

Wood mulching consist of applying a mixture of shredded wood mulch, bark or compost to disturbed soils. The primary function of wood mulching is to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff.

## Suitable Applications

Wood mulching is suitable for disturbed soil areas requiring temporary protection until permanent stabilization is established.

## Limitations

- Not suitable for use on slopes steeper than 3:1 (H:V). Best suited to flat areas or gentle slopes or 5:1 (H:V) or flatter.
- Wood mulch and compost may introduce unwanted species.
- Not suitable for areas exposed to concentrated flows.
- May need to be removed prior to further earthwork.

## Implementation

### *Mulch Selection*

There are many types of mulches. Selection of the appropriate type of mulch should be based on the type of application, site conditions, and compatibility with planned or future uses.

### *Application Procedures*

Prior to application, after existing vegetation has been removed, roughen embankment and fill areas by rolling with a device such



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as a punching type roller or by track walking. The construction application procedures for mulches vary significantly depending upon the type of mulching method specified. Two methods are highlighted here:

- Green Material: This type of mulch is produced by the recycling of vegetation trimmings such as grass, shredded shrubs, and trees. Methods of application are generally by hand although pneumatic methods are available.
  - Green material can be used as a temporary ground cover with or without seeding.
  - The green material should be evenly distributed on site to a depth of not more than 2 in.
- Shredded Wood: Suitable for ground cover in ornamental or revegetated plantings.
  - Shredded wood/bark is conditionally suitable. See note under limitations.
  - Distribute by hand or use pneumatic methods.
  - Evenly distribute the mulch across the soil surface to a depth of 2 to 3 in.
- Avoid mulch placement onto roads, sidewalks, drainage channels, existing vegetation, etc.

### Costs
Average annual cost for installation and maintenance (3-4 months useful life) is around $4,000 per acre, but cost can increase if the source is not close to the project site.

### Inspection and Maintenance
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- Regardless of the mulching technique selected, the key consideration in inspection and maintenance is that the mulch needs to last long enough to achieve erosion control objectives. If the mulch is applied as a stand alone erosion control method over disturbed areas (without seed), it should last the length of time the site will remain barren or until final re-grading and revegetation.
- Where vegetation is not the ultimate cover, such as ornamental and landscape applications of bark or wood chips, inspection and maintenance should focus on longevity and integrity of the mulch.
- Reapply mulch when bare earth becomes visible.

### References
Controlling Erosion of Construction Sites Agriculture Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, U.S. EPA, April 1990.

Soil Erosion by Water Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

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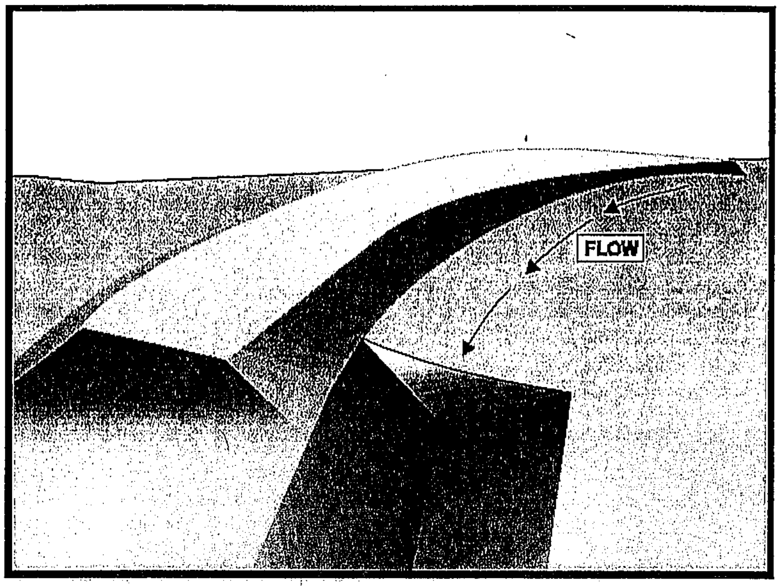


### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

None

## Description and Purpose

An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

## Suitable Applications

Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

- Earth dikes and drainage swales may be used:
  - To convey surface runoff down sloping land
  - To intercept and divert runoff to avoid sheet flow over sloped surfaces
  - To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
  - To intercept runoff from paved surfaces
  - Below steep grades where runoff begins to concentrate
  - Along roadways and facility improvements subject to flood drainage

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- At the top of slopes to divert runon from adjacent or undisturbed slopes
- At bottom and mid slope locations to intercept sheet flow and convey concentrated flows
- Divert sediment laden runoff into sediment basins or traps

### Limitations

Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

- Earth dikes may create more disturbed area on site and become barriers to construction equipment.
- Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
- Diverted stormwater may cause downstream flood damage.
- Dikes should not be constructed of soils that may be easily eroded.
- Regrading the site to remove the dike may add additional cost.
- Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
- Temporary drains and swales must conform to local floodplain management requirements.
- Earth dikes/drainage swales are not suitable as sediment trapping devices.
- It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.

### Implementation

The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations, and should not be used in areas with slopes steeper than 10%.

Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert runoff to a location where it can be brought to the bottom of the slope (see EC-11, Slope Drains). A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

### *General*

- Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.
- Conveyances should be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff onto other property without securing written authorization from the property owner.
- When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

### *Earth Dikes*

Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

- All dikes should be compacted by earth moving equipment.
- All dikes should have positive drainage to an outlet.
- All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.
- The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin (SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.

- Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.
- If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

| Channel Grade | Riprap Stabilization |
|---|---|
| 0.5-1.0% | 4 in. Rock |
| 1.1-2.0% | 6 in. Rock |
| 2.1-4.0% | 8 in. Rock |
| 4.1-5.0% | 8 in. -12 in. Riprap |

- The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.
- Filter cloth may be used to cover dikes in use for long periods.
- Construction activity on the earth dike should be kept to a minimum.

### *Drainage Swales*

Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost effective diversion.

Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- No more than 5 acres may drain to a temporary drainage swale.
- Place drainage swales above or below, not on, a cut or fill slope.
- Swale bottom width should be at least 2 ft
- Depth of the swale should be at least 18 in.
- Side slopes should be 2:1 or flatter.
- Drainage or swales should be laid at a grade of at least 1 percent, but not more than 15 percent.
- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.
- Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.
- Compact any fill material along the path of the swale.

- Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 percent, and use rip-rap or sod for swales with a slope between 5 and 15 percent. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

### Costs

- Cost ranges from $15 to $55 per ft for both earthwork and stabilization and depends on availability of material, site location, and access.
- Small dikes: $2.50 - $6.50/linear ft; Large dikes: $2.50/yd$^3$.
- The cost of a drainage swale increases with drainage area and slope. Typical swales for controlling internal erosion are inexpensive, as they are quickly formed during routine earthwork.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction

### References

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursetynsky, P.E., McGraw Hill Book Company, 1986.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

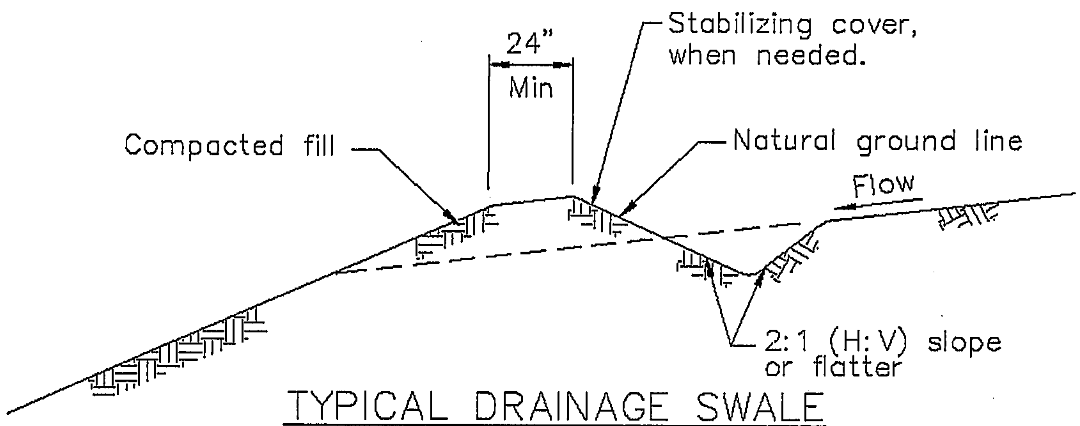
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

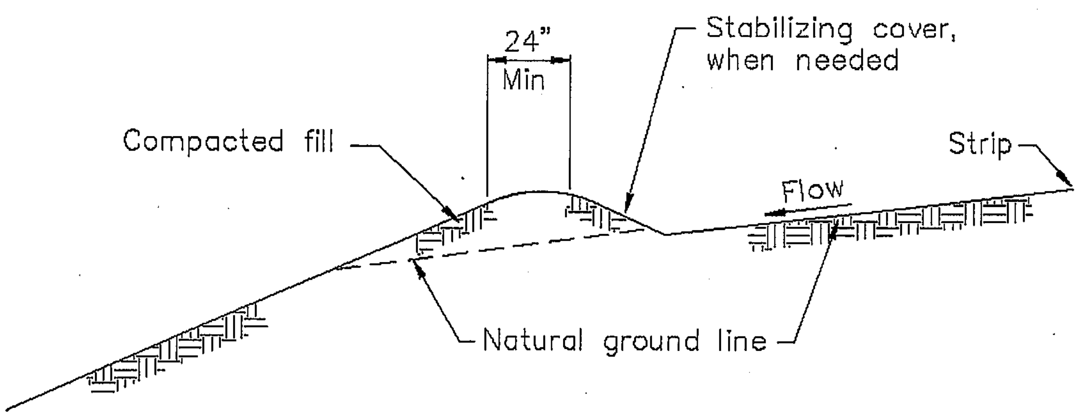
Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.




TYPICAL DRAINAGE SWALE
NOT TO SCALE

NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.




TYPICAL EARTH DIKE
NOT TO SCALE



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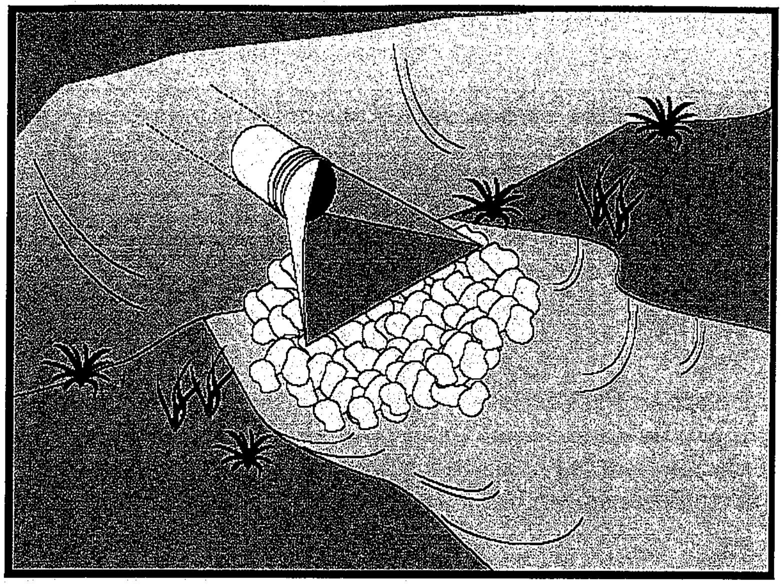
# Velocity Dissipation Devices EC-10



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

None

## Description and Purpose

Outlet protection is a physical device composed of rock, grouted riprap, or concrete rubble, which is placed at the outlet of a pipe or channel to prevent scour of the soil caused by concentrated, high velocity flows.

## Suitable Applications

Whenever discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This includes temporary diversion structures to divert runon during construction.

- These devices may be used at the following locations:
  - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits, or channels.
  - Outlets located at the bottom of mild to steep slopes.
  - Discharge outlets that carry continuous flows of water.
  - Outlets subject to short, intense flows of water, such as flash floods.
  - Points where lined conveyances discharge to unlined conveyances

## Limitations

- Large storms or high flows can wash away the rock outlet protection and leave the area susceptible to erosion.

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- Sediment captured by the rock outlet protection may be difficult to remove without removing the rock.
- Outlet protection may negatively impact the channel habitat.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.

## Implementation

### *General*

Outlet protection is needed where discharge velocities and energies at the outlets of culverts, conduits or channels are sufficient to erode the immediate downstream reach. This practice protects the outlet from developing small eroded pools (plange pools), and protects against gully erosion resulting from scouring at a culvert mouth.

### *Design and Layout*

As with most channel design projects, depth of flow, roughness, gradient, side slopes, discharge rate, and velocity should be considered in the outlet design. Compliance to local and state regulations should also be considered while working in environmentally sensitive streambeds. General recommendations for rock size and length of outlet protection mat are shown in the rock outlet protection figure in this BMP and should be considered minimums. The apron length and rock size gradation are determined using a combination of the discharge pipe diameter and estimate discharge rate: Select the longest apron length and largest rock size suggested by the pipe size and discharge rate. Where flows are conveyed in open channels such as ditches and swales, use the estimated discharge rate for selecting the apron length and rock size. Flows should be same as the culvert or channel design flow but never the less than the peak 5 year flow for temporary structures planned for one rainy season, or the 10 year peak flow for temporary structures planned for two or three rainy seasons.

- There are many types of energy dissipaters, with rock being the one that is represented in the attached figure.
- Best results are obtained when sound, durable, and angular rock is used.
- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction. Grouted or wired tied rock riprap can minimize maintenance requirements.
- Rock outlet protection is usually less expensive and easier to install than concrete aprons or energy dissipaters. It also serves to trap sediment and reduce flow velocities.
- Carefully place riprap to avoid damaging the filter fabric.
  - Stone 4 in. to 6 in. may be carefully dumped onto filter fabric from a height not to exceed 12 in.
  - Stone 8 in. to 12 in. must be hand placed onto filter fabric, or the filter fabric may be covered with 4 in. of gravel and the 8 in. to 12 in. rock may be dumped from a height not to exceed 16 in.

- Stone greater than 12 in. shall only be dumped onto filter fabric protected with a layer of gravel with a thickness equal to one half the $D_{50}$ rock size, and the dump height limited to twice the depth of the gravel protection layer thickness.

- For proper operation of apron: Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in upper section of apron.

- Outlets on slopes steeper than 10 percent should have additional protection.

### Costs

Costs are low if material is readily available. If material is imported, costs will be higher. Average installed cost is $150 per device.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur.

- Inspect apron for displacement of the riprap and damage to the underlying fabric. Repair fabric and replace riprap that has washed away. If riprap continues to wash away, consider using larger material.

- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.

- Temporary devices should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.

### References

County of Sacramento Improvement Standards, Sacramento County, May 1989.

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursztynsky, P.E., McGraw Hill Book Company, 1986.

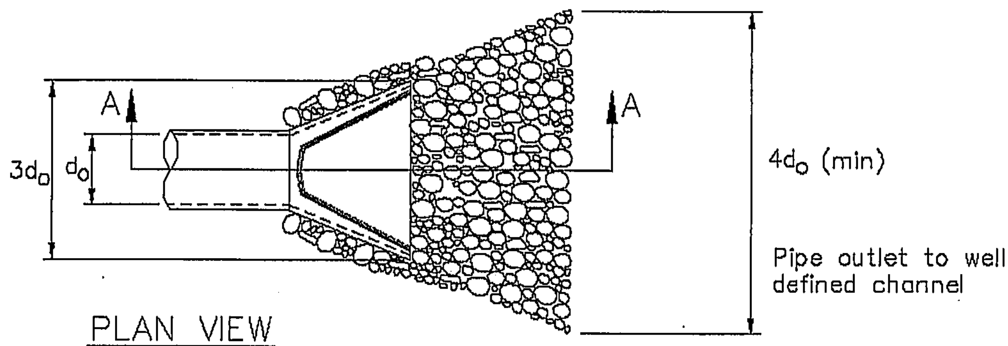
Handbook of Steel Drainage & Highway Construction, American Iron and Steel Institute, 1983.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

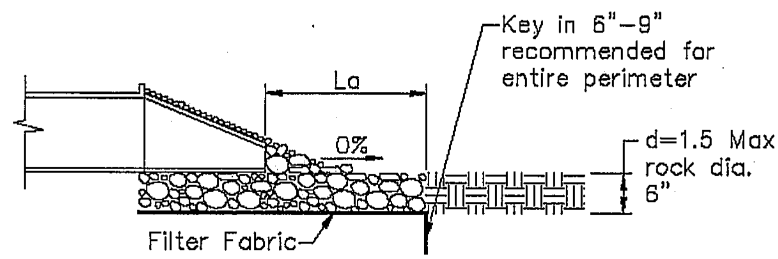
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, state of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.




PLAN VIEW




SECTION A–A

| Pipe Diameter inches | Discharge $ft^3/s$ | Apron Length, La ft | Rip Rap $D_{50}$ Diameter Min inches |
|---|---|---|---|
| 12 | 5 | 10 | 4 |
| | 10 | 13 | 6 |
| 18 | 10 | 10 | 6 |
| | 20 | 16 | 8 |
| | 30 | 23 | 12 |
| | 40 | 26 | 16 |
| 24 | 30 | 16 | 8 |
| | 40 | 26 | 8 |
| | 50 | 26 | 12 |
| | 60 | 30 | 16 |

For larger or higher flows consult a Registered Civil Engineer
Source: USDA - SCS



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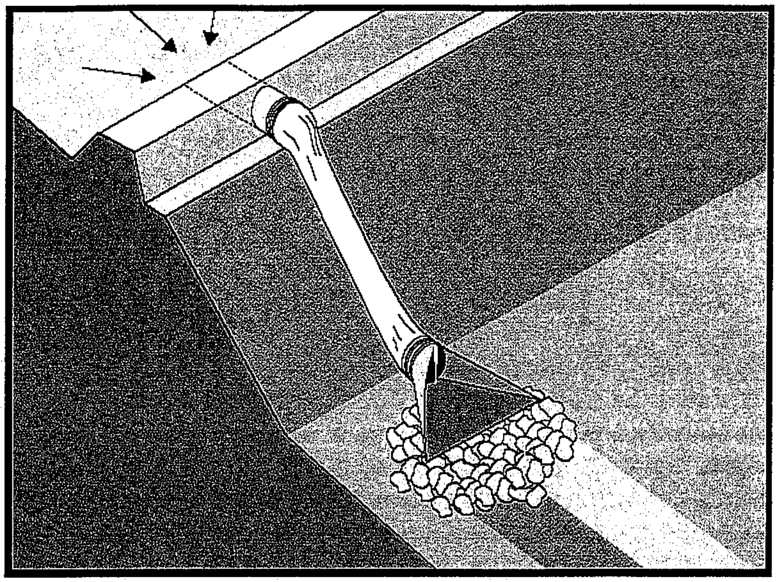
# Slope Drains

# EC-11



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

EC-9 Earth Dike, Drainage Swales

## Description and Purpose

A slope drain is a pipe used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Slope drains are used with earth dikes and drainage ditches to intercept and direct surface flow away from slope areas to protect cut or fill slopes.

## Suitable Applications

- Where concentrated flow of surface runoff must be conveyed down a slope in order to prevent erosion.
- Drainage for top of slope diversion dikes or swales.
- Drainage for top of cut and fill slopes where water can accumulate.
- Emergency spillway for a sediment basin.

## Limitations

Installation is critical for effective use of the pipe slope drain to minimize potential gully erosion.

- Maximum drainage area per slope drain is 10 acres. (For large areas use a paved chute, rock lined channel, or additional pipes.)
- Severe erosion may result when slope drains fail by overtopping, piping, or pipe separation.

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- During large storms, pipe slope drains may become clogged or over charged, forcing water around the pipe and causing extreme slope erosion.
- If the sectional downdrain is not sized correctly, the runoff can spill over the drain sides causing gully erosion and potential failure of the structure.

- Dissipation of high flow velocities at the pipe outlet is required to avoid downstream erosion.

## Implementation

### *General*

The slope drain is applicable for any construction site where concentrated surface runoff can accumulate and must be conveyed down the slope in order to prevent erosion. The slope drain is effective because it prevents the stormwater from flowing directly down the slope by confining all the runoff into an enclosed pipe or channel. Due to the time lag between grading slopes and installation of permanent stormwater collection systems and slope stabilization measures, temporary provisions to intercept runoff are sometimes necessary. Particularly in steep terrain, slope drains can protect unstabilized areas from erosion.

### *Installation*

The slope drain may be a rigid pipe, such as corrugated metal, a flexible conduit, or a lined terrace drain with the inlet placed on the top of a slope and the outlet at the bottom of the slope. This BMP typically is used in combination with a diversion control, such as an earth dike or drainage swale at the top of the slope.

The following criteria must be considered when siting slope drains.

- Permanent structures included in the project plans can often serve as construction BMPs if implemented early. However, the permanent structure must meet or exceed the criteria for the temporary structure.
- Inlet structures must be securely entrenched and compacted to avoid severe gully erosion.
- Slope drains must be securely anchored to the slope and must be adequately sized to carry the capacity of the design storm and associated forces.
- Outlets must be stabilized with riprap, concrete or other type of energy dissipator, or directed into a stable sediment trap or basin. See EC-10, Velocity Dissipation Devices.
- Debris racks are recommended at the inlet. Debris racks located several feet upstream of the inlet can usually be larger than racks at the inlet, and thus provide enhanced debris protection and less plugging.
- Safety racks are also recommended at the inlet and outlet of pipes where children or animals could become entrapped.
- Secure inlet and surround with dikes to prevent gully erosion and anchor pipe to slope.
- When using slope drains, limit drainage area to 10 acres per pipe. For larger areas, use a rock lined channel or a series of pipes.

- Size to convey at least the peak flow of a 10-year storm. The design storm is conservative due to the potential impact of system failures.
- Maximum slope generally limited to 2:1 (H:V) as energy dissipation below steeper slopes is difficult.
- Direct surface runoff to slope drains with interceptor dikes. See BMP EC-9, Earth Dikes and Drainage Swales. Top of interceptor dikes should be 12 in. higher than the top of the slope drain.
- Slope drains can be placed on or buried underneath the slope surface.
- Recommended materials include both metal and plastic pipe, either corrugated or smooth wall. Concrete pipe can also be used.
- When installing slope drains:
  - Install slope drains perpendicular to slope contours.
  - Compact soil around and under entrance, outlet, and along length of pipe.
  - Securely anchor and stabilize pipe and appurtenances into soil.
  - Check to ensure that pipe connections are watertight.
  - Protect area around inlet with filter cloth. Protect outlet with riprap or other energy dissipation device. For high energy discharges, reinforce riprap with concrete or use reinforced concrete device.
  - Protect outlet of slope drains using a flared end section when outlet discharges to a flexible energy dissipation device.
  - A flared end section installed at the inlet will improve flow into the slope drain and prevent erosion at the pipe entrance. Use a flared end section with a 6 in. minimum toe plate to help prevent undercutting. The flared section should slope towards the pipe inlet.

### *Design and Layout*

The capacity for temporary drains should be sufficient to convey at least the peak runoff from a 10-year rainfall event. The pipe size may be computed using the Rational Method or a method established by the local municipality. Higher flows must be safely stored or routed to prevent any offsite concentration of flow and any erosion of the slope. The design storm is purposely conservative due to the potential impacts associated with system failures.

As a guide, temporary pipe slope drains should not be sized smaller than shown in the following table:

| Minimum Pipe Diameter (Inches) | Maximum Drainage Area (Acres) |
|---|---|
| 12 | 1.0 |
| 18 | 3.0 |
| 21 | 5.0 |
| 24 | 7.0 |
| 30 | 10.0 |

Larger drainage areas can be treated if the area can be subdivided into areas of 10 acres or less and each area is treated as a separate drainage. Drainage areas exceeding 10 acres must be designed by a Registered Civil Engineer and approved by the agency that issued the grading permit.

### *Materials:*

Soil type, rainfall patterns, construction schedule, local requirements, and available supply are some of the factors to be considered when selecting materials. The following types of slope drains are commonly used:

- **Rigid Pipe:** This type of slope drain is also known as a pipe drop. The pipe usually consists of corrugated metal pipe or rigid plastic pipe. The pipe is placed on undisturbed or compacted soil and secured onto the slope surface or buried in a trench. Concrete thrust blocks must be used when warranted by the calculated thrust forces. Collars should be properly installed and secured with metal strappings or watertight collars.

- **Flexible Pipe**: The flexible pipe slope drain consists of a flexible tube of heavy-duty plastic, rubber, or composite material. The tube material is securely anchored onto the slope surface. The tube should be securely fastened to the metal inlet and outlet conduit sections with metal strappings or watertight collars.

- **Section Downdrains**: The section downdrain consists of pre-fabricated, section conduit of half round or third round material. The sectional downdrain performs similar to a flume or chute. The pipe must be placed on undisturbed or compacted soil and secured into the slope.

- **Concrete-lined Terrace Drain:** This is a concrete channel for draining water from a terrace on a slope to the next level. These drains are typically specified as permanent structures and, if installed early, can serve as slope drains during construction, which should be designed according to local drainage design criteria.

### Costs

- Cost varies based on pipe selection and selected outlet protection.

| Corrugated Steel Pipes, Per Foot | |
|---|---|
| Size | Supplied and Installed Cost (No Trenching Included) |
| 12" | $19.60 per LF |
| 15" | $22.00 |
| 18" | $26.00 |
| 24" | $32.00 |
| 30" | $50.00 |
| **PVC Pipes, Per Foot** | |
| Size | Supplied and Installed Cost (No Trenching Included) |
| 12" | $24.50 |
| 14" | $49.00 |
| 16" | $51.00 |
| 18" | $54.00 |
| 20" | $66.00 |
| 24" | $93.00 |
| 30" | $130.00 |

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventative measures are implemented.
- Insert inlet for clogging or undercutting. Remove debris from inlet to maintain flows. Repair undercutting at inlet and if needed, install flared section or rip rap around the inlet to prevent further undercutting.
- Inspect pipes for leakage. Repair leaks and restore damaged slopes.
- Inspect slope drainage for accumulations of debris and sediment.
- Remove built up sediment from entrances and outlets as required. Flush drains if necessary; capture and settle out sediment from discharge.



A002525

- Make sure water is not ponding onto inappropriate areas (e.g., active traffic lanes, material storage areas, etc.).
- Pipe anchors must be checked to ensure that the pipe remains anchored to the slope. Install additional anchors if pipe movement is detected.

### References

Draft – Sedimentation and Erosion Control, An Inventory of Current Practices, U.S.E.P.A., April 1990.

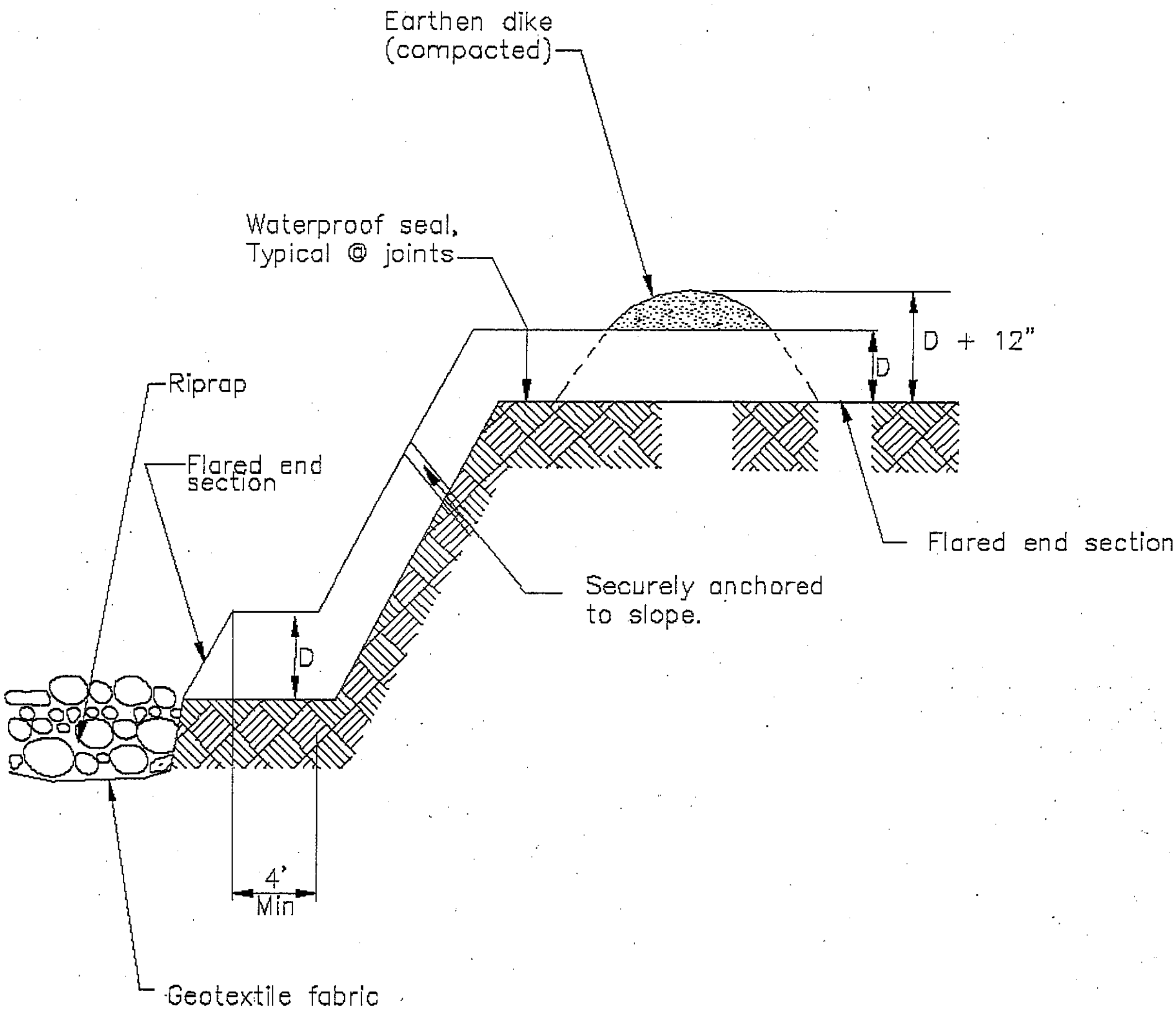
National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.




TYPICAL SLOPE DRAIN
NOT TO SCALE

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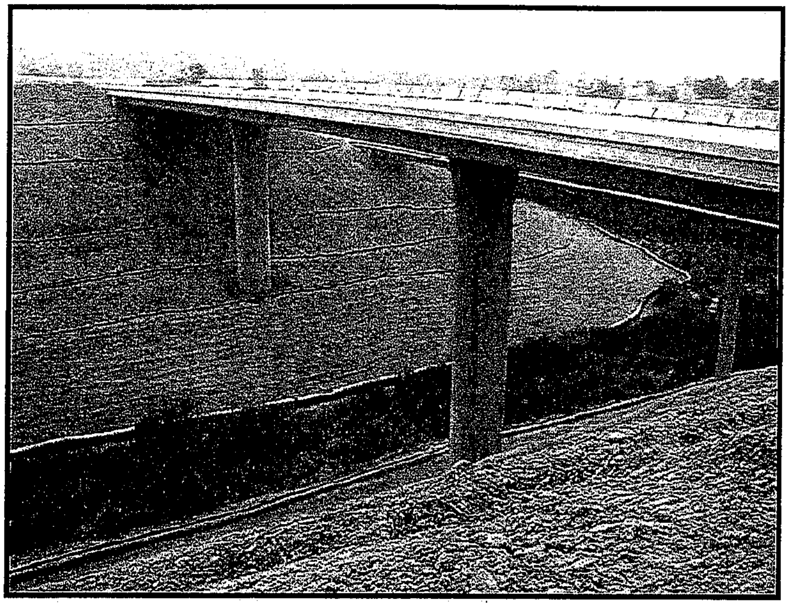


## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☒ |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

Combination of erosion and sediment controls.

## Description and Purpose

Stream channels, streambanks, and associated riparian areas are dynamic and sensitive ecosystems that respond to changes in land use activity. Streambank and channel disturbance resulting from construction activities can increase the stream's sediment load, which can cause channel erosion or sedimentation and have adverse affects on the biotic system. BMPs can reduce the discharge of sediment and other pollutants to minimize the impact of construction activities on watercourses. Streams on the 303(d) list and listed for sediment may require numerous measures to prevent any increases in sediment load to the stream.

## Suitable Applications

These procedures typically apply to all construction projects that disturb or occur within stream channels and their associated riparian areas.

## Limitations

Specific permit requirements or mitigation measures such as Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game supercede the guidance in this BMP.

- If numerical based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required. Streams listed as 303(d) impaired for sediment, silt, or turbidity, are required to conduct sampling



A002529

to verify that there is no net increase in sediment load due to construction activities.

## Implementation

### *Planning*

- Proper planning, design, and construction techniques can minimize impacts normally associated with in stream construction activities. Poor planning can adversely affect soil, fish, wildlife resources, land uses, or land users. Planning should take into account: scheduling; avoidance of in-stream construction; minimizing disturbance area and construction time period; using pre-disturbed areas; selecting crossing location; and selecting equipment.

*Scheduling*

- Construction activities should be scheduled according to the relative sensitivity of the environmental concerns and in accordance with EC-1, Scheduling. Scheduling considerations will be different when working near perennial streams vs. ephemeral streams and are as follows.

- When in-stream construction is conducted in a perennial stream, work should optimally be performed during the rainy season. This is because in the summer, any sediment-containing water that is discharged into the watercourse will cause a large change in both water clarity and water chemistry. During the rainy season, there is typically more and faster flowing water in the stream so discharges are diluted faster. However, should in-stream work be scheduled for summer, establishing an isolation area, or diverting the stream, will significantly decrease the amount of sediment stirred up by construction work. Construction work near perennial streams should optimally be performed during the dry season (see below).

- When working in or near ephemeral streams, work should be performed during the dry season. By their very nature, ephemeral streams are usually dry in the summer, and therefore, in-stream construction activities will not cause significant water quality problems. However, when tying up the site at the end of the project, wash any fines (see Washing Fines) that accumulated in the channel back into the bed material, to decrease pollution from the first rainstorm of the season.

- When working near ephemeral or perennial streams, erosion and sediment controls (see silt fences, straw bale barriers, etc.) should be implemented to keep sediment out of stream channel.

*Minimize Disturbance*

- Minimize disturbance through: selection of the narrowest crossing location; limiting the number of equipment trips across a stream during construction; and, minimizing the number and size of work areas (equipment staging areas and spoil storage areas). Place work areas at least 50 ft from stream channel. Field reconnaissance should be conducted during the planning stage to identify work areas.

*Use of Pre-Disturbed Areas*

- Locate project sites and work areas in areas disturbed by prior construction or other activity when possible.

*Selection of Project Site*

- Avoid steep and unstable banks, highly erodible or saturated soils, or highly fractured rock.
- Select project site that minimizes disturbance to aquatic species or habitat.

*Equipment Selection*

- Select equipment that reduces the amount of pressure exerted on the ground surface, and therefore, reduces erosion potential and/or use overhead or aerial access for transporting equipment across drainage channels. Use equipment that exerts ground pressures of less than 5 or 6 $lb/in^2$, where possible. Low ground pressure equipment includes: wide or high flotation tires (34 to 72 in. wide); dual tires; bogie axle systems; tracked machines; lightweight equipment; and, central tire inflation systems.

### Streambank Stabilization

***Preservation of Existing Vegetation***

- Preserve existing vegetation in accordance with EC-2, Preservation of Existing Vegetation. In a streambank environment, preservation of existing vegetation provides the following benefits.

*Water Quality Protection*

- Vegetated buffers on slopes trap sediment and promote groundwater recharge. The buffer width needed to maintain water quality ranges from 15 to 100 ft. On gradual slopes, most of the filtering occurs within the first 30 ft. Steeper slopes require a greater width of vegetative buffer to provide water quality benefits.

*Streambank Stabilization*

- The root system of riparian vegetation stabilizes streambanks by increasing tensile strength in the soil. The presence of vegetation modifies the moisture condition of slopes (infiltration, evapo transpiration, interception) and increases bank stability.

*Riparian Habitat*

- Buffers of diverse riparian vegetation provide food and shelter for riparian and aquatic organisms. Minimizing impacts to fisheries habitat is a major concern when working near streams and rivers. Riparian vegetation provides shade, shelter, organic matter (leaf detritus and large woody debris), and other nutrients that are necessary for fish and other aquatic organisms. Buffer widths for habitat concerns are typically wider than those recommended for water quality concerns (100 to 1500 ft).
- When working near watercourses, it is important to understand the work site's placement in the watershed. Riparian vegetation in headwater streams has a greater impact on overall water quality than vegetation in downstream reaches. Preserving existing vegetation upstream is necessary to maintain water quality, minimize bank failure, and maximize riparian habitat, downstream of the work site.

*Limitations*

- Local county and municipal ordinances regarding width, extent and type of vegetative buffer required may exceed the specifications provided here; these ordinances should be investigated prior to construction.



A002531

*Streambank Stabilization Specific Installation*

- As a general rule, the width of a buffer strip between a road and the stream is recommended to be 50 ft plus four times the percent slope of the land, measured between the road and the top of stream bank.

***Hydraulic Mulch***

- Apply hydraulic mulch on disturbed streambanks above mean high water level in accordance with EC-3, Hydraulic Mulch to provide temporary soil stabilization.

*Limitations*

- Do not place hydraulic mulch or tackifiers below the mean high water level, as these materials could wash into the channel and impact water quality or possibly cause eutrophication (eutrophication is an algal bloom caused by excessively high nutrient levels in the water).

***Hydroseeding***

- Hydroseed disturbed streambanks in accordance with EC-4, Hydroseeding.

*Limitations*

- Do not place tackifiers or fertilizers below the mean high water level, as these materials could wash into the channel and impact water quality or possibly cause eutrophication.

***Soil Binders***

- Apply soil binders to disturbed streambanks in accordance with EC-5, Soil Binders.

*Limitations*

- Do not place soil binders below the mean high water level. Soil binder must be environmentally benign and non-toxic to aquatic organisms.

***Straw Mulch***

- Apply straw mulch to disturbed streambanks in accordance with EC-6, Straw Mulch.

*Limitations*

- Do not place straw mulch below the mean high water level, as this material could wash into the channel and impact water quality or possibly cause eutrophication.

***Geotextiles and Mats***

- Install geotextiles and mats as described in EC-7, Geotextiles and Mats, to stabilize disturbed channels and streambanks. Not all applications should be in the channel, for example, certain geotextile netting may snag fish gills and are not appropriate in fish bearing streams. Geotextile fabrics that are not biodegradable are not appropriate for in stream use. Additionally, geotextile fabric or blankets placed in channels must be adequate to sustain anticipated hydraulic forces.

***Earth Dikes, Drainage Swales, and Lined Ditches***

- Convey, intercept, or divert runoff from disturbed streambanks using EC-9, Earth Dikes and Drainage Swales.

*Limitations*

- Do not place earth dikes in watercourses, as these structures are only suited for intercepting sheet flow, and should not be used to intercept concentrated flow.
- Appropriately sized velocity dissipation devices (EC-10) must be placed at outlets to minimize erosion and scour.

***Velocity Dissipation Devices***

- Place velocity dissipation devices at outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits or channels in accordance with EC-10, Velocity Dissipation Devices.

***Slope Drains***

- Use slope drains to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device or stabilized area in accordance with EC-11, Slope Drains.

*Limitations*

- Appropriately sized outlet protection and velocity dissipation devices (EC-10) must be placed at outlets to minimize erosion and scour.

**Streambank Sediment Control**

***Silt Fences***

- Install silt fences in accordance with SE-1, Silt Fence, to control sediment. Silt fences should only be installed where sediment laden water can pond, thus allowing the sediment to settle out.

***Fiber Rolls***

- Install fiber rolls in accordance with SE-5, Fiber Rolls, along contour of slopes above the high water level to intercept runoff, reduce flow velocity, release the runoff as sheet flow and provide removal of sediment from the runoff. In a stream environment, fiber rolls should be used in conjunction with other sediment control methods such as SE-1, Silt Fence or SE-9 Straw Bale Barrier. Install silt fence, straw bale barrier, or other erosion control method along toe of slope above the high water level.

***Gravel Bag Berm***

- A gravel bag berm or barrier can be utilized to intercept and slow the flow of sediment laden sheet flow runoff in accordance with SE-6, Gravel Bag Berm. In a stream environment gravel bag barriers can allow sediment to settle from runoff before water leaves the construction site and can be used to isolate the work area from the live stream.

*Limitations*

- Gravel bag barriers are not recommended as a perimeter sediment control practice around streams.

***Straw Bale Barrier***

- Install straw bale barriers in accordance with SE-9, Straw Bale Barrier, to control sediment. Straw bale barriers should only be installed where sediment laden water can pond, thus allowing the sediment to settle out. Install a silt fence in accordance with SE-1, Silt Fence, on down slope side of straw bale barrier closest to stream channel to provide added sediment control.

### *Rock Filter*

*Description and Purpose*

Rock filters are temporary erosion control barriers composed of rock that is anchored in place. Rock filters detain the sediment laden runoff, retain the sediment, and release the water as sheet flow at a reduced velocity. Typical rock filter installations are illustrated at the end of this BMP.

*Applications*

- Near the toe of slopes that may be subject to flow and rill erosion.

*Limitations*

- Inappropriate for contributing drainage areas greater than 5 acres.
- Requires sufficient space for ponded water.
- Ineffective for diverting runoff because filters allow water to slowly seep through.
- Rock filter berms are difficult to remove when construction is complete.
- Unsuitable in developed areas or locations where aesthetics is a concern.

*Specifications*

- Rock: open graded rock, 0.75 to 5 in. for concentrated flow applications.
- Woven wire sheathing: 1 in. diameter, hexagonal mesh, galvanized 20gauge (used with rock filters in areas of concentrated flow).
- In construction traffic areas, maximum rock berm heights should be 12 in. Berms should be constructed every 300 ft on slopes less than 5%, every 200 ft on slopes between 5% and 10%, and every 100 ft on slopes greater than 10%.

*Maintenance*

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Reshape berms as needed and replace lost or dislodged rock, and filter fabric.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.

### *K-rail*

*Description and Purpose*

This is temporary sediment control that uses K-rails to form the sediment deposition area, or to isolate the near bank construction area. Install K-rails at toe of slope in accordance with procedures described in NS-5, Clear Water Diversion.

Barriers are placed end to end in a pre-designed configuration and gravel filled bags are used at the toe of the barrier and at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls.

*Appropriate Applications*

- This technique is useful at the toe of embankments, cuts or fills slopes.

*Limitations*

- The K-rail method should not be used to dewater a project site, as the barrier is not watertight.

*Implementation*

- Refer to NS-5, Clear Water Diversion, for implementation requirements.

## Instream Construction Sediment Control

There are three different options currently available for reducing turbidity while working in a stream or river. The stream can be isolated from the area in which work is occurring by means of a water barrier, the stream can be diverted around the work site through a pipe or temporary channel, or one can employ construction practices that minimize sediment suspension.

Whatever technique is implemented, an important thing to remember is that dilution can sometimes be the solution. A probable "worst time" to release high TSS into a stream system might be when the stream is very low; summer low flow, for example. During these times, the flow may be low while the biological activity in the stream is very high. Conversely, the addition of high TSS or sediment during a big storm discharge might have a relatively low impact, because the stream is already turbid, and the stream energy is capable of transporting both suspended solids, and large quantities of bedload through the system. The optimum time to "pull" in-stream structures may be during the rising limb of a storm hydrograph.

### *Techniques to minimize Total Suspended Solids (TSS)*

- **Padding** - Padding laid in the stream below the work site may trap some solids that are deposited in the stream during construction. After work is done, the padding is removed from the stream, and placed on the bank to assist in re-vegetation.

- **Clean, washed gravel** - Using clean, washed gravel decreases solid suspension, as there are fewer small particles deposited in the stream.

- **Excavation using a large bucket** - Each time a bucket of soil is placed in the stream, a portion is suspended. Approximately the same amount is suspended whether a small amount of soil is placed in the stream, or a large amount. Therefore, using a large excavator bucket instead of a small one, will reduce the total amount of soil that washes downstream.

- **Use of dozer for backfilling** - Using a dozer for backfilling instead of a backhoe follows the same principles – the fewer times soil is deposited in the stream, the less soil will be suspended.

- **Partial dewatering with a pump** - Partially dewatering a stream with a pump reduces the amount of water, and thus the amount of water that can suspend sediment.

### *Washing Fines*

*Definition and Purpose*

- Washing fines is an "in-channel" sediment control method, which uses water, either from a water truck or hydrant, to wash stream fines that were brought to the surface of the channel bed during restoration, back into the interstitial spaces of the gravel and cobbles.

- The purpose of this technique is to reduce or eliminate the discharge of sediment from the channel bottom during the first seasonal flow. Sediment should not be allowed into stream channels; however, occasionally in-channel restoration work will involve moving or otherwise disturbing fines (sand and silt sized particles) that are already in the stream, usually below bankfull discharge elevation. Subsequent re-watering of the channel can result in a plume of turbidity and sedimentation.

- This technique washes the fines back into the channel bed. Bedload materials, including gravel cobbles, boulders and those fines, are naturally mobilized during higher storm flows. This technique is intended to delay the discharge until the fines would naturally be mobilized.

*Appropriate Applications*

- This technique should be used when construction work is required in channels. It is especially useful in intermittent or ephemeral streams in which work is performed "in the dry", and which subsequently become re-watered.

*Limitations*

- The stream must have sufficient gravel and cobble substrate composition.

- The use of this technique requires consideration of time of year and timing of expected stream flows.

- The optimum time for the use of this technique is in the fall, prior to winter flows.

- Consultation with, and approval from the Department of Fish and Game and the Regional Water Quality Control Board may be required.

*Implementation*

- Apply sufficient water to wash fines, but not cause further erosion or runoff.

- Apply water slowly and evenly to prevent runoff and erosion.

- Consult with Department of Fish and Game and the Regional Water Quality Control Board for specific water quality requirements of applied water (e.g. chlorine).



A002536

*Inspection and Maintenance*

- None necessary

### Costs

Cost may vary according to the combination of practices implemented.

### Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).

### References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

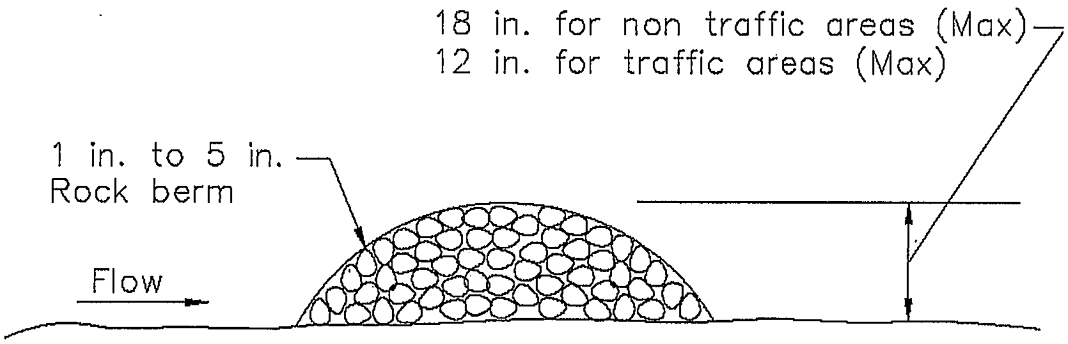
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, An Inventory of Current Practices (Draft), UESPA, 1990.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

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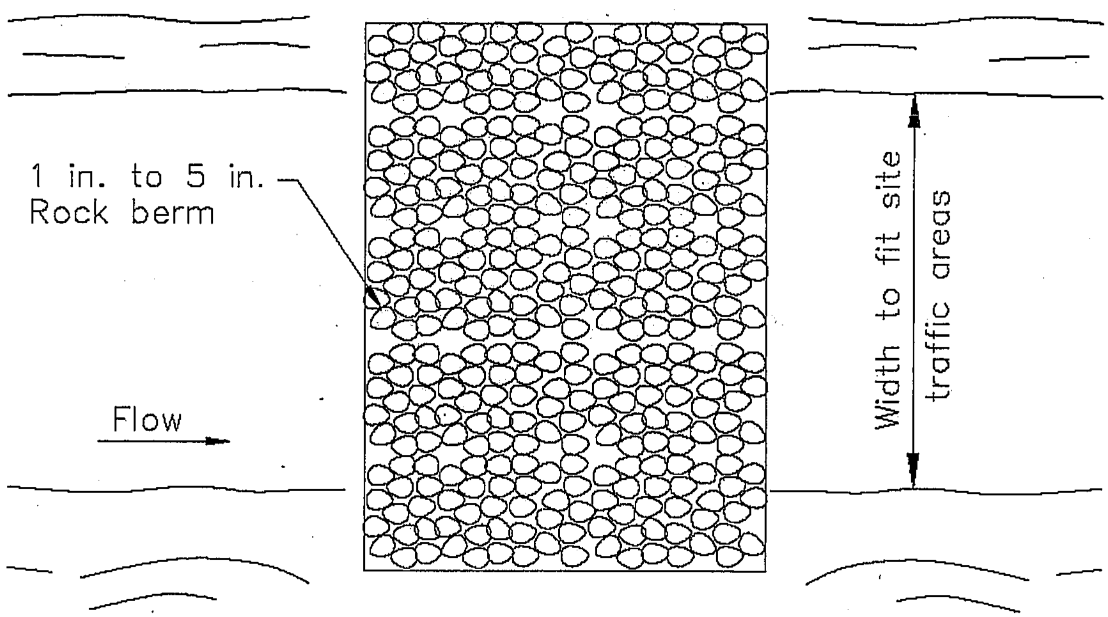
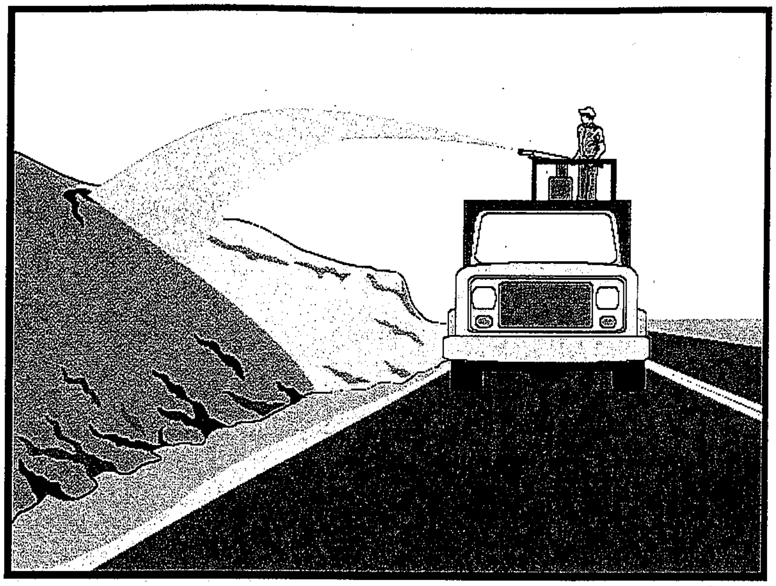



PLAN

TYPICAL ROCK FILTER

NOT TO SCALE

# Polyacrylamide EC-13



## Objectives

| | |
|---|---|
| EC | Erosion Control |
| SE | Sediment Control |
| TR | Tracking Control |
| WE | Wind Erosion Control |
| NS | Non-Stormwater Management Control |
| WM | Waste Management and Materials Pollution Control |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

Sediment
Nutrients
Trash
Metals
Bacteria
Oil and Grease
Organics

## Potential Alternatives

None

## Description and Purpose

Polyacrylamide (PAM) is a chemical that can be applied to disturbed oils at construction sites to reduce erosion and improve settling of suspended sediment.

PAM increases the soil's available pore volume, thus increasing infiltration and reducing the quantity of stormwater runoff that can cause erosion. Suspended sediments from PAM treated soils exhibit increased flocculation over untreated soils. The increased flocculation aids in their deposition, thus reducing stormwater runoff turbidity and improving water quality.

## Suitable Applications

PAM is suitable for use on disturbed soil areas that discharge to a sediment trap or sediment basin. PAM is typically used in conjunction with other BMPs to increase their performance.

PAM can be applied to the following areas:

- Rough graded soils that will be inactive for a period of time.
- Final graded soils before application of final stabilization (e.g., paving, planting, mulching).
- Temporary haul roads prior to placement of crushed rock surfacing.
- Compacted soil road base.
- Construction staging, materials storage, and layout areas.

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- Soil stockpiles.
- Areas that will be mulched.

## Limitations

- There is limited experience in California with use of PAM for erosion and sediment control.
- PAM shall not be directly applied to water or allowed to enter a water body.
- Do not use PAM on a slope that flows into a water body without passing through a sediment trap or sediment basin.
- PAM will work when applied to saturated soil but is not as effective as applications to dry or damp soil.
- Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used.
- The specific PAM copolymer formulation must be anionic. **Cationic PAM shall not be used in any application because of known aquatic toxicity problems.** Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, will be used for soil applications.
- PAM designated for erosion and sediment control should be "water soluble" or "linear" or "non-cross linked".
- A sampling and analysis plan must be incorporated into the SWPPP as PAM may be considered to be a source of non-visible pollutants.

## Implementation

### *General*

PAM shall be used in accordance with the following general guidance:

- Pam shall be used in conjunction with other BMPs and not in place of other BMPs, including both erosion controls and sediment controls.
- Stormwater runoff from PAM treated soils should pass through a sediment control BMP prior to discharging to surface waters.
  - When the total drainage area is greater than or equal to 5 acres, PAM treated areas shall drain/to a sediment basin.
  - Areas less than 5 acres shall drain to sediment control BMPs, such as a sediment trap, or a minimum of 3 check dams per acre. The total number of check dams used shall be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam shall be spaced evenly in the drainage channel. Through which stormwater flows are discharged off site.
- Do not add PAM to water discharging from site.

- On PAM treated sites, the use of silt fence and fiber rolls shall be maximized to limit the discharges of sediment to sediment traps and sediment basins.
- All areas not being actively worked one should be covered and protected from rainfall. PAM should not be the only cover BMP used.
- PAM can be applied to wet soil, but dry soil is preferred due to less sediment loss.
- Keep the granular PAM supply out of the sun. Granular PAM loses its effectiveness in three months after exposure to sunlight and air.
- Proper application and re-application plans are necessary to ensure total effectiveness of PAM usage.
- PAM, combined with water, is very slippery and can be a safety hazard. Care must be taken to prevent spills of PAM powder onto paved surfaces. During an application of PAM, prevent over spray from reaching pavement, as pavement will become slippery. If PAM powder gets on skin or clothing, wipe it off with a rough towel rather than washing with water this only makes cleanup messier and longer.
- Recent high interest in PAM has resulted in some entrepreneurial exploitation of the term "polymer". All PAMs are polymer, but not all polymers are PAM, and not all PAM products comply with ANSI/NSF Standard 60. PAM use shall be reviewed and approved by the local permitting authority.
- The PAM anionic charge density may vary from 2-30%; a value of 18% is typical. Studies conducted by the United States Department of Agriculture (USDA)/ Agricultural Research Service (ARS) demonstrated that soil stabilization was optimized by using very high molecular weight (12-15 mg/mole), highly anionic (>20% hydrolosis) PAM.
- PAM tackifiers are available and being used in place of guar and alpha plantago. Typically, PAM tackifiers should be used at a rate of no more than 0.5-1 lb per 1,000 gallons of water in hydro mulch machine. Some tackifier product instructions say to use at a rate of 3-5 lbs per acre, which can be too much. In addition, pump problems can occur at higher rates due to increased viscosity.

### *Preferred Application Method*

PAM may be applied in dissolved form with water, or it may be applied in dry, granular, or powered form. The preferred application method is the dissolved form.

PAM is to be applied at a maximum rate of ½ pound PAM per 1000 gallons water per 1 acre of bare soil. Table 1 and Figure 1 can be used to determine the PAM and water application rate for a disturbed soil area. Higher concentrations of PAM **do not** provide any additional effectiveness.

| Table 1 PAM and Water Application Rates | | |
|---|---|---|
| Disturbed Area (acre) | PAM (lbs) | Water (gallons) |
| 0.50 | 0.25 | 500 |
| 1.00 | 0.50 | 1,000 |
| 1.50 | 0.75 | 1,500 |
| 2.00 | 1.00 | 2,000 |
| 2.50 | 1.25 | 2,500 |
| 3.00 | 1.50 | 3,000 |
| 3.50 | 1.75 | 3,500 |
| 4.00 | 2.00 | 4,000 |
| 4.50 | 2.25 | 4,500 |
| 5.00 | 2.50 | 5,000 |

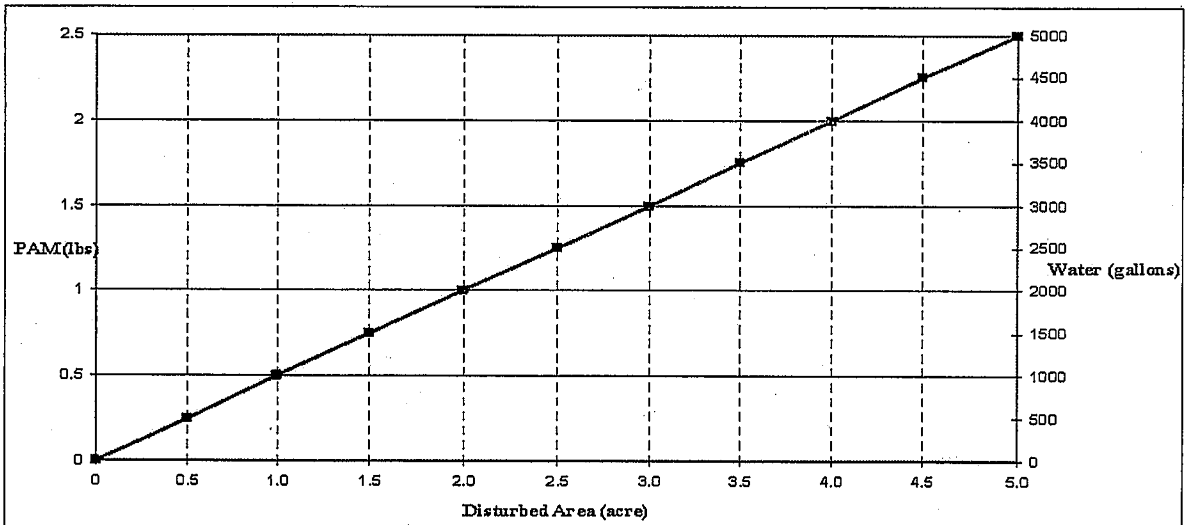


**Figure 1 - PAM and Water Application Rates**

- Pre-measure the area where PAM is to be applied and calculate the amount of product and water necessary to provide coverage at the specified application rate (1/2 pound PAM/1000 gallons/acre).
- PAM has infinite solubility in water, but dissolves very slowly. Dissolve pre-measured dry granular PAM with a known quantity of clean water in a bucket several hours or overnight. Mechanical mixing will help dissolve the PAM. Always add PAM to water – not water to PAM.



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- Pre-fill the water truck about 1/8 full with water. The water does not have to be potable, but it must have relatively low turbidity – in the range of 20 NTU or less.
- Add the dissolved PAM and water mixture to the truck.
- Fill the water truck to specified volume for the amount of PAM to be applied.
- Spray the PAM/water mixture onto dry soil until the soil surface is uniformly and completely wetted.

***Alternate Application Method***

PAM may also be applied as a powder at the rate of 5 lbs per acre. This must be applied on a day that is dry. For areas less than 5-10 acres, a hand held "organ grinder" fertilizer spreader set to the smallest setting will work. Tractor mounted spreaders will work for larger areas.

## Costs

- PAM: $1.30 - $5.50/lb (material cost only).

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- PAM must be reapplied on actively worked areas after a 48-hour period if PAM is to remain effective.
- Reapplication is not required unless PAM treated soil is disturbed or unless turbidity levels show the need for an additional application.
- If PAM treated soil is left undisturbed a reapplication may be necessary after two months.
- More PAM applications may be required for steep slopes, silty and clayey soils (USDA Classification Type "C" and "D" soils), long grades, and high precipitation areas.
- When PAM is applied first to bare soil and then covered with straw, a reapplication may not be necessary for several months.
- Discharges from PAM treated areas must be monitored for non-visible pollutants.

## References

Entry, J.A., and R.E. Sojka. Polyacrylamide Application to Soil Reduces the Movement of Microorganisms in Water. In 1999 Proceedings of the International Irrigation Show. Irrigation Associations, Orlando, FL, November, 1999.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.



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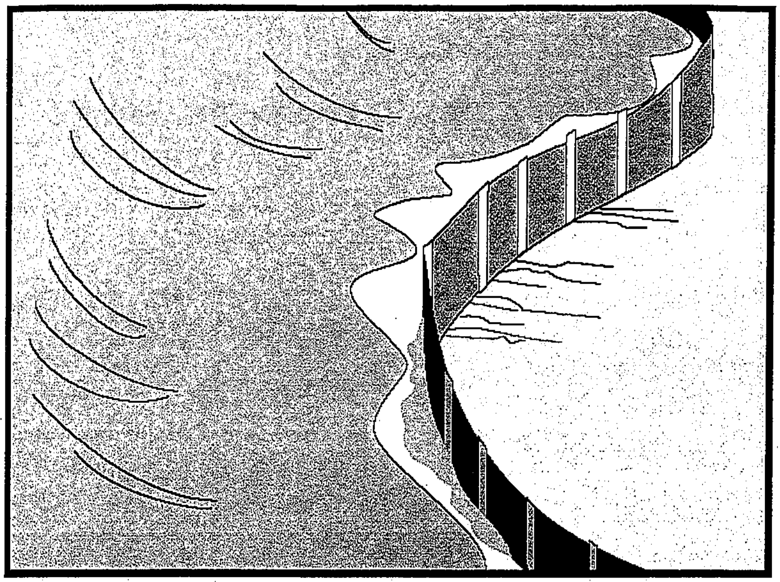
Sojka, R.E., and R.D. Lentz, eds. Managing Irrigation Induced Erosion and Infiltration with Polyacrylamide. In Proceedings from Conference held at College of Southern Idaho, Twin Falls, Idaho, University of Idaho Miscellaneous Publication No. 101-96, May, 1996

Stormwater Management Manual for Western Washington, Volume II – Construction Stormwater Pollution Prevention, Washington State Department of Ecology, August 2001.

# Silt Fence





## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

## Description and Purpose

A silt fence is made of a filter fabric that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains sediment-laden water, promoting sedimentation behind the fence.

## Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They should also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion. Silt fences are generally ineffective in locations where the flow is concentrated and are only applicable for sheet or overland flows. Silt fences are most effective when used in combination with erosion controls. Suitable applications include:

- Along the perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Below other small cleared areas.

## Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.

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- Do not use in locations where ponded water may cause flooding.

- Do not place fence on a slope, or across any contour line. If not installed at the same elevation throughout, silt fences will create erosion.

- Filter fences will create a temporary sedimentation pond on the upstream side of the fence and may cause temporary flooding. Fences not constructed on a level contour will be overtopped by concentrated flow resulting in failure of the filter fence.

- Improperly installed fences are subject to failure from undercutting, overlapping, or collapsing.

  - Not effective unless trenched and keyed in.

  - Not intended for use as mid-slope protection on slopes greater than 4:1 (H:V).

  - Do not allow water depth to exceed 1.5 ft at any point.

## Implementation

### *General*

A silt fence is a temporary sediment barrier consisting of filter fabric stretched across and attached to supporting posts, entrenched, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap sediment by intercepting and detaining small amounts of sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

Silt fences are preferable to straw bale barriers in many cases. Laboratory work at the Virginia Highway and Transportation Research Council has shown that silt fences can trap a much higher percentage of suspended sediments than can straw bales. While the failure rate of silt fences is lower than that of straw bale barriers, there are many instances where silt fences have been improperly installed. The following layout and installation guidance can improve performance and should be followed:

- Use principally in areas where sheet flow occurs.

- Don't use in streams, channels, or anywhere flow is concentrated. Don't use silt fences to divert flow.

- Don't use below slopes subject to creep, slumping, or landslides.

- Select filter fabric that retains 85% of soil by weight, based on sieve analysis, but that is not finer than an equivalent opening size of 70.

- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.

- The maximum length of slope draining to any point along the silt fence should be 200 ft or less.

- The maximum slope perpendicular to the fence line should be 1:1.

- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 $ft^2$ of ponding area should be provided for every acre draining to the fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.
- Silt fences should remain in place until the disturbed area is permanently stabilized.

***Design and Layout***

Selection of a filter fabric is based on soil conditions at the construction site (which affect the equivalent opening size (EOS) fabric specification) and characteristics of the support fence (which affect the choice of tensile strength). The designer should specify a filter fabric that retains the soil found on the construction site yet that it has openings large enough to permit drainage and prevent clogging. The following criteria is recommended for selection of the equivalent opening size:

1. If 50 percent or less of the soil, by weight, will pass the U.S. Standard Sieve No. 200, select the EOS to retain 85 % of the soil. The EOS should not be finer than EOS 70.
2. For all other soil types, the EOS should be no larger than the openings in the U.S. Standard Sieve No. 70 except where direct discharge to a stream, lake, or wetland will occur, then the EOS should be no larger than Standard Sieve No. 100.

To reduce the chance of clogging, it is preferable to specify a fabric with openings as large as allowed by the criteria. No fabric should be specified with an EOS smaller than U.S. Standard Sieve No. 100. If 85% or more of a soil, by weight, passes through the openings in a No. 200 sieve, filter fabric should not be used. Most of the particles in such a soil would not be retained if the EOS was too large and they would clog the fabric quickly if the EOS were small enough to capture the soil.

The fence should be supported by a plastic or wire mesh if the fabric selected does not have sufficient strength and bursting strength characteristics for the planned application (as recommended by the fabric manufacturer). Filter fabric material should contain ultraviolet inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 °F to 120 °F.

- Layout in accordance with attached figures.
- For slopes steeper than 2:1 (H:V) and that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to install additional protection immediately adjacent to the bottom of the slope, prior to installing silt fence. Additional protection may be a chain link fence or a cable fence.
- For slopes adjacent to sensitive receiving waters or Environmentally Sensitive Areas (ESAs), silt fence should be used in conjunction with erosion control BMPs.

### *Materials*

- Silt fence fabric should be woven polypropylene with a minimum width of 36 in. and a minimum tensile strength of 100 lb force. The fabric should conform to the requirements in ASTM designation D4632 and should have an integral reinforcement layer. The reinforcement layer should be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric should be between 0.1 $sec^{-1}$ and 0.15 $sec^{-1}$ in conformance with the requirements in ASTM designation D4491.

- Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

- There are new products that may use prefabricated plastic holders for the silt fence and use bar reinforcement instead of wood stakes. If bar reinforcement is used in lieu of wood stakes, use number four or greater bar. Provide end protection for any exposed bar reinforcement.

### *Installation Guidelines*

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line the proposed silt fence.

- Bottom of the silt fence should be keyed-in a minimum of 12 in.

- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.

- When standard strength filter fabric is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench. When extra-strength filter fabric and closer post spacing are used, the mesh support fence may be eliminated. Filter fabric should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, filter cloth should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.

- The trench should be backfilled with compacted native material.

- Construct silt fences with a setback of at least 3 ft from the toe of a slope. Where a silt fence is determined to be not practicable due to specific site conditions, the silt fence may be constructed at the toe of the slope, but should be constructed as far from the toe of the slope as practicable. Silt fences close to the toe of the slope will be less effective and difficult to maintain.

- Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case should the reach exceed 500 ft.

### Costs

- Average annual cost for installation and maintenance (assumes 6 month useful life): $7 per lineal foot ($850 per drainage acre). Range of cost is $3.50 - $9.10 per lineal foot.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed of, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Silt fences should be left in place until the upstream area is permanently stabilized. Until then, the silt fence must be inspected and maintained.
- Holes, depressions, or other ground disturbance caused by the removal of the silt fences should be backfilled and repaired.

### References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

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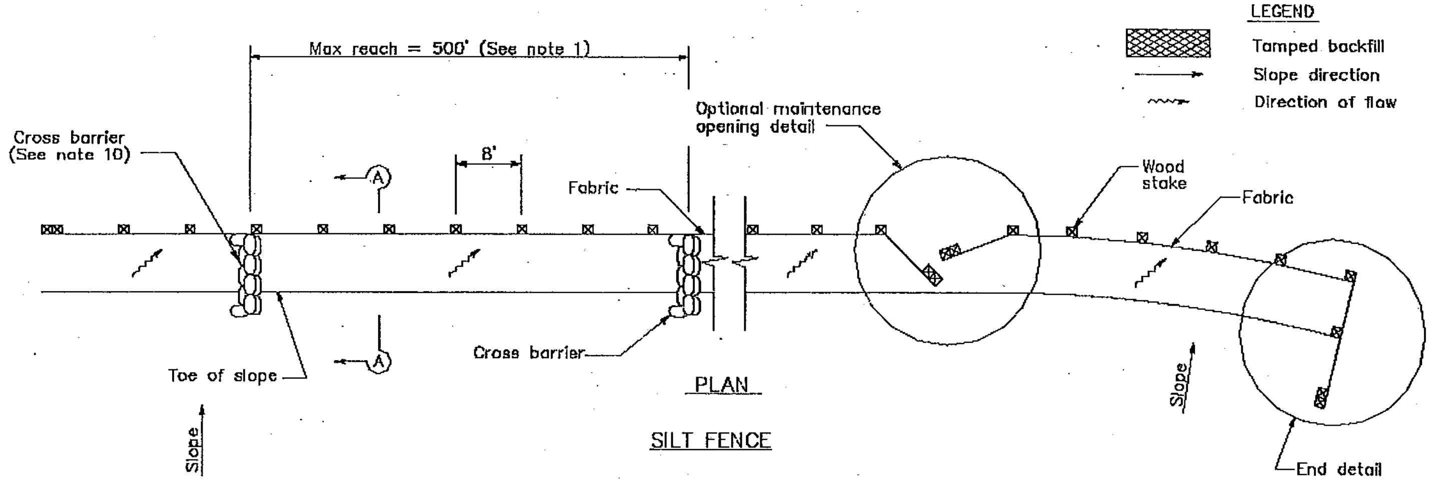
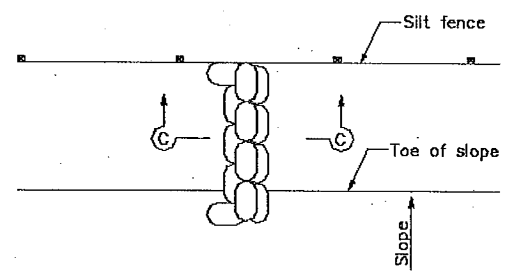



PLAN

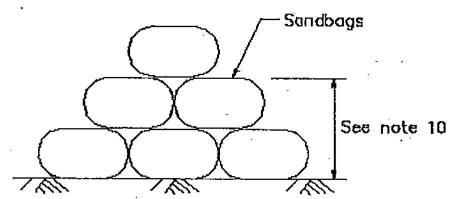
SILT FENCE

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the linear barrier, in no case shall the reach length exceed 500'.
2. The last 8'-0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'-0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with 4 staples.
7. Stakes shall be driven tightly together to prevent potential flow-through of sediment at joint. The tops of the stakes shall be secured with wire.
8. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
9. Minimum 4 staples per stake. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.




CROSS BARRIER DETAIL




SECTION C-C



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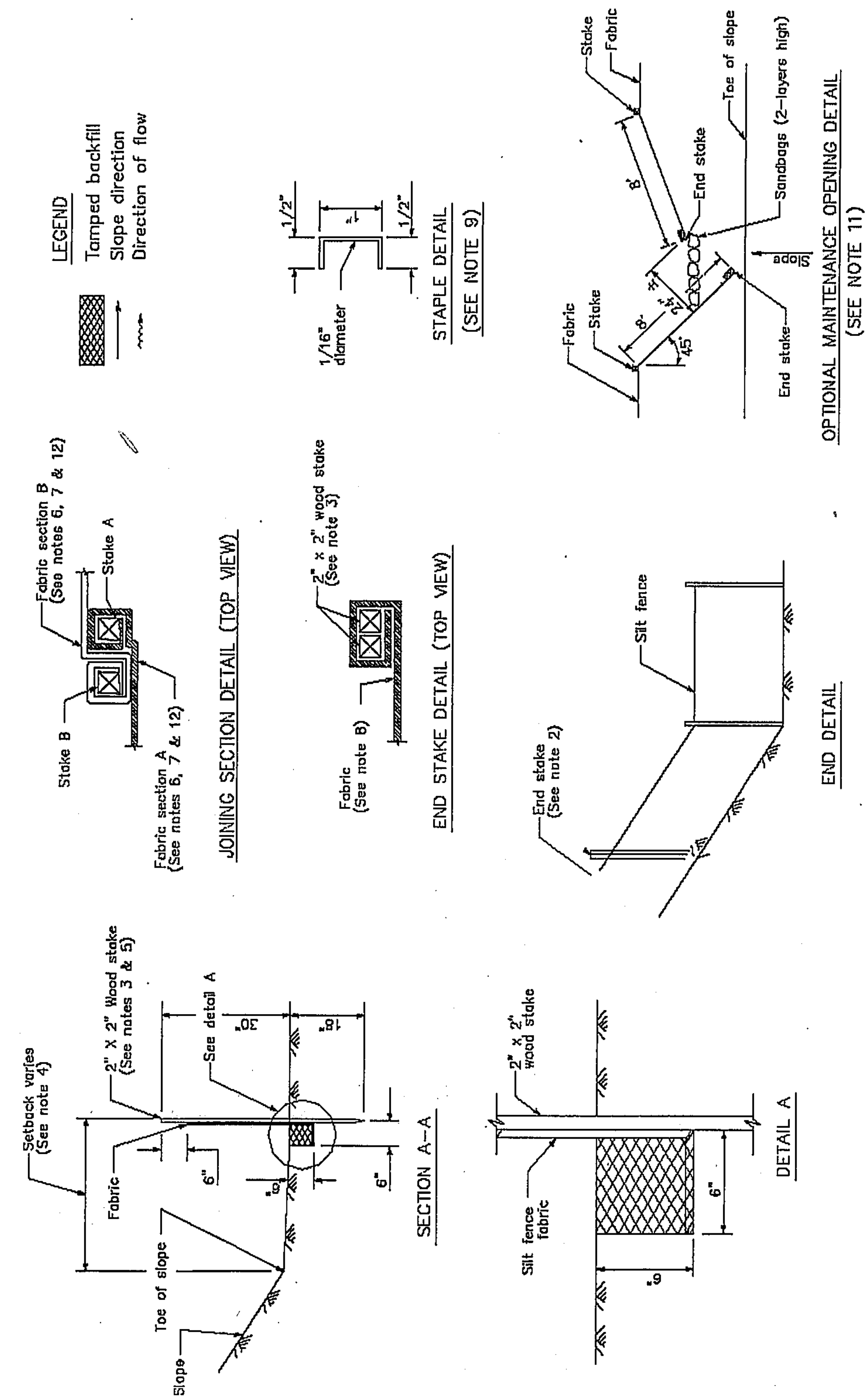
LEGEND
Tamped backfill
Slope direction
Direction of flow
Fabric section B (See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A (See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
2" x 2" wood stake (See note 3)
Fabric (See note 8)
END STAKE DETAIL (TOP VIEW)
1/2"
1"
1/16" diameter
STAPLE DETAIL
(SEE NOTE 9)
Stake
Fabric
Toe of slope
Sandbags (2-layers high)
End stake
8'
45°
Slope
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)
Setback varies (See note 4)
2" X 2" Wood stake (See notes 3 & 5)
See detail A
30"
18"
6"
Toe of slope
Slope
SECTION A-A
2" x 2" wood stake
Silt fence fabric
DETAIL A
Silt fence
End stake (See note 2)
END DETAIL



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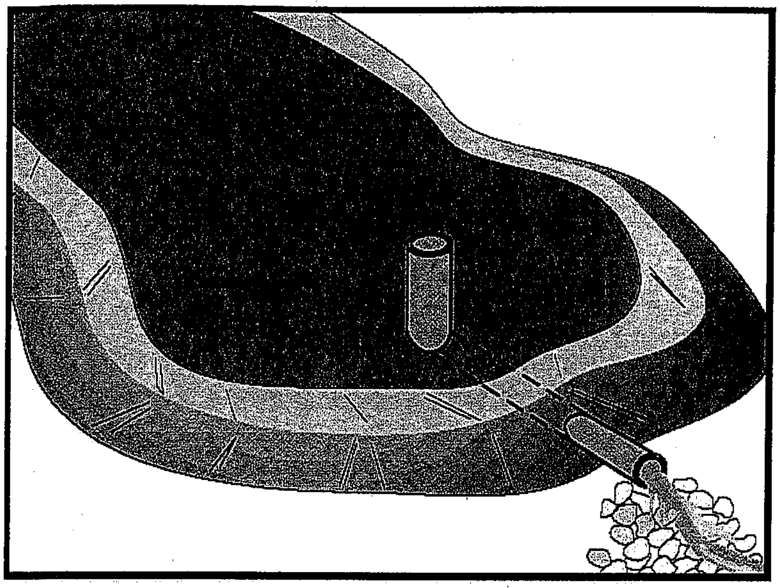
# Sediment Basin



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

SE-3 Sediment Trap (for smaller areas)

## Description and Purpose

A sediment basin is a temporary basin formed by excavation or by constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is discharged.

## Suitable Applications

Sediment basins may be suitable for use on larger projects with sufficient space for constructing the basin. Sediment basins should be considered for use:

- Where sediment-laden water may enter the drainage system or watercourses
- On construction projects with disturbed areas during the rainy season
- At the outlet of disturbed watersheds between 5 acres and 75 acres
- At the outlet of large disturbed watersheds, as necessary
- Where post construction detention basins are required
- In association with dikes, temporary channels, and pipes used to convey runoff from disturbed areas

## Limitations

Sediment basins must be installed only within the property limits and where failure of the structure will not result in loss of life, damage to homes or buildings, or interruption of use or service of

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A002553

public roads or utilities. In addition, sediment basins are attractive to children and can be very dangerous. Local ordinances regarding health and safety must be adhered to. If fencing of the basin is required, the type of fence and its location should be shown in the SWPPP and in the construction specifications.

- Generally, sediment basins are limited to drainage areas of 5 acres or more, but not appropriate for drainage areas greater than 75 acres.
- Sediment basins may become an "attractive nuisance" and care must be taken to adhere to all safety practices. If safety is a concern, basin may require protective fencing.
- Sediment basins designed according to this handbook are only practically effective in removing sediment down to about the medium silt size fraction. Sediment-laden runoff with smaller size fractions (fine silt and clay) may not be adequately treated unless chemical treatment is used in addition to the sediment basin.
- Sites with very fine sediments (fine silt and clay) may require longer detention times for effective sediment removal.
- Basins with a height of 25 ft or more or an impounding capacity of 50 ac-ft or more must obtain approval from Division of Safety of Dams.
- Standing water may cause mosquitoes or other pests to breed.
- Basins require large surface areas to permit settling of sediment. Size may be limited by the available area.

## Implementation

### *General*

A sediment basin is a controlled stormwater release structure formed by excavation or by construction of an embankment of compacted soil across a drainage way, or other suitable location. It is intended to trap sediment before it leaves the construction site. The basin is a temporary measure with a design life of 12 to 28 months in most cases and is to be maintained until the site area is permanently protected against erosion or a permanent detention basin is constructed.

Sediment basins are suitable for nearly all types of construction projects. Whenever possible, construct the sediment basins before clearing and grading work begins. Basins should be located at the stormwater outlet from the site but not in any natural or undisturbed stream. A typical application would include temporary dikes, pipes, and/or channels to divert runoff to the basin inlet.

Many development projects in California will be required by local ordinances to provide a stormwater detention basin for post-construction flood control, desilting, or stormwater pollution control. A temporary sediment basin may be constructed by rough grading the post-construction control basins early in the project.

Sediment basins trap 70-80 % of the sediment that flows into them if designed according to this handbook. Therefore, they should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.

### *Planning*

To improve the effectiveness of the basin, it should be located to intercept runoff from the largest possible amount of disturbed area. The best locations are generally low areas. Drainage into the basin can be improved by the use of earth dikes and drainage swales (see BMP EC-9). The basin must not be located in a stream but it should be located to trap sediment-laden runoff before it enters the stream. The basin should not be located where its failure would result in the loss of life or interruption of the use or service of public utilities or roads.

- Construct before clearing and grading work begins when feasible.
- Do not locate in a stream.
- Basin sites should be located where failure of the structure will not cause loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities.
- Large basins are subject to state and local dam safety requirements.
- Limit the contributing area to the sediment basin to only the runoff from the disturbed soil areas. Use temporary concentrated flow conveyance controls to divert runoff from undisturbed areas away from the sediment basin.
- The basin should be located: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where post-construction (permanent) detention basins will be constructed, and (3) where the basins can be maintained on a year-round basis to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area, and to maintain the basin to provide the required capacity.

### *Design*

Sediment basins must be designed in accordance with Section A of the State of California NPDES General Permit for Stormwater Discharges Associated with Construction Activities (General Permit) where sediment basins are the only control measure proposed for the site. If there is insufficient area to construct a sediment basin in accordance with the General Permit requirements, then the alternate design standards specified herein may be used.

Sediment basins designed per the General Permit shall be designed as follows:

*Option 1:*

Pursuant to local ordinance for sediment basin design and maintenance, provided that the design efficiency is as protective or more protective of water quality than Option 3.

OR

*Option 2:*

Sediment basin(s), as measured from the bottom of the basin to the principal outlet, shall have at least a capacity equivalent to 3,600 cubic feet (133 $yd^3$) of storage per acre draining into the sediment basin. The length of the basin shall be more than twice the width of the basin. The length is determined by measuring the distance between the inlet and the outlet; and the depth must not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency.

OR

*Option 3:*
Sediment basin(s) shall be designed using the standard equation:

$$As=1.2Q/Vs \qquad \text{(Eq. 1)}$$

Where:

As = Minimum surface area for trapping soil particles of a certain size

Vs = Settling velocity of the design particle size chosen

Q = C I A

Where

Q = Discharge rate measured in cubic feet per second

C = Runoff coefficient

I = Precipitation intensity for the 10-year, 6-hour rain event

A = Area draining into the sediment basin in acres

The design particle size shall be the smallest soil grain size determined by wet sieve analysis, or the fine silt sized (0.01 mm [or 0.0004 in.]) particle, and the *Vs* used shall be 100 percent of the calculated settling velocity.

The length is determined by measuring the distance between the inlet and the outlet; the length shall be more than twice the dimension as the width; the depth shall not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity). The basin(s) shall be located on the site where it can be maintained on a year-round basis and shall be maintained on a schedule to retain the 2 ft of capacity.

OR

*Option 4:*
The use of an equivalent surface area design or equation, provided that the design efficiency is as protective or more protective of water quality than Option 3.

Other design considerations are:

- The volume of the settling zone should be sized to capture runoff from a 2-year storm or other appropriate design storms specified by the local agency. A detention time of 24 to 40 hours should allow 70 to 80 % of sediment to settle.
- The basin volume consists of two zones:
  - A sediment storage zone at least 1 ft deep.
  - A settling zone at least 2 ft deep.
- The length to settling depth ratio (L/SD) should be less than 200.
- Sediment basins are best used in conjunction with erosion controls. Sediment basins that will be used as the only means of treatment, without upstream erosion and sediment controls, must be designed according to the four options required by the General Permit (see Options 1-4 above). Sediment basins that are used in conjunction with upstream erosion and sediment controls should be designed to have a capacity equivalent to 67 $yd^3$ of sediment storage per acre of contributory area.
- The length of the basin should be more than twice the width of the basin; the length should be determined by measuring the distance between the inlet and the outlet.
- The depth must be no less than 3 ft.
- Basins with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and basins capable of impounding more than 35,000 $ft^3$, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the basin outlet and bypass structures.
- Basins should be designed to drain within 72 hours following storm events. If a basin fails to drain within 72 hours, it must be pumped dry.
- Sediment basins, regardless of size and storage volume, should include features to accommodate overflow or bypass flows that exceed the design storm event.
  - Include an emergency spillway to accommodate flows not carried by the principal spillway. The spillway should consist of an open channel (earthen or vegetated) over undisturbed material (not fill) or constructed of a non-erodible riprap.
  - The spillway control section, which is a level portion of the spillway channel at the highest elevation in the channel, should be a minimum of 20 ft in length.
- Rock or vegetation should be used to protect the basin inlet and slopes against erosion.
- A forebay, constructed upstream of the basin may be provided to remove debris and larger particles.

- The outflow from the sediment basin should be provided with velocity dissipation devices (see BMP EC-10) to prevent erosion and scouring of the embankment and channel.
- Basin inlets should be located to maximize travel distance to the basin outlet.
- The principal outlet should consist of a corrugated metal, high density polyethylene (HDPE), or reinforced concrete riser pipe with dewatering holes and an anti-vortex device and trash rack attached to the top of the riser, to prevent floating debris from flowing out of the basin or obstructing the system. This principal structure should be designed to accommodate the inflow design storm.
- A rock pile or rock-filled gabions can serve as alternatives to the debris screen; although the designer should be aware of the potential for extra maintenance involved should the pore spaces in the rock pile clog.
- The outlet structure should be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation.
- Attach riser pipe (watertight connection) to a horizontal pipe (barrel). Provide anti-seep collars on the barrel.
- Cleanout level should be clearly marked on the riser pipe.
- Proper hydraulic design of the outlet is critical to achieving the desired performance of the basin. The outlet should be designed to drain the basin within 24 to 72 hours (also referred to as "drawdown time"). The 24-hour limit is specified to provide adequate settling time; the 72-hour limit is specified to mitigate vector control concerns.
- The two most common outlet problems that occur are: (1) the capacity of the outlet is too great resulting in only partial filling of the basin and drawdown time less than designed for; and (2) the outlet clogs because it is not adequately protected against trash and debris. To avoid these problems, the following outlet types are recommended for use: (1) a single orifice outlet with or without the protection of a riser pipe, and (2) perforated riser. Design guidance for single orifice and perforated riser outlets follow:
  - *Flow Control Using a Single Orifice At The Bottom Of The Basin (Figure 1)*: The outlet control orifice should be sized using the following equation:

$$a = \frac{2A(H-Ho)^{0.5}}{3600CT(2g)^{0.5}} = \frac{(7x10^{-5})A(H-Ho)^{0.5}}{CT} \qquad \text{(Eq. 2)}$$

where:

a = area of orifice (ft$^2$)

A = surface area of the basin at mid elevation (ft$^2$)

C = orifice coefficient

T = drawdown time of full basin (hrs)

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g = gravity (32.2 ft/s$^2$)

H = elevation when the basin is full (ft)

Ho = final elevation when basin is empty (ft)

With a drawdown time of 40 hours, the equation becomes:

$$a = \frac{(1.75x10^{-6})A(H-Ho)^{0.5}}{C} \qquad \text{(Eq. 3)}$$

- *Flow Control Using Multiple Orifices (see Figure2):*

$$a_t = \frac{2A(h_{\max})}{3600CT(2g[h_{\max} - h_{centroid\ of\ orifices}])^{0.5}} \qquad \text{(Eq. 4)}$$

With terms as described above except:

$a_t$ = total area of orifices

$h_{max}$ = maximum height from lowest orifice to the maximum water surface (ft)

$h_{centroid\ of\ orifices}$ = height from the lowest orifice to the centroid of the orifice configuration (ft)

Allocate the orifices evenly on two rows; separate the holes by 3x hole diameter vertically, and by 120 degrees horizontally (refer to Figure 2).

Because basins are not maintained for infiltration, water loss by infiltration should be disregarded when designing the hydraulic capacity of the outlet structure.

Care must be taken in the selection of "C"; 0.60 is most often recommended and used. However, based on actual tests, GKY (1989), "Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission", recommends the following:

C = 0.66 for thin materials; where the thickness is equal to or less than the orifice diameter, or

C = 0.80 when the material is thicker than the orifice diameter

### *Installation*

- Securely anchor and install an anti-seep collar on the outlet pipe/riser and provide an emergency spillway for passing major floods (see local flood control agency).
- Areas under embankments must be cleared and stripped of vegetation.
- Chain link fencing should be provided around each sediment basin to prevent unauthorized entry to the basin or if safety is a concern.

## Costs

Average annual costs for installation and maintenance (2 year useful life) are:

- Basin less than 50,000 $ft^3$: Range, \$0.24 - \$1.58/$ft^3$. Average, \$0.73 per $ft^3$. \$400 - \$2,400, \$1,200 average per drainage acre.

- Basin size greater than 50,000 $ft^3$: Range, \$0.12 – \$0.48/$ft^3$. Average, \$0.36 per $ft^3$. \$200 - \$800, \$600 average per drainage acre.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Examine basin banks for seepage and structural soundness.

- Check inlet and outlet structures and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.

- Check inlet and outlet area for erosion and stabilize if required.

- Check fencing for damage and repair as needed.

- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage volume. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at appropriate locations.

- Remove standing water from basin within 72 hours after accumulation.

- BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs shall be implemented at all times during dewatering activities.

- To minimize vector production:

  - Remove accumulation of live and dead floating vegetation in basins during every inspection.

  - Remove excessive emergent and perimeter vegetation as needed or as advised by local or state vector control agencies.

## References

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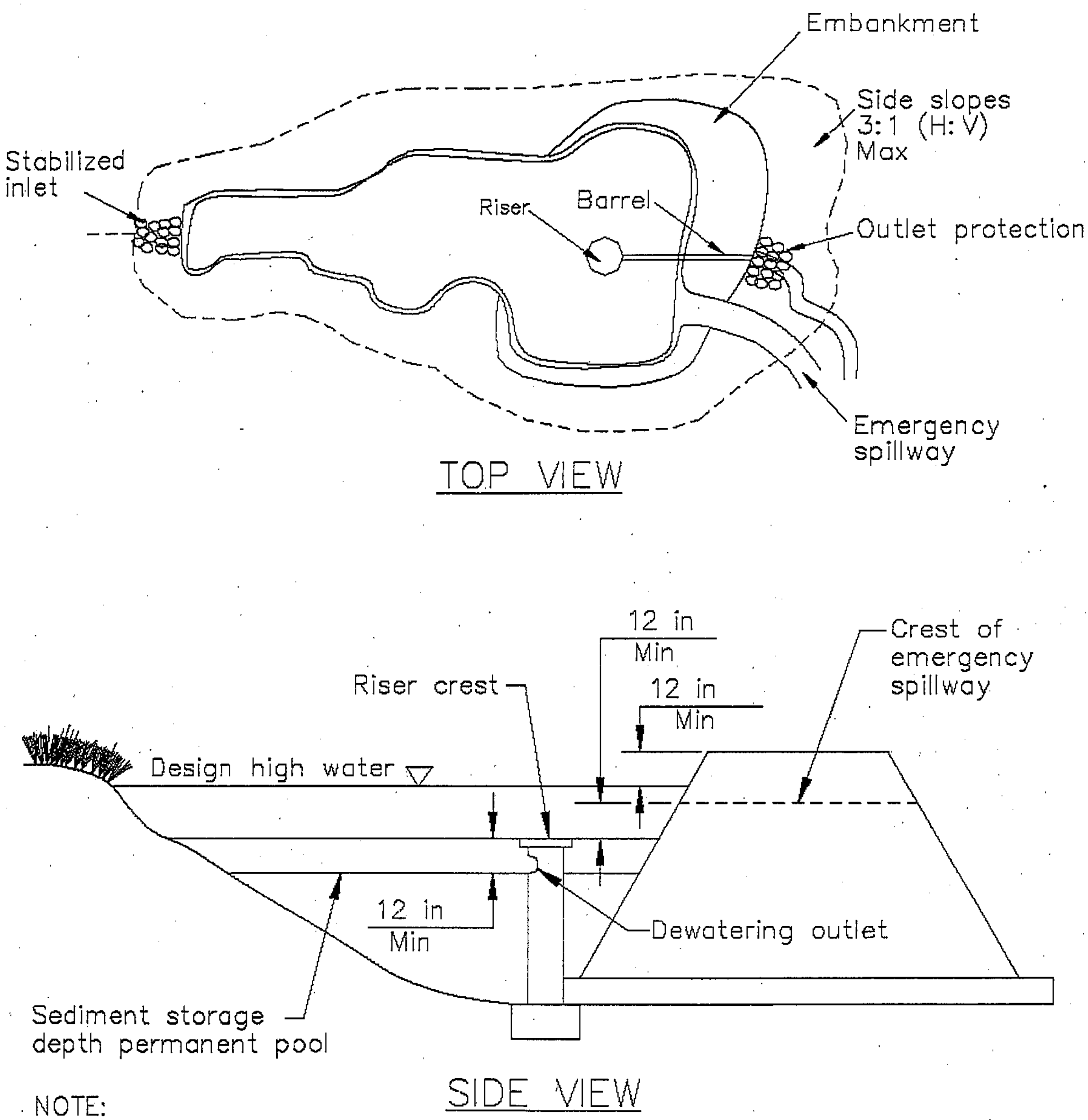


NOTE:
This outlet provides no drainage
for permanent pool.

FIGURE 1: TYPICAL TEMPORARY SEDIMENT BASIN
SINGLE ORIFICE DESIGN
NOT TO SCALE

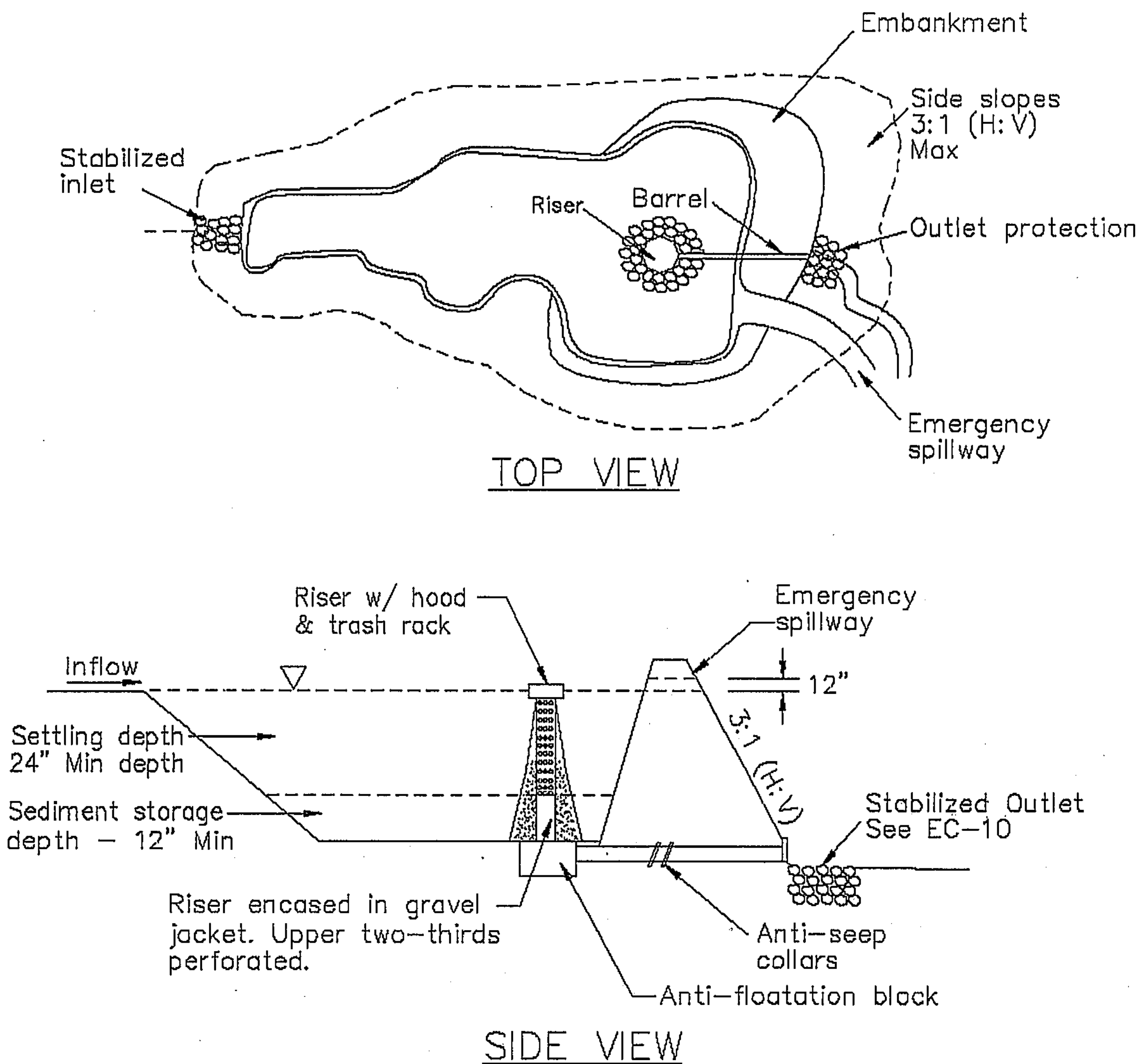


FIGURE 2: TYPICAL TEMPORARY SEDIMENT BASIN MULTIPLE ORIFICE DESIGN

NOT TO SCALE



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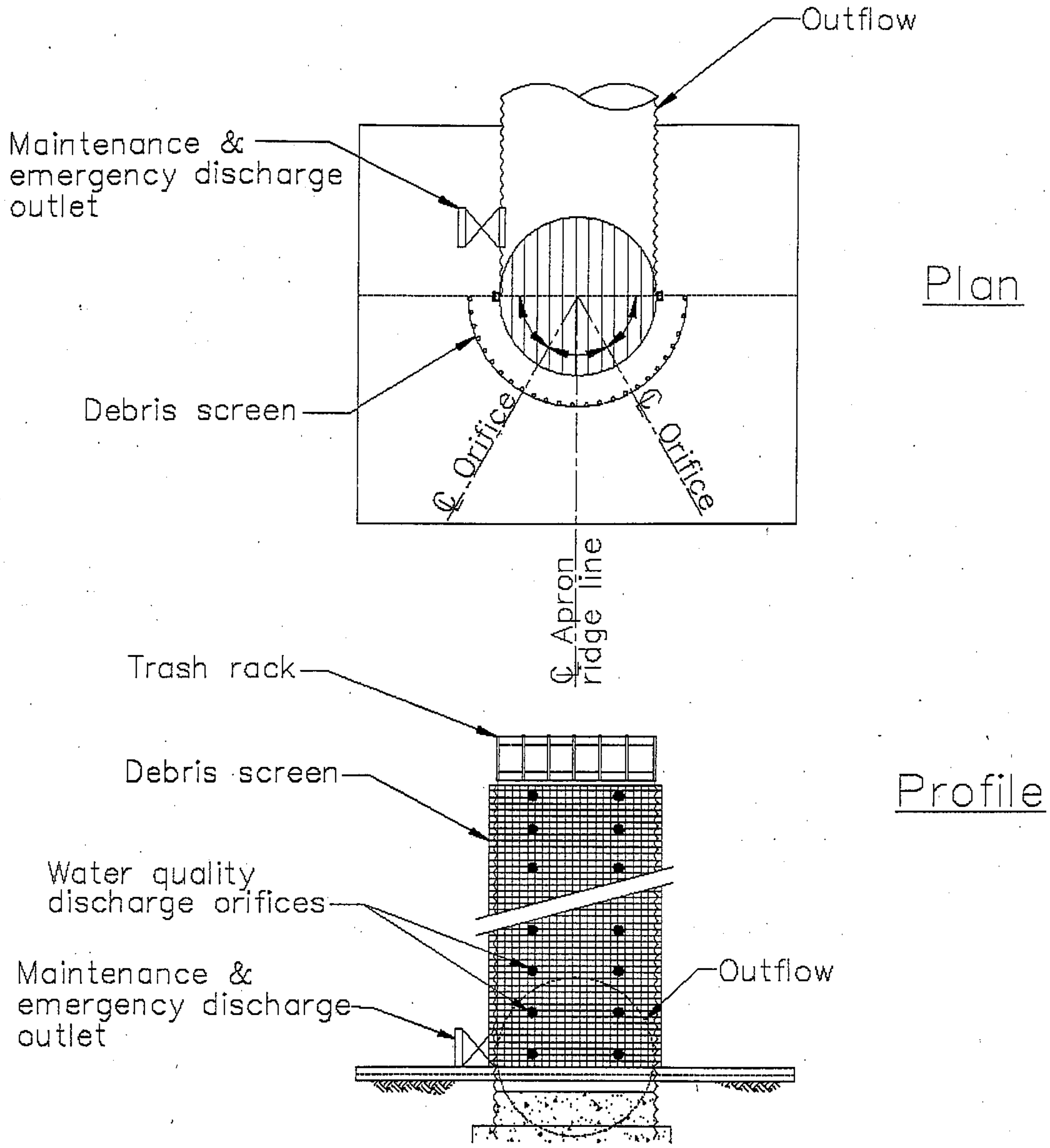


FIGURE 3: MULTIPLE ORIFICE OUTLET RISER

NOT TO SCALE



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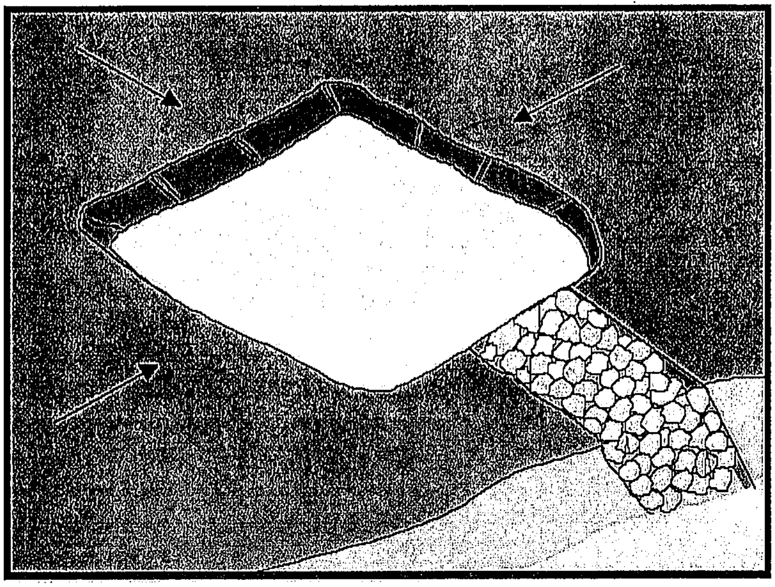
# Sediment Trap SE-3



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-2 Sediment Basin (for larger areas)

## Description and Purpose

A sediment trap is a containment area where sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out or before the runoff is discharged. Sediment traps are formed by excavating or constructing an earthen embankment across a waterway or low drainage area.

## Suitable Applications

Sediment traps should be considered for use:

- At the perimeter of the site at locations where sediment-laden runoff is discharged offsite.
- At multiple locations within the project site where sediment control is needed.
- Around or upslope from storm drain inlet protection measures.
- Sediment traps may be used on construction projects where the drainage area is less than 5 acres. Traps would be placed where sediment-laden stormwater may enter a storm drain or watercourse. SE-2, Sediment Basins, must be used for drainage areas greater than 5 acres.
- As a supplemental control, sediment traps provide additional protection for a water body or for reducing sediment before it enters a drainage system.

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## Limitations

- Requires large surface areas to permit infiltration and settling of sediment.
- Not appropriate for drainage areas greater than 5 acres.
- Only removes large and medium sized particles and requires upstream erosion control.
- Attractive and dangerous to children, requiring protective fencing.
- Conducive to vector production.
- Should not be located in live streams.

## Implementation

### *Design*

A sediment trap is a small temporary ponding area, usually with a gravel outlet, formed by excavation or by construction of an earthen embankment. Its purpose is to collect and store sediment from sites cleared or graded during construction. It is intended for use on small drainage areas with no unusual drainage features and projected for a quick build-out time. It should help in removing coarse sediment from runoff. The trap is a temporary measure with a design life of approximately six months to one year and is to be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps should be used only for small drainage areas. If the contributing drainage area is greater than 5 acres, refer to SE-2, Sediment Basins, or subdivide the catchment area into smaller drainage basins.

Sediment usually must be removed from the trap after each rainfall event. The SWPPP should detail how this sediment is to be disposed of, such as in fill areas onsite, or removal to an approved offsite dump. Sediment traps used as perimeter controls should be installed before any land disturbance takes place in the drainage area.

Sediment traps are usually small enough that a failure of the structure would not result in a loss of life, damage to home or buildings, or interruption in the use of public roads or utilities. However, sediment traps are attractive to children and can be dangerous. The following recommendations should be implemented to reduce risks:

- Install continuous fencing around the sediment trap or pond. Consult local ordinances regarding requirements for maintaining health and safety.
- Restrict basin side slopes to 3:1 or flatter.

Sediment trap size depends on the type of soil, size of the drainage area, and desired sediment removal efficiency (see SE-2, Sediment Basin). As a rule of thumb, the larger the basin volume the greater the sediment removal efficiency. Sizing criteria are typically established under the local grading ordinance or equivalent. The runoff volume from a 2-year storm is a common design criteria for a sediment trap. The sizing criteria below assume that this runoff volume is 0.042 acre-ft/acre (0.5 in. of runoff). While the climatic, topographic, and soil type extremes make it difficult to establish a statewide standard, the following criteria should trap moderate to high amounts of sediment in most areas of California:

- Locate sediment traps as near as practical to areas producing the sediment.
- Trap should be situated according to the following criteria: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where failure would not cause loss of life or property damage, and (3) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.
- Trap should be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 67 $yd^3$/acre and 33 $yd^3$/acre of contributing drainage area, respectively, based on 0.5 in. of runoff volume over a 24-hour period. In many cases, the size of an individual trap is limited by available space. Multiple traps or additional volume may be required to accommodate specific rainfall, soil, and site conditions.
- Traps with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and traps capable of impounding more than 35,000 $ft^3$, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the trap outlet and bypass structures.
- The outlet pipe or open spillway must be designed to convey anticipated peak flows.
- Use rock or vegetation to protect the trap outlets against erosion.
- Fencing should be provided to prevent unauthorized entry.

### *Installation*

Sediment traps can be constructed by excavating a depression in the ground or creating an impoundment with a small embankment. Sediment traps should be installed outside the area being graded and should be built prior to the start of the grading activities or removal of vegetation. To minimize the area disturbed by them, sediment traps should be installed in natural depressions or in small swales or drainage ways. The following steps must be followed during installation:

- The area under the embankment must be cleared, grubbed, and stripped of any vegetation and root mat. The pool area should be cleared.
- The fill material for the embankment must be free of roots or other woody vegetation as well as oversized stones, rocks, organic material, or other objectionable material. The embankment may be compacted by traversing with equipment while it is being constructed.
- All cut-and-fill slopes should be 3:1 or flatter.
- When a riser is used, all pipe joints must be watertight.
- When a riser is used, at least the top two-thirds of the riser should be perforated with 0.5 in. diameter holes spaced 8 in. vertically and 10 to 12 in. horizontally. See SE-2, Sediment Basin.
- When an earth or stone outlet is used, the outlet crest elevation should be at least 1 ft below the top of the embankment.

- When crushed stone outlet is used, the crushed stone used in the outlet should meet AASHTO M43, size No. 2 or 24, or its equivalent such as MSHA No. 2. Gravel meeting the above gradation may be used if crushed stone is not available.

### Costs

Average annual cost per installation and maintenance (18 month useful life) is \$0.73 per $ft^3$ (\$1,300 per drainage acre). Maintenance costs are approximately 20% of installation costs.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect outlet area for erosion and stabilize if required.
- Inspect trap banks for seepage and structural soundness, repair as needed.
- Inspect outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Inspect fencing for damage and repair as needed.
- Inspect the sediment trap for area of standing water during every visit. Corrective measures should be taken if the BMP does not dewater completely in 72 hours or less to prevent vector production.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the trap capacity. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at an appropriate location.
- Remove vegetation from the sediment trap when first detected to prevent pools of standing water and subsequent vector production.
- BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs shall be implemented at all times during dewatering activities.

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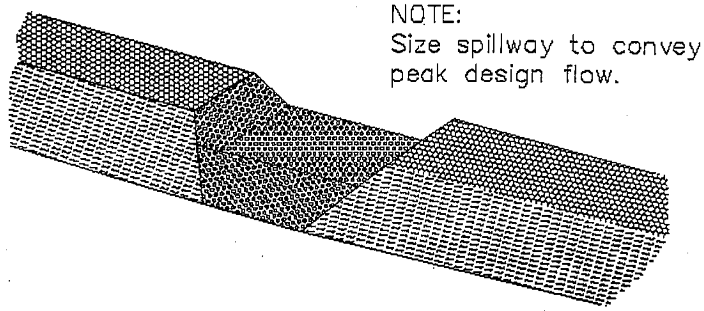
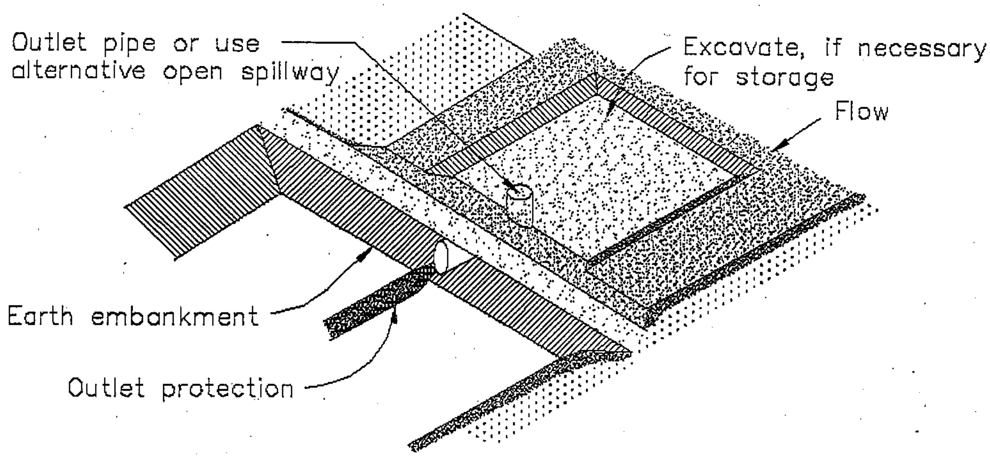
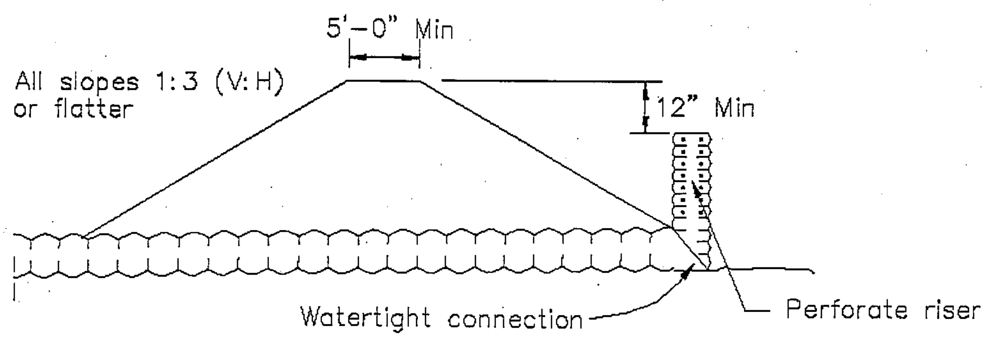



TYPICAL OPEN SPILLWAY




EMBANKMENT SECTION THRU RISER

TYPICAL SEDIMENT TRAP
NOT TO SCALE



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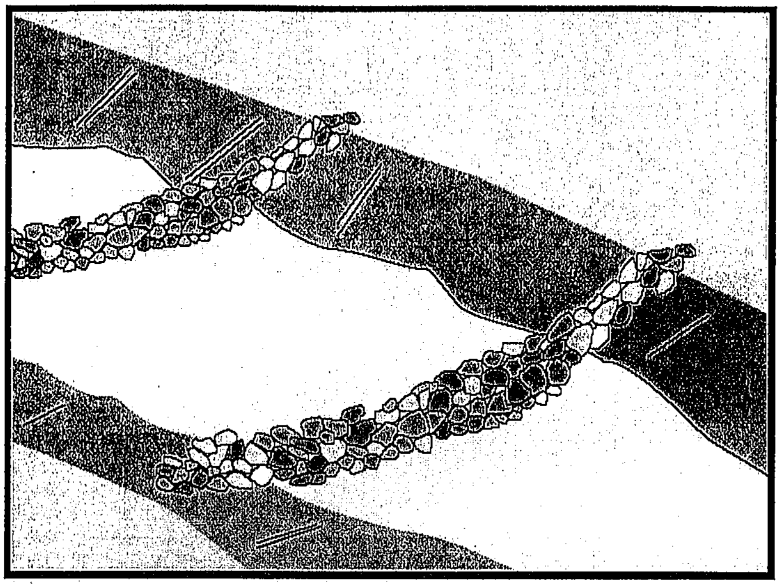
# Check Dams





### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

## Description and Purpose

A check dam is a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or reusable products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing the velocity of flowing water, allowing sediment to settle and reducing erosion.

## Suitable Applications

Check dams may be appropriate in the following situations:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow in small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.
- In steep channels where stormwater runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.

## Limitations

- Not to be used in live streams or in channels with extended base flows.

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- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.

## Implementation

### *General*

Check dams reduce the effective slope and create small pools in swales and ditches that drain 10 acres or less. Reduced slopes reduce the velocity of stormwater flows, thus reducing erosion of the swale or ditch and promoting sedimentation. Use of check dams for sedimentation will likely result in little net removal of sediment because of the small detention time and probable scour during longer storms. Using a series of check dams will generally increase their effectiveness. A sediment trap (SE-3) may be placed immediately upstream of the check dam to increase sediment removal efficiency.

### *Design and Layout*

Check dams work by decreasing the effective slope in ditches and swales. An important consequence of the reduced slope is a reduction in capacity of the ditch or swale. This reduction in capacity must be considered when using this BMP, as reduced capacity can result in overtopping of the ditch or swale and resultant consequences. In some cases, such as a "permanent" ditch or swale being constructed early and used as a "temporary" conveyance for construction flows, the ditch or swale may have sufficient capacity such that the temporary reduction in capacity due to check dams is acceptable. When check dams reduce capacities beyond acceptable limits, there are several options:

- Don't use check dams. Consider alternative BMPs.
- Increase the size of the ditch or swale to restore capacity.

Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam. The center section of the dam should be lower than the edge sections so that the check dam will direct flows to the center of the ditch or swale.

Check dams are usually constructed of rock, gravel bags, sandbags, and fiber rolls. A number of products manufactured specifically for use as check dams are also being used, and some of these products can be removed and reused. Check dams can also be constructed of logs or lumber, and have the advantage of a longer lifespan when compared to gravel bags, sandbags, and fiber rolls. Straw bales can also be used for check dams and can work if correctly installed; but in practice, straw bale check dams have a high failure rate. Check dams should not be constructed from straw bales or silt fences, since concentrated flows quickly wash out these materials.

Rock check dams are usually constructed of 8 to 12 in. rock. The rock is placed either by hand or mechanically, but never just dumped into the channel. The dam must completely span the ditch or swale to prevent washout. The rock used must be large enough to stay in place given the expected design flow through the channel.

Log check dams are usually constructed of 4 to 6 in. diameter logs. The logs should be embedded into the soil at least 18 in. Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

Gravel bag and sandbag check dams are constructed by stacking bags across the ditch or swale, shaped as shown in the drawings at the end of this fact sheet.

Manufactured products should be installed in accordance with the manufacturer's instructions.

If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured (unless the slope of the swales is greater than 4%).

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- Backwater from a downstream check dam should reach the toes of the upstream check dam.
- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap must be cleaned following each storm event.
- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.
- Gravel bags may be used as check dams with the following specifications:

### *Materials*

Gravel bags used for check dams should conform to the requirements of SE-6, Gravel Bag Berms. Sandbags used for check dams should conform to SE-8, Sandbag Barrier. Fiber rolls used for check dams should conform to SE-5, Fiber Rolls. Straw bales used for check dams should conform to SE-9, Straw Bale Barrier.

### *Installation*

- Rock should be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Tightly abut bags and stack according to detail shown in the figure at the end of this section. Gravel bags and sandbags should not be stacked any higher than 3 ft.
- Fiber rolls and straw bales must be trenched in and firmly staked in place.

### Costs
Cost consists of only installation costs if materials are readily available. If material must be imported, costs may increase. For material costs, see SE-5, SE-6, SE-8 and SE-9.

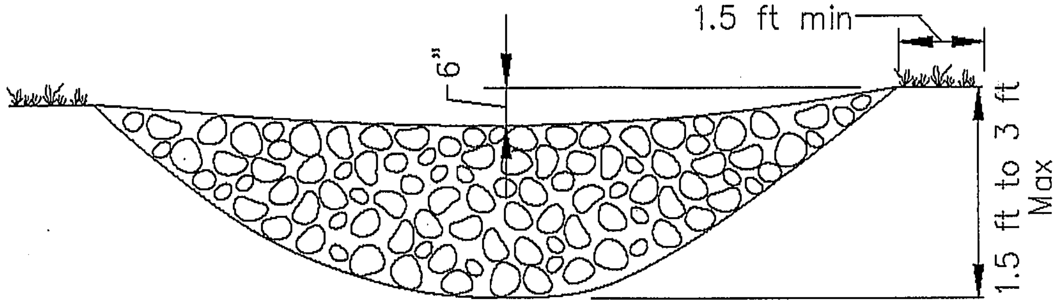
### Inspection and Maintenance
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Replace missing rock, bags, bales, etc. Replace bags or bales that have degraded or have become damaged.
- If the check dam is used as a sediment capture device, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

### References
Draft – Sedimentation and Erosion Control, and Inventory of Current Practices, USEPA, April 1990.

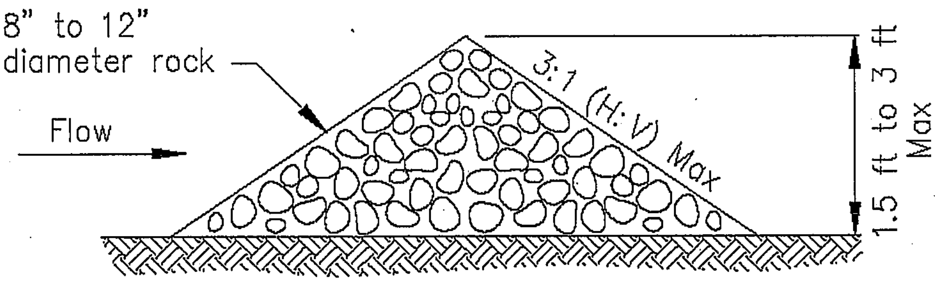
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

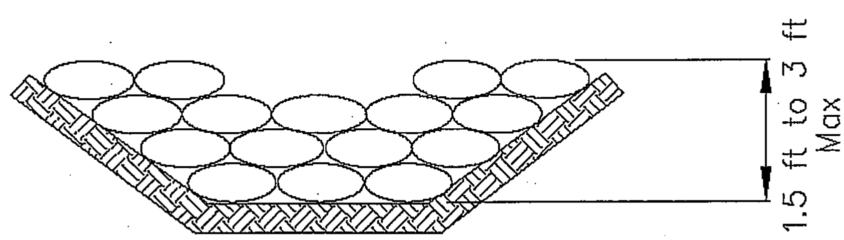



ELEVATION




TYPICAL ROCK CHECK DAM SECTION

ROCK CHECK DAM
NOT TO SCALE




GRAVEL BAG CHECK DAM ELEVATION
NOT TO SCALE



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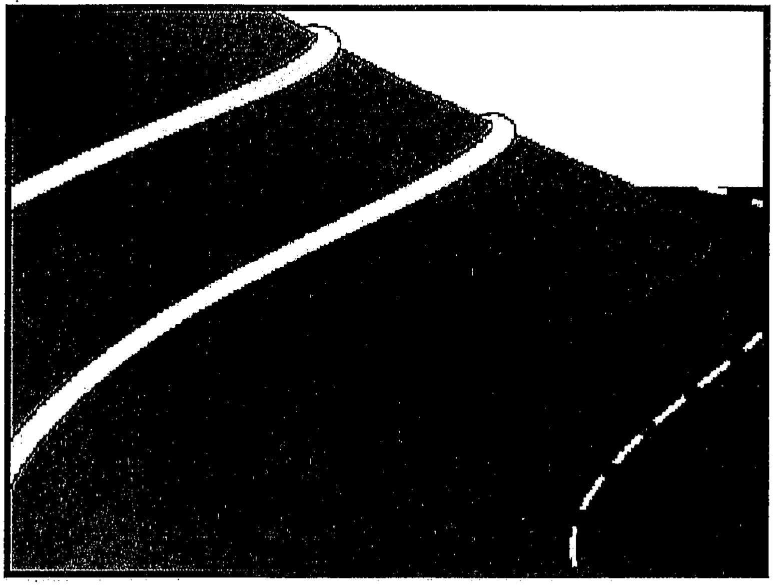
# Fiber Rolls



## Description and Purpose

A fiber roll consists of straw, flax, or other similar materials bound into a tight tubular roll. When fiber rolls are placed at the toe and on the face of slopes, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff. By interrupting the length of a slope, fiber rolls can also reduce erosion.

## Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
- At the end of a downward slope where it transitions to a steeper slope
- Along the perimeter of a project
- As check dams in unlined ditches
- Down-slope of exposed soil areas
- Around temporary stockpiles

## Limitations

- Fiber rolls are not effective unless trenched

### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

SE-1 Silt Fence
SE-6 Gravel Bag Berm
SE-8 Sandbag Barrier
SE-9 Straw Bale Barrier

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- Fiber rolls at the toe of slopes greater than 5:1 (H:V) should be a minimum of 20 in. diameter or installations achieving the same protection (i.e. stacked smaller diameter fiber rolls, etc.).
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.

## Implementation

### *Fiber Roll Materials*

- Fiber rolls should be either prefabricated rolls or rolled tubes of erosion control blanket.

### *Assembly of Field Rolled Fiber Roll*

- Roll length of erosion control blanket into a tube of minimum 8 in. diameter.
- Bind roll at each end and every 4 ft along length of roll with jute-type twine.

### *Installation*

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.
- Stake fiber rolls into a 2 to 4 in. deep trench with a width equal to the diameter of the fiber roll.
  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.

### *Removal*

- Fiber rolls are typically left in place.

- If fiber rolls are removed, collect and dispose of sediment accumulation, and fill and compact holes, trenches, depressions or any other ground disturbance to blend with adjacent ground.

### Costs

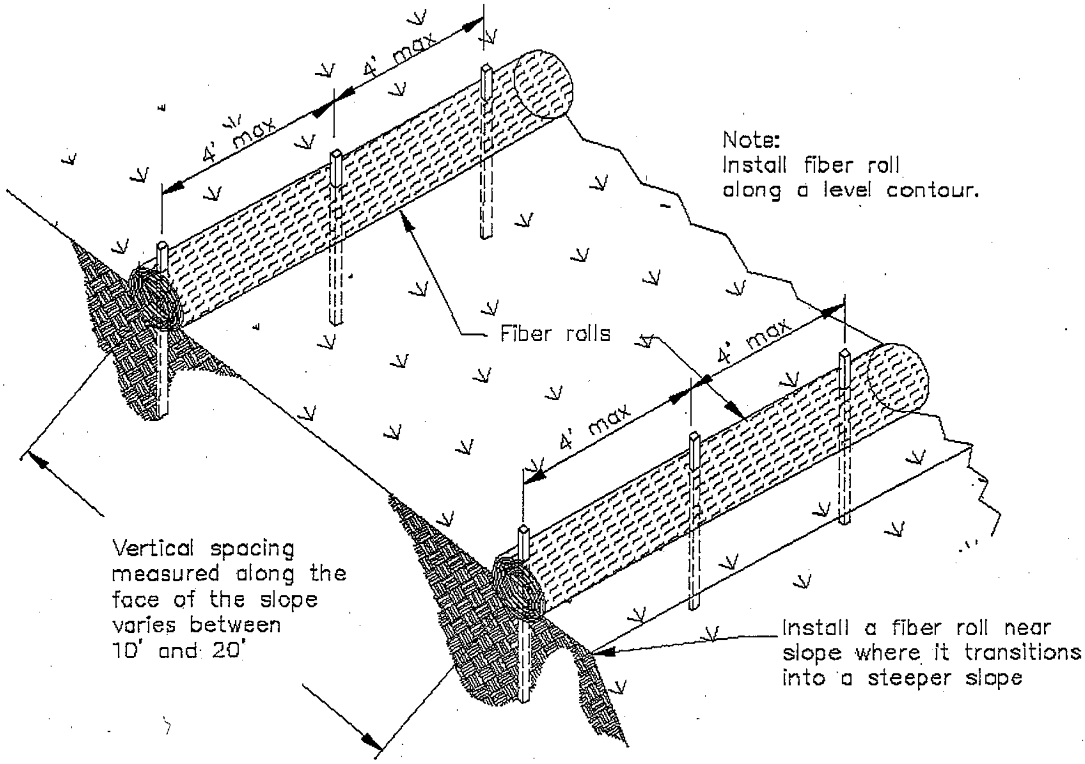
Material costs for fiber rolls range from $20 - $30 per 25 ft roll.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage depth, usually one-half the distance between the top of the fiber roll and the adjacent ground surface. Sediment removed during maintenance may be incorporated into earthwork on the site of disposed at an appropriate location.
- If fiber rolls are used for erosion control, such as in a mini check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.

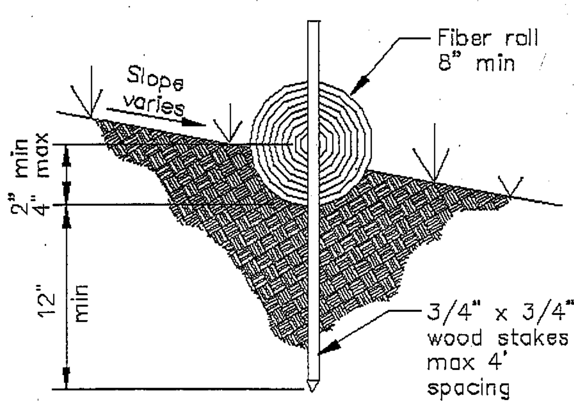
### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.




TYPICAL FIBER ROLL INSTALLATION

N.T.S.




ENTRENCHMENT DETAIL

N.T.S.



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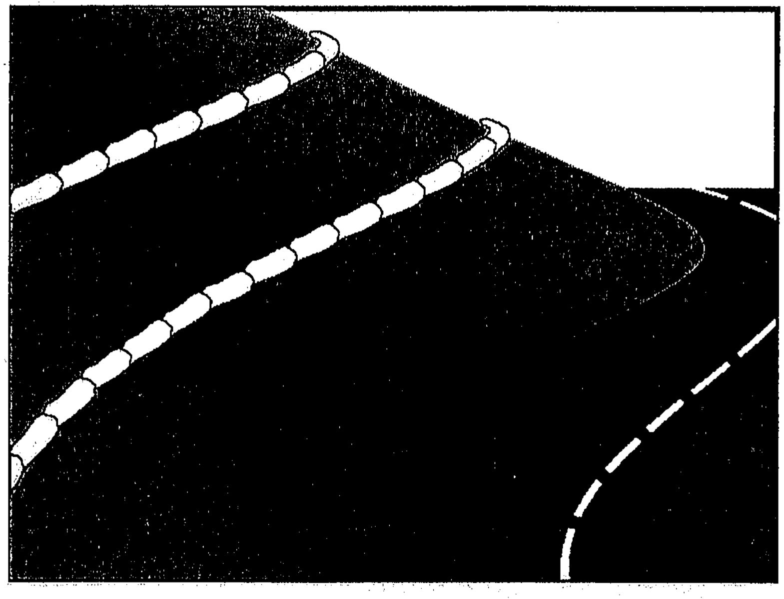

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-1 Silt Fence
SE-5 Fiber Roll
SE-8 Sandbag Barrier
SE-9 Straw Bale Barrier

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## Description and Purpose

A gravel bag berm is a series of gravel-filled bags placed on a level contour to intercept sheet flows. Gravel bags pond sheet flow runoff, allowing sediment to settle out, and release runoff slowly as sheet flows, preventing erosion.

## Suitable Applications

Gravel bag berms may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:



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- Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

## Limitations

- Gravel berms may be difficult to remove.
- Removal problems limit their usefulness in landscaped areas.
- Gravel bag berm may not be appropriate for drainage areas greater than 5 acres.
- Runoff will pond upstream of the filter, possibly causing flooding if sufficient space does not exist.
- Degraded gravel bags may rupture when removed, spilling contents.
- Installation can be labor intensive.
- Berms may have limited durability for long-term projects.
- When used to detain concentrated flows, maintenance requirements increase.

## Implementation

### *General*

A gravel bag berm consists of a row of open graded gravel–filled bags placed on a level contour. When appropriately placed, a gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. The open graded gravel in the bags is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flows. Gravel bag berms also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils. Gravel bag berms are similar to sand bag barriers, but are more porous.

### *Design and Layout*

- Locate gravel bag berms on level contours.
  - Slopes between 20:1 and 2:1 (H:V): Gravel bags should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Gravel bags should be placed at a maximum interval of 25 ft (a closer spacing is more effective), with the first row placed the slope toe.
- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the gravel bag berm to allow ponding, and to provide room for sediment storage.

- For installation near the toe of the slope, consider moving the gravel bag barriers away from the slope toe to facilitate cleaning. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- In Non-Traffic Areas:
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Top width = 12 in. minimum for one or two layer construction
  - Side slopes = 2:1 or flatter
- In Construction Traffic Areas:
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Top width = 12 in. minimum for one or two layer construction.
  - Side slopes = 2:1 or flatter.
- Butt ends of bags tightly
- On multiple row, or multiple layer construction, overlapp butt joints of adjacent row and row beneath.
- Use a pyramid approach when stacking bags.

### *Materials*

- ***Bag Material:*** Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/$yd^2$, Mullen burst strength exceeding 300 lb/$in^2$ in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.
- ***Bag Size:*** Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.
- ***Fill Material:*** Fill material should be 0.5 to 1 in. Class 2 aggregate base, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

## Costs

Gravel filter: Expensive, since off-site materials, hand construction, and demolition/removal are usually required. Material costs for gravel bags are average of $2.50 per empty gravel bag. Gravel costs range from $20-$35 per $yd^3$.

### Inspection and Maintenance

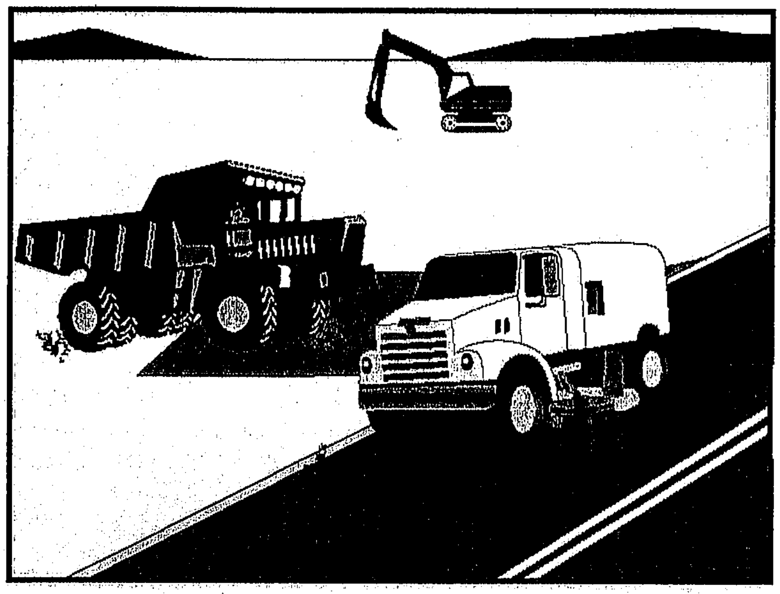
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Gravel bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.
- Reshape or replace gravel bags as needed.
- Repair washouts or other damage as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove gravel bag berms when no longer needed. Remove sediment accumulation and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of.

### References

Handbook of Steel Drainage and Highway Construction, American Iron and Steel Institute, 1983.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Pollution Plan Handbook, First Edition, State of California, Department of Transportation Division of New Technology, Materials and Research, October 1992.



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | ☑ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

### Potential Alternatives

None

## Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

## Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

## Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

## Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

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- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

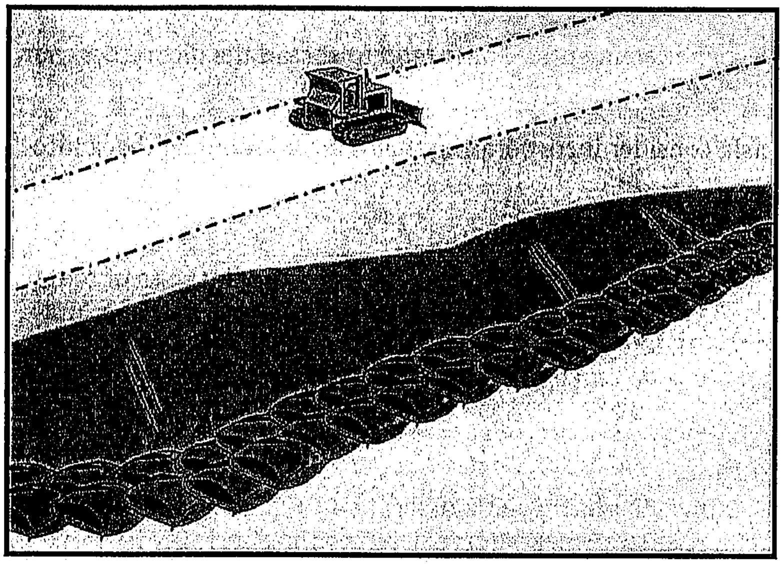
### Costs
Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from \$58/hour (3 $yd^3$ hopper) to \$88/hour (9 $yd^3$ hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

### Inspection and Maintenance
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

### References
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

# Sandbag Barrier SE-8



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-9 Straw Bale Barrier

## Description and Purpose

A sandbag barrier is a series of sand-filled bags placed on a level contour to intercept sheet flows. Sandbag barriers pond sheet flow runoff, allowing sediment to settle out.

## Suitable Applications

Sandbag barriers may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow

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- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

## Limitations

- It is necessary to limit the drainage area upstream of the barrier to 5 acres.
- Degraded sandbags may rupture when removed, spilling sand.
- Installation can be labor intensive.
- Barriers may have limited durability for long-term projects.
- When used to detain concentrated flows, maintenance requirements increase.
- Burlap should not be used for sandbags.

## Implementation

### *General*

A sandbag barrier consists of a row of sand-filled bags placed on a level contour. When appropriately placed, a sandbag barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. While the sand-filled bags are porous, the fine sand tends to quickly plug with sediment, limiting the rate of flow through the barrier. If a porous barrier is desired, consider SE-1, Silt Fence, SE-5, Fiber Rolls, SE-6, Gravel Bag Berms, or SE-9, Straw Bale Barriers. Sandbag barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets which erode rills, and ultimately gullies, into disturbed, sloped soils. Sandbag barriers are similar to ground bag berms, but less porous.

### *Design and Layout*

- Locate sandbag barriers on a level contour.
  - Slopes between 20:1 and 2:1 (H:V): Sandbags should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Sandbags should be placed at a maximum interval of 25 ft (a closer spacing is more effective), with the first row placed near the slope toe.
- Turn the ends of the sandbag barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, consider moving the barrier away from the slope toe to facilitate cleaning. To prevent flow behind the barrier, sandbags can be placed perpendicular to the barrier to serve as cross barriers.
- Drainage area should not exceed 5 acres.

- Stack sandbags at least three bags high.
- Butt ends of bags tightly.
- Overlapp butt joints of row beneath with each successive row.
- Use a pyramid approach when stacking bags.
- In non-traffic areas
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Side slope = 2:1 or flatter
- In construction traffic areas
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Side slopes = 2:1 or flatter.

### *Materials*

- ***Sandbag Material:*** Sandbag should be woven polypropylene, polyethylene or polyamide fabric, minimum unit weight of 4 ounces/yd$^2$, Mullen burst strength exceeding 300 lb/in$^2$ in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355. Use of burlap may not acceptable in some jurisdictions.

- ***Sandbag Size:*** Each sand-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** All sandbag fill material should be non-cohesive, Class 1 or Class 2 permeable material free from clay and deleterious material.

## Costs

Sandbag barriers are more costly, but typically have a longer useful life than other barriers. Empty sandbags cost $0.25 - $0.75. Average cost of fill material is $8 per yd$^3$. Pre-filled sandbags are more expensive at $1.50 - $2.00 per bag.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Sandbags exposed to sunlight will need to be replaced every two to three months due to degradation of the bags.

- Reshape or replace sandbags as needed.



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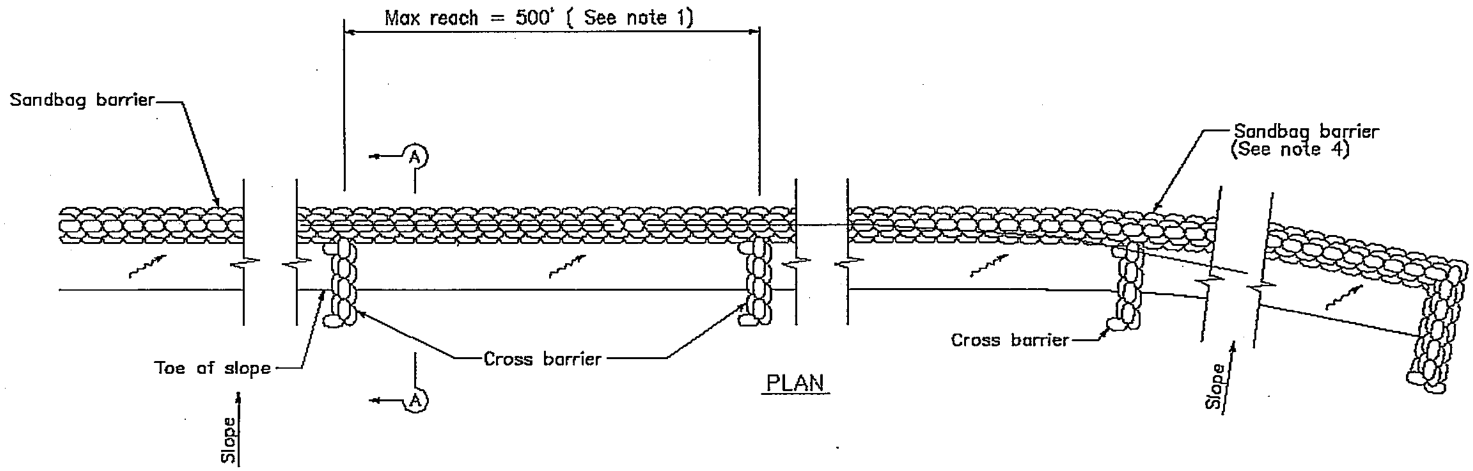
- Repair washouts or other damage as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove sandbags when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilize the area.

## References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

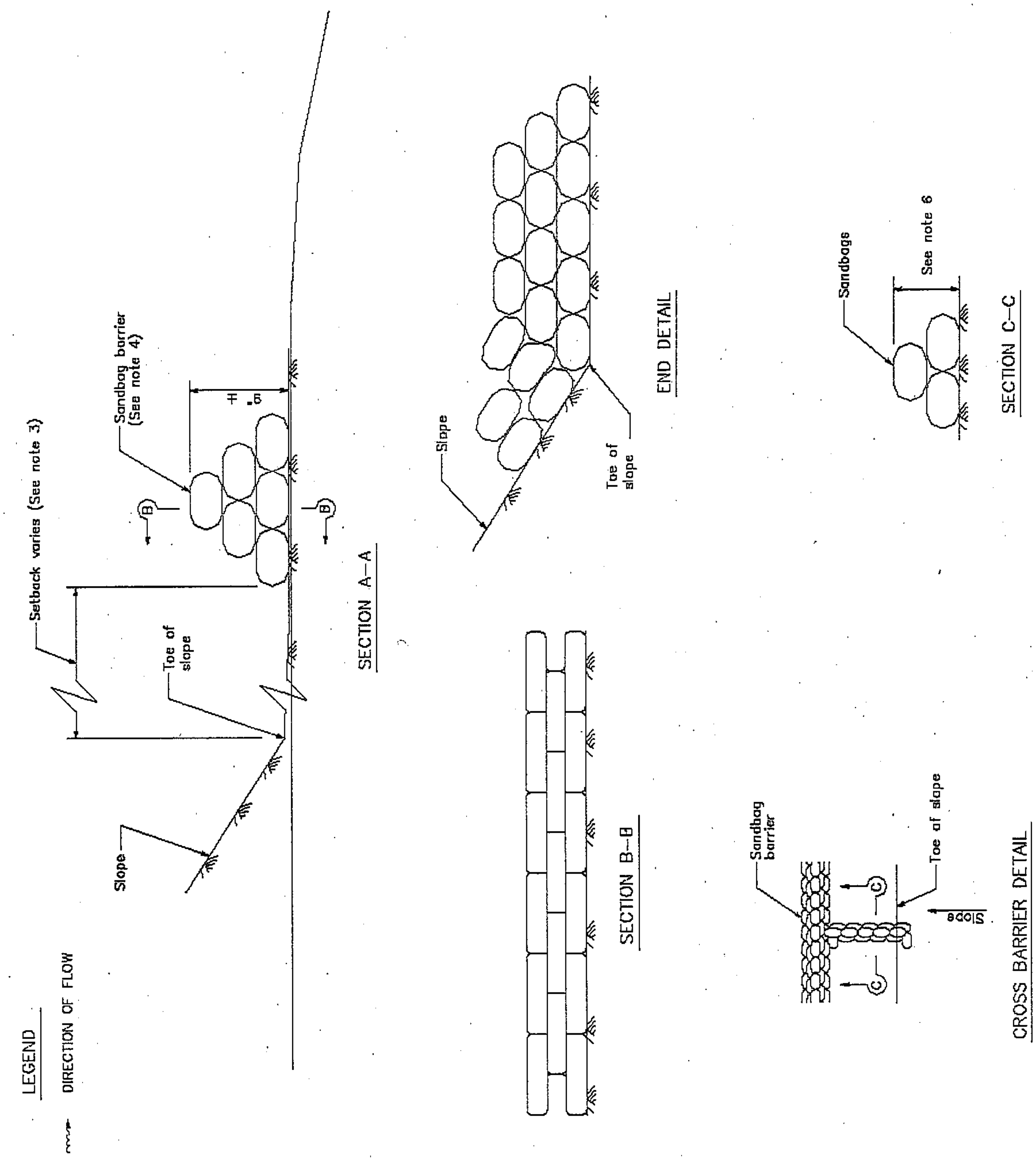


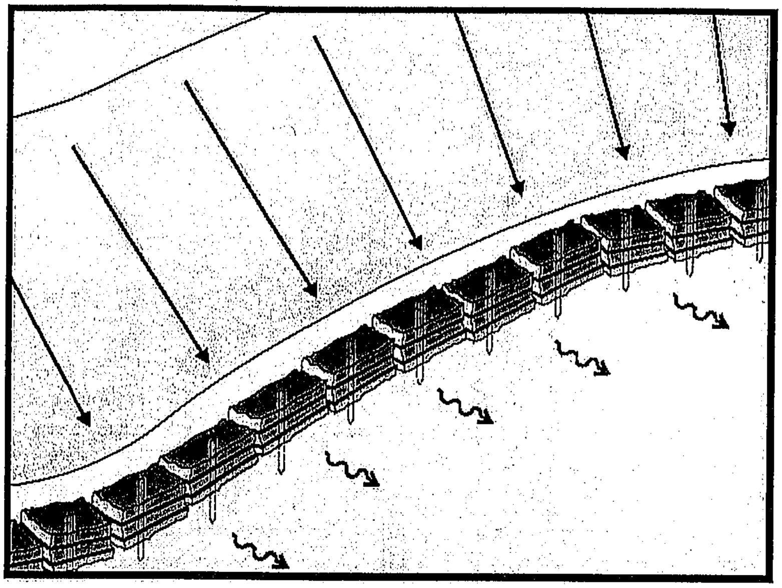

PLAN

SANDBAG BARRIER

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. Place sandbags tightly.
3. Dimension may vary to fit field condition.
4. Sandbag barrier shall be a minimum of 3 bags high.
5. The end of the barrier shall be turned up slope.
6. Cross barriers shall be a min of 1/2 and a max of 2/3 the height of the linear barrier.
7. Sandbag rows and layers shall be staggered to eliminate gaps.


LEGEND
DIRECTION OF FLOW
Slope
Toe of slope
Setback varies (See note 3)
Sandbag barrier (See note 4)
SECTION A-A
Slope
Toe of slope
END DETAIL
SECTION B-B
Sandbags
See note 6
SECTION C-C
Sandbag barrier
Toe of slope
Slope
CROSS BARRIER DETAIL



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

SE-1 Silt Fence
SE-5 Fiber Rolls
SE-6 Gravel Bag Berm
SE-8 Sandbag Barrier

## Description and Purpose

A straw bale barrier is a series of straw bales placed on a level contour to intercept sheet flows. Straw bale barriers pond sheet- flow runoff, allowing sediment to settle out.

## Suitable Applications

Straw bale barriers may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow

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- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

## Limitations

Straw bale barriers:

- Are not to be used for extended periods of time because they tend to rot and fall apart
- Are suitable only for sheet flow on slopes of 10 % or flatter
- Are not appropriate for large drainage areas, limit to one acre or less
- May require constant maintenance due to rotting
- Are not recommended for concentrated flow, inlet protection, channel flow, and live streams
- Cannot be made of bale bindings of jute or cotton
- Require labor-intensive installation and maintenance
- Cannot be used on paved surfaces
- Should not to be used for drain inlet protection
- Should not be used on lined ditches
- May introduce undesirable non-native plants to the area

## Implementation

### *General*

A straw bale barrier consists of a row of straw bales placed on a level contour. When appropriately placed, a straw bale barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. Straw bale barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils.

Straw bale barriers have not been as effective as expected due to improper use. These barriers have been placed in streams and drainage ways where runoff volumes and velocities have caused the barriers to wash out. In addition, failure to stake and entrench the straw bale has allowed undercutting and end flow. Use of straw bale barriers in accordance with this BMP should produce acceptable results.

### *Design and Layout*

- Locate straw bale barriers on a level contour.
  - Slopes up to 10:1 (H:V): Straw bales should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the toe of slope.
  - Slopes greater than 10:1 (H:V): Not recommended.

- Turn the ends of the straw bale barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, consider moving the barrier away from the slope toe to facilitate cleaning. To prevent flow behind the barrier, sand bags can be placed perpendicular to the barrier to serve as cross barriers.
- Drainage area should not exceed 1 acre, or 0.25 acre per 100 ft of barrier.
- Maximum flow path to the barrier should be limited to 100 ft.
- Straw bale barriers should consist of two parallel rows.
  - Butt ends of bales tightly
  - Stagger butt joints between front and back row
  - Each row of bales must be trenched in and firmly staked
- Straw bale barriers are limited in height to one bale laid on its side.
- Anchor bales with either two wood stakes or four bars driven through the bale and into the soil. Drive the first stake towards the butt joint with the adjacent bale to force the bales together.
- See attached figure for installation details.

### *Materials*

- ***Straw Bale Size:*** Each straw bale should be a minimum of 14 in. wide, 18 in. in height, 36 in. in length and should have a minimum mass of 50 lbs. The straw bale should be composed entirely of vegetative matter, except for the binding material.
- ***Bale Bindings:*** Bales should be bound by steel wire, nylon or polypropylene string placed horizontally. Jute and cotton binding should not be used. Baling wire should be a minimum diameter of 14 gauge. Nylon or polypropylene string should be approximately 12 gauge in diameter with a breaking strength of 80 lbs force.
- ***Stakes:*** Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake, or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable. Steel bar reinforcement should be equal to a #4 designation or greater. End protection should be provided for any exposed bar reinforcement.

### Costs

Straw bales cost $5 - $7 each. Adequate labor should be budgeted for installation and maintenance.

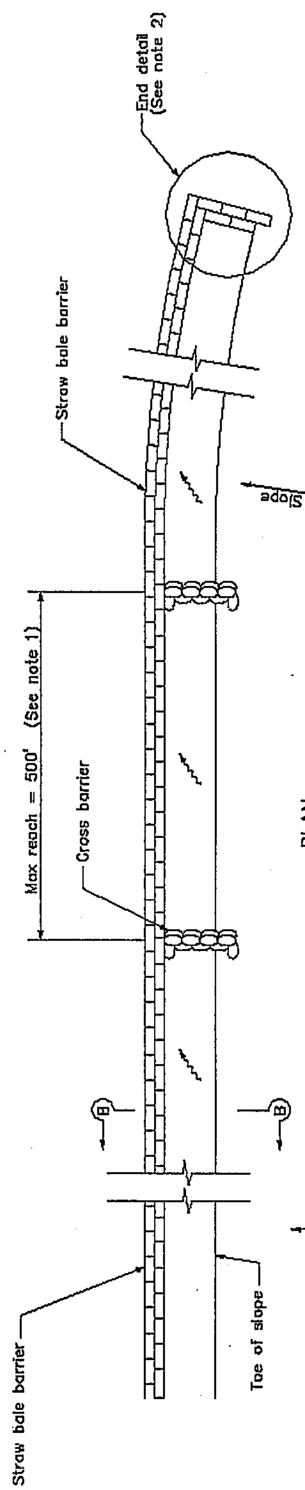
## Inspection and Maintenance

*Maintenance*

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Straw bales degrade, especially when exposed to moisture. Rotting bales will need to be replaced on a regular basis.
- Replace or repair damaged bales as needed.
- Repair washouts or other damages as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove straw bales when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of.

## References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.




PLAN

STRAW BALE BARRIER

LEGEND

DIRECTION OF FLOW

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. The end of barrier shall be turned up slope.
3. Dimension may vary to fit field condition.
4. Stake dimensions are nominal.
5. Place straw bales tightly together.
6. Tamp embedment spoils against sides of installed bales.
7. Drive angled wood stake before vertical stake to ensure tight abutment to adjacent bale.
8. Sandbag cross barriers should be a min of 1/2 and a max of 2/3 the height of the linear barrier.
9. Sandbag rows and layers should be offset to eliminate gaps.



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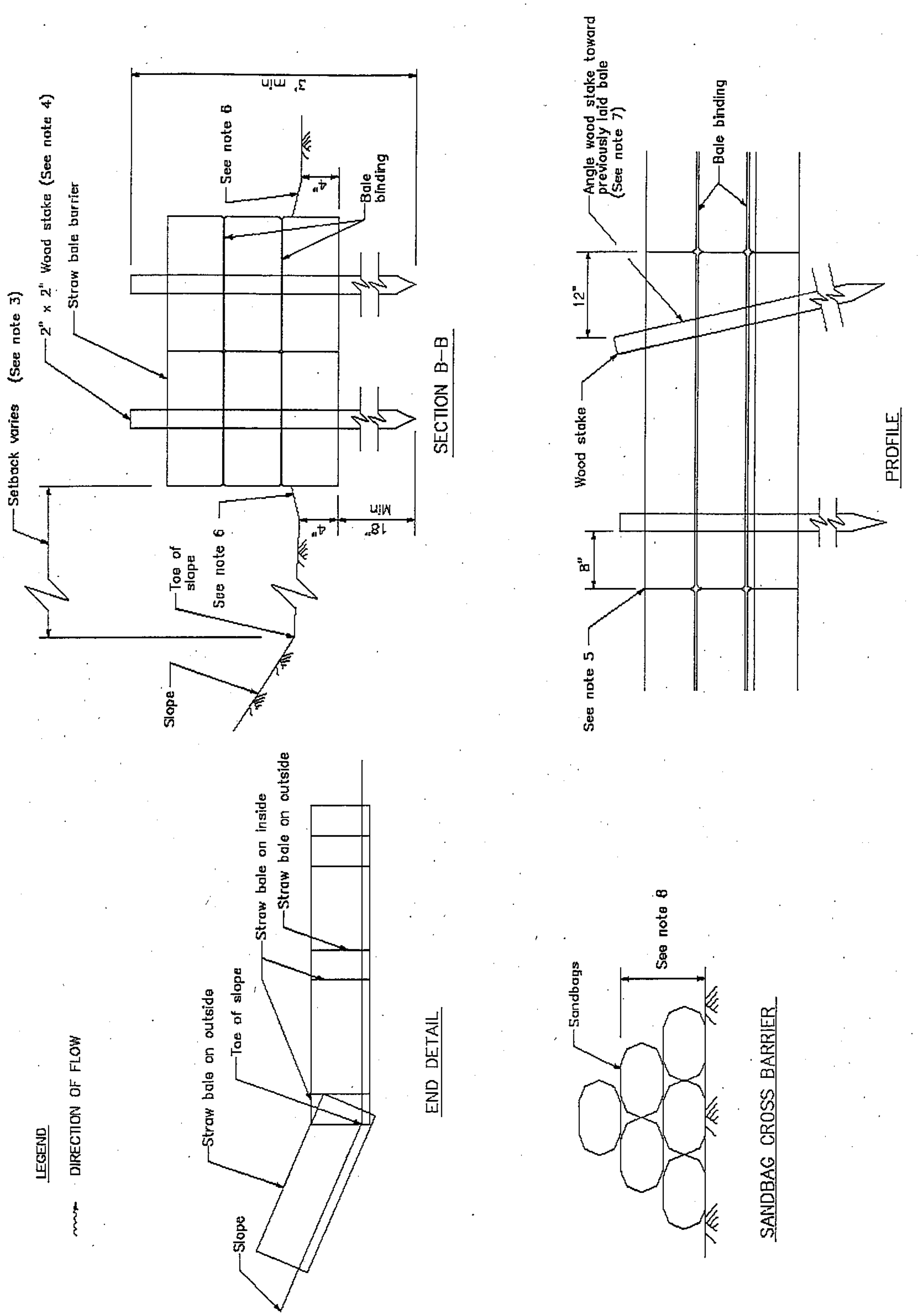
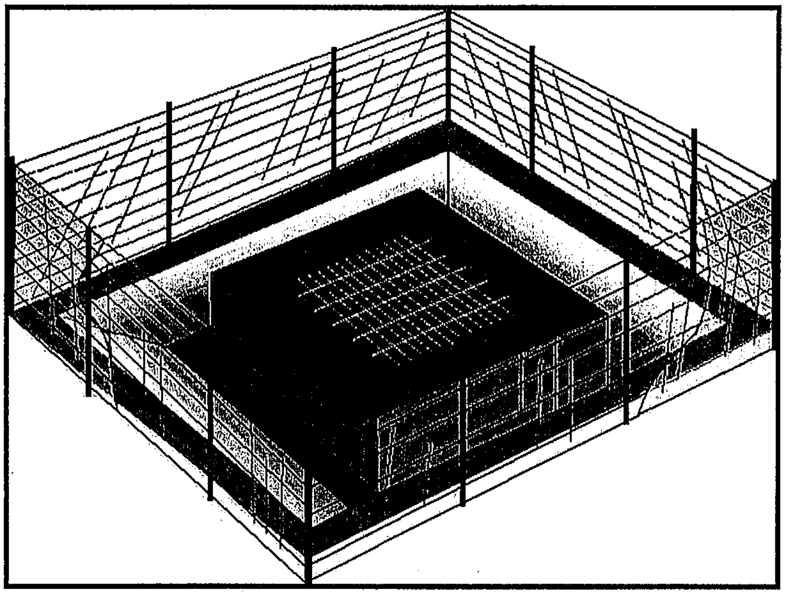


Setback varies (See note 3)
2" x 2" Wood stake (See note 4)
Straw bale barrier
See note 6
3' min
4"
Bale binding
18" Min
Toe of slope
See note 6
Slope
SECTION B-B
Angle wood stake toward previously laid bale (See note 7)
Bale binding
12"
Wood stake
8"
See note 5
PROFILE
LEGEND
DIRECTION OF FLOW
Straw bale on outside
Toe of slope
Straw bale on inside
Straw bale on outside
Slope
END DETAIL
Sandbags
See note 8
SANDBAG CROSS BARRIER



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

## Description and Purpose

Storm drain inlet protection consists of a sediment filter or an impounding area around or upstream of a storm drain, drop inlet, or curb inlet. Storm drain inlet protection measures temporarily pond runoff before it enters the storm drain, allowing sediment to settle. Some filter configurations also remove sediment by filtering, but usually the ponding action results in the greatest sediment reduction.

## Suitable Applications

Every storm drain inlet receiving sediment-laden runoff should be protected.

## Limitations

- Drainage area should not exceed 1 acre.
- Straw bales, while potentially effective, have not produced in practice satisfactory results, primarily due to improper installation.
- Requires an adequate area for water to pond without encroaching into portions of the roadway subject to traffic.
- Inlet protection usually requires other methods of temporary protection to prevent sediment-laden stormwater and non-stormwater discharges from entering the storm drain system.
- Sediment removal may be difficult in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are

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expected, use other onsite sediment trapping techniques in conjunction with inlet protection.

- Frequent maintenance is required.
- For drainage areas larger than 1 acre, runoff should be routed to a sediment-trapping device designed for larger flows. See BMPs SE-2, Sediment Basin, and SE-3, Sediment Traps.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected, and overflow capability is needed.

## Implementation

### *General*

Large amounts of sediment may enter the storm drain system when storm drains are installed before the upslope drainage area is stabilized, or where construction is adjacent to an existing storm drain. In cases of extreme sediment loading, the storm drain itself may clog and lose a major portion of its capacity. To avoid these problems, it is necessary to prevent sediment from entering the system at the inlets.

Inlet control measures presented in this handbook should not be used for inlets draining more than one acre. Runoff from larger disturbed areas should be first routed through SE-2, Sediment Basin or SE-3, Sediment Trap. Different types of inlet protection are appropriate for different applications depending on site conditions and the type of inlet. Inlet protection methods not presented in this handbook should be approved by the local stormwater management agency.

### *Design and Layout*

Identify existing and planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed and which method to use.

- Limit upstream drainage area to 1 acre maximum.. For larger drainage areas, use SE-2, Sediment Basin, or SE-3, Sediment Trap, upstream of the inlet protection device.
- The key to successful and safe use of storm drain inlet protection devices is to know where runoff will pond or be diverted.
  - Determine the acceptable location and extent of ponding in the vicinity of the drain inlet. The acceptable location and extent of ponding will influence the type and design of the storm drain inlet protection device.
  - Determine the extent of potential runoff diversion caused by the storm drain inlet protection device. Runoff ponded by inlet protection devices may flow around the device and towards the next downstream inlet. In some cases, this is acceptable; in other cases, serious erosion or downstream property damage can be caused by these diversions. The possibility of runoff diversions will influence whether or not storm drain inlet protection is suitable; and, if suitable, the type and design of the device.
- The location and extent of ponding, and the extent of diversion, can usually be controlled through appropriate placement of the inlet protection device. In some cases, moving the

inlet protection device a short distance upstream of the actual inlet can provide more efficient sediment control, limit ponding to desired areas, and prevent or control diversions.

- Four types of inlet protection are presented below. However, it is recognized that other effective methods and proprietary devices exist and may be selected.
  - Filter Fabric Fence: Appropriate for drainage basins with less than a 5% slope, sheet flows, and flows under 0.5 cfs.
  - Excavated Drop Inlet Sediment Trap: An excavated area around the inlet to trap sediment (SE-3).
  - Gravel bag barrier: Used to create a small sediment trap upstream of inlets on sloped, paved streets. Appropriate for sheet flow or when concentrated flow may exceed 0.5 cfs, and where overtopping is required to prevent flooding.
  - Block and Gravel Filter: Appropriate for flows greater than 0.5 cfs.
- Select the appropriate type of inlet protection and design as referred to or as described in this fact sheet.
- Provide area around the inlet for water to pond without flooding structures and property.
- Grates and spaces around all inlets should be sealed to prevent seepage of sediment-laden water.
- Excavate sediment sumps (where needed) 1 to 2 ft with 2:1 side slopes around the inlet.

### *Installation*

- ***DI Protection Type 1 - Filter Fabric Fence*** - The filter fabric fence (Type 1) protection is shown in the attached figure. Similar to constructing a silt fence; see BMP SE-1, Silt Fence. Do not place filter fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced.

  1. Excavate a trench approximately 6 in. wide and 6 in. deep along the line of the silt fence inlet protection device.
  2. Place 2 in. by 2 in. wooden stakes around the perimeter of the inlet a maximum of 3 ft apart and drive them at least 18 in. into the ground or 12 in. below the bottom of the trench. The stakes must be at least 48 in.
  3. Lay fabric along bottom of trench, up side of trench, and then up stakes. See SE-1, Silt Fence, for details. The maximum silt fence height around the inlet is 24 in.
  4. Staple the filter fabric (for materials and specifications, see SE-1, Silt Fence) to wooden stakes. Use heavy-duty wire staples at least 1 in. in length.
  5. Backfill the trench with gravel or compacted earth all the way around.

- ***DI Protection Type 2 - Excavated Drop Inlet Sediment Trap*** - The excavated drop inlet sediment trap (Type 2) is shown in the attached figures. Install filter fabric fence in accordance with DI Protection Type 1. Size excavated trap to provide a minimum storage capacity calculated at the rate 67 $yd^3$/acre of drainage area.

- ***DI Protection Type 3 - Gravel bag*** - The gravel bag barrier (Type 3) is shown in the figures. Flow from a severe storm should not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with SE-6, Gravel Bag Berm. Gravel bags should be used due to their high permeability.

  1. Use sand bag made of geotextile fabric (not burlap) and fill with 0.75 in. rock or 0.25 in. pea gravel.
  2. Construct on gently sloping street.
  3. Leave room upstream of barrier for water to pond and sediment to settle.
  4. Place several layers of sand bags – overlapping the bags and packing them tightly together.
  5. Leave gap of one bag on the top row to serve as a spillway. Flow from a severe storm (e.g., 10 year storm) should not overtop the curb.

- ***DI Protection Type 4 – Block and Gravel Filter*** - The block and gravel filter (Type 4) is shown in the figures. Block and gravel filters are suitable for curb inlets commonly used in residential, commercial, and industrial construction.

  1. Place hardware cloth or comparable wire mesh with 0.5 in. openings over the drop inlet so that the wire extends a minimum of 1 ft beyond each side of the inlet structure. If more than one strip is necessary, overlap the strips. Place filter fabric over the wire mesh.
  2. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, so that the open ends face outward, not upward. The ends of adjacent blocks should abut. The height of the barrier can be varied, depending on design needs, by stacking combinations of blocks that are 4 in., 8 in., and 12 in. wide. The row of blocks should be at least 12 in. but no greater than 24 in. high.
  3. Place wire mesh over the outside vertical face (open end) of the concrete blocks to prevent stone from being washed through the blocks. Use hardware cloth or comparable wire mesh with 0.5 in. opening.
  4. Pile washed stone against the wire mesh to the top of the blocks. Use 0.75 to 3 in.

## Costs

- Average annual cost for installation and maintenance (one year useful life) is $200 per inlet.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Filter Fabric Fences. If the fabric becomes clogged, torn, or degrades, it should be replaced. Make sure the stakes are securely driven in the ground and are in good shape (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes.

- Gravel Filters. If the gravel becomes clogged with sediment, it must be carefully removed from the inlet and either cleaned or replaced. Since cleaning gravel at a construction site may be difficult, consider using the sediment-laden stone as fill material and put fresh stone around the inlet. Inspect bags for holes, gashes, and snags, and replace bags as needed. Check gravel bags for proper arrangement and displacement.

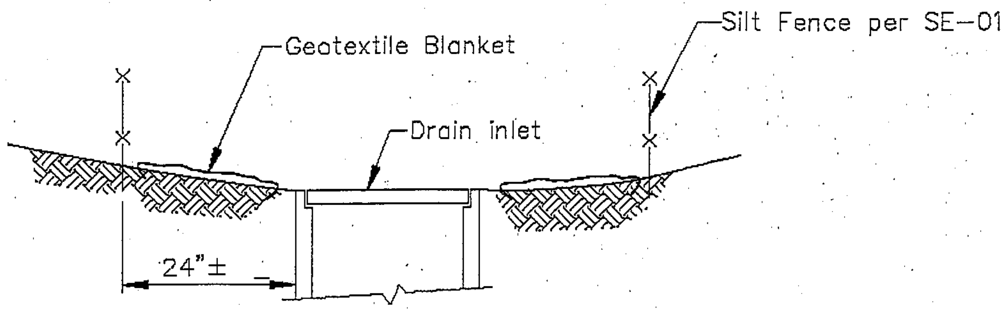
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site ore disposed at an appropriate location.

- Remove storm drain inlet protection once the drainage area is stabilized.
  - Clean and regrade area around the inlet and clean the inside of the storm drain inlet as it must be free of sediment and debris at the time of final inspection.

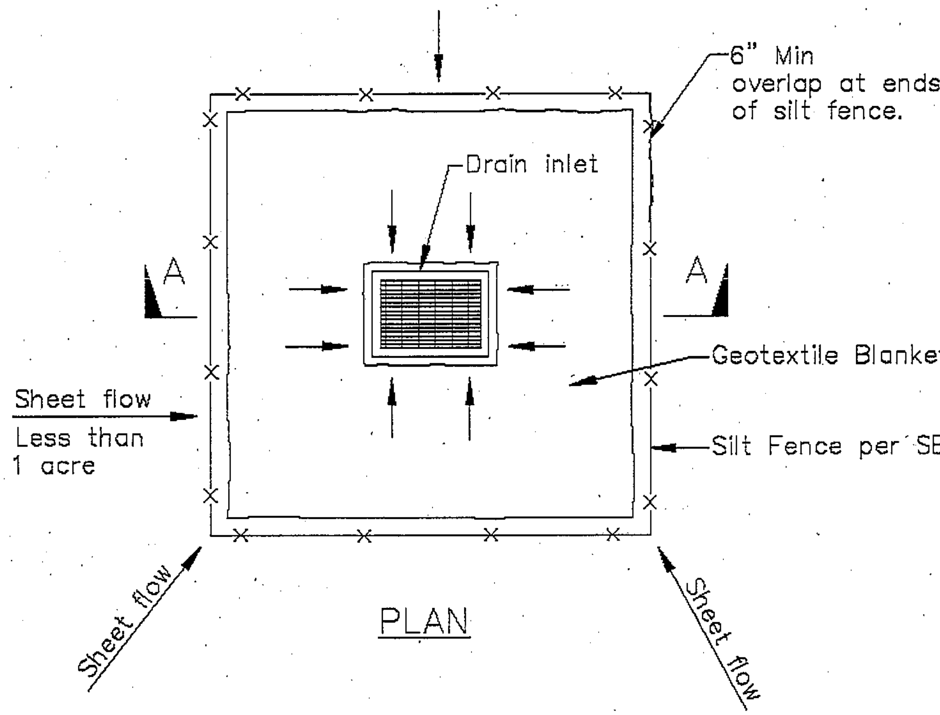
### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.




SECTION A-A




PLAN

DI PROTECTION TYPE 1
NOT TO SCALE

NOTES:

1. For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2. Not applicable in paved areas.
3. Not applicable with concentrated flows.



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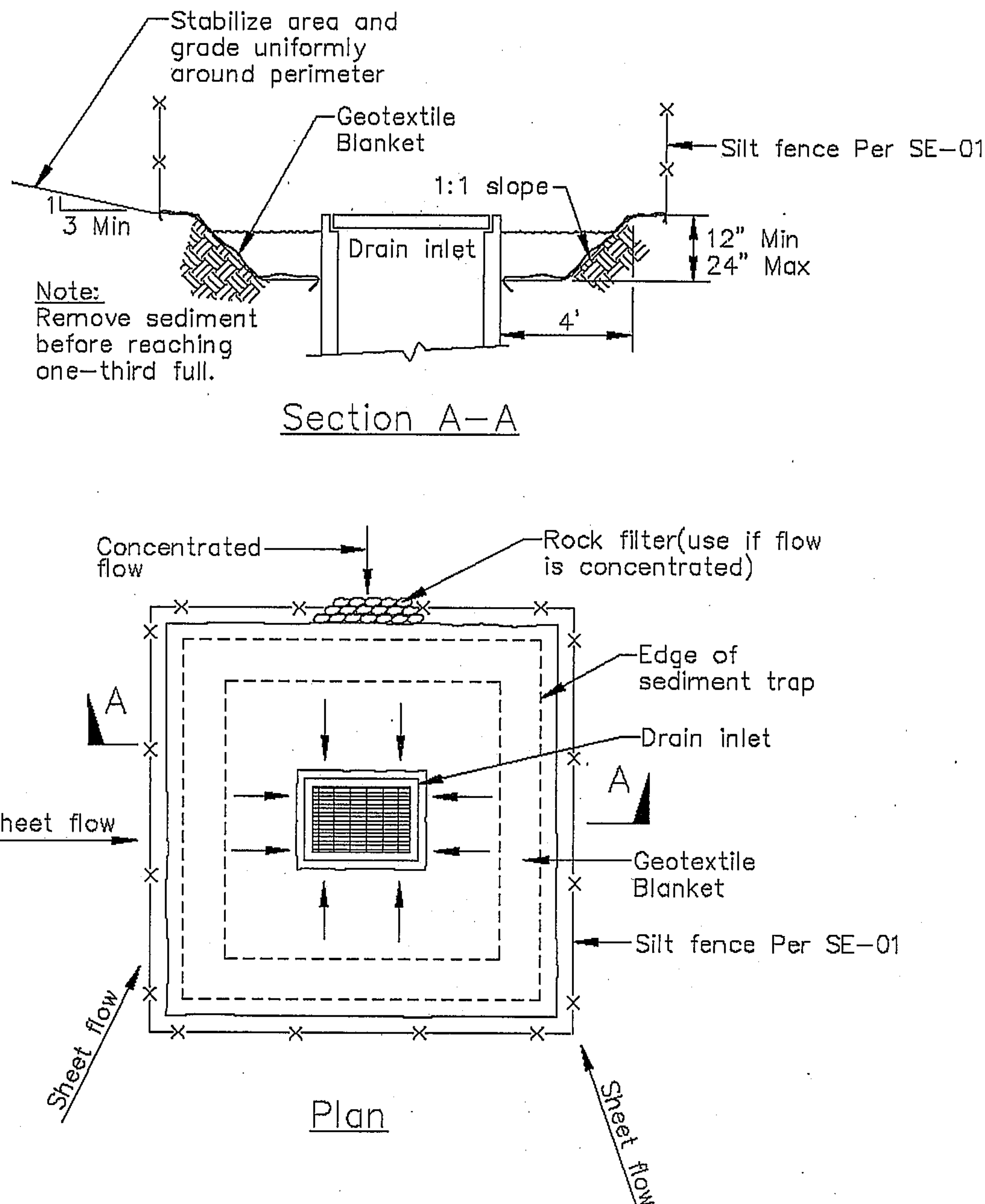
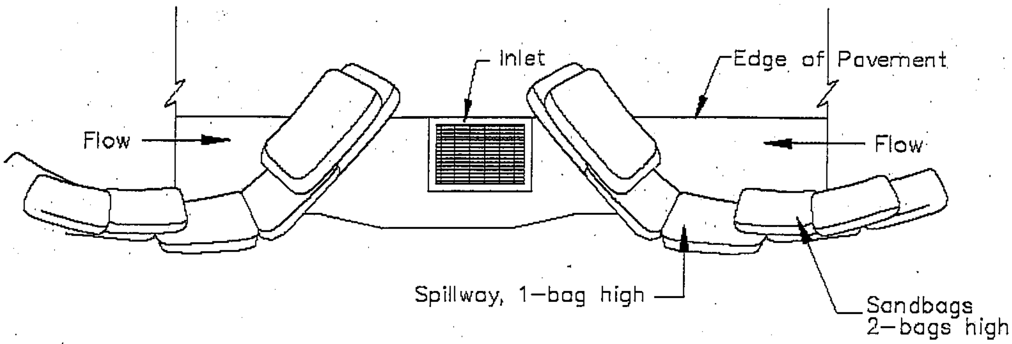
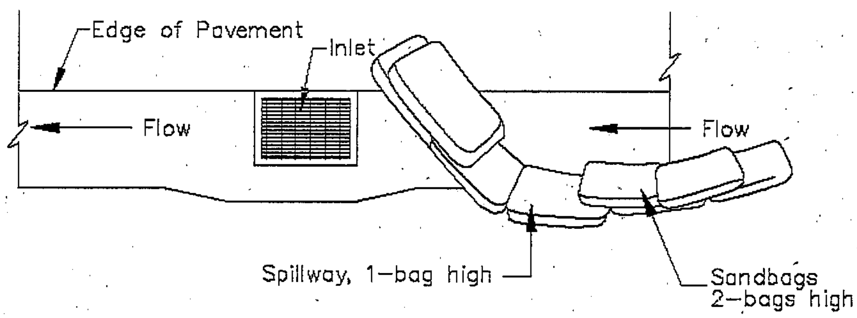



DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.




TYPICAL PROTECTION FOR INLET ON SUMP




TYPICAL PROTECTION FOR INLET ON GRADE

NOTES:
1. Intended for short-term use.
2. Use to inhibit non-storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.

DI PROTECTION TYPE 3
NOT TO SCALE



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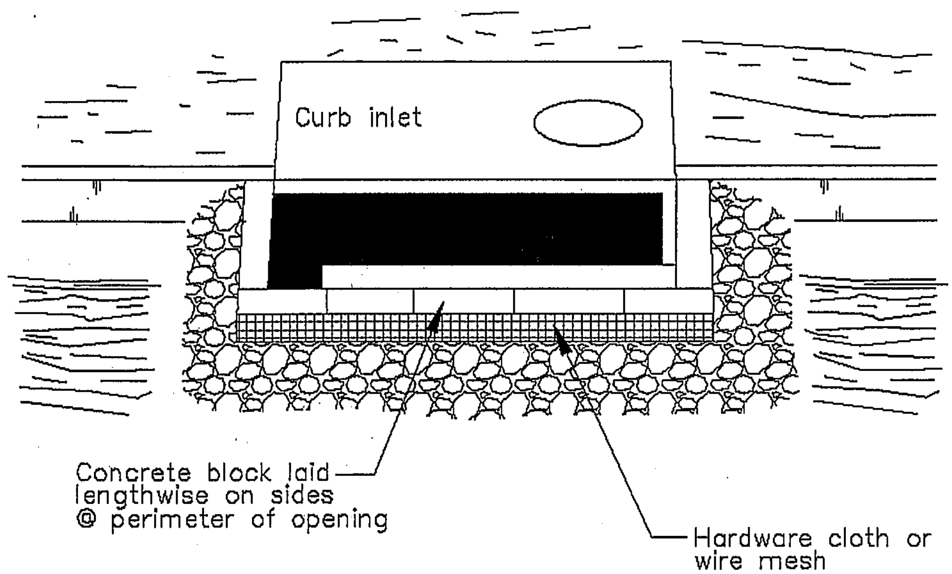


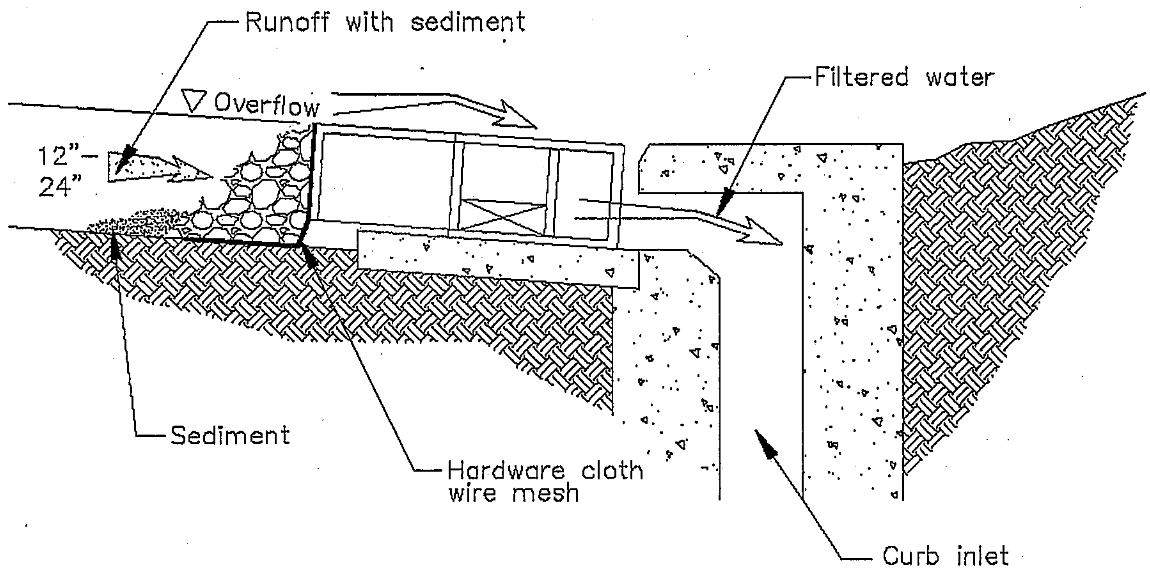


DI PROTECTION – TYPE 4

NOT TO SCALE

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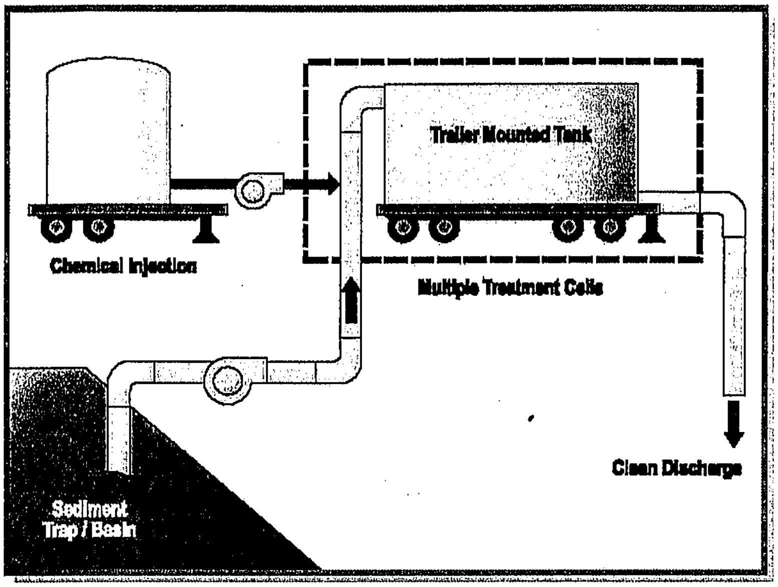


### Objectives

| | |
|---|---|
| EC | Erosion Control |
| SE | Sediment Control |
| TR | Tracking Control |
| WE | Wind Erosion Control |
| NS | Non-Stormwater Management Control |
| WM | Waste Management and Materials Pollution Control |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

None

## Description and Purpose

Chemical treatment includes the application of chemicals to stormwater to aid in the reduction of turbidity caused by fine suspended sediment.

## Suitable Applications

Chemical treatment can reliably provide exceptional reductions of turbidity and associated pollutants and should be considered where turbid discharges to sensitive wastes cannot be avoided using other BMPs. Typically, chemical use is limited to waters with numeric turbidity standards.

## Limitations

The use of chemical treatment must have the advanced approval of the Regional Water Quality Control Board.

- Chemical Treatment of stormwater is relatively new and unproven technology in California.
- BMP has not been used often in California
- Petroleum based polymers should not be used
- Requires sediment basin or trailer mounted unit for chemical application
- Batch treatment required, flow through continuous treatment not allowed
- Requires large area

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- Limited discharge rates depending on receiving water body
- Labor intensive operation and maintenance
- Requires monitoring for non-visible pollutants

**Implementation**

Turbidity is difficult to control once fine particles are suspended in stormwater runoff from a construction site. Sedimentation ponds are effective at removing larger particulate matter by gravity settling, but are ineffective at removing smaller particulates such as clay and fine silt. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Chemical treatment may be used to reduce the turbidity of stormwater runoff. Very high turbidities can be reduced to levels comparable to what is found in streams during dry weather.

***Criteria for Chemical Treatment Product Use***

Chemically treated stormwater discharged from construction sites must be non-toxic to aquatic organisms. The following protocol should be used to evaluate chemicals proposed for stormwater treatment at construction sites. Authorization to use a chemical in the field based on this protocol does not relieve the applicant from responsibility for meeting all discharge and receiving water criteria applicable to a site.

- Treatment chemicals must be approved by EPA for potable water use.
- Petroleum-based polymers are prohibited.
- Prior to authorization for field use, jar tests should be conducted to demonstrate that turbidity reduction necessary to meet the receiving water criteria could be achieved. Test conditions, including but not limited to raw water quality and jar test procedures, should be indicative of field conditions. Although these small-scale tests cannot be expected to reproduce performance under field conditions, they are indicative of treatment capability.
- Prior to authorization for field use, the chemically treated stormwater should be tested for aquatic toxicity. Applicable state or local Whole Effluent Toxicity Testing and Limits, should be used. Testing should use stormwater from the construction site at which the treatment chemical is proposed for use or a water solution using soil from the proposed site.
- The proposed maximum dosage should be at least a factor of five lower than the no observed effects concentration (NOEC).
- The approval of a proposed treatment chemical should be conditional, subject to full-scale bioassay monitoring of treated stormwater at the construction site where the proposed treatment chemical is to be used.
- Treatment chemicals that have already passed the above testing protocol do not need to be reevaluated. Contact the RWQCB for a list of treatment chemicals that may be approved for use.

***Treatment System Design Considerations***

The design and operation of a chemical treatment system should take into consideration the factors that determine optimum, cost-effective performance. It may not be possible to fully incorporate all of the classic concepts into the design because of practical limitations at construction sites. Nonetheless, it is important to recognize the following:

- The right chemical must be used at the right dosage. A dosage that is either too low or too high will not produce the lowest turbidity. There is an optimum dosage rate. This is a situation where the adage "adding more is always better" is not the case.
- The coagulant must be mixed rapidly into the water to insure proper dispersion.
- Experience has found that sufficient flocculation occurs in the pipe leading from the point of chemical addition to the settling or sediment basin.
- Since the volume of the basin is a determinant in the amount of energy per unit volume, the size of the energy input system can be too small relative to the volume of the basin.
- Care must be taken in the design of the withdrawal system to minimize outflow velocities and to prevent floc discharge. The discharge should be directed through a physical filter such as vegetated swale that would catch any unintended floc discharge.
- A pH-adjusting chemical should be added into the sediment basin to control pH. Experience shows that the most common problem is low pH.

### *Treatment System Design*

Chemical treatment systems should be designed as batch treatment systems using either ponds or portable trailer-mounted tanks. Flow-through continuous treatment systems are not allowed at this time.

A chemical treatment system consists of the stormwater collection system (either temporary diversion or the permanent site drainage system), a sediment basin or sediment trap, pumps, a chemical feed system, treatment cells, and interconnecting piping.

The treatment system should use a minimum of two lined treatment cells. Multiple treatment cells allow for clarification of treated water while other cells are being filled or emptied. Treatment cells may be basins, traps or tanks. Portable tanks may also be suitable for some sites.

The following equipment should be located in an operation shed:

- The chemical injector
- Secondary contaminant for acid, caustic, buffering compound, and treatment chemical
- Emergency shower and eyewash
- Monitoring equipment which consists of a pH meter and a turbidimeter

### *Sizing Criteria*

The combination of the sediment basin or other holding area and treatment capacity should be large enough to treat stormwater during multiple day storm events. See SE-2, Sediment Basin, for design criteria. Bypass should be provided around the chemical treatment system to accommodate extreme storm events. Runoff volume should be calculated using the Rational Method. Primary settling should be encouraged in the sediment basin/storage pond. A forebay with access for maintenance may be beneficial.

There are two opposing considerations in sizing the treatment cells. A larger cell is able to treat a larger volume of water each time a batch is processed. However, the larger the cell the longer the time required to empty the cell. A larger cell may also be less effective at flocculation and therefore require a longer settling time. The simplest approach to sizing the treatment cell is to multiply the allowable discharge flow rate times the desired drawdown time. A 4-hour drawdown time allows one batch per cell per 8-hour work period, given 1 hour of flocculation followed by 2 hours of settling.

The permissible discharge rate governed by potential downstream effect can be used to calculate the recommended size of the treatment cells. The following discharge flow rate limits apply absent any local requirements:

- If the discharge is direct or indirect to a stream, the discharge flow rate should not exceed 50 percent of the peak flow rate for all events between the 2-year and the 10-year, 24-hour event.
- If discharge is occuring during a storm event equal to or greater than the 10-year storm the allowable discharge rate is the peak flow rate of the 10-year, 24-hour event.
- Discharge to a stream should not increase the stream flow rate by more than 10 percent.
- If the discharge is directly to a lake or major receiving water there is no discharge flow limit.
- If the discharge is to a municipal storm drainage system, the allowable discharge rate may be limited by the capacity of the public system. It may be necessary to clean the municipal storm drainage system prior to the start of the discharge to prevent scouring solids from the drainage system.
- Runoff rates may be calculated using the Rational Method, unless another method is required by the local flood control agency or agency that issued the grading permit.

### Costs
Costs for chemical treatment may be significant due to equipment required and cost of chemicals. The cost is offset by the ability to reduce some use of other onsite erosion control BMPs and the reuse of equipment (e.g., pumps and dosing equipment). The incremental cost is generally less than 1% of the total construction costs.

### Inspection and Maintenance
Chemical treatment systems must be operated and maintained by individuals with expertise in their use. Chemical treatment systems should be monitored continuously while in use.

The following monitoring should be conducted. Test results should be recorded on a daily log kept on site.

*Operational Monitoring*

- pH conductivity (as a surrogate for alkalinity), turbidity, and temperature of the untreated stormwater
- Total volume treated and discharged
- Discharge time and flow rate
- Type and amount of chemical used for pH adjustment
- Amount of polymer used for treatment
- Settling time

*Compliance Monitoring*

- pH and turbidity of the treated stormwater
- pH and turbidity of the receiving water

*Bio-monitoring*

Treated stormwater should be tested for acute (lethal) toxicity. Bioassays should be conducted by a laboratory accredited by the State of California. **The performance standard for acute toxicity is no statistically significant difference in survival between the control and 100 percent chemically treated stormwater.**

Acute toxicity tests should be conducted with the following species and protocols:

- Fathead minnow, Pimephales promelas (96 hour static-renewal test, method: EPA/600/4-90/027F). Rainbow trout, Oncorhynchus mykiss (96 hour static-renewal test, method: EPA/600/4-90/027F) may be used as a substitute for fathead minnow.
- Daphnid, Ceriodaphnia dubia, Daphnia pulex, or Daphnia magna (48 hour static test, method: EPA/600/4-90/027F).

All toxicity tests should meet quality assurance criteria and test conditions in the most recent versions of the EPA test method.

Bioassays should be performed on the first five batches and on every tenth batch thereafter or as otherwise approved by the RWQCB. Failure to meet the performance standard should be immediately reported to the RWQCB.

*Discharge Compliance:*

**Prior to discharge, each batch of treated stormwater must be sampled and tested for compliance with pH and turbidity limits.** These limits may be established by the water quality standards or a site-specific discharge permit. Sampling and testing for other pollutants may also be necessary at some sites. Turbidity must be within 5 NTUs of the background turbidity. Background is measured in the receiving water, upstream from the treatment process discharge point. pH must be within the range of 6.5 to 8.5 standard units and not cause a change in the pH of the receiving water of more than 0.2 standard units. It is often possible to discharge treated stormwater that has a lower turbidity than the receiving water and that matches the pH.

Treated stormwater samples and measurements should be taken from the discharge pipe or another location representative of the nature of the treated stormwater discharge. Samples used for determining compliance with the water quality standards in the receiving water should not be taken from the treatment pond to decanting. Compliance with the water quality standards is determined in the receiving water.

***Operator Training:***
Each contractor who intends to use chemical treatment should be trained by an experienced contractor on an active site for at least 40 hours.

***Standard BMPs:***
Erosion and sediment control BMPs should be implemented throughout the site to prevent erosion and discharge of sediment.

***Sediment Removal and Disposal***

- Sediment should be removed from the storage or treatment cells as necessary. Typically, sediment removal is required at least once during a wet season and at the decommissioning of the cells. Sediment remaining in the cells between batches may enhance the settling process and reduce the required chemical dosage.
- Sediment may be incorporated into the site away from drainages.

## References

Stormwater Management Manual for Western Washington, Volume II – Construction Stormwater Pollution Prevention, Washington State Department of Ecology, August 2001.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



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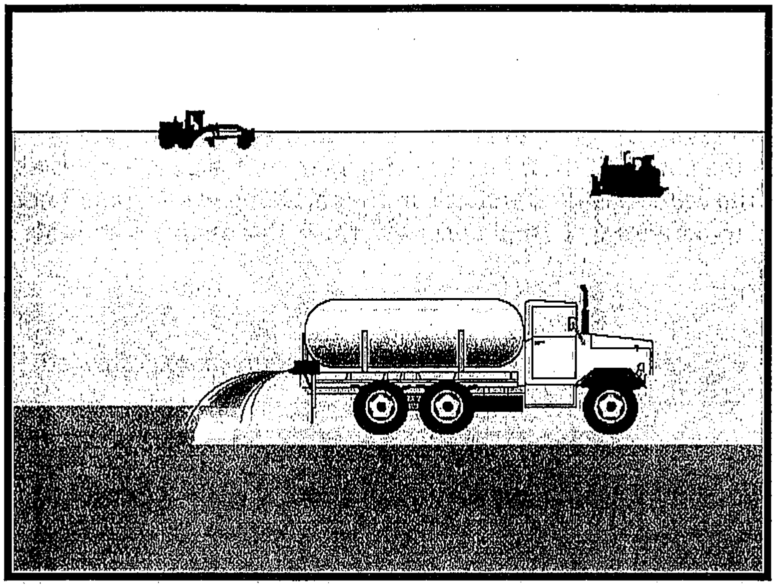

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☒ |
| TC | Tracking Control | |
| WE | Wind Erosion Control | ☑ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Wind erosion or dust control consists of applying water or other dust palliatives as necessary to prevent or alleviate dust nuisance generated by construction activities. Covering small stockpiles or areas is an alternative to applying water or other dust palliatives.

## Suitable Applications

Wind erosion control BMPs are suitable during the following construction activities:

- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Sediment tracking onto paved roads
- Soils and debris storage piles
- Batch drop from front-end loaders
- Areas with unstabilized soil
- Final grading/site stabilization

## Limitations

- Watering prevents dust only for a short period and should be applied daily (or more often) to be effective.
- Over watering may cause erosion.

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- Oil or oil-treated subgrade should not be used for dust control because the oil may migrate into drainageways and/or seep into the soil.
- Effectiveness depends on soil, temperature, humidity, and wind velocity.
- Chemically treated sub grades may make the soil water repellant, interfering with long-term infiltration and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- Asphalt, as a mulch tack or chemical mulch, requires a 24-hour curing time to avoid adherence to equipment, worker shoes, etc. Application should be limited because asphalt surfacing may eventually migrate into the drainage system.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.

## Implementation

### *General*

California's Mediterranean climate, with short wet seasons and long hot dry seasons, allows the soils to thoroughly dry out. During these dry seasons, construction activities are at their peak, and disturbed and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment.

Dust control, as a BMP, is a practice that is already in place for many construction activities. Los Angeles, the North Coast, and Sacramento, among others, have enacted dust control ordinances for construction activities that cause dust to be transported beyond the construction project property line.

Recently, the State Air Resources Control Board has, under the authority of the Clean Air Act, started to address air quality in relation to inhalable particulate matter less than 10 microns (PM-10). Approximately 90 percent of these small particles are considered to be dust. Existing dust control regulations by local agencies, municipal departments, public works department, and public health departments are in place in some regions within California.

Many local agencies require dust control in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. The following are measures that local agencies may have already implemented as requirements for dust control from contractors:

- Construction and Grading Permits: Require provisions for dust control plans.
- Opacity Emission Limits: Enforce compliance with California air pollution control laws.
- Increase Overall Enforcement Activities: Priority given to cases involving citizen complaints.
- Maintain Field Application Records: Require records of dust control measures from contractor;
- Stormwater Pollution Prevention Plan: (SWPPP): Integrate dust control measures into SWPPP.

### *Dust Control Practices*

Dust control BMPs generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. The following table shows dust control practices that can be applied to site conditions that cause dust. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel asphalt surfacing, temporary gravel construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control applications. Permanent or temporary vegetation and mulching can be employed for areas of occasional or no construction traffic. Preventive measures would include minimizing surface areas to be disturbed, limiting onsite vehicle traffic to 15 mph, and controlling the number and activity of vehicles on a site at any given time.

| SITE CONDITION | DUST CONTROL PRACTICES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Permanent Vegetation | Mulching | Wet Suppression (Watering) | Chemical Dust Suppression | Gravel or Asphalt | Silt Fences | Temporary Gravel Construction Entrances/Equipment Wash Down | Haul Truck Covers | Minimize Extent of Disturbed Area |
| Disturbed Areas not Subject to Traffic | X | X | X | X | X | | | | X |
| Disturbed Areas Subject to Traffic | | | X | X | X | | X | | X |
| Material Stock Pile Stabilization | | | X | X | | X | | | X |
| Demolition | | | X | | | | X | X | |
| Clearing/ Excavation | | | X | X | | X | | | X |
| Truck Traffic on Unpaved Roads | | | X | X | X | | X | X | |
| Mud/Dirt Carry Out | | | | | X | | X | | |

Additional preventive measures include:

- Schedule construction activities to minimize exposed area (EC-1, Scheduling).
- Quickly stabilize exposed soils using vegetation, mulching, spray-on adhesives, calcium chloride, sprinkling, and stone/gravel layering.
- Identify and stabilize key access points prior to commencement of construction.
- Minimize the impact of dust by anticipating the direction of prevailing winds.
- Direct most construction traffic to stabilized roadways within the project site.
- Water should be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.
- All distribution equipment should be equipped with a positive means of shutoff.
- Unless water is applied by means of pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.

- If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality Control Board requirements. Non-potable water should not be conveyed in tanks or drain pipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes, and other conveyances should be marked, "NON-POTABLE WATER - DO NOT DRINK."
- Materials applied as temporary soil stabilizers and soil binders also generally provide wind erosion control benefits.
- Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.
- Provide covers for haul trucks transporting materials that contribute to dust.
- Provide for wet suppression or chemical stabilization of exposed soils.
- Provide for rapid clean up of sediments deposited on paved roads. Furnish stabilized construction road entrances and vehicle wash down areas.
- Stabilize inactive construction sites using vegetation or chemical stabilization methods.
- Limit the amount of areas disturbed by clearing and earth moving operations by scheduling these activities in phases.

For chemical stabilization, there are many products available for chemically stabilizing gravel roadways and stockpiles. If chemical stabilization is used, the chemicals should not create any adverse effects on stormwater, plant life, or groundwater.

### Costs
Installation costs for water and chemical dust suppression are low, but annual costs may be quite high since these measures are effective for only a few hours to a few days.

### Inspection and Maintenance
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Check areas protected to ensure coverage.
- Most dust control measures require frequent, often daily, or multiple times per day attention.

### References
Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

California Air Pollution Control Laws, California Air Resources Board, 1992.



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Caltrans, Standard Specifications, Sections 10, "Dust Control"; Section 17, "Watering"; and Section 18, "Dust Palliative".

Prospects for Attaining the State Ambient Air Quality Standards for Suspended Particulate Matter (PM10), Visibility Reducing Particles, Sulfates, Lead, and Hydrogen Sulfide, California Air Resources Board, April 1991.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

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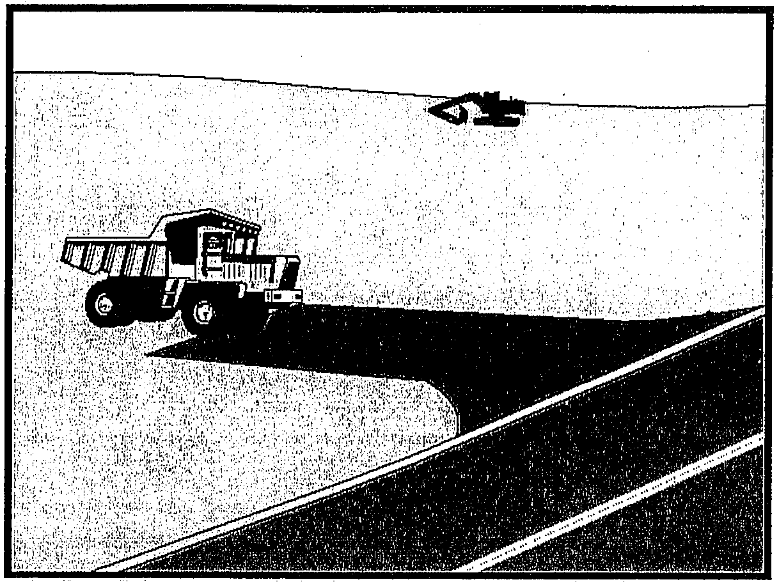

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☒ |
| TC | Tracking Control | ☑ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

A stabilized construction access is defined by a point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

## Suitable Applications

Use at construction sites:

- Where dirt or mud can be tracked onto public roads.
- Adjacent to water bodies.
- Where poor soils are encountered.
- Where dust is a problem during dry weather conditions.

## Limitations

- Entrances and exits require periodic top dressing with additional stones.
- This BMP should be used in conjunction with street sweeping on adjacent public right of way.
- Entrances and exits should be constructed on level ground only.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

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## Implementation

### *General*

A stabilized construction entrance is a pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk, or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights of way or streets. Reducing tracking of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving the construction site, a stabilized construction entrance should be used. NPDES permits require that appropriate measures be implemented to prevent tracking of sediments onto paved roadways, where a significant source of sediments is derived from mud and dirt carried out from unpaved roads and construction sites.

Stabilized construction entrances are moderately effective in removing sediment from equipment leaving a construction site. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance/Exit is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance/exit.

### *Design and Layout*

- Construct on level ground where possible.
- Select 3 to 6 in. diameter stones.
- Use minimum depth of stones of 12 in. or as recommended by soils engineer.
- Construct length of 50 ft minimum, and 30 ft minimum width.
- Rumble racks constructed of steel panels with ridges and installed in the stabilized entrance/exit will help remove additional sediment and to keep adjacent streets clean.
- Provide ample turning radii as part of the entrance.
- Limit the points of entrance/exit to the construction site.
- Limit speed of vehicles to control dust.
- Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment trapping device before discharge.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.
- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. Do not use asphalt concrete (AC) grindings for stabilized construction access/roadway.



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- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.
- Designate combination or single purpose entrances and exits to the construction site.
- Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.
- Implement SE-7, Street Sweeping and Vacuuming, as needed.
- All exit locations intended to be used for more than a two-week period should have stabilized construction entrance/exit BMPs.

### Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMPs are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect local roads adjacent to the site daily. Sweep or vacuum to remove visible accumulated sediment.
- Remove aggregate, separate and dispose of sediment if construction entrance/exit is clogged with sediment.
- Keep all temporary roadway ditches clear.
- Check for damage and repair as needed.
- Replace gravel material when surface voids are visible.
- Remove all sediment deposited on paved roadways within 24 hours.
- Remove gravel and filter fabric at completion of construction

### Costs

Average annual cost for installation and maintenance may vary from $1,200 to $4,800 each, averaging $2,400 per entrance. Costs will increase with addition of washing rack, and sediment trap. With wash rack, costs range from $1,200 - $6,000 each, averaging $3,600 per entrance.

### References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

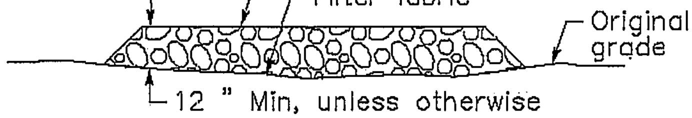
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters, EPA 840-B-9-002, USEPA, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

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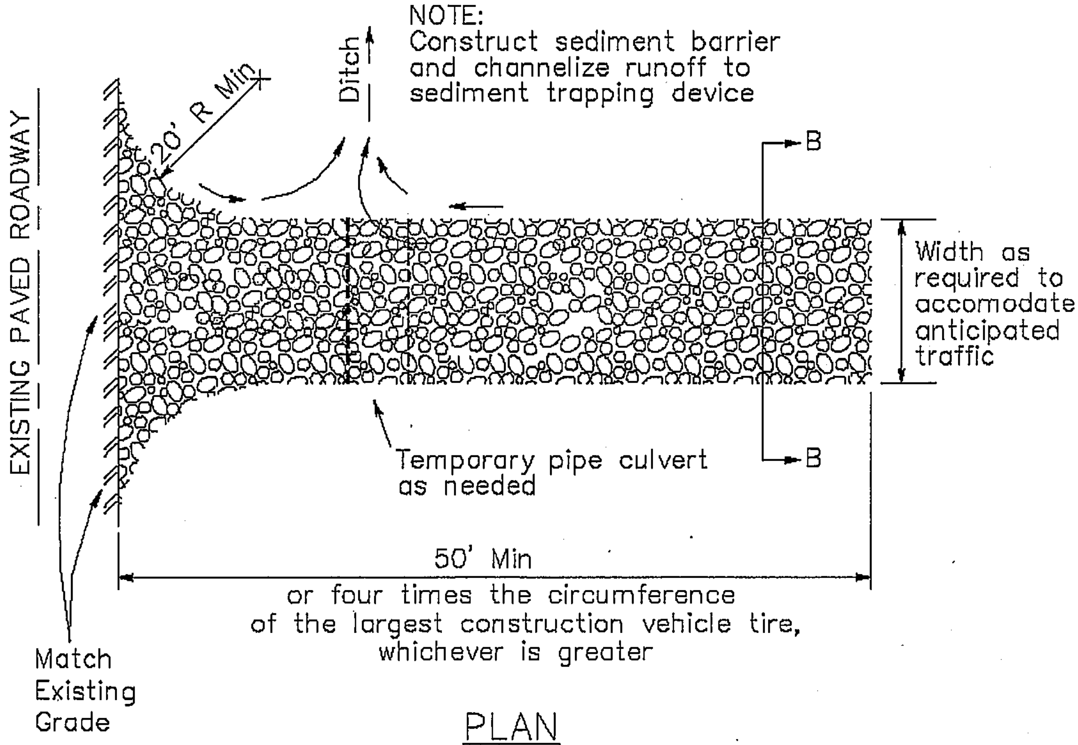


PLAN
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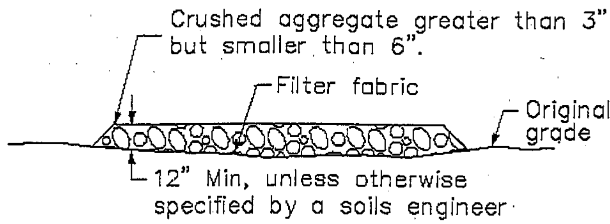


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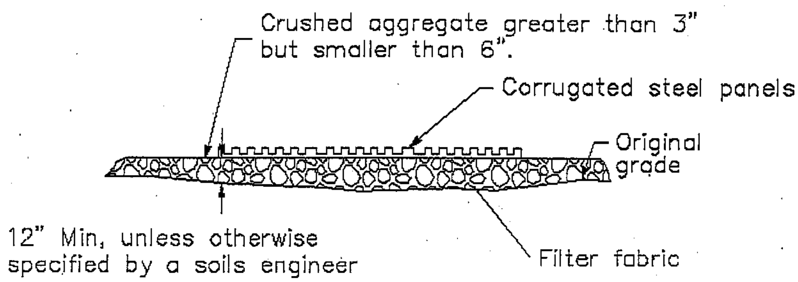


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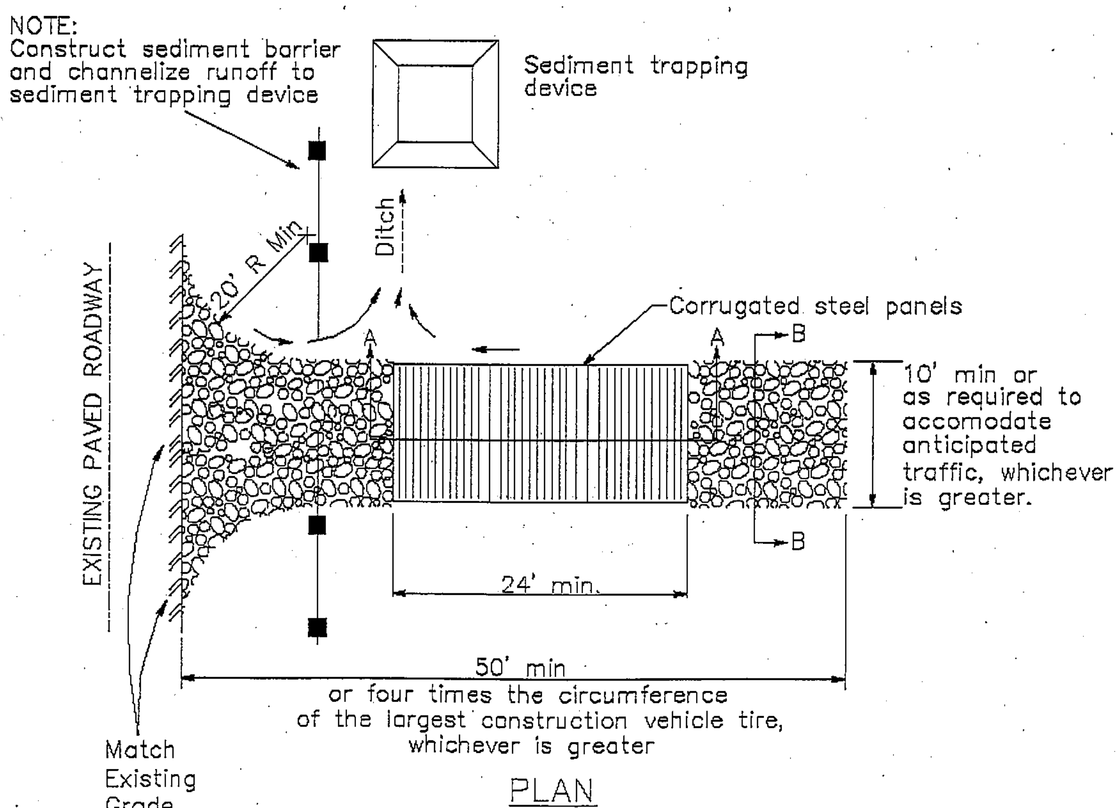


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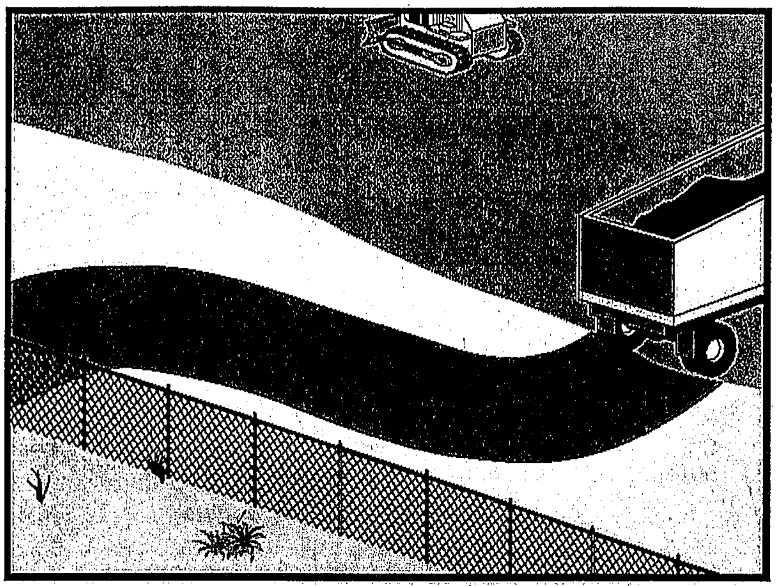
# Stabilized Construction Roadway TC-2



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☒ |
| TC | Tracking Control | ☑ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Access roads, subdivision roads, parking areas, and other onsite vehicle transportation routes should be stabilized immediately after grading, and frequently maintained to prevent erosion and control dust.

## Suitable Applications

This BMP should be applied for the following conditions:

- Temporary Construction Traffic:
  - Phased construction projects and offsite road access
  - Construction during wet weather
- Construction roadways and detour roads:
  - Where mud tracking is a problem during wet weather
  - Where dust is a problem during dry weather
  - Adjacent to water bodies
  - Where poor soils are encountered

## Limitations

- The roadway must be removed or paved when construction is complete.

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- Certain chemical stabilization methods may cause stormwater or soil pollution and should not be used. See WE-1, Wind Erosion Control.
- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.
- Materials will likely need to be removed prior to final project grading and stabilization.
- Use of this BMP may not be applicable to very short duration projects.

## Implementation

### *General*

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion and dust. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy quagmires that generate significant quantities of sediment that may pollute nearby streams or be transported offsite on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Efficient construction road stabilization not only reduces onsite erosion but also can significantly speed onsite work, avoid instances of immobilized machinery and delivery vehicles, and generally improve site efficiency and working conditions during adverse weather

### *Installation/Application Criteria*

Permanent roads and parking areas should be paved as soon as possible after grading. As an alternative where construction will be phased, the early application of gravel or chemical stabilization may solve potential erosion and stability problems. Temporary gravel roadway should be considered during the rainy season and on slopes greater than 5%.

Temporary roads should follow the contour of the natural terrain to the maximum extent possible. Slope should not exceed 15%. Roadways should be carefully graded to drain transversely. Provide drainage swales on each side of the roadway in the case of a crowned section or one side in the case of a super elevated section. Simple gravel berms without a trench can also be used.

Installed inlets should be protected to prevent sediment laden water from entering the storm sewer system (SE-10, Storm Drain Inlet Protection). In addition, the following criteria should be considered.

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15%.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (WE-1, Wind Erosion Control).
- Properly grade roadway to prevent runoff from leaving the construction site.
- Design stabilized access to support heaviest vehicles and equipment that will use it.

- Stabilize roadway using aggregate, asphalt concrete, or concrete based on longevity, required performance, and site conditions. The use of cold mix asphalt or asphalt concrete (AC) grindings for stabilized construction roadway is not allowed.
- Coordinate materials with those used for stabilized construction entrance/exit points.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.

### Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, impact weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and repair slopes.
- Periodically apply additional aggregate on gravel roads.
- Active dirt construction roads are commonly watered three or more times per day during the dry season.

### Costs

Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay. No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

### References


Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



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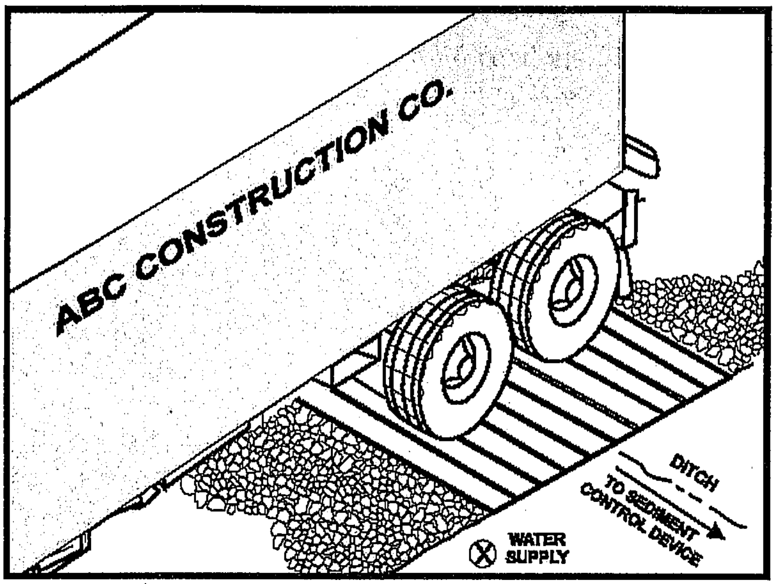


### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☒ |
| TC | Tracking Control | ☑ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

TC-1 Stabilized Construction Entrance/Exit

## Description and Purpose

A tire wash is an area located at stabilized construction access points to remove sediment from tires and under carriages and to prevent sediment from being transported onto public roadways.

## Suitable Applications

Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.

## Limitations

- The tire wash requires a supply of wash water.
- A turnout or doublewide exit is required to avoid having entering vehicles drive through the wash area.
- Do not use where wet tire trucks leaving the site leave the road dangerously slick.

## Implementation

- Incorporate with a stabilized construction entrance/exit. See TC-1, Stabilized Construction Entrance/Exit.
- Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. but smaller than 6 in. A geotextile fabric should be placed below the aggregate.
- Wash rack should be designed and constructed/manufactured for anticipated traffic loads.

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- Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
- Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
- Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
- Implement SC-7, Street Sweeping and Vacuuming, as needed.

### Costs

Costs are low for installation of wash rack.

### Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

### References

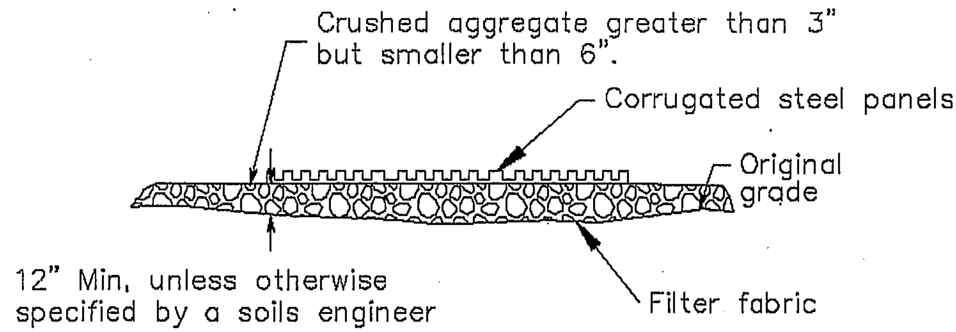
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

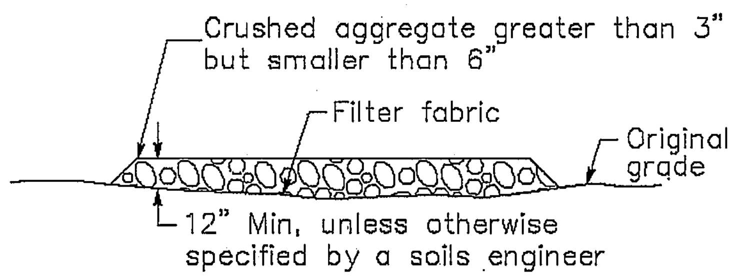
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

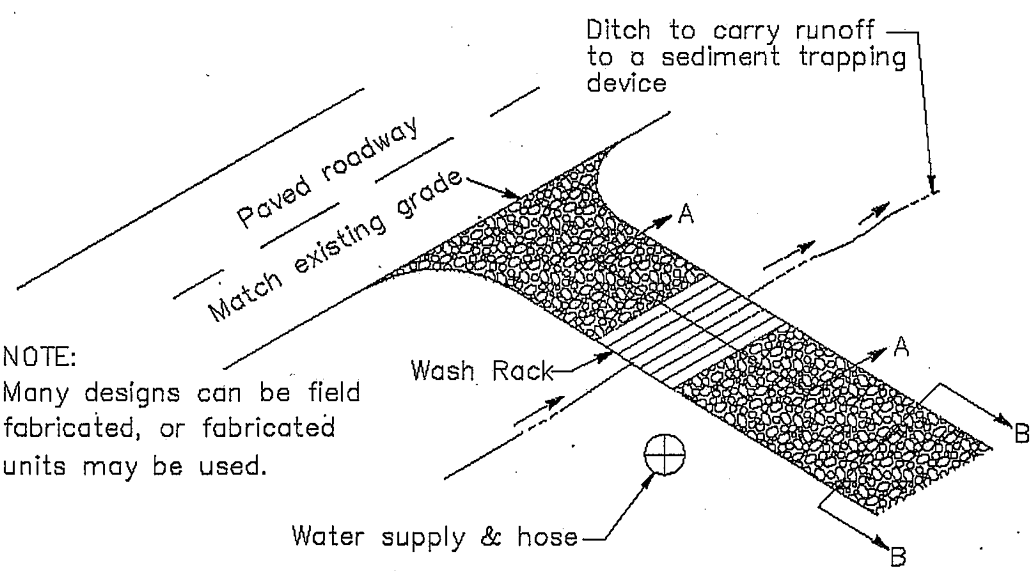
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.




SECTION A–A
NOT TO SCALE




SECTION B–B
NTS




NOTE:
Many designs can be field fabricated, or fabricated units may be used.

TYPICAL TIRE WASH
NOT TO SCALE

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# Section 4
# Non-Stormwater Management and Material Management BMPs

## 4.1 Non-Stormwater Management BMPs

The Construction General Permit prohibits the discharge of materials other than stormwater and authorized non-stormwater discharges. It is recognized that certain non-stormwater discharges may be necessary for the completion of construction projects. Such discharges include but are not limited to irrigation of vegetative erosion control measures, pipe flushing and testing, and street cleaning.

Non-stormwater management BMPs are source control BMPs that prevent pollution by limiting or reducing potential pollutants at their source or eliminating off-site discharge. These practices involve day-to-day operations of the construction site and are usually under the control of the contractor. These BMPs are also referred to as "good housekeeping practices" which involve keeping a clean, orderly construction site.

Non-stormwater management BMPs also include procedures and practices designed to minimize or eliminate the discharge of pollutants from vehicle and equipment cleaning, fueling, and maintenance operations to stormwater drainage systems or to watercourses.

Table 4-1 lists the non-stormwater management BMPs. All these BMPs must be implemented depending on the conditions and applicability of deployment described as part of the BMP.

**Table 4-1 Non-Stormwater Management BMPs**

| BMP# | BMP Name |
|---|---|
| NS-1 | Water Conservation Practices |
| NS-2 | Dewatering Operations |
| NS-3 | Paving and Grinding Operations |
| NS-4 | Temporary Stream Crossing |
| NS-5 | Clear Water Diversion |
| NS-6 | Illicit Connection/Discharge |
| NS-7 | Potable Water/Irrigation |
| NS-8 | Vehicle and Equipment Cleaning |
| NS-9 | Vehicle and Equipment Fueling |
| NS-10 | Vehicle and Equipment Maintenance |
| NS-11 | Pile Driving Operations |
| NS-12 | Concrete Curing |
| NS-13 | Concrete Finishing |
| NS-14 | Material and Equipment Use |
| NS-15 | Demolition Adjacent to Water |
| NS-16 | Temporary Batch Plants |

It is recommended that owners and contractors be vigilant regarding implementation of these BMPs, including making their implementation a condition of continued employment, and part of all prime and subcontract agreements. By doing so, the chance of inadvertent violation by an uncaring individual can be prevented, potentially saving thousands of dollars in fines and project delays. Also, if procedures are not properly implemented and/or if BMPs are compromised then the discharge is subject to sampling and analysis requirements contained in the General Permit.

# 4.2 Waste Management & Materials Pollution Control BMPs

Waste management and materials pollution control BMPs, like non-stormwater management BMPs, are source control BMPs that prevent pollution by limiting or reducing potential pollutants at their source before they come in contact with stormwater. These BMPs also involve day-to-day operations of the construction site, are under the control of the contractor, and are additional "good housekeeping practices" which involve keeping a clean, orderly construction site.

**Table 4-2 Waste Management & Materials Pollution Control BMPs**

| BMP# | BMP Name |
|---|---|
| WM-1 | Material Delivery and Storage |
| WM-2 | Material Use |
| WM-3 | Stockpile Management |
| WM-4 | Spill Prevention and Control |
| WM-5 | Solid Waste Management |
| WM-6 | Hazardous Waste Management |
| WM-7 | Contaminated Soil Management |
| WM-8 | Concrete Waste Management |
| WM-9 | Sanitary/ Septic Waste Management |
| WM-10 | Liquid Waste Management |

Waste management consists of implementing procedural and structural BMPs for handling, storing, and disposing of wastes generated by a construction project. The objective is to prevent the release of waste materials into stormwater runoff or discharges through proper management of the following types of wastes:

- Solid
- Sanitary
- Concrete
- Hazardous
- Equipment – related wastes

Materials pollution control (also called materials handling) consists of implementing procedural and structural BMPs in the handling, storing, and the use of construction materials. The BMPs are intended to prevent the release of pollutants during stormwater and non-stormwater discharges. The objective is to prevent or reduce the opportunity for contamination of stormwater runoff from construction materials by covering and/or providing secondary containment of storage areas, and by taking adequate precautions when handling materials. These controls must be implemented for all applicable activities, material usage, and site conditions.

Table 4-2 lists the waste management and materials pollution control BMPs. It is important to note that these BMPs should be implemented depending on the conditions/applicability of deployment described as part of the BMP.



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## 4.3 Fact Sheet Format

A BMP fact sheet is a short document that gives all the information about a particular BMP. Typically, each fact sheet contains the information outlined in Figure 4-1. Completed fact sheets for each of the above activities are provided in Section 4.4.

The fact sheets also contain side bar presentations with information on BMP objectives, targeted constituents, removal effectiveness, and potential alternatives.

**NS-xx Example Fact Sheet**

Description and Purpose

Suitable Applications

Limitations

Implementation

Costs

Inspection and Maintenance

References

**Figure 4-1**
**Example Fact Sheet**

## 4.4 BMP Fact Sheets

BMP Fact Sheets for non-stormwater management and waste management and materials pollution control follow. The BMP fact sheets are individually page numbered and are suitable for photocopying and inclusions in SWPPPs. Fresh copies of the fact sheets can be individually downloaded from the Caltrans Stormwater BMP Handbook website at http://www.cabmphandbooks.com.

# Water Conservation Practices NS-1

| Objectives | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

| Targeted Constituents | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

**Potential Alternatives**

None

## Description and Purpose
Water conservation practices are activities that use water during the construction of a project in a manner that avoids causing erosion and the transport of pollutants offsite. These practices can reduce or eliminate non-stormwater discharges.

## Suitable Applications
Water conservation practices are suitable for all construction sites where water is used, including piped water, metered water, trucked water, and water from a reservoir.

## Limitations
- None identified.

## Implementation
- Keep water equipment in good working condition.
- Stabilize water truck filling area.
- Repair water leaks promptly.
- Washing of vehicles and equipment on the construction site is discouraged.
- Avoid using water to clean construction areas. If water must be used for cleaning or surface preparation, surface should be swept and vacuumed first to remove dirt. This will minimize amount of water required.

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- Direct construction water runoff to areas where it can soak into the ground or be collected and reused.
- Authorized non-stormwater discharges to the storm drain system, channels, or receiving waters are acceptable with the implementation of appropriate BMPs.
- Lock water tank valves to prevent unauthorized use.

### Costs
The cost is small to none compared to the benefits of conserving water.

### Inspection and Maintenance
- Inspect and verify that activity based BMPs are in place prior to the commencement of authorized non-stormwater discharges.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges are occuring.
- Repair water equipment as needed to prevent unintended discharges.
  - Water trucks
  - Water reservoirs (water buffalos)
  - Irrigation systems
  - Hydrant connections

### References
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



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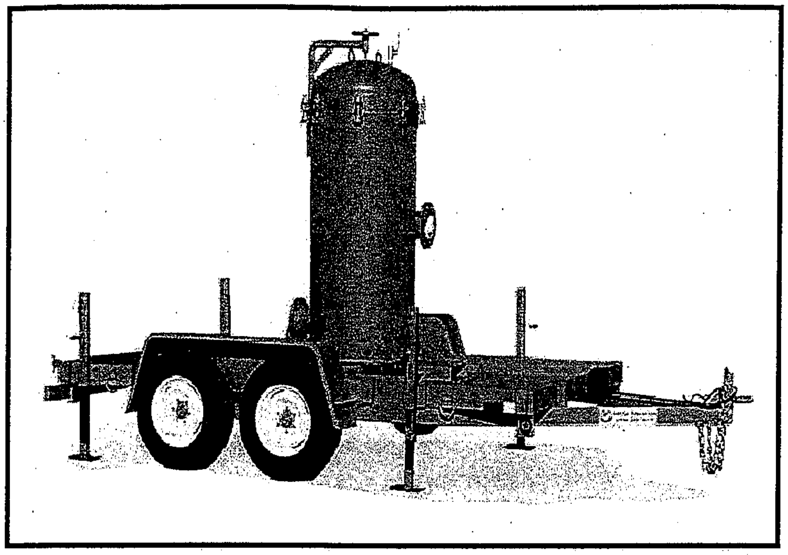
# Dewatering Operations NS-2



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

## Potential Alternatives

SE-5: Fiber Roll

SE-6: Gravel Bag Berm

SE-9: Straw Bale Barrier

## Description and Purpose

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation must be removed from a work location so that construction work may be accomplished.

## Suitable Applications

These practices are implemented for discharges of non-stormwater from construction sites. Non-stormwaters include, but are not limited to, groundwater, water from cofferdams, water diversions, and waters used during construction activities that must be removed from a work area.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated precipitation (stormwater) from depressed areas at a construction site.

## Limitations

- Site conditions will dictate design and use of dewatering operations.
- The controls discussed in this best management practice (BMP) address sediment only.
- The controls detailed in this BMP only allow for minimal settling time for sediment particles. Use only when site conditions restrict the use of the other control methods.
- Dewatering operations will require, and must comply with, applicable local permits.

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- Avoid dewatering discharges where possible by using the water for dust control, by infiltration, etc.

## Implementation

- Dewatering non-stormwater cannot be discharged without prior notice to and approval from the Regional Water Quality Control Board (RWQCB) and local stormwater management agency. This includes stormwater that is co-mingled with groundwater or other non-stormwater sources. Once the discharge is allowed, appropriate BMPs must be implemented to ensure the discharge complies with all permit requirements and regional and watershed-specific requirements.

- RWQCB may require a separate NPDES permit prior to the dewatering discharge of non-stormwater. These permits will have specific testing, monitoring, and discharge requirements and can take significant time to obtain.

- The flow chart shown in Figure 1 should be utilized to guide dewatering operations.

- The owner will coordinate monitoring and permit compliance.

- Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.

- Dewatering discharges must not cause erosion at the discharge point.

A variety of methods can be used to treat water during dewatering operations. Several devices are presented below and provide options to achieve sediment removal. The size of particles present in the sediment and Permit or receiving water limitations on sediment are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate.

### *Sediment Basin (see also SE-2)*

*Description:*

- A sediment basin is a temporary basin with a controlled release structure that is formed by excavation or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment basins are generally larger than Sediment Traps (SE-3).

*Appropriate Applications:*

- Effective for the removal of gravel, sand, silt, some metals that settle out with the sediment, and trash.

*Implementation:*

- Excavation and construction of related facilities is required.

- Temporary sediment basins must be fenced if safety is a concern.

- Outlet protection is required to prevent erosion at the outfall location.



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*Maintenance:*

- Maintenance is required for safety fencing, vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-half.

***Sediment Trap (See also SE-3)***

*Description:*

- A sediment trap is a temporary basin formed by excavation and/or construction of an earthen embankment across a waterway or low drainage area to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment traps are generally smaller than Sediment Basins (SE-2).

*Appropriate Applications:*

Effective for the removal of large and medium sized particles (sand and gravel) and some metals that settle out with the sediment.

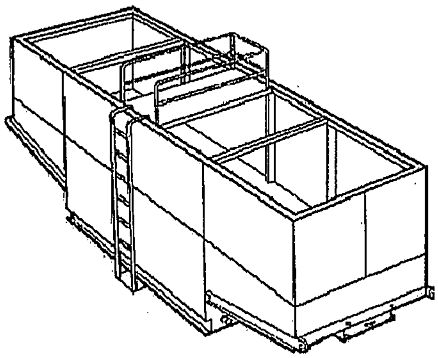
*Implementation:*

- Excavation and construction of related facilities is required.
- Trap inlets should be located to maximize the travel distance to the trap outlet.
- Use rock or vegetation to protect the trap outlets against erosion.

*Maintenance:*

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

*Weir Tanks*



*Description:*

- A weir tank separates water and waste by using weirs. The configuration of the weirs (over and under weirs) maximizes the residence time in the tank and determines the waste to be removed from the water, such as oil, grease, and sediments.

*Appropriate Applications:*

- The tank removes trash, some settleable solids (gravel, sand, and silt), some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

*Implementation:*

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.

- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

*Maintenance:*

- Periodic cleaning is required based on visual inspection or reduced flow.

- Oil and grease disposal must be by licensed waste disposal company.



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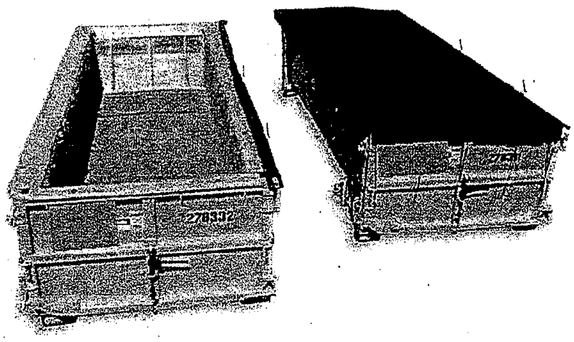
*Dewatering Tanks*



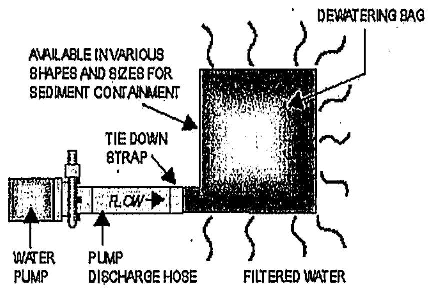
*Description:*
- A dewatering tank removes debris and sediment. Flow enters the tank through the top, passes through a fabric filter, and is discharged through the bottom of the tank. The filter separates the solids from the liquids.

*Appropriate Applications:*
- The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

*Implementation:*
- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

*Maintenance:*
- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal must be by licensed waste disposal company.

### *Gravity Bag Filter*




*Description:*

- A gravity bag filter, also referred to as a dewatering bag, is a square or rectangular bag made of non-woven geotextile fabric that collects sand, silt, and fines.

*Appropriate Applications:*

- Effective for the removal of sediments (gravel, sand, and silt). Some metals are removed with the sediment.

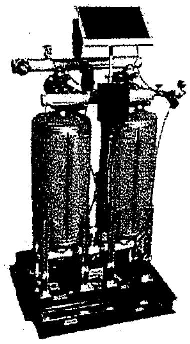
*Implementation:*

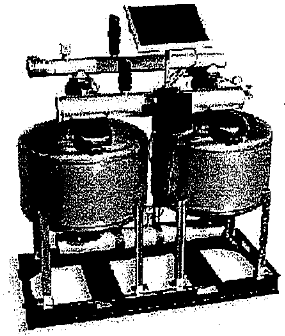
- Water is pumped into one side of the bag and seeps through the bottom and sides of the bag.
- A secondary barrier, such as a rock filter bed or straw/hay bale barrier, is placed beneath and beyond the edges of the bag to capture sediments that escape the bag.

*Maintenance:*

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier is required.
- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.
- The bag is disposed of offsite.

***Sand Media Particulate Filter***





*Description:*

- Water is treated by passing it through canisters filled with sand media. Generally, sand filters provide a final level of treatment. They are often used as a secondary or higher level of treatment after a significant amount of sediment and other pollutants have been removed using other methods.

*Appropriate Applications:*

- Effective for the removal of trash, gravel, sand, and silt and some metals, as well as the reduction of biochemical oxygen demand (BOD) and turbidity.
- Sand filters can be used for stand-alone treatment or in conjunction with bag and cartridge filtration if further treatment is required.
- Sand filters can also be used to provide additional treatment to water treated via settling or basic filtration.

*Implementation:*

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

*Maintenance:*

- The filters require regular service to monitor and maintain the level of the sand media. If subjected to high loading rates, filters can plug quickly.
- Venders generally provide data on maximum head loss through the filter. The filter should be monitored daily while in use, and cleaned when head loss reaches target levels.
- If cleaned by backwashing, the backwash water may need to be hauled away for disposal, or returned to the upper end of the treatment train for another pass through the series of dewatering BMPs.



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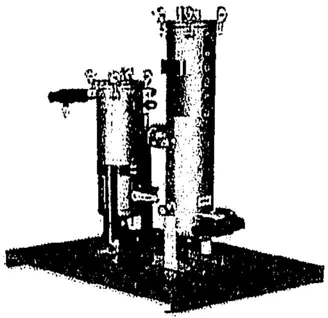
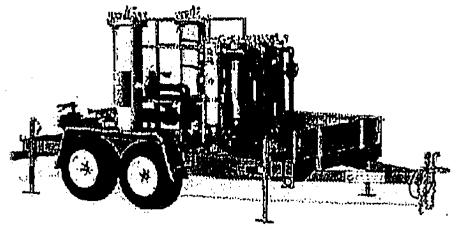
*Pressurized Bag Filter*





*Description:*

- A pressurized bag filter is a unit composed of single filter bags made from polyester felt material. The water filters through the unit and is discharged through a header. Vendors provide bag filters in a variety of configurations. Some units include a combination of bag filters and cartridge filters for enhanced contaminant removal.

*Appropriate Applications:*

- Effective for the removal of sediment (sand and silt) and some metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Oil absorbent bags are available for hydrocarbon removal.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

*Implementation:*

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

*Maintenance:*

- The filter bags require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.



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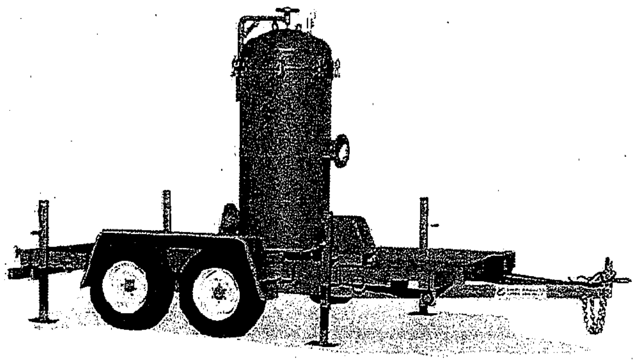
*Cartridge Filter*



*Description:*

- Cartridge filters provide a high degree of pollutant removal by utilizing a number of individual cartridges as part of a larger filtering unit. They are often used as a secondary or higher (polishing) level of treatment after a significant amount of sediment and other pollutants are removed. Units come with various cartridge configurations (for use in series with bag filters) or with a larger single cartridge filtration unit (with multiple filters within).

*Appropriate Applications:*

- Effective for the removal of sediment (sand, silt, and some clays) and metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Hydrocarbons can effectively be removed with special resin cartridges.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

*Implementation:*

- The filters require delivery to the site and initial set up. The vendor can provide assistance.

*Maintenance:*

- The cartridges require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

## Costs

- Sediment controls are low to high cost measures depending on the dewatering system that is selected. Pressurized filters tend to be more expensive than gravity settling, but are often more effective. Simple tanks are generally rented on a long-term basis (one or more months) and can range from $360 per month for a 1,000 gallon tank to $2,660 per month for a 10,000 gallon tank. Mobilization and demobilization costs vary considerably.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Unit-specific maintenance requirements are included with the description of each unit.
- Sediment removed during the maintenance of a dewatering device may be either spread onsite and stabilized, or disposed of at a disposal site as approved by the owner.
- Sediment that is commingled with other pollutants must be disposed of in accordance with all applicable laws and regulations and as approved by the owner.

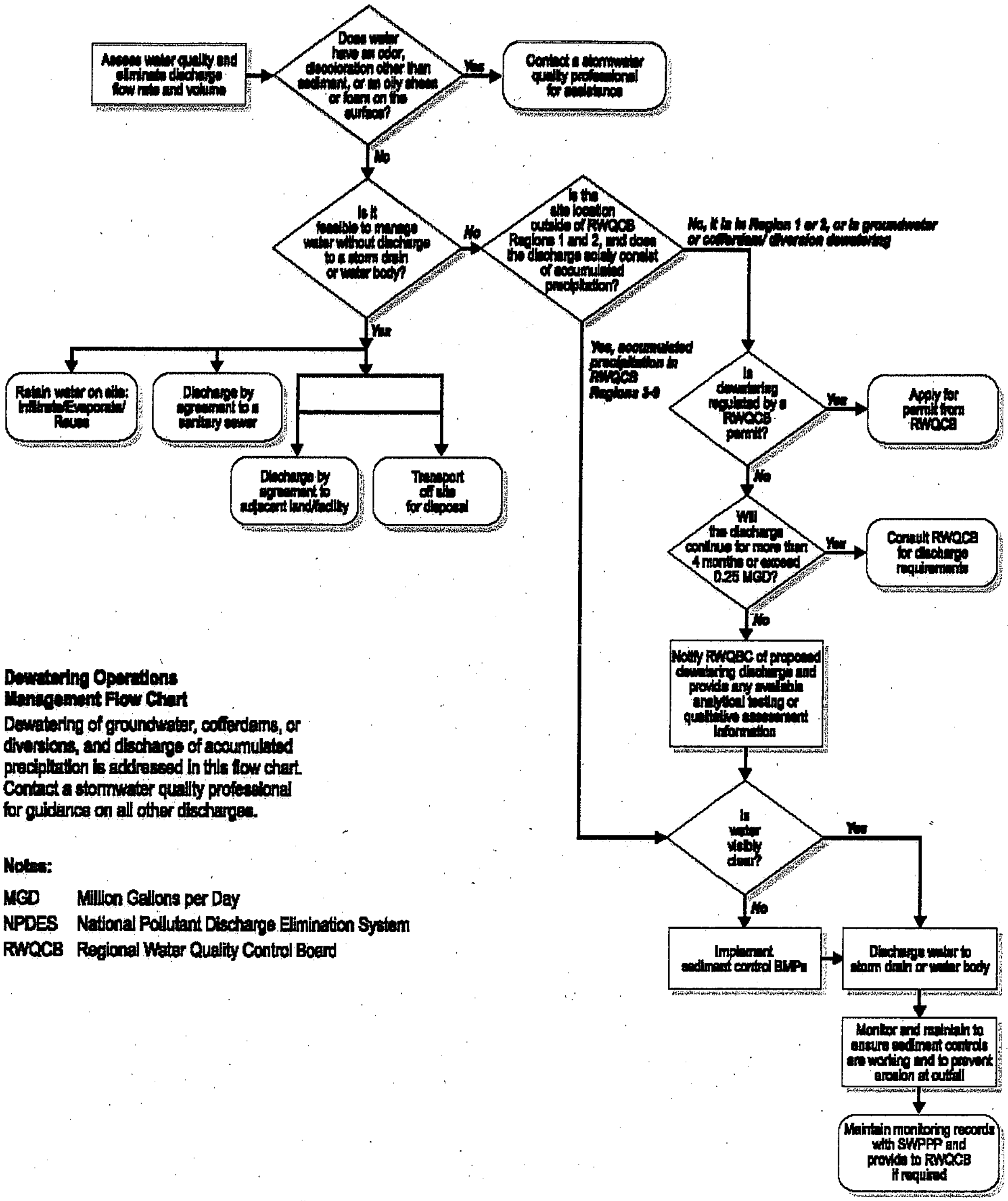
### References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Labor Surcharge & Equipment Rental Rates, April 1, 2002 through March 31, 2003, California Department of Transportation (Caltrans).




**Dewatering Operations**
**Management Flow Chart**

Dewatering of groundwater, cofferdams, or diversions, and discharge of accumulated precipitation is addressed in this flow chart. Contact a stormwater quality professional for guidance on all other discharges.

**Notes:**

| | |
|---|---|
| MGD | Million Gallons per Day |
| NPDES | National Pollutant Discharge Elimination System |
| RWQCB | Regional Water Quality Control Board |

**Figure 1**
**Operations Flow Chart**



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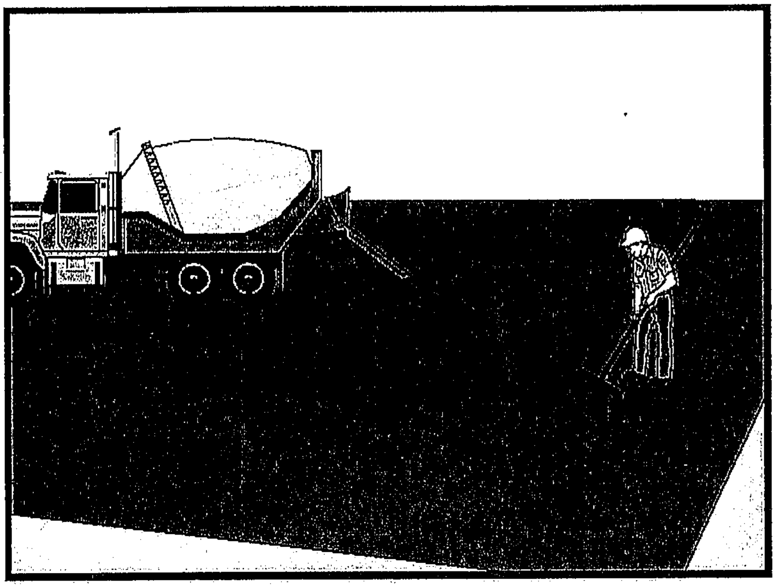
# Paving and Grinding Operations NS-3



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | ☒ |

Legend:
☑ Primary Objective
☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Prevent or reduce the discharge of pollutants from paving operations, using measures to prevent runon and runoff pollution, properly disposing of wastes, and training employees and subcontractors.

## Suitable Applications

These procedures are implemented where paving, surfacing, resurfacing, or sawcutting, may pollute stormwater runoff or discharge to the storm drain system or watercourses.

## Limitations

- Finer solids are not effectively removed by filtration systems.
- Paving opportunities may be limited during wet weather.

## Implementation

### *General*

- Avoid paving during the wet season when feasible.
- Reschedule paving and grinding activities if rain is in the forecast.
- Train employees and sub-contractors in pollution prevention and reduction.
- Store materials away from drainage courses to prevent stormwater runon (see WM-1, Material Delivery and Storage).

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A002652

- Protect drainage courses, particularly in areas with a grade, by employing BMPs to divert runoff or to trap and filter sediment.

- If paving involves an onsite mixing plant, follow the stormwater permitting requirements for industrial activities.

- Stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses, These materials should be stored consistent with WM-3, Stockpile Management.

- Disposal of PCC and AC waste should be in conformance with WM-8, Concrete Waste Management.

### *Saw Cutting, Grinding, and Pavement Removal*

- Shovel or vacuum saw-cut slurry and remove from site. Cover or barricade storm drains during saw cutting to contain slurry.

- When paving involves AC, the following steps should be implemented to prevent the discharge of grinding residue, uncompacted or loose AC, tack coats, equipment cleaners, or unrelated paving materials:

  - AC grindings, pieces, or chunks used in embankments or shoulder backing must not be allowed to enter any storm drains or watercourses. Install silt fence until structure is stabilized or permanent controls are in place. Examples of temporary perimeter controls can be found in EC-9, Earth Dikes and Drainage Swales; SE-1, Silt Fence; or SE-5, Fiber Rolls.

  - Collect and remove all broken asphalt and recycle when practical. Old or spilled asphalt must be recycled or disposed.

  - Any AC chunks and pieces used in embankments must be placed above the water table and covered by at least 1 ft of material.

- Do not allow saw-cut slurry to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine, should not be allowed to flow across the pavement, and should not be left on the surface of the pavement. See also WM-8, Concrete Waste Management, and WM-10, Liquid Waste Management.

- Dig out activities should not be conducted in the rain.

- Collect dig out material by mechanical or manual methods. This material may be recycled for use as shoulder backing or base material.

- If dig out material cannot be recycled, transport the material back to an approved storage site.

### *Asphaltic Concrete Paving*

- If paving involves asphaltic cement concrete, follow these steps:

- Do not allow sand or gravel placed over new asphalt to wash into storm drains, streets, or creeks. Vacuum or sweep loose sand and gravel and properly dispose of this waste by referring to WM-5, Solid Waste Management.

- Old asphalt must be disposed of properly. Collect and remove all broken asphalt from the site and recycle whenever possible.

***Portland Cement Concrete Paving***

- Do not wash sweepings from exposed aggregate concrete into a storm drain system. Collect and return to aggregate base stockpile or dispose of properly.

- Allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit as described in WM-8, Concrete Waste Management, or pump the water to the sanitary sewer if allowed by the local wastewater authority.

***Sealing Operations***

- During chip seal application and sweeping operations, petroleum or petroleum covered aggregate must not be allowed to enter any storm drain or water courses. Apply temporary perimeter controls until structure is stabilized.

- Drainage inlet structures and manholes should be covered with filter fabric during application of seal coat, tack coat, slurry seal, and fog seal.

- Seal coat, tack coat, slurry seal, or fog seal should not be applied if rainfall is predicted to occur during the application or curing period.

***Paving Equipment***

- Leaks and spills from paving equipment can contain toxic levels of heavy metals and oil and grease. Place drip pans or absorbent materials under paving equipment when not in use. Clean up spills with absorbent materials rather than burying. See NS-10, Vehicle and Equipment Maintenance, WM-4, Spill Prevention and Control, and WM-10, Liquid Waste Management.

- Substances used to coat asphalt transport trucks, and asphalt spreading equipment should not contain soap and should be non-foaming and non-toxic.

- Use only non-toxic substances to coat asphalt transport trucks and asphalt spreading equipment.

- Paving equipment parked onsite should be parked over plastic to prevent soil contamination.

- Clean asphalt coated equipment offsite whenever possible. When cleaning dry, hardened asphalt from equipment, manage hardened asphalt debris as described in WM-5, Solid Waste Management. Any cleaning onsite should follow NS-8, Vehicle and Equipment Cleaning.

### *Thermoplastic Striping*

- Thermoplastic striper and pre-heater equipment shutoff valves should be inspected to ensure that they are working properly to prevent leaking thermoplastic from entering drain inlets, the stormwater drainage system, or watercourses.

- Pre-heaters should be filled carefully to prevent splashing or spilling of hot thermoplastic. Leave six inches of space at the top of the pre-heater container when filling thermoplastic to allow room for material to move when the vehicle is deadheaded.

- Do not pre-heat, transfer, or load thermoplastic near drain inlets or watercourses.

- Clean truck beds daily of loose debris and melted thermoplastic. When possible, recycle thermoplastic material.

### *Raised/Recessed Pavement Marker Application and Removal*

- Do not transfer or load bituminous material near drain inlets, the stormwater drainage system, or watercourses.

- Melting tanks should be loaded with care and not filled to beyond six inches from the top to leave room for splashing when vehicle is deadheaded.

- When servicing or filling melting tanks, ensure all pressure is released before removing lids to avoid spills.

- On large-scale projects, use mechanical or manual methods to collect excess bituminous material from the roadway after removal of markers.

## Costs

- All of the above are low cost measures.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.

- Keep ample supplies of drip pans or absorbent materials onsite.

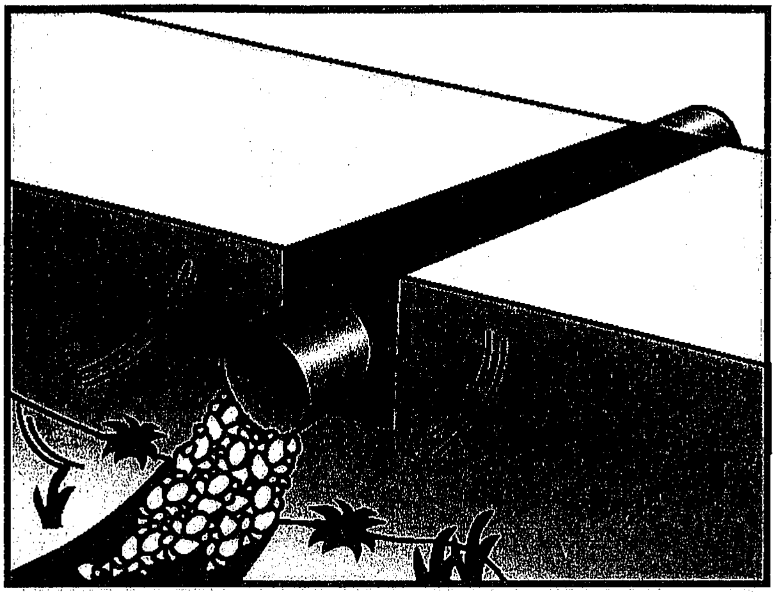
- Inspect and maintain machinery regularly to minimize leaks and drips.

## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Hot Mix Asphalt-Paving Handbook AC 150/5370-14, Appendix I, U.S. Army Corps of Engineers, July 1991.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | ☒ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

A temporary stream crossing is a temporary culvert, ford or bridge placed across a waterway to provide access for construction purposes for a period of less than one year. Temporary access crossings are not intended to maintain traffic for the public. The temporary access will eliminate erosion and downstream sedimentation caused by vehicles.

## Suitable Applications

Temporary stream crossings should be installed at all designated crossings of perennial and intermittent streams on the construction site, as well as for dry channels that may be significantly eroded by construction traffic.

Temporary streams crossings are installed at sites:

- Where appropriate permits have been secured (404 Permits, and 401 Certifications)
- Where construction equipment or vehicles need to frequently cross a waterway
- When alternate access routes impose significant constraints
- When crossing perennial streams or waterways causes significant erosion
- Where construction activities will not last longer than one year

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- Where appropriate permits have been obtained for the stream crossing

### Limitations

The following limitations may apply:

- Installation and removal will usually disturb the waterway.
- Installation may require Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game. If numerical-based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required.
- Installation may require dewatering or temporary diversion of the stream. See NS-2, Dewatering Operations and NS-5, Clear Water Diversion.
- Installation may cause a constriction in the waterway, which can obstruct flood flow and cause flow backups or washouts. If improperly designed, flow backups can increase the pollutant load through washouts and scouring.
- Use of natural or other gravel in the stream for construction of Cellular Confinement System (CCS) ford crossing will be contingent upon approval by fisheries agencies.
- Ford crossings may degrade water quality due to contact with vehicles and equipment.
- May be expensive for a temporary improvement.
- Requires other BMPs to minimize soil disturbance during installation and removal.
- Fords should only be used in dry weather.

### Implementation

#### *General*

The purpose of this BMP is to provide a safe, erosion-free access across a stream for construction equipment. Minimum standards and specifications for the design, construction, maintenance, and removal of the structure should be established by an engineer registered in California. Temporary stream crossings may be necessary to prevent construction equipment from causing erosion of the stream and tracking sediment and other pollutants into the stream.

Temporary stream crossings are used as access points to construction sites when other detour routes may be too long or burdensome for the construction equipment. Often heavy construction equipment must cross streams or creeks, and detour routes may impose too many constraints such as being too narrow or poor soil strength for the equipment loadings. Additionally, the contractor may find a temporary stream crossing more economical for light–duty vehicles to use for frequent crossings, and may have less environmental impact than construction of a temporary access road.

Location of the temporary stream crossing should address:

- Site selection where erosion potential is low.



A002657

- Areas where the side slopes from site runoff will not spill into the side slopes of the crossing.

The following types of temporary stream crossings should be considered:

- **Culverts** – A temporary culvert is effective in controlling erosion but will cause erosion during installation and removal. A temporary culvert can be easily constructed and allows for heavy equipment loads.
- **Fords** - Appropriate during the dry season in arid areas. Used on dry washes and ephemeral streams, and low-flow perennial streams. CCS, a type of ford crossing, is also appropriate for use in streams that would benefit from an influx of gravels. A temporary ford provides little sediment and erosion control and is ineffective in controlling erosion in the stream channel. A temporary ford is the least expensive stream crossing and allows for maximum load limits. It also offers very low maintenance. Fords are more appropriate during the dry ice season and in arid areas of California.
- **Bridges** - Appropriate for streams with high flow velocities, steep gradients and where temporary restrictions in the channel are not allowed.

### *Design*

During the long summer construction season in much of California, rainfall is infrequent and many streams are dry. Under these conditions, a temporary ford may be sufficient. A ford is not appropriate if construction will continue through the winter rainy season, if summer thunderstorms are likely, or if the stream flows during most of the year. Temporary culverts and bridges should then be considered and, if used, should be sized to pass a significant design storm (i.e., at least a 10-year storm). The temporary stream crossing should be protected against erosion, both to prevent excessive sedimentation in the stream and to prevent washout of the crossing.

Design and installation requires knowledge of stream flows and soil strength. Designs should be prepared under direction of, and approved by, a registered civil engineer and for bridges, a registered structural engineer. Both hydraulic and construction loading requirements should be considered with the following:

- Comply with any special requirements for culvert and bridge crossings, particularly if the temporary stream crossing will remain through the rainy season.
- Provide stability in the crossing and adjacent areas to withstand the design flow. The design flow and safety factor should be selected based on careful evaluation of the risks due to over topping, flow backups, or washout.
- Install sediment traps immediately downstream of crossings to capture sediments. See SE-3, Sediment Trap.
- Avoid oil or other potentially hazardous materials for surface treatment.
- Culverts are relatively easy to construct and able to support heavy equipment loads.
- Fords are the least expensive of the crossings, with maximum load limits.

- CCS crossing structures consist of clean, washed gravel and cellular confinement system blocks. CCS are appropriate for streams that would benefit from an influx of gravel; for example, salmonid streams, streams or rivers below reservoirs, and urban, channelized streams. Many urban stream systems are gravel-deprived due to human influences, such as dams, gravel mines, and concrete channels.

- CCS allow designers to use either angular or naturally occurring rounded gravel, because the cells provide the necessary structure and stability. In fact, natural gravel is optimal for this technique, because of the habitat improvement it will provide after removal of the CCS.

- A gravel depth of 6 to 12 in. for a CCS structure is sufficient to support most construction equipment.

- An advantage of a CCS crossing structure is that relatively little rock or gravel is needed, because the CCS provides the stability.

- Bridges are generally more expensive to design and construct, but provide the least disturbance of the streambed and constriction of the waterway flows.

### *Construction and Use*

- Stabilize construction roadways, adjacent work area, and stream bottom against erosion.

- Construct during dry periods to minimize stream disturbance and reduce costs.

- Construct at or near the natural elevation of the streambed to prevent potential flooding upstream of the crossing.

- Install temporary erosion control BMPs in accordance with erosion control BMP fact sheets to minimize erosion of embankment into flow lines.

- Any temporary artificial obstruction placed within flowing water should only be built from material, such as clean gravel or sandbags, that will not introduce sediment or silt into the watercourse.

- Temporary water body crossings and encroachments should be constructed to minimize scour. Cobbles used for temporary water body crossings or encroachments should be clean, rounded river cobble.

- Vehicles and equipment should not be driven, operated, fueled, cleaned, maintained, or stored in the wet or dry portions of a water body where wetland vegetation, riparian vegetation, or aquatic organisms may be destroyed.

- The exterior of vehicles and equipment that will encroach on the water body within the project should be maintained free of grease, oil, fuel, and residues.

- Drip pans should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than one hour.

- Disturbance or removal of vegetation should not exceed the minimum necessary to complete operations. Precautions should be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation should be replaced with the appropriate soil stabilization measures.

- Riparian vegetation, when removed pursuant to the provisions of the work, should be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation should be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble must be removed upon completion of project activities.

- Conceptual temporary stream crossings are shown in the attached figures.

### Costs
Caltrans Construction Cost index for temporary bridge crossings is $45-$95/ft$^2$.

### Inspection and Maintenance
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two week intervals in the non-rainy season to verify continued BMP implementation.

- Check for blockage in the channel, sediment buildup or trapped debris in culverts, blockage behind fords or under bridges

- Check for erosion of abutments, channel scour, riprap displacement, or piping in the soil

- Check for structural weakening of the temporary crossings, such as cracks, and undermining of foundations and abutments

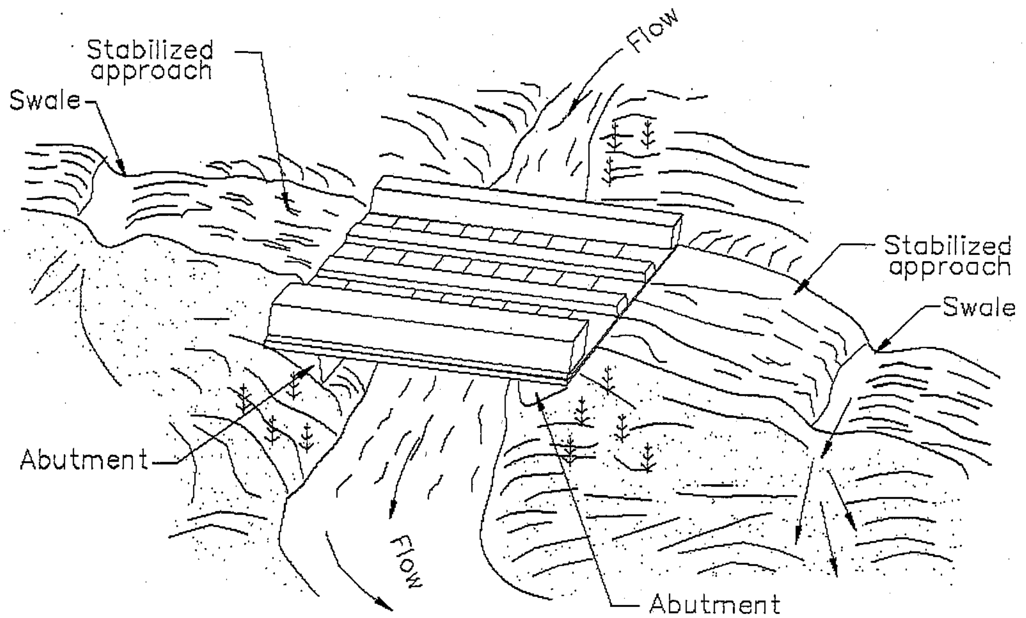
- Remove sediment that collects behind fords, in culverts, and under bridges periodically

- Replace lost or displaced aggregate from inlets and outlets of culverts and cellular confinement systems

- Remove temporary crossing promptly when it is no longer needed

### References
California Bank and Shore Rock Slope Protection Design – Practitioners Guide and Field Evaluations of Riprap Methods, Caltrans Study No. F90TL03, October 2000.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.




NOTE:
Surface flow of road diverted by swale and/or dike.

TYPICAL BRIDGE CROSSING
NOT TO SCALE



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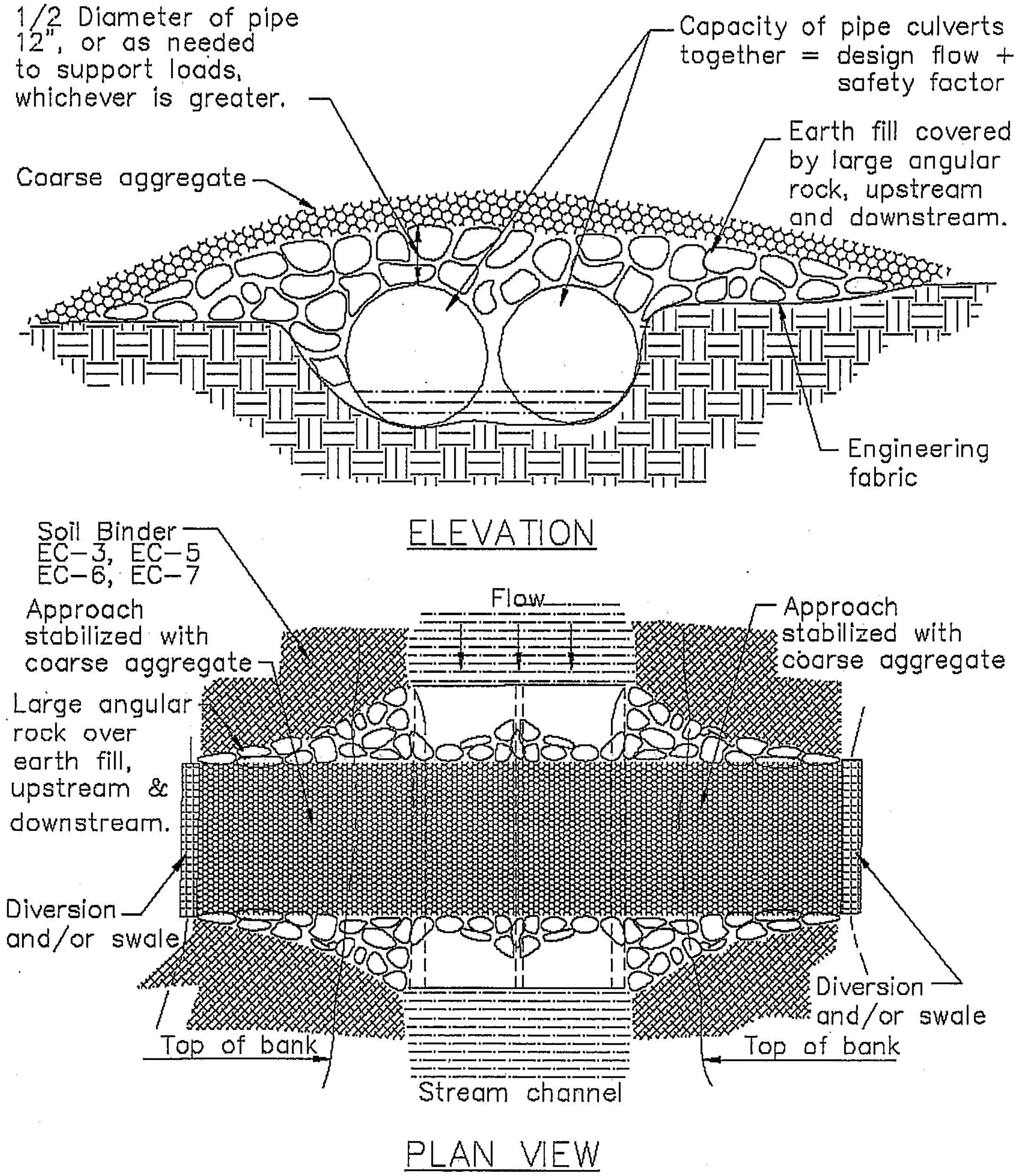


TYPICAL CULVERT CROSSING
NOT TO SCALE



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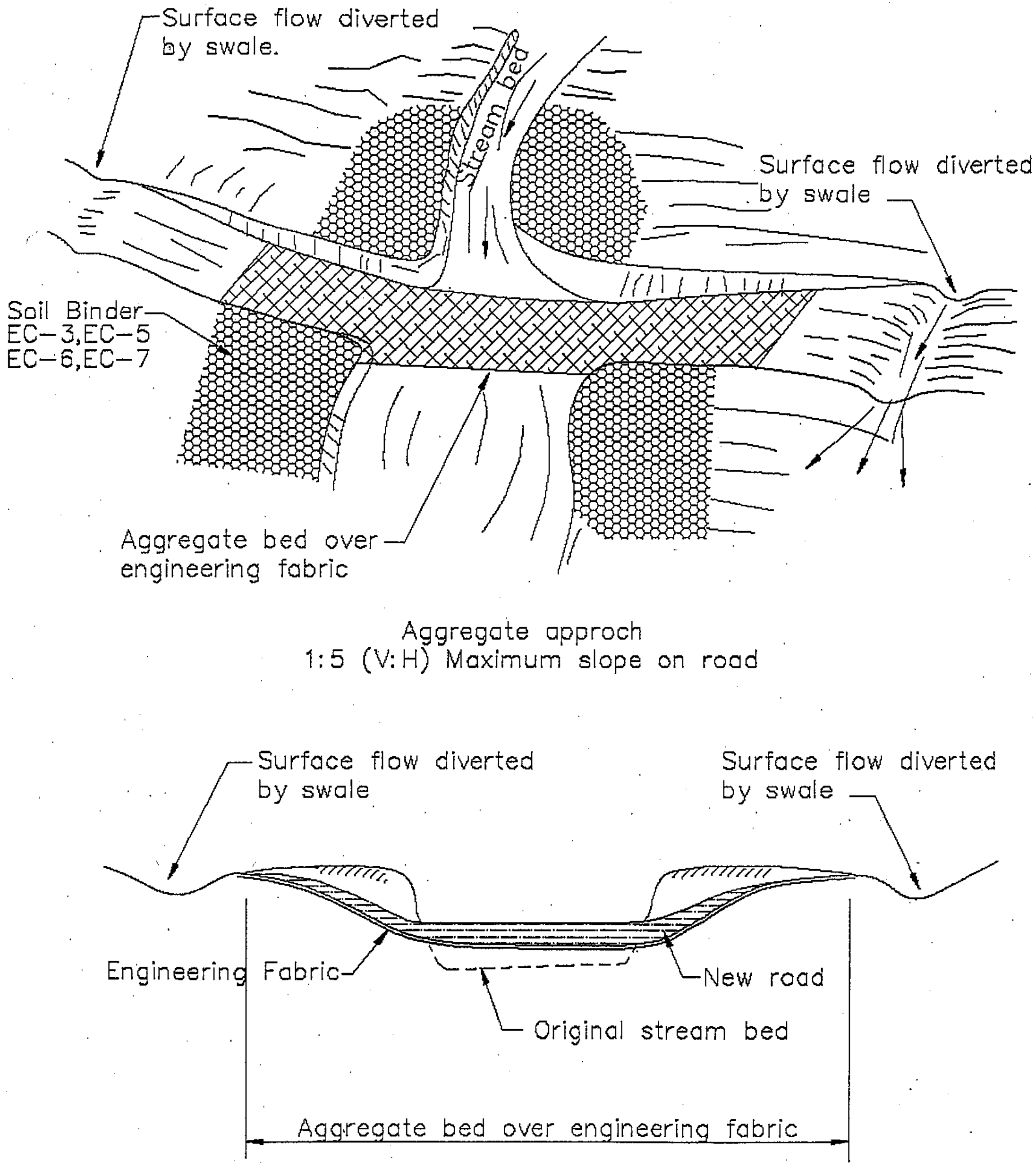


TYPICAL FORD CROSSING
NOT TO SCALE



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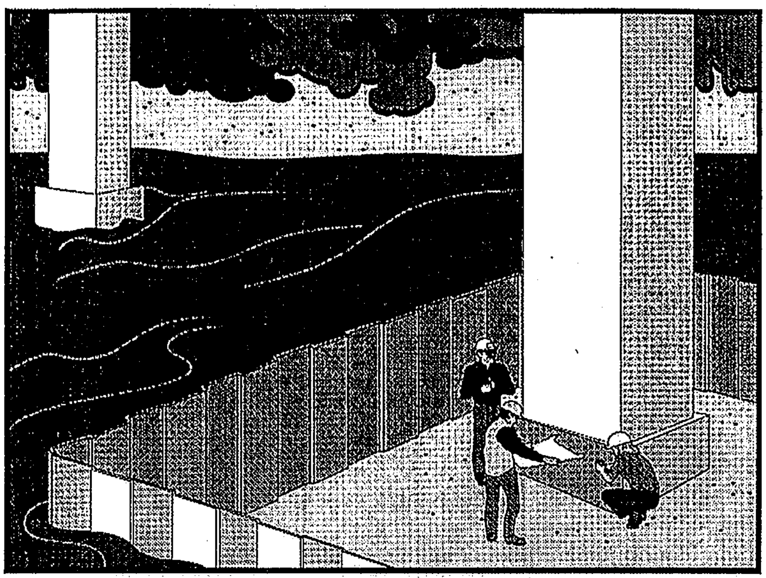

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
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Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Clear water diversion consists of a system of structures and measures that intercept clear surface water runoff upstream of a project, transport it around the work area, and discharge it downstream with minimal water quality degradation from either the project construction operations or the construction of the diversion. Clear water diversions are used in a waterway to enclose a construction area and reduce sediment pollution from construction work occurring in or adjacent to water. Structures commonly used as part of this system include diversion ditches, berms, dikes, slope drains, rock, gravel bags, wood, aqua barriers, cofferdams, filter fabric or turbidity curtains, drainage and interceptor swales, pipes, or flumes.

## Suitable Applications

A clear water diversion is typically implemented where appropriate permits (1601 Agreement) have been secured and work must be performed in a flowing stream or water body.

- Clear water diversions are appropriate for isolating construction activities occurring within or near a water body such as streambank stabilization, or culvert, bridge, pier or abutment installation. They may also be used in combination with other methods, such as clear water bypasses and/or pumps.
- Pumped diversions are suitable for intermittent and low flow streams.
- Excavation of a temporary bypass channel, or passing the flow through a heavy pipe (called a "flume") with a trench

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A002664

excavated under it, is appropriate for the diversion of streams less than 20 ft wide, with flow rates less than 100 cfs.

- Clear water diversions incorporating clean washed gravel may be appropriate for use in salmonid spawning streams.

## Limitations

- Diversion and encroachment activities will usually disturb the waterway during installation and removal of diversion structures.
- Installation may require Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game. If numerical-based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required.
- Diversion and encroachment activities may constrict the waterway, which can obstruct flood flows and cause flooding or washouts. Diversion structures should not be installed without identifying potential impacts to the stream channel.
- Diversion or isolation activities are not appropriate in channels where there is insufficient stream flow to support aquatic species in the area dewatered as a result of the diversion.
- Diversion or isolation activities are inappropriate in deep water unless designed or reviewed by an engineer registered in California.
- Diversion or isolation activities should not completely dam stream flow.
- Dewatering and removal may require additional sediment control or water treatment. See NS-2, Dewatering Operations.
- Not appropriate if installation, maintenance, and removal of the structures will disturb sensitive aquatic species of concern.

## Implementation

### *General*

- Implement guidelines presented in NS-17, Streambank Stabilization to minimize impacts to streambanks.
- Where working areas encroach on flowing streams, barriers adequate to prevent the flow of muddy water into streams should be constructed and maintained between working areas and streams. During construction of the barriers, muddying of streams should be held to a minimum.
- Diversion structures must be adequately designed to accommodate fluctuations in water depth or flow volume due to tides, storms, flash floods, etc.
- Heavy equipment driven in wet portions of a water body to accomplish work should be completely clean of petroleum residue, and water levels should be below the fuel tanks, gearboxes, and axles of the equipment unless lubricants and fuels are sealed such that inundation by water will not result in discharges of fuels, oils, greases, or hydraulic fluids.

- Excavation equipment buckets may reach out into the water for the purpose of removing or placing fill materials. Only the bucket of the crane/ excavator/backhoe may operate in a water body. The main body of the crane/excavator/backhoe should not enter the water body except as necessary to cross the stream to access the work site.
- Stationary equipment such as motors and pumps located within or adjacent to a water body, should be positioned over drip pans.
- When any artificial obstruction is being constructed, maintained, or placed in operation, sufficient water should, at all times, be allowed to pass downstream to maintain aquatic life.
- Equipment should not be parked below the high water mark unless allowed by a permit.
- Disturbance or removal of vegetation should not exceed the minimum necessary to complete operations. Precautions should be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation should be replaced with the appropriate erosion control measures.
- Riparian vegetation approved for trimming as part of the project should be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation should be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble should be removed upon completion of project activities.
- Drip pans should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- Where possible, avoid or minimize diversion and encroachment impacts by scheduling construction during periods of low flow or when the stream is dry. Scheduling should also consider seasonal releases of water from dams, fish migration and spawning seasons, and water demands due to crop irrigation.
- Construct diversion structures with materials free of potential pollutants such as soil, silt, sand, clay, grease, or oil.

### *Temporary Diversions and Encroachments*

- Construct diversion channels in accordance with EC-9, Earth Dikes and Drainage Swales.
- In high flow velocity areas, stabilize slopes of embankments and diversion ditches using an appropriate liner, in accordance with EC-7, Geotextiles and Mats, or use rock slope protection.
- Where appropriate, use natural streambed materials such as large cobbles and boulders for temporary embankment and slope protection, or other temporary soil stabilization methods.
- Provide for velocity dissipation at transitions in the diversion, such as the point where the stream is diverted to the channel and the point where the diverted stream is returned to its natural channel. See also EC-10, Velocity Dissipation Devices.

### *Temporary Dry Construction Areas*

- When dewatering behind temporary structures to create a temporary dry construction area, such as cofferdams, pass pumped water through a sediment-settling device, such as a portable tank or settling basin, before returning water to the water body. See also NS-2, Dewatering Operations.

- Any substance used to assemble or maintain diversion structures, such as form oil, should be non-toxic and non-hazardous.

- Any material used to minimize seepage underneath diversion structures, such as grout, should be non-toxic, non-hazardous, and as close to a neutral pH as possible.

### *Comparison of Diversion and Isolation Techniques:*

- Gravel bags are relatively inexpensive, but installation and removal can be labor intensive. It is also difficult to dewater the isolated area. Sandbags should not be used for this technique in rivers or streams, as sand should never be put into or adjacent to a stream, even if encapsulated in geotextile.

- Gravel Bag Berms (SE-6) used in conjunction with an impermeable membrane are cost effective, and can be dewatered relatively easily. If spawning gravel is used, the impermeable membrane can be removed from the stream, and the gravel can be spread out and left as salmonid spawning habitat if approved in the permit. Only clean, washed gravel should be used for both the gravel bag and gravel berm techniques.

- Cofferdams are relatively expensive, but frequently allow full dewatering. Also, many options now available are relatively easy to install.

- Sheet pile enclosures are a much more expensive solution, but do allow full dewatering. This technique is not well suited to small streams, but can be effective on large rivers or lakes, and where staging and heavy equipment access areas are available.

- K-rails are an isolation method that does not allow full dewatering, but can be used in small to large watercourses, and in fast-water situations.

- A relatively inexpensive isolation method is filter fabric isolation. This method involves placement of gravel bags or continuous berms to 'key-in' the fabric, and subsequently staking the fabric in place. This method should be used in relatively calm water, and can be used in smaller streams. Note that this is not a dewatering method, but rather a sediment isolation method.

- Turbidity curtains should be used where sediment discharge to a stream is unavoidable. They can also be used for in-stream construction, when dewatering an area is not required.

- When used in watercourses or streams, cofferdams must be used in accordance with permit requirements.

- Manufactured diversion structures should be installed following manufacturer's specifications.



A002667

- Filter fabric and turbidity curtain isolation installation methods can be found in the specific technique descriptions that follow.

### *Filter Fabric Isolation Technique*

*Definition and Purpose*

A filter fabric isolation structure is a temporary structure built into a waterway to enclose a construction area and reduce sediment pollution from construction work in or adjacent to water. This structure is composed of filter fabric, gravel bags, and steel t-posts.

*Appropriate Applications*

- Filter fabric may be used for construction activities such as streambank stabilization, or culvert, bridge, pier or abutment installation. It may also be used in combination with other methods, such as clean water bypasses and/or pumps.
- Filter fabric isolation is relatively inexpensive. This method involves placement of gravel bags or continuous berms to 'key-in' the fabric, and subsequently staking the fabric in place.
- If spawning gravel is used, all other components of the isolation can be removed from the stream, and the gravel may be spread out and left as salmonid spawning habitat if approved in the permit. Whether spawning gravel or other types of gravel are used, only clean washed gravel should be used as infill for the gravel bags or continuous berm.
- This method should be used in relatively calm water, and can be used in smaller streams. This is not a dewatering method, but rather a sediment isolation method.
- Water levels inside and outside the fabric curtain must be about the same, as differential heads will cause the curtain to collapse.

*Limitations*

- Do not use if the installation, maintenance and removal of the structures will disturb sensitive aquatic species of concern.
- Filter fabrics are not appropriate for projects where dewatering is necessary.
- Filter fabrics are not appropriate to completely dam stream flow.

*Design and Installation*

- For the filter fabric isolation method, a non-woven or heavy-duty fabric is recommended over standard silt fence. Using rolled geotextiles allows non-standard widths to be used.
- Anchor filter fabric with gravel bags filled with clean, washed gravel. Do not use sand. If a bag should split open, the gravel can be left in the stream, where it can provide aquatic habitat benefits. If a sandbag splits open in a watercourse, the sand could cause a decrease in water quality, and could bury sensitive aquatic habitat.
- Another anchor alternative is a continuous berm, made with the Continuous Berm Machine. This is a gravel-filled bag that can be made in very long segments. The length of the berms is usually limited to 18 ft for ease of handling (otherwise, it gets too heavy to move).

- Place the fabric on the bottom of the stream, and place either a bag of clean, washed gravel or a continuous berm over the bottom of the silt fence fabric, such that a bag-width of fabric lies on the stream bottom. The bag should be placed on what will be the outside of the isolation area.
- Pull the fabric up, and place a metal t-post immediately behind the fabric, on the inside of the isolation area; attach the silt fence to the post with three diagonal nylon ties.
- Continue placing fabric as described above until the entire work area has been isolated, staking the fabric at least every 6 ft.

*Inspection and Maintenance*

- Immediately repair any gaps, holes or scour.
- Remove and properly dispose of sediment buildup.
- Remove BMP upon completion of construction activity. Recycle or reuse if applicable.
- Revegetate areas disturbed by BMP removal if needed.

### *Turbidity Curtain Isolation Technique*

*Definition and Purpose*

A turbidity curtain is a fabric barrier used to isolate the near shore work area. The barriers are intended to confine the suspended sediment. The curtain is a floating barrier, and thus does not prevent water from entering the isolated area; rather, it prevents suspended sediment from getting out.

*Appropriate Applications*

Turbidity curtains should be used where sediment discharge to a stream is unavoidable. They are used when construction activities adjoin quiescent waters, such as lakes, ponds, and slow flowing rivers. The curtains are designed to deflect and contain sediment within a limited area and provide sufficient retention time so that the sediment particles will fall out of suspension.

*Limitations*

- Turbidity curtains should not be used in flowing water; they are best suited for use in ponds, lakes, and very slow-moving rivers.
- Turbidity curtains should not be placed across the width of a channel.
- Removing sediment that has been deflected and settled out by the curtain may create a discharge problem through the resuspension of particles and by accidental dumping by the removal equipment.

*Design and Installation*

- Turbidity curtains should be oriented parallel to the direction of flow.
- The curtain should extend the entire depth of the watercourse in calm-water situations.
- In wave conditions, the curtain should extend to within 1 ft of the bottom of the watercourse, such that the curtain does not stir up sediment by hitting the bottom repeatedly. If it is

desirable for the curtain to reach the bottom in an active-water situation, a pervious filter fabric may be used for the bottom 1 ft.

- The top of the curtain should consist of flexible flotation buoys, and the bottom should be held down by a load line incorporated into the curtain fabric. The fabric should be a brightly colored impervious mesh.
- The curtain should be held in place by anchors placed at least every 100 ft.
- First, place the anchors, then tow the fabric out in a furled condition, and connect to the anchors. The anchors should be connected to the flotation devices, and not to the bottom of the curtain. Once in place, cut the furling lines, and allow the bottom of the curtain to sink.
- Consideration must be given to the probable outcome of the removal procedure. It must be determined if it will create more of a sediment problem through re-suspension of the particles or by accidental dumping of material during removal. It is recommended that the soil particles trapped by the turbidity curtain only be removed if there has been a significant change in the original contours of the affected area in the watercourse.
- Particles should always be allowed to settle for a minimum of 6 to 12 hours prior to their removal or prior to removal of the turbidity curtain.

*Maintenance and Inspection:*

- The curtain should be inspected for holes or other problems, and any repairs needed should be made promptly.
- Allow sediment to settle for 6 to 12 hours prior to removal of sediment or curtain. This means that after removing sediment, wait an additional 6 to 12 hours before removing the curtain.
- To remove, install furling lines along the curtain, detach from anchors, and tow out of the water.

### *K-rail River Isolation*

*Definition and Purpose*

This temporary sediment control or stream isolation method uses K-rails to form the sediment deposition area, or to isolate the in-stream or near-bank construction area.

Barriers are placed end-to-end in a pre-designed configuration and gravel-filled bags are used at the toe of the barrier and at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls.

*Appropriate Applications*

The K-rail isolation can be used in streams with higher water velocities than many other isolation techniques.

- This technique is also useful at the toe of embankments, and cut or fill slopes.



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*Limitations*

- The K-rail method should not be used to dewater a project site, as the barrier is not watertight.

*Design and Installation*

- To create a floor for the K-rail, move large rocks and obstructions. Place washed gravel and gravel-filled bags to create a level surface for K-rails to sit. Washed gravel should always be used.
- Place the bottom two K-rails adjacent to each other, and parallel to the direction of flow; fill the center portion with gravel bags. Then place the third K-rail on top of the bottom two. There should be sufficient gravel bags between the bottom K-rails such that the top rail is supported by the gravel. Place plastic sheeting around the K-rails, and secure at the bottom with gravel bags.
- Further support can be added by pinning and cabling the K-rails together. Also, large riprap and boulders can be used to support either side of the K-rail, especially where there is strong current.

*Inspection and Maintenance:*

- The barrier should be inspected and any leaks, holes, or other problems should be addressed immediately.
- Sediment should be allowed to settle for at least 6 to 12 hours prior to removal of sediment, and for 6 to 12 hours prior to removal of the barrier.

### *Stream Diversions*

The selection of which stream diversion technique to use will depend upon the type of work involved, physical characteristics of the site, and the volume of water flowing through the project.

*Advantages of a Pumped Diversion*

- Downstream sediment transport can be nearly eliminated.
- Dewatering of the work area is possible.
- Pipes can be moved around to allow construction operations.
- The dams can serve as temporary access to the site.
- Increased flows can be managed by adding more pumping capacity.

*Disadvantages of a Pumped Diversion*

- Flow volume is limited by pump capacity.
- A pumped diversion requires 24 hour monitoring of pumps.
- Sudden rain could overtop dams.
- Erosion at the outlet.

- Minor in-stream disturbance is required to install and remove dams.

*Advantages of Excavated Channels and Flumes*

- Excavated channels isolate work from water flow and allow dewatering.
- Excavated channels can handle larger flows than pumps.

*Disadvantages of Excavated Channels and Flumes*

- Bypass channel or flume must be sized to handle flows, including possible floods.
- Channels must be protected from erosion.
- Flow diversion and re-direction with small dams involves in-stream disturbance and mobilization of sediment.

*Design and Installation*

- Installation guidelines will vary based on existing site conditions and type of diversion used.
- Pump capacity must be sufficient for design flow.
- A standby pump is required in case a primary pump fails.
- Dam materials used to create dams upstream and downstream of diversion should be erosion resistant; materials such as steel plate, sheet pile, sandbags, continuous berms, inflatable water bladders, etc., would be acceptable.

When constructing a diversion channel, begin excavation of the channel at the proposed downstream end, and work upstream. Once the watercourse to be diverted is reached and the excavated channel is stable, breach the upstream end and allow water to flow down the new channel. Once flow has been established in the diversion channel, install the diversion weir in the main channel; this will force all water to be diverted from the main channel.

*Inspection and Maintenance*

- Pumped diversions require 24 hour monitoring of pumps.
- Inspect embankments and diversion channels for damage to the linings, accumulating debris, sediment buildup, and adequacy of the slope protection. Remove debris and repair linings and slope protection as required. Remove holes, gaps, or scour.
- Upon completion of work, the diversion or isolation structure should be removed and flow should be redirected through the new culvert or back into the original stream channel. Recycle or reuse if applicable.
- Revegetate areas disturbed by BMP removal if needed.

## Costs

Costs of clear water diversion vary considerably and can be very high.

### Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

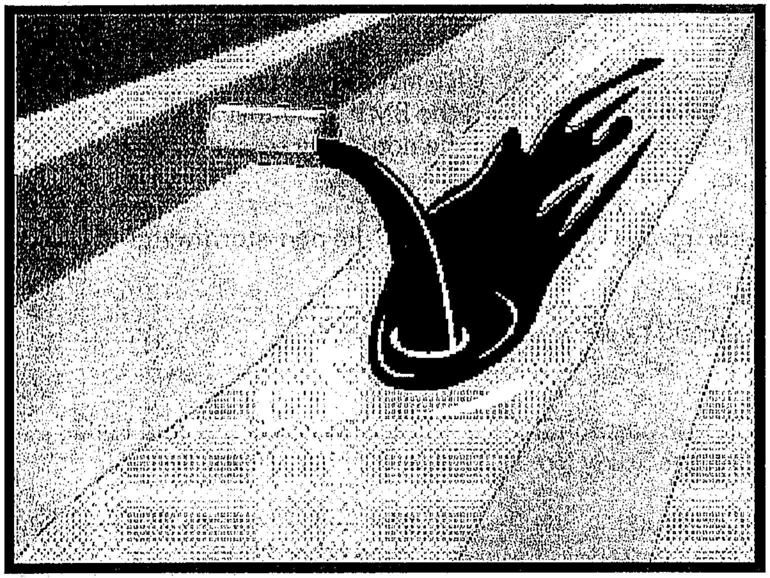
- Refer to BMP-specific inspection and maintenance requirements.

### References

California Bank and Shore Rock Slope Protection Design – Practitioners Guide and Field Evaluations of Riprap Methods, Caltrans Study No. F90TL03, October, 2000.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Illicit Connection/Discharge NS-6



**Objectives**

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

**Targeted Constituents**

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |

**Potential Alternatives**

None

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## Description and Purpose

Procedures and practices designed for construction contractors to recognize illicit connections or illegally dumped or discharged materials on a construction site and report incidents.

## Suitable Applications

This best management practice (BMP) applies to all construction projects. Illicit connection/discharge and reporting is applicable anytime an illicit connection or discharge is discovered or illegally dumped material is found on the construction site.

## Limitations

Illicit connections and illegal discharges or dumping, for the purposes of this BMP, refer to discharges and dumping caused by parties other than the contractor. If pre-existing hazardous materials or wastes are known to exist onsite, they should be identified in the SWPPP and handled as set forth in the SWPPP.

## Implementation

### *Planning*

- Review the SWPPP. Pre-existing areas of contamination should be identified and documented in the SWPPP.
- Inspect site before beginning the job for evidence of illicit connections, illegal dumping or discharges. Document any pre-existing conditions and notify the owner.

- Inspect site regularly during project execution for evidence of illicit connections, illegal dumping or discharges.
- Observe site perimeter for evidence for potential of illicitly discharged or illegally dumped material, which may enter the job site.

### *Identification of Illicit Connections and Illegal Dumping or Discharges*

- **General** – unlabeled and unidentifiable material should be treated as hazardous.
- **Solids** - Look for debris, or rubbish piles. Solid waste dumping often occurs on roadways with light traffic loads or in areas not easily visible from the traveled way.
- **Liquids** - signs of illegal liquid dumping or discharge can include:
  - Visible signs of staining or unusual colors to the pavement or surrounding adjacent soils
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Abnormal water flow during the dry weather season
- **Urban Areas** - Evidence of illicit connections or illegal discharges is typically detected at storm drain outfall locations or at manholes. Signs of an illicit connection or illegal discharge can include:
  - Abnormal water flow during the dry weather season
  - Unusual flows in sub drain systems used for dewatering
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Excessive sediment deposits, particularly adjacent to or near active offsite construction projects
- **Rural Areas** - Illicit connections or illegal discharges involving irrigation drainage ditches are detected by visual inspections. Signs of an illicit discharge can include:
  - Abnormal water flow during the non-irrigation season
  - Non-standard junction structures
  - Broken concrete or other disturbances at or near junction structures

### *Reporting*

Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery. For illicit connections or discharges to the storm drain system, notify the local stormwater management agency. For illegal dumping, notify the local law enforcement agency.

### *Cleanup and Removal*

The responsibility for cleanup and removal of illicit or illegal dumping or discharges will vary by location. Contact the local stormwater management agency for further information.

### Costs
Costs to look for and report illicit connections and illegal discharges and dumping are low. The best way to avoid costs associated with illicit connections and illegal discharges and dumping is to keep the project perimeters secure to prevent access to the site, to observe the site for vehicles that should not be there, and to document any waste or hazardous materials that exist onsite before taking possession of the site.

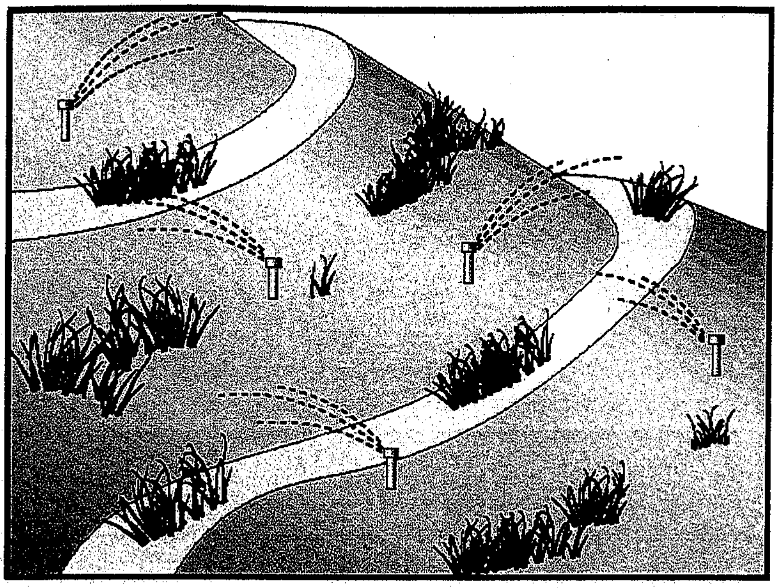
### Inspection and Maintenance
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect the site regularly to check for any illegal dumping or discharge.
- Prohibit employees and subcontractors from disposing of non-job related debris or materials at the construction site.
- Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery.

### References
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Potable Water/Irrigation NS-7



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Potable Water/Irrigation consists of practices and procedures to manage the discharge of potential pollutants generated during discharges from irrigation water lines, landscape irrigation, lawn or garden watering, planned and unplanned discharges from potable water sources, water line flushing, and hydrant flushing.

## Suitable Applications

Implement this BMP whenever potable water or irrigation water discharges occur at or enter a construction site.

## Limitations

None identified.

## Implementation

- Direct water from offsite sources around or through a construction site, where feasible, in a way that minimizes contact with the construction site.
- Discharges from water line flushing should be reused for landscaping purposes where feasible.
- Shut off the water source to broken lines, sprinklers, or valves as soon as possible to prevent excess water flow.
- Protect downstream stormwater drainage systems and watercourses from water pumped or bailed from trenches excavated to repair water lines.

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- Inspect irrigated areas within the construction limits for excess watering. Adjust watering times and schedules to ensure that the appropriate amount of water is being used and to minimize runoff. Consider factors such as soil structure, grade, time of year, and type of plant material in determining the proper amounts of water for a specific area.

## Costs

Cost to manage potable water and irrigation are low and generally considered to be a normal part of related activities.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Repair broken water lines as soon as possible.

- Inspect irrigated areas regularly for signs of erosion and/or discharge.

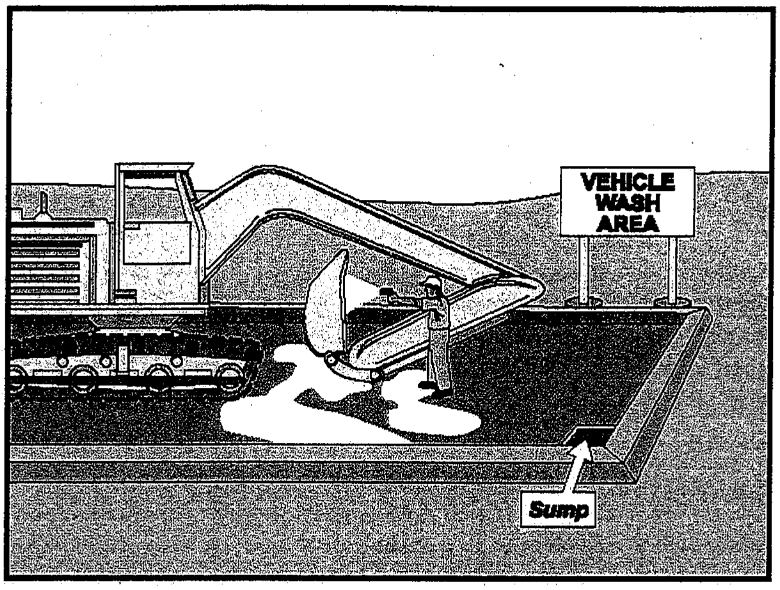
## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Vehicle and Equipment Cleaning NS-8




### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

### Potential Alternatives

None

## Description and Purpose

Vehicle and equipment cleaning procedures and practices eliminate or reduce the discharge of pollutants to stormwater from vehicle and equipment cleaning operations. Procedures and practices include but are not limited to: using offsite facilities; washing in designated, contained areas only; eliminating discharges to the storm drain by infiltrating the wash water; and training employees and subcontractors in proper cleaning procedures.

## Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment cleaning is performed.

## Limitations

Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades. Sending vehicles/equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/Exit.

## Implementation

Other options to washing equipment onsite include contracting with either an offsite or mobile commercial washing business. These businesses may be better equipped to handle and dispose of the wash waters properly. Performing this work offsite can also be economical by eliminating the need for a separate washing operation onsite.

If washing operations are to take place onsite, then:

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- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning onsite. Steam cleaning can generate significant pollutant concentrates.
- Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site unless resulting wastes are fully contained and disposed of. Resulting wastes should not be discharged or buried, and must be captured and recycled or disposed according to the requirements of WM-10, Liquid Waste Management or WM-6, Hazardous Waste Management, depending on the waste characteristics. Minimize use of solvents. Use of diesel for vehicle and equipment cleaning is prohibited.
- All vehicles and equipment that regularly enter and leave the construction site must be cleaned offsite.
- When vehicle and equipment washing and cleaning must occur onsite, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area should have the following characteristics:
  - Located away from storm drain inlets, drainage facilities, or watercourses
  - Paved with concrete or asphalt and bermed to contain wash waters and to prevent runon and runoff
  - Configured with a sump to allow collection and disposal of wash water
  - No discharge of wash waters to storm drains or watercourses
  - Used only when necessary
- When cleaning vehicles and equipment with water:
  - Use as little water as possible. High-pressure sprayers may use less water than a hose and should be considered
  - Use positive shutoff valve to minimize water usage
  - Facility wash racks should discharge to a sanitary sewer, recycle system or other approved discharge system and must not discharge to the storm drainage system, watercourses, or to groundwater

### Costs

Cleaning vehicles and equipment at an offsite facility may reduce overall costs for vehicle and equipment cleaning by eliminating the need to provide similar services onsite. When onsite cleaning is needed, the cost to establish appropriate facilities is relatively low on larger, long-duration projects, and moderate to high on small, short-duration projects.

### Inspection and Maintenance

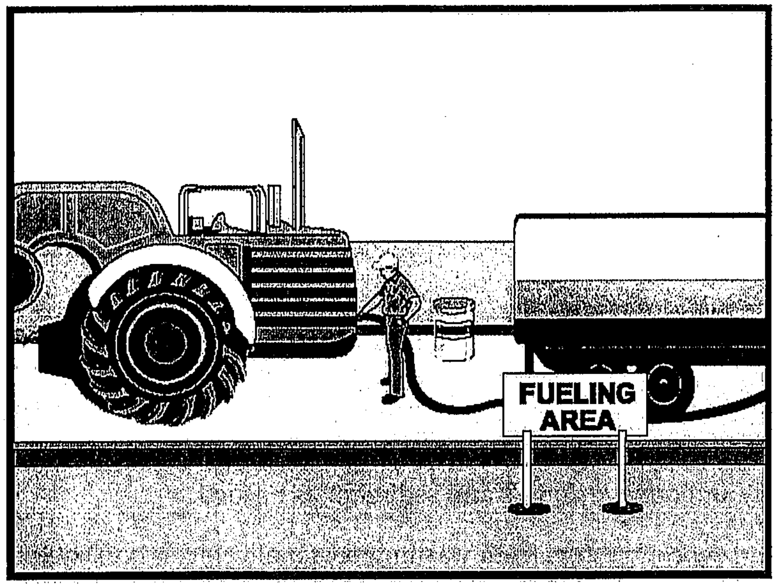
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspection and maintenance is minimal, although some berm repair may be necessary.
- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.
- Inspect sump regularly and remove liquids and sediment as needed.
- Prohibit employees and subcontractors from washing personal vehicles and equipment on the construction site.

### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Swisher, R.D. Surfactant Biodegradation, Marcel Decker Corporation, 1987.

# Vehicle and Equipment Fueling NS-9




## Description and Purpose

Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks, and reduce or eliminate contamination of stormwater. This can be accomplished by using offsite facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.

## Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment fueling takes place.

## Limitations

Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite for fueling. Sending vehicles and equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/ Exit.

## Implementation

- Use offsite fueling stations as much as possible. These businesses are better equipped to handle fuel and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate fueling area at a site.

- Discourage "topping-off" of fuel tanks.

### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

### Potential Alternatives

None

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- Absorbent spill cleanup materials and spill kits should be available in fueling areas and on fueling trucks, and should be disposed of properly after use.
- Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the adsorbent materials promptly and dispose of properly.
- Avoid mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and large excavators, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.
- When fueling must take place onsite, designate an area away from drainage courses to be used. Fueling areas should be identified in the SWPPP.
- Dedicated fueling areas should be protected from stormwater runon and runoff, and should be located at least 50 ft away from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.
- Protect fueling areas with berms and dikes to prevent runon, runoff, and to contain spills.
- Nozzles used in vehicle and equipment fueling should be equipped with an automatic shutoff to control drips. Fueling operations should not be left unattended.
- Use vapor recovery nozzles to help control drips as well as air pollution where required by Air Quality Management Districts (AQMD).
- Federal, state, and local requirements should be observed for any stationary above ground storage tanks.

### Costs

- All of the above measures are low cost except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.

### Inspection and Maintenance

- Vehicles and equipment should be inspected each day of use for leaks. Leaks should be repaired immediately or problem vehicles or equipment should be removed from the project site.
- Keep ample supplies of spill cleanup materials onsite.
- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.

## References

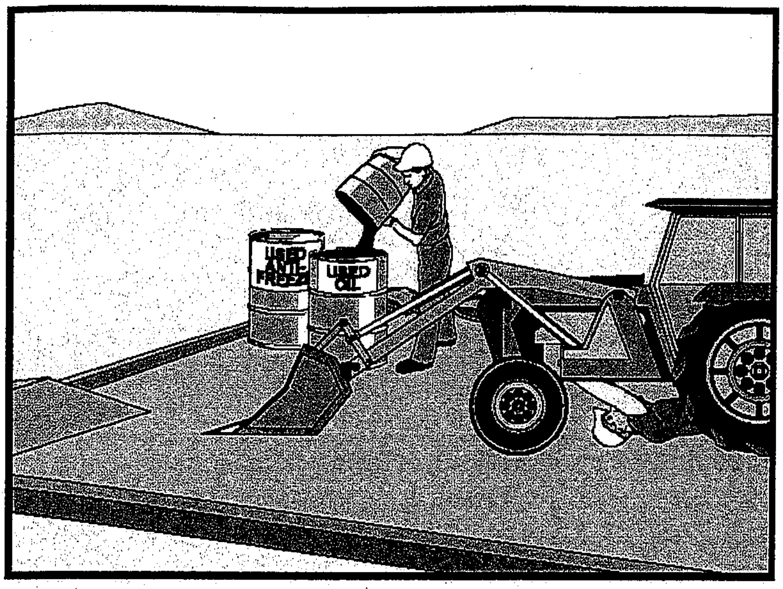
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Vehicle & Equipment Maintenance NS-10



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

### Potential Alternatives

None

## Description and Purpose

Prevent or reduce the contamination of stormwater resulting from vehicle and equipment maintenance by running a "dry and clean site". The best option would be to perform maintenance activities at an offsite facility. If this option is not available then work should be performed in designated areas only, while providing cover for materials stored outside, checking for leaks and spills, and containing and cleaning up spills immediately. Employees and subcontractors must be trained in proper procedures.

## Suitable Applications

These procedures are suitable on all construction projects where an onsite yard area is necessary for storage and maintenance of heavy equipment and vehicles.

## Limitations

Onsite vehicle and equipment maintenance should only be used where it is impractical to send vehicles and equipment offsite for maintenance and repair. Sending vehicles/equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/Exit.

Outdoor vehicle or equipment maintenance is a potentially significant source of stormwater pollution. Activities that can contaminate stormwater include engine repair and service, changing or replacement of fluids, and outdoor equipment storage and parking (engine fluid leaks). For further information on vehicle or equipment servicing, see NS-8, Vehicle and Equipment Cleaning, and NS-9, Vehicle and Equipment Fueling.

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# NS-10 Vehicle & Equipment Maintenance

### Implementation

- Use offsite repair shops as much as possible. These businesses are better equipped to handle vehicle fluids and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur onsite, use designated areas, located away from drainage courses. Dedicated maintenance areas should be protected from stormwater runon and runoff, and should be located at least 50 ft from downstream drainage facilities and watercourses.
- Drip pans or absorbent pads should be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a dedicated maintenance area.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- All fueling trucks and fueling areas are required to have spill kits and/or use other spill protection devices.
- Use adsorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- Inspect onsite vehicles and equipment daily at startup for leaks, and repair immediately.
- Keep vehicles and equipment clean; do not allow excessive build-up of oil and grease.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluids. Provide secondary containment and covers for these materials if stored onsite.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.
- Drip pans or plastic sheeting should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- For long-term projects, consider using portable tents or covers over maintenance areas if maintenance cannot be performed offsite.
- Consider use of new, alternative greases and lubricants, such as adhesive greases, for chassis lubrication and fifth-wheel lubrication.
- Properly dispose of used oils, fluids, lubricants, and spill cleanup materials.
- Do not place used oil in a dumpster or pour into a storm drain or watercourse.
- Properly dispose of or recycle used batteries.
- Do not bury used tires.
- Repair leaks of fluids and oil immediately.

Listed below is further information if you must perform vehicle or equipment maintenance onsite.

### *Safer Alternative Products*

- Consider products that are less toxic or hazardous than regular products. These products are often sold under an "environmentally friendly" label.
- Consider use of grease substitutes for lubrication of truck fifth-wheels. Follow manufacturers label for details on specific uses.
- Consider use of plastic friction plates on truck fifth-wheels in lieu of grease. Follow manufacturers label for details on specific uses.

### *Waste Reduction*

Parts are often cleaned using solvents such as trichloroethylene, trichloroethane, or methylene chloride. Many of these cleaners are listed in California Toxic Rule as priority pollutants. These materials are harmful and must not contaminate stormwater. They must be disposed of as a hazardous waste. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents. Also, if possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials. For example, replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check the list of active ingredients to see whether it contains chlorinated solvents. The "chlor" term indicates that the solvent is chlorinated. Also, try substituting a wire brush for solvents to clean parts.

### *Recycling and Disposal*

Separating wastes allows for easier recycling and may reduce disposal costs. Keep hazardous wastes separate, do not mix used oil solvents, and keep chlorinated solvents (like,- trichloroethane) separate from non-chlorinated solvents (like kerosene and mineral spirits). Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around. Provide cover and secondary containment until these materials can be removed from the site.

Oil filters can be recycled. Ask your oil supplier or recycler about recycling oil filters.

Do not dispose of extra paints and coatings by dumping liquid onto the ground or throwing it into dumpsters. Allow coatings to dry or harden before disposal into covered dumpsters.

Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

### Costs

All of the above are low cost measures. Higher costs are incurred to setup and maintain onsite maintenance areas.



A002687

### Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Keep ample supplies of spill cleanup materials onsite.
- Maintain waste fluid containers in leak proof condition.
- Vehicles and equipment should be inspected on each day of use. Leaks should be repaired immediately or the problem vehicle(s) or equipment should be removed from the project site.
- Inspect equipment for damaged hoses and leaky gaskets routinely. Repair or replace as needed.

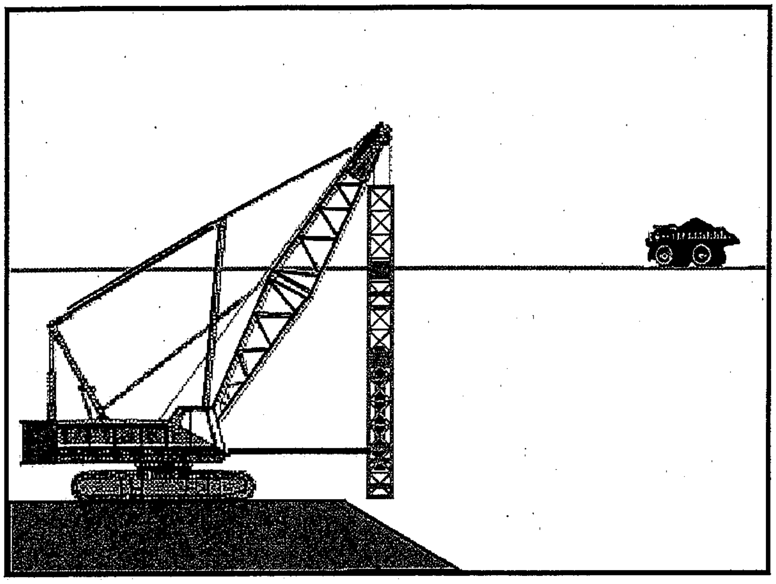
### References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Pile Driving Operations NS-11



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

### Potential Alternatives

None

## Description and Purpose

The construction and retrofit of bridges and retaining walls often include driving piles for foundation support and shoring operations. Driven piles are typically constructed of precast concrete, steel, or timber. Driven sheet piles are also used for shoring and cofferdam construction. Proper control and use of equipment, materials, and waste products from pile driving operations will reduce or eliminate the discharge of potential pollutants to the storm drain system, watercourses, and waters of the United States.

## Suitable Applications

These procedures apply to all construction sites near or adjacent to a watercourse or groundwater where permanent and temporary pile driving (impact and vibratory) takes place, including operations using pile shells as well as construction of cast-in-steel-shell and cast-in-drilled-hole piles.

## Limitations

None identified.

## Implementation

- Use drip pans or absorbent pads during vehicle and equipment operation, maintenance, cleaning, fueling, and storage. Refer to NS-8, Vehicle and Equipment Cleaning, NS-9, Vehicle and Equipment Fueling, and NS-10, Vehicle and Equipment Maintenance.

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- Have spill kits and cleanup materials available at all locations of pile driving. Refer to WM-4, Spill Prevention and Control.
- Equipment that is stored or in use in streambeds, or on docks, barges, or other structures over water bodies should be kept leak free.
- Park equipment over plastic sheeting or equivalent where possible. Plastic is not a substitute for drip pans or absorbent pads. The storage or use of equipment in streambeds or other bodies of water must comply with all applicable permits.
- Implement other BMPs as applicable, such as NS-2, Dewatering Operations, WM-5, Solid Waste Management, WM-6, Hazardous Waste Management, and WM-10, Liquid Waste Management.
- When not in use, store pile-driving equipment away from concentrated flows of stormwater, drainage courses, and inlets. Protect hammers and other hydraulic attachments from runon and runoff by placing them on plywood and covering them with plastic or a comparable material prior to the onset of rain.
- Use less hazardous products, e.g., vegetable oil, when practicable.

### Costs
All of the above measures can be low cost.

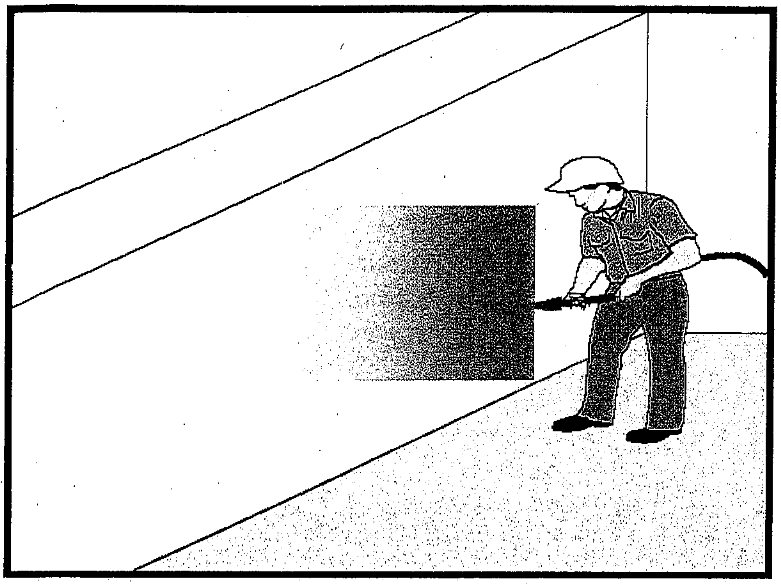
### Inspection and Maintenance
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect equipment every day at startup and repair equipment as needed (i.e., worn or damaged hoses, fittings, and gaskets). Recheck equipment at shift changes or at the end of the day and scheduled repairs as needed.

### References
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Concrete Curing

# NS-12



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

### Potential Alternatives

None

## Description and Purpose

Concrete curing is used in the construction of structures such as bridges, retaining walls, pump houses, large slabs, and structured foundations. Concrete curing includes the use of both chemical and water methods. Discharges of stormwater and non-stormwater exposed to concrete during curing may have a high pH and may contain chemicals, metals, and fines. Proper procedures reduce or eliminate the contamination of stormwater runoff during concrete curing.

## Suitable Applications

Suitable applications include all projects where Portland Cement Concrete (PCC) and concrete curing chemicals are placed where they can be exposed to rainfall, runoff from other areas, or where runoff from the PCC will leave the site.

## Limitations

None identified.

## Implementation

### *Chemical Curing*

- Avoid over spray of curing compounds.
- Minimize the drift of chemical cure as much as possible by applying the curing compound close to the concrete surface. Apply an amount of compound that covers the surface, but does not allow any runoff of the compound.

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- Use proper storage and handling techniques for concrete curing compounds. Refer to WM-1, Material Delivery and Storage.
- Protect drain inlets prior to the application of curing compounds.
- Refer to WM-4, Spill Prevention and Control.

***Water Curing for Bridge Decks, Retaining Walls, and other Structures***

- Direct cure water away from inlets and watercourses to collection areas for infiltration or other means of removal in accordance with all applicable permits.
- Collect cure water at the top of slopes and transport or dispose of water in a non-erodible manner. See EC-9 Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Utilize wet blankets or a similar method that maintains moisture while minimizing the use and possible discharge of water.

## Costs

All of the above measures are generally low cost.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Ensure that employees and subcontractors implement appropriate measures for storage, handling, and use of curing compounds.
- Inspect cure containers and spraying equipment for leaks.

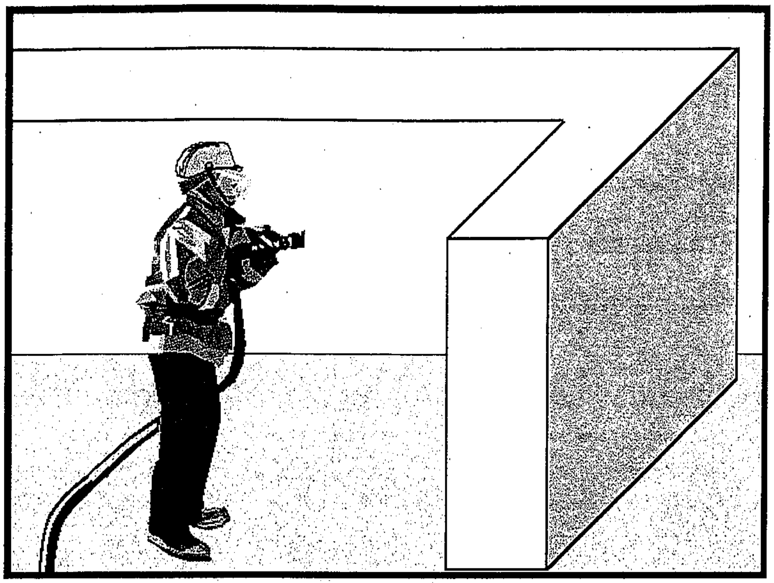
## References

Blue Print for a Clean Bay-Construction-Related Industries: Best Management Practices for Stormwater Pollution Prevention; Santa Clara Valley Non Point Source Pollution Control Program, 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Concrete Finishing NS-13



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | |
| Organics | ☑ |

### Potential Alternatives

None

## Description and Purpose

Concrete finishing methods are used for bridge deck rehabilitation, paint removal, curing compound removal, and final surface finish appearances. Methods include sand blasting, shot blasting, grinding, or high pressure water blasting. Stormwater and non-stormwater exposed to concrete finishing by-products may have a high pH and may contain chemicals, metals, and fines. Proper procedures and implementation of appropriate BMPs can minimize the impact that concrete-finishing methods may have on stormwater and non-stormwater discharges.

## Suitable Applications

These procedures apply to all construction locations where concrete finishing operations are performed.

## Limitations

None identified.

## Implementation

- Collect and properly dispose of water from high-pressure water blasting operations.
- Collect contaminated water from blasting operations at the top of slopes. Transport or dispose of contaminated water while using BMPs such as those for erosion control. Refer to EC-9, Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.

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- Direct water from blasting operations away from inlets and watercourses to collection areas for infiltration or other means of removal (dewatering). Refer to NS-2 De-Watering Operations.

- Protect inlets during sandblasting operations. Refer to SE-10, Storm Drain Inlet Protection.

- Refer to WM-8, Concrete Waste Management for disposal of concrete based debris.

- Minimize the drift of dust and blast material as much as possible by keeping the blasting nozzle close to the surface.

- When blast residue contains a potentially hazardous waste, refer to WM-6, Hazardous Waste Management.

### Costs
These measures are generally of low cost.

### Inspection and Maintenance
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Sweep or vacuum up debris from sandblasting at the end of each shift.

- At the end of each work shift, remove and contain liquid and solid waste from containment structures, if any, and from the general work area.

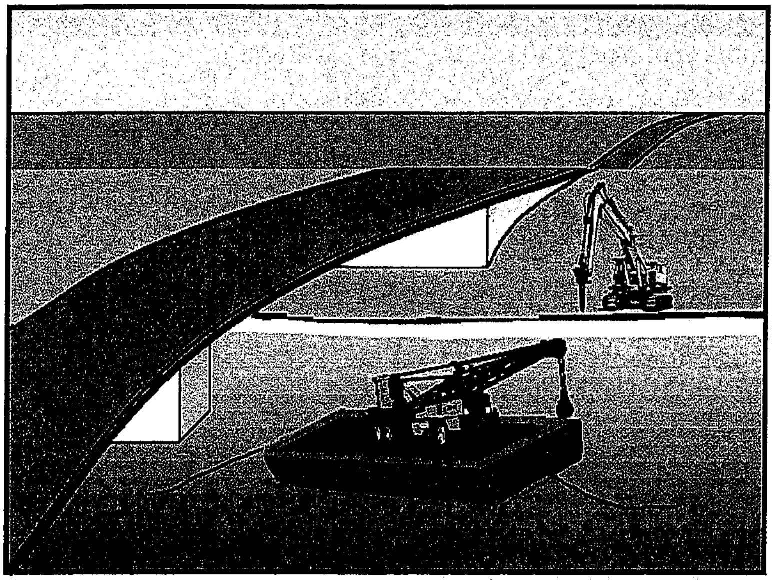
### References
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Material Over Water

# NS-14



**Objectives**

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:

☑ Primary Objective

☒ Secondary Objective

**Targeted Constituents**

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |

**Potential Alternatives**

None

## Description and Purpose

Procedures for the proper use, storage, and disposal of materials and equipment on barges, boats, temporary construction pads, or similar locations, that minimize or eliminate the discharge of potential pollutants to a watercourse.

## Suitable Applications

Applies where materials and equipment are used on barges, boats, docks, and other platforms over or adjacent to a watercourse including waters of the United States. These procedures should be implemented for construction materials and wastes (solid and liquid), soil or dredging materials, or any other materials that may cause or contribute to exceedances of water quality standards.

## Limitations

Dredge and fill activities are regulated by the US Army Corps of Engineers and Regional Boards under Section 404/401 of the Clean Water Act.

## Implementation

- Refer to WM-1, Material Delivery and Storage and WM-4, Spill Prevention and Control.
- Use drip pans and absorbent materials for equipment and vehicles and ensure that an adequate supply of spill clean up materials is available.
- Drip pans should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies

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A002695

when the vehicle or equipment is expected to be idle for more than 1 hour.

- Maintain equipment in accordance with NS-10, Vehicle and Equipment Maintenance. If a leaking line cannot be repaired, remove equipment from over the water.
- Provide watertight curbs or toe boards to contain spills and prevent materials, tools, and debris from leaving the barge, platform, dock, etc.
- Secure all materials to prevent discharges to receiving waters via wind.
- Identify types of spill control measures to be employed, including the storage of such materials and equipment. Ensure that staff is trained regarding the use of the materials, deployment and access of control measures, and reporting measures.
- In case of spills, contact the local Regional Board as soon as possible but within 48 hours.
- Refer to WM-5, Solid Waste Management (non-hazardous) and WM-6, Hazardous Waste Management. Ensure the timely and proper removal of accumulated wastes
- Comply with all necessary permits required for construction within or near the watercourse, such as Regional Water Quality Control Board, U.S. Army Corps of Engineers, Department of Fish and Game or and other local permitting.
- Discharges to waterways should be reported to the Regional Water Quality Control Board immediately upon discovery. A written discharge notification must follow within 7 days. Follow the spill reporting procedures contained in SWPPP.

### Costs
These measures are generally of low to moderate cost. Exceptions are areas for temporary storage of materials, engine fluids, or wastewater pump out.

### Inspection and Maintenance
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Ensure that employees and subcontractors implement the appropriate measures for storage and use of materials and equipment.
- Inspect and maintain all associated BMPs and perimeter controls to ensure continuous protection of the water courses, including waters of the United States.

### References
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



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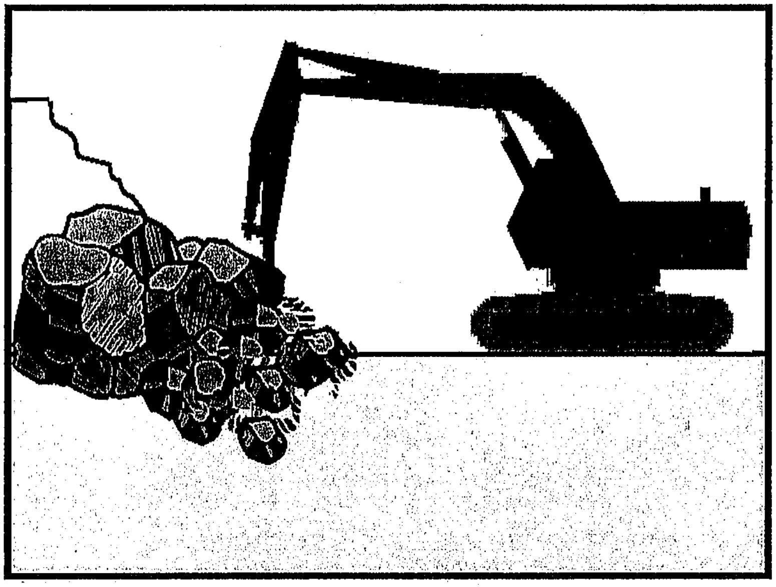

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Procedures to protect water bodies from debris and wastes associated with structure demolition or removal over or adjacent to watercourses.

## Suitable Applications

Full bridge demolition and removal, partial bridge removal (barrier rail, edge of deck) associated with bridge widening projects, concrete channel removal, or any other structure removal that could potentially affect water quality.

## Limitations

None identified.

## Implementation

- Refer to NS-5, Clear Water Diversion, to direct water away from work areas.
- Use attachments on construction equipment such as backhoes to catch debris from small demolition operations.
- Use covers or platforms to collect debris.
- Platforms and covers are to be approved by the owner.
- Stockpile accumulated debris and waste generated during demolition away from watercourses and in accordance with WM-3, Stockpile Management.
- Ensure safe passage of wildlife, as necessary.

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A002698

- Discharges to waterways shall be reported to the Regional Water Quality Control Board immediately upon discovery. A written discharge notification must follow within 7 days. Follow the spill reporting procedures in the SWPPP.

- For structures containing hazardous materials, i.e., lead paint or asbestos, refer to BMP WM-6, Hazardous Waste Management. For demolition work involving soil excavation around lead-painted structures, refer to WM-7, Contaminated Soil Management.

### Costs

Cost may vary according to the combination of practices implemented.

### Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

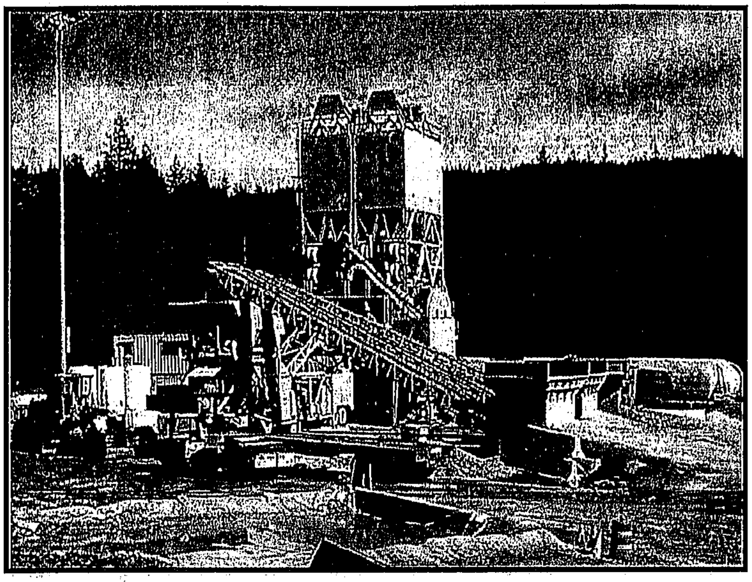
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Any debris-catching devices shall be emptied regularly. Collected debris shall be removed and stored away from the watercourse and protected from runon and runoff.

### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



| Objectives | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:
☑ Primary Objective
☒ Secondary Objective

| Targeted Constituents | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | |
| Organics | |

**Potential Alternatives**

None

## Description and Purpose

The construction of roads, bridges, retaining walls, and other large structures in remote areas, often requires temporary batch plant facilities to manufacture Portland Cement Concrete (PCC) or asphalt cement (AC). Temporary batch plant facilities typically consist of silos containing fly ash, lime, and cement; heated tanks of liquid asphalt; sand and gravel material storage areas; mixing equipment; above ground storage tanks containing concrete additives and water; and designated areas for sand and gravel truck unloading, concrete truck loading, and concrete truck washout. Proper control and use of equipment, materials, and waste products from temporary batch plant facilities will reduce the discharge of potential pollutants to the storm drain system or watercourses, reduce air emissions, and mitigate noise impacts.

## Suitable Applications

These procedures typically apply to construction sites where temporary batch plant facilities are used.

## Limitations

The General Permit for discharges of stormwater associated with industrial activities may be applicable to temporary batch plants.

Specific permit requirements or mitigation measures such as Air Resources Board (ARB), Air Quality Management District (AQMD), Air Pollution Control District (APCD), Regional Water Quality Control Board (RWQCB), county ordinances and city

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ordinances may require alternative mitigation measures for temporary batch plants.

## Implementation

### *Planning*

Implementation steps are as follows:

- Temporary batch plants may be subject to the General Industrial NPDES permit. To comply with the permit, a Notice of Intent (NOI) must be submitted to the State Water Resource Control Board.

- Proper planning, design, and construction of temporary batch plants should be implemented to minimize potential water quality, air pollution, and noise impacts associated with temporary batch plants.

- BMPs and a Sampling and Analysis Plan (SAP) must be included in the project Stormwater Pollution Prevention Plan (SWPPP). BMPs must be implemented, inspected, and maintained.

- Temporary batch plants should be managed to comply with AQMD Statewide Registration Program and/or local AQMD Portable Equipment Registration requirements.

- Construct temporary batch plants down-wind of existing developments whenever possible.

- Placement of access roads should be planned to mitigate water and air quality impacts.

### *Layout and Design*

- Temporary batch plants should be properly located and designed to mitigate water quality impacts to receiving water bodies. Batch plants should be located away from watercourses, drainage courses, and drain inlets. Batch plants should be located to minimize the potential for stormwater runon onto the site.

- Temporary batch plant facilities (including associated stationary equipment and stockpiles) should be located at least 300 ft from any recreational area, school, residence, or other structure not associated with the construction project.

- Construct continuous interior AC or PCC berms around batch plant equipment (mixing equipment, silos, concrete drop points, conveyor belts, admixture tanks, etc.) to facilitate proper containment and cleanup of releases. Rollover or flip top curb or dikes should be placed at ingress and egress points.

- Direct runoff from the paved or unpaved portion of the batch plant into a sump and pipe to a lined washout area or dewatering tank.

- Direct stormwater and non-stormwater runoff from unpaved portions of batch plant facility to catchment ponds or tanks.

- Construct and remove concrete washout facilities in accordance with WM-8, Concrete Waste Management.

- Layout of a typical batch plant and associated BMP is located at the end of this BMP fact sheet.

*Operational Procedures*

- Washout of concrete trucks should be conducted in a designated area in accordance with WM-8, Concrete Waste Management.
- Do not dispose of concrete into drain inlets, the stormwater drainage system, or watercourses.
- Equipment washing should occur in a designated area in accordance with WM-8, Concrete Waste Management. Washing equipment, tools, or vehicles to remove PCC shall be conducted in accordance with NS-7, Potable Water/Irrigation, and NS-8, Vehicle and Equipment Cleaning.
- All dry material transfer points should be ducted through a fabric or cartridge type filter unless there are no visible emissions from the transfer point.
- Equip all bulk storage silos, including auxiliary bulk storage trailers, with fabric or cartridge type filter(s).
- Maintain silo vent filters in proper operating condition.
- Equip silos and auxiliary bulk storage trailers with dust-tight service hatches.
- Fabric dust collection system should be capable of controlling 99 percent of the particulate matter.
- Fabric dust collectors (except for vent filters) should be equipped with an operational pressure differential gauge to measure the pressure drop across the filters.
- All transfer points should be equipped with a wet suppression system to control fugitive particulate emissions unless there are no visible emissions.
- All conveyors should be covered, unless the material being transferred results in no visible emissions.
- There should be no visible emissions beyond the property line, while the equipment is being operated.
- Collect dust emissions from the loading of open-bodied trucks at the drip point of dry batch plants, or dust emissions from the drum feed for central mix plants.
- Equip silos and auxiliary bulk storage trailers with a visible and/or audible warning mechanism to warn operators that the silo or trailer is full.
- All open-bodied vehicles transporting material should be loaded with a final layer of wet sand and the truck shall be covered with a tarp to reduce emissions.

*Tracking Control*

- Plant roads (batch truck and material delivery truck roads) and areas between stockpiles and conveyor hoppers should be stabilized (TR-2, Stabilized Construction Roadway), watered (WE-1, Wind Erosion Control), treated with dust-suppressant chemicals, or paved with a cohesive hard surface that can be repeatedly swept, maintained intact, and cleaned as necessary to control dust emissions.
- Trucks should not track PCC from plants onto public roads. Use appropriate practices from TR-1, Stabilized Construction Entrance/Exit to prevent tracking.

*Materials Storage*

- WM-1, Material Delivery and Storage, should be implemented at all batch plants using concrete components or compounds. An effective strategy is to cover and contain materials.
- WM-2, Material Use should be conducted in a way to minimize or eliminate the discharge of materials to storm drain system or watercourse.
- Ensure that finer materials are not dispersed into the air during operations, such as unloading of cement delivery trucks.
- Stockpiles should be covered and enclosed with perimeter sediment barriers per WM-3, Stockpile Management. Uncovered stockpiles should be sprinkled with water and/or dust-suppressant chemicals as necessary to control dust emissions, unless the stockpiled material results in no visible emissions. An operable stockpile watering system should be onsite at all times.
- Store bagged and boxed materials on pallets and cover on non-working days prior to rain.
- Minimize stockpiles of demolished PCC by recycling them in a timely manner.
- Provide secondary containment for liquid materials (WM-1). Containment should provide sufficient volume to contain precipitation from a 25-year storm plus 10% of the aggregate volume of all containers or plus 100% of the largest container, whichever is greater.
- Handle solid and liquid waste in accordance with WM-5, Solid Waste Management, WM-10, Liquid Waste Management, and WM-8, Concrete Waste Management.
- Maintain adequate supplies of spill cleanup materials and train staff to respond to spills per WM-4, Spill Prevention and Control.
- Immediately clean up spilled cement and fly ash and contain or dampen so that dust or emissions from wind erosion or vehicle traffic are minimized.

*Equipment Maintenance*

- Equipment should be maintained to prevent fluid leaks and spills per NS-9, Vehicle and Equipment Fueling, and NS-10, Vehicle and Equipment Maintenance.
- Maintain adequate supplies of spill cleanup materials and train staff to respond to spills per WM-4, Spill Prevention and Control.

- Incorporate other BMPs such as WM-5, Solid Waste Management, WM-6, Hazardous Waste Management, and WM-10, Liquid Waste Management.

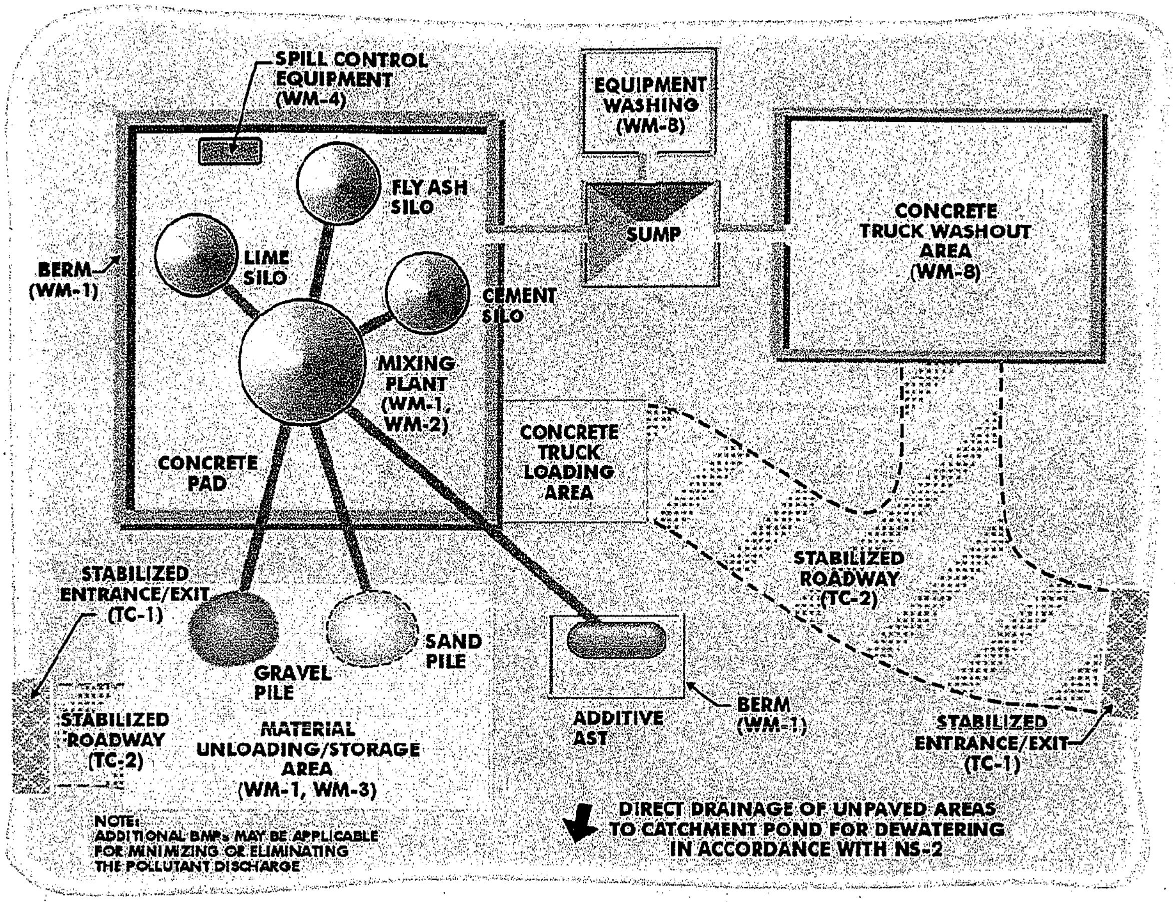
### Costs
Costs will vary depending on the size of the facility and combination of BMPs implemented.

### Inspection and Maintenance
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).
- Inspect and maintain Stabilized Construction Entrance/Exit (TR-1) as needed.
- Inspect and maintain stabilized haul roads as needed.
- Inspect and maintain materials and waste storage areas as needed.

### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.




**Typical Temporary Batch**



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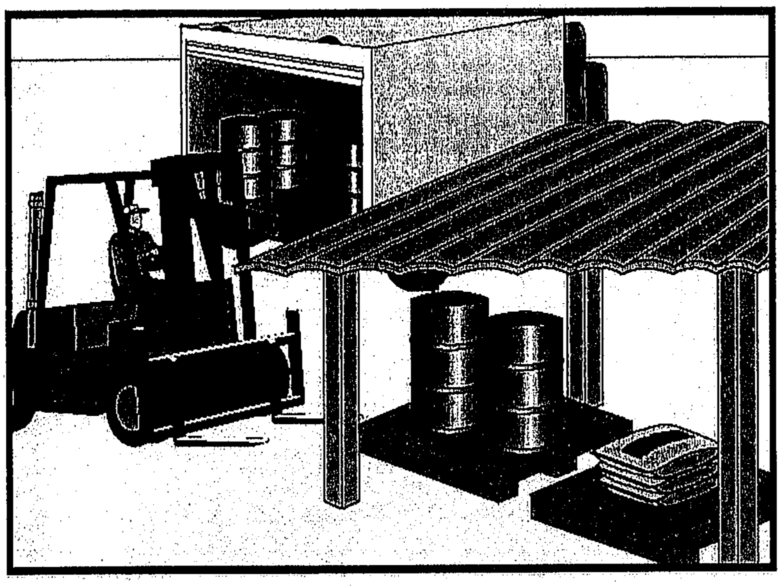
# Material Delivery and Storage WM-1



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:
☑ Primary Objective
☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in a designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see WM-2, Material Use, or WM-4, Spill Prevention and Control. For information on wastes, see the waste management BMPs in this section.

## Suitable Applications

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Soil stabilizers and binders
- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease
- Asphalt and concrete components

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- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

### Limitations
- Space limitation may preclude indoor storage.
- Storage sheds often must meet building and fire code requirements.

### Implementation
The following steps should be taken to minimize risk:

- Temporary storage area should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) should be supplied for all materials stored.
- Construction site areas should be designated for material delivery and storage.
- Material delivery and storage areas should be located near the construction entrances, away from waterways, if possible.
  - Avoid transport near drainage paths or waterways.
  - Surround with earth berms. See EC-9, Earth Dikes and Drainage Swales.
  - Place in an area which will be paved.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- An up to date inventory of materials delivered and stored onsite should be kept.
- Hazardous materials storage onsite should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the rainy season, consider storing materials in a covered area. Store materials in secondary containments such as earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, in secondary containment.



A002707

- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.
- Chemicals should be kept in their original labeled containers.
- Employees and subcontractors should be trained on the proper material delivery and storage practices.
- Employees trained in emergency spill cleanup procedures must be present when dangerous materials or liquid chemicals are unloaded.
- If significant residual materials remain on the ground after construction is complete, properly remove materials and any contaminated soil. See WM-7, Contaminated Soil Management. If the area is to be paved, pave as soon as materials are removed to stabilize the soil.

***Material Storage Areas and Practices***

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 should be stored in approved containers and drums and should not be overfilled. Containers and drums should be placed in temporary containment facilities for storage.
- A temporary containment facility should provide for a spill containment volume able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest container within its boundary, whichever is greater.
- A temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours.
- A temporary containment facility should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be collected and placed into drums. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. All collected liquids or non-hazardous liquids should be sent to an approved disposal site.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Throughout the rainy season, each temporary containment facility should be covered during non-working days, prior to, and during rain events.
- Materials should be stored in their original containers and the original product labels should be maintained in place in a legible condition. Damaged or otherwise illegible labels should be replaced immediately.



A002708

- Bagged and boxed materials should be stored on pallets and should not be allowed to accumulate on the ground. To provide protection from wind and rain throughout the rainy season, bagged and boxed materials should be covered during non-working days and prior to and during rain events.
- Stockpiles should be protected in accordance with WM-3, Stockpile Management.
- Materials should be stored indoors within existing structures or sheds when available.
- Proper storage instructions should be posted at all times in an open and conspicuous location.
- An ample supply of appropriate spill clean up material should be kept near storage areas.
- Also see WM-6, Hazardous Waste Management, for storing of hazardous materials.

### *Material Delivery Practices*

- Keep an accurate, up-to-date inventory of material delivered and stored onsite.
- Arrange for employees trained in emergency spill cleanup procedures to be present when dangerous materials or liquid chemicals are unloaded.

### *Spill Cleanup*

- Contain and clean up any spill immediately.
- Properly remove and dispose of any hazardous materials or contaminated soil if significant residual materials remain on the ground after construction is complete. See WM-7, Contaminated Soil Management.
- See WM-4, Spill Prevention and Control, for spills of chemicals and/or hazardous materials.

## Cost

- The largest cost of implementation may be in the construction of a materials storage area that is covered and provides secondary containment.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep an ample supply of spill cleanup materials near the storage area.
- Keep storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.



A002709

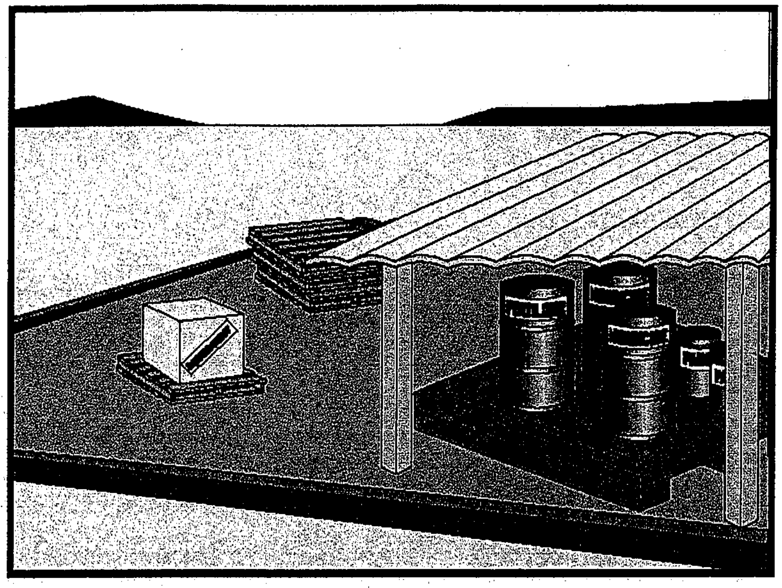
## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:
☑ Primary Objective
☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Prevent or reduce the discharge of pollutants to the storm drain system or watercourses from material use by using alternative products, minimizing hazardous material use onsite, and training employees and subcontractors.

## Suitable Applications

This BMP is suitable for use at all construction projects. These procedures apply when the following materials are used or prepared onsite:

- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete components
- Other hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

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## Limitations

Safer alternative building and construction products may not be available or suitable in every instance.

## Implementation

The following steps should be taken to minimize risk:

- Minimize use of hazardous materials onsite.
- Follow manufacturer instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.
- Train personnel who use pesticides. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct onsite inspections.
- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydro seeding. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains.
- Train employees and subcontractors in proper material use.
- Supply Material Safety Data Sheets (MSDS) for all materials.
- Dispose of latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, with other construction debris.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Mix paint indoors or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain, or watercourse. Dispose of any paint thinners, residue, and sludge(s) that cannot be recycled, as hazardous waste.
- For water-based paint, clean brushes to the extent practicable, and rinse to a drain leading to a sanitary sewer where permitted, or into a concrete washout pit or temporary sediment trap. For oil-based paints, clean brushes to the extent practicable, and filter and reuse thinners and solvents.
- Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.
- Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials onsite when practical.

- Require contractors to complete the "Report of Chemical Spray Forms" when spraying herbicides and pesticides.
- Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.

### Costs
All of the above are low cost measures.

### Inspection and Maintenance
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two–week intervals in the non-rainy season to verify continued BMP implementation.
- Maintenance of this best management practice is minimal.
- Spot check employees and subcontractors throughout the job to ensure appropriate practices are being employed.

### References
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

### Potential Alternatives

None

## Description and Purpose

Stockpile Management procedures and practices are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub base or pre-mixed aggregate, asphalt minder (so called "cold mix" asphalt), and pressure treated wood.

## Suitable Applications

Implement in all projects that stockpile soil and other materials.

## Limitations

None identified.

## Implementation

Protection of stockpiles is a year-round requirement. To properly manage stockpiles:

- Locate stockpiles a minimum of 50 ft away from concentrated flows of stormwater, drainage courses, and inlets.
- Protect all stockpiles from stormwater runon using a temporary perimeter sediment barrier such as berms, dikes, fiber rolls, silt fences, sandbag, gravel bags, or straw bale barriers.

- Implement wind erosion control practices as appropriate on all stockpiled material. For specific information, see WE-1, Wind Erosion Control.
- Manage stockpiles of contaminated soil in accordance with WM-7, Contaminated Soil Management.
- Place bagged materials on pallets and under cover.

### *Protection of Non-Active Stockpiles*

Non-active stockpiles of the identified materials should be protected further as follows:

*Soil stockpiles*

- During the rainy season, soil stockpiles should be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- During the non-rainy season, soil stockpiles should be covered or protected with a temporary perimeter sediment barrier prior to the onset of precipitation.

*Stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate sub base*

- During the rainy season, the stockpiles should be covered or protected with a temporary perimeter sediment barrier at all times.
- During the non-rainy season, the stockpiles should be covered or protected with a temporary perimeter sediment barrier prior to the onset of precipitation.

*Stockpiles of "cold mix"*

- During the rainy season, cold mix stockpiles should be placed on and covered with plastic or comparable material at all times.
- During the non-rainy season, cold mix stockpiles should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

*Stockpiles/Storage of pressure treated wood with copper, chromium, and arsenic or ammonical, copper, zinc, and arsenate*

- During the rainy season, treated wood should be covered with plastic or comparable material at all times.
- During the non-rainy season, treated wood should be covered with plastic or comparable material at all times and cold mix stockpiles should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

### *Protection of Active Stockpiles*

Active stockpiles of the identified materials should be protected further as follows:

- All stockpiles should be protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Stockpiles of "cold mix" should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

### Costs

All of the above are low cost measures.

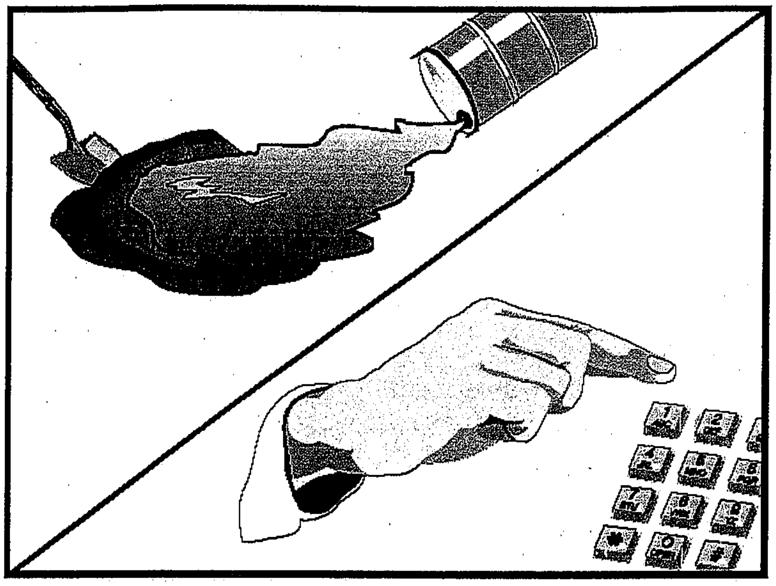
### Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation

- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.

### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



| Objectives | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:
☑ Primary Objective
☒ Secondary Objective

| Targeted Constituents | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

**Potential Alternatives**

None

## Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, WM-1, Materials Delivery and Storage, and WM-2, Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this section.

## Suitable Applications

This BMP is suitable for all construction projects. Spill control procedures are implemented anytime chemicals or hazardous substances are stored on the construction site, including the following materials:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals

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A002717

- Fuels
- Lubricants
- Other petroleum distillates

### Limitations

- In some cases it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite

### Implementation

The following steps will help reduce the stormwater impacts of leaks and spills:

#### *Education*

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.
- Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

#### *General Measures*

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater runon during rainfall to the extent that it doesn't compromise clean up activities.
- Do not bury or wash spills with water.

- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.
- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with WM-10, Liquid Waste Management.
- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.
- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.
- Keep waste storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

### *Cleanup*

- Clean up leaks and spills immediately.
- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

### *Minor Spills*

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Absorbent materials should be promptly removed and disposed of properly.
- Follow the practice below for a minor spill:
  - Contain the spread of the spill.
  - Recover spilled materials.
  - Clean the contaminated area and properly dispose of contaminated materials.

### *Semi-Significant Spills*

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.



A002719

- Spills should be cleaned up immediately:
  - Contain spread of the spill.
  - Notify the project foreman immediately.
  - If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  - If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  - If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

### *Significant/Hazardous Spills*

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
  - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  - Notify the Governor's Office of Emergency Services Warning Center, (916) 845-8911.
  - For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
  - Notification should first be made by telephone and followed up with a written report.
  - The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
  - Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

### *Reporting*

- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).

Use the following measures related to specific activities:

### *Vehicle and Equipment Maintenance*

- If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Regularly inspect onsite vehicles and equipment for leaks and repair immediately
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under paving equipment when not in use.
- Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

### *Vehicle and Equipment Fueling*

- If fueling must occur onsite, use designate areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Discourage "topping off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

## Costs

Prevention of leaks and spills is inexpensive. Treatment and/ or disposal of contaminated soil or water can be quite expensive.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.



A002721

- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Update your spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.

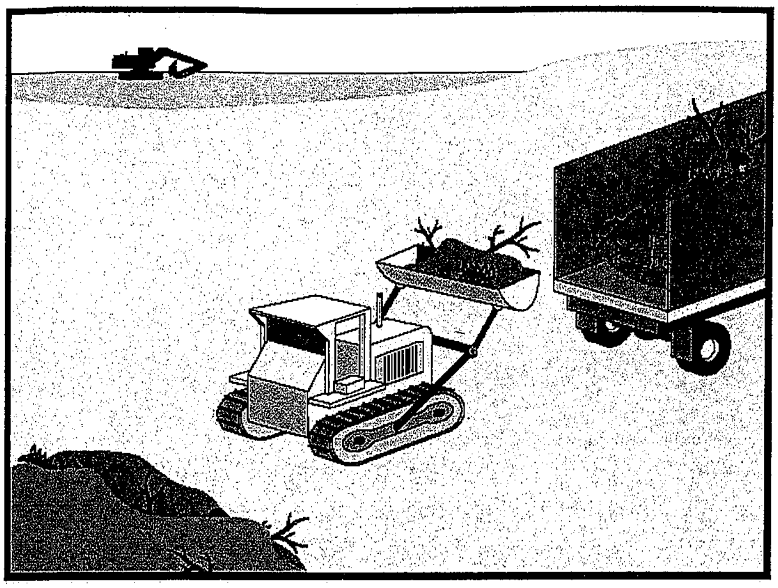
### References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Solid Waste Management WM-5



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

### Potential Alternatives

None

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## Description and Purpose

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

## Suitable Applications

This BMP is suitable for construction sites where the following wastes are generated or stored:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction
- Packaging materials including wood, paper, and plastic
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces and masonry products
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes
- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials



A002723

- Highway planting wastes, including vegetative material, plant containers, and packaging materials

## Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

## Implementation

The following steps will help keep a clean site and reduce stormwater pollution:

- Select designated waste collection areas onsite.
- Inform trash-hauling contractors that you will accept only watertight dumpsters for onsite use. Inspect dumpsters for leaks and repair any dumpster that is not watertight.
- Locate containers in a covered area or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it is windy.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Remove this solid waste promptly since erosion and sediment control devices tend to collect litter.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Arrange for regular waste collection before containers overflow.
- Clean up immediately if a container does spill.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.

### *Education*

- Have the contractor's superintendent or representative oversee and enforce proper solid waste management procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Educate employees and subcontractors on solid waste storage and disposal procedures.



A002724

- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Require that employees and subcontractors follow solid waste handling and storage procedures.
- Prohibit littering by employees, subcontractors, and visitors.
- Minimize production of solid waste materials wherever possible.

***Collection, Storage, and Disposal***

- Littering on the project site should be prohibited.
- To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.
- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.
- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project.
- Full dumpsters should be removed from the project site and the contents should be disposed of by the trash hauling contractor.
- Construction debris and waste should be removed from the site biweekly or more frequently as needed.
- Construction material visible to the public should be stored or stacked in an orderly manner.
- Stormwater runon should be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.
- Solid waste storage areas should be located at least 50 ft from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.
- Except during fair weather, construction and highway planting waste not stored in watertight dumpsters should be securely covered from wind and rain by covering the waste with tarps or plastic.
- Segregate potentially hazardous waste from non-hazardous construction site waste.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

### Costs

All of the above are low cost measures.

### Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur

- Inspect construction waste area regularly.

- Arrange for regular waste collection.

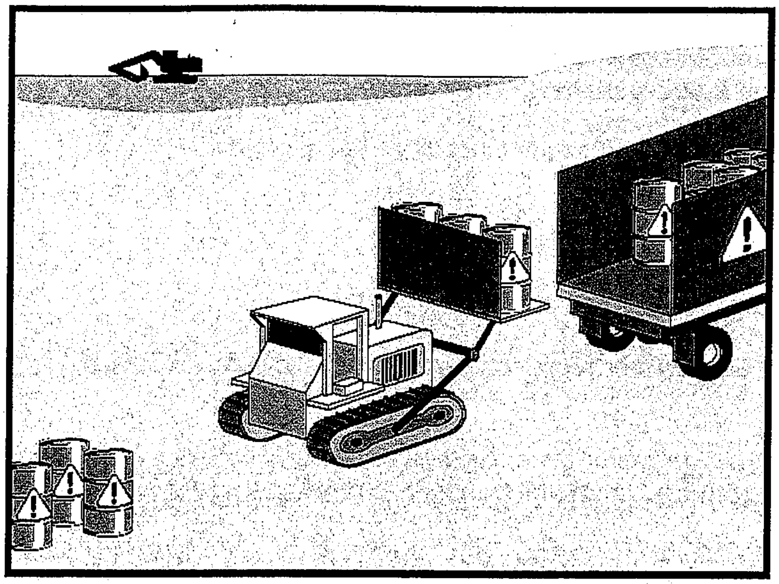
### References

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Hazardous Waste Management WM-6



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from hazardous waste through proper material use, waste disposal, and training of employees and subcontractors.

## Suitable Applications

This best management practice (BMP) applies to all construction projects. Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum Products
- Concrete Curing Compounds
- Palliatives
- Septic Wastes
- Stains
- Wood Preservatives
- Asphalt Products
- Pesticides
- Acids
- Paints
- Solvents
- Roofing Tar
- Any materials deemed a hazardous waste in California, Title 22 Division 4.5, or listed in 40 CFR Parts 110, 117, 261, or 302

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

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In addition, sites with existing structures may contain wastes, which must be disposed of in accordance with federal, state, and local regulations. These wastes include:

- Sandblasting grit mixed with lead-, cadmium-, or chromium-based paints
- Asbestos
- PCBs (particularly in older transformers)

## Limitations

- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Nothing in this BMP relieves the contractor from responsibility for compliance with federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.
- This BMP does not cover aerially deposited lead (ADL) soils. For ADL soils refer to WM-7, Contaminated Soil Management.

## Implementation

The following steps will help reduce stormwater pollution from hazardous wastes:

### *Material Use*

- Wastes should be stored in sealed containers constructed of a suitable material and should be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172, 173, 178, and 179.
- All hazardous waste should be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.
- Waste containers should be stored in temporary containment facilities that should comply with the following requirements:
  - Temporary containment facility should provide for a spill containment volume equal to 1.5 times the volume of all containers able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.
  - Temporary containment facility should be impervious to the materials stored there for a minimum contact time of 72 hours.
  - Temporary containment facilities should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be placed into drums after each rainfall. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids should be sent to an approved disposal site.
  - Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.



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- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Throughout the rainy season, temporary containment facilities should be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs.

- Drums should not be overfilled and wastes should not be mixed.
- Unless watertight, containers of dry waste should be stored on pallets.
- Do not over-apply herbicides and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over application is expensive and environmentally harmful. Apply surface dressings in several smaller applications, as opposed to one large application. Allow time for infiltration and avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains. People applying pesticides must be certified in accordance with federal and state regulations.
- Paint brushes and equipment for water and oil based paints should be cleaned within a contained area and should not be allowed to contaminate site soils, watercourses, or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused should be disposed of as hazardous waste. When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths should be disposed of as solid waste.
- Do not clean out brushes or rinse paint containers into the dirt, street, gutter, storm drain, or stream. "Paint out" brushes as much as possible. Rinse water-based paints to the sanitary sewer. Filter and reuse thinners and solvents. Dispose of excess oil-based paints and sludge as hazardous waste.
- The following actions should be taken with respect to temporary contaminant:
  - Ensure that adequate hazardous waste storage volume is available.
  - Ensure that hazardous waste collection containers are conveniently located.
  - Designate hazardous waste storage areas onsite away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.
  - Minimize production or generation of hazardous materials and hazardous waste on the job site.
  - Use containment berms in fueling and maintenance areas and where the potential for spills is high.
  - Segregate potentially hazardous waste from non-hazardous construction site debris.
  - Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.

- Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
- Place hazardous waste containers in secondary containment.
- Do not allow potentially hazardous waste materials to accumulate on the ground.
- Do not mix wastes.
- Use all of the product before disposing of the container.
- Do not remove the original product label; it contains important safety and disposal information.

### *Waste Recycling Disposal*

- Select designated hazardous waste collection areas onsite.
- Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
- Place hazardous waste containers in secondary containment.
- Do not mix wastes, this can cause chemical reactions, making recycling impossible and complicating disposal.
- Recycle any useful materials such as used oil or water-based paint.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Arrange for regular waste collection before containers overflow.
- Make sure that hazardous waste (e.g., excess oil-based paint and sludge) is collected, removed, and disposed of only at authorized disposal areas.

### *Disposal Procedures*

- Waste should be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
- A Department of Health Services certified laboratory should sample waste to determine the appropriate disposal facility.
- Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
- Attention is directed to "Hazardous Material", "Contaminated Material", and "Aerially Deposited Lead" of the contract documents regarding the handling and disposal of hazardous materials.

### *Education*

- Educate employees and subcontractors on hazardous waste storage and disposal procedures.
- Educate employees and subcontractors on potential dangers to humans and the environment from hazardous wastes.
- Instruct employees and subcontractors on safety procedures for common construction site hazardous wastes.
- Instruct employees and subcontractors in identification of hazardous and solid waste.
- Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).
- The contractor's superintendent or representative should oversee and enforce proper hazardous waste management procedures and practices.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Warning signs should be placed in areas recently treated with chemicals.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- If a container does spill, clean up immediately.

### Costs

All of the above are low cost measures.

### *Inspection and Maintenance*

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur
- Hazardous waste should be regularly collected.
- A foreman or construction supervisor should monitor onsite hazardous waste storage and disposal procedures.
- Waste storage areas should be kept clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.
- Hazardous spills should be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.

- The National Response Center, at (800) 424-8802, should be notified of spills of federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302. Also notify the Governors Office of Emergency Services Warning Center at (916) 845-8911.
- A copy of the hazardous waste manifests should be provided.

### References

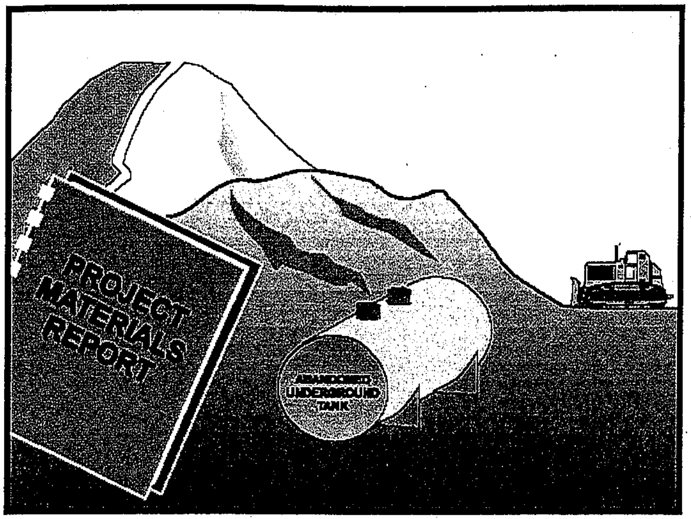
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Contaminated Soil Management WM-7




**Objectives**

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly.

## Suitable Applications

Contaminated soil management is implemented on construction projects in highly urbanized or industrial areas where soil contamination may have occurred due to spills, illicit discharges, aerial deposition, past use and leaks from underground storage tanks.

## Limitations

Contaminated soils that cannot be treated onsite must be disposed of offsite by a licensed hazardous waste hauler. The presence of contaminated soil may indicate contaminated water as well. See NS-2, Dewatering Operations, for more information.

The procedures and practices presented in this BMP are general. The contractor should identify appropriate practices and procedures for the specific contaminants known to exist or discovered onsite.

## Implementation

Most owners and developers conduct pre-construction environmental assessments as a matter of routine. Contaminated soils are often identified during project planning and development with known locations identified in the plans, specifications and in the SWPPP. The contractor should review applicable reports and investigate appropriate call-outs in the plans, specifications, and

**Targeted Constituents**

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |

**Potential Alternatives**

None

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SWPPP. Recent court rulings holding contractors liable for cleanup costs when they unknowingly move contaminated soil highlight the need for contractors to confirm a site assessment is completed before earth moving begins.

The following steps will help reduce stormwater pollution from contaminated soil:

- Conduct thorough, pre-construction inspections of the site and review documents related to the site. If inspection or reviews indicated presence of contaminated soils, develop a plan before starting work.
- Look for contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris.
- Prevent leaks and spills. Contaminated soil can be expensive to treat and dispose of properly. However, addressing the problem before construction is much less expensive than after the structures are in place.
- The contractor may further identify contaminated soils by investigating:
  - Past site uses and activities
  - Detected or undetected spills and leaks
  - Acid or alkaline solutions from exposed soil or rock formations high in acid or alkaline forming elements
  - Contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris.
  - Suspected soils should be tested at a certified laboratory.

### *Education*

- Have employees and subcontractors complete a safety training program which meets 29 CFR 1910.120 and 8 CCR 5192 covering the potential hazards as identified, prior to performing any excavation work at the locations containing material classified as hazardous.
- Educate employees and subcontractors in identification of contaminated soil and on contaminated soil handling and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

### *Handling Procedures for Material with Aerially Deposited Lead (ADL)*

- Materials from areas designated as containing (ADL) may, if allowed by the contract special provisions, be excavated, transported, and used in the construction of embankments and/or backfill.
- Excavation, transportation, and placement operations should result in no visible dust.
- Caution should be exercised to prevent spillage of lead containing material during transport.

- Quality should be monitored during excavation of soils contaminated with lead.

### *Handling Procedures for Contaminated Soils*

- Minimize onsite storage. Contaminated soil should be disposed of properly in accordance with all applicable regulations. All hazardous waste storage will comply with the requirements in Title 22, CCR, Sections 66265.250 to 66265.260.
- Test suspected soils at an approved certified laboratory.
- Work with the local regulatory agencies to develop options for treatment or disposal if the soil is contaminated.
- Avoid temporary stockpiling of contaminated soils or hazardous material.
- Take the following precautions if temporary stockpiling is necessary:
  - Cover the stockpile with plastic sheeting or tarps.
  - Install a berm around the stockpile to prevent runoff from leaving the area.
  - Do not stockpile in or near storm drains or watercourses.
- Remove contaminated material and hazardous material on exteriors of transport vehicles and place either into the current transport vehicle or into the excavation prior to the vehicle leaving the exclusion zone.
- Monitor the air quality continuously during excavation operations at all locations containing hazardous material.
- Procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work, including registration for transporting vehicles carrying the contaminated material and the hazardous material.
- Collect water from decontamination procedures and treat or dispose of it at an appropriate disposal site.
- Collect non-reusable protective equipment, once used by any personnel, and dispose of at an appropriate disposal site.
- Install temporary security fence to surround and secure the exclusion zone. Remove fencing when no longer needed.
- Excavate, transport, and dispose of contaminated material and hazardous material in accordance with the rules and regulations of the following agencies (the specifications of these agencies supersede the procedures outlined in this BMP):
  - United States Department of Transportation (USDOT)
  - United States Environmental Protection Agency (USEPA)
  - California Environmental Protection Agency (CAL-EPA)

- California Division of Occupation Safety and Health Administration (CAL-OSHA)
- Local regulatory agencies

***Procedures for Underground Storage Tank Removals***

- Prior to commencing tank removal operations, obtain the required underground storage tank removal permits and approval from the federal, state, and local agencies that have jurisdiction over such work.
- To determine if it contains hazardous substances, arrange to have tested, any liquid or sludge found in the underground tank prior to its removal.
- Following the tank removal, take soil samples beneath the excavated tank and perform analysis as required by the local agency representative(s).
- The underground storage tank, any liquid or sludge found within the tank, and all contaminated substances and hazardous substances removed during the tank removal and transported to disposal facilities permitted to accept such waste.

***Water Control***

- All necessary precautions and preventive measures should be taken to prevent the flow of water, including ground water, from mixing with hazardous substances or underground storage tank excavations. Such preventative measures may consist of, but are not limited to, berms, cofferdams, grout curtains, freeze walls, and seal course concrete or any combination thereof.
- If water does enter an excavation and becomes contaminated, such water, when necessary to proceed with the work, should be discharged to clean, closed top, watertight transportable holding tanks, treated, and disposed of in accordance with federal, state, and local laws.

## Costs

Prevention of leaks and spills is inexpensive. Treatment or disposal of contaminated soil can be quite expensive.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Arrange for contractor's Water Pollution Control Manager, foreman, and/or construction supervisor to monitor onsite contaminated soil storage and disposal procedures.
- Monitor air quality continuously during excavation operations at all locations containing hazardous material.
- Coordinate contaminated soils and hazardous substances/waste management with the appropriate federal, state, and local agencies.

- Implement WM-4, Spill Prevention and Control, to prevent leaks and spills as much as possible.

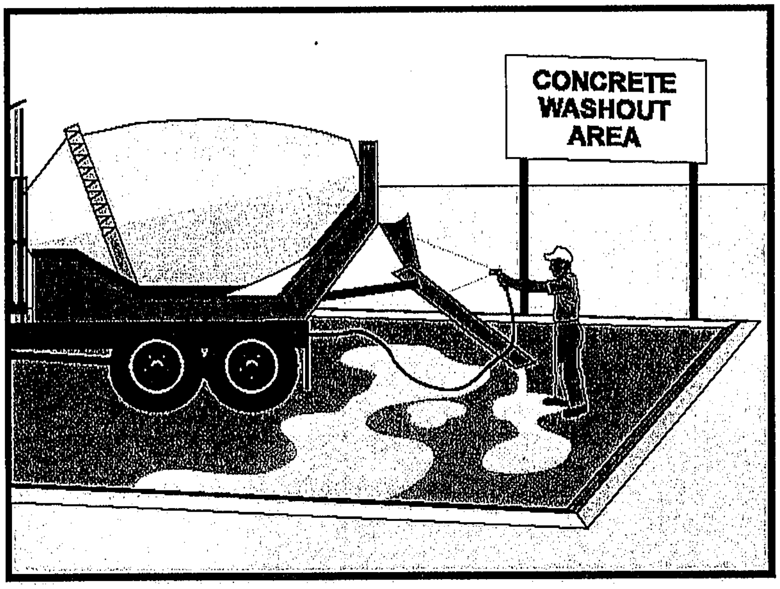
## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.




### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:

☑ Primary Objective

☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | |
| Organics | |

### Potential Alternatives

None

## Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from concrete waste by conducting washout offsite, performing onsite washout in a designated area, and training employee and subcontractors.

## Suitable Applications

Concrete waste management procedures and practices are implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result form demolition activities
- Slurries containing portland cement concrete (PCC) or asphalt concrete (AC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition
- Concrete trucks and other concrete-coated equipment are washed onsite
- Mortar-mixing stations exist
- See also NS-8, Vehicle and Equipment Cleaning

## Limitations

- Offsite washout of concrete wastes may not always be possible.

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**Implementation**

The following steps will help reduce stormwater pollution from concrete wastes:

- Discuss the concrete management techniques described in this BMP (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.
- Incorporate requirements for concrete waste management into material supplier and subcontractor agreements.
- Store dry and wet materials under cover, away from drainage areas.
- Avoid mixing excess amounts of fresh concrete.
- Perform washout of concrete trucks offsite or in designated areas only.
- Do not wash out concrete trucks into storm drains, open ditches, streets, or streams.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- For onsite washout:
  - Locate washout area at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste.
  - Wash out wastes into the temporary pit where the concrete can set, be broken up, and then disposed properly.
- Avoid creating runoff by draining water to a bermed or level area when washing concrete to remove fine particles and expose the aggregate.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.

***Education***

- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.
- Arrange for contractor's superintendent or representative to oversee and enforce concrete waste management procedures.

***Concrete Slurry Wastes***

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC waste should be collected and disposed of or placed in a temporary concrete washout facility.
- A sign should be installed adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.

- Below grade concrete washout facilities are typical. Above grade facilities are used if excavation is not practical.

- A foreman or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure proper methods are implemented.

- Saw-cut PCC slurry should not be allowed to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine. Saw cutting residue should not be allowed to flow across the pavement and should not be left on the surface of the pavement. See also NS-3, Paving and Grinding Operations; and WM-10, Liquid Waste Management.

- Slurry residue should be vacuumed and disposed in a temporary pit (as described in OnSite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allowed to dry. Dispose of dry slurry residue in accordance with WM-5, Solid Waste Management.

***Onsite Temporary Concrete Washout Facility, Transit Truck Washout Procedures***

- Temporary concrete washout facilities should be located a minimum of 50 ft from storm drain inlets, open drainage facilities, and watercourses. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.

- A sign should be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.

- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.

- Washout of concrete trucks should be performed in designated areas only.

- Only concrete from mixer truck chutes should be washed into concrete wash out.

- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of offsite.

- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per WM-5, Solid Waste Management. Dispose of hardened concrete on a regular basis.

- Temporary Concrete Washout Facility (Type Above Grade)

  - Temporary concrete washout facility (type above grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.

  - Straw bales, wood stakes, and sandbag materials should conform to the provisions in SE-9, Straw Bale Barrier.

  - Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

- Temporary Concrete Washout Facility (Type Below Grade)

  - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft. The quantity and volume should be sufficient to contain all liquid and concrete waste generated by washout operations.

  - Lath and flagging should be commercial type.

  - Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

***Removal of Temporary Concrete Washout Facilities***

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete should be removed and disposed of. Materials used to construct temporary concrete washout facilities should be removed from the site of the work and disposed of.

- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities should be backfilled and repaired.

## Costs

All of the above are low cost measures.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 in. for above grade facilities and 12 in. for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials should be removed and disposed of.

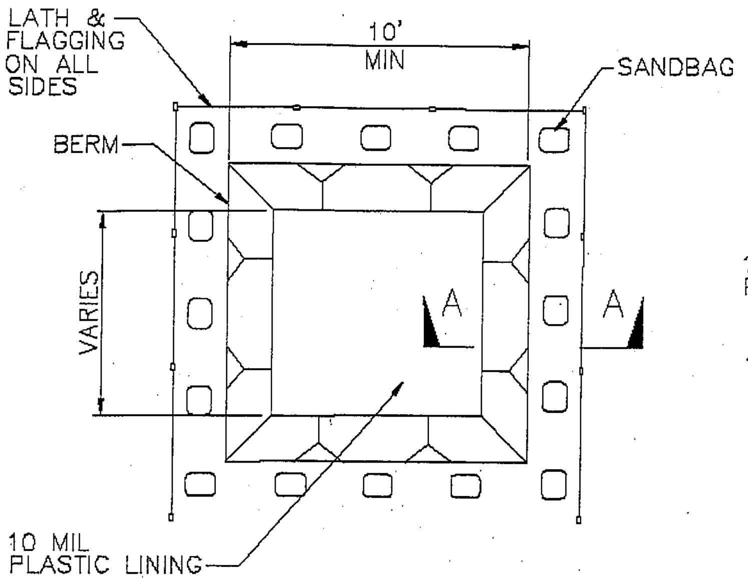
- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

## References

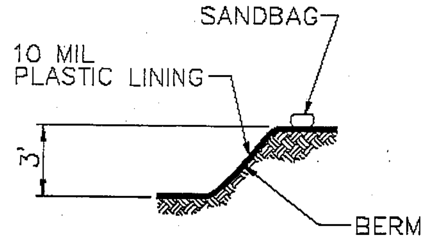
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

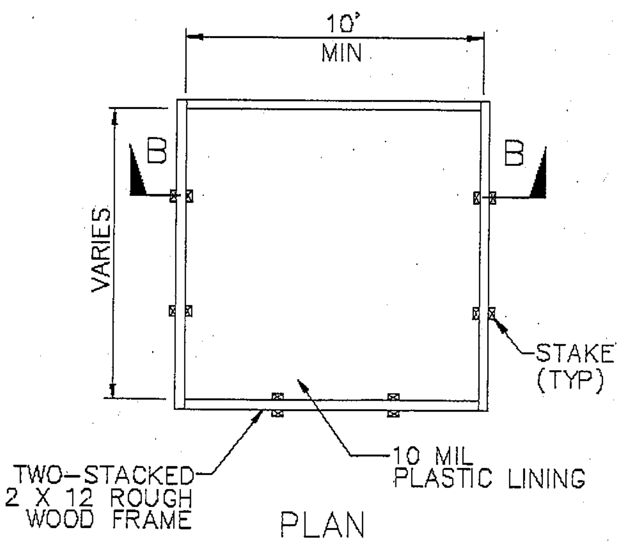
Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



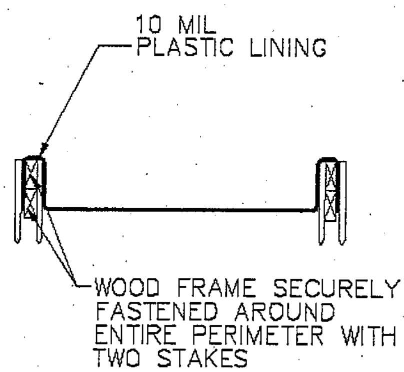

PLAN
NOT TO SCALE
TYPE "BELOW GRADE"




SECTION A–A
NOT TO SCALE



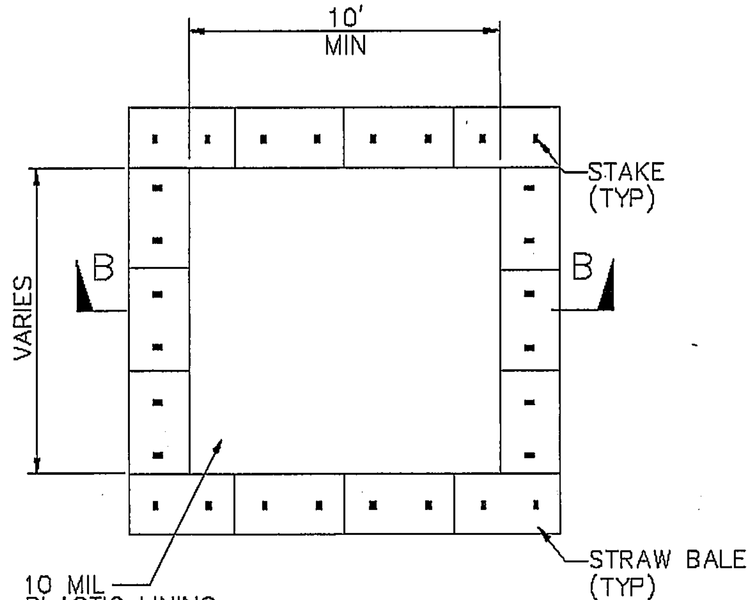

PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"



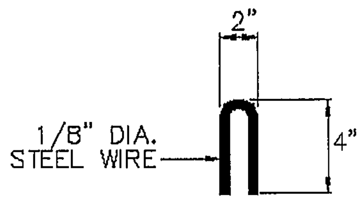

SECTION B–B
NOT TO SCALE

NOTES

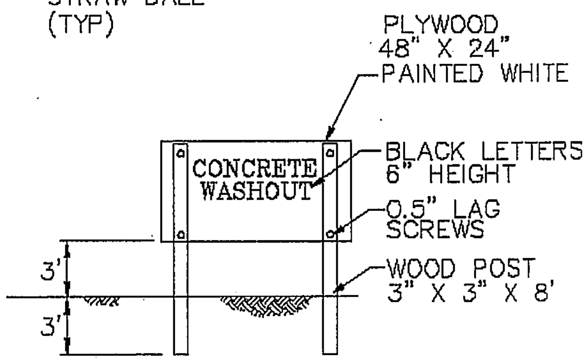
1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.



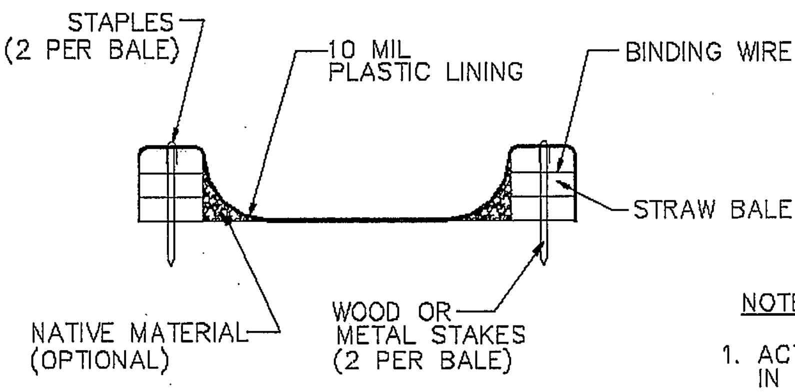

PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"
WITH STRAW BALES




STAPLE DETAIL




CONCRETE WASHOUT
SIGN DETAIL
(OR EQUIVALENT)

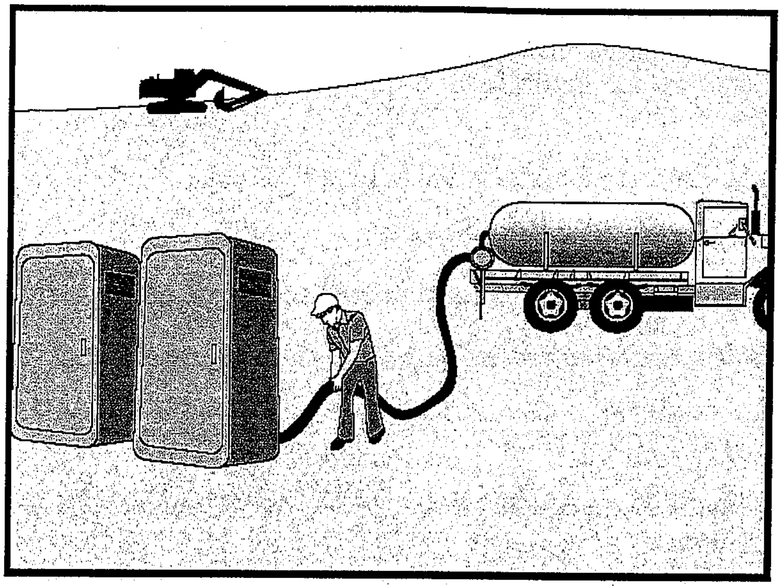



SECTION B–B
NOT TO SCALE

NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

# Sanitary/Septic Waste Management WM-9



**Objectives**

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:
☑ Primary Objective
☒ Secondary Objective

**Targeted Constituents**

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | |
| Bacteria | ☑ |
| Oil and Grease | |
| Organics | ☑ |

**Potential Alternatives**

None

## Description and Purpose

Proper sanitary and septic waste management prevent the discharge of pollutants to stormwater from sanitary and septic waste by providing convenient, well-maintained facilities, and arranging for regular service and disposal.

## Suitable Applications

Sanitary septic waste management practices are suitable for use at all construction sites that use temporary or portable sanitary and septic waste systems.

## Limitations

None identified.

## Implementation

Sanitary or septic wastes should be treated or disposed of in accordance with state and local requirements. In many cases, one contract with a local facility supplier will be all that it takes to make sure sanitary wastes are properly disposed.

### *Storage and Disposal Procedures*

- Temporary sanitary facilities should be located away from drainage facilities, watercourses, and from traffic circulation. When subjected to high winds or risk of high winds, temporary sanitary facilities should be secured to prevent overturning.
- Wastewater should not be discharged or buried within the project site.

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- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, should comply with the local health agency, city, county, and sewer district requirements.
- Only reputable, licensed sanitary and septic waste haulers should be used.
- Sanitary facilities should be located in a convenient location.
- Untreated raw wastewater should never be discharged or buried.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- If using an onsite disposal system (OSDS), such as a septic system, local health agency requirements must be followed.
- Temporary sanitary facilities that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- Sanitary and septic facilities should be maintained in good working order by a licensed service.
- Regular waste collection by a licensed hauler should be arranged before facilities overflow.

### *Education*

- Educate employees, subcontractors, and suppliers on sanitary and septic waste storage and disposal procedures.
- Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary and septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary and septic waste.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.

## Costs

All of the above are low cost measures.

## Inspection and Maintenance

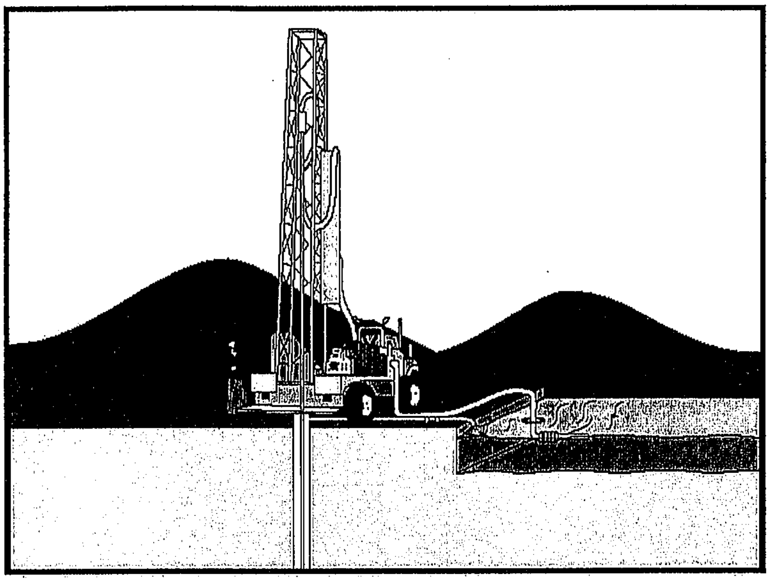
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Arrange for regular waste collection.
- If high winds are expected, portable sanitary facilities must be secured with spikes or weighed down to prevent over turning.

## References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Liquid Waste Management **WM-10**



### Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

Legend:
☑ Primary Objective
☒ Secondary Objective

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

### Potential Alternatives

None

## Description and Purpose

Liquid waste management includes procedures and practices to prevent discharge of pollutants to the storm drain system or to watercourses as a result of the creation, collection, and disposal of non-hazardous liquid wastes.

## Suitable Applications

Liquid waste management is applicable to construction projects that generate any of the following non-hazardous by-products, residuals, or wastes:

- Drilling slurries and drilling fluids
- Grease-free and oil-free wastewater and rinse water
- Dredgings
- Other non-stormwater liquid discharges not permitted by separate permits

## Limitations

- Disposal of some liquid wastes may be subject to specific laws and regulations or to requirements of other permits secured for the construction project (e.g., NPDES permits, Army Corps permits, Coastal Commission permits, etc.).
- Liquid waste management does not apply to dewatering operations (NS-2 Dewatering Operations), solid waste management (WM-5, Solid Waste Management), hazardous

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wastes (WM-6, Hazardous Waste Management), or concrete slurry residue (WM-8, Concrete Waste Management).

- Typical permitted non-stormwater discharges can include: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; uncontaminated pumped ground water; discharges from potable water sources; foundation drains; irrigation water; springs; water from crawl space pumps; footing drains; lawn watering; flows from riparian habitats and wetlands; and discharges or flows from emergency fire fighting activities.

## Implementation

### *General Practices*

- Instruct employees and subcontractors how to safely differentiate between non-hazardous liquid waste and potential or known hazardous liquid waste.

- Instruct employees, subcontractors, and suppliers that it is unacceptable for any liquid waste to enter any storm drainage device, waterway, or receiving water.

- Educate employees and subcontractors on liquid waste generating activities and liquid waste storage and disposal procedures.

- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

- Verify which non-stormwater discharges are permitted by the statewide NPDES permit; different regions might have different requirements not outlined in this permit.

- Apply NS-8, Vehicle and Equipment Cleaning for managing wash water and rinse water from vehicle and equipment cleaning operations.

### *Containing Liquid Wastes*

- Drilling residue and drilling fluids should not be allowed to enter storm drains and watercourses and should be disposed of.

- If an appropriate location is available, drilling residue and drilling fluids that are exempt under Title 23, CCR § 2511(g) may be dried by infiltration and evaporation in a containment facility constructed in conformance with the provisions concerning the Temporary Concrete Washout Facilities detailed in WM-8, Concrete Waste Management.

- Liquid wastes generated as part of an operational procedure, such as water-laden dredged material and drilling mud, should be contained and not allowed to flow into drainage channels or receiving waters prior to treatment.

- Liquid wastes should be contained in a controlled area such as a holding pit, sediment basin, roll-off bin, or portable tank.

- Containment devices must be structurally sound and leak free.

- Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated.

- Precautions should be taken to avoid spills or accidental releases of contained liquid wastes. Apply the education measures and spill response procedures outlined in WM-4, Spill Prevention and Control.

- Containment areas or devices should not be located where accidental release of the contained liquid can threaten health or safety or discharge to water bodies, channels, or storm drains.

### *Capturing Liquid Wastes*

- Capture all liquid wastes that have the potential to affect the storm drainage system (such as wash water and rinse water from cleaning walls or pavement), before they run off a surface.

- Do not allow liquid wastes to flow or discharge uncontrolled. Use temporary dikes or berms to intercept flows and direct them to a containment area or device for capture.

- Use a sediment trap (SE-3, Sediment Trap) for capturing and treating sediment laden liquid waste or capture in a containment device and allow sediment to settle.

### *Disposing of Liquid Wastes*

- A typical method to handle liquid waste is to dewater the contained liquid waste, using procedures such as described in NS-2, Dewatering Operations, and SE-2, Sediment Basin, and dispose of resulting solids per WM-5, Solid Waste Management.

- Methods of disposal for some liquid wastes may be prescribed in Water Quality Reports, NPDES permits, Environmental Impact Reports, 401 or 404 permits, and local agency discharge permits, etc. Review the SWPPP to see if disposal methods are identified.

- Liquid wastes, such as from dredged material, may require testing and certification whether it is hazardous or not before a disposal method can be determined.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management.

- If necessary, further treat liquid wastes prior to disposal. Treatment may include, though is not limited to, sedimentation, filtration, and chemical neutralization.

## Costs

Prevention costs for liquid waste management are minimal. Costs increase if cleanup or fines are involved.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Remove deposited solids in containment areas and capturing devices as needed and at the completion of the task. Dispose of any solids as described in WM-5, Solid Waste Management.
- Inspect containment areas and capturing devices and repair as needed.

### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Section 5
# Glossary and List of Acronyms
## 5.1 Glossary

***303(d) Listed:*** Water bodies listed as impaired as per Section 303(d) of the 1972 Clean Water Act.

***Best Management Practices (BMPs):*** Includes schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent, eliminate, or reduce the pollution of waters of the receiving waters. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

***Catch Basin (Also known as Inlet):*** Box-like underground concrete structure with openings in curbs and gutters designed to collect runoff from streets and pavement.

***Clean Water Act (CWA):*** (33 U.S.C. 1251 et seq.) requirements of the NPDES program are defined under Sections 307, 402, 318 and 405 of the CWA.

***Construction Activity:*** Includes clearing, grading, excavation, and contractor activities that result in soil disturbance.

***Construction General Permit:*** A National Pollutant Discharge Elimination System (NPDES) permit issued by the State Water Resources Control Board for the discharge of stormwater associated with construction activity from soil disturbance of five acres or more. Threshold lowered to one acre beginning October 10, 2003. Construction General Permit No. CAS000002.

***Denuded:*** Land stripped of vegetation or land that has had its vegetation worn down due to the impacts from the elements or humans.

***Detention:*** The capture and subsequent release of stormwater runoff from the site at a slower rate than it is collected, the difference being held in temporary storage.

***Discharge:*** A release or flow of stormwater or other substance from a conveyance system or storage container. Broader – includes release to storm drains, etc.

***Effluent Limits:*** Limitations on amounts of pollutants that may be contained in a discharge. Can be expressed in a number of ways including as a concentration, as a concentration over a time period (e.g., 30-day average must be less than 20 mg/l), or as a total mass per time unit, or as a narrative limit.

***Erosion:*** The wearing away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, new development, redevelopment, road building, or timber cutting.

***Facility:*** Is a collection of industrial processes discharging stormwater associated with industrial activity within the property boundary or operational unit.

***Grading:*** The cutting or filling of the land surface to a desired slope or elevation.

***Hazardous Waste:*** A waste or combination of wastes that, because of its quantity, concentration, or physical, chemical or infectious characteristics, may either cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity) or appears on special EPA or state lists. Regulated under the federal Resource Conservation and Recovery Act and the California Health and Safety Code.

***Illicit Discharges:*** Any discharge to a municipal separate storm sewer that is not in compliance with applicable laws and regulations as discussed in this document.

***Industrial General Permit:*** A National Pollutant Discharge Elimination System (NPDES) Permit (No. CAS000001) issued by the State Water Resources Control Board for discharge of stormwater associated with industrial activity. Board Order 97-03-DWQ.

***Inlet:*** An entrance into a ditch, storm drain, or other waterway.

***Integrated Pest Management (IPM):*** An ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism.

***Municipal Separate Storm Sewer System (MS4):*** A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) designed or used for collecting or conveying storm water; (ii) which is not a combined sewer; and (iii) which is not part of a Publicly Owned Treatment Works (POTW) as defined at Title 40 of the Code of Federal Regulations (CFR) 122.2. A "Small MS4" is defined as an MS4 that is not a permitted MS4 under the Phase I regulations. This definition of a Small MS4 applies to MS4 operated within cities and counties as well as governmental facilities that have a system of storm sewers.

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

***Nonpoint Source Pollution:*** Pollution that does not come from a point source. Nonpoint source pollution originates from aerial diffuse sources that are mostly related to land use.

***Notice of Intent (NOI):*** A formal notice to SWRCB submitted by the owner of an industrial site or construction site that said owner seeks coverage under a General Permit for discharges associated with industrial and construction activities. The NOI provides information on the

owner, location, type of project, and certifies that the owner will comply with the conditions of the construction General Permit.

***Notice of Termination (NOT):*** Formal notice to SWRCB submitted by owner/ developer that a construction project is complete.

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

***Outfall:*** The end point where storm drains discharge water into a waterway.

***Point Source:*** Any discernible, confined, and discrete conveyance from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff.

***Pollutant:*** Generally, any substance introduced into the environment that adversely affects the usefulness of a resource.

***Pollution Prevention (P2):*** Practices and actions that reduce or eliminate the generation of pollutants.

***Precipitation:*** Any form of rain or snow.

***Pretreatment:*** Treatment of waste stream before it is discharged to a collection system.

***Reclaim (water reclamation):*** Planned use of treated effluent that would otherwise be discharged without being put to direct use.

***Retention:*** The storage of stormwater to prevent it from leaving the development site.

***Reuse (water reuse):*** (see Reclaim)

***Runoff:*** Water originating from rainfall, melted snow, and other sources (e.g., sprinkler irrigation) that flows over the land surface to drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands.

***Run-on:*** Off site stormwater surface flow or other surface flow which enters your site.

***Scour:*** The erosive and digging action in a watercourse caused by flowing water.

***Secondary Containment:*** Structures, usually dikes or berms, surrounding tanks or other storage containers, designed to catch spilled materials from the storage containers.

***Sedimentation:*** The process of depositing soil particles, clays, sands, or other sediments that were picked up by runoff.

***Sediments:*** Soil, sand, and minerals washed from land into water, usually after rain, that collect in reservoirs, rivers, and harbors, destroying fish nesting areas and clouding the water, thus preventing sunlight from reaching aquatic plants. Farming, mining, and building activities without proper implementation of BMPs will expose sediment materials, allowing them to be washed off the land after rainfalls.

***Significant Materials:*** Includes, but not limited to, raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designed under Section 101(14) of CERLCA; any chemical the facility is required to report pursuant to Section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with stormwater discharges.

***Significant Quantities:*** The volume, concentrations, or mass of a pollutant in stormwater discharge that can cause or threaten to cause pollution, contamination, or nuisance that adversely impact human health or the environment and cause or contribute to a violation of any applicable water quality standards for receiving water.

***Source Control BMPs:*** Operational practices that reduce potential pollutants at the source.

***Source Reduction (also source control):*** The technique of stopping and/ or reducing pollutants at their point of generation so that they do not come into contact with stormwater.

***Storm Drains:*** Above- and below-ground structures for transporting stormwater to streams or outfalls for flood control purposes.

***Stormwater:*** Defined as urban runoff and snowmelt runoff consisting only of those discharges, which originate from precipitation events. Stormwater is that portion of precipitation that flows across a surface to the storm drain system or receiving waters.

***Stormwater Discharge Associated with Industrial Activity:*** Discharge from any conveyance which is used for collecting and conveying stormwater from an area that is directly related to manufacturing, processing, or raw materials storage activities at an industrial plant.

***Stormwater Pollution Control Plan (SWPCP):*** A less formal plan than the SWPPP that addresses the implementation of BMPs at facilities/businesses not covered by a general permit but that have the potential to discharge pollutants.

***Stormwater Pollution Prevention Plan (SWPPP):*** A written plan that documents the series of phases and activities that, first, characterizes your site, and then prompts you to select and carry out actions which prevent the pollution of stormwater discharges.

***Treatment Control BMPs:*** Treatment methods to remove pollutants from stormwater.

***Toxicity:*** Adverse responses of organisms to chemicals or physical agents ranging from mortality to physiological responses such as impaired reproduction or growth anomalies.

***Turbidity:*** Describes the ability of light to pass through water. The cloudy appearance of water caused by suspended and colloidal matter (particles).

## 5.2 Acronyms

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| AC | Asphalt Concrete |
| ADL | Aerially Deposited Lead |
| AIMP | Impervious Area |
| AINF | Infiltration Area |
| ANSI | American National Standards Institute |
| APHA | American Public Health Association |
| APWA | American Public Works Association |
| ARS | Agricultural Research Service |
| AQMD | Air Quality Management District |
| ASTM | American Society for Testing Materials |
| AWWA | American Water Works Association |
| BAT | Best Available Technology (economically available) |
| BCT | Best Conventional Technology (pollution control) |
| BFP | Bonded Fiber Matrix |
| BMPs | Best Management Practices |
| BOD | Biological Oxygen Demand |
| CA | Contractor Activities |
| CAL-EPA | California Environmental Protection Agency |
| CAL-OSHA | California Division of Occupational Safety and Health Administration |
| CASQA | California Stormwater Quality Association |
| CCR | California Code of Regulations |

| | |
|---|---|
| CCS | Cellular Confinement System |
| CEQA | California Environmental Quality Act |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| CFR | Code of Federal Register |
| CMA | Congestion Management Program |
| COE | U.S. Army Corps of Engineers |
| CPI | Coalescing Plate Interceptor |
| CWA | Clean Water Act (Federal Water Pollution Control Act of 1972 as amended in 1987) |
| DCIA | Directly Connected Impervious Area |
| DTSC | California Department of Toxic Substances Control |
| EEC | Effect Effluent Concentration |
| EIR | Environmental Impact Report |
| EMC | Event Mean Concentration |
| EOS | Equivalent Opening Size |
| ESA | Environmentally Sensitive Area |
| ESC | Erosion and Sedimentation Control |
| FEMA | Federal Emergency Management Agency |
| FHWA | Federal Highway Administration |
| GIS | Geographical Information System |
| Hazmat | Hazardous Material |
| HSG | Hydrologic Soil Groups |
| IPM | Integrated Pest Management |
| JURMP | Jurisdictional Urban Runoff Management Program |
| MEP | Maximum Extent Practicable |

| | |
|---|---|
| MS4 | Municipal Separate Storm Sewer System |
| MSDS | Material Safety Data Sheet |
| MSHA | Mine Safety and Health Administration |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanographic and Atmospheric Administration |
| NOI | Notice of Intent |
| NPDES | National Pollution Discharge Elimination System |
| NPS | Nonpoint Source |
| NRC | National Response Center |
| NRCS | Natural Resources Conservation Service |
| NSF | National Science Foundation |
| NURP | National Urban Runoff Program |
| O&G | Oil and Grease |
| O&M | Operations and Maintenance |
| OSDS | On-site Disposal System |
| OSHA | Occupational Safety and Health Administration |
| P2 | Pollution Prevention |
| PAHs | Polyaromatic Hydrocarbons |
| PAM | Polyacrylamide |
| PCBs | Polychlorinated Biphenyls |
| PCC | Portland Concrete Cement |
| PPT | Pollution Prevention Team |
| POTW | Publicly Owned Treatment Works |
| PSD | Particle Size Distribution |
| RCRA | Resource Conservation and Recovery Act |

| | |
|---|---|
| RWQCB | Regional Water Quality Control Board |
| SAP | Sampling and Analysis Plan |
| SARA | Superfund Amendments and Reauthorization Act |
| SIC | Standard Industrial Classification |
| SPCC | Spill Prevention Control and Countermeasure |
| SUSMP | Standard Urban Stormwater Mitigation Plan |
| SWMP | Stormwater Management Program |
| SWPCP | Stormwater Pollution Control Plan |
| SWPPP | Stormwater Pollution Prevention Plan |
| SWRCB | State Water Resource Control Board |
| TMDL | Total Maximum Daily Load |
| TOC | Total Organic Carbon |
| TSS | Total Suspended Solids |
| UFC | Uniform Fire Code |
| USACE | United States Army Corps of Engineers |
| USDA | United States Department of Agriculture |
| USDOT | United States Department of Transportation |
| USEPA | United States Environmental Protection Agency |
| WEF | Water Environment Federation |

# Appendix A
# General Permit

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Winston H. Hickox
*Secretary for Environmental Protection*

# State Water Resources Control Board

**Division of Water Quality**
1001 I Street • Sacramento, California 95814 • (916) 341-5537
Mailing Address: P.O. Box 1977 • Sacramento, California • 95812-1977
FAX (916) 341-5543 • Internet Address: http://www.swrcb.ca.gov

**Gray Davis**
*Governor*

To: CONSTRUCTION STORM WATER DISCHARGER

SUBJECT: CHECKLIST FOR SUBMITTING A NOTICE OF INTENT

In order for the State Water Resources Control Board to expeditiously process your Notice of Intent (NOI), the following items must be submitted to either of the addresses indicated below:

1._______ NOI (please keep a copy for your files) with all applicable sections completed and original signature of the landowner or signatory agent;

2._______ Check made out to the "State Water Resources Control Board" for $700.00; and

3. _______ Site Map of the facility (see NOI instructions). DO NOT SEND BLUEPRINTS

**U.S. Postal Service Address**

State Water Resources Control Board
Division of Water Quality
Attn: Storm Water Section
P.O. Box 1977
Sacramento, CA 95812-1977

**Overnight Mailing Address**

State Water Resources Control Board
Division Of Water Quality
Attn: Storm Water, 15th Floor
1001 I Street
Sacramento, CA 95814

NOIs are processed in the order they are received. A NOI receipt letter will be mailed to the land owner within approximately two weeks. Incomplete NOI submittals will be returned to the landowner's address within the same timeframe and will specify the reason(s) for return. If you need a receipt letter by a specific date (for example, to provide to a local agency), we advise that you submit your NOI thirty (30) days prior to the date the receipt letter is needed.

Please do not call us to verify your NOI status. A copy of your NOI receipt letter will be available on our web page within twenty-four (24) hours of processing. Go to: http://esmr.swrcb.ca.gov/dwq/ConReceiptLetter.asp to retrieve an electronic copy of your NOI receipt letter. If you have any questions regarding this matter, please contact us at (916) 341-5537.

FACT SHEET
FOR
WATER QUALITY ORDER 99-08-DWQ

STATE WATER RESOURCES CONTROL BOARD (SWRCB)
901 P STREET, SACRAMENTO, CALIFORNIA 95814

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT FOR
STORM WATER DISCHARGES ASSOCIATED WITH
CONSTRUCTION ACTIVITY (GENERAL PERMIT)

## BACKGROUND

In 1972, the Federal Water Pollution Control Act (also referred to as the Clean Water Act [CWA]) was amended to provide that the discharge of pollutants to waters of the United States from any point source is unlawful unless the discharge is in compliance with an NPDES permit. The 1987 amendments to the CWA added Section 402(p) which establishes a framework for regulating municipal and industrial storm water discharges under the NPDES Program. On November 16, 1990, the U.S. Environmental Protection Agency (USEPA) published final regulations that establish storm water permit application requirements for specified categories of industries. The regulations provide that discharges of storm water to waters of the United States from construction projects that encompass five (5) or more acres of soil disturbance are effectively prohibited unless the discharge is in compliance with an NPDES Permit. Regulations (Phase II Rule) that became final on December 8, 1999 expand the existing NPDES program to address storm water discharges from construction sites that disturb land equal to or greater than one (1) acre and less than five (5) acres (small construction activity). The regulations require that small construction activity, other than those regulated under an individual or Regional Water Quality Control Board General Permit, must be permitted no later than March 10, 2003.

While federal regulations allow two permitting options for storm water discharges (individual permits and General Permits), the SWRCB has elected to adopt only one statewide General Permit at this time that will apply to all storm water discharges associated with construction activity, except from those on Tribal Lands, in the Lake Tahoe Hydrologic Unit, and those performed by the California Department of Transportation (Caltrans). Construction on Tribal Lands is regulated by an USEPA permit, the Lahontan Regional Water Control Board adopted a separate NPDES permit for the Lake Tahoe Hydrologic Unit, and the SWRCB adopted a separate NPDES permit for Caltrans projects. This General Permit requires all dischargers where construction activity disturbs one acre or more, to:

1. Develop and implement a Storm Water Pollution Prevention Plan (SWPPP) which specifies Best Management Practices (BMPs) that will prevent all construction pollutants from contacting storm water and with the intent of keeping all products of erosion from moving off site into receiving waters.

2. Eliminate or reduce nonstorm water discharges to storm sewer systems and other waters of the nation.

3. Perform inspections of all BMPs.

This General Permit shall be implemented and enforced by the nine California Regional Water Quality Control Boards (RWQCBs).

The General Permit accompanying this fact sheet regulates storm water runoff from construction sites. Regulating many storm water discharges under one permit will greatly reduce the otherwise overwhelming administrative burden associated with permitting individual storm water discharges. Dischargers shall submit a Notice of Intent (NOI) to obtain coverage under this General Permit. It is expected that as the storm water program develops, the RWQCBs may issue General Permits or individual permits containing more specific permit provisions. When this occurs, those dischargers will no longer be regulated by this General Permit.

On August 19, 1999, the State Water Resources Control Board (SWRCB) reissued the General Construction Storm Water Permit (Water Quality Order 99-08-DWQ referred to as "General Permit"). The San Francisco BayKeeper, Santa Monica BayKeeper, San Diego BayKeeper, and Orange Coast Keeper filed a petition for writ of mandate challenging the General Permit in the Superior Court, County of Sacramento. The Court issued a judgment and writ of mandate on September 15, 2000. The Court directed the SWRCB to modify the provisions of the General Permit to require permittees to implement specific sampling and analytical procedures to determine whether Best Management Practices (BMPs) implemented on a construction site are: (1) preventing further impairment by sediment in storm waters discharged directly into waters listed as impaired for sediment or silt, and (2 ) preventing other pollutants, that are known or should be known by permittees to occur on construction sites and that are not visually detectable in storm water discharges, from causing or contributing to exceedances of water quality objectives. The monitoring provisions in the General Permit have been modified pursuant to the court order.

TYPES OF CONSTRUCTION ACTIVITY COVERED BY THIS GENERAL PERMIT

Construction activity subject to this General Permit includes clearing, grading, disturbances to the ground such as stockpiling, or excavation that results in soil disturbances of at least one acre of total land area. Construction activity that results in soil disturbances of less than one acre is subject to this General Permit if the construction activity is part of a larger common plan of development that encompasses one or more acres of soil disturbance or if there is significant water quality impairment resulting from the activity. Construction activity does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility, nor does it include emergency construction activities required to protect public health and safety. Dischargers should confirm with the local RWQCB whether or not a particular routine maintenance activity is subject to this General Permit.

A construction project which includes a dredge and/or fill discharge to any jurisdictional surface water (e.g., wetland, channel, pond, or marine water) will also need a CWA Section 404 permit from the U.S. Army Corps of Engineers and a CWA Section 401 Water Quality Certification from the RWQCB/SWRCB. Storm water discharges from dredge spoil placement which occurs outside of Corps jurisdiction (upland sites) and are part of construction activity which disturbs one or more acres of land are covered by this general permit. Proponents of construction projects which disturb one or more acres of land within the jurisdictional boundaries of a CWA Section 404 permit should contact the local RWQCB to determine the applicability of this permit to the project.

NOTIFICATION REQUIREMENTS

It is the responsibility of the landowner to obtain coverage under this General Permit prior to commencement of construction activities. To obtain coverage, the landowner must file an NOI with a vicinity map and the appropriate fee with the SWRCB. In addition, coverage under this permit shall not occur until the applicant develops an adequate SWPPP for the project. Section A of the General Permit outlines the required contents of a SWPPP. For proposed construction activity on easements or on nearby property by agreement or permission, the entity responsible for the construction activity shall file an NOI and filing fee and shall be responsible for development of the SWPPP, all of which must occur prior to commencement of construction activities.

A separate NOI shall be submitted to the SWRCB for each construction site. Owners of new construction shall file an NOI prior to the commencement of construction. Owners of an ongoing construction site that is covered under the previous General Construction Permit (WQ Order No.92-08-DWQ) (1) shall continue to implement their existing SWPPP and monitoring program and (2) shall implement any necessary revisions to their SWPPP in a timely manner but in no case later than 90-calender days from adoption of this General Permit in accordance with Section A of this General Permit.

The NOI requirements of the General Permit are intended to establish a mechanism which can be used to clearly identify the responsible parties, locations, and scope of operations of dischargers covered by the General Permit and to document the discharger's knowledge of the requirements for a SWPPP.

The NOI must be sent to the following address:

State Water Resources Control Board
Division of Water Quality
Storm Water Permit Unit
P.O. Box 1977
Sacramento, CA 95812-1977

The current annual fee for this General Permit is $700.

When construction is complete or ownership has been transferred, dischargers shall file a Notice of Termination with the RWQCB certifying that all State and local requirements have been met in accordance with Special Provisions for Construction Activity, C.7, of the General Permit.

Dischargers who fail to obtain coverage under this General Permit for storm water discharges to surface waters will be in violation of the CWA and the California Water Code.

## CONSTRUCTION ACTIVITY NOT COVERED BY THIS GENERAL PERMIT

This General Permit does not apply to storm water discharges from (1) those areas on Tribal Lands; (2) the Lake Tahoe Hydrologic Unit; (3) construction under one acre, unless part of a larger common plan of development or sale; (4) projects covered by an individual NPDES Permit for storm water discharges associated with construction activity; and (5) landfill construction that is subject to the general industrial permit.

Storm water discharges in the Lake Tahoe Hydrologic Unit are regulated by a separate permit(s) adopted by the California Regional Water Quality Control Board, Lahontan Region (LRWQCB). USEPA regulates storm water discharges on Tribal Lands. Permit applications for storm water discharges that will be conducted in the Lake Tahoe Hydrologic Unit must be submitted directly to the LRWQCB.

## DESCRIPTION OF GENERAL PERMIT CONDITIONS

The following is a brief description of the major provisions of the General Permit and the basis for the General Permit.

### Prohibitions

This General Permit authorizes the discharge of storm water to surface waters from construction activities that result in the disturbance of one or more acres of land. It prohibits the discharge of materials other than storm water and authorized non-storm water discharges and all discharges which contain a hazardous substance in excess of reportable quantities established at 40 Code of Federal Regulations (CFR) 117.3 or 40 CFR 302.4 unless a separate NPDES Permit has been issued to regulate those discharges. In addition, this General Permit contains provisions that uphold discharge prohibitions contained in water quality control plans, as implemented through the nine RWQCBs.

### Effluent Limitations

Permits for storm water discharges associated with construction activity shall meet all applicable provisions of Sections 301 and 402 of the CWA. These provisions require controls of pollutant discharges that utilize best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT) to reduce pollutants and any more stringent controls necessary to meet water quality standards.

It is not feasible at this time for the SWRCB to establish numeric effluent limitations. The reasons why it is not feasible to establish numeric effluent limitations are discussed in detail in SWRCB Order Nos. WQ 91-03 and WQ 91-04. Therefore, the effluent limitations contained in this General Permit are narrative and include the requirement to implement appropriate BMPs. The BMPs shall primarily emphasize source controls such as erosion control and pollution prevention methods. The discharger shall also install structural controls, as necessary, such as sediment control which will constitute BAT and BCT and will achieve compliance with water quality standards. The narrative effluent limitations constitute compliance with the requirements of the CWA.

Elimination or reduction of nonstorm water discharges is a major goal of this General Permit. Nonstorm water discharges include a wide variety of sources, including improper dumping, spills, or leakage from storage tanks or transfer areas. Nonstorm water discharges may contribute a significant pollutant load to receiving waters. Measures to control spills, leakage, and dumping and to prevent illicit connections during construction shall be addressed through structural as well as non-structural BMPs.

This General Permit prohibits the discharge of materials other than storm water and authorized nonstorm water discharges. It is recognized that certain nonstorm water discharges may be necessary for the completion of construction projects. Such discharges include, but are not limited to irrigation of vegetative erosion control measures, pipe flushing and testing, street cleaning, and dewatering. Such discharges are allowed by this General Permit provided they are not relied upon to clean up failed or inadequate construction or post-construction BMPs designed to keep materials onsite. These authorized nonstorm water discharges shall (1) be infeasible to eliminate, (2) comply with BMPs as described in the SWPPP, and (3) not cause or contribute to a violation of water quality standards. Additionally, these discharges may be required to be permitted by the local RWQCB (e.g., some RWQCBs have adopted General Permits for dewatering discharges). This General Permit is performance-based to the extent that it prohibits the discharge of storm water that causes or threatens to cause pollution, contamination, or nuisance; but it also allows the owner/developer to determine the most economical, effective, and possibly innovative BMPs.

The requirements of this General Permit are intended to be implemented on a year-round basis, not just during the part of the year when there is a high probability of a precipitation event which results in storm water runoff. The permit should be implemented at the appropriate level and in a proactive manner during all seasons while construction is ongoing.

Weather and storm predictions or weather information concerning the 10-year, 6-hour storm event and mean annual rainfall can be obtained by calling the Western Regional Climate Center at 775-674-7010 or via the internet at www.wrcc.dri.edu/precip.html and/or www.wrcc.dri.edu/pcpnfreq.html.

<u>Receiving Water Limitations Language</u>

The receiving water limitations language is fundamentally different from the language adopted in the SWRCB General Industrial Activities Storm Water Permit on April 17, 1997. Construction related activities which cause or contribute to an exceedance of water quality standards must be corrected immediately and cannot wait for the RWQCB to approve a plan of action to correct. The dynamic nature of construction activity allows the discharger the ability to more quickly identify and correct the source of the exceedances. Therefore, the owner is required to take immediate corrective action and to provide a report to the appropriate RWQCB within
14-calendar days of the violation describing the corrective action.

Storm Water Pollution Prevention Plan (SWPPP)

This General Permit requires development and implementation of a SWPPP. This document emphasizes the use of appropriately selected, correctly installed and maintained pollution reduction BMPs. This approach provides the flexibility necessary to establish BMPs which can effectively address source control of pollutants during changing construction activities.

All dischargers shall prepare and implement a SWPPP prior to disturbing a site. The SWPPP must be implemented at the appropriate level to protect water quality at all times throughout the life of the project. Nonstorm water BMPs must be implemented year round. The SWPPP shall remain on the site while the site is under construction, commencing with the initial mobilization and ending with the termination of coverage under the permit.

The SWPPP has two major objectives: (1) to help identify the sources of sediment and other pollutants that affect the quality of storm water discharges and (2) to describe and ensure the implementation of BMPs to reduce or eliminate sediment and other pollutants in storm water as well as nonstorm water discharges. The SWPPP shall include BMPs which address source control and, if necessary, shall also include BMPs which address pollutant control.

Required elements of a SWPPP include: (1) site description addressing the elements and characteristics specific to the site, (2) descriptions of BMPs for erosion and sediment controls, (3) BMPs for construction waste handling and disposal, (4) implementation of approved local plans, (5) proposed post-construction controls, including description of local post-construction erosion and sediment control requirements, and (6) nonstorm water management.

To ensure that the preparation, implementation, and oversight of the SWPPP is sufficient for effective pollution prevention, individuals responsible for creating, revising, overseeing, and implementing the SWPPP should participate in applicable training programs and document such training in the SWPPP.

SWPPPs are reports that are available to the public under Section 308(b) of the CWA and will be made available by the RWQCB upon request.

Monitoring Program

Another major feature of the General Permit is the development and implementation of a monitoring program. All dischargers are required to conduct inspections of the construction site prior to anticipated storm events and after actual storm events. During extended storm events, inspections must be made during each 24-hour period. The goals of these inspections are (1) to identify areas contributing to a storm water discharge; (2) to evaluate whether measures to reduce pollutant loadings identified in the SWPPP are adequate and properly installed and functioning in accordance with the terms of the General Permit; and (3) whether additional control practices or corrective maintenance activities are needed. Equipment, materials, and workers must be available for rapid response to failures and emergencies. All corrective maintenance to BMPs shall be performed as soon as possible, depending upon worker safety.

Each discharger shall certify annually that the construction activities are in compliance with the requirements of this General Permit. Dischargers who cannot certify annual compliance shall notify the appropriate RWQCB. A well-developed monitoring program will provide a good method for checking the effectiveness of the SWPPP.

Retention of Records

The discharger is required to retain records of all monitoring information, copies of all reports required by this General Permit, and records of all data used to complete the NOI for all construction activities to be covered by the General Permit for a period of at least three years from the date generated. This period may be extended by request of the SWRCB and/or RWQCB. With the exception of reporting noncompliance to the appropriate RWQCB, dischargers are not required to submit the records, except upon specific request by the RWQCB.

STATE WATER RESOURCES CONTROL BOARD (SWRCB)
ORDER NO. 99 - 08 - DWQ
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
GENERAL PERMIT NO. CAS000002

WASTE DISCHARGE REQUIREMENTS (WDRS)
FOR
DISCHARGES OF STORM WATER RUNOFF ASSOCIATED WITH CONSTRUCTION ACTIVITY

The State Water Resources Control Board finds that:

1. Federal regulations for controlling pollutants in storm water runoff discharges were promulgated by the U.S. Environmental Protection Agency (USEPA) on November 16, 1990 (40 Code of Federal Regulations (CFR) Parts 122, 123, and 124). The regulations require discharges of storm water to surface waters associated with construction activity including clearing, grading, and excavation activities (except operations that result in disturbance of less than five acres of total land area and which are not part of a larger common plan of development or sale) to obtain an NPDES permit and to implement Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) to reduce or eliminate storm water pollution.

   On December 8, 1999 federal regulations promulgated by USEPA (40CFR Parts 9, 122, 123, and 124) expanded the NPDES storm water program to include storm water discharges from municipal separate storm sewer systems (MS4s) and construction sites that were smaller than those previously included in the program. Federal regulation 40 CFR § 122.26(b)(15) defines small construction activity as including clearing, grading, and excavating that result in land disturbance of equal to or greater than one acre or less than five acres or is part of a larger common plan of development or sale. Permit applications for small construction activities are due by March 10, 2003.

2. This General Permit regulates pollutants in discharges of storm water associated with construction activity (storm water discharges) to surface waters, except from those areas on Tribal Lands; Lake Tahoe Hydrologic Unit; construction projects which disturb less than one acre, unless part of a larger common plan of development or sale; and storm water discharges which are determined ineligible for coverage under this General Permit by the California Regional Water Quality Control Boards (RWQCBs). Attachment 1 contains addresses and telephone numbers of each RWQCB office.

3. This General Permit does not preempt or supersede the authority of local storm water management agencies to prohibit, restrict, or control storm water discharges to separate storm sewer systems or other watercourses within their jurisdiction, as allowed by State and Federal law.

4. To obtain authorization for proposed storm water discharges to surface waters, pursuant to this General Permit, the landowner (discharger) must submit a Notice of Intent (NOI) with a vicinity map and the appropriate fee to the SWRCB prior to commencement of construction activities. In addition, coverage under this General Permit shall not occur until the applicant develops a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the requirements of Section A of this permit for the project. For proposed construction activity conducted on easements or on nearby property by agreement or permission, or by an owner or lessee of a mineral estate (oil, gas, geothermal, aggregate, precious metals, and/or industrial minerals) entitled to conduct the activities, the entity responsible for the construction activity must submit the NOI and filing fee and shall be responsible for development of the SWPPP.

5. If an individual NPDES Permit is issued to a discharger otherwise subject to this General Permit or if an alternative General Permit is subsequently adopted which covers storm water discharges regulated by this General Permit, the applicability of this General Permit to such discharges is automatically terminated on the effective date of the individual permit or the date of approval for coverage under the subsequent General Permit.

6. This action to adopt an NPDES permit is exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21100, et seq.) in accordance with section 13389 of the California Water Code.

7. The SWRCB adopted the California Ocean Plan, and the RWQCBs have adopted and the SWRCB has approved Water Quality Control Plans (Basin Plans). Dischargers regulated by this General Permit must comply with the water quality standards in these Basin Plans and subsequent amendments thereto.

8. The SWRCB finds storm water discharges associated with construction activity to be a potential significant sources of pollutants. Furthermore, the SWRCB finds that storm water discharges associated with construction activities have the reasonable potential to cause or contribute to an excursion above water quality standards for sediment in the water bodies listed in Attachment 3 to this permit.

9. It is not feasible at this time to establish numeric effluent limitations for pollutants in storm water discharges from construction activities. Instead, the provisions of this General Permit require implementation of Best Management Practices (BMPs) to control and abate the discharge of pollutants in storm water discharges.

10. Discharges of non-storm water may be necessary for the completion of certain construction projects. Such discharges include, but are not limited to: irrigation of vegetative erosion control measures, pipe flushing and testing, street cleaning, and dewatering. Such discharges are authorized by this General Permit as long as they (a) do comply with Section A.9 of this General Permit, (b) do not cause or contribute to violation of any water quality standard, (c) do not violate any other provision of this

General Permit, (d) do not require a non-storm water permit as issued by some RWQCBs, and (e) are not prohibited by a Basin Plan. If a non-storm water discharge is subject to a separate permit adopted by a RWQCB, the discharge must additionally be authorized by the RWQCB permit.

11. Following adoption of this General Permit, the RWQCBs shall enforce the provisions herein including the monitoring and reporting requirements.

12. Following public notice in accordance with State and Federal laws and regulations, the SWRCB in a public meeting on June 8, 1998, heard and considered all comments. The SWRCB has prepared written responses to all significant comments.

13. This Order is an NPDES permit in compliance with section 402 of the Clean Water Act (CWA) and shall take effect upon adoption by the SWRCB provided the Regional Administrator of the USEPA has no objection. If the USEPA Regional Administrator objects to its issuance, the General Permit shall not become effective until such objection is withdrawn.

14. This General Permit does not authorize discharges of fill or dredged material regulated by the U.S. Army Corps of Engineers under CWA section 404 and does not constitute a waiver of water quality certification under CWA section 401.

15 The Monitoring Program and Reporting Requirements are modified in compliance with a judgment in the case of San Francisco BayKeeper, et al. v. State Water Resources Control Board. The modifications include sampling and analysis requirements for direct discharges of sediment to waters impaired due to sediment and for pollutants that are not visually detectable in runoff that may cause or contribute to an exceedance of water quality objectives.

16 Storm water discharges associated with industrial activity that are owned or operated by municipalities serving populations less than 100,000 people are no longer exempt from the need to apply for or obtain a storm water discharge permit. A temporary exemption, which was later extended by USEPA, was provided under section 1068(c) of the Intermodal Surface Transportation and Efficiency Act (ISTEA) of 1991. Federal regulation 40 CFR § 122.26(e)(1)(ii) requires the above municipalities to submit permit application by March 10, 2003.

17 This permit may be reopened and modified to include different monitoring requirements for small construction activity than for construction activity over five (5) acres.

IT IS HEREBY ORDERED that all dischargers who file an NOI indicating their intention to be regulated under the provisions of this General Permit shall comply with the following:

A. DISCHARGE PROHIBITIONS:

1. Authorization pursuant to this General Permit does not constitute an exemption to applicable discharge prohibitions prescribed in Basin Plans, as implemented by the nine RWQCBs.

2. Discharges of material other than storm water which are not otherwise authorized by an NPDES permit to a separate storm sewer system (MS4) or waters of the nation are prohibited, except as allowed in Special Provisions for Construction Activity, C.3.

3. Storm water discharges shall not cause or threaten to cause pollution, contamination, or nuisance.

4. Storm water discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of a reportable quantity listed in 40 CFR Part 117 and/or 40 CFR Part 302.

B. RECEIVING WATER LIMITATIONS:

1. Storm water discharges and authorized nonstorm water discharges to any surface or ground water shall not adversely impact human health or the environment.

2. The SWPPP developed for the construction activity covered by this General Permit shall be designed and implemented such that storm water discharges and authorized nonstorm water discharges shall not cause or contribute to an exceedance of any applicable water quality standards contained in a Statewide Water Quality Control Plan and/or the applicable RWQCB's Basin Plan.

3. Should it be determined by the discharger, SWRCB, or RWQCB that storm water discharges and/or authorized nonstorm water discharges are causing or contributing to an exceedance of an applicable water quality standard, the discharger shall:

   a. Implement corrective measures immediately following discovery that water quality standards were exceeded, followed by notification to the RWQCB by telephone as soon as possible but no later than 48 hours after the discharge has been discovered. This notification shall be followed by a report within 14-calender days to the appropriate RWQCB, unless otherwise directed by the RWQCB, describing (1) the nature and cause of the water quality standard exceedance; (2) the BMPs currently being implemented; (3) any additional BMPs which will be implemented to prevent or reduce pollutants that are causing or contributing to the exceedance of water quality standards; and (4) any maintenance or repair of BMPs. This report shall include an implementation schedule for corrective actions and shall describe the actions taken to reduce the pollutants causing or contributing to the exceedance.

b. The discharger shall revise its SWPPP and monitoring program immediately after the report to the RWQCB to incorporate the additional BMPs that have been and will be implemented, the implementation schedule, and any additional monitoring needed.

c. Nothing in this section shall prevent the appropriate RWQCB from enforcing any provisions of this General Permit while the discharger prepares and implements the above report.

C. SPECIAL PROVISIONS FOR CONSTRUCTION ACTIVITY:

1. All dischargers shall file an NOI and pay the appropriate fee for construction activities conducted at each site as required by Attachment 2: Notice of Intent--General Instructions.

2. All dischargers shall develop and implement a SWPPP in accordance with Section A: Storm Water Pollution Prevention Plan. The discharger shall implement controls to reduce pollutants in storm water discharges from their construction sites to the BAT/BCT performance standard.

3. Discharges of non-storm water are authorized only where they do not cause or contribute to a violation of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants. Implementation of appropriate BMPs is a condition for authorization of non-storm water discharges. Non-storm water discharges and the BMPs appropriate for their control must be described in the SWPPP. Wherever feasible, alternatives which do not result in discharge of nonstorm water shall be implemented in accordance with Section A.9. of the SWPPP requirements.

4. All dischargers shall develop and implement a monitoring program and reporting plan in accordance with Section B: Monitoring Program and Reporting Requirements.

5. All dischargers shall comply with the lawful requirements of municipalities, counties, drainage districts, and other local agencies regarding discharges of storm water to separate storm sewer systems or other watercourses under their jurisdiction, including applicable requirements in municipal storm water management programs developed to comply with NPDES permits issued by the RWQCBs to local agencies.

6. All dischargers shall comply with the standard provisions and reporting requirements contained in Section C: Standard Provisions.

7. The discharger may terminate coverage for a portion of the project under this General Permit when ownership of a portion of this project has been transferred or when a phase within this multi-phase project has been completed. When ownership has transferred, the discharger must submit to its RWQCB a Change of Information Form (COI) Attachment 4 with revised site map and the name, address and telephone number of the new owner(s). Upon transfer of title, the discharger should notify the new owner(s) of the need to obtain coverage under this General Permit. The new owner must comply with provisions of Sections A. 2. (c) and
B. 2. (b) of this General Permit. To terminate coverage for a portion of the project when a phase has been completed, the discharger must submit to its RWQCB a COI with a revised map that identifies the newly delineated site.

8. The discharger may terminate coverage under this General Permit for a complete project by submitting to its RWQCB a Notice of Termination Form (NOT), and the post-construction BMPs plan according to Section A.10 of this General Permit. Note that a construction project is considered complete only when all portions of the site have been transferred to a new owner; or the following conditions have been met:

   a. There is no potential for construction related storm water pollution,

   b. All elements of the SWPPP have been completed,

   c. Construction materials and waste have been disposed of properly,

   d. The site is in compliance with all local storm water management requirements, and

   e. A post-construction storm water management plan is in place as described in the site's SWPPP.

9. This General Permit expires five years from the date of adoption.

D. REGIONAL WATER QUALITY CONTROL BOARD (RWQCB) AUTHORITIES:

1. RWQCBs shall:

   a. Implement the provisions of this General Permit. Implementation of this General Permit may include, but is not limited to requesting the submittal of SWPPPS, reviewing SWPPPs, reviewing monitoring reports, conducting compliance inspections, and taking enforcement actions.

   b. Issue permits as they deem appropriate to individual dischargers, categories of dischargers, or dischargers in a geographic area. Upon issuance of such permits by a RWQCB, the affected dischargers shall no longer be regulated by this General Permit.

2. RWQCBs may require, on a case-by-case basis, the inclusion of an analysis of potential downstream impacts on receiving waterways due to the permitted construction.

3. RWQCBs may provide information to dischargers on the development and implementation of SWPPPs and monitoring programs and may require revisions to SWPPPs and monitoring programs.

4. RWQCBs may require dischargers to retain records for more than three years.

5. RWQCBs may require additional monitoring and reporting program requirements including sampling and analysis of discharges to water bodies listed in Attachment 3 to this permit. Additional requirements imposed by the RWQCB should be consistent with the overall monitoring effort in the receiving waters.

6. RWQCBs may issue individual NPDES permits for those construction activities found to be ineligible for coverage under this permit.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on August 19, 1999.

| | |
|---|---|
| AYE: | James M. Stubchaer<br>Mary Jane Forster<br>John W. Brown<br>Arthur G. Baggett, Jr. |
| NO: | None |
| ABSENT: | None |
| ABSTAIN: | None |

/s/

Maureen Marché
Administrative Assistant to the Board

## SECTION A: STORM WATER POLLUTION PREVENTION PLAN

1. Objectives

A Storm Water Pollution Prevention Plan (SWPPP) shall be developed and implemented to address the specific circumstances for each construction site covered by this General Permit. The SWPPP shall be certified in accordance with the signatory requirements of section C, Standard Provision for Construction Activities (9). The SWPPP shall be developed and amended or revised, when necessary, to meet the following objectives:

a. Identify all pollutant sources including sources of sediment that may affect the quality of storm water discharges associated with construction activity (storm water discharges) from the construction site, and

b. Identify non-storm water discharges, and

c. Identify, construct, implement in accordance with a time schedule, and maintain Best Management Practices (BMPs) to reduce or eliminate pollutants in storm water discharges and authorized nonstorm water discharges from the construction site during construction, and

d. Develop a maintenance schedule for BMPs installed during construction designed to reduce or eliminate pollutants after construction is completed (post-construction BMPs).

e. Identify a sampling and analysis strategy and sampling schedule for discharges from construction activity which discharge directly into water bodies listed on Attachment 3. (Clean Water Act Section 303(d) [303(d)] Water Bodies listed for Sedimentation).

f. For all construction activity, identify a sampling and analysis strategy and sampling schedule for discharges that have been discovered through visual monitoring to be potentially contaminated by pollutants not visually detectable in the runoff.

2. Implementation Schedule

a. For construction activity commencing on or after adoption of this General Permit, the SWPPP shall be developed prior to the start of soil-disturbing activity in accordance with this Section and shall be implemented concurrently with commencement of soil-disturbing activities.

b. Existing permittees engaging in construction activities covered under the terms of the previous General Construction Permit SWPPP (WQ Order No.92-08-DWQ) shall continue to implement their existing SWPPP and shall implement any necessary revisions to their SWPPP in accordance with this Section of the General Permit in a timely manner, but in no case more than 90-calender days from the date of adoption of this General Permit.

c. For ongoing construction activity involving a change of ownership of property, the new owner shall review the existing SWPPP and amend if necessary, or develop a new SWPPP within 45-calender days.

d. Existing permittees shall revise their SWPPP in accordance with the sampling and analysis modifications prior to August 1, 2001. For ongoing construction activity involving a change of ownership the new owner shall review the existing SWPPP and amend the sampling and analysis strategy, if required, within 45 days. For construction activity commencing after the date of adoption, the SWPPP shall be developed in accordance with the modification language adopted.

3. Availability

The SWPPP shall remain on the construction site while the site is under construction during working hours, commencing with the initial construction activity and ending with termination of coverage under the General Permit.

4. Required Changes

a. The discharger shall amend the SWPPP whenever there is a change in construction or operations which may affect the discharge of pollutants to surface waters, ground waters, or a municipal separate storm sewer system (MS4). The SWPPP shall also be amended if the discharger violates any condition of this General Permit or has not achieved the general objective of reducing or eliminating pollutants in storm water discharges. If the RWQCB determines that the discharger is in violation of this General Permit, the SWPPP shall be amended and implemented in a timely manner, but in no case more than 14-calendar days after notification by the RWQCB. All amendments should be dated and directly attached to the SWPPP.

b. The RWQCB or local agency with the concurrence of the RWQCB may require the discharger to amend the SWPPP.

5. Source Identification

The SWPPP shall include: (a) project information and (b) pollutant source identification combined with an itemization of those BMPs specifically chosen to control the pollutants listed.

a. Project Information

(1) The SWPPP shall include a vicinity map locating the project site with respect to easily identifiable major roadways, geographic features, or landmarks. At a minimum, the map must show the construction site perimeter, the geographic features surrounding the site, and the general topography.

(2) The SWPPP shall include a site map(s) which shows the construction project in detail, including the existing and planned paved areas and buildings.

(a) At a minimum, the map must show the construction site perimeter; existing and proposed buildings, lots, roadways, storm water collection and discharge points; general topography both before and after construction; and the anticipated discharge location(s) where the storm water from the construction site discharges to a municipal storm sewer system or other water body.

(b) The drainage patterns across the project area must clearly be shown on the map, and the map must extend as far outside the site perimeter as necessary to illustrate the relevant drainage areas. Where relevant drainage areas are too large to depict on the map, map notes or inserts illustrating the upstream drainage areas are sufficient.

(c) Temporary on-site drainages to carry concentrated flow shall be selected to comply with local ordinances, to control erosion, to return flows to their natural drainage courses, and to prevent damage to downstream properties.

3. Information presented in the SWPPP may be represented either by narrative or by graphics. Where possible, narrative descriptions should be plan notes. Narrative descriptions which do not lend themselves to plan notes can be contained in a separate document which must be referenced on the plan.

b. Pollutant Source and BMP Identification

The SWPPP shall include a description of potential sources which are likely to add pollutants to storm water discharges or which may result in nonstorm water discharges from the construction site. Discharges originating from off-site which flow across or through areas disturbed by construction that may contain pollutants should be reported to the RWQCB.

The SWPPP shall:

(1) Show drainage patterns and slopes anticipated after major grading activities are completed. Runoff from off-site areas should be prevented from flowing through areas that have been disturbed by construction unless appropriate conveyance systems are in place. The amount of anticipated storm water run-on must be considered to determine the appropriateness of the BMPs chosen. Show all calculations for anticipated storm water run-on, and describe all BMPs implemented to divert off-site drainage described in section A. 5 a. (2) (c) around or through the construction project.

(2) Show the drainage patterns into each on-site storm water inlet point or receiving water. Show or describe the BMPs that will protect operational storm water inlets or receiving waters from contaminated discharges other than sediment discharges, such as, but not limited to: storm water with elevated pH levels from contact with soil amendments such as lime or gypsum; slurry from sawcutting of concrete or asphalt ;washing of exposed aggregate concrete; concrete rinse water; building washing operations; equipment washing operations; minor street washing associated with street delineation; and/or sealing and paving activities occurring during rains.

(3) Show existing site features that, as a result of known past usage, may contribute pollutants to storm water, (e.g., toxic materials that are known to have been treated, stored, disposed, spilled, or leaked onto the construction site). Show or describe the BMPs implemented to minimize the exposure of storm water to contaminated soil or toxic materials.

(4) Show areas designated for the (a) storage of soil or waste, (b) vehicle storage and service areas, (c) construction material loading, unloading, and access areas, (d) equipment storage, cleaning, and maintenance areas.

(5) Describe the BMPs for control of discharges from waste handling and disposal areas and methods of on-site storage and disposal of construction materials and construction waste. Describe the BMPs designed to minimize or eliminate the exposure of storm water to construction materials, equipment, vehicles, waste storage areas, or service areas. The BMPs described shall be in compliance with Federal, State, and local laws, regulations, and ordinances.

(6) Describe all post-construction BMPs for the project, and show the location of each BMP on the map. (Post-construction BMPs consist of permanent features designed to minimize pollutant discharges, including sediment, from the site after construction has been completed.) Also, describe the agency or parties to be the responsible party for long-term maintenance of these BMPs.

(7) Show the locations of direct discharge from the construction site into a Section 303(d) list water body. Show the designated sampling locations in the receiving waters, which represent the prevailing conditions of the water bodies upstream of the construction site discharge and immediately downstream from the last point of discharge.

(8) Show the locations designated for sampling the discharge from areas identified in Section A. 5. b. (2), (3), and (4) and Section A. 5. c. (1) and (2). Samples shall be taken should visual monitoring indicate that there has been a breach, malfunction, leakage, or spill from a BMP which could result in the discharge in storm water of pollutants that would not be visually detectable, or if storm water comes into contact with soil amendments or other exposed materials or contamination and is allowed to be discharged. Describe the sampling procedure, location, and rationale for obtaining the uncontaminated sample of storm water.

c. Additional Information

(1) The SWPPP shall include a narrative description of pollutant sources and BMPs that cannot be adequately communicated or identified on the site map. In addition, a narrative description of preconstruction control practices (if any) to reduce sediment and other pollutants in storm water discharges shall be included.

(2) The SWPPP shall include an inventory of all materials used and activities performed during construction that have the potential to contribute to the discharge of pollutants other than sediment in storm water. Describe the BMPs selected and the basis for their selection to eliminate or reduce these pollutants in the storm water discharges.

(3) The SWPPP shall include the following information regarding the construction site surface area: the size (in acres or square feet), the runoff coefficient before and after construction, and the percentage that is impervious (e.g., paved, roofed, etc.) before and after construction.

(4) The SWPPP shall include a copy of the NOI, and the Waste Discharge Identification (WDID) number. Should a WDID number not be received from the SWRCB at the time construction commences, the discharger shall include proof of mailing of the NOI, e.g., certified mail receipt, copy of check, express mail receipt, etc.

(5) The SWPPP shall include a construction activity schedule which describes all major activities such as mass grading, paving, lot or parcel

improvements at the site and the proposed time frame to conduct those activities.

(6) The SWPPP shall list the name and telephone number of the qualified person(s) who have been assigned responsibility for prestorm, poststorm, and storm event BMP inspections; and the qualified person(s) assigned responsibility to ensure full compliance with the permit and implementation of all elements of the SWPPP, including the preparation of the annual compliance evaluation and the elimination of all unauthorized discharges.

6. Erosion Control

Erosion control, also referred to as "soil stabilization" is the most effective way to retain soil and sediment on the construction site. The most efficient way to address erosion control is to preserve existing vegetation where feasible, to limit disturbance, and to stabilize and revegetate disturbed areas as soon as possible after grading or construction. Particular attention must be paid to large mass-graded sites where the potential for soil exposure to the erosive effects of rainfall and wind is great. Mass graded construction sites may be exposed for several years while the project is being built out. Thus, there is potential for significant sediment discharge from the site to surface waters.

At a minimum, the discharger/operator must implement an effective combination of erosion and sediment control on all disturbed areas during the rainy season. These disturbed areas include rough graded roadways, slopes, and building pads. Until permanent vegetation is established, soil cover is the most cost-effective and expeditious method to protect soil particles from detachment and transport by rainfall. Temporary soil stabilization can be the single-most important factor in reducing erosion at construction sites. The discharger shall consider measures such as: covering with mulch, temporary seeding, soil stabilizers, binders, fiber rolls or blankets, temporary vegetation, permanent seeding, and a variety of other measures.

The SWPPP shall include a description of the erosion control practices, including a time schedule, to be implemented during construction to minimize erosion on disturbed areas of a construction site. The discharger must consider the full range of erosion control BMPs. The discharger must consider any additional site-specific and seasonal conditions when selecting and implementing appropriate BMPs. The above listed erosion control measures are examples of what should be considered and are not exclusive of new or innovative approaches currently available or being developed.

a. The SWPPP shall include:

(1) An outline of the areas of vegetative soil cover or native vegetation onsite which will remain undisturbed during the construction project.

(2) An outline of all areas of soil disturbance including cut or fill areas which will be stabilized during the rainy season by temporary or permanent erosion control measures, such as seeding, mulch, or blankets, etc.

(3) An outline of the areas of soil disturbance, cut, or fill which will be left exposed during any part of the rainy season, representing areas of potential soil erosion where sediment control BMPs are required to be used during construction.

(4) A proposed schedule for the implementation of erosion control measures.

b. The SWPPP shall include a description of the BMPs and control practices to be used for both temporary and permanent erosion control measures.

c. The SWPPP shall include a description of the BMPs to reduce wind erosion at all times, with particular attention paid to stock-piled materials.

7. Stabilization

(1) All disturbed areas of the construction site must be stabilized. Final stabilization for the purposes of submitting a NOT is satisfied when:

-All soil disturbing activities are completed AND EITHER OF THE TWO FOLLOWING CRITERIA ARE MET:

-A uniform vegetative cover with 70 percent coverage has been established OR:

-equivalent stabilization measures have been employed. These measures include the use of such BMPs as blankets, reinforced channel liners, soil cement, fiber matrices, geotextiles, or other erosion resistant soil coverings or treatments.

(2) Where background native vegetation covers less than 100 percent of the surface, such as in arid areas, the 70 percent coverage criteria is adjusted as follows: If the native vegetation covers 50 percent of the ground surface, 70 percent of 50 percent (.70 X .50=.35) would require 35 percent total uniform surface coverage.

8. <u>Sediment Control</u>

The SWPPP shall include a description or illustration of BMPs which will be implemented to prevent a net increase of sediment load in storm water discharge relative to preconstruction levels. Sediment control BMPs are required at appropriate locations along the site perimeter and at all operational internal inlets to the storm drain system at all times during the rainy season. Sediment control practices may include filtration devices and barriers (such as fiber rolls, silt fence, straw bale barriers, and gravel inlet filters) and/or settling devices (such as sediment traps or basins). Effective filtration devices, barriers, and settling devices shall be selected, installed and maintained properly. A proposed schedule for deployment of sediment control BMPs shall be included in the SWPPP. These are the most basic measures to prevent sediment from leaving the project site and moving into receiving waters. Limited exemptions may be authorized by the RWQCB when work on active areas precludes the use of sediment control BMPs temporarily. Under these conditions, the SWPPP must describe a plan to establish perimeter controls prior to the onset of rain.

During the nonrainy season, the discharger is responsible for ensuring that adequate sediment control materials are available to control sediment discharges at the downgrade perimeter and operational inlets in the event of a predicted storm. The discharger shall consider a full range of sediment controls, in addition to the controls listed above, such as straw bale dikes, earth dikes, brush barriers, drainage swales, check dams, subsurface drain, sandbag dikes, fiber rolls, or other controls. At a minimum, the discharger/operator must implement an effective combination of erosion and sediment control on all disturbed areas during the rainy season.

If the discharger chooses to rely on sediment basins for treatment purposes, sediment basins shall, at a minimum, be designed and maintained as follows:

Option 1: Pursuant to local ordinance for sediment basin design and maintenance, provided that the design efficiency is as protective or more protective of water quality than Option 3.

OR

Option 2: Sediment basin(s), as measured from the bottom of the basin to the principal outlet, shall have at least a capacity equivalent to 3,600 cubic feet of storage per acre draining into the sediment basin. The length of the basin shall be more than twice the width of the basin. The length is determined by measuring the distance between the inlet and the outlet; and the depth must not be less than three feet nor greater than five feet for safety reasons and for maximum efficiency.

OR

Option 3: Sediment basin(s) shall be designed using the standard equation:

$$As=1.2Q/Vs$$

Where: As is the minimum surface area for trapping soil particles of a certain size; Vs is the settling velocity of the design particle size chosen; and Q=C x I x A where Q is the discharge rate measured in cubic feet per second; C is the runoff coefficient; I is the precipitation intensity for the 10-year, 6-hour rain event and A is the area draining into the sediment basin in acres. The design particle size shall be the smallest soil grain size determined by wet sieve analysis, or the fine silt sized (0.01mm) particle, and the Vs used shall be 100 percent of the calculated settling velocity.

The length is determined by measuring the distance between the inlet and the outlet; the length shall be more than twice the dimension as the width; the depth shall not be less than three feet nor greater than five feet for safety reasons and for maximum efficiency (two feet of storage, two feet of capacity). The basin(s) shall be located on the site where it can be maintained on a year-round basis and shall be maintained on a schedule to retain the two feet of capacity;

OR

Option 4: The use of an equivalent surface area design or equation, provided that the design efficiency is as protective or more protective of water quality than Option 3.

A sediment basin shall have a means for dewatering within 7-calendar days following a storm event. Sediment basins may be fenced if safety (worker or public) is a concern.

The outflow from a sediment basin that discharges into a natural drainage shall be provided with outlet protection to prevent erosion and scour of the embankment and channel.

The discharger must consider any additional site-specific and seasonal conditions when selecting and designing sediment control BMPs. The above listed sediment control measures are examples of what should be considered and are not exclusive of new or innovative approaches currently available or being developed.

The SWPPP shall include a description of the BMPs to reduce the tracking of sediment onto public or private roads at all times. These public and private roads shall be inspected and cleaned as necessary. Road cleaning BMPs shall be discussed in the SWPPP and will not rely on the washing of accumulated sediment or silt into the storm drain system.

9. <u>Non-Storm Water Management</u>

Describe all non-storm water discharges to receiving waters that are proposed for the construction project. Non-storm water discharges should be eliminated or reduced to the extent feasible. Include the locations of such discharges and descriptions of all BMPs designed for the control of pollutants in such discharges. Onetime discharges shall be monitored during the time that such discharges are occurring. A qualified person should be assigned the responsibility for ensuring that no materials other than storm water are discharged in quantities which will have an adverse effect on receiving waters or storm drain systems (consistent with BAT/BCT), and the name and contact number of that person should be included in the SWPPP document.

Discharging sediment-laden water which will cause or contribute to an exceedance of the applicable RWQCB's Basin Plan from a dewatering site or sediment basin into any receiving water or storm drain without filtration or equivalent treatment is prohibited.

10. Post-Construction Storm Water Management

The SWPPP shall include descriptions of the BMPs to reduce pollutants in storm water discharges after all construction phases have been completed at the site (Post-Construction BMPs). Post-Construction BMPs include the minimization of land disturbance, the minimization of impervious surfaces, treatment of storm water runoff using infiltration, detention/retention, biofilter BMPs, use of efficient irrigation systems, ensuring that interior drains are not connected to a storm sewer system, and appropriately designed and constructed energy dissipation devices. These must be consistent with all local post-construction storm water management requirements, policies, and guidelines. The discharger must consider site-specific and seasonal conditions when designing the control practices. Operation and maintenance of control practices after construction is completed shall be addressed, including short-and long-term funding sources and the responsible party.

11. Maintenance, Inspection, and Repair

The SWPPP shall include a discussion of the program to inspect and maintain all BMPs as identified in the site plan or other narrative documents throughout the entire duration of the project. A qualified person will be assigned the responsibility to conduct inspections. The name and telephone number of that person shall be listed in the SWPPP document. Inspections will be performed before and after storm events and once each 24-hour period during extended storm events to identify BMP effectiveness and implement repairs or design changes as soon as feasible depending upon field conditions. Equipment, materials, and workers must be available for rapid response to failures and emergencies. All corrective maintenance to BMPs shall be performed as soon as possible after the conclusion of each storm depending upon worker safety.

For each inspection required above, the discharger shall complete an inspection checklist. At a minimum, an inspection checklist shall include:

a. Inspection date.

b. Weather information: best estimate of beginning of storm event, duration of event, time elapsed since last storm, and approximate amount of rainfall (inches).

c. A description of any inadequate BMPs.

d. If it is possible to safely access during inclement weather, list observations of all BMPs: erosion controls, sediment controls, chemical and waste controls, and non-storm water controls. Otherwise, list result of visual inspection at relevant outfall, discharge point, or downstream location and projected required maintenance activities.

e. Corrective actions required, including any changes to SWPPP necessary and implementation dates.

f. Inspectors name, title, and signature.

The dischargers shall prepare their inspection checklists using the inspection checklist form provided by the SWRCB or RWQCB or on forms that contain the equivalent information.

12. Training

Individuals responsible for SWPPP preparation, implementation, and permit compliance shall be appropriately trained, and the SWPPP shall document all training. This includes those personnel responsible for installation, inspection, maintenance, and repair of BMPs. Those responsible for overseeing, revising, and amending the SWPPP shall also document their training. Training should be both formal and informal, occur on an ongoing basis when it is appropriate and convenient, and should include training/workshops offered by the SWRCB, RWQCB, or other locally recognized agencies or professional organizations.

13. List of Contractors/Subcontractors

The SWPPP shall include a list of names of all contractors, (or subcontractors) and individuals responsible for implementation of the SWPPP. This list should include telephone numbers and addresses. Specific areas of responsibility of each subcontractor and emergency contact numbers should also be included.

14. Other Plans

This SWPPP may incorporate by reference the appropriate elements of other plans required by local, State, or Federal agencies. A copy of any requirements incorporated by reference shall be kept at the construction site.

15. Public Access

The SWPPP shall be provided, upon request, to the RWQCB. The SWPPP is considered a report that shall be available to the public by the RWQCB under section 308(b) of the Clean Water Act.

16. Preparer Certification

The SWPPP and each amendment shall be signed by the landowner (discharger) or his representative and include the date of initial preparation and the date of each amendment.

SECTION B: MONITORING PROGRAM AND REPORTING REQUIREMENTS

1. Required Changes

The RWQCB may require the discharger to conduct additional site inspections, to submit reports and certifications, or perform sampling and analysis.

2. Implementation

a. The requirements of this Section shall be implemented at the time of commencement of construction activity (see also Section A. 2. Implementation Schedule). The discharger is responsible for implementing these requirements until construction activity is complete and the site is stabilized.

b. For ongoing construction activity involving a change in ownership of property covered by this General Permit, the new owner must complete a NOI and implement the requirements of this Section concurrent with the change of ownership. For changes of information, the owner must follow instructions in C. 7. Special Provisions for Construction Activity of the General Permit.

3. Site Inspections

Qualified personnel shall conduct inspections of the construction site prior to anticipated storm events, during extended storm events, and after actual storm events to identify areas contributing to a discharge of storm water associated with construction activity. The name(s) and contact number(s) of the assigned inspection personnel shall be listed in the SWPPP. Pre-storm inspections are to ensure that BMPs are properly installed and maintained; post-storm inspections are to assure that the BMPs have functioned adequately. During extended storm events, inspections shall be required each 24-hour period. Best Management Practices (BMPs) shall be evaluated for adequacy and proper implementation and whether additional BMPs are required in accordance with the terms of the General Permit (see language in Section A. 11. Maintenance, Inspection, and Repair). Implementation of nonstorm water discharge BMPs shall be verified and their effectiveness evaluated. One time discharges of non-storm water shall be inspected when such discharges occur.

4. Compliance Certification

Each discharger or qualified assigned personnel listed by name and contact number in the SWPPP must certify annually that construction activities are in compliance with the requirements of this General Permit and the SWPPP. This Certification shall be based upon the site inspections required in Item 3 of this Section. The certification must be completed by July 1 of each year.

5. Noncompliance Reporting

Dischargers who cannot certify compliance, in accordance with Item 4 of this Section and/or who have had other instances of noncompliance excluding exceedances of water quality standards as defined in section B. 3. Receiving Water Limitations Language, shall notify the appropriate RWQCB within 30 days. Corrective measures should be implemented immediately following discovery that water quality standards were exceeded. The notifications shall identify the noncompliance event, including an initial assessment of any impact caused by the event; describe the actions necessary to achieve compliance; and include a time schedule subject to the modifications by the RWQCB indicating when compliance will be achieved. Noncompliance notifications must be submitted within 30-calendar days of identification of noncompliance.

6. Monitoring Records

Records of all inspections, compliance certifications, and noncompliance reporting must be retained for a period of at least three years from the date generated. With the exception of noncompliance reporting, dischargers are not required to submit these records.

7. Monitoring Program for Sedimentation/Siltation

Dischargers of storm water associated with construction activity that directly enters a water body listed in Attachment 3 shall conduct a sampling and analysis program for the pollutants (sedimentation/siltation or turbidity) causing the impairment. The discharger shall monitor for the applicable parameter. If the water body is listed for sedimentation or siltation, samples should be analyzed for Settleable Solids (ml/l) and Total Suspended Solids (mg/l). Alternatively or in addition, samples may be analyzed for suspended sediment concentration according to ASTM D3977-97. If the water body is listed for turbidity, samples should be analyzed for turbidity (NTU). Discharges that flow through tributaries that are not listed in Attachment 3 or that flow into Municipal Separate Storm Sewer Systems (MS4) are not subject to these sampling and analysis requirements. The sampling and analysis parameters and procedures must be designed to determine whether the BMPs installed and maintained prevent discharges of sediment from contributing to impairment in receiving waters.

Samples shall be collected during the first two hours of discharge from rain events which result in a direct discharge to any water body listed in Attachment 3. Samples shall be collected during daylight hours (sunrise to sunset). Dischargers need not collect more than four (4) samples per month. All samples shall be taken in the receiving waters and shall be representative of the prevailing conditions of the water bodies. Samples shall be collected from safely accessible locations upstream of the construction site discharge and immediately downstream from the last point of discharge.

For laboratory analysis, all sampling, sample preservation, and analyses must be conducted according to test procedures under 40 CFR Part 136. Field samples shall be collected and analyzed according to the specifications of the manufacturer of the sampling devices employed. Portable meters shall be calibrated according to manufacturer's specification. All field and/or laboratory analytical data shall be kept in the SWPPP document, which is to remain at the construction site at all times until a Notice of Termination has been submitted and approved.

8. <u>Monitoring Program for Pollutants Not Visually Detectable in Storm Water</u>

A sampling and analysis program shall be developed and conducted for pollutants which are not visually detectable in storm water discharges, which are or should be known to occur on the construction site, and which could cause or contribute to an exceedance of water quality objectives in the receiving water. Pollutants that should be considered for inclusion in this sampling and analysis program are those identified in Sections A.5.b. and A.5.c.

Construction materials and compounds that are not stored in water-tight containers under a water-tight roof or inside a building are examples of materials for which the discharger may have to implement sampling and analysis procedures. The goal of the sampling and analysis is to determine whether the BMPs employed and maintained on site are effective in preventing the potential pollutants from coming in contact with storm water and causing or contributing to an exceedance of water quality objectives in the receiving waters. Examples of construction sites that may require sampling and analysis include: sites that are known to have contaminants spilled or spread on the ground; sites where construction practices include the application of soil amendments, such as gypsum, which can increase the pH of the runoff; or sites having uncovered stockpiles of material exposed to storm water. Visual observations before, during, and after storm events may trigger the requirement to collect samples. Any breach, malfunction, leakage, or spill observed which could result in the discharge of pollutants to surface waters that *would* not be visually detectable in storm water shall trigger the collection of a sample of discharge. Samples shall be collected at all discharge locations which drain the areas identified by the visual observations and which can be safely accessed. For sites where sampling and analysis is required, personnel trained in water quality sampling procedures shall collect storm water samples. A sufficiently large sample of storm water that has not come in contact with the disturbed soil or the materials stored or used on-site (uncontaminated sample) shall be collected for comparison with the discharge sample. Samples shall be collected during the first two hours of discharge from rain events that occur during daylight hours and which generate runoff.

The uncontaminated sample shall be compared to the samples of discharge using field analysis or through laboratory analysis. Analyses may include, but are not limited to, indicator parameters such as: pH, specific conductance, dissolved oxygen, conductivity, salinity, and TDS.

For laboratory analysis, all sampling, sample preservation, and analyses must be conducted according to test procedures under 40 CFR Part 136. Field discharge samples shall be collected and analyzed according to the specifications of the manufacturer of the sampling devices employed. Portable meters shall be calibrated according to manufacturer's specification. All field and/or analytical data shall be kept in the SWPPP document, which is to remain at the construction site at all times until a *Notice of* Termination has been submitted and approved.

## SECTION C: STANDARD PROVISIONS FOR CONSTRUCTION ACTIVITY

1. Duty to Comply

The discharger must comply with all of the conditions of this General Permit. Any permit noncompliance constitutes a violation of the Clean Water Act (CWA) and the Porter-Cologne Water Quality Control Act and is grounds for enforcement action and/or removal from General Permit coverage.

The discharger shall comply with effluent standards or prohibitions established under Section 307(a) of the CWA for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if this General Permit has not yet been modified to incorporate the requirement.

2. General Permit Actions

This General Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the discharger for a General Permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not annul any General Permit condition.

If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the CWA for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this General Permit, this General Permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the dischargers so notified.

3. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this General Permit.

4. Duty to Mitigate

The discharger shall take all responsible steps to minimize or prevent any discharge in violation of this General Permit, which has a reasonable likelihood of adversely affecting human health or the environment.

5. Proper Operation and Maintenance

The discharger shall at all times properly operate and maintain any facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with the conditions of this General Permit and with the requirements of Storm Water Pollution Prevention Plans (SWPPP). Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance may require the operation of backup or auxiliary facilities or similar systems installed by a discharger when necessary to achieve compliance with the conditions of this General Permit.

6. Property Rights

This General Permit does not convey any property rights of any sort or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor does it authorize any infringement of Federal, State, or local laws or regulations.

7. Duty to Provide Information

The discharger shall furnish the RWQCB, State Water Resources Control Board, or USEPA, within a reasonable time, any requested information to determine compliance with this General Permit. The discharger shall also furnish, upon request, copies of records required to be kept by this General Permit.

8. Inspection and Entry

The discharger shall allow the RWQCB, SWRCB, USEPA, and/or, in the case of construction sites which discharge through a municipal separate storm sewer, an authorized representative of the municipal operator of the separate storm sewer system receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the discharger's premises at reasonable times where a regulated construction activity is being conducted or where records must be kept under the conditions of this General Permit;

b. Access and copy at reasonable times any records that must be kept under the conditions of this General Permit;

c. Inspect at reasonable times the complete construction site, including any off-site staging areas or material storage areas, and the erosion/sediment controls; and

d. Sample or monitor at reasonable times for the purpose of ensuring General Permit compliance.

9. Signatory Requirements

a. All Notice of Intents (NOIs), Notice of Terminations (NOTs), SWPPPs, certifications, and reports prepared in accordance with this Order submitted to the SWRCB shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this Section, a responsible corporate officer means: (a) a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or (b) the manager of the construction activity if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer, ranking elected official, or duly authorized representative. The principal executive officer of a Federal agency includes the chief executive officer of the agency or the senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator of USEPA).

b. All SWPPPs, reports, certifications, or other information required by the General Permit and/or requested by the RWQCB, SWRCB, USEPA, or the local storm water management agency shall be signed by a person described above or by a duly authorized representative. A person is a duly authorized representative if:

(1) The authorization is made in writing by a person described above and retained as part of the SWPPP; or

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the construction activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

c. If an authorization is no longer accurate because a different individual or position has responsibility for the overall operation of the construction activity, a new authorization must be attached to the SWPPP prior to submittal of any reports, information, or certifications to be signed by the authorized representative.

10. Certification

Any person signing documents under Section C, Provision 9 above, shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly 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 information submitted is, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

11. Anticipated Noncompliance

The discharger will give advance notice to the RWQCB and local storm water management agency of any planned changes in the construction activity which may result in noncompliance with General Permit requirements.

12. Penalties for Falsification of Reports

Section 309(c)(4) of the CWA provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this General Permit, including reports of compliance or noncompliance shall upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than two years or by both.

13. Oil and Hazardous Substance Liability

Nothing in this General Permit shall be construed to preclude the institution of any legal action or relieve the discharger from any responsibilities, liabilities, or penalties to which the discharger is or may be subject to under Section 311 of the CWA.

14. Severability

The provisions of this General Permit are severable; and, if any provision of this General Permit or the application of any provision of this General Permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this General Permit shall not be affected thereby.

15. Reopener Clause

This General Permit may be modified, revoked and reissued, or terminated for cause due to promulgation of amended regulations, receipt of USEPA guidance concerning regulated activities, judicial decision, or in accordance with 40 Code of Federal Regulations (CFR) 122.62, 122.63, 122.64, and 124.5.

16. Penalties for Violations of Permit Conditions

a. Section 309 of the CWA provides significant penalties for any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the CWA or any permit condition or limitation implementing any such section in a permit issued under Section 402. Any person who violates any permit condition of this General Permit is subject to a civil penalty not to exceed $27,500 per calendar day of such violation, as well as any other appropriate sanction provided by Section 309 of the CWA.

b. The Porter-Cologne Water Quality Control Act also provides for civil and criminal penalties which in some cases are greater than those under the CWA.

17. Availability

A copy of this General Permit shall be maintained at the construction site during construction activity and be available to operating personnel.

18. Transfers

This General Permit is not transferable. A new owner of an ongoing construction activity must submit a NOI in accordance with the requirements of this General Permit to be authorized to discharge under this General Permit. An owner who sells property covered by this General Permit shall inform the new owner of the duty to file a NOI and shall provide the new owner with a copy of this General Permit.

19. Continuation of Expired Permit

This General Permit continues in force and effect until a new General Permit is issued or the SWRCB rescinds this General Permit. Only those dischargers authorized to discharge under the expiring General Permit are covered by the continued General Permit.

SWRCB AND RWQCB CONTACT LIST

Please see Storm Water Contacts at
http://www.swrcb.ca.gov/stormwtr/contact.html

NOTICE OF INTENT (NOI) TO COMPLY WITH THE TERMS
OF THE GENERAL PERMIT TO DISCHARGE STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY

GENERAL INSTRUCTIONS

Who Must Submit

Discharges of storm water associated with construction that results in the disturbance of one acre or more of land must apply for coverage under the General Construction Activities Storm Water Permit (General Permit). Construction activity which is a part of a larger common area of development or sale must also be permitted. (For example, if 4 acres of a 20-acre subdivision is disturbed by construction activities, and the remaining 16 acres is to be developed at a future date, the property owner must obtain a General Storm Water Permit for the 4-acre project). Construction activity includes, but is not limited to: clearing, grading, demolition, excavation, construction of new structures, and reconstruction of existing facilities involving removal and replacement that results in soil disturbance. This includes construction access roads, staging areas, storage areas, stockpiles, and any off-site areas which receive run-off from the construction project such as discharge points into a receiving water. Construction activity does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility.

The owner of the land where the construction activity is occurring is responsible for obtaining a permit. Owners may obtain coverage under the General Permit by filing a NOI in accordance with the following instructions. Coverage for construction activity conducted on easements (e.g., pipeline construction) or on nearby properties by agreement or permission, or by an owner or lessee of a mineral estate (oil, gas, geothermal, aggregate, precious metals, and/or industrial minerals) entitled to conduct the activities, shall be obtained by the entity responsible for the construction activity. Linear construction projects which will have construction activity occurring in one or more than one Region should contact the State Water Resources Control Board at the number listed below prior to submitting an NOI application for specific information related to the use of the NOI form.

Construction Activity Not Covered By This General Permit

Storm water discharges in the Lake Tahoe Hydrologic Unit will be regulated by a separate permit(s) adopted by the California Regional Water Quality Control Board, Lahontan Region, and will not be covered under the State Water Resources Control Board's (SWRCB) General Permit. Storm water discharges on Indian Lands will be regulated by the U.S. Environmental Protection Agency.

Where to Apply

The NOI form, vicinity map, and appropriate fee must be mailed to the SWRCB at the following address:

State Water Resources Control Board
Division of Water Quality
Attn: Storm Water Permit Unit
P.O. Box 1977
Sacramento, CA 95812-1977

When to Apply

Property owners proposing to conduct construction activities subject to this General Permit must file a Notice of Intent prior to the commencement of construction activity.

Fees

The annual fee is $700 for all construction sites submitting an NOI. Checks should be made payable to: SWRCB.

Completing the Notice of Intent (NOI)

The submittal to obtain coverage under the General Permit must include a completed NOI Form (Notice of Intent, attached), a vicinity map, and the appropriate annual fee. The NOI must be completely and accurately filled out; the vicinity map and annual fee must be included with the NOI or the submittal is considered incomplete and will be rejected. A construction site is considered to be covered by the General Permit upon filing a complete NOI submittal, and implementation of a defensible Storm Water Pollution Prevention Plan (SWPPP). Upon receipt of a complete NOI submittal, each discharger will be sent a receipt letter containing the waste discharger's identification (WDID) number.

Questions?

If you have any questions on completing the NOI please call the SWRCB at (916) 341-5537.

## NOI-LINE-BY-LINE INSTRUCTIONS

Please type or print when completing the NOI Form and vicinity map.

SECTION I--NOI STATUS

Mark one of the two boxes at the top portion of the NOI. Check box 1 if the NOI is being completed for new construction. Check box 2 if the NOI is being submitted to report changes for a construction site already covered by the General Permit. An example of a change that warrants a resubmittal of the NOI is a change of total area of the construction site. The permit is non-transferable, a change of ownership requires a Notice of Termination (NOT) submittal and a new NOI. Complete only those portions of the NOI that apply to the changes (the NOI must always be signed). If box 2 is checked, the WDID number must be included.

SECTION II--PROPERTY OWNER

Enter the construction site owner's official or legal name and address; contact person (if other than owner), title, and telephone number.

SECTION III--DEVELOPER / CONTRACTOR INFORMATION

Enter the name of the developer's (or general contractor's) official or legal name, address, contact person, title, and telephone number. The contact person should be someone who is familiar with the construction site and is responsible for compliance and oversight of the general permit.

SECTION IV-CONSTRUCTION PROJECT INFORMATION

Enter the project name, site address, county, city, (or nearest city if construction is occurring in an unincorporated area), zip code, and telephone number (if any) of the construction site. Include an emergency contact telephone or pager number. Construction site information should include latitude and longitude designations, tract numbers, and/or mile post markers, if applicable. The site contact person should be someone who is familiar with the project, site plans, SWPPP, and monitoring program. All NOIs must be accompanied by a vicinity map.

Part A: Enter the total size in acres of all areas associated with construction activity, including all access roads.

Part B: Enter the total size in acres of the area to be disturbed by construction activity and the percentage of the area listed in Part A above that this represents.

Part C: Enter the percentage of the site that is impervious (areas where water cannot soak into the ground, such as concrete, asphalt, rooftops, etc.) before and after construction.

Part D: Include tract numbers, if available.

Part E: Enter the mile post marker number at the project site location.

Part F: Indicate whether the construction site is part of a larger common plan of development or sale. For example, if the construction activity is occurring on a two-acre site which is within a development that is one acre or greater, answer yes.

Part G: Enter the name of the development (e.g. "Quail Ridge Subdivision", "Orange Valley Estates", etc.).

Part H: Indicate when construction will begin (month, day, year). When a NOI is being submitted due to a change in ownership, the commencement date should be the date the new ownership took effect.

Part I: Indicate the percentage of the total project area to be mass graded.

Part J: Enter the estimated completion dates for the mass grading activities and for the project completion.

Part K: Indicate the type(s) of construction taking place. For example, "Transportation" should be checked for the construction of roads; "Utility" should be checked for installation of sewer, electric, or telephone systems. Include a description of the major construction activities, (e.g., 20 single family homes, a supermarket, an office building, a factory, etc.)

SECTION V--BILLING ADDRESS

To continue coverage under the General Permit, the annual fee must be paid. Indicate where the annual fee invoice should be mailed by checking one of the following boxes:

Owner: sent to the owners address as it appears in Section II.

Developer/Contractor: sent to the developer's address as it appears in Section III.

Other: sent to a different address and enter that address in the spaces provided.

SECTION VI--REGULATORY STATUS

Indicate whether or not the site is subject to local erosion/sediment control ordinances. Indicate whether the erosion/sediment control plan designed to comply with the ordinance addresses the construction of infrastructure and structures in addition to grading. Identify the name and telephone number of the local agency, if applicable.

SECTION VII--RECEIVING WATER INFORMATION

Part A: Indicate whether the storm water runoff from the construction site discharges indirectly to waters of the United States, directly to waters of the United States, or to a separate storm drain system.

Indirect discharges include discharges that may flow overland across adjacent properties or rights-of-way prior to discharging into waters of the United States.

Enter the name of the owner/operator of the relevant storm drain system, if applicable. Storm water discharges directly to waters of the United States will typically have an outfall structure directly from the facility to a river, lake, creek, stream, bay, ocean, etc. Discharges to separate storm sewer systems are those that discharge to a collection system operated by municipalities, flood control districts, utilities, or similar entities.

Part B: Enter the name of the receiving water. Regardless of point of discharge, the owner must determine the receiving water for the construction site's storm water discharge. Enter the name of the receiving water.

SECTION VIII--IMPLEMENTATION OF NPDES PERMIT REQUIREMENTS

Part A: Indicate the status of the SWPPP, date prepared, or availability for review. Also indicate if a tentative construction schedule has been included in the SWPPP (the inclusion of a construction activity schedule is a mandatory SWPPP requirement).

Part B: Provide information concerning the status of the development of a monitoring program, a component of the SWPPP which outlines an inspection and maintenance schedule for the proposed Best Management Practices (BMPs). Provide name and phone number of program preparer.

Part C: Provide the name and phone numbers of the responsible party or parties designated to insure compliance with all elements of the General Permit and SWPPP.

SECTION IX--VICINITY MAP AND FEE

Provide a "to scale" or "to approximate scale" drawing of the construction site and the immediate surrounding area. Whenever possible, limit the map to an 8.5" x 11' or 11" x 17" sheet of paper. At a minimum, the map must show the site perimeter, the geographic features surrounding the site, and general topography, and a north arrow. The map must also include the location of the construction project in relation to named streets, roads, intersections, or landmarks. A NOI containing a map which does not clearly indicate the location of the construction project will be rejected. Do not submit blueprints unless they meet the above referenced size limits.

SECTION X--CERTIFICATIONS

This section must be completed by the owner or signatory agent of the construction site*. The certification provides assurances that the NOI and vicinity map were completed in an accurate and complete fashion and with the knowledge that penalties exist for providing false information. Certification also requires the owner to comply with the provisions in the General Permit.

* For a corporation: a responsible corporate officer (or authorized individual). For a partnership or sole proprietorship: a general partner or the proprietor, respectively. For a municipality, State, Federal, or other public agency: either a principal executive officer, ranking elected official, or duly authorized representative.

Attachment 2

State Water Resources Control Board

# NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF THE
GENERAL PERMIT TO DISCHARGE STORM WATER
ASSOCIATED WITH CONSTRUCTION ACTIVITY (WQ ORDER No. 99-08-DWQ)

## I. NOI STATUS (SEE INSTRUCTIONS)

MARK ONLY ONE ITEM 1. ☐ New Construction 2. ☐ Change of Information for WDID# ______

## II. PROPERTY OWNER

| | | | |
|---|---|---|---|
| Name | Contact Person | | |
| Mailing Address | Title | | |
| City | State | Zip | Phone ( ) - |

## III. DEVELOPER/CONTRACTOR INFORMATION

| | | | |
|---|---|---|---|
| Developer/Contractor | Contact Person | | |
| Mailing Address | Title | | |
| City | State | Zip | Phone ( ) - |

## IV. CONSTRUCTION PROJECT INFORMATION

| | | | | |
|---|---|---|---|---|
| Site/Project Name | Site Contact Person | | | |
| Physical Address/Location | Latitude ____ ° | Longitude ____ ° | County | |
| City (or nearest City) | Zip | Site Phone Number ( ) - | Emergency Phone Number ( ) - | |

A. Total size of construction site area: ________ Acres

B. Total area to be disturbed: ________ Acres (% of total ______)

C. Percent of site imperviousness (including rooftops):

Before Construction: ________%

After Construction: ________%

D. Tract Number(s): ________; ________

E. Mile Post Marker: ________

F. Is the construction site part of a larger common plan of development or sale? ☐ YES ☐ NO

G. Name of plan or development:

H. Construction commencement date: ___/___/___

I. % of site to be mass graded: ________

J. Projected construction dates:

Complete grading: ___/___/___ Complete project: ___/___/___

K. Type of Construction (Check all that apply):

1. ☐ Residential 2. ☐ Commercial 3. ☐ Industrial 4. ☐ Reconstruction 5. ☐ Transportation

6. ☐ Utility Description: ________ 7. ☐ Other (Please List): ________

## V. BILLING INFORMATION

| | | | |
|---|---|---|---|
| SEND BILL TO: ☐ OWNER (as in II. above) | Name | Contact Person | |
| ☐ DEVELOPER (as in III. above) | Mailing Address | Phone/Fax | |
| ☐ OTHER (enter information at right) | City | State | Zip |

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## VI. REGULATORY STATUS

A. Has a local agency approved a required erosion/sediment control plan? ☐ YES ☐ NO

Does the erosion/sediment control plan address construction activities such as infrastructure and structures? ☐ YES ☐ NO

Name of local agency: ______________________ Phone: (    ) ___ - ______

B. Is this project or any part thereof, subject to conditions imposed under a CWA Section 404 permit of 401 Water Quality Certification? ☐ YES ☐ NO

If yes, provide details: ______________________

## VII. RECEIVING WATER INFORMATION

A. Does the storm water runoff from the construction site discharge to (Check all that apply):

1. ☐ **Indirectly to waters of the U.S.**
2. ☐ **Storm drain system - Enter owner's name:** ______________________
3. ☐ **Directly to waters of U.S. (e.g., river, lake, creek, stream, bay, ocean, etc.)**

B. Name of receiving water: (river, lake, creek, stream, bay, ocean): ______________________

## VIII. IMPLEMENTATION OF NPDES PERMIT REQUIREMENTS

A. STORM WATER POLLUTION PREVENTION PLAN (SWPPP) (check one)

☐ A SWPPP has been prepared for this facility and is available for review: Date Prepared: ___/___/___ Date Amended: ___/___/___

☐ A SWPPP will be prepared and ready for review by (enter date): ___/___/___

☐ A tentative schedule has been included in the SWPPP for activities such as grading, street construction, home construction, etc.

B. MONITORING PROGRAM

☐ A monitoring and maintenance schedule has been developed that includes inspection of the construction BMPs before anticipated storm events and after actual storm events and is available for review.

If checked above: A qualified person has been assigned responsibility for pre-storm and post-storm BMP inspections to identify effectiveness and necessary repairs or design changes ☐ YES ☐ NO

Name: ______________________ Phone: (    ) ___ - ______

C. PERMIT COMPLIANCE RESPONSIBILITY

A qualified person has been assigned responsibility to ensure full compliance with the Permit, and to implement all elements of the Storm Water Pollution Prevention Plan including:

1. Preparing an annual compliance evaluation ☐ YES ☐ NO

Name: ______________________ Phone: (    ) ___ -- ______

2. Eliminating all unauthorized discharges ☐ YES ☐ NO

## IX. VICINITY MAP AND FEE (must show site location in relation to nearest named streets, intersections, etc.)

Have you included a vicinity map with this submittal? ☐ YES ☐ NO

Have you included payment of the annual fee with this submittal? ☐ YES ☐ NO

## X. CERTIFICATIONS

"I certify under penalty of law that this document and all attachments were prepared under my direction and 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, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. In addition, I certify that the provisions of the permit, including the development and implementation of a Storm Water Pollution Prevention Plan and a Monitoring Program Plan will be complied with."

**Printed Name:** ______________________

**Signature:** ______________________ **Date:** ______________

**Title:** ______________________

ATTACHMENT 3

## 303d Listed Water Bodies for Sedimentation

| REGION | WATER BODY NAME | CODE | POLLUTANT |
|---|---|---|---|
| 1 | MATTOLE RIVER | 1100 | Sedimentation/Siltation |
| 1 | TRINITY RIVER, SOUTH FORK | 1100 | Sedimentation/Siltation |
| 1 | REDWOOD CREEK | 1100 | Sedimentation/Siltation |
| 1 | MAD RIVER | 1100 | Sedimentation/Siltation |
| 1 | ELK RIVER | 1100 | Sedimentation/Siltation |
| 1 | EEL RIVER, SOUTH FORK | 1100 | Sedimentation/Siltation |
| 1 | EEL RIVER, NORTH FORK | 1100 | Sedimentation/Siltation |
| 1 | TRINITY RIVER | 1100 | Sedimentation/Siltation |
| 1 | EEL RIVER, MIDDLE FORK | 1100 | Sedimentation/Siltation |
| 1 | MAD RIVER | 2500 | Turbidity |
| 1 | TEN MILE RIVER | 1100 | Sedimentation/Siltation |
| 1 | NOYO RIVER | 1100 | Sedimentation/Siltation |
| 1 | BIG RIVER | 1100 | Sedimentation/Siltation |
| 1 | ALBION RIVER | 1100 | Sedimentation/Siltation |
| 1 | NAVARRO RIVER | 1100 | Sedimentation/Siltation |
| 1 | GARCIA RIVER | 1100 | Sedimentation/Siltation |
| 1 | GUALALA RIVER | 1100 | Sedimentation/Siltation |
| 1 | RUSSIAN RIVER | 1100 | Sedimentation/Siltation |
| 1 | TOMKI CREEK | 1100 | Sedimentation/Siltation |
| 1 | VAN DUZEN RIVER | 1100 | Sedimentation/Siltation |
| 1 | EEL RIVER DELTA | 1100 | Sedimentation/Siltation |
| 1 | EEL RIVER, MIDDLE MAIN FORK | 1100 | Sedimentation/Siltation |
| 1 | ESTERO AMERICANO | 1100 | Sedimentation/Siltation |
| 1 | NAVARRO RIVER DELTA | 1100 | Sedimentation/Siltation |
| 1 | EEL RIVER, UPPER MAIN FORK | 1100 | Sedimentation/Siltation |
| 1 | FRESHWATER CREEK | 1100 | Sedimentation/Siltation |
| 1 | SCOTT RIVER | 1100 | Sedimentation/Siltation |
| 2 | TOMALES BAY | 1100 | Sedimentation/Siltation |
| 2 | NAPA RIVER | 1100 | Sedimentation/Siltation |
| 2 | SONOMA CREEK | 1100 | Sedimentation/Siltation |
| 2 | PETALUMA RIVER | 1100 | Sedimentation/Siltation |
| 2 | LAGUNITAS CREEK | 1100 | Sedimentation/Siltation |
| 2 | WALKER CREEK | 1100 | Sedimentation/Siltation |
| 2 | SAN GREGORIO CREEK | 1100 | Sedimentation/Siltation |

| | | | |
|---|---|---|---|
| 2 | SAN FRANCISQUITO CREEK | 1100 | Sedimentation/Siltation |
| 2 | PESCADERO CREEK (REG 2) | 1100 | Sedimentation/Siltation |
| 2 | BUTANO CREEK | 1100 | Sedimentation/Siltation |
| 3 | MORRO BAY | 1100 | Sedimentation/Siltation |
| 3 | SAN LORENZO RIVER ESTUARY | 1100 | Sedimentation/Siltation |
| 3 | SHINGLE MILL CREEK | 1100 | Sedimentation/Siltation |
| 3 | MOSS LANDING HARBOR | 1100 | Sedimentation/Siltation |
| 3 | WATSONVILLE SLOUGH | 1100 | Sedimentation/Siltation |
| 3 | SAN LORENZO RIVER | 1100 | Sedimentation/Siltation |
| 3 | ELKHORN SLOUGH | 1100 | Sedimentation/Siltation |
| 3 | SALINAS RIVER LAGOON (NORTH) | 1100 | Sedimentation/Siltation |
| 3 | GOLETA SLOUGH/ESTUARY | 1100 | Sedimentation/Siltation |
| 3 | CARPINTERIA MARSH (EL ESTERO MARSH) | 1100 | Sedimentation/Siltation |
| 3 | LOMPICO CREEK | 1100 | Sedimentation/Siltation |
| 3 | MORO COJO SLOUGH | 1100 | Sedimentation/Siltation |
| 3 | VALENCIA CREEK | 1100 | Sedimentation/Siltation |
| 3 | PAJARO RIVER | 1100 | Sedimentation/Siltation |
| 3 | RIDER GULCH CREEK | 1100 | Sedimentation/Siltation |
| 3 | LLAGAS CREEK | 1100 | Sedimentation/Siltation |
| 3 | SAN BENITO RIVER | 1100 | Sedimentation/Siltation |
| 3 | SALINAS RIVER | 1100 | Sedimentation/Siltation |
| 3 | CHORRO CREEK | 1100 | Sedimentation/Siltation |
| 3 | LOS OSOS CREEK | 1100 | Sedimentation/Siltation |
| 3 | SANTA YNEZ RIVER | 1100 | Sedimentation/Siltation |
| 3 | SAN ANTONIO CREEK (SANTA BARBARA COUNTY) | 1100 | Sedimentation/Siltation |
| 3 | CARBONERA CREEK | 1100 | Sedimentation/Siltation |
| 3 | SOQUEL LAGOON | 1100 | Sedimentation/Siltation |
| 3 | APTOS CREEK | 1100 | Sedimentation/Siltation |
| 4 | MUGU LAGOON | 1100 | Sedimentation/Siltation |
| 5 | HUMBUG CREEK | 1100 | Sedimentation/Siltation |
| 5 | PANOCHE CREEK | 1100 | Sedimentation/Siltation |
| 5 | FALL RIVER (PIT) | 1100 | Sedimentation/Siltation |
| 6 | BEAR CREEK (R6) | 1100 | Sedimentation/Siltation |
| 6 | MILL CREEK (3) | 1100 | Sedimentation/Siltation |
| 6 | HORSESHOE LAKE (2) | 1100 | Sedimentation/Siltation |
| 6 | BRIDGEPORT RES | 1100 | Sedimentation/Siltation |
| 6 | TOPAZ LAKE | 1100 | Sedimentation/Siltation |
| 6 | LAKE TAHOE | 1100 | Sedimentation/Siltation |

| | | | |
|---|---|---|---|
| 6 | PINE CREEK (2) | 1100 | Sedimentation/Siltation |
| 6 | TRUCKEE RIVER | 1100 | Sedimentation/Siltation |
| 6 | CLEARWATER CREEK | 1100 | Sedimentation/Siltation |
| 6 | GRAY CREEK (R6) | 1100 | Sedimentation/Siltation |
| 6 | WARD CREEK | 1100 | Sedimentation/Siltation |
| 6 | BLACKWOOD CREEK | 1100 | Sedimentation/Siltation |
| 6 | GOODALE CREEK | 1100 | Sedimentation/Siltation |
| 6 | EAST WALKER RIVER | 1100 | Sedimentation/Siltation |
| 6 | HEAVENLY VALLEY CREEK | 1100 | Sedimentation/Siltation |
| 6 | WOLF CREEK (1) | 1100 | Sedimentation/Siltation |
| 6 | WEST WALKER RIVER | 1100 | Sedimentation/Siltation |
| 6 | HOT SPRINGS CANYON CREEK | 1100 | Sedimentation/Siltation |
| 6 | BRONCO CREEK | 1100 | Sedimentation/Siltation |
| 6 | SQUAW CREEK | 1100 | Sedimentation/Siltation |
| 7 | IMPERIAL VALLEY DRAINS | 1100 | Sedimentation/Siltation |
| 7 | NEW RIVER (R7) | 1100 | Sedimentation/Siltation |
| 7 | ALAMO RIVER | 1100 | Sedimentation/Siltation |
| 8 | SAN DIEGO CREEK, REACH 1 | 1100 | Sedimentation/Siltation |
| 8 | RATHBONE (RATHBUN) CREEK | 1100 | Sedimentation/Siltation |
| 8 | SAN DIEGO CREEK, REACH 2 | 1100 | Sedimentation/Siltation |
| 8 | UPPER NEWPORT BAY ECOLOGICAL RESERVE | 1100 | Sedimentation/Siltation |
| 8 | BIG BEAR LAKE | 1100 | Sedimentation/Siltation |
| 8 | ELSINORE, LAKE | 1100 | Sedimentation/Siltation |
| 9 | SAN ELIJO LAGOON | 1100 | Sedimentation/Siltation |
| 9 | LOS PENASQUITOS LAGOON | 1100 | Sedimentation/Siltation |
| 9 | AGUA HEDIONDA LAGOON | 1100 | Sedimentation/Siltation |
| 9 | BUENA VISTA LAGOON | 1100 | Sedimentation/Siltation |

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NEW OWNER INFORMATION AND
CHANGE OF INFORMATION (COI) FORM FOR THE
GENERAL CONSTRUCTION PERMIT NO. CAS000002

Owners Name: ______________________
WDID No.: ______________________
Prepared By: ______________________

Date: ______________________
Date of Last NOI Change: ______________________
Signature of Preparer: ______________________

| | Area Transferred (acres)[1] column 1 | Area Remaining (acres)[2] column 2 | Lot/Tract Numbers Transferred | Contact Person and Company Name of NewOwner(s) | Address(es) of the New Owner(s) | Phone # of New Owner | Is Const/Post Construction Complete? Yes/No | Date of Ownership Transfer |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |

[1]Use approximate area (in acres) if no exact figure is available.
[2]Calculate running total in this column as follows:
Enter in column 2, line 1, the area from NOI minus the area in column 1.
Enter in column 2, line 2, the area in column 2, line 1, minus the area in line 2, column 1.
Enter in column 2, line 3, the area in column 2, line 2, minus the area in line 3, column 1, and so forth.

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# Appendix B
# SWPPP Template

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CALIFORNIA STORMWATER BMP HANDBOOK

CONSTRUCTION

# STORM WATER

# POLLUTION

# PREVENTION

# PLAN

## TEMPLATE

The California Stormwater Quality Association (CASQA)
is an independent advisory group.
The statements, views, and contents of this document do no necessarily reflect those of the State Water Resources Control Board or the Regional Water Quality Control Boards.

Revised January 20, 2006

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# California Stormwater Best Management Practices Handbook Construction

## REQUIREMENTS FOR A STORM WATER POLLUTION PREVENTION PLAN

A Storm Water Pollution Prevention Plan (SWPPP) must be developed and implemented for construction projects that disturb one (1) acre or more, in accordance with the following:

(1) *State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Storm Water Runoff Associated with Construction Activity (General Permit);*

(2) *State Water Resources Control Board Resolution No. 2001- 046, Modification of Water Quality Order 99-08-DWQ State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity (General Permit);* and

(3) *State Water Resources Control Board Resolution No. 2001-155, Modification of Water Quality Order 99-08-DWQ State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity (General Permit) to include Small Construction Activity (One to Five Acres)*

The purpose of the SWPPP is to identify potential pollutant sources that may affect the quality of discharges associated with construction activity, to identify non-storm water discharges, and to design the use and placement of Best Management Practices (BMPs) to effectively prohibit the entry of pollutants from the construction site into the storm drain system during construction. Erosion and sediment source control BMPs must be considered for both active and inactive (previously disturbed) construction areas. BMPs for wind erosion and dust control are also included. The SWPPP will likely require modification as the project progresses and as conditions warrant.

The template herein is provided for information purposes to assist Developers/Contractors in preparing a SWPPP. Other SWPPP templates developed by individual agencies may also be used.

Prior to the issuance of any construction/grading permit for private projects subject to the General Permit, the Owner/Contractor must provide proof of submittal of a Notice of Intent (NOI) to the Regional Water Quality Control Board (RWQCB) to comply with the General Permit.

Prior to the commencement of any clearing, grading or excavation of any public works project subject to the General Permit, a SWPPP will be prepared and implemented. The template herein can be used for preparing the SWPPP.

The Owner, or owner's authorized representative as defined in Section C, Item 9.b. of the General Permit, is responsible for signing or approving NOIs, SWPPP Approval or Certification, Annual Compliance Certifications, and Amendments to the SWPPP, and for ensuring that all project Contractors and subcontractors implement applicable BMPs.

The Storm Water Pollution Prevention Plan and BMPs (EC, SE, WM, etc.) referenced are from the following sources:

> California Stormwater BMP Handbook - Construction, 2003 Edition. The Handbooks may be downloaded from the California Stormwater BMP Handbook web site at www.cabmphandbooks.com.

## INSTRUCTIONS

- The title page shall have the following information:
  - ☐ Title: "Storm Water Pollution Prevention Plan"
  - ☐ Project Name
  - ☐ Project Grading Permit Number, Building Permit Number, Tract Number, CUP, SUP, and/or APN
  - ☐ Project Owner - or Lead Agency (City, County, Transportation, Military, or other Agency) - Name, Address, Telephone Number, and Authorized Representative
  - ☐ Construction Contractor company Name, Address, Telephone Number, and Authorized Representative
  - ☐ Job Site Location/Address and Telephone Number, if Any
  - ☐ Name of Contractor's Storm Water Pollution Prevention Manager (SWPPM). This person shall be responsible for SWPPP implementation, inspection and repairs.
  - ☐ Name of the Consulting Engineering company that prepared the SWPPP (if it was prepared by an outside consultant), including name and title of preparer
  - ☐ SWPPP Preparation Date
  - ☐ Estimated dates for start and end of construction
  - ☐ WDID Number (hand written)

- A template title page is provided below.

## REQUIRED TEXT:

# Storm Water Pollution Prevention Plan

**For:**

**Start Here...Triple Click here to insert Project Name-then TAB to next field**

**INSERT GRADING PERMIT NO., BUILDING PERMIT NO., TRACT NUMBER, CUP, SUP AND/OR APN -THEN TAB TO NEXT FIELD.**

**Prepared for:**

**Insert Name of Owner or Lead Agency-then TAB.**
**Insert Address 1 and press ENTER to insert Address 2 or TAB to next field.**
**Insert City, State, ZIP-then TAB.**
**Insert Name of Authorized Representative [or Engineer for a Public Agency] -then TAB.**
**Insert Authorized Representative's Telephone Number-then TAB.**

**Contractor:**

**Insert Contractor's Company Name-then TAB.**
**Insert Address 1 then press ENTER to insert Address 2 or TAB to next field.**
**Insert City, State, ZIP-then TAB.**
**Insert Telephone-then TAB.**
**Insert Contractor's Representative's Name-then TAB.**

**Project Site Location/Address:**

**Insert project site address if any. Press the DELETE key if not and TAB to next field.**
**Insert job site telephone number, if any. Press the DELETE key if not and TAB to next field.**

**Contractor's Storm Water Pollution Prevention Manager**

**Insert SWPPM's Name-then TAB.**
**Insert Telephone Number(s)-then TAB.**

**SWPPP Prepared by:**

**Insert Company Name-then TAB.**
**Insert Address-then TAB.**
**Insert City, State, ZIP-then TAB.**
**Insert Telephone-then TAB**
**Insert Name and Title of Preparer-then TAB.**

**SWPPP Preparation Date:**

**Insert Date**

**Estimated Project Dates:**

**Start of Construction: Insert Date Completion of Construction: Insert Date**

**WDID No.:________________**

## INSTRUCTIONS

- ☐ Include the numbers and names for each section of the SWPPP, from Section 100 to Section 600. List the first page number of each subsection.
- ☐ Include a Tab for each major section of the SWPPP and for each of the attachments.

## REQUIRED TEXT:

# Contents

## SWPPP Attachments

# Section 100
# SWPPP Certifications and Approval

## 100.1 SWPPP Certification by Preparer

**INSTRUCTIONS:**

- ☐ Include a Separator and Tab for Section 100 for ready reference.

- ■ The SWPPP should be signed and certified by the Preparer or authorized qualified designee.

- ☐ Fill in the project name and the grading permit number, building permit number, tract number, CUP, SUP or APN at the top of the form.
- ☐ Certification shall be signed and dated by the person responsible for preparation of the SWPPP.
- ☐ Fill in the name, title and telephone number of the person signing the certification.
- ☐ The SWPPP and Monitoring Program Checklist in Attachment L shall be completed and submitted.
- ☐ The Notice of Intent (NOI) is to be attached in Attachment F. The completed form must be provided by the Owner or Owner's signatory agent.

**REQUIRED TEXT: To be completed by SWPPP Preparer**

Project Name: Start Here...Triple Click here to insert Project Name-then TAB to next field

Project Number: Insert Grading Permit No., Building Permit No., Tract Number, CUP, SUP and/or APN -then TAB to next field.

"I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure 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 information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Preparer's Signature

Date

Preparer's Name and Title

Telephone Number

## 100.2 Owner Approval and Certification of SWPPP

### INSTRUCTIONS:

- The SWPPP shall be signed and certified by the Owner or Owner's Authorized Representative in conformance with Section C, Item 9 of the General Construction Permit (CAS000002, Order No. 99-08-DWQ).
- This certification shall be signed by a responsible corporate officer, principal executive officer, general partner or proprietor, or by a duly authorized representative. A person is a duly authorized representative only if:
  1. The authorization is made in writing by a person described above and retained as part of the SWPPP.
  2. The authorization specifies either an individual or a position having responsibility for the overall operation of the construction activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility or an individual or position having overall responsibility for environmental matters of the company or agency.
  3. If an authorization is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization must be reported to the Regional Board and attached to the SWPPP prior to submittal of any reports, certifications, or information signed by the authorized representative.
- In the case of Public Works projects, the [City] Engineer is the authorized representative of the agency for approving, signing, and certifying the SWPPP, in conformance with Section C, Item 9 of the General Construction Permit (CAS000002, Order No. 99-09-DWQ).

  - ☐ Fill in the project name and the grading permit number, building permit number, tract number, CUP, SUP or APN at the top of the form.
  - ☐ Certification shall be signed and dated by the Owner staff; specifically, the person responsible for preparation of the SWPPP and/or person responsible for overall management of the site, such as a corporate officer or person assigned the responsibility by a corporate officer, according to corporate procedures.
  - ☐ Fill in the name(s), title(s) and telephone number(s) of the person(s) signing the certification.

### REQUIRED TEXT:

## Owner's (or Authorized Representative) Approval and Certification of the Storm Water Pollution Prevention Plan

| | |
|---|---|
| Project Name: | Start Here…Triple Click here to insert Project Name-then TAB to next field |
| Project Number: | Insert Grading Permit No., Building Permit No., Tract Number, CUP, SUP and/or APN -then TAB to next field. |

"I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure 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 information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Owner (or Authorized Representative) Signature | Date

Name and Title | Telephone Number

## 100.3 Annual Compliance Certification

**INSTRUCTIONS:**

- Owner or Owner's Authorized Representative, qualified assigned/authorized personnel or signatory agent, listed by name and contact telephone number in the SWPPP, shall certify annually that construction activities comply with the requirements of the Permit and the SWPPP. This Certification is based upon the site inspections required in Section 600.
- The Owner or Owner's Authorized Representative is responsible for completing and submitting a Letter of Certification and Annual Fee to the RWQCB prior to July 1 of each year.
- A blank copy of the Annual Certification of Compliance shall be included in the SWPPP as Attachment M.
- Completed and signed Annual Compliance Certifications and [City] Engineer Approvals shall be included in this section of the SWPPP following the required text, below.
- Do not complete the Annual Certification during the initial SWPPP approval. Annual certifications are completed by July 1 each year. For those projects that start construction on or after July 1, an Annual Certification will not be required until the following July 1.

**REQUIRED TEXT:**

By July 1 of each year, the Owner shall submit an Annual Certification of Compliance to the appropriate Regional Water Quality Control Board (RWQCB), stating compliance with the terms and conditions of the Permit and the SWPPP. The Annual Certification of Compliance Form is included in Attachment M. Completed Annual Certifications of Compliance and Approvals can be found in the following pages.

# Section 200
# SWPPP Amendments

## 200.1 SWPPP Amendment Certification and Approval

**INSTRUCTIONS:**

- ☐ Include a Separator and Tab for Section 200 for ready reference.

- When changes to the approved SWPPP are required, the SWPPP Preparer shall prepare and certify an amendment. The Owner or Owner's Authorized Representative shall review and approve all amendments.
- The SWPPP shall be amended:
  - Whenever there is a change in construction or operations which may affect the discharge of pollutants to surface waters, groundwater(s), or a municipal separate storm sewer system (MS4);

    Or
  - If any condition of the Permit is violated or the general objective of reducing or eliminating pollutants in storm water discharges has not been achieved. If the RWQCB determines that a Permit violation has occurred, the SWPPP shall be amended and implemented within 14-calendar days after notification by the RWQCB;

    And
  - Annually, prior to the defined rainy season.
- All SWPPP amendments shall include revised drawings as appropriate.
- All amendments shall be recorded in the SWPPP Amendment Log that is located in Section 200.2 of the SWPPP.
- Amendments will be inserted into the on-site SWPPP. Owner Certifications for all amendments shall be inserted into this section.
- The following items shall be included in each amendment:
  - Discuss who requested the amendment.
  - Describe the location of proposed change.
  - Describe reason for change.

- Describe the original BMP proposed, if any.
- Describe the new BMP proposed.
- Describe any existing implemented BMP(s)

- [ ] This SWPPP certification and approval form shall be used as a cover sheet for each amendment.
- [ ] Fill-in the Project name and number.
- [ ] The Owner or Owner's Authorized Representative shall sign and date the certification form.
- [ ] For Public Works projects, the [City] Engineer or Agency's authorized representative shall sign and date the certification approval form.
- [ ] Print the names and telephone numbers.

## EXAMPLE:

The Regional Water Quality Board has requested the following Amendment:

The concrete washout is to be relocated away from the drainage inlet at Miller Ave. It is now located on the northeast section of the construction site, see revised map. This change will prevent concrete washout water from entering the drainage inlet.

## REQUIRED TEXT:

This SWPPP shall be amended:

- Whenever there is a change in construction or operations which may affect the discharge of pollutants to surface waters, groundwater(s), or a municipal separate storm sewer system (MS4); or
- If any condition of the Permits is violated or the general objective of reducing or eliminating pollutants in storm water discharges has not been achieved. If the RWQCB determines that a Permit violation has occurred, the SWPPP shall be amended and implemented within 14-calendar days after notification by the RWQCB;
- Annually, prior to the defined rainy season; and
- When deemed necessary by the Owner.

The following items will be included in each amendment:

- Who requested the amendment.
- The location of proposed change.
- The reason for change.
- The original BMP proposed, if any.
- The new BMP proposed.

The amendments for this SWPPP, along with the Owner's Certification and the Owner approval, can be found in the following pages. Amendments are listed in the Amendment Log in section 200.2

INSERT ADDITIONAL RESPONSIBILITIES AND/OR NAMES HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

## SWPPP Amendment No.

| | |
|---|---|
| Project Name: | Start Here...Triple Click here to insert Project Name-then TAB to next field |
| Project Number: | Insert Grading Permit No., Building Permit No., Tract Number, CUP, SUP and/or APN -then TAB to next field. |

### Preparer Certification of the Storm Water Pollution Prevention Plan Amendment

"I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure 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 information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Preparer's Signature — Date

Preparer's Name and Title — Telephone Number

### Owner (or Owner's Authorized Representative) Approval of the Storm Water Pollution Prevention Plan Amendment

"I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure 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 information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Owner (or Authorized Representative) Signature — Date

Name and Title — Telephone Number

## 200.2 Amendment Log

**INSTRUCTIONS:**

- SWPPP amendment(s) prepared and approved as discussed in Section 200.1 shall be documented in the Amendment Log, which shall be kept in Section 200 of the SWPPP, immediately following the Certification and Approval forms.
- All amendments shall be dated, directly attached to the SWPPP, and listed in the Amendment Log.
  - ❑ Enter the project name and number(s) at the top of the form.
  - ❑ Enter the Amendment number, Date, Brief Description, and Name of Person Who Prepared the Amendment in the table.

**EXAMPLE:**

| Amendment No. | Date | Brief Description of Amendment | Prepared By |
|---|---|---|---|
| 001 | Dec 10, 2000 | Grading schedule changed to begin on Feb 10, 2001, and will include additional 2 acres. Amended plans attached to SWPPP. | John Doe, Superintendent |

**REQUIRED TEXT:**

Project Name: Start Here...Triple Click here to insert Project Name-then TAB to next field

Project Number: Insert Grading Permit No., Building Permit No., Tract Number, CUP, SUP and/or APN -then TAB to next field.

| Amendment No. | Date | Brief Description of Amendment | Prepared By |
|---|---|---|---|
| | | | |
| | | | |

| Amendment No. | Date | Brief Description of Amendment | Prepared By |
|---|---|---|---|
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# Section 300
# Introduction and Project Description

## 300.1 Introduction and Project Description

**INSTRUCTIONS:**

- ❑ Include a Separator and Tab for Section 300 for ready reference.
- ❑ Provide the project's legal description, (County, City and address). Describe proximity to receiving waters to which the project will discharge, including surface waters, drainage channels, and drainage systems (identify who owns the drainage system; i.e., municipality or agency.)

**EXAMPLE:**

The construction project is located in Orange County, in Any city. The project is a land development that will ultimately include 600 single-family homes, a planned senior community and commercial properties. The project will be constructed in four stages. The main project features include mass grading, construction of water, storm drain and sewer lines, underground telephone, electric and cable TV lines, roadways and buildings.

**REQUIRED TEXT:**

CLICK AND TYPE PROJECT DESCRIPTION HERE

## 300.2 Unique Site Features

**INSTRUCTIONS:**

- ❑ Provide a brief description of any unique site features (water bodies, wetlands, environmentally sensitive areas, endangered or protected species, etc.) and significant or high-risk construction activities that may impact storm water quality. Include any unique features or activities within or adjacent to water bodies (such as dredging, dewatering, re-use of aerially deposited lead material, large excavations, or work within a water body).

**EXAMPLE:**

Conejo Creek traverses the project in a southwesterly direction. Conejo Creek is located east of the project site adjacent to the project limits. Conejo Creek is a dry creek that only flows during storm events.

**REQUIRED TEXT:**

CLICK AND TYPE PROJECT FEATURES HERE

## 300.3 Construction Site Estimates

**INSTRUCTIONS:**

- Provide an estimate of the following site features (Refer also to Attachments D and E):
  - ❑ Construction site area (acres)
  - ❑ Runoff coefficient before and after construction
  - ❑ Percentage impervious area before and after construction
  - ❑ Anticipated storm water run-on to the construction site (Show calculations and include as Attachment E).

**EXAMPLE:**

The following are estimates of the construction site:

| | |
|---|---|
| Construction site area: | 530 Acres |
| Percentage impervious area before construction: | 0 % |
| Runoff coefficient before construction (1): | 0.43 |
| Percentage impervious area after construction | 40% |
| Runoff coefficient after construction (1) | 0.60 |
| Anticipated storm water flow on to the construction site (2) | 35.1 cfs |

(1) Calculations are shown in Attachment D
(2) Calculations are shown in Attachment E

**REQUIRED TEXT:**

The following are estimates of the construction site:

| | | |
|---|---|---|
| Construction site area | ________ | acres |
| Percentage impervious area before construction | ________ | % |
| Runoff coefficient before construction (1) | ________ | |
| Percentage impervious area after construction | ________ | % |
| Runoff coefficient after construction (1) | ________ | |
| Anticipated storm water flow on to the construction site (2) | ________ | cfs |

(1) Calculations are shown in Attachment D
(2) Calculations are shown in Attachment E

## 300.4 Project Schedule/Water Pollution Control Schedule

**INSTRUCTIONS:**

- ❑ Provide a written and graphical project schedule. The schedule shall clearly show how the rainy season relates to soil-disturbing and re-stabilization activities. The schedule shall contain an adequate level of detail to show major activities sequenced with implementation of construction site BMPs, including:
  - ❑ Project start and finish dates
  - ❑ Rainy season dates
  - ❑ Annual certifications
  - ❑ Mobilization dates
  - ❑ Mass clearing and grubbing/roadside clearing dates
  - ❑ Major grading/excavation dates
  - ❑ Special dates named in other permits such as Fish and Game and Army Corps of Engineers Permits
  - ❑ Dates for submittal of SWPPP Amendments required by the contract documents
  - ❑ Annual submittal of rainy season implementation schedule if required by the Owner or Permittee

- ❑ Dates for implementation of pre-rainy season temporary soil stabilization and temporary sediment control BMPs, if required by the contract documents
- ❑ Rainy season implementation schedule
  - ❑ Deployment of temporary soil stabilization BMPs
  - ❑ Deployment of temporary sediment control BMPs
  - ❑ Deployment of wind erosion control BMPs
  - ❑ Deployment of tracking control BMPs
  - ❑ Deployment of non-storm water BMPs
  - ❑ Deployment of waste management and materials pollution control BMPs
- ❑ Non-rainy season implementation schedule
  - ❑ Deployment of temporary soil stabilization BMPs
  - ❑ Deployment of temporary sediment control BMPs
  - ❑ Deployment of wind erosion control BMPs
  - ❑ Deployment of tracking control BMPs
  - ❑ Deployment of non-storm water BMPs
  - ❑ Deployment of waste management and materials pollution control BMPs
- ❑ Paving, saw-cutting, and any other pavement related operations
- ❑ Major planned stockpiling operations
- ❑ Dates for other significant long-term operations or activities that may plan non-storm water discharges such as dewatering, grinding, etc.
- ❑ Final stabilization activities staged over time for each area of the project

■ Note: Projects located in the Lake Tahoe, Truckee River, East Fork Carson River, or West Fork Carson River Hydrologic Units, and project above 1,200 meters (5,000 ft) in elevations in the portions of Mono County or Inyo County within the Lahontan RWQCB are not allowed to perform removal of vegetation nor disturbance of existing ground surface conditions between October 15 of each year and May 1 of the following year; except when there is an emergency situation that threatens the public health or welfare, or when the project is granted a variance by the RWQCB Executive Officer.

# EXAMPLE: Written Schedule

Estimate Construction Start: 05/01/2000

Estimate Construction Finish: 04/15/2002

Mobilization of equipment and materials to begin on 05/01/2000

Store temporary soil stabilization and temporary sediment control products beginning on 05/01/2000.

Install stabilized construction entrance on 05/01/2000

Site preparation: Clearing and grubbing (Phase I) will occur from 05/25/2000-06/30/2000

Begin construction of residential units 5/30/2000-6/30/2001

Submit annual rainy season implementation schedule 9/25/00

Prepare soil stabilization and sediment control implementation plan prior to the rainy season; submit to the Owner by 09/25/2000

Start implementation of temporary soil stabilization and sediment control BMPs on 09/28/00 (before rainy season starts). Continue to implement and maintain temporary BMPs throughout rainy season.

Complete installation of temporary soil stabilization and sediment control BMPs on 10/05/2000

Rainy season begins 10/15/2000

Excavation to begin on 06/30/2000 and continue through 02/20/2001

Installation of utilities (power lines, phone lines, storm drain and sewer lines) 3/2001-9/2001

Grading work 07/15/2000 - 02/20/2001.

Clearing and grading for commercial property lots 7/30/2000 - 12/31/2000

Schedule soil stabilization subcontractors for application of temporary soil stabilization on disturbed areas and permanent erosion control on areas substantially complete: 09/01/2000

Rainy season ends 04/15/2001

Clearing and grubbing (Phase II) from 05/01/2001 through 07/30/2001

SWPPP Annual Certification due on 07/01/2001

Begin trenching, backfilling and compaction on 07/15/2001

Implement final erosion control of substantially completed areas 8/1/2001

Install temporary concrete washout 09/10/2001

Submit annual rainy season implementation schedule 09/25/2001

Start implementation of temporary soil stabilization and sediment control BMPs on 09/28/2001 (before rainy season starts). Continue to implement and maintain temporary BMPs throughout rainy season.

Complete installation of temporary soil stabilization and sediment control BMPs on 10/05/2001

Rainy season starts 10/15/2001

End construction of residential units on or before 01/25/2002

Begin final paving/construction on 02/01/2002. Continue to apply soil stabilization and sediment controls as needed during construction

Remove concrete washout and restore area to original grade

Schedule subcontractors for application of permanent erosion control 03/01/2002

Start final stabilization, revegetation, and landscape by 03/15/2002

Project complete 04/15/2002

**REQUIRED TEXT:**

CLICK AND TYPE EITHER NARRATIVE PROJECT SCHEDULE OR STATE THAT THE GRAPHIC SCHEDULE IS ON THE FOLLOWING PAGE. ADD PAGE BREAKS AS NEEDED TO MAKE SURE THAT THE PAGE NUMBERING IS CONSISTENT THROUGHOUT THE DOCUMENT.

## 300.5 Contact Information/List of Responsible Parties

**INSTRUCTIONS:**

- Contractor is required to show the Name, Address and Telephone number(s) of the person(s) responsible for SWPPP management/implementation, water pollution control and Permit compliance during construction. This person shall be called the Storm Water Pollution Prevention Manager (SWPPM).
- Duties of the SWPPM include but are not limited to:
  - Ensuring full compliance with the SWPPP and the Permit
  - Implementing all elements of the SWPPP and contract documents, including but not limited to:
    - Implementation of prompt and effective erosion and sediment control measures
    - Implementing all non-storm water management, and materials and waste management activities such as: monitoring discharges (dewatering, diversion devices); general site clean-up; vehicle and equipment cleaning, fueling and maintenance; spill control; ensuring that no materials other than storm water are

discharged in quantities which will have an adverse effect on receiving waters or storm drain systems; etc.

- Pre-storm inspections
- Storm event inspections
- Post-storm inspections
- Routine inspections as specified in the project's specifications or described in the SWPPP
- Updates/Amendments to the SWPPP, as needed
- Preparing annual compliance certification
- Ensuring elimination of all unauthorized discharges
- The SWPPM shall be assigned authority by the Contractor to mobilize crews in order to make immediate repairs to the control measures
- Coordinate with the Contractor to assure all of the necessary corrections/repairs are made immediately, and that the project complies with the SWPPP, the Permit and approved plans at all times.
- Submitting Notices of Discharge and reports of Illicit Connections or Illegal Discharges

■ If anyone else other than the SWPPM is responsible for any of these duties, enter Name, address, telephone number(s) of the person(s) and the duty or duties for which they are responsible and edit the template below as needed.

❑ Name and Telephone Number(s) of the Contractor's SWPPM. The Contractor's SWPPM shall have primary responsibility and significant authority for the implementation, maintenance, inspection and amendments to the approved SWPPP.

## REQUIRED TEXT:

The Storm Water Pollution Prevention Manager (SWPPM) assigned to this project is:

Insert SWPPM's Name-then TAB.

Insert Telephone Number(s)-then TAB.

Insert Contractor's Company Name-then TAB.

Insert Address 1 then press ENTER to insert Address 2 or TAB to next field.

Insert City, State, ZIP-then TAB.

The SWPPM shall have primary responsibility and significant authority for the implementation, maintenance, inspection and amendments to the approved SWPPP. The SWPPM will be available at all times throughout the duration of the project. Duties of the SWPPM include but are not limited to:

- Ensuring full compliance with the SWPPP and the Permit
- Implementing all elements of the SWPPP, including but not limited to:
  - Implementation of prompt and effective erosion and sediment control measures
  - Implementing all non-storm water management, and materials and waste management activities such as: monitoring discharges (dewatering, diversion devices); general site clean-up; vehicle and equipment cleaning, fueling and maintenance; spill control; ensuring that no materials other than storm water are discharged in quantities which will have an adverse effect on receiving waters or storm drain systems; etc.
- Pre-storm inspections
- Storm event inspections
- Post-storm inspections
- Routine inspections as specified in the project's specifications or described in the SWPPP
- Updates/Amendments to the SWPPP, as needed
- Preparing annual compliance certification for owner's, or owner's authorized representative, signature
- Ensuring elimination of all unauthorized discharges
- The SWPPM shall be assigned authority by the Contractor to mobilize crews in order to make immediate repairs to the control measures
- Coordinate with the Contractor to assure all of the necessary corrections/repairs are made immediately, and that the project complies with the SWPPP, the Permit and approved plans at all times
- Submitting Notices of Discharge and reports of Illicit Connections or Illegal Discharges

INSERT ADDITIONAL RESPONSIBILITIES AND/OR NAMES HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

# Section 400
# References

## INSTRUCTIONS:

- ☐ Include a Separator and Tab for Section 400 for ready reference.
- ☐ Identify and prepare a list of the documents referenced in the SWPPP. Project Plans & Specifications, reports, design, and storm water management related documents used to prepare the SWPPP must also be included in the references.

- Documents that shall be referenced are:
  - ☐ All permits that apply to the project (Federal, state and local), such as Fish and Game, U.S. Army Corps of Engineers, DTSC Aerially Deposited Lead Reuse Variance, local RWQCB Permits or specific requirements, etc.
- Referenced materials may also include:
  - ☐ On-site project information such as the project plans and specifications, Geotechnical Report, Hydrology/Hydraulic Report, other reports provided by the Owner, regulatory guidance from federal or state agencies, and published technical specifications
- The reference for each document shall include:
  - ☐ Complete name of the referenced document
  - ☐ Number of the document (if applicable)
  - ☐ Author
  - ☐ Date Published
  - ☐ Document date/revision that applies
- Referenced documents shall be kept on-site and be readily available for review.

## EXAMPLE:

The following documents are made a part of this SWPPP by reference:

- Project plans and specifications No. xx-xxxx
- State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Storm Water Runoff Associated with Construction Activity. August 19, 1999, ("Permit").
- State Water Resources Control Board (SWRCB) Resolution No. 2001- 046, Modification of Water Quality Order 99-08-DWQ State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated With Construction Activity (General Permit), adopted by the SWRCB on April 26, 2001.
- Modification of Water Quality Order 99-08-DWQ State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated With Construction Activity (General Permit) to Include Small Construction Activity (One to Five Acres), adopted by the SWRCB on December 2, 2002.
- California Regional Water Quality Control Board, Los Angeles Region, Waiver of Clean Water Act Section 401 Water Quality Certification, dated xx/xx/xx.
- US Army Corps of Engineers, Nationwide Permit 26-authorization letter, dated xx/xx/xx.
- California Stormwater BMP Handbook - Construction, January 2003
- Storm Water Management for Construction Activities - Developing Pollution Prevention Plans and Best Management Practices, USEPA 832-R-92-005, October 1992.

## REQUIRED TEXT:

The following documents are made a part of this SWPPP by reference:

- Project plans and specifications No. INSERT NUMBER, dated INSERT DATE, prepared by ENTITY PREPARING THE PLANS, SPECIFICATIONS AND ESTIMATE.
- State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Storm Water Runoff Associated with Construction Activity.
- California Stormwater BMP Handbook – Construction, January 2003
- CLICK AND TYPE OTHER REFERENCES HERE

■

# Section 500
# Body of SWPPP

## 500.1 Objectives

**INSTRUCTIONS:**

- ☐ Include a Separator and Tab for Section 500 for ready reference.
- The six primary SWPPP objectives are described in the General Permit and are shown below in the "required text" section. Pollutant source identification and BMP selections shall be developed in the body of the SWPPP to support the six SWPPP objectives.

**REQUIRED TEXT:**

This Storm Water Pollution Prevention Plan (SWPPP) has six main objectives:

- Identify all pollutant sources, including sources of sediment that may affect the quality of storm water discharges associated with construction activity (storm water discharges) from the construction site, and
- Identify non-storm water discharges, and
- Identify, construct, implement in accordance with a time schedule, and maintain Best Management Practices (BMPs) to reduce or eliminate pollutants in storm water discharges and authorized non-storm water discharges from the construction site during construction, and
- Develop a maintenance schedule for BMPs installed during construction designed to reduce or eliminate pollutants after construction is completed (post-construction BMPs).
- Identify a sampling and analysis strategy and sampling schedule for discharges from construction activity which discharge directly into water bodies listed on Attachment 3 of the Permit (Clean Water Act Section 303(d) [303(d)] Water Bodies listed for Sedimentation).

- For all construction activity, identify a sampling and analysis strategy and sampling schedule for discharges that have been discovered through visual monitoring to be potentially contaminated by pollutants not visually detectable in the runoff.

This SWPPP conforms with the required elements of the General Permit No. CAS000002 issued by the State of California, State Water Resources Control Board (SWRCB). This SWPPP will be modified and amended to reflect any amendments to the Permit or any changes in construction or operations that may affect the discharge of pollutants from the construction site to surface waters, groundwaters, or the municipal separate storm sewer system (MS4). The SWPPP will also be amended if it is in violation of any condition of the Permit or has not achieved the general objective of reducing pollutants in storm water discharges. The SWPPP shall be readily available on-site for the duration of the project.

## 500.2 Vicinity Map

**INSTRUCTIONS:**

- The General Permit requires that both a vicinity and site map be included in the SWPPP.
  - ❑ The Vicinity Map shall be a 8-1/2" x 11" color copy of a USGS map or equal and shall extend approximately 400 meters (one-quarter mile) beyond the property boundaries of the construction site (an 11" x 17" may be used if needed). Insert the vicinity map as Attachment A and place a reference in Section 500.2. To meet the site map requirement, insert a reduced copy (8-1/2" x 11" or 11" x 17") of the project's Title Sheet in Attachment A and make reference to it in Section 500.2.
  - ❑ Provide a brief narrative description of the vicinity to support the map in Attachment A. Describe important features, drainage areas, or receiving waters that could not be shown on the map.

- The vicinity map shall show:
  - ❑ Outline of the site's perimeter;
  - ❑ Easily identifiable major roadways;
  - ❑ Geographic features or landmarks;
  - ❑ Water bodies within or adjacent to the construction limits;
  - ❑ Construction site perimeter;
  - ❑ Known wells;
  - ❑ Outline of the offsite drainage area(s) that discharge into the construction site;

- ☐ Identification of anticipated discharge location(s) where the construction site's storm water discharges to a municipal storm sewer system or other water body;
- ☐ Other geographic features surrounding the site; and
- ☐ General topography.

**REQUIRED TEXT**

The construction project vicinity map showing the project location, surface water boundaries, geographic features, construction site perimeter, and general topography, is located in Attachment A. The project's Title Sheet provides more detail regarding the project location and is also included in Attachment A.

## 500.3 Pollutant Source Identification and BMP Selection

### 500.3.1 Inventory of Materials and Activities that May Pollute Storm Water

**INSTRUCTIONS:**

- ☐ List all construction materials that will have the potential to contribute to the discharge of pollutants to storm water.
- ☐ List all construction activities that have the potential to contribute sediment to storm water discharges.
- ☐ Insert as many bullets as necessary to complete the inventory.

**EXAMPLE:**

Control practices for each activity are identified in Sections 500.3.4 through 500.3.9

The following is a list of construction materials that will be used and activities that will be performed that will have the potential to contribute pollutants, other than sediment, to storm water runoff. Control practices for each activity are identified in the Sections 500.3.4 through 500.3.9:

- Vehicle fluids, including oil, grease, petroleum, and coolants
- Asphaltic emulsions associated with asphalt-concrete paving operations

- Cement materials associated with PCC concrete paving operations, drainage structures, median barriers, and bridge construction
- Base and subbase material
- Joint and curing compounds
- Concrete curing compounds
- Paints
- Solvents, thinners, acids
- Sandblasting materials
- Mortar mix
- Raw landscaping materials and wastes (topsoil, plant materials, herbicides, fertilizers, mulch, pesticides)
- BMP materials (sandbags, liquid copolymer)
- Treated lumber (materials and waste)
- PCC rubble
- Masonry block rubble
- General litter

Construction activities that have the potential to contribute sediment to storm water discharges include:

- Clear and grub operations
- Grading operations
- Soil import operations
- Utility excavation operations
- Sandblasting operations
- Landscaping operations

## REQUIRED TEXT:

The following is a list of construction materials that will be used and activities that will be performed that will have the potential to contribute pollutants, other than sediment, to storm water runoff (control practices for each activity are identified in the Water Pollution Control Drawings (WPCDs) and/or in Sections 500.3.4 through 500.3.9:

- LIST

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Construction activities that have the potential to contribute sediment to storm water discharges include:

- LIST
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INSERT ADDITIONAL NARRATIVE TEXT HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs) .

Attachment C lists all Best Management Practices (BMPs) that have been selected for implementation in this project. Implementation and location of BMPs are shown on the WPCDs in Attachment B. Narrative descriptions of BMPs to be used during the project are listed by category in each of the following SWPPP sections. Attachment Q includes a list, and/or copies of the fact sheets of all the BMPs selected for this project.

## 500.3.2 Existing (pre-construction) Control Measures

**INSTRUCTIONS:**

- ☐ Identify the existing control measures in place prior to construction. Pre-construction control measures may include any measures used to reduce erosion, sediment or other pollutants in storm water discharges. Pre-construction control measures may include but not be limited to: Detention basins, infiltration basins, sediment basins, rock slope protection, existing erosion control, existing landscaping, lined ditches, energy dissipaters etc.

**EXAMPLE:**

The following are existing (pre-construction) control measures encountered within the project site:

- Detention basin located at the southeast end of the project. This basin was designed as a combination flood control and permanent treatment control measure. It is anticipated that the basin will be used as a temporary sediment basin during construction, and will be restored to original condition prior to project completion.

**REQUIRED TEXT:**

The following are existing (pre-construction) control measures encountered within the project site:

- LIST
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INSERT ADDITIONAL NARRATIVE TEXT HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

## 500.3.3 Nature of Fill Material and Existing Data Describing the Soil

### INSTRUCTIONS:

- ❑ Describe the conditions of the fill material and the soils at the construction site (i.e. types of soils, groundwater location and conditions, dewatering operations that may be necessary, etc.) and the source and conditions of the fill material at the construction site. A general description can usually be found in the geotechnical report or other environmental documents.
- ❑ Show and/or describe existing site features that, as a result of known past usage, may contribute pollutants to storm water, (e.g., toxic materials that are known to have been treated, stored, disposed, spilled, or leaked onto the construction site). Review the contract documents and associated environmental documents to determine the known site contaminants and list them in this section.

### EXAMPLE:

Existing site features that, as a result of known past usage, may contribute pollutants to storm water, (e.g., toxic materials that are known to have been treated, stored, disposed, spilled, or leaked onto the construction site) include:

- Several old farms are within the project property. Extensive use of farming related chemicals may have left detectable amounts of toxic materials in the soil.
- This site includes aerially deposited lead located at the northeast corner of the site.

### REQUIRED TEXT:

DESCRIBE CONDITIONS OF FILL MATERIALS AND EXISTING SOILS AT THE PROJECT SITE

Existing site features that, as a result of past usage, may contribute pollutants to storm water (e.g., toxic materials that are known to have been treated, stored, disposed, spilled, or leaked onto the construction site) include:

- LIST
- 
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INSERT ADDITIONAL NARRATIVE TEXT HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

## INSTRUCTIONS:

### BMP SELECTION PROCESS

BMP selection is an iterative process that first identifies potential pollutant sources and then identifies the BMPs necessary to reduce or eliminate pollutant discharges from the construction site.

- ☐ Identify all BMPs selected for implementation (indicated in Attachment C, and any other BMPs required by the contract documents).
- ☐ Select BMPs to eliminate or reduce the pollutants identified in the inventory list (Section 500.3.1). See Section 3 of the *California Stormwater BMP Handbook – Construction*, for instructions for selecting and implementing construction site BMPs and fact sheets for construction site BMPs. Refer to the BMP Consideration Checklist in Attachment C to select BMPs in each of the following sections:

| | |
|---|---|
| 500.3.4 | Erosion Control (Soil Stabilization) |
| 500.3.5 | Sediment Control |
| 500.3.6 | Tracking Control |
| 500.3.7 | Wind Erosion Control |
| 500.3.8 | Non-Storm Water Control |
| 500.3.9 | Waste Management and Materials Pollution Control |

- ☐ Show the selected BMPs on the WPCDs. Use the instructions in Section 500.4 and the SWPPP and Monitoring Program Checklist (Attachment L) to confirm that all WPCD requirements are included. Provide a narrative description of the BMPs selected in the appropriate section.

## 500.3.4 Erosion Control

**INSTRUCTIONS:**

- The General Permit requires that projects implement an effective combination of erosion control (soil stabilization) and sediment controls on all disturbed areas during the rainy season.
  - ☐ Select temporary erosion control BMPs to be used and complete the Erosion Control section of the BMP Consideration Checklist in Attachment C. See Section 3 of the *California Stormwater BMP Handbook – Construction*, for instructions for selecting and implementing construction site BMPs and working details for construction site BMPs.
  - ☐ Provide introductory paragraphs that define erosion control and give a general approach on how temporary erosion control BMPs will be implemented on the project.
  - ☐ List all the temporary erosion control BMPs to be used in the project.
  - ☐ Show selected temporary erosion control BMPs on the WPCDs. Provide a narrative description of temporary erosion control BMPs that cannot be adequately identified on the WPCDs.
  - ☐ Discuss the on-site availability of temporary erosion control materials (materials kept for temporary erosion control BMPs) and proposed mobilization and implementation of temporary erosion control BMPs in the event of a predicted storm. (Explain how and when BMPs will be implemented when rain is forecasted). Sufficient material(s) needed to install temporary soil stabilization BMPs necessary to completely protect the exposed portions (disturbed soil area) of the site from erosion and to prevent sediment discharges must be stored on site. Areas that have already been protected from erosion using temporary or permanent physical stabilization or established vegetation stabilization BMPs are not considered to be "exposed disturbed soil areas" for purposes of this requirement.

**EXAMPLE:**

Erosion Control, also referred to as soil stabilization, is a source control measure that is designed to prevent soil particles from detaching and becoming suspended in the storm water runoff. Erosion control BMPs protect the soil surface by covering and/or binding the soil particles. This project will incorporate erosion control measures required by the contract documents, and other measures selected by the Contractor. This construction project will implement the following practices to assure effective temporary and final erosion control during construction:

1) Preserve existing vegetation where required and when feasible.

2) Apply temporary erosion control to remaining active and non-active areas as required by the California Stormwater BMP Handbook – Construction, and the contract documents. Reapply as necessary to maintain effectiveness.
3) Implement temporary erosion control measures at regular intervals throughout the defined rainy season to achieve and maintain the contract's disturbed soil area requirements. When the project's specifications require it, temporary erosion control BMPs will be implemented 20 days prior to the defined rainy season.
4) Stabilize non-active areas as soon as feasible after the cessation of construction activities.
5) Control erosion in concentrated flow paths by applying erosion control blankets, check dams, erosion control seeding, and lining swales as required in the contract documents.
6) Apply seed to areas deemed substantially complete by the [City] Engineer during the defined rainy season.
7) At completion of construction, apply permanent erosion control to all remaining disturbed soil areas.

Sufficient erosion control materials will be maintained on-site to allow implementation in conformance with Permit requirements and described in this SWPPP. This includes implementation requirements for active areas and non-active areas that require deployment before the onset of rain.

Implementation and locations of erosion control BMPs are shown on the Water Pollution Control Drawings (WPCDs) in Attachment B and/or described in this section. The BMP Consideration Checklist in Attachment C indicates the BMPs that will be implemented to control erosion on the construction site; these are:

- EC-2, Preservation of Existing Vegetation
- EC-6, Straw Mulch
- EC-7, Geotextiles and Mats
- EC-9, Earth Dikes and Drainage Swales

**Implementation of Erosion Control BMPs**

- BMPs will be deployed in a sequence to follow the progress of grading and construction. As the locations of soil disturbance change, erosion and sedimentation controls will be adjusted accordingly to control storm water runoff at the downgrade perimeter and drain inlets. BMPs will be mobilized as follows:

*Year-round:*

- The Storm Water Pollution Prevention Manager (SWPPM) will monitor weather using National Weather Service reports to track conditions and alert crews to the onset of rainfall events.

- Disturbed soil areas will be stabilized with temporary erosion control or with permanent erosion control as soon as possible after grading or construction is complete.

*During the rainy season:*

- Disturbed areas will be stabilized with temporary or permanent erosion control before rain events.

- Disturbed areas that are substantially complete will be stabilized with permanent erosion control (soil stabilization) and vegetation (if within seeding window for seed establishment).

- Prior to forecast storm events, temporary erosion control BMPs will be deployed and inspected.

*During the non-rainy season:*

- The project schedule will sequence construction activities with the installation of both erosion control and sediment control measures. The construction schedule will be arranged as much as practicable to leave existing vegetation undisturbed until immediately prior to grading.

**Straw Mulch**

- Straw mulch will be primarily used throughout the disturbed areas adjacent to excavations and on shallow slopes surrounding the site. See the WPCDs in Attachment B of this SWPPP for locations where straw mulch will be used.

**Geotextiles, Plastic Covers and Erosion Control Blankets/Mats**

- Geotextile blankets will be used to provide temporary and long-term stabilization for the flow line of the vegetated swale on the western boundary of the project.

- Polyethylene covers will be used to cover exposed soil and sand stockpiled material areas. Covers will be placed over stockpiles prior to forecast storm events, and anchored to prevent damage by wind.

## REQUIRED TEXT:

Erosion control, also referred to as soil stabilization, consists of source control measures that are designed to prevent soil particles from detaching and becoming transported in storm water runoff. Erosion control BMPs protect the soil surface by covering and/or binding soil particles. This project will incorporate erosion control measures required by the contract documents, and other measures selected by the Contractor, SWPPP Manager, or Owner. This project will implement the following practices for effective temporary and final erosion control during construction:

1) Preserve existing vegetation where required and when feasible.

2) Apply temporary erosion control to remaining active and non-active areas as required by the California Stormwater BMPs Handbook – Construction, and the contract documents. Reapply as necessary to maintain effectiveness.

3) Implement temporary erosion control measures at regular intervals throughout the defined rainy season to achieve and maintain the contract's disturbed soil area requirements. Implement erosion control prior to the defined rainy season.

4) Stabilize non-active areas as soon as feasible after the cessation of construction activities.

5) Control erosion in concentrated flow paths by applying erosion control blankets, erosion control seeding, and lining swales as required in the contract documents.

6) Apply seed to areas deemed substantially complete by the Owner during the defined rainy season.

7) At completion of construction, apply permanent erosion control to all remaining disturbed soil areas.

Sufficient erosion control materials will be maintained on-site to allow implementation in conformance with Permit requirements and described in this SWPPP. This includes implementation requirements for active areas and non-active areas that require deployment before the onset of rain.

Implementation and locations of temporary erosion control BMPs are shown on the Water Pollution Control Drawings (WPCDs) in Attachment B and/or described in this section. The BMP Consideration Checklist in Attachment C indicates the BMPs that will be implemented to control erosion on the construction site; these are:

- EC-1, Scheduling
- EC-2, Preservation of Existing Vegetation
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INSERT ADDITIONAL NARRATIVE TEXT OF SOIL STABILIZATION HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

### 500.3.5 Sediment Control

## INSTRUCTIONS:

- ❑ Select sediment control BMPs to be used and complete the Sediment Control BMPs section of the BMP Consideration Checklist in Attachment C. See Section 3 of the *California Stormwater BMP Handbook – Construction*, for instructions for selecting and implementing construction site BMPs and working details for construction site BMPs.
- ❑ Provide introductory paragraphs that define what are sediment controls and give a general approach on how sediment control BMPs will be implemented at the draining perimeter of disturbed soil areas, at the toe of slopes, at inlets and outfall areas at all times.
- ❑ List all the temporary sediment control BMPs to be used in the project.
- ❑ Show selected temporary sediment control BMPs on the WPCDs. Provide a narrative description of temporary sediment control BMPs that cannot be adequately identified on the WPCDs.
- ❑ Show BMPs used to divert off-site drainage around and/or through the construction project.
- ❑ Discuss the on-site availability of temporary sediment control materials (materials kept for temporary sediment control BMPs) and proposed mobilization and implementation of temporary sediment control BMPs in the event of a predicted storm.

## EXAMPLE:

Sediment controls are structural measures that are intended to complement and enhance the erosion control measures and reduce sediment discharges from construction areas. Sediment controls are designed to intercept and filter out soil particles that have been detached and transported by the force of water. This project will incorporate sediment control measures required by the contract documents, and other measures selected by the Owner.

Sufficient quantities of temporary sediment control materials will be maintained on-site throughout the duration of the project, to allow implementation of temporary sediment controls in the event of predicted rain, and for rapid response to failures or emergencies, in conformance with other Permit requirements and as described in this SWPPP. This includes implementation requirements for active areas and non-active areas before the onset of rain.

Implementation and locations of temporary sediment control BMPs are shown on the Water Pollution Control Drawings (WPCDs) in Attachment B. The BMP Consideration Checklist in Attachment C indicates all the BMPs that will be implemented to control sediment on the construction site; these are:

- SE-1, Silt fence
- SE-4, Check dams
- SE-5, Fiber rolls
- SE-7, Street Sweeping and Vacuuming
- SE-8, Sandbag barrier
- SE-10, Storm Drain Inlet Protection

**Implementation of Temporary Sediment Controls**

- Temporary sediment control BMPs will be deployed according to the schedule shown in SWPPP Section 300.4.
- During the rainy season, temporary sediment controls will be implemented at the draining perimeter of disturbed soil areas, at the toe of slopes, at storm drain inlets and at outfall areas at all times.
- During the non-rainy season, temporary sediment controls will be implemented at the draining perimeter of disturbed soil areas and at storm drain downstream from disturbed areas before rain events.
- As shown on the WPCDs, silt fences will be deployed along the toe of exterior slopes to filter storm water runoff.
- Storm drain inlet protection will be used at all operational internal inlets to the storm drain system during the rainy season as shown on the WPCDs.
- During the non-rainy season, in the event of a predicted storm, the following temporary sediment control materials will be maintained on-site: silt fence materials, sandbags for linear barriers, fiber rolls

## REQUIRED TEXT:

Sediment controls are structural measures that are intended to complement and enhance the selected erosion control measures and reduce sediment discharges from active construction areas. Sediment controls are designed to intercept and settle out soil particles that have been detached and transported by the force of water. This project will incorporate sediment control measures required by the contract documents, and other measures selected by the Contractor, SWPPP Manager, or Owner.

Sufficient quantities of temporary sediment control materials will be maintained on-site throughout the duration of the project, to allow implementation of temporary sediment controls in the event of predicted rain, and for rapid response to failures or emergencies, in conformance with other Permit requirements and as described in this SWPPP. This includes implementation requirements for active areas and non-active areas before the onset of rain.

Implementation and locations of temporary sediment control BMPs are shown on the Water Pollution Control Drawings (WPCDs) in Attachment B. The BMP Consideration Checklist in Attachment C indicates all the BMPs that will be implemented to control sediment on the construction site; these are:

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INSERT ADDITIONAL NARRATIVE TEXT OF SEDIMENT CONTROLS HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

### 500.3.6 Tracking Control

**INSTRUCTIONS:**

- Tracking controls shall be considered and implemented year round and throughout the duration of the project, at all access (ingress/egress) points to the project site where vehicles and/or equipment may track sediment from the construction site onto public or private roadways.

- ☐ Select BMPs and provide a narrative description of tracking control BMPs that will be used to reduce sediment tracking onto public or private roads.
- ☐ Show on the WPCDs the location of all ingress/egress points to the project site where sediment tracking is likely.
- ☐ Describe measures to prevent sediment tracking in this section.
- ☐ Discuss road-cleaning BMPs.

## EXAMPLE:

The following BMPs have been selected to reduce sediment tracking from the construction site onto private or public roads:

- SE-7, Street Sweeping and Vacuuming
- TC-1, Stabilized Construction Entrance/Exit
- TC-2, Stabilized Construction Roadway
- TC-3, Entrance/Outlet Tire Wash

**BMPs to Reduce Sediment Tracking**

*Stabilized Construction Entrance/Exit*

- A stabilized construction entrance/exit will be constructed and maintained at construction site entrances and exits, equipment yard, PCC batch plants and crushing plants, water filling area for water trucks, and project office location, as shown on the site map.

- The site entrance/exit will be stabilized to reduce tracking of sediment as a result of construction traffic. The entrance will be designated and graded to prevent runoff from leaving the site. Stabilization material will be 3 to 6-inch aggregate. The entrance will be flared where it meets the existing road to provide an adequate turning radius. During dirt-hauling activities that extend over a one-week time period, a site entrance/exit will be installed to reduce tracking of sediment.

*Stabilized Construction Roadway*

- The construction roadway through the site will also be designated and stabilized to prevent erosion and to control tracking of mud and soil material onto adjacent roads. The roadway will be clearly marked for limited speed to control dust. Refer to the WPCDs for entrance/exit and construction roadway locations. Stabilization material will be 3 to 6-inch aggregate. A regular maintenance program will be conducted to replace sediment-clogged stabilization material with new stabilization material.

*Entrance/Outlet Tire Wash*

- An entrance/outlet tire wash station will be used to ensure that sediment tracking to public streets is minimized.

*Road Cleaning BMPs – Street Sweeping and Vacuuming*

Road sweeping and vacuuming will occur during soil hauling and as necessary to keep street surfaces clear of soil and debris. Washing of sediment tracked onto streets into storm drains will not occur.

**REQUIRED TEXT:**

The following BMPs have been selected to reduce sediment tracking from the construction site onto private or public roads:

- SE-7, Street Sweeping and Vacuuming
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INSERT ADDITIONAL NARRATIVE TEXT OF TRACKING CONTROL PRACTICES HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

### 500.3.7 Wind Erosion Control

**INSTRUCTIONS:**

- Wind erosion control BMPs shall be considered and implemented year-round and throughout the duration of the project on all disturbed soils on the project site that are subject to wind erosion, and when significant wind and dry conditions are anticipated during project construction. The objective of wind controls is to prevent the transport of soil from soil-disturbed areas of the project site, offsite by wind.

  - ☐ Select BMPs and provide a narrative description of BMPs that will be used to control dust during construction operations, including stockpile operations.

## EXAMPLE:

The following BMPs have been selected to control dust from the construction site:

- WE-1, Wind Erosion Control

**Dust Control**

- Potable water will be applied to disturbed soil areas of the project site to control dust and maintain optimum moisture levels for compaction. The water will be applied using water trucks. As shown on the project schedule, project soils will be disturbed and exposed from approximately May 1 through December 15. Water applications will be concentrated during the late summer and early fall months and especially during the embankment construction operations scheduled for July. The total water to be applied is expected to be between 110,000 and 180,000 $ft^3$.
- BMP WE-1, Wind Erosion Control, and BMP NS-1, Water Conservation Practices, will be implemented to provide dust control and prevent discharges from dust control activities and water supply equipment. Water application rates will be minimized as necessary to prevent runoff and ponding and water equipment leaks will be repaired immediately.
- During windy conditions (forecast or actual wind conditions of approximately 25 mph or greater), dust control will be applied to disturbed areas, including haul roads, to adequately control wind erosion.
- BMP WM-3, Stockpile Management, using silt fences and plastic covers will be implemented to prevent wind dispersal of sediment from stockpiles.

## REQUIRED TEXT:

The following BMPs have been selected to control dust from the construction site:

- WE-1, Wind Erosion Control
-
-

INSERT ADDITIONAL NARRATIVE TEXT OF WIND EROSION CONTROL PRACTICES HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

## 500.3.8 Non-Storm Water Control

**INSTRUCTIONS:**

- Non-storm water discharges consist of all discharges from a municipal storm water conveyance, which do not originate from precipitation events (i.e., all discharges from a conveyance system other than storm water).
- ***PROHIBITED (ILLICIT) DISCHARGES.*** Non-storm water discharges into storm drainage systems or waterways, which are not authorized under the Permit or authorized under a separate NPDES permit, are prohibited. Examples of prohibited discharges common to construction activities include:
  - Vehicle and equipment cleaning, fueling and maintenance operations
  - Vehicle and equipment wash water, including concrete washout water
  - Slurries from concrete cutting and coring operations, PCC grinding or AC grinding operations
  - Slurries from concrete or mortar mixing operations
  - Slurries from drilling or boring operations
  - Blast residue from high-pressure washing of structures or surfaces
  - Wash water from cleaning painting equipment
  - Runoff from dust control applications of water or dust palliatives
  - Sanitary and septic wastes
  - Chemical leaks and/or spills of any kind including but not limited to petroleum, paints, cure compounds, etc.
- Discharges of construction materials and wastes, such as fuel or paint, resulting from dumping, spills, or direct contact with rainwater or storm water runoff are also prohibited and shall be addressed in Section 500.3.9, Waste Management and Materials Pollution Control.
- Some specific non-storm water discharges may be allowed provided they are not relied upon to clean up failed or inadequate construction or post-construction BMPs designed to keep materials onsite. However, they must be identified as not being sources of pollutants to receiving waters and appropriate BMPs may be required to de developed and implemented to minimize adverse impacts from these sources/discharges. The RWQCB may require a separate NPDES permit or specific monitoring and reporting requirements for some non-storm water discharges. All possible non-storm water discharges shall be listed, along with narrative description of BMPs designed to control potential pollutants in such discharges. Examples of non-storm water discharges that may be allowed include:

- Flows from riparian habitats or wetlands
- Diverted stream flows
- Springs, rising groundwater
- Landscape irrigation runoff for purpose of establishing erosion control
- De-chlorinated water line flushing
- Hydrant flushing
- Foundation and footing drains
- Uncontaminated groundwater infiltration

■ Other discharges such as pumped groundwater, irrigation water and water line and hydrant flushing are not prohibited if they are identified as not being sources of pollutants to receiving waters or if appropriate control measures (BMPs) to minimize the adverse impacts of such sources are developed and implemented. Some RWQCBs may require a separate NPDES permit or specific monitoring and reporting requirements for the conditionally exempt discharges. Check with the local jurisdiction on what discharges may be conditionally exempt.

■ Use the following process to identify, quantify, and select BMPs for non-storm water discharges. List each potential non-storm water discharge and provide the information addressed by each step. Complete the BMP Consideration Checklist in Attachment C to show selected BMPs.

❑ Identify all potential non-storm water discharges within the project. Examine all project activities and determine what discharges will be generated or may be required in order to complete each activity, including mobile-type operations. Discuss how mobile operations, such as maintenance and fueling for large or stationary equipment, will be addressed. Examples of common construction activities that may result in non-storm water discharges on a project are:

- Vehicle and equipment cleaning, fueling and maintenance
- Surface water diversions,
- Dewatering operations
- Saw-cutting
- Drilling
- Boring
- AC and PCC grinding
- AC and PCC recycling
- Concrete mixing
- Crushing

- Bridge cleaning
- Blasting
- Painting
- Hydro-demolition
- Mortar mixing
- Air-blown mortar, etc.

❑ Describe each planned non-storm water discharge from the project into the storm drain system or waterway, including flow/quantity and expected pollutants. If a flow or quantity cannot be determined, then fully describe the nature and extent of the activity such that the quantity can be inferred. One-time discharges shall be monitored by the person responsible for SWPPP implementation during the time that such discharges are occurring.

❑ Describe each non-storm water source or activity that may generate a discharge; containment facilities and appurtenances that would be employed; and flow paths of discharge to downstream inlets, drainage facilities, and receiving waters. Where possible, depict BMP locations on the WPCDs.

❑ Indicate the time period and frequency of each activity that generates or may generate a discharge.

❑ Describe mandatory non-storm water control BMPs and practices required by the local jurisdiction, the RWQCB (such as WDR requirements for projects that reuse Aerially Deposited Lead soils), other permits, or other federal, state, or local agencies. Provide details and schedules as appropriate. Include maintenance, inspection, testing, and reporting requirements. Provide permit information for discharges covered by a separate NPDES permit.

❑ Describe the selected non-storm water control BMPs and practices to minimize, contain, and dispose prohibited discharges or to minimize adverse impacts of authorized discharges from the project into the storm drain system or waterway. BMPs within both the Non-Storm Water Management and the Materials Handling and Waste Management categories may be applicable to non-storm water discharges. Include maintenance, inspection, testing, and reporting procedures, if applicable. Also include sediment controls for landscape irrigation prior to establishment of vegetation.

❑ Indicate how illicit connections and illegal discharges will be handled.

■ When an Owner sells or leases individual lots or properties, there may be instances when the new Owner(s)/occupant(s) get involved in construction activities that may contribute to the discharge of pollutants into storm water. It is suggested that the Owner develops a notification pamphlet or brochure that makes the new Owner(s)/occupant(s) aware of the potential for unauthorized discharges and practices to limit, reduce or eliminate the risks of discharging pollutants into storm water.

**EXAMPLE:**

An inventory of construction activities and potential non-storm water discharges is provided in Section 5.3.1. The BMP Consideration Checklist in Attachment C and the following list indicates the BMPs that have been selected to control non-storm water pollution on the construction site. Implementation and locations of some non-storm water control BMPs are shown on the Water Pollution Control Drawings (WPCDs) in Attachment B. A narrative description of each BMP follows.

- NS-1, Water Conservation Practices
- NS-3, Paving and Grinding Operations
- NS-6, Illicit Connection/Illegal Discharge Detection and Reporting
- NS-8, Vehicle and Equipment Cleaning
- NS-9, Vehicle and Equipment Fueling
- NS-10, Vehicle and Equipment Maintenance
- NS-11, Pile Driving Operations
- NS-12, Concrete Curing
- NS-13, Materials and Equipment Use over Water
- NS-14, Concrete Finishing
- NS-15, Structure Demolition/Removal
- WM-08, Concrete Waste Management

**Illicit Connection/Illegal Discharge Detection and Reporting**

- The Contractor will implement BMP NS-6, Illicit Connection/Illegal Discharge Detection and Reporting throughout the duration of the project.

**Paving Operations**

- The project will include placement of approximately 20 acres of AC pavement. Paving locations and adjacent storm drain inlets are shown on WPCDs 2, 3, and 5. Paving operations will generally be conducted in August and September as shown on the project schedule in Section 300.4. BMP NS-3, Paving and Grinding Operations, will be implemented to prevent paving materials from being discharged off-site. Covers will be placed over each inlet adjacent to paving operations. The covers will consist of scrap carpeting placed over, and tucked under, each inlet grate. Following paving operations, the area will be swept, inlet covers will be removed, and the inlets will be inspected for paving materials.

### Vehicle and Equipment Operations

- Several types of vehicles and equipment will be used on-site throughout the project, including graders, scrapers, excavators, loaders, paving equipment, rollers, trucks and trailers, backhoes, forklifts, generators, compressors, and traffic control equipment. BMPs NS-9, Vehicle and Equipment Fueling, and NS-10, Vehicle and Equipment Maintenance will be utilized to prevent discharges of fuel and other vehicle fluids. Except for concrete washout, which is addressed in Section 500.3.8, vehicle cleaning will not be performed on-site.

- A paved temporary fueling area will be constructed in the Contractor's yard as shown on WPCD-4. All self-propelled vehicles will be fueled off-site or at the temporary fueling area. Fuel trucks, each equipped with absorbent spill clean-up materials, will be used for all on-site fueling, whether at the temporary fueling area or for mobile fueling elsewhere on the site. Drip pans will be used for all mobile fueling. The fueling truck will be parked on the paved fueling area for overnight storage.

- Drip pans or absorbent pads will be used for all vehicle and equipment maintenance activities that involve grease, oil, solvents, or other vehicle fluids.

- All vehicle maintenance and mobile fueling operations will be conducted at least 50 feet away from operational inlets and drainage facilities and on a level graded area.

### Concrete Saw-cutting

- The project will include approximately 600 ft of concrete saw-cutting. Saw-cutting locations and adjacent storm drain inlets are shown on WPCDs 2, 3, and 4. Estimated saw-cutting dates are shown on the schedule in Section 300.4. Saw-cutting operations will not be conducted during or immediately prior to rainfall events. Saw-cutting operations are expected to produce about 1.5 cubic yards of waste slurry consisting of water and fine PCC grit.

- BMP WM-08, Concrete Waste Management, will be implemented to contain and dispose of saw-cutting slurries. The slurry will be vacuumed and discharged to the concrete washout facility described above. Dried and cured concrete wastes will be disposed off-site during concrete washout maintenance activities.

## REQUIRED TEXT:

An inventory of construction activities and potential non-storm water discharges is provided in Section 5.3.1. The BMP Consideration Checklist in Attachment C and the following list indicates the BMPs that have been selected to control non-storm water pollution on the construction site. Implementation and locations of some non-storm water control BMPs are shown on the Water Pollution Control Drawings (WPCDs) in Attachment B. A narrative description of each BMP follows.

- NS-6, Illicit Connection/Illegal Discharge Detection and Reporting
- NS-8, Vehicle and Equipment Cleaning
- NS-9, Vehicle and Equipment Fueling
- NS-10, Vehicle and Equipment Maintenance
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INSERT ADDITIONAL NARRATIVE TEXT OF NON-STORM WATER CONTROL PRACTICES HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

### 500.3.9 Waste Management and Materials Pollution Control

**INSTRUCTIONS:**

- Waste management consists of implementing procedural and structural BMPs for collecting, handling, storing and disposing of wastes generated by a construction project to prevent the release of waste materials into storm water discharges. Wastes are going to be generated during construction; however, the methods in which the wastes are collected, stored, and removed will determine the success of the waste management activities. Construction site wastes can range from residues collected from non-storm water discharges (i.e. paint removal) to general site litter and debris (i.e. empty marker paint cans).
- Materials pollution control (materials handling) consist of implementing procedural and structural BMPs for handling, storing and using construction materials to prevent the release of those materials into storm water discharges. The amount and type of construction materials to be utilized at the site will be dependent upon the type of construction and the length of the construction period. The materials may be used continuously, such as fuel for vehicles and equipment, or the materials may be used for a discrete period, such as fertilizer for landscaping.
- Waste management and materials pollution control BMPs shall be implemented to minimize storm water contact with construction materials, wastes and service areas, and to prevent materials and wastes from being discharged off-site. The primary mechanisms for storm water contact that shall be addressed are:

- Direct contact with precipitation
- Contact with storm water run-on and runoff
- Wind dispersion of loose materials
- Direct discharge to the storm drain system through spills or dumping

■ Extended contact with some materials and wastes, such as asphalt cold mix and treated wood products can also leach pollutants into storm water.

■ Use the following process to identify and select BMPs for waste management and materials pollution control:

- ❑ Review construction activities to identify and quantify likely construction materials and wastes. Identify materials and wastes with special handling or disposal requirements; such as lead contaminated soils, concrete saw-cutting liquids, waste chemicals and empty chemical containers. (See Section 500.3.1)
- ❑ Substitute safer, less polluting products where possible.
- ❑ Use the BMP Consideration Checklist in Attachment C to identify BMPs selected to address project-specific activities.
- ❑ List the selected BMPs and describe proposed facilities for materials storage and waste management (including on-site storage and disposal of waste). Discuss how each storm water contact mechanism will be addressed. Include schedules, inspection, and maintenance requirements. Show facility locations and details on the WPCDs where possible.
- ❑ Describe proposed waste collection and removal schedules.

## EXAMPLE:

An inventory of construction activities, materials, and wastes is provided in Section 5.3.1. The BMP Consideration Checklist in Attachment C and the following list indicate the BMPs that have been selected to control construction site wastes and materials. Implementation and locations of some materials handling and waste management BMPs are shown on the Water Pollution Control Drawings (WPCDs) in Attachment B. A narrative description of each BMP follows.

- WM-1, Material Delivery and Storage
- WM-2, Material Use
- WM-3, Stockpile Management

- WM-4, Spill Prevention and Control
- WM-5, Solid Waste Management
- WM-6, Hazardous Waste Management
- WM-8, Concrete Waste Management

### Material Delivery, Storage, and Use

- In general, BMPs WM-1 and WM-2 will be implemented to help prevent discharges of construction materials during delivery, storage, and use. The general material storage area will be located in the Contractor's yard as shown on WPCD-4. A sandbag barrier (BMP SE-8) will be provided around the storage area to prevent run-on from adjacent areas. Two types of storage/containment facilities will be provided within the storage area to minimize storm water contact with construction materials:
  - Two watertight shipping containers will be used to store hand tools, small parts, and most construction materials that can be carried by hand, such as paint cans, solvents and grease.
  - A separate covered storage/containment facility will be constructed adjacent to the shipping containers to provide storage for larger items such as drums and items shipped or stored on pallets. The containment facility will consist of a 10 ft by 20 ft raised concrete pad with 6 inch curbed sides. A wood frame and corrugated tin roof and sides will be constructed to protect the facility from sun and rain. The facility will provide about 530 gal of containment volume. The containment volume is adequate to store 9-55 gallon drums pursuant to BMP WM-1.
- Very large items, such as light standards, framing materials, and stockpiled lumber, will be stored in the open in the general storage area. Such materials will be elevated with wood blocks to minimize contact with run-on.
- Spill clean-up materials, material safety data sheets, a material inventory, and emergency contact numbers will be maintained and stored in the southern shipping container.

### Stockpile Management

- BMPs WM-3, Stockpile Management, will be implemented to reduce or eliminate pollution of storm water from stockpiles of soil and paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate subbase, pre-mixed aggregate, and asphalt minder (so called "cold mix" asphalt). Stockpiles will be surrounded with sediment controls (SE-5, Fiber Rolls or SE-8, Sandbag Barrier). Plastic covers (EC-7, Geotextiles & Mats), or EC-5, Soil Binders, will be used.

## Spill Prevention and Control

- BMP WM-4, Spill Prevention and Control, will be implemented to contain and clean-up spills and prevent material discharges to the storm drain system. Spill prevention is also discussed above in Material Delivery, Storage, and below in the following waste management and equipment maintenance sections.

## Waste Management

- BMP WM-5, Solid Waste Management, and BMP WM-6, Hazardous Waste Management will be implemented to minimize storm water contact with waste materials and prevent waste discharges. Solid wastes will be loaded directly into trucks for off-site disposal. When on-site storage is necessary, solid wastes will be stored in watertight dumpsters in the general storage area of the Contractors yard. Dumpster locations are shown on WPCD-4. AC and PCC rubble will be stockpiled in the general storage area and will be surrounded with sediment controls (SE-8, Sandbag Barrier) and covered when necessary. Solid waste, including rubble stockpiles, will be removed and disposed off-site at least weekly. ABC Waste Disposal (License CA9999999) will provide solid waste disposal services. Hazardous wastes will be stored in the shipping containers or covered containment area discussed above for materials storage. Hazardous wastes will be appropriate and clearly marked containers and segregated from other non-waste materials.

## Contaminated Soil Management

- When contaminated soils are encountered, the City Engineer will be notified, the contaminated soils will be contained, covered if stockpiled, and disposed of per WM-7, Contaminated Soil Management, and the contract documents. Employees will be instructed to recognize evidence of contaminated soil, such as buried debris, discolored soil, and unusual odors.

## Concrete Residuals and Washout Wastes

- This project includes placement of about 130 cubic yards of concrete. The estimated maximum washout volume is 3.5 cubic feet. Discharges will consist of rinse water and residual concrete (Portland cement, aggregates, admixture, and water). Estimated pour dates are shown on the project schedule in Section 300.4. Concrete pours will not be conducted during or immediately prior to rainfall events.

- BMP WM-8, Concrete Waste Management, will be implemented and a below grade concrete washout facility will be constructed and maintained at the Contractor's yard as shown on WPCD-4. All excess concrete and concrete washout slurries will be discharged to the washout facility for drying. The minimum-sized washout, at 10 ft x 10 ft x 3.3 ft deep, will provide more than sufficient volume to contain concrete washout wastes and waste collected from concrete saw-cutting operations, discussed below. BMP maintenance, waste disposal, and BMP removal will be conducted as described in WM-8. Dried-off concrete will be used as fill material if permitted by the City Engineer.

- Concrete waste solids/liquids will be removed and disposed of as required by WM-8.

**Sanitary and Septic Wastes**

- The Contractor will implement BMP WM-9, Sanitary and Septic Waste Management, and portable toilets will be located and maintained at the Contractor's yard for the duration of the project. Specific locations are shown on WPCD-4. Weekly maintenance will be provided each Wednesday by ABC Sanitation (license CA0Q45W) and wastes will be disposed off-site. The toilets will be located away from concentrated flow paths and traffic flow.

**REQUIRED TEXT:**

An inventory of construction activities, materials, and wastes is provided in Section 5.3.1. The BMP Consideration Checklist in Attachment C and the following list indicates the BMPs that have been selected to handle materials and control construction site wastes. A narrative description of each BMP follows.

- WM-1, Material Delivery and Storage
- WM- 2, Material Use
- WM-3, Stockpile Management
- WM-4, Spill Prevention and Control
- WM-5, Solid Waste Management
- WM-9, Sanitary/Septic Waste Management
- 
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INSERT ADDITIONAL NARRATIVE TEXT OF WASTE MANAGEMENT AND MATERIALS POLLUTION CONTROL PRACTICES HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

### 500.3.10 Cost Breakdown for Water Pollution Control

**EXAMPLE:**

A cost breakdown itemizing the contract lump sum for water pollution control has been developed for this project and included in Attachment O. The cost breakdown reflects the items of work, quantities and costs for BMPs shown in the SWPPP, except for those construction site BMPs and permanent BMPs that are shown on the project plans and for which there is a contract item of work.

**REQUIRED TEXT:**

A cost breakdown itemizing the contract lump sum for water pollution control has been developed for this project and included in Attachment O. The cost breakdown reflects the items of work, quantities and costs for BMPs shown in the SWPPP, except for those construction site BMPs and permanent BMPs that are shown on the project plans and for which there is a contract item of work.

## 500.4 Water Pollution Control Drawings (WPCDs)

**INSTRUCTIONS:**

- Prepare water pollution control drawings (WPCDs) in conformance with these instructions and the requirements of the General Construction Permit requirements for a site map. Include the WPCDs as Attachment B to the SWPPP.
  - ❑ Include a cover sheet(s) listing the BMPs that will be used and any selected options shown on the fact sheets, along with construction notes and a legend.
  - ❑ The WPCDs shall show locations for the BMPs that will be used.
  - ❑ Include detailed sheets showing construction details for the BMPs that will be used. BMP Fact Sheets provided in the *California Stormwater BMP Handbook – Construction* may be used as appropriate and included in Attachment Q.
  - ❑ Additional details may be necessary to describe site-specific BMP applications.
  - ❑ Use grading sheets, drainage sheets or erosion control sheets as base sheets for the WPCDs. Use Section 500.3, "Pollutant Source Identification and BMP Selection" as a guide to pollutant sources and BMPs for construction activities. Select BMPs that are appropriate for the site and show their locations on the site map.

- The base sheets shall show the construction project in detail, including:
  - ❑ The construction site perimeter.

- ☐ Geographic features within or immediately adjacent to the site. Include surface waters such as lakes, streams, springs, wetlands, estuaries, ponds, and the ocean.
- ☐ Site topography before and after construction. Include roads, paved areas, buildings, slopes, drainage facilities, and areas of known or suspected contamination.
- ☐ Permanent (post-construction) BMPs. These are usually shown on the project plans.

- Also delineate the following site information:
  - ☐ Discharge points from the project to off-site storm drain systems or receiving waters.
  - ☐ Tributary areas and drainage patterns across the project area (show using flow arrows) into each on-site storm water inlet or receiving water.
  - ☐ Tributary areas and drainage patterns to each on-site storm water inlet, receiving water or discharge point.
  - ☐ Off-site tributary drainage areas that generate run-on to the project. (Where off-site tributary drainage areas are too large to depict on the drawings, use map notes or inserts illustrating the upstream drainage areas).
  - ☐ Temporary on-site drainage(s) to carry concentrated flows.
  - ☐ Drainage patterns and slopes anticipated after major grading activities are completed.
  - ☐ Outline all areas of existing vegetation, soil cover, or native vegetation that will remain undisturbed during the project
  - ☐ Areas of cut and fill.
  - ☐ Outline all areas of soil disturbance (disturbed soil areas, DSAs). Indicate which areas will be disturbed during the rainy season and which areas will be left exposed during the rainy season.
  - ☐ Identify location(s) or areas where it is known that toxic materials have been stored, disposed, spilled, or leaked onto the construction site.
  - ☐ Identify location(s) of contaminated or hazardous soils.
  - ☐ Locate potential non-storm water discharges and activities, such as dewatering operations, concrete saw-cutting or coring, pressure washing, waterline flushing, diversions, cofferdams, and vehicle and equipment cleaning. If operations can't be located, provide a narrative description.
  - ☐ Identify location(s) or direct discharge from the construction site into a Section 303(d) list water body (discharges that do not flow into an accepted MS4 system).

- ❑ Identify locations designated for sampling the discharge(s) from areas of the construction site.

- Show proposed locations for all construction site BMPs. Include additional detail drawings if necessary to convey site-specific configurations.
  - ❑ Show temporary erosion control and temporary sediment control BMPs that will be used during construction. Including temporary on-site drainage(s) to carry concentrated flows, BMPs implemented to divert off-site drainage around or through the construction site, and BMPs that protect storm water inlets.
  - ❑ Locate site ingress and egress points and any proposed temporary construction roads.
  - ❑ Show BMPs to mitigate or eliminate non-storm water discharges.
  - ❑ Show BMPs for waste management and materials pollution control, including, but not limited to storage of soil or waste; construction material loading, unloading, storage and access areas; and areas designated for waste handling and disposal.
  - ❑ Show location(s) of temporary stockpiles and BMPs to protect those areas.
  - ❑ Show BMPs for vehicle and equipment storage, fueling, maintenance, and cleaning.
  - ❑ Show location of all post-construction BMPs.

- The SWPPP shall apply to all areas that are directly related to the construction activity, including but not limited to staging areas, storage yards, material borrow areas and storage areas, access roads, etc., whether or not they reside within the project site. Therefore:
  - ❑ If the Contractor's yard for the project is not within the project site, but is located in the vicinity of the project, the WPCDs shall show all BMPs to be used at Contractor's yard.

- The WPCDs shall reflect the Contractor's phasing and/or construction staging, and shall address the entire scope of the contract work. (The Owner and Contractor may address certain individual operations at a later date per the SWPPP amendment process established in Sections 200.1 and 200.2)

## EXAMPLE:

The Water Pollution Control Drawings can be found in Attachment B of the SWPPP.

**REQUIRED TEXT:**

The Water Pollution Control Drawings can be found in Attachment B of the SWPPP.

## 500.5 Construction BMP Maintenance, Inspection, and Repair

**INSTRUCTIONS:**

- The purpose of storm water inspections is to evaluate BMP effectiveness and implement repairs or design changes as soon as feasible.
- Inspections shall be completed by the Contractor's SWPPM.
- Inspections are recommended on a regular basis during dry weather. The purpose of dry-weather inspections is to ensure proper implementation of BMPs that are not necessarily weather-related. Examples include non-storm water, waste management, and sediment tracking control BMPs.
- A sample maintenance, inspection, and repair program is shown in Attachment G.
- A checklist is required during each inspection. A Storm Water Quality Construction Site Inspection Checklist is included as Attachment H. This checklist shall be used for all inspections unless the project's contract documents require the Contractor to use a different checklist.
- Inspections are required:
    - Prior to a forecast storm
    - after a rain event that causes runoff from the construction site
    - at 24-hour intervals during extended rain events
    - at any other time(s) or intervals of time specified in the contract documents.
- Copies of the completed checklists shall be kept with the SWPPP.
- A tracking or follow-up procedure shall follow any inspection that identifies deficiencies in BMPs.

- [ ] Include a discussion of the program to inspect and maintain all BMPs as identified in the site plan or other narrative documents throughout the duration of the project. Insert the complete program as Attachment G.

**EXAMPLE:**

Inspections will be conducted as follows:

- Prior to a forecast storm
- after a rain event that causes runoff from the construction site
- at 24-hour intervals during extended rain events
- weekly during the rainy season
- every 2 weeks during the non-rainy season
- at any other time(s) or intervals of time specified in the contract documents

A program for Maintenance, Inspection and Repair of BMPs is shown in Attachment G.

**REQUIRED TEXT**

Inspections will be conducted as follows:

- Prior to a forecast storm
- after a rain event that causes runoff from the construction site
- at 24-hour intervals during extended rain events
- at any other time(s) or intervals of time specified in the contract documents

Completed inspection checklists will be kept with the SWPPP.

A tracking or follow-up procedure shall follow any inspection that identifies deficiencies in BMPs. A program for Maintenance, Inspection and Repair of BMPs is shown in Attachment G.

## 500.6 Post-Construction Storm Water Management

### 500.6.1 Post-Construction Control Practices

**INSTRUCTIONS:**

- Post-Construction BMPs are permanent measures installed during construction, designed to reduce or eliminate pollutant discharges from the site after construction is completed. The Owner, Engineer, or Permittee may provide listings, descriptions, and special operations and maintenance requirements for post-construction BMPs.

- [ ] Provide descriptions of the BMPs employed after all construction phases have been completed at the site (Post-Construction BMPs). Examples of post-construction measures are:
  - Infiltration basins;
  - Detention/retention devices;
  - Vegetated strips and/or swales;
  - Biofilters;
  - Permanent erosion control, seeding and planting;
  - Outlet protection/velocity dissipation devices;
  - Earth dikes, drainage swales, and lined ditches;
  - Rock slope protection;
  - Mulching;
  - Other proprietary permanent structural BMPs; and
  - Verification that interior drains are not connected to a storm sewer system.

- When an Owner sells or leases individual lots or properties, there may be instances when the new Owner(s)/occupant(s) get involved in construction activities that may contribute to the discharge of pollutants into storm water. It is suggested that the Owner develops a notification pamphlet or brochure that makes the new Owner(s)/occupant(s) aware of the potential for unauthorized discharges and practices to limit, reduce or eliminate the risks of discharging pollutants into storm water.

## EXAMPLE:

The following are the post-construction BMPs that are to be used at this construction site after all construction is complete:

- Outlet protection/velocity dissipation devices at all culvert outlets.
- All slopes will be seeded with, planted and protected with wood mulch.
- Numerous drainage strips and swales.
- An infiltration basin.

**REQUIRED TEXT:**

The following are the post-construction BMPs that are to be used at this construction site after all construction is complete:

- LIST
-
-
-
-
-

INSERT ADDITIONAL NARRATIVE TEXT HERE OR DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

### 500.6.2 Operation/Maintenance after Project Completion

**INSTRUCTIONS:**

- Describe the following information regarding post-construction BMPs. In some cases, the Owner or Engineer may provide specific language for any operations and maintenance requirements of post-construction control practices. Any pertinent language provided by the Owner shall be added to this section of the SWPPP.
  - ☐ List the parties responsible for long-term operation and maintenance of permanent BMPs. Examples of responsible parties are: a Home Owners Association (HOA); a local agency or municipality; or the Owner.

**EXAMPLE:**

The post-construction BMPs that are described above will be funded and maintained by the Rancho del Cielo Home Owners Association (RCHOA).

**REQUIRED TEXT:**

The post-construction BMPs that are described above will be funded and maintained by ENTER RESPONSIBLE PARTY

INSERT ANY ADDITIONAL LANGUAGE PROVIDED BY OWNER HERE. DELETE THIS LINE (Use the "FORMAT OPTIONS" button to insert subtitles and/or paragraphs)

## 500.7 Training

**INSTRUCTIONS:**

- Individuals responsible for SWPPP preparation, implementation, and permit compliance are required to be trained, and the SWPPP shall document all training. This includes those personnel responsible for installation, inspection, maintenance, and repair of BMPs. Describe the types of training that the Contractor's inspection, maintenance, and repair personnel have received or will receive that are directly related to storm water pollution prevention.
- Subcontractors and employees whose activities may generate non-storm water discharges shall be trained to minimize the potential for such discharges.
- Training may be both formal and informal
- Formal storm water pollution prevention or erosion and sediment control training sessions may include certification as a Certified Professional in Erosion Control and Sediment Control (CPESC); workshops offered by the SWRCB, RWQCB, Community College or University of California Extension, or other locally recognized agencies or professional organizations such as the International Erosion Control Association (IECA), California Stormwater Quality Association (CASQA), Association of Bay Area Governments (ABAG), Association of General Contractors (AGC), etc. Owners and Contractors are encouraged to contact the RWQCB or the SWRCB to inquire about availability of training.
- A listing of training organizations, subject matter and classes are located at http://www.dot.ca.gov/hq/construc/stormwater.html
- The Storm Water Pollution Prevention Manager (SWPPM) should have a minimum of 24 hours (3 days) of formal storm water pollution prevention training.
- On-site storm water pollution prevention training shall be conducted on an on-going basis.

  - ☐ Document formal and informal storm water training using the sample Trained Contractor Personnel Log sheet provided as Attachment I.
  - ☐ Formal storm water training may be documented by providing a list of classes and copies of class completion documents.

## EXAMPLE:

Section 300.5 shows the name of the Contractor's Storm Water Pollution Prevention Manager (SWPPM). This person has received the following training:

- Two (2) day construction storm water management course given by the County of Los Angeles Storm Water Program in October of 1999.
- Attended 2001 IECA 3-day Conference.

On-going, formal training sessions will be selected from one of the following organizations:

- City of Los Angeles Storm Water Program
- County of Los Angeles Storm Water Program
- State of California Regional Water Quality Control Board
- IECA, ABAG and/or AGC sponsored training
- USEPA sponsored training
- Recognized municipal stakeholder organizations throughout California
- Professional organizations and societies in the building and construction field

Other Contractor personnel attending tailgate training will document attendance using the form in Attachment I. Informal training will include tailgate site briefings to be conducted bi-weekly and will address the following topics:

- Erosion Control BMPs
- Sediment Control BMPs
- Non-Storm Water BMPs
- Waste Management and Materials Pollution Control BMPs
- Emergency Procedures specific to the construction site storm water management

This SWPPP was prepared by ABC Engineering, under the direction of Mr. John Doe, a registered Professional Engineer in the State of California. Mr. Doe has over 5 years of experience in the preparation of Storm Water Pollution Prevention Plans (SWPPPs), and has the following previous experience:

- Has prepared over 15 project-specific SWPPPs
- Over 15 years of experience in storm drain design, hydrology, and hydraulics
- SWPPP Preparation training sponsored by Orange County Storm Water Program, June 2002
- Attended the 1999, 2000, 2001, and 2002 International Erosion Control Association (IECA) 3-day conferences
- Received certification as a Certified Professional in Erosion Control and Sediment Control (CPSEC) in July 2001
- Attended "NPDES Storm Water Permit Compliance" course in spring 2002, sponsored by the American Society of Civil Engineers (ASCE)

**REQUIRED TEXT:**

Section 300.5 shows the name of the Contractor's Storm Water Pollution Prevention Manager (SWPPM). This person has received the following training:

- LIST
-
-
-

The training log showing formal and informal training of various Contractor personnel is shown in Attachment I.

INSERT HERE ANY ADDITIONAL TEXT REGARDING TRAINING OF PERSONNEL.

This SWPPP was prepared by INSERT COMPANY, NAME AND PROFESSIONAL REGISTRATION OR OTHER QUALIFICATIONS OF THE PERSON THAT PREPARED THE SWPPP.

## 500.8 List of Subcontractors

**INSTRUCTIONS:**

- The SWPPP is required to include a list of names of all Contractors, (or subcontractors) and individuals responsible for implementation of the SWPPP. This list shall include telephone numbers and addresses. Specific areas of responsibility of each subcontractor (type of work to be performed) and emergency contact numbers shall also be included.
- A sample sub-contractor notification letter and log is provided as Attachment J. Discuss pertinent conditions in the contractual agreement and/or letter of approval that address subcontractor responsibility for General Permit compliance.

❑ Include a completed Attachment J in the SWPPP.

**EXAMPLE:**

All Contractors and subcontractors will be notified of the requirement for storm water management measures during the project. A list of contractors will be maintained and included in the SWPPP.

If subcontractors change during the project, the list will be updated accordingly. The sub-contractor notification letter and log is included in the SWPPP as Attachment J.

**REQUIRED TEXT:**

All contractors and subcontractors will be notified of the requirement for storm water management measures during the project. A list of contractors will be maintained and included in the SWPPP. If subcontractors change during the project, the list will be updated accordingly. The subcontractor notification letter and log is included in the SWPPP as Attachment J.

## 500.9 Other Plans/Permits

**INSTRUCTIONS:**

- ☐ The SWPPP shall incorporate appropriate elements of other plans or permits required by local, State, or Federal agencies.
- ☐ Include a copy of the General Permit CAS000002.
- ☐ Provide a list of all of the other plans and permits in this section, and describe any special requirements for each permit. Insert additional bullets as needed. Delete bullets if not needed.
- ☐ Include a copy of all other plans/permits as Attachment N of the SWPPP.

**EXAMPLE:**

Following is a list of the plans and permits included in Attachment N of this SWPPP.

- State Water Resources Control Board (SWRCB) Resolution No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Storm Water Runoff Associated with Construction Activity, August 1999, and amendments.
- California Department of Fish and Game Code Section 1601 Streambed Alteration Agreement
- Clean Water Act Section 401 Water Quality Certification issued by the State of California as processed through the RWQCB
- U.S. Army Corps of Engineers Clean Water Act Section 404 Nationwide Permit

## REQUIRED TEXT:

Attachment N includes copies of other local, state, and federal plans and permits. Following is a list of the plans and permits included in Attachment N:

- State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Storm Water Runoff Associated with Construction Activity.

# Section 600
# Monitoring Program and Reports

## 600.1 Site Inspections

**INSTRUCTIONS:**

- [ ] Include a Separator and Tab for Section 600 for ready reference.

- The site shall be inspected:
  - Prior to a forecast storm
  - after a rain event that causes runoff from the construction site
  - at 24-hour intervals during extended rain events
  - as specified in the contract documents

- BMPs shall be evaluated for adequacy, proper implementation, and whether additional BMPs are required in accordance with the terms of the Permits and the contract documents.
- Implementation of non-storm water discharge BMPs shall be verified and their effectiveness evaluated.
- One-time discharges of non-storm water shall be inspected when such discharges occur.
- The results of the inspections and assessments shall be recorded on the Storm Water Quality Construction Site Inspection Checklist included in Attachment H. This checklist shall be used for all inspections.
- A copy of each completed Storm Water Quality Construction Site Inspection Checklist shall be included in the on-site SWPPP. A tracking or follow-up procedure shall follow any inspection that identifies deficiencies in BMPs.

**REQUIRED TEXT:**

The SWPPM will inspect the site prior to a forecast storm, after a rain event that causes runoff from the construction site, at 24-hour intervals during extended rain events, and as specified in the contract documents. The results of all inspections and assessments will be documented. Copies of the completed inspection checklists will be maintained with the SWPPP. Site inspections conducted for monitoring purposes will be performed using the inspection checklist shown in Attachment H.

The name(s) and contact number(s) of the assigned inspection personnel are listed below:

Assigned inspector: NAME OF INSPECTOR Contact phone: TELEPHONE NUMBER

## 600.2 Non-Compliance Reporting

**INSTRUCTIONS:**

- Discharges will be reported to the Owner verbally upon discovery and in writing within 7 days of occurrence, or as specified in the contract documents. A sample Notice of Non-Compliance form is provided in Attachment K and a sample form for logging discharges is shown in Attachment T.
- Note: USEPA has issued regulations that define Reportable Quantity (RQ) levels for oil and hazardous substances. These regulations are found in the Code of Federal Regulations at 40 CFR Part 110, Part 117, or Part 302.
    - For example, an oily sheen in storm water runoff as a result of a spill or release is an exceedance of a RQ level. The RQ level for dieldrin, a pesticide, is 1 kilogram. A spill or release of one or more kg of dieldrin is an exceedance of the RQ threshold.

**REQUIRED TEXT:**

If a discharge occurs or if the project receives a written notice of non-compliance, the Contractor will immediately notify the Owner and will file a written report to the Owner within 7 days of the discharge or notice. The Owner is responsible for filing a written report to the Regional Water Quality Control Board (RWQCB) within 30 days or identification of non-compliance. Corrective measures will be implemented immediately following the discharge, notice or order. A sample Notice of Non-Compliance (NONC) form is provided in Attachment K. All discharges will be documented on a Discharge Reporting Log using the example form in Attachment T.

The report to the Owner and to the RWQCB will contain the following items:

- The date, time, location, nature of operation, and type of unauthorized discharge, including the cause or nature of the notice or order,
- The control measures (BMPs) deployed before the discharge event, or prior to receiving notice or order,

- The date of deployment and type of control measures (BMPs) deployed after the discharge event, or after receiving the notice or order, including additional measures installed or planned to reduce or prevent re-occurrence, and
- An implementation and maintenance schedule for any affected BMPs

## 600.3 Record Keeping and Reports

**REQUIRED TEXT:**

Records shall be retained for a minimum of three years for the following items:

- Site inspections
- Compliance certifications
- Discharge reports
- Approved SWPPP document and amendments

## 600.4 Sampling and Analysis Plan for Sediment

**INSTRUCTIONS:**

- If the project has the potential to discharge directly into a water body listed as impaired due to Sedimentation/Siltation and/or Turbidity pursuant to Section 303(d) of the Clean Water Act, the SWPPP must include a Sampling and Analysis Plan (SAP) for Sediment. The purpose of a SAP for Sediment is to determine if BMPs implemented on the construction site are effective for preventing impacts to levels of sedimentation/siltation and/or turbidity in 303(d) listed water bodies impaired by those pollutants.
  - Refer to the SWRCB web site at http://www.swrcb.ca.gov/tmdl/docs/303d98.pdf for the list of 303(d) water bodies in California. Determine if the project will discharge directly into one of the 303(d) water bodies listed as impaired due to Sedimentation/Siltation and/or Turbidity.
  - ***Direct discharge*** is defined as a point source or conveyance that discharges directly to the 303(d) listed water body that does not first flow through a tributary river or stream (that itself is not listed as impaired) or combine with storm water from off-site in a municipal separate storm sewer system (MS4).
- Include the following required text to identify whether or not the project discharges directly to a 303(d) listed water body.

**REQUIRED TEXT:**

This project does have the potential to discharge directly to a water body listed as impaired due to Sedimentation/Siltation and/or Turbidity pursuant to Clean Water Act, Section 303(d).

**INSTRUCTIONS:**

- If the project does not discharge to a 303(d) listed water body, delete Sections 600.4.1 through 600.4.9 from the template and continue with Section 600.5.
- If the project does discharge to a 303(d) listed water body, complete Sections 600.4.1 through 600.4.9 by following the instructions provided at the beginning of each section.

### 600.4.1 Scope of Monitoring Activities

**INSTRUCTIONS:**

- ❑ Provide the name(s) of the 303(d) listed water bodies and identify the reason for impairment. (Sedimentation/Siltation and/or Turbidity)
- ❑ Describe the location(s) of direct discharge from the project site to each 303(d) listed water body and show the locations of direct discharge on the WPCDs.
- ❑ Include the appropriate required text to identify whether run-on to the project site may combine with storm water and directly discharge to the 303(d) water body. If the project does receive run-on, describe the locations of run-on and show the locations on the WPCDs.

**REQUIRED TEXT:**

This project discharges directly into [specify 303(d) water body], a water body listed as impaired due to [specify reason(s) for impairment: Sedimentation/Siltation and/or Turbidity] pursuant to Clean Water Act, Section 303(d). This Sampling and Analysis Plan (SAP) has been prepared pursuant to the requirements of the General Permit (including Resolution 2001-046). The SAP describes the sampling and analysis strategy and schedule for monitoring [specify impairment: Sedimentation/Siltation and/or Turbidity] in the 303(d) listed water body and potential increases in the [specify impairment: Sedimentation/Siltation and/or Turbidity] levels caused by storm water discharges from the project site.

The project has the potential for direct (concentrated) storm water discharges to [specify 303(d) water body] at the following locations, as shown on the WPCDs in Attachment B.

- 
- 
- 

**REQUIRED TEXT for PROJECTS that do not RECEIVE RUN-ON:**

The project does not receive run-on with the potential to combine with storm water that discharges directly to the 303(d) listed water body.

**REQUIRED TEXT for PROJECTS that RECEIVE RUN-ON:**

The project receives run-on with the potential to combine with storm water that discharges directly to the 303(d) listed water body at the following locations, as shown on the WPCDs in Attachment B:

- 
- 
- 

### 600.4.2 Monitoring Strategy

**INSTRUCTIONS:**

- ☐ Describe the sampling schedule for monitoring the impacts of direct storm water discharges to the 303(d) water body.
- ☐ Describe the sampling locations for monitoring the impacts of direct storm water discharges from the project to the 303(d) water body.
- ☐ Describe the rationale for the selection of sampling locations.
- ☐ Identify a location upstream of all direct discharge from the construction site that appears to represent the flow of the water body, to analyze the prevailing condition of the receiving water without any influence from the construction site. Describe exactly, either using GPS coordinates of post kilometer/post mile, where the sample will be collected. Note: Sampling too far upstream may not show prevailing conditions immediately upstream of the construction site.

- ☐ Identify a location immediately downstream from the last point of direct discharge from the construction site that appears to represent the nature of the flow to analyze potential pollutants to the 303(d) listed water body from the project. Describe exactly where the sample will be collected. Downstream samples should represent the receiving water mixed with flow from the construction site. Note: Sampling too far downstream may detect pollutants from other discharges.
- ☐ For projects that, in Section 600.4.1, identified locations of run-on to the project, include the required text to identify run-on sampling location(s) to determine potential impairments that originate off the project site. Describe exactly where the sample will be collected.
- ☐ Show all sampling locations on the WPCDs.

- Locate sampling locations in areas that are safe, out of the path of heavy traffic, and reasonably accessible.
  - ☐ Describe surrounding areas such as agricultural fields, or other sites that may contribute run-on sediment to the site.
  - ☐ Do not locate sampling points upstream or downstream of point sources or confluences to minimize backwater effects or poorly mixed flows.
  - ☐ Do not locate sampling points directly downstream from a bridge, which may contaminate flows from the bridge structure or from road surface runoff.

## REQUIRED TEXT:

<u>Sampling Schedule</u>

Upstream, downstream, discharge, and run-on samples, if applicable, shall be collected for [specify impairment: Sedimentation/Siltation and/or Turbidity] during the first two hours of discharge from rain events that result in a direct discharge from the project site to [enter 303(d) water body]. Samples shall be collected during daylight hours (sunrise to sunset) and shall be collected regardless of the time of the year, status of the construction site, or day of the week.

All storm events that occur during daylight hours will be sampled up to a maximum of four rain events within a 30-day period. In conformance with the U.S. Environmental Protection Agency definition, a minimum of 72 hours of dry weather will be used to distinguish between separate rain events.

## Sampling Locations

Sampling locations are based on proximity to identified discharge or run-on location(s), accessibility for sampling, personnel safety, and other factors in accordance with the applicable requirements in the General Permit. Sampling locations are shown on the WPCDs and include:

- A sample location (designated number ) is upstream of all direct discharge from the construction site for the collection of a control sample to be analyzed for the prevailing condition of the receiving water without any influence from the construction site. The control sample will be used to determine the background levels of [specify impairment: Sedimentation/Siltation and/or Turbidity] in the 303(d) listed water body upstream of the project, if any.
  - Sample location number is located .
- A sample location (designated number ) is immediately downstream from the last point of direct discharge from the construction site for the collection of a sample to be analyzed for potential increases in [specify impairment: Sedimentation/Siltation and/or Turbidity] in the 303(d) listed water body caused by the storm water discharged from the project, if any.
  - Sample location number is located .

**REQUIRED TEXT only for PROJECTS that RECEIVE RUN-ON:**

- [Enter number of locations] sampling location(s) (designated number(s) ) has been identified for the collection of samples of run-on to the project site with the potential to combine with discharges from the construction site in other than MS4 to the 303(d) water body. These samples will identify potential [specify impairment: Sedimentation/Siltation and/or Turbidity] that originates off the project site and contributes to direct storm water discharges from the construction site to the 303(d) listed water body.

**If the following is not needed, place cursor in a field and use the "Delete Line" option on the toolbar.**

  - Sample location number is located .

- If needed Sample location number is located .
- If needed Sample location number is located .

### 600.4.3 Monitoring Preparation

**INSTRUCTIONS:**

- ❑ Identify whether samples will be collected by the Contractor's personnel, by a commercial laboratory, or by an environmental consultant.
- ❑ Identify training and experience of individuals responsible for collecting water samples.
- ❑ Identify Contractor's health and safety procedures for sampling personnel.
- ❑ Identify alternate sampling personnel in case of emergency, sick leave, and/or vacations during storm water monitoring. Identify training of alternate sampling personnel.
- ❑ Identify the state-certified laboratory(ies) that will analyze the samples. For a list of California state-certified laboratories, access the following web site: www.dhs.ca.gov/ps/ls/elap/html/lablist_county.htm
- ❑ Include the appropriate required text to describe the strategy for ensuring that adequate sample collection supplies are available to the project in preparation for a sampling event.
- ❑ Describe the strategy for ensuring that appropriate field-testing equipment is available to the project in preparation for a sampling event. If equipment is to be rented, contact a local environmental rental company, such as www.totalsafetyinc.com.

**REQUIRED TEXT IF Contractor personnel will collect samples:**

Samples on the project site will Select one of the following Contractor sampling personnel:

| | |
|---|---|
| Name/Telephone Number: | Name Phone Number |
| Name/Telephone Number: | Name Phone Number |
| Alternate(s)/Telephone Number: | Name Phone Number |
| Alternate(s)/Telephone Number: | Name Phone Number |

Prior to the rainy season, all sampling personnel and alternates will review the SAP. Qualifications of designated Contractor personnel describing environmental sampling training and experience are provided in Attachment I.

An adequate stock of supplies and equipment for monitoring [specify impairment: Sedimentation/Siltation and/or Turbidity] will be available on the project site or provided by [specify laboratory] prior to a sampling event. Monitoring supplies and equipment will be stored in a cool-temperature environment that will not come into contact with rain or direct sunlight. Sampling personnel will be available to collect samples in accordance with the sampling schedule.

Supplies maintained at the project site will include, but will not be limited to, surgical gloves, sample collection equipment, coolers, appropriate number and volume of sample bottles, identification labels, re-sealable storage bags, paper towels, personal rain gear, ice, Sampling Activity Log forms, and Chain of Custody (COC) forms. The Contractor will obtain and maintain the field-testing instruments, as identified in Section 600.4.5, for analyzing samples in the field by Contractor sampling personnel. Safety practices for sample collection will be in accordance with the [enter title and publication date of contactor health and safety plan for the project].

**REQUIRED TEXT only if consultant or laboratory will collect samples:**

Samples on the project site will be collected by the following [specify laboratory or environmental consultant]:

Company Name:

Address:

Telephone Number:

Point of Contact:

Qualifications of designated Contractor personnel describing environmental sampling training and experience are provided in Attachment I.

SWPPM will contact [specify name of laboratory or environmental consultant] [enter number of hours] hours prior to a predicted rain event to ensure that adequate sample collection personnel, supplies and field test equipment for monitoring [specify impairment: Sedimentation/Siltation and/or Turbidity] are available and will be mobilized to collect samples on the project site in accordance with the sampling schedule.

[Specify name of laboratory or environmental consultant] will obtain and maintain the field-testing instruments, as identified in Section 600.4.5, for analyzing samples in the field by their sampling personnel.

### 600.4.4 Sample Collection and Handling

**INSTRUCTIONS:**

- ☐ Describe sample collection procedures to be used on the project.
- ■ Run-on samples could be collected using the following procedures:
  - Place several rows of sandbags in a half circle directly in the path of the run-on to pond water and wait for enough water to spill over. Then place a cleaned or decontaminated flexible hose along the top and cover with another sandbag so that ponded water will only pour through the flexible hose and into sample bottles. Do not reuse the same sandbags in future sampling events as they may cross-contaminate future samples.
  - Place a cleaned or decontaminated dustpan with open handle in the path of the run-on so that water will pour through the handle and into sample bottles.
- ■ For laboratory analysis, all sampling, sample preservation, and analyses must be conducted according to test procedures under 40 CFR Part 136.
- ■ For a list of California state-certified laboratories, access the following web site: www.dhs.ca.gov/ps/ls/elap/html/lablist_county.htm
- ☐ Describe sample-handling procedures.
- ☐ Describe decontamination waste disposal requirements (i.e., TSP soapy water shall not be discharged to the storm drainage system or receiving water).
- ☐ Describe sample collection documentation procedures.
- ☐ Describe procedures for recording and correcting sampling data.
- ■ A Chain of Custody (COC) form is required to be submitted to the laboratory with the samples to trace the possession and handling of samples from collection through analysis.
- ■ A Sampling Activity Log should be kept to document details of all sampling events and to record results for samples analyzed in the field.
- ■ Each sample bottle is required to have a proper and complete identification label.

**REQUIRED TEXT:**

## Sample Collection Procedures

Grab samples will be collected and preserved in accordance with the methods identified in Table 600-1, "Sample Collection, Preservation and Analysis for Monitoring Sedimentation/Siltation and/or Turbidity" provided in Section 600.4.5. Only personnel trained in proper water quality sampling will collect samples.

Upstream samples will be collected to represent the condition of the water body upgradient of the construction site. Downstream samples will be collected to represent the water body mixed with direct flow from the construction site. Samples will not be collected directly from ponded, sluggish, or stagnant water.

Upstream and downstream samples will be collected using one of the following methods:

- Placing a sample bottle directly into the stream flow in or near the main current upstream of sampling personnel, and allowing the sample bottle to fill completely;

  OR,

- Placing a decontaminated or 'sterile' bailer or other 'sterile' collection device in or near the main current to collect the sample, and then transferring the collected water to appropriate sample bottles, allowing the sample bottles to fill completely.

Run-on samples, if applicable, will be collected to identify potential sedimentation/siltation and/or turbidity that originates off the project site and contributes to direct discharges from the construction site to the 303(d) listed water body. Run-on samples will be collected downgradient and within close proximity of the point of run-on to the project by pooling or ponding water and allowing the ponded water to spill over into sample bottles directly in the stream of water.

To maintain sample integrity and prevent cross-contamination, sampling collection personnel will:

- Wear a clean pair of surgical gloves prior to the collection and handling of each sample at each location.
- Not contaminate the inside of the sample bottle by not allowing it to come into contact with any material other than the water sample.
- Discard sample bottles or sample lids that have been dropped onto the ground prior to sample collection.

- Not leave the cooler lid open for an extended period of time once samples are placed inside.
- Not touch the exposed end of a sampling tube, if applicable.
- Avoid allowing rainwater to drip from rain gear or other surfaces into sample bottles.
- Not eat, smoke, or drink during sample collection.
- Not sneeze or cough in the direction of an open sample bottle.
- Minimize the exposure of the samples to direct sunlight, as sunlight may cause biochemical transformation of the sample to take place.
- Decontaminate sampling equipment prior to sample collection using a TSP-soapy water wash, distilled water rinse, and final rinse with distilled water.
- Dispose of decontamination water/soaps appropriately; i.e., not discharge to the storm drain system or receiving water.

Sample Handling Procedures

**REQUIRED TEXT only IF laboratory will analyze ALL or SOME OF THE samples: Select Yes/No**

Immediately following collection, sample bottles for laboratory analytical testing will be capped, labeled, documented on a Chain of Custody (COC) form provided by the analytical laboratory, sealed in a re-sealable plastic storage bag, placed in an ice-chilled cooler, at as near to 4 degrees Celsius as practicable, and delivered within 24 hours to the following California state-certified laboratory:

Laboratory Name:

Address:

Telephone Number:

Point of Contact:

**REQUIRED TEXT only if Contractor will analyze ALL OR SOME OF THE samples:**

Immediately following collection, samples for field analysis will be tested in accordance with the field instrument manufacturer's instructions and results recorded on the Sampling Activity Log.

**REQUIRED TEXT:**

Sample Documentation Procedures

All original data documented on sample bottle identification labels, Chain of Custody forms, Sampling Activity Logs, and Inspection Checklists will be recorded using waterproof ink. These will be considered accountable documents. If an error is made on an accountable document, the individual will make corrections by lining through the error and entering the correct information. The erroneous information will not be obliterated. All corrections will be initialed and dated. Copies of the Sampling Activity Log and Chain of Custody form are provided in Attachment R. Sampling and field analysis activities will be documented using the following:

- Sample Bottle Identification Labels: Sampling personnel will attach an identification label to each sample bottle. At a minimum, the following information will be recorded on the label, as appropriate:
  - Project name
  - Project number
  - Unique sample identification number and location.
    [Project Number]-[Six digit sample collection date]-[Location]
    (*Example:* 0G5304-081801-Upstream).
    Quality assurance/quality control (QA/QC) samples shall be identified similarly using a unique sample number or designation
    (*Example:* 0G5304-081801-DUP1).
  - Collection date/time (No time applied to QA/QC samples)
  - Analysis constituent
- Sampling Activity Logs: A log of sampling events will identify:
  - Sampling date
  - Separate times for sample collection of upstream, downstream, run-on, and QA/QC samples recorded to the nearest minute
  - Unique sample identification number and location

- Analysis constituent
- Names of sampling personnel
- Weather conditions (including precipitation amount)
- Field analysis results
- Other pertinent data

- Chain of Custody (COC) forms: All samples to be analyzed by a laboratory will be accompanied by a COC form provided by the laboratory. Only the sample collectors will sign the COC form over to the lab. COC procedures will be strictly adhered to for QA/QC purposes.
- Storm Water Quality Construction Inspection Checklists: When applicable, the Contractor's storm water inspector will document on the checklist that samples for sedimentation/siltation and/or turbidity were taken during a rain event.

### 600.4.5 Sample Analysis

**INSTRUCTIONS:**

- ☐ Identify the tests to be used on the project by completing Table 600-1, "Sample Collection, Preservation and Analysis for Monitoring Sedimentation/Siltation and/or Turbidity".
- ☐ For 303(d) listed water bodies impaired due to Sedimentation/Siltation, select YES for (b) and (c) OR YES for (b), and (c) and/or (a).
- ☐ For 303(d) listed water bodies impaired due to Turbidity, select YES for (d).
- ☐ For each test selected, fill in the blank fields in the table. Contact the selected laboratory for the specifications to obtain the necessary information.

**REQUIRED TEXT:**

Samples will be analyzed for the constituents indicated in Table 600-1, "Sample Collection, Preservation and Analysis for Monitoring Sedimentation/Siltation and/or Turbidity".

## Table 600-1
## Sample Collection, Preservation and Analysis for Monitoring Sedimentation/Siltation and/or Turbidity

| Constituent (1) | Analytical Method | Test to be Used? | Sample Preservation | Minimum Sample Volume | Sample Bottle | Maximum Holding Time | Reporting Limit |
|---|---|---|---|---|---|---|---|
| (a) Suspended Sediment Concentration (SSC) | ASTM D3977-97 | ☐ YES ☐ NO | Store at 4□C (39.2□F) | | | | |
| (b) Settleable Solids (SS) | EPA 160.5<br>Std Method 2540(f) | ☐ YES ☐ NO | Store at 4□C (39.2□F) | | | | mL/L/hr |
| (c) Total Suspended Solids (TSS) | EPA 160.2<br>Std Method 2540(d) | ☐ YES ☐ NO | Store at 4□C (39.2□F) | | | | mg/L |
| (d) Turbidity | EPA 180.1<br>Std Method 2130(b) | ☐ YES ☐ NO | Store at 4□C (39.2□F) | | | | NTU |

**Notes: (1) Samples shall be analyzed by using methods (b) and (c), or only method (a)**

ASTM – American Society for Testing and Materials
°C – Degrees Celsius
°F – Degrees Fahrenheit
EPA – U.S. Environmental Protection Agency
L – Liter
mL/L/hr – Milliliters per liter per hour
mg/L – Milligrams per liter
mL – Milliliters
NTU – Nephelometric Turbidity Unit
Std Method – Per the *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, American Water Works Association

**REQUIRED TEXT only IF samples will be analyzed in the field: Select Yes/No**

For samples collected for field analysis, collection, analysis and equipment calibration will be in accordance with the field instrument manufacturer's specifications.

The following field instrument(s) will be used to analyze the following constituents:

| Field Instrument | Constituent |
|---|---|
| | |
| | |
| | |

- The instrument(s) will be maintained in accordance with manufacturer's instructions.
- The instrument(s) will be calibrated before each sampling and analysis event.
- Maintenance and calibration records will be maintained with the SWPPP.

### 600.4.6 Quality Assurance/Quality Control

**REQUIRED TEXT:**

For an initial verification of laboratory or field analysis, duplicate samples will be collected at a rate of 10 percent or 1 duplicate per sampling event. The duplicate sample will be collected, handled, and analyzed using the same protocols as primary samples, and will be collected where contaminants are likely, and not on the upstream sample. A duplicate sample will be collected immediately after the primary sample has been collected. Duplicate samples will not influence any evaluations or conclusions; however, they will be used as a check on laboratory quality assurance.

### 600.4.7 Data Management and Reporting

**REQUIRED TEXT:**

A copy of all water quality analytical results and QA/QC data will be included in the on-site SWPPP within 5 days of sampling (for field analyses) and within 30 days of sampling (for laboratory analyses). Lab reports and COCs will be reviewed for consistency between lab methods, sample identifications, dates, and times for both primary samples and QA/QC samples. All data, including COC forms and Sampling Activity Logs, shall be kept with the SWPPP document.

### 600.4.8 Data Evaluation

**INSTRUCTIONS:**

- The General Permit requires that BMPs be implemented on the construction site to prevent a net increase of sediment load in storm water discharges relative to pre-construction levels. The upstream sample, while not representative of pre-construction levels, provides a basis for comparison with the sample collected downstream of the construction site.
- The downstream water quality sample analytical results will be evaluated to determine if the downstream sample(s) show elevated levels of the tested constituent relative to the levels found in the upstream (control) sample. The run-on sample analytical results will be used as an aid in evaluating potential offsite influences on water quality results. If elevated levels of pollutants are identified, additional BMPs must be implemented in an iterative manner to prevent a net increase in pollutants to receiving waters.

**REQUIRED TEXT:**

An evaluation of the water quality sample analytical results, including figures with sample locations, the water quality analytical results, and the QA/QC data for every event that samples are collected, will be included in the on-site SWPPP. Should the downstream sample concentrations exceed the upstream sample concentrations, the Storm Water Pollution Prevention Manager or other personnel will evaluate the BMPs, site conditions, surrounding influences (including the run-on sample analysis), and other site factors to determine the probable cause for the increase.

As determined by the data and project evaluation, appropriate BMPs will be repaired or modified to mitigate increases in sediment concentrations in the water body. Any revisions to the BMPs will be recorded as an amendment to the SWPPP.

### 600.4.9 Change of Conditions

**REQUIRED TEXT:**

Whenever SWPPP monitoring, pursuant to Section B of the General Permit, indicates a change in site conditions that might affect the appropriateness of sampling locations, testing protocols will be revised accordingly. All such revisions will be recorded as amendments to the SWPPP.

## 600.5 Sampling and Analysis Plan for Non-Visible Pollutants

**INSTRUCTIONS:**

- The project SWPPP must include a Sampling and Analysis Plan (SAP) for pollutants not visually detectable in storm water. The purpose of a SAP for Non-Visible Pollutants is to determine if BMPs implemented on the construction site are effective in preventing pollutants not visually detectable in storm water, from leaving the construction site and potentially impacting water quality objectives.

**REQUIRED TEXT:**

This Sampling and Analysis Plan (SAP) for Non-Visible Pollutants describes the sampling and analysis strategy and schedule for monitoring non-visible pollutants in storm water discharges from the project site and off-site activities directly related to the project, in accordance with the requirements of Section B of the General Permit, including SWRCB Resolution 2001-046.

### 600.5.1 Scope of Monitoring Activities

**INSTRUCTIONS:**

❑ Identify the general sources and locations of potential non-visible pollutants on the project site in the following categories:

- Materials or wastes as identified in Section 500.3.1, containing potential non-visible pollutants and that are not stored under watertight conditions.
- Materials or wastes containing potential non-visible pollutants that are stored under watertight conditions, but (1) a breach, leakage, malfunction, or spill is observed; and (2) the leak or spill has not been cleaned up prior to the rain event; and (3) there is the potential for discharge of non-visible pollutants to surface waters or drainage system.
- Construction activities such as application of fertilizers, pesticides, herbicides or non-pigmented curing compounds, that have occurred during a rain event or within 24 hours preceding a rain event, and there is the potential for discharge of pollutants to surface waters or drainage system.
- Existing site features contaminated with non-visible pollutants as identified in Section 500.3.3.
- Applications of soil amendments, including soil stabilization products, with the potential to alter pH levels or other properties of soil (such as chemical properties, engineering properties, or erosion resistance), or contribute toxic pollutants to storm water runoff, and there is the potential for discharge of pollutants to surface waters or drainage system (unless independent test data are available that demonstrate acceptable concentration levels of non-visible pollutants in the soil amendment).

- Certain soil amendments, when sprayed on straw or mulch, are considered visible pollutants and are not subject to water quality monitoring requirements.

- Storm water runoff from an area contaminated by historical usage of the site is observed to combine with storm water, and there is the potential for discharge of pollutants to surface waters or drainage system.

- Storm water run-on to the project site with the potential to contribute non-visible pollutants to discharges from the project.

- Breaches, malfunctions, leakages, or spills from a BMP

## EXAMPLE:

The following construction materials, wastes, or activities, as identified in Section 500.3.1, are potential sources of non-visible pollutants to storm water discharges from the project. Storage, use, and operational locations are shown on the WPCDs in Attachment B.

- Solvents, thinners
- Concrete curing
- Treated wood
- Soil stabilizers
- Lime treated subgrade
- Fertilizers, herbicides, and pesticides

The following existing site features, as identified in Section 500.3.3, are potential sources of non-visible pollutants to storm water discharges from the project. Locations of existing site features contaminated with non-visible pollutants are shown on the WPCDs in Attachment B.

- Southwest portion of the construction site was previously used as a municipal landfill until 1987 and may have volatile organics in the soil.
- North portion of the construction site was a storage area for a metal plating shop until 1960 and may have metals in the soil.

The following soil amendments have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil and will be used on the project site. Locations of soil amendment application are shown on the WPCDs in Attachment B.

- None

The project has the potential to receive storm water run-on with the potential to contribute non-visible pollutants to storm water discharges from the project. Locations of such run-on to the project site are shown on the WPCDs in Attachment B.

- One location downgradient of the Millennium Chemical Company chemical plant and the Progress Industrial Park is identified as a run-on location to the construction site.
- Two locations are identified as run-on locations along the eastern edge of the construction site boundary.
- The northern boundary of the construction site has one location where run-on is likely.

**REQUIRED TEXT:**

The following construction materials, wastes or activities, as identified in Section 500.3.1, are potential sources of non-visible pollutants to storm water discharges from the project. Storage, use, and operational locations are shown on the WPCDs in Attachment B.

- LIST
-
-

The following existing site features, as identified in Section 500.3.3, are potential sources of non-visible pollutants to storm water discharges from the project. Locations of existing site features contaminated with non-visible pollutants are shown on the WPCDs in Attachment B.

- (DESCRIBE)
-
-

The following soil amendments have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil and will be used on the project site. Locations of soil amendment application are shown on the WPCDs in Attachment B.

- (LIST)
-
-

The project has the potential to receive storm water run-on with the potential to contribute non-visible pollutants to storm water discharges from the project. Locations of such run-on to the project site are shown on the WPCDs in Attachment B.

- (LIST LOCATIONS)
-
-

Sampling for non-visible pollutants will be conducted when (1) a breach, leakage, malfunction, or spill is observed; and (2) the leak or spill has not been cleaned up prior to the rain event; and (3) there is the potential for discharge of non-visible pollutants to surface waters or drainage system.

### 600.5.2 Monitoring Strategy

**INSTRUCTIONS:**

- ☐ Describe the sampling schedule for monitoring potential non-visible pollutants in storm water runoff. Note the specific conditions under which a sampling event for non-visible pollutants is triggered.
- ☐ Describe the sampling locations for monitoring non-visible pollutants.
- ☐ Describe the rationale for the selection of sampling locations.
- ☐ Identify a location for collecting samples of storm water runoff from each source location of non-visible pollutant identified in Section 600.5.1. Describe exactly where the sample will be collected.
- ☐ Identify a location for collecting an uncontaminated background sample of runoff that has not come into contact with the non-visible pollutants identified in Section 600.5.1 or disturbed soil areas of the project. Describe exactly where the sample will be collected.
- ☐ Identify a location for collecting samples of storm water run-on from each of the locations identified in Section 600.5.1 to identify possible sources of contamination that may originate from off the project site. Describe exactly where the sample will be collected.
- ☐ Identify sampling locations at off-site activities directly related to the project such as storage areas, Contractor's yard, PCC or asphalt batch plants, etc., whether or not it is located within the project site.
- ☐ Show all sampling locations on the WPCDs.
- ☐ Locate sampling locations in areas that are safe, out of the path of heavy traffic, and have attainable access.
- ☐ Describe or list surrounding areas, such as industrial sites, that may contribute run-on or airborne constituents to the site.

- [ ] If no inspections of the site are performed prior to or during a rain event, monitoring and sampling of all non-visible pollutants is required.

## REQUIRED TEXT:

### Sampling Schedule

Samples for the applicable non-visible pollutant(s) and a sufficiently large uncontaminated background sample shall be collected during the first two hours of discharge from rain events that result in a sufficient discharge for sample collection. Samples shall be collected during daylight hours (sunrise to sunset) and shall be collected regardless of the time of year, status of the construction site, or day of the week.

In conformance with the U.S. Environmental Protection Agency definition, a minimum of 72 hours of dry weather will be used to distinguish between separate rain events.

Collection of discharge samples for non-visible pollutant monitoring will be triggered when any of the following conditions are observed during the required inspections conducted before or during rain events:

- Materials or wastes containing potential non-visible pollutants are not stored under watertight conditions. Watertight conditions are defined as (1) storage in a watertight container, (2) storage under a watertight roof or within a building, or (3) protected by temporary cover and containment that prevents storm water contact and runoff from the storage area.
- Materials or wastes containing potential non-visible pollutants are stored under watertight conditions, but (1) a breach, malfunction, leakage, or spill is observed, (2) the leak or spill is not cleaned up prior to the rain event, and (3) there is the potential for discharge of non-visible pollutants to surface waters or a storm sewer system.
- An operational activity, including but not limited to those in Section 600.5.1, with the potential to contribute non-visible pollutants (1) was occurring during or within 24 hours prior to the rain event, (2) applicable BMPs were observed to be breached, malfunctioning, or improperly implemented, and (3) there is the potential for discharge of non-visible pollutants to surface waters or a storm sewer system.
- Soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil have been applied, and there is the potential for discharge of non-visible pollutants to surface waters or a storm sewer system.
- Storm water runoff from an area contaminated by historical usage of the site has been observed to combine with storm water runoff from the site, and there is the potential for discharge of non-visible pollutants to surface waters or a storm sewer system.

## Sampling Locations

Sampling locations are based on proximity to planned non-visible pollutant storage, occurrence or use; accessibility for sampling; personnel safety; and other factors in accordance with the applicable requirements in the Permit. Planned sampling locations are shown on the WPCDs in Attachment B and include the following:

**If the following is not "applicable", place cursor in a field and use the "Delete Line" option on the toolbar.**

- [Enter number of locations] sampling locations have been identified for the collection of samples of runoff that drain areas where soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil will be applied.
- If applicable Sample location number(s) is located .
- [Enter number of locations] sampling locations have been identified for the collection of samples of runoff that drain areas contaminated by historical usage of the site.
- If applicable Sample location number(s) is located .
- [Enter number of locations] sampling locations have been identified for the collection of samples of run-on to the project site with the potential to combine with discharges being sampled for non-visible pollutants. These samples are intended to identify sources of potential non-visible pollutants that originate off the project site.
- If applicable Sample location number(s) is located .
- A location has been identified for the collection of an uncontaminated sample of runoff as a background sample for comparison with the samples being analyzed for non-visible pollutants. This location was selected such that the sample will not have come in contact with (1) operational or storage areas associated with the materials, wastes, and activities identified in Section 500.3.1; (2) potential non-visible pollutants due to historical use of the site as identified in Section 500.3.3; (3) areas in which soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil have been applied; or (4) disturbed soils areas.
- If applicable Sample location number(s) is located .

If an operational activity or storm water inspection conducted 24 hours prior to or during a rain event identifies the presence of a material storage, waste storage, or operations area with spills or the potential for the discharge of non-visible pollutants to surface waters or a storm sewer system that was an unplanned location and has not been identified on the WPCDs, sampling locations will be selected using the same rationale as that used to identify planned locations.

### 600.5.3 Monitoring Preparation

**INSTRUCTIONS:**

- ❑ Identify whether samples will be collected by the Contractor's personnel, by a commercial laboratory, or by an environmental consultant.
- ❑ Identify training and experience of individuals responsible for collecting water samples.
- ❑ Identify the Contractor's health and safety procedures for sampling personnel.
- ❑ Identify alternate sampling personnel in case of emergency, sick leave, and/or vacations during storm water monitoring. Identify training of alternate sampling personnel.
- ❑ Identify the state-certified laboratory(ies) that will analyze the samples. For a list of California state-certified laboratories, access the following website: http://www.dhs.ca.gov/ps/ls/elap/html/lablist_county.htm.
- ❑ Include the appropriate required text to describe the strategy for ensuring that adequate sample collection supplies are available to the project in preparation for a sampling event.
- ❑ Describe the strategy for ensuring that appropriate field-testing equipment is available to the project in preparation for a sampling event. If equipment is to be rented, contact a local environmental equipment rental company, such as www.totalsafetyinc.com.

**REQUIRED TEXT if Contractor personnel will collect samples: Select Yes/No**

Samples on the project site will be collected by the following Contractor sampling personnel:

Name/Telephone Number:
Name/Telephone Number:
Alternate(s)/Telephone Number:
Alternate(s)/Telephone Number:

Prior to the rainy season, all sampling personnel and alternates will review the SAP. Qualifications of designated Contractor personnel describing environmental sampling training and experience are provided in Attachment I.

An adequate stock of monitoring supplies and equipment for monitoring non-visible pollutants will be available on the project site prior to a sampling event. Monitoring supplies and equipment will be stored in a cool-temperature environment that will not come into contact with rain or direct sunlight. Sampling personnel will be available to collect samples in accordance with the sampling schedule.

Supplies maintained at the project site will include, but are not limited to, surgical gloves, sample collection equipment, coolers, appropriate number and volume of sample bottles, identification labels, re-sealable storage bags, paper towels, personal rain gear, ice, Sampling Activity Log forms, and Chain of Custody (COC) forms. The Contractor will obtain and maintain the field-testing instruments, as identified in Section 600.5.6, for analyzing samples in the field by Contractor sampling personnel.

Safety practices for sample collection will be in accordance with the [ENTER TITLE AND PUBLICATION DATE OF CONTRACTOR'S HEALTH AND SAFETY PLAN FOR THE PROJECT OR PROVIDE SPECIFIC REQUIREMENTS HEREIN].

**REQUIRED TEXT if consultant or laboratory will collect samples:**

Samples on the project site will be collected by the following [specify laboratory or environmental consultant]:

Company Name:

Address:

Telephone Number:

Point of Contact:

Qualifications of designated Contractor personnel describing environmental sampling training and experience are provided in Attachment I.

SWPPM will contact [specify name of laboratory or environmental consultant] [enter number of hours] hours prior to a predicted rain event and if one of the triggering conditions is identified during an inspection before, during, or after a storm event to ensure that adequate sample collection personnel, supplies and field test equipment for monitoring non-visible pollutants are available and will be mobilized to collect samples on the project site in accordance with the sampling schedule.

[Specify name of laboratory or environmental consultant] will obtain and maintain the field-testing instruments, as identified in Section 600.5.6, for analyzing samples in the field by their sampling personnel.

### 600.5.4 Analytical Constituents

**INSTRUCTIONS:**

- ❑ Identify the specific non-visible pollutants on the project site by completing Table 600-2, "Potential Non-Visible Pollutants and Water Quality Indicator Constituents".
- ❑ List the non-visible pollutant source, non-visible pollutant name, and water quality indicator.
- ❑ Refer to the "Construction Material and Pollutant Testing Guidance Table - Non-Visible Pollutants" in Attachment S for a partial list of some of the common non-visible pollutants.
- ❑ Add lines to the table as needed.
- ■ Do not include visible pollutants such as:
  - Petroleum products: gas, diesel, and lubricants
  - Colored paints
  - Sand, gravel or topsoil
  - Asphalt cold mix
- ❑ Fill in Table 600-3, Sample Collection, Preservation and Analysis for Monitoring Non-Visible Pollutants.

**REQUIRED TEXT:**

<u>Identification of Non-Visible Pollutants</u>

Table 600-2 lists the specific sources and types of potential non-visible pollutants on the project site and the applicable water quality indicator constituent(s) for that pollutant.

Table 600-2

Potential Non-Visible Pollutants and Water Quality Indicator Constituents

| | Pollutant Source | Pollutant | Water Quality Indicator Constituent |
|---|---|---|---|
| *Example:* | Vehicle batteries | Lead, Sulfate or pH | Lead, sulfate or pH |

## 600.5.5 Sample Collection and Handling

**INSTRUCTIONS:**

- For laboratory analysis, all sampling, sample preservation, and analyses must be conducted according to test procedures under 40 CFR Part 136.
- For a the list of California state-certified laboratories, access the following web site: www.dhs.ca.gov/ps/ls/elap/html/lablist_county.htm
- A Chain of Custody (COC) form is required to be submitted to the laboratory with the samples to trace the possession and handling of samples from collection through analysis.
- A Sampling Activity Log is required to document details of all sampling events and to record results for samples analyzed in the field.
- Each sample bottle is required to have a proper and complete identification label.
- Run-on samples could be collected using the following collection procedures:
  - Place several rows of sandbags in a half circle directly in the path of the run-on to pond water and wait for enough water to spill over. Then place a decontaminated or clean flexible hose along the top and cover with another sandbag so that ponded water will only pour through the flexible hose and into sample bottles. Do not reuse the same sandbags in future sampling events as they may cross-contaminate future samples.
  - Place a decontaminated or clean dustpan with open handle in the path of the run-on so that water will pour through the handle and into sample bottles.
  - If not using clean equipment, decontaminate by washing equipment in a TSP-soapy water wash, distilled water rinse, and final rinse with distilled water.

- ☐ Describe sample collection procedures to be used on the project site.
- ☐ Describe sample-handling procedures.
- ☐ Describe decontamination waste disposal requirements (i.e., TSP soapy water shall not be discharged to the storm drainage system or receiving water)
- ☐ Describe sample collection documentation procedures.
- ☐ Describe procedures for recording and correcting sampling data.
- ☐ Fill in Table 600-3, Sample Collection, Preservation and Analysis for Monitoring Non-Visible Pollutants, in Section 600.5.6.

**REQUIRED TEXT:**

<u>Sample Collection Procedures</u>

Samples of discharge will be collected at the designated sampling locations shown on the WPCDs for observed breaches, malfunctions, leakages, spills, operational areas, soil amendment application areas, and historical site usage areas that triggered the sampling event.

Grab samples will be collected and preserved in accordance with the methods identified in the Table 600-3, "Sample Collection, Preservation and Analysis for Monitoring Non-Visible Pollutants," provided in Section 600.5.6. Only personnel trained in proper water quality sampling will collect samples.

Samples will be collected by placing a separate lab-provided sample container directly into a stream of water downgradient and within close proximity to the potential non-visible pollutant discharge location. This separate lab-provided sample container will be used to collect water, which will be transferred to sample bottles for laboratory analysis. The upgradient and uncontaminated background samples shall be collected first prior to collecting the downgradient to minimize cross-contamination. The sampling personnel will collect the water upgradient of where they are standing. Once the separate lab-provided sample container is filled, the water sample will be poured directly into sample bottles provided by the laboratory for the analyte(s) being monitored.

To maintain sample integrity and prevent cross-contamination, sampling collection personnel will:

- Wear a clean pair of surgical gloves prior to the collection and handling of each sample at each location.
- Not contaminate the inside of the sample bottle by not allowing it to come into contact with any material other than the water sample.
- Discard sample bottles or sample lids that have been dropped onto the ground prior to sample collection.
- Not leave the cooler lid open for an extended period of time once samples are placed inside.
- Not sample near a running vehicle where exhaust fumes may impact the sample.
- Not touch the exposed end of a sampling tube, if applicable.
- Avoid allowing rainwater to drip from rain gear or other surfaces into sample bottles.
- Not eat, smoke, or drink during sample collection.
- Not sneeze or cough in the direction of an open sample bottle.
- Minimize the exposure of the samples to direct sunlight, as sunlight may cause biochemical transformation of the sample to take place.
- Decontaminate sampling equipment prior to sample collection using a TSP-soapy water wash, distilled water rinse, and final rinse with distilled water.
- Dispose of decontamination water/soaps appropriately; i.e., not discharge to the storm drain system or receiving water.

Sample Handling Procedures

**REQUIRED TEXT only if a laboratory will analyze ALL OR SOME OF THE samples: Select Yes/No**

Immediately following collection, sample bottles for laboratory analytical testing will be capped, labeled, documented on a Chain of Custody form provided by the analytical laboratory, sealed in a re-sealable storage bag, placed in an ice-chilled cooler, at as near to 4 degrees Celsius as practicable, and delivered within 24 hours to the following California state-certified laboratory:

Laboratory Name:

Address:

Telephone Number:

Point of Contact:

**REQUIRED TEXT only IF Contractor will analyze ALL OR SOME samples:**

Immediately following collection, samples for field analysis will be tested in accordance with the field instrument manufacturer's instructions and results recorded on the Sampling Activity Log.

**REQUIRED TEXT:**

Sample Documentation Procedures

All original data documented on sample bottle identification labels, Chain of Custody forms, Sampling Activity Logs, and Inspection Checklists will be recorded using waterproof ink. These will be considered accountable documents. If an error is made on an accountable document, the individual will make corrections by lining through the error and entering the correct information. The erroneous information will not be obliterated. All corrections will be initialed and dated. Copies of the Sampling Activity Log and Chain of Custody form are provided in Attachment R.

Sampling and field analysis activities will be documented using the following:

- Sample Bottle Identification Labels: Sampling personnel will attach an identification label to each sample bottle. At a minimum, the following information will be recorded on the label, as appropriate:
  - Project name
  - Project number
  - Unique sample identification number and location.
    [Project Number]-[Six digit sample collection date]-[Location]
    (*Example:* 0G5304-081801-Inlet472).
    Quality assurance/quality control (QA/QC) samples shall be identified similarly using a unique sample number or designation
    (*Example:* 0G5304-081801-DUP1).
    - Collection date/time (No time applied to QA/QC samples
    - Analysis constituent

- Sampling Activity Logs: A log of sampling events will identify:
  - Sampling date
  - Separate times for collected samples and QA/QC samples recorded to the nearest minute
  - Unique sample identification number and location
  - Analysis constituent
  - Names of sampling personnel
  - Weather conditions (including precipitation amount)
  - Field analysis results
  - Other pertinent data

- Chain of Custody (COC) forms: All samples to be analyzed by a laboratory will be accompanied by a COC form provided by the laboratory. Only the sample collectors will sign the COC form over to the lab. COC procedures will be strictly adhered to for QA/QC purposes.

- Storm Water Quality Construction Inspection Checklists: When applicable, the Contractor's storm water inspector will document on the checklist that samples for non-visible pollutants were taken during a rain event.

### 600.5.6 Sample Analysis

**INSTRUCTIONS:**

- ❑ Identify the test method and specifications to be used to monitor the non-visible pollutants included in Table 600-2, "Potential Non-Visible Pollutants and Water Quality Indicator Constituents" in Section 600.5.4.
- ❑ Fill-in Table 600-3, "Sample Collection, Preservation and Analysis for Monitoring Non-Visible Pollutants".
- ❑ There should be a test method identified for each Water Quality Indicator Constituent listed in Table 600-2 in Section 600.5.4.
- ❑ Contact the selected laboratory for the appropriate test method(s)/specifications to be used for each constituent.
- ❑ Identify field test instruments to be used for analyzing samples in the field, if any.

**REQUIRED TEXT:**

Samples will be analyzed for the applicable constituents using the analytical methods identified in Table 600-3, "Sample Collection, Preservation and Analysis for Monitoring Non-Visible Pollutants" in this section.

## Example:

**Table 600-3 (Sample)**
**Sample Collection, Preservation and Analysis for Monitoring Non-Visible Pollutants**

| Constituent | Analytical Method | Minimum Sample Volume | Sample Bottle | Sample Preservation | Reporting Limit | Maximum Holding Time |
|---|---|---|---|---|---|---|
| VOCs-Solvents | EPA 8260B | 3 x 40 mL | VOA-glass | Store at 4□C, HCl to pH<2 | 1 µg/L | 14 days |
| SVOCs | EPA 8270C | 1 x 1 L | Glass-Amber | Store at 4□C | 10 µg/L | 7 days |
| Pesticides/PCBs | EPA 8081A/8082 | 1 x 1 L | Glass-Amber | Store at 4□C | 0.1 µg/L | 7 days |
| Herbicides | EPA 8151A | 1 x 1 L | Glass-Amber | Store at 4□C | Check Lab | 7 days |
| BOD | EPA 405.1 | 1 x 500 mL | Polypropylene | Store at 4□C | 1 mg/L | 48 hours |
| COD | EPA 410.4 | 1 x 250 mL | Glass-Amber | Store at 4□C, $H_2SO_4$ to pH<2 | 5 mg/L | 28 days |
| DO | SM 4500-O G | 1 x 250 mL | Glass-Amber | Store at 4□C | Check Lab | 8 hours |
| pH | EPA 150.1 | 1 x 100 mL | Polypropylene | None | Unitless | Immediate |
| Alkalinity | SM 2320B | 1 x 250 mL | Polypropylene | Store at 4□C | 1 mg/L | 14 days |
| Metals (Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, Se, Na, Th, Va, Zn) | EPA 6010B/7470A | 1 x 250 mL | Polypropylene | Store at 4□C, $HNO_3$ to pH<2 | 0.1 mg/L | 6 months |
| Metals (Chromium VI) | EPA 7199 | 1 x 500 mL | Polypropylene | Store at 4□C | 1 µg/L | 24 hours |

Notes:

| | | | |
|---|---|---|---|
| °C – | Degrees Celsius | µg/L – | Micrograms per Liter |
| BOD – | Biological Oxygen Demand | mL – | Milliliter |
| COD – | Chemical Oxygen Demand | PCB – | Polychlorinated Biphenyl |
| DO – | Dissolved Oxygen | SVOC – | Semi-Volatile Organic Compound |
| EPA – | Environmental Protection Agency | SM – | Standard Method |
| HCl – | Hydrogen Chloride | TPH – | Total Petroleum Hydrocarbons |
| $H_2SO_4$ – | Hydrogen Sulfide | TRPH – | Total Recoverable Petroleum Hydrocarbons |
| $HNO_3$ – | Nitric Acid | VOA – | Volatile Organic Analysis |
| L – | Liter | VOC – | Volatile Organic Compound |
| mg/L – | Milligrams per Liter | | |

**REQUIRED TEXT:**

Table 600-3

Sample Collection, Preservation and Analysis for Monitoring Non-Visible Pollutants

| Constituent | Analytical Method | Minimum Sample Volume | Sample Bottle | Sample Preservation | Reporting Limit | Maximum Holding Time |
|---|---|---|---|---|---|---|
| | | | | | | |
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| Notes: | | | | | | |



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**REQUIRED TEXT only IF samples will be analyzed in the field: Select Yes/No**

For samples collected for field analysis, collection, analysis and equipment calibration will be in accordance with the field instrument manufacturer's specifications.

The following field instrument(s) will be used to analyze the following constituents:

| Field Instrument | Constituent |
|---|---|
| | |
| | |
| | |

- The instrument(s) will be maintained in accordance with manufacturer's instructions.
- The instrument(s) will be calibrated before each sampling and analysis event.
- Maintenance and calibration records will be maintained with the SWPPP.

### 600.5. 7 Quality Assurance/Quality Control

**REQUIRED TEXT:**

For an initial verification of laboratory or field analysis, duplicate samples will be collected at a rate of 10 percent or 1 duplicate per sampling event. The duplicate sample will be collected, handled, and analyzed using the same protocols as primary samples. A duplicate sample will be collected at each location immediately after the primary sample has been collected. Duplicates will be collected where contamination is likely, not on the background sample. Duplicate samples will not influence any evaluations or conclusions; however, they will be used as a check on laboratory quality assurance.

### 600.5.8 Data Management and Reporting

**REQUIRED TEXT:**

A copy of all water quality analytical results and QA/QC data will be included in the on-site SWPPP within 5 days of sampling (for field analyses) and within 30 days (for laboratory analyses).

Lab reports and COCs will be reviewed for consistency between lab methods, sample identifications, dates, and times for both primary samples and QA/QC samples. All data, ~~including COC forms and Sampling Activity Logs, shall be kept with the SWPPP.~~

## 600.5.9 Data Evaluation

**INSTRUCTIONS:**

- The General Permit requires that BMPs be implemented on the construction site to reduce non-visible pollutants in discharges of storm water from the construction site.
- The runoff/downgradient water quality sample analytical results will be evaluated to determine if the runoff/downgradient sample(s) show significantly elevated concentrations of the tested analyte relative to the concentrations found in the uncontaminated background sample.
- The water quality sample analytical results will be evaluated to determine if the runoff and run-on samples show significantly elevated levels of the tested constituent relative to the levels found in the background sample. The run-on sample analytical results will be used as an aid in evaluating potential offsite influences on water quality results.

**REQUIRED TEXT:**

An evaluation of the water quality sample analytical results, including figures with sample locations, the water quality analytical results, and the QA/QC data, will be included in the on-site SWPPP.

Should the runoff/downgradient sample show an increased level of the tested analyte relative to the background sample, the BMPs, site conditions, and surrounding influences will be assessed to determine the probable cause for the increase. As determined by the site and data evaluation, appropriate BMPs will be repaired or modified to mitigate discharges of non-visual pollutant concentrations. Any revisions to the BMPs will be recorded as an amendment to the SWPPP.

## 600.5.10 Change of Conditions

**REQUIRED TEXT:**

Whenever SWPPP monitoring, pursuant to Section B of the General Permit, indicates a change in site conditions that might affect the appropriateness of sampling locations or introduce additional non-visible pollutants of concern, testing protocols will be revised accordingly. All such revisions will be recorded as amendments to the SWPPP.

# Appendix C
# Construction Stormwater Sampling and Analysis Guidance

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SWQTF

7000 East Ave., L-627 Livermore, CA 92550-9234
Ph (925) 423-6679 Fax (925) 422-2746
www.stormwatertaskforce.org

# Construction Storm Water Sampling and Analysis Guidance Document

## To assist dischargers in complying with California State Water Resources Control Board Resolution No. 2001-046

October 2001

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## Purpose of Document, Compliance Notification, and Limitations

The purpose of this guidance document is to assist members of the Task Force and other dischargers subject to the Construction Activity Storm Water Discharge Permit, Order 99-08-DWQ, (General Permit) in implementing Resolution 2001-046. Users of this document are fully responsible for determining its suitability. Dischargers are fully responsible for compliance with the permit as amended. Compliance determinations are made by the Regional Water Quality Control Boards, the State Water Resources Control Board, and the U.S. Environmental Protection Agency. Dischargers who have questions about specific requirements of the General Permit, or this guidance document are advised to consult with the appropriate Regional Water Quality Control Board. Failure to comply with the General Permit as amended can result in significant administrative, civil, and criminal penalties.

Users of this document shall note the following limitations on its use:

- The scope of this document is limited to providing guidance on Resolution 2001-046 and does not address all of the monitoring requirements of General Permit. Subsequent Resolutions and Orders issued by the State Board and Orders or policies issued by Regional Boards are also not addressed by this document.

- The purpose of this document was to provide general information to assist dischargers through the process of developing a sampling and analysis strategy. Every possible situation that may expose pollutants to storm water on a construction site is not considered by this document. Dischargers must consider the full range of exposure of materials on their construction sites and develop an appropriate sampling and analysis strategies.

- Storm water requirements, including sampling and analysis strategies must be site specific for each individual project. Users need to adapt the recommendations in this document to each project individually.

- Regulatory interpretations may change over time as a result of new information, new court cases, or new laws. While this document was developed with the input of State and Regional Board input, users should consult with their regulators for current interpretations.

- The sampling and analysis requirements of Resolution 2001-046 are governed by the NPDES regulations. Users should be aware that these regulations and State regulations implementing the NPDES program contain significant requirements regarding quality assurance, quality control, qualifications of analytical laboratories, etc. that are not explicitly addressed by this document. Users should consult the NPDES regulations, or Regional Board staff to determine any additional requirements.

- Compliance with this guidance document does not automatically equate to compliance with the General Permit or Resolution 2001-046. Further, modifying a site specific sampling and analysis strategy to include or exclude items described in this guidance document does not necessarily mean that the site specific strategy is out of compliance the General Permit or Resolution 2001-046.

# Contents

# List of Tables



# List of Figures



# Appendices

# Construction Storm Water Sampling and Analysis Guidance Document

## 1.0 Introduction

The purpose of this document is to provide guidance to owners and operators of construction sites who are permitees under the State Water Resources Control Board's National Pollutant Discharge Elimination System (NPDES) General Permit For Storm Water Discharges Associated With Construction Activity (General Permit), as modified by Resolution No. 2001-046, *"Modification of Water Quality Order 99-08-DWQ State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) General Permit For Storm Water Discharges Associated With Construction Activity (General Permit)"*. The modifications to the General Permit require that a sampling and analysis strategy and sampling schedule for discharges from construction activity be developed and included in the project's Storm Water Pollution Prevention Plan (SWPPP). A sampling and analysis strategy and sampling schedule must be developed regardless of the time of the year that construction occurs.

This document was developed by the Construction General Permit Working Group of the California Storm Water Quality Task Force (Task Force) at the request of the State Water Resources Control Board (State Board). The Task Force was formed in 1989 to advise the State Board on storm water discharge issues. The Task Force membership is composed of storm water management and storm water quality professionals from cities, counties, special districts, industries, and consultants throughout California.

The sampling requirements and guidance provided in this document will apply to most construction projects, but may not apply to all construction projects. It is the responsibility of each construction site owner or operator (hereafter discharger) to evaluate their construction project and develop a site-specific sampling and analysis strategy in compliance with the General Permit's requirements. For further guidance and/or direction about what must be accomplished to comply with the General Permit and Resolution 2001-046, please contact your local Regional Water Quality Control Board (RWQCB).

The sampling requirements added to the General Permit by Resolution 2001-046 are intended to supplement the visual monitoring program previously required by the General Permit. All construction projects must continue the visual monitoring program that requires inspections before predicted rain events, during extended rain events, and following actual rain events that produce runoff.

## 1.1 Organization of this Document

This document is organized to assist the discharger through the evaluation process necessary to develop a sampling and analysis strategy in compliance with the General Permit. Appendix A provides an outline of the actual information that should be included in the project's SWPPP.

Section 1 provides the user with general information on why a sampling and analysis strategy is required.

Section 2 provides information on sediment, silt and turbidity sampling and analysis.

Section 3 provides information on non-visible pollutant sampling and analysis, including what to sample for in construction storm water runoff.

Section 4 provides general information on the sampling and analysis procedures that are applicable to the types of sampling and analysis required by the General Permit.

Section 5 provides useful definitions.

Section 6 provides other sources where one can obtain more information.

## 1.2 Background

The General Permit was reissued by the SWRCB on August 19, 1999. The San Francisco BayKeeper, Santa Monica BayKeeper, San Diego BayKeeper, and Orange Coast Keeper filed a petition for writ of mandate challenging the General Permit in the Superior Court, County of Sacramento.

On September 15, 2000, the Court issued a judgment and writ of mandate and directed the SWRCB to modify the provisions of the General Permit to require permittees to implement specific sampling and analytical procedures to determine whether Best Management Practices (BMPs) implemented on a construction site are:

(1) preventing further impairment by sediment in storm waters discharged directly into waters listed as impaired (Clean Water Act Section 303(d) List [303(d) List]) for sediment, silt, or turbidity; and

(2) preventing other pollutants that are known or should be known by permittees to occur on construction sites and that can not be visually observed or detected in storm water discharges, from causing or contributing to exceedances of water quality objectives.

The monitoring, sampling and analysis provisions in the General Permit were modified pursuant to the court order and were issued as Resolution No. 2001- 046, adopted by the SWRCB on April 26, 2001.

### 1.2.1 Impaired Water Bodies

Certain lakes, streams, rivers, creeks and other bodies of water in California have been determined by Regional Water Quality Control Boards to be impaired for sedimentation, siltation, or turbidity. These water bodies are listed in Attachment 3 to the General Permit. (Clean Water Act [CWA] Section 303(d) [303(d)] Water Bodies listed for Sedimentation). Discharges of storm water from construction sites into a 303(d) listed body of water is not prohibited as long as the type and level of pollutant(s) does not cause or contribute to a water quality exceedance.

To obtain the latest list of 303(d) water bodies, visit the State Water Resources Control Board's Web site at http://www.swrcb.ca.gov/.

### 1.2.2 Non-visible pollutant sampling

**Sampling and analysis for non-visible pollutants is required only when construction materials that could pollute runoff are exposed to rain and runoff.** Just because a material is present on the construction site does not mean that dischargers must automatically sample for it in runoff. Dischargers can limit the amount of sampling and analysis they perform by limiting the exposure of construction materials to rain and storm water runoff. Materials that are not exposed do not have the potential to enter storm water runoff, and therefore do not need to be sampled in runoff. In cases where construction materials are exposed to rain water but the rain water that contacts them is contained, then sampling only needs to occur when inspections shows the containment failed. Many common Best Management Practices (BMPs) already limit exposure to most materials. Improving these practices to prevent exposure is a better approach to preventing pollution of runoff and will limit the amount of sampling and analysis. Improved BMPs are likely to be less costly than an on-going sampling and analysis program.

## 1.3 Purpose of Sampling

The purpose of sampling is to determine whether the BMPs employed on a construction site are effective in controlling potential construction site pollutants, which come in contact with storm water, from leaving the site and causing or contributing to an exceedance of water quality objectives in the receiving waters. According to the modifications to the General Permit (Resolution No. 2001-046), there are two categories of monitoring required, as shown below. These new monitoring requirements are illustrated in Figure 1-1.

- sediment in storm water discharged directly to water bodies listed as impaired for sediment/siltation or turbidity on the SWRCB's 303(d) list water bodies; and
- non-visible pollutants.

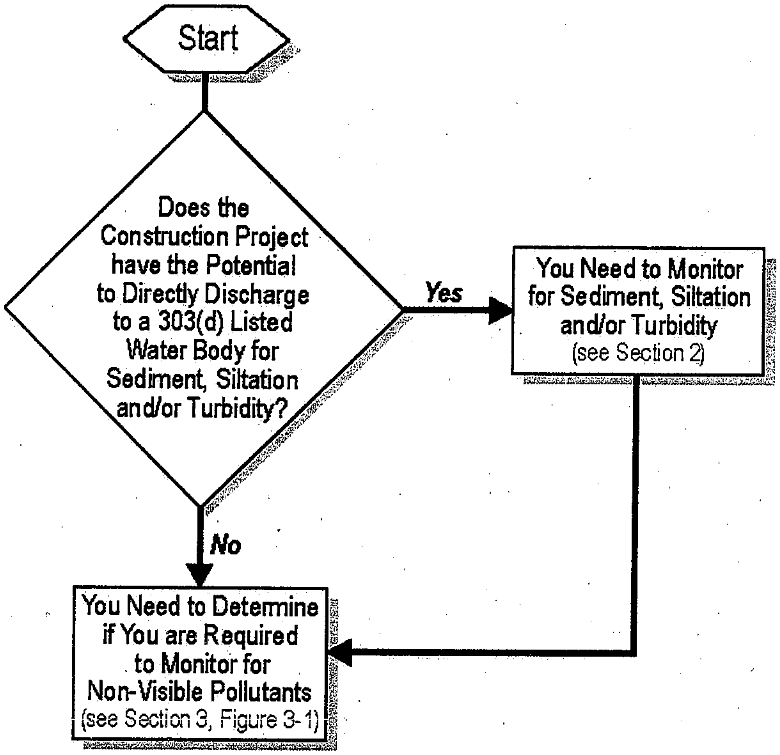


*Figure 1-1*
*General Permit Monitoring and Analysis Requirements*

# 2.0 Monitoring Program for Sedimentation/Siltation

## 2.1 What the Permit Says on Monitoring

The General Permit requires that storm water BMPs be developed, designed, installed and maintained during construction and post-construction phases. The purpose of the storm water BMPs is to reduce or eliminate pollutants which are caused by, or are the result of, the construction activities from coming in contact with rainfall and storm water surface drainage and/or being discharged off-site with the construction site's storm water runoff.

Soils, sediments, and fine (suspendable) particles that result from grading and earthwork activities and soil erosion from disturbed, un-stabilized land areas are potentially significant sources of storm water pollution at construction sites. The General Permit requires construction sites to develop, implement and maintain a combination of effective erosion control and sediment control BMPs to prevent soils, sediments, debris and suspendable solids from leaving the construction site and moving into receiving waters at levels above pre-construction levels.

The General Permit only requires sampling and analysis for sediment/silt or turbidity when the construction site runoff **discharges directly** into a water body that is impaired by sediment/silt or turbidity (that is, the water body is on the 303d list for one of these impairments.) A key point is that the discharge of runoff must directly enter the impaired water body or impaired segment of a water body. Construction site runoff that flows through a tributary or storm drainage system is not considered a direct discharge even if the flow eventually enters an impaired water body. (See the definition of direct discharge in Section 5 for further details.)

The General Permit requires that the SWPPP identify a strategy for conducting the sampling and analysis, including the frequency at which sampling will be conducted. The SWPPP must also show:

- the location(s) of direct discharges from construction activities to a water body listed on the SWRCB's 303(d) list for sediment, silt and/or turbidity;
- the designated sampling location in the listed water body representing the prevailing conditions up-stream of the discharge; and
- the designated sampling location in the listed water body representing the prevailing conditions down-stream of the discharge.

## 2.2 Deciding When to Sample

- Sampling must occur when storm water runoff directly discharges from the construction site to a 303(d) listed water body. Refer to Section 2.4, *Where to Sample*, for guidance on sampling locations.

- Samples need only be collected during daylight hours (sunrise to sunset), during the first two hours of discharge (runoff) from storm events which result in a direct discharge to any 303(d) listed water body.
- Storm water runoff samples must be collected regardless of the time of year, status of the construction site, or day of the week. Samples should be collected during the first two hours of runoff. Storm water inspections and sample collections are required even during non-working days (including weekends and holidays).
- Dischargers do not need to sample runoff for more than four (4) rain events per month.

## 2.3. Deciding What to Sample

- If the water body is listed as impaired for sedimentation or siltation, samples should be analyzed for Settleable Solids (mL/L) and Total Suspended Solids (mg/L) according to EPA 160.2. Samples may be analyzed for suspended sediment concentration (SSC) according to ASTM D3977-97 instead of or in addition to Total Suspended Solids.
- If the water body is listed as impaired for turbidity, samples should be analyzed for turbidity per EPA 180.1 or analyzed in the field using a turbidity meter.
- It is very important that consistent sampling and analysis methods are used for all sampling locations.
- Table 2-1 shows general sample handling and laboratory requirements for sediment sampling.

**Table 2-1**
LABORATORY REQUIREMENTS[1] FOR STORM WATER MONITORING OF SEDIMENT, SILTATION AND/OR TURBIDITY

| Parameters | Analytical Method | Target Reporting Limit | Minimum Sample Volume [2] | Container | Preservative | Holding Time |
|---|---|---|---|---|---|---|
| Total Suspended Solids (TSS) [2] | EPA 160.2 | 1 mg/L | 100 mL | 500 mL polypropylene | Store in ice or refrigerator at 4°C (39.2°F) | 7 days |
| Settleable Solids (SS) | EPA 160.5 | 0.1 mL/L/hour | 1 liter | 1 liter mL polypropylene | Store in ice or refrigerator at 4°C (39.2°F) | 48 hours |
| Suspended Sediment Concentration (SSC) [3] | ASTM D 3977-97 | Contact Laboratory | 200 mL | Contact Laboratory | Store in ice or refrigerator at 4°C (39.2°F) | 7 days |
| Turbidity | EPA 180.1 | 1 NTU | 100 mL | 500 mL polypropylene or glass | Store in ice or refrigerator at 4°C (39.2°F), Dark | 48 hours |

1 The data in this table is a summary of recommended laboratory requirements. For specific EPA regulatory requirements, consult the sampling and analysis requirements found in 40 CFR 136.

2 Minimum sample volume recommended. Specific volume requirements will vary by laboratory; please check with your laboratory when setting up bottle orders.

3 Use either TSS or SSC, or both, for suspended solids analysis. Upstream and downstream samples should be analyzed by the same method.

## 2.4 Deciding Where to Sample

The General Permit requires that samples be collected at the following locations:

- Sample the 303(d) listed water body upstream of the construction site discharge

- Sample the 303(d) listed water body immediately downstream of the last point of discharge from the construction site

Additionally, for the purpose of interpreting the results of the samples collected from the 303(d) listed water body, it is advisable to collect and analyze samples of the actual discharge from the construction site. Remember that samples should only be collected from safely accessible locations.

In general, sample away from the bank in or near the main current. Collecting samples directly from ponded, sluggish, or stagnant water should be avoided. Be careful when collecting water upstream or downstream of confluences or point sources to minimize problems caused by backwater effects or poorly mixed flows. Note that samples collected directly downstream from a bridge can be contaminated from the bridge structure or runoff from the road surface.

Choose the upstream location in water that appears to represent the nature of the flow in the stream, for example, if there is a noticeable muddy plume in the center of the stream versus the outer edges, collect the sample from the center of the stream, if possible.

Downstream samples should represent the receiving water mixed with flow from the construction site. For instance if the flow from the site can be observed by either a color or a flow difference, collect the downstream sample from within the affected water.

## 2.5 Deciding How to Sample

- Only personnel trained in water quality sampling procedures should collect storm water samples.

- Sampling methods and locations should be determined in advance of the runoff event in order to provide sufficient time to gather the supplies and equipment necessary to sample and plan for safe access by the sampling crew(s).

- General guidance for sampling procedures is provided in Section 4 of this document.

## 2.6 How to Use Your Data

### 2.6.1 Coupling Your Visual Observations with Your Analytical Data

The General Permit requires that an effective combination of erosion and sediment control measures be implemented on the site at all times during the rainy season. Site inspections and observations before, during, and after storm events should provide visual indications of whether accelerated erosion is occurring on the site and whether the eroded material is being transported off-site. Visual observations of storm water runoff that appears to be transporting silt or sediment off-site (e.g., the water is soil-colored and non-transparent) probably indicate that you have a problem on the site that will be confirmed by the analytical data.

### 2.6.2 What on Your Site May Be Causing Sediment, Silt and/or Turbidity

Conditions or areas on your site that may be causing sediment, silt, and/or turbidity in your storm water runoff may include:

- Exposed soil areas with inadequate erosion control measures
- Active grading areas
- Poorly stabilized slopes
- Lack of perimeter sediment controls
- Areas of concentrated flow on unprotected soils
- Poorly maintained erosion and sediment control measures
- Unprotected soil stockpiles
- Failure of an erosion or sediment control measure

### 2.6.3 What To Do If You Get Data That Shows a Problem

The General Permit requires that BMPs be implemented on the construction site to prevent a net increase of sediment load in storm water discharges relative to pre-construction levels. Although the upstream un-contaminated (background) sample may not be representative of pre-construction levels at your site, it will provide a basis for comparison with the sample taken downstream of the construction site.

If a comparison of the upstream and downstream samples indicates an increase in silt, sediment and/or turbidity, follow the reporting requirements as shown in section B.3 (Receiving Water Limitations) of the General Permit. If you have collected samples of the discharge from your site, use these results to help identify if it is your project that is discharging sediment into the receiving water. It is recommended that the following steps be taken as soon as possible.

1. Identify the source of the silt, sediment or turbidity

2. Repair or replace any BMP that has failed

3. Maintain any BMP that is not functioning properly due to lack of maintenance

4. Evaluate whether additional or alternative BMPs should be implemented to provide an effective combination of erosion and sediment control measures on the site. Do not rely solely on perimeter sediment controls, particularly where there are fine-grained soils (such as silts or clays) on the site. Implement erosion controls (source controls) that keep the soil in place, even on temporary slopes and rough graded areas, wherever possible and as necessary to prevent sediment from leaving the site.

If sampling and analysis during subsequent storm events shows that there is still a problem, then repeat the steps above until the analytical results of upstream and downstream samples are relatively comparable.

## 2.7 Retention of Data

Results of field measurements and laboratory analyses must be kept in the SWPPP, which is required to be kept on the project site until the Notice of Termination is filed and approved by the appropriate RWQCB. It is also recommended that training logs, Chain-Of-Custody (COC) forms and other documentation relating to sampling and analysis be kept with the project's SWPPP). The General Permit requires that records of all inspections, compliance certifications, and noncompliance reporting must be retained for a period of at least three years from the date generated or after project completion.

# 3.0 Monitoring Program for Pollutants Not Visually Detectable in Storm Water

Monitoring for pollutants not visually detectable is only required if those pollutants are determined to be potentially present in storm water leaving the construction site. Projects should attempt to eliminate the exposure of construction materials to prevent pollution of storm water and limit sampling and analysis requirements.

## 3.1 What the Permit Says on Monitoring

The General Permit requires that a sampling and analysis program be developed and conducted for pollutants which:

- Are not visually detectable in storm water discharges,
- Are or should be known to occur on the construction site, and
- Could cause or contribute to an exceedance of water quality objectives in the receiving water.

Pollutants that should be considered for inclusion in this sampling and analysis strategy are those identified in your SWPPP (as required by Sections A.5.b. and A.5.c. of the General Permit). The General Permit states that the SWPPP needs to identify a strategy for conducting the sampling and analysis, including the frequency and location(s) at which sampling will be conducted.

Sampling for non-visibly detectable pollutants is required under the following two conditions:

- Visual inspections, currently required before, during and after storm events, indicate that there has been a breach, malfunction, leakage or spill from a BMP that could result in the discharge of pollutants in storm water and the pollutants would not be visually detectable; or
- Storm water comes into contact with soil amendments, other exposed materials, or site contamination that is discharged off the construction site.

A sample of uncontaminated (background) storm water from the site must be collected for comparison with the sample(s) collected from storm water suspected of containing construction-related pollutants. The General Permit also states that the SWPPP needs to describe the sampling procedure, location and rationale for obtaining the uncontaminated sample of storm water.

## 3.2 What are "known or should be known pollutants"

Pollutants can be considered to be known or should be known to occur on the construction site if they are currently in use or are present as a result of previous land uses. This includes materials that:

- are being used in the construction activities
- are stored on the construction site
- were spilled during construction operations and not cleaned up
- were stored (or used) in a manner that presented the potential for a release of the materials during past land use activities
- were spilled during previous land use activities and not cleaned up
- were applied to the soil as part of past land use activities.

Construction material inventories and the project SWPPP should provide adequate information on materials currently in use or proposed for use on the construction site.

To determine the potential for pollutants to exist on the construction site as a result of past land use activities dischargers should review existing environmental and real estate documentation. Good sources of information on previously existing contamination and past land uses include Environmental Assessments, Initial Studies, Environmental Impact Reports or Environmental Impact Statements prepared under the requirements of the National Environmental Policy Act or the California Environmental Quality Act, and Phase 1 Assessments prepared for property transfers. In some instances, the results of soil chemical analyses may be available and can provide additional information on potential contamination.

## 3.3 Deciding If Sampling is Required (When to Sample)

All construction projects must ensure that proper inspections are conducted throughout the duration of the project to make sure that appropriately selected BMPs have been implemented, are being maintained, and are effective in preventing potential pollutants from coming in contact with storm water and causing or contributing to an exceedance of water quality objectives in the receiving waters.

The frequency of sampling for non-visible pollutants must be determined based on the exposure of pollutant sources. Runoff only needs to be sampled when there is exposure of a pollutant source to storm water that enters a storm drain or surface water. Inspections of material storage areas that identify a BMP failure, which exposes potential non-visible pollutants to storm water that runs off the construction site, trigger sampling and analysis. If spills are cleaned up and the contaminated material is isolated, eliminating exposure to storm water runoff, sampling does not need to occur. For instances when the potential for previously existing contamination is identified, it may be appropriate to conduct screening analysis during the first one or two storm events of the season to determine if the potential contaminant is running off the construction site.

Figure 3.1 provides a flow chart to help determine when sampling and analysis is required.

### 3.3.1 Sampling and Analysis is Not Required

Sampling and analysis is not required to be implemented under the following conditions. However, a contingency sampling strategy should be prepared in the event of an incidental discharge. Your SWPPP should also describe why you expect sampling and analysis not to be needed.

- Where a construction project is "self-contained", meaning that the project generates no runoff or any potential runoff discharges containing pollutants can be totally contained within the construction project site without discharging to a water body or storm drain system.
- Where construction materials and compounds are kept or used so that they are not in contact with storm water (e.g., in water-tight containers, under a water-tight roof, inside a building, etc.).
- Where for specific pollutants, the BMPs implemented at the construction site fully contain the exposed pollutants (e.g., bermed concrete washout area).
- For building materials that are in their final constructed form or are designed for exposure (e.g., fence materials, support structures and equipment that will remain exposed at the completion of the project, etc.).
- Where pollutants may have been spilled or released on-site, but have been properly cleaned-up and storm water exposure has been eliminated prior to a storm event.
- For stockpiles of construction materials for which both cover and containment BMPs have been properly implemented to protect them from run-on and from contributing pollutants to storm water runoff.

### 3.3.2 Sampling and Analysis Is Required

Sampling and analysis is required when non-visible pollutants have the potential to contact storm water and run off the construction site into a storm drainage system or water body. Some examples of this situation are:

- Where construction materials and compounds are stored or used such that they may come in contact with storm water.
- For construction projects that utilize soil amendments (see definition in Section 5) that can come in contact with storm water runoff. (If you have independent test data are available that demonstrates acceptable concentration levels, sampling and analysis may not be required. Contact the appropriate Regional Board to determine acceptable concentration(s) of the material(s) in question.)

- When a leak or spill occurs prior to a storm event and is not fully contained and cleaned.

- When a leak or spill occurs during a storm event, and it cannot immediately be isolated and/or cleaned-up, and the possibility of an off-site discharge exists.

- When during regular inspections of stockpiles, it is discovered that cover and containment BMPs have been compromised and storm water comes in contact with the stockpiled materials resulting in runoff discharging into a storm drain system or water body.

- When material storage BMPs have been compromised, breached, or have failed.

If a determination has been made that sampling is needed, storm water runoff samples must be collected regardless of the time of year, status of the construction site, or day of the week. Samples should be collected during the first two hours of runoff. Storm water inspections and sample collections are required even during non-working days (including weekends and holidays).

### 3.3.3 Coordinating between Inspection Findings and Sampling

- A breach or malfunction in a BMP, leakage, or a spill observed during regular inspections, which could result in the discharge of pollutants to a storm drain system or water body (e.g., because it was not cleaned up) and that would not be visually detectable in storm water, triggers sampling and analysis.

- If a leakage or spill is observed during inspections, and appropriate measures are taken to fully contain and clean up the leakage or spill, then the potential to discharge pollutants to storm water no longer exists and no sampling is required.

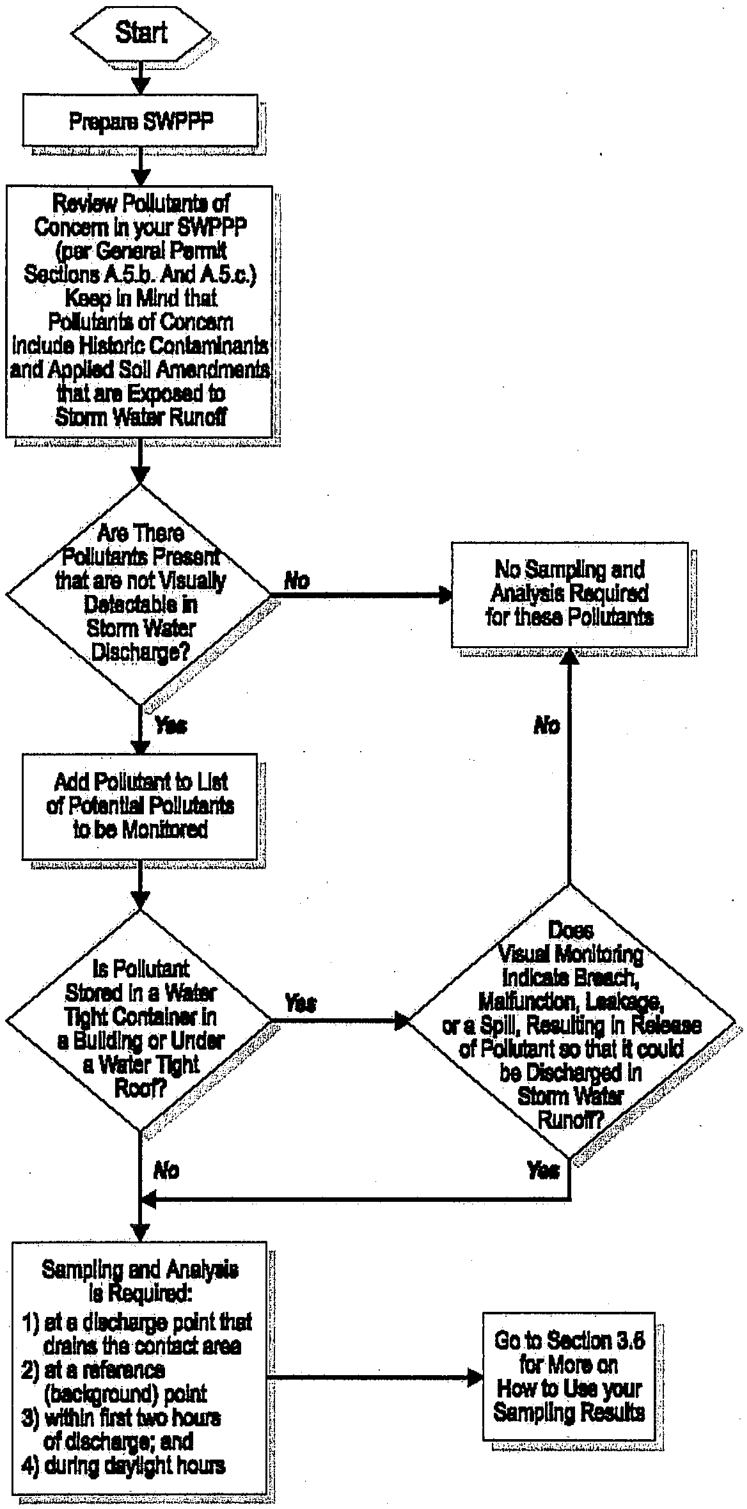


*Figure 3-1*
*Monitoring for Non-Visually Detectable Pollutants*

## 3.4 Deciding What to Sample

Based on your review of potential sources from your SWPPP (required by General Permit sections A5b and A5c), which will include construction related materials, soil amendments, and historic contaminants, develop a list of potential pollutants. Identify from this list those pollutants that are not visibly detectable. These are the constituents that you will likely have to sample for in runoff if the materials are exposed to storm water. Consult with your analytical laboratory or water quality chemist to determine if there are field tests or indicator parameters that can be used. Appendix B lists typical construction materials that might cause non-visible contamination of runoff if exposed to storm water.

## 3.5 Deciding How to Sample

- Only personnel trained in water quality sampling procedures should collect storm water samples.
- Sampling methods and locations should be determined in advance of the runoff event in order to provide sufficient time to gather the supplies and equipment necessary to sample and plan for safe access by the sampling personnel.
- General guidance for sampling procedures is provided in Section 4 of this document.

## 3.6 Deciding Where to Sample

Sampling locations must be identified that provide information on both the runoff quality that is affected by material storage, historic contamination or other exposed potential pollutants, and the background runoff quality (i.e., uncontaminated sample). Material storage may be confined to a small area of the project while historic contamination or exposed materials, such as soil amendments, may be widely spread throughout the construction site. For this reason, the sampling locations identified for these two types of potential pollutants may be different.

- Samples must be collected at locations identified in your SWPPP or areas identified by visual observations/inspections where there has been a BMP failure or breach and which can be safely accessed.
- A location that is not affected by material storage activities or by runoff from material storage areas should be selected as a background or reference sampling location for collecting the uncontaminated runoff sample. For a widely spread potential contaminant, you may need to select sampling locations at the perimeter of your site, where storm water enters (unaffected by your activities) and leaves (affected by your activities) the site. The SWPPP must describe the sampling procedure, the location, and the rationale for selecting this location.

## 3.7 How to Use Your Sampling Data

Corrective action must be initiated where non-visible pollutant sample test results indicate that the construction site's storm water discharges may cause or contribute to a water quality exceedance in the receiving water. This can be determined by comparing your construction site's storm water test results with the background sample.

Where your site's storm water test results significantly exceed the background concentrations, you must evaluate the BMPs to determine what is causing the difference. Possible solutions may include repairing the existing BMPs, evaluating alternative BMPs that could be implemented, and/or implementing additional BMPs (cover and/or containment) which further limit or eliminate contact between storm water and non-visible pollutant sources at your site. Where contact cannot be reduced or eliminated, storm water that has come in contact with the non-visible pollutant source should be retained on-site and not allowed to be discharged to the storm drainage system or a water body. Contact your RWQCB to determine whether it is permissible to discharge the retained storm water. It is advisable to conduct additional sampling during the next runoff event after corrective actions are implemented to demonstrate and document that the problems have been corrected.

### 3.7.1 Coupling Your Visual Observations with Your Sampling Results

If visual inspection of storm water BMPs used to contain non-visible pollutants at a construction site indicates that a BMP has failed or been compromised then field monitoring of the storm water from the site for non-visible pollutants is required. Of course, any BMP that has been visually inspected and found breached or compromised should be immediately repaired or replaced.

The intent of conducting field monitoring for non-visible pollutants is to obtain an immediate indication if storm water that is discharging from a site has been contaminated. An immediate indication of a polluted discharge requires an immediate response in the form of back tracking from the point of discharge to find the source and take appropriate measures to prevent a recurrence of a polluted discharge.

If at all feasible, the contaminated discharge should be contained and prevented from being discharged off site. After taking steps to correct the failed BMP, it is advisable that field monitoring in the vicinity of the BMP be conducted to verify that pollutants are no longer in the storm water.

### 3.7.2 What To Do If You Get Data That Shows a Problem

If your data shows a problem, follow the reporting requirements as shown in section B.3 (Receiving Water Limitations) of the General Permit. It is recommended that the following steps be taken as soon as possible:

1. Identify the source

2. Repair or replace any BMP that has failed

3. Maintain any BMP that is not functioning properly due to lack of maintenance

4. Evaluate whether additional or alternative BMPs should be implemented.

If sampling and analysis during subsequent storm events shows that there is still a problem, then repeat the steps above until the analytical results of upstream and downstream samples are relatively comparable.

## 3.8 Retention of Data

Results of field measurements and laboratory analyses must be kept in the SWPPP, which is required to be kept on the project site until the Notice of Termination is filed and approved by the appropriate RWQCB. It is also recommended that field training logs, Chain-Of-Custody (COC) forms and other documentation relating to sampling and analysis be kept with the project's SWPPP. The General Permit requires that records of all inspections, compliance certifications, and noncompliance reporting must be retained for a period of at least three years from the date generated or after project completion.

# 4.0 Sampling Procedures

The collection and handling of storm water runoff samples requires care to ensure the integrity and validity of the samples. Special documentation, a Chain of Custody (COC) form, must follow the sample from the collection through the analysis process. Additional documentation to track other information of interest, e.g. field conditions, or required field measurements may also be used. This type of information is recorded on a field tracking form.

Every sample must be collected with care to ensure that the sample is representative of the runoff being tested, must be collected in the right kind of container, be preserved in accordance with the test method's specifications, and stored cold until delivered to an analytical laboratory. Some types of samples have very short holding times and must be analyzed before this holding time is exceeded. Sample handling requirements and documentation form the basis of your sampling quality assurance program.

Before starting any sampling program, contact the analytical laboratory that you plan to use to analyze your samples. Make sure to select a laboratory that will provide you with the support that you need, such as, properly cleaned and preserved sampling containers and COC forms. Some laboratories can assist in identifying courier services available to transport samples to the laboratory, or may be able to provide sampling service for you. All these details need to be worked out in advance of sample collection. The analytical laboratory should also be consulted on what additional samples will need to be collected for quality assurance and quality control purposes.

Both field and/or analytical analysis methods can be used to meet the Permit requirements. Field techniques have the advantage of providing immediate results. However, there are only a limited number of analyses that can be done in the field. Analytical laboratories can analyze for a wide range of parameters, but the data may take several weeks or longer to get back.

Some constituents (e.g. pH) can be evaluated in the field with special equipment. Field samples must be collected and analyzed according to the specifications of the manufacturer of the sampling devices employed. Field equipment must be used by trained staff and the equipment must be calibrated and maintained according to the manufacturer's specifications.

Laboratory analyses should be conducted by a laboratory that is currently accredited by the California Department of Health Services Environmental Laboratory Accreditation Program (ELAP). Analyses must be conducted in accordance with 40 CFR Part 136.

Refer to the California Department of Transportation (Caltrans) *Guidance Manual: Stormwater Monitoring Protocols (Second Edition), July 2000* to assist you in developing a sampling and analysis program. This document may be downloaded from the Caltrans Website, at http://www.dot.ca.gov/hq/env/stormwater/special/index.htm.

Figure 4-1 is an outline for a typical comprehensive storm water sampling and analysis plan. As some laboratories may have specific requirements for sample collection and handling, specific information or requirements on your samples should be checked with your laboratory.

1 PROJECT OVERVIEW/DESCRIPTION
- 1.1 Description of why the project is being conducted
- 1.2 Description of who is conducting the project
- 1.3 General scope of monitoring activities
- 1.4 Project organization/roles and responsibilities

2 MONITORING SITES
- 2.1 Site location (map)
- 2.2 Written driving directions
- 2.3 Site access instructions (gates, locks, keys, combinations)
- 2.4 Notification procedures

3 ANALYTICAL CONSTITUENTS
- 3.1 List of constituents for sampling and analysis (including sample collection methods, container type, volume required, preservation and laboratory performing analysis)

4 DATA QUALITY OBJECTIVES (DQOs)
- 4.1 Analytical reporting limits
- 4.2 Analytical precision, accuracy and completeness

5 FIELD EQUIPMENT MAINTENANCE
- 5.1 Equipment calibration
- 5.2 Equipment maintenance
- 5.3 Equipment cleaning (bottles/lids/tubing)

6 MONITORING PREPARATION AND LOGISTICS
- 6.1 Weather tracking
- 6.2 Storm selection criteria
- 6.3 Storm action levels
- 6.4 Communications/notification procedures
- 6.5 Sample bottle order
- 6.6 Sample bottle labeling
- 6.7 Field equipment preparation

7 SAMPLE COLLECTION, PRESERVATION AND DELIVERY
- 7.1 Sample collection methods
- 7.2 Field measurement methods
- 7.3 Field equipment list
- 7.4 Sample containers, preservation and handling
- 7.5 QA/QC sample collection methods
- 7.6 Sample labeling (site names, codes, etc.)
- 7.7 Composite sample splitting
- 7.8 Forms and procedures for documenting sample collection and field measurements
- 7.9 Laboratory communication procedures
- 7.10 Sample shipping/delivery, chain-of-custody

8 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)
- 8.1 Field procedures for QA/QC sample collection

9 LABORATORY SAMPLE PREPARATION AND ANALYTICAL METHODS
- 9.1 Laboratory sample preparation procedures
- 9.2 Analytical constituent table (including analytical methods, holding times and reporting limits)

10 DATA MANAGEMENT AND REPORTING PROCEDURES
- 10.1 Analytical data validation
- 10.2 Electronic data transfer
- 10.3 Filing of electronic and hard copy data
- 10.4 Reports

APPENDICES
- A Clean Sampling Techniques
- B Health and Safety Plan

*Figure 4-1*
*Outline for a Typical Storm Water Sampling and Analysis Plan*

# 5.0 Definitions

### Chain of Custody (COC) Form

A form used to track sample handling as samples progress from sample collection to the analytical laboratory. The COC is then used to track the resulting analytical data from the laboratory to the client. COC forms can be provided by an analytical laboratory upon request.

### Direct Discharge

Storm water runoff that flows from a construction site directly into a 303(d) water body listed for sedimentation, siltation, or turbidity. Storm water runoff from the construction site is considered a direct discharge to a 303(d) listed water body unless it first flows through:

1) A municipal separate storm sewer system (MS4) that has been formally accepted by and is under control and operation of a municipal entity;

2) A separate storm water conveyance system where there is co-mingling of site storm water with off-site sources; or

3) A tributary or segment of a water body that is not listed on the 303d list before reaching the 303d listed water body or segment.

### Electrical Conductivity (EC)

Measure of the ability of water to carry an electric current. This ability depends on the presence of ions, their concentration, valence, mobility and temperature. EC measurements can give an estimate of the variations in the dissolved mineral content of storm water in relation to receiving waters.

### Field Measurements

Water quality testing performed in the field with portable field-testing kits or meters.

### Field Tracking Form (FTF)

A form that serves as a guide to sampling crews to obtain sampling information and to prescribe and document sample collection information in the field. The FTF usually contains sample identifiers, sampling locations, requested analyses, QC sample identifiers, special instructions, and field notes.

### Holding Time

Holding time is specified by the analytical method and is the elapsed time between the time the sample is collected and the time the analysis must be initiated.

### pH

The pH is universally used to express the intensity of the acid or alkaline condition of a water sample. The pH of natural waters tends to range between 6 and 9, with neutral being 7. Extremes of pH can have deleterious effects on aquatic systems.

### Sampling and Analysis Plan

A document that describes how the samples will be collected and under what conditions, where and when the samples will be collected, what the sample will be tested for, what test methods and detection limits will be used, and what methods/procedures will be maintained to insure the integrity of the sample during collection, storage, shipping and testing (i.e., quality assurance/quality control protocols).

### Sediment

Solid particulate matter, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.

### Sedimentation/Siltation

The process of sediment/silt deposition.

### Settleable Solids

The settleable solids (SS) test measures the solid material that can be settled within a water column during a specified time frame. This typically is tested by placing a water sample into an Imhoff settling cone and allowing the solids to settle by gravity. Results are reported either as a volume (mL/L) or a weight (mg/L).

### Silt

Soil particles between 0.05mm and 0.002mm in size. (For the purposes of its use here, it also includes clay, which is categorized by a particle size less than 0.002mm.)

### Soil Amendment

Any material that is added to the soil to change its chemical properties, engineering properties, or erosion resistance that could become mobilized by storm water and would be not visible in the runoff. Soil amendments include lime, cementitious binders, chlorides, emulsions, polymers, soil stabilizers, and tackifiers applied as a stand-alone treatment (i.e., without mulch). Plant fibers (such as straw or hay), wood and recycled paper fibers (such as mulches and matrices), bark or wood chips, green waste or composted organic materials, and biodegradable or synthetic blanket fibers would not be included as soil amendments in this context because they would be visible in storm water runoff.

### Suspended Sediment Concentration (SSC)

The suspended sediment concentration (SSC) test measures the concentration of suspended solid material in a water sample by measuring the dry weight of all of the solid material from a known volume of a collected water sample. Results are reported in mg/L.

### Total Suspended Solids (TSS)

Suspended solids in a water sample include inorganic substances, such as soil particles and organic substances, such as algae, aquatic plant/animal waste, particles related to industrial/sewage waste, etc. The total suspended solids test (TSS) test measures the concentration of suspended solids in water by measuring the dry weight of a solid material contained in a known volume of a sub-sample of a collected water sample. Results are reported in mg/L.

### Turbidity

Cloudiness of water quantified by the degree to which light traveling through a water column is scattered by the suspended organic and inorganic particles it contains. The scattering of light increases with a greater suspended load. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU).

# 6.0 Sources of Further Assistance

## Regional Water Quality Control Boards

| Regional Water Quality Control Board | Address | Contact Name<br>E-mail | Telephone/Fax |
|---|---|---|---|
| **NORTH COAST REGION** | 5550 Skylane Blvd., Suite A<br>Santa Rosa, CA 95403 | John Short<br>shorj@rb1.swrcb.ca.gov | (707) 576-2065<br>FAX: (707) 523-0135 |
| **SAN FRANCISCO BAY REGION** | 1515 Clay St., Suite 1400<br>Oakland, CA 94612 | Hossain Kazemi<br>mhk@rb2.swrcb.ca.gov | (510) 622-2369<br>FAX: (510) 622-2460 |
| **CENTRAL COAST REGION** | 81 Higuera St., Suite 200<br>San Luis Obispo, CA 93401-5427 | Jennifer Bitting<br>jbitting@rb3.swrcb.ca.gov | (805) 549-3334<br>FAX: (805) 543-0397 |
| **LOS ANGELES REGION** | 320 W. 4th St., Suite 200<br>Los Angeles, CA 90013 | Yi Lu (Inland Los Angeles)<br>ylu@rb4.swrcb.ca.gov | (213) 576-6728<br>FAX: (213) 576-6686 |
| | | Ejigu Soloman (Ventura County)<br>esoloman@rb4.swrcb.ca.gov | 213) 576-6727<br>FAX: (213) 576-6686 |
| | | Xavier Swamikannu (Coastal)<br>xswami@rb4.swrcb.ca.gov | (213) 576-6654<br>FAX (213) 576-6686 |
| **CENTRAL VALLEY REGION**<br>**Sacramento Office** | 3443 Routier Rd., Suite A<br>Sacramento, CA 95827-3098 | Sue McConnell<br>mcconns@rb5s.swrcb.ca.gov | (916) 255-3098<br>FAX: (916) 255-3015 |
| **CENTRAL VALLEY REGION**<br>**Fresno Branch Office** | 3614 East Ashlan Ave.<br>Fresno, CA 93726 | Jarma Bennett<br>bennettj@rb5f.swrcb.ca.gov | (559) 445-6046<br>FAX: (559) 445-5910 |
| **CENTRAL VALLEY REGION**<br>**Redding Branch Office** | 415 Knollcrest Dr.<br>Redding, CA 96002 | Carole Crowe<br>crowec@rb5r.swrcb.ca.gov | (530) 224-4849<br>FAX: (530) 224-4857 |
| **LAHONTAN REGION**<br>**South Lake Tahoe Office** | 2501 Lake Tahoe Blvd.<br>South Lake Tahoe, CA 96150 | Mary Fiore-Wagner<br>fiorm@rb6s.swrcb.ca.gov | (530) 542-5245<br>FAX: (530) 544-2271 |
| **LAHONTAN REGION**<br>**Victorville Office** | 15428 Civic Dr., Suite 100<br>Victorville, CA 92392 | Eugene Rondash<br>erondash@rb6v.swrcb.ca.gov | (760) 241-2434<br>FAX: (760) 241-7308 |
| **COLORADO RIVER BASIN REGION** | 73-720 Fred Waring Dr., Suite 100<br>Palm Desert, CA 92260 | Abdi Haile<br>haila@rb7.swrcb.ca.gov | (760) 776-8939<br>FAX: (760) 341-6820 |
| | | Rosalyn Fleming<br>flemr@rb7.swrcb.ca.gov | (760) 776-8939<br>FAX: (760) 341-6820 |

| Regional Water Quality Control Board | Address | Contact Name<br>E-mail | Telephone/Fax |
|---|---|---|---|
| **SANTA ANA REGION** | 3737 Main St., Suite 500<br>Riverside, CA 92501-3339 | Michael Roth (Riverside County)<br>mroth@rb8.swrcb.ca.gov | (909) 320-2027<br>FAX: (909) 781-6288 |
| | | Aaron Buck (Orange County)<br>abuck@rb8.swrcb.ca.gov | (909) 782-4469<br>FAX: (909) 781-6288 |
| | | Muhammad Bashir (San Bernardino County)<br>mbashir@rb8.swrcb.ca.gov | (909) 320-6396<br>FAX: (909) 781-6288 |
| **SAN DIEGO REGION** | 9771 Clairemont Mesa Blvd., Suite A<br>San Diego, CA 92124 | Jane Ledford<br>ledfj@rb9.swrcb.ca.gov | (858) 467-3272<br>FAX: (858) 571-6972 |

## State Water Resources Control Board

Division of Water Quality
Storm Water Permit Section
P.O. Box 1977
Sacramento, CA 95812-1977
Construction Inquiry Line: (916) 341-5537
Web Site: http://www.swrcb.ca.gov/
e-mail: stormwater@swrcb.ca.gov

## How to Obtain a List of State Certified Laboratories

http://www.dhs.ca.gov/ps/ls/elap/html/lablist_county.htm

## Other Useful Web Sites

***California Stormwater Quality Task Force***
http://www.stormwatertaskforce.org/

***California Department of Transportation***
Environmental Program http://www.dot.ca.gov/hq/env/index.htm

Storm Water Management Program http://www.dot.ca.gov/hq/env/stormwater/

# APPENDIX A

# General Outline of Information that should be included in your SWPPP for the Sampling and Analysis Requirements

## 1. Sedimentation monitoring

(In this section identify whether you need to sample for sedimentation, siltation, or turbidity. At a minimum, identify elements a & b. Note that some water bodies are identified as impaired on a segment basis rather than for the whole water body. Only construction sites with direct discharges into water bodies impaired for sediment, silt, or turbidity are required to perform this sampling. This type of monitoring may not be necessary for all projects. If you do need to conduct this monitoring your SWPPP needs to include section 2, if not move on to section 3.)

a. Site storm water discharge points

b. Receiving water

c. Review 303d list

## 2. Monitoring strategy for sediment

(In this section, identify the sampling process. Include where you will sample (at least one up and one down stream location is needed), what you will sample for, and your field quality control samples. Identify how your samples will be analyzed. Field measurements may be appropriate. If you conduct field sampling, you need to follow the field meter instructions, including calibration requirements.)

a. Sample locations

  i. Location upstream of the construction site in the receiving water (permit required location)

  ii. Location immediately downstream of the construction site in the receiving water (permit required location)

  iii. Location where storm water is discharged from the construction site (recommended location)

b. Parameters to be analyzed

  i. Field measurements

  ii. Laboratory analyses

c. Quality control samples, such as split samples, field blanks, equipment blanks.

## 3. Non-visible pollutant monitoring

(In this section, identify the potential sources of non-visual pollutants. Your SWPPP should discuss the materials in use and the activities conducted on your site, and any past contamination of your project site. These three elements are the potential pollutant sources. Determine if the potential pollutants from these sources are non-visible and can be discharged in storm water runoff. Most projects will have to develop this sampling and analysis plan. If you don't think your site can discharge pollutants, because every thing is either stored so that it doesn't contact storm water or because your site doesn't discharge runoff, it is advisable to develop a contingency sampling plan and analysis strategy, in the event of spill or containment failure. Identify how you will use your current inspection program to trigger sampling and analysis.)

a. Source identification

   i. Pre-construction contamination

   ii. Construction activities

   iii. Construction materials

b. Connect your sampling program to your inspection program

## 4. Monitoring strategy for non-visual pollutants

(In this section, identify the sampling process. Include where you will sample, what you will sample for, when you will sample, and your field quality control samples. For sampling locations, you need to collect samples of runoff that contacts the stored materials and runoff unaffected by it. The unaffected runoff can be immediately upstream of the potential source or from a reference location on the site. Identify how your samples will be analyzed. Field measurements and indicator parameters may be appropriate. If you conduct field sampling, you need to follow the field meter instructions including calibration requirements.)

a. Sample locations

   i. Location downstream from the storage or spill area

   ii. Location unaffected by the storage or spill area

b. Parameters to be analyzed

c. Quality control samples, such as split samples, field blanks, equipment blanks

## 5. Data Evaluation

(In this section, you need to identify how you will use your data. In general, if you find high levels of sediment, analytes or indicator parameters, relative to background levels, you need to contact the Regional Board, identify the source, and review your BMPs for malfunctions or potential upgrades.)

## 6. Training for sampling personnel

(In this section, identify how you have trained your staff or whether you hired trained sampling staff. All personnel collecting samples should be trained to collect samples in accordance with the regulatory requirements (40 CFR Part 136) or follow manufacturers instructions for use and calibration of field meters and instruments. You may want to subcontract sample collection to firms that specialize in water quality sampling)

## 7. Sampling procedures

(In this section identify your sampling procedures, e.g., how you will decide when to sample; how samples will be collected; if there is a special order to sample collection; what field paper work will be completed (field tracking forms, chains of custody); how samples will be handled and transmitted to the laboratory. Other sampling procedures may be needed depending on the specifics of you site and sampling program.)

## 8. Sampling and analysis records

(In this section, identify where you are storing records associated with sampling and analysis. Field and analytical data must be kept in the SWPPP until the Notice of Termination is filed and approved. But you also need to keep other documents associated with the sampling program, such as calibration charts, field tracking forms chains of custody, training records of samplers, laboratory certification information. Identify where this information is kept if other than in the SWPPP.)

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# APPENDIX B

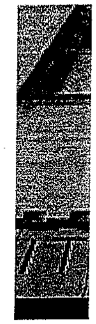
## List of Common Potential Non-visible Pollutants at Construction Projects

The following table represents potential sources of non-visible pollutants that are common to most construction sites. This list is not meant to be inclusive but to provide direction to construction site operators. Over the next year, the State Water Resources Control Board plans to conduct research into non-visible pollutants to provide further guidance and information on appropriate analytical and field tests for common construction pollutants.

**List of Common Potential Non-visible Pollutants at Construction Projects**

| Category | Potential Pollutant Source | Field Indicator of Pollutant Release | Laboratory Analysis |
|---|---|---|---|
| Line flushing | Chlorinated water | Colormetric kit | Residual chlorine |
| Portable toilets | Bacteria, disinfectants | NA | Total/fecal coliform |
| Concrete & Masonry | Acid wash | pH meter | pH |
| | Curing compounds | pH meter | pH, alkalinity, volatile organic compounds (VOCs) |
| | Concrete rinse water | ph meter | pH |
| Painting | Resins | NA | Semi-volatile organic compounds (SVOCs) |
| | Thinners | Phenols kit | Phenols, VOCs |
| | Paint Strippers | NA | VOCs |
| | Solvents | Phenols kit | Phenols, VOCs |
| | Adhesives | Phenols kit | Phenols, SVOCs |
| | Sealants | N/A | SVOCs |
| Cleaning | Detergents | Colorimetric kit | MBAS, phosphates |
| | Bleaches | Colorimetric kit | Residual chlorine |
| | Solvents | Phenols kit | VOCs |
| Landscaping | Pesticides/Herbicides | NA | Check with analytical laboratory |
| | Fertilizers | NA | $NO_3/NH_3/P$ |
| | Lime and gypsum | pH meter | Acidity/alkalinity |
| | Aluminum sulfate, sulfur | Total dissolved solids (TDS), pH | TDS, alkalinity |
| Treated wood | Copper, arsenic, selenium | Metals test kits may be available | Metals |
| Soil amendments & dust control | Lime, gypsum | pH meter | pH |
| | Plant gums | NA | Biochemical oxygen demand (BOD) |
| | Magnesium chloride | TDS | Alkalinity, TDS |
| | Calcium chloride | TDS | Alkalinity, TDS |
| | Natural brines | TDS | Alkalinity, TDS |
| | Lignosulfonates | TDS | Alkalinity, TDS |

# Municipal Handbook



The purpose of this handbook is to provide general guidance for selecting and implementing Best Management Practices (BMPs) to reduce pollutants in runoff from municipal operations.

CASQA

CALIFORNIA STORMWATER QUALITY ASSOCIATION

Click here to view the 2004 Errata Pages.

Adobe Get Acrobat Reader You will need *Acrobat Reader* to view and print these files.

Search BMPs

Home

Click on the links below to view the individual handbook sections or click here to view the entire Handbook. Size: 3,222 KB.
**Due to large document size, expect lengthy download time.**
Note: The handbooks are formated to print double-sided.

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**TABLE OF CONTENTS**

*California Stormwater Quality Association*
*PO Box 2105*
*Menlo Park, CA 94026*

# Section 1
# Introduction

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

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

## 1.1 Handbook Purpose and Scope

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

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

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

- Implementation - Is the BMP compatible with land uses, facilities, or activities in question?
- Cost - Will the cost for implementing the BMP significantly exceed the pollution control benefits? Does a revenue stream exist for ongoing maintenance?
- Technical Feasibility - Is the BMP technically feasible considering soils, geography, water resources, etc.?

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

### 1.1.1 Users of the Handbook

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

### 1.1.2 Organization of the Handbook

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

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

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

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

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

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

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

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

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

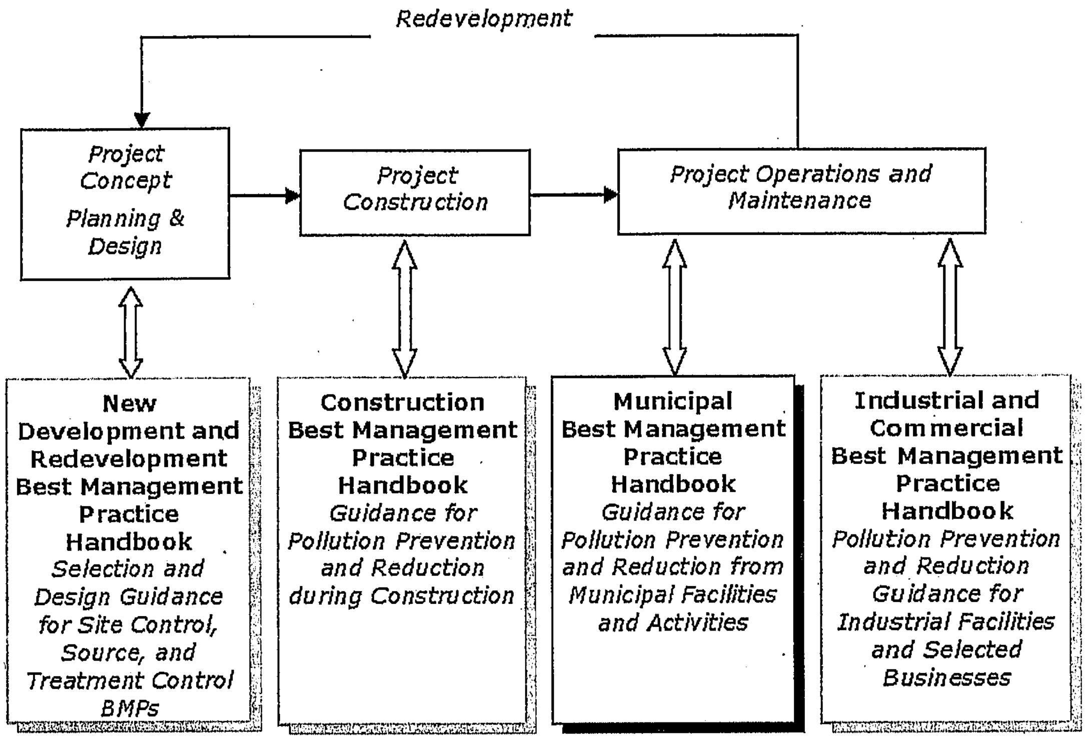
**Appendix C**
**BMP Selection Process**
*This appendix provides an example of BMP selection for a fixed facility.*

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

## 1.1.3 Relationship to Other Handbooks

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

***Project Lifecycle***




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

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

## 1.2 Stormwater Pollutants and Impacts on Water Quality

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

### Municipal Activities Generating Pollutants

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

#### Typical Municipal Operations that Generate Pollutants

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



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**Table 1-1 Pollutant Impacts on Water Quality**

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

## 1.3 Regulatory Requirements

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

### 1.3.1 Federal NPDES Programs

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

### 1.3.2 State NPDES Programs

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

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

- Individual Permits
- Area Wide Permits
- General Permits

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

**Table 1-2 Stormwater Discharge-Permit Type Combinations**

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

## 1.3.3 Municipal NPDES Stormwater Programs

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

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

- **Program Evaluation**: including performance standards, annual and sub-annual reports, internal reporting and record keeping, and Stormwater Management Plan revisions.

- **Monitoring**: including system characterization, source identification, control measure effectiveness, pollutant loading, and data management

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

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

- **Public Involvement and Participation** - Providing opportunities for citizens to participate in program development, implementation, and review, including effectively publicizing public hearings or participation.

- **Illicit Discharge Detection and Elimination** - Developing and implementing a plan to detect and eliminate illicit discharges to the storm drain system including illicit connections and illegal dumping.

- **Construction Site Runoff Control** - Developing, implementing, and enforcing an erosion and sediment control program for construction activities that disturb one or more acres of land.

- **Pollution Prevention / Good Housekeeping for Municipal Operations** - Developing and implementing a program to prevent or reduce pollutant runoff from municipal operations. (This is a primary focus of this handbook.)

- **Post-Construction Stormwater Management in New Development and Redevelopment** - Developing, implementing, and enforcing a program to address discharges of stormwater runoff from new and redevelopment areas.

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

## 1.4 Definitions

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



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

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

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

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

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

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

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

## 1.5 References and Resources

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

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

United States Environmental Protection Agency (U.S.E.P.A.). *EPA Administered Permit Programs: The National Pollutant Discharge Elimination System, 40 CFR 122, (1983, amended 1991).*

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

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

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

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

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

Municipal Programs

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

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

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

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

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

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

# Section 2
# Stormwater Pollution Prevention Planning for Municipal Operations

## 2.1 Introduction

As noted in Section 1 municipalities are required to develop and implement a comprehensive stormwater management program including the reduction of pollutants from municipal operations. In this section, a planning process is suggested for municipal operations, which allows the municipality to identify the activities that generate pollutants and the best management practices (BMPs) applicable to the activities. The recommended process includes the following key components:

- **Inventory:** First, an inventory is developed of all municipal facilities and activities that may be a source of pollutants in stormwater (Section 2.2).
- **Assessment:** Next, the activities are evaluated for their potential to discharge pollutants to storm drains and/or to receiving waters (Section 2.3).
- **BMP Selection:** BMPs are then selected to deal with the identified sources of stormwater pollution. Emphasis is placed on source control (procedures) BMPs and proper maintenance of treatment control BMPs (Section 2.4 and Sections 3 and 4).
- **Implementation:** BMPs are implemented and their effectiveness evaluated. The monitoring, reporting, and inspection requirements of the BMPs is oriented toward gaining insight into the performance of the BMPs (Section 5).

It is worth noting that some municipal facilities may be classified as an industrial–type facility subject to the State NPDES General Permit for Industrial Activities. The reader is referred to the Industrial and Commercial BMP Handbook to determine the classification of the municipal facility. If classified as an industrial facility then the reader should use the Industrial and Commercial BMP Handbook. For all other municipal facilities, the planning procedure described here is applicable.

## 2.2 Develop Inventory of Public Agency Activities

This section describes steps that may be used to generate and maintain comprehensive inventories of the pollutant generating activities associated with municipal operations. These activities can be categorized into two groups as described below:

- Fixed Facilities – specific locations municipalities own and operate and at which municipal activities occur. These types of facilities may also be municipally owned but privately leased. Examples of fixed facility types include municipal waste facilities and corporation yards.
- Field Programs - a set of related municipal activities that take place throughout the municipality. These types of activities may also be privately contracted. Examples of

municipal field programs include roads, streets, and highways maintenance, and drainage system operation and maintenance.

The flow chart presented in Figure 2-1 illustrates the two steps involved in compiling the inventories for both fixed facilities and field programs. A summary of the information that is collected as part of inventory is provided in Table 2-1. Sections 2.2.1 and 2.2.2 provide the guidelines for fully completing the inventories.

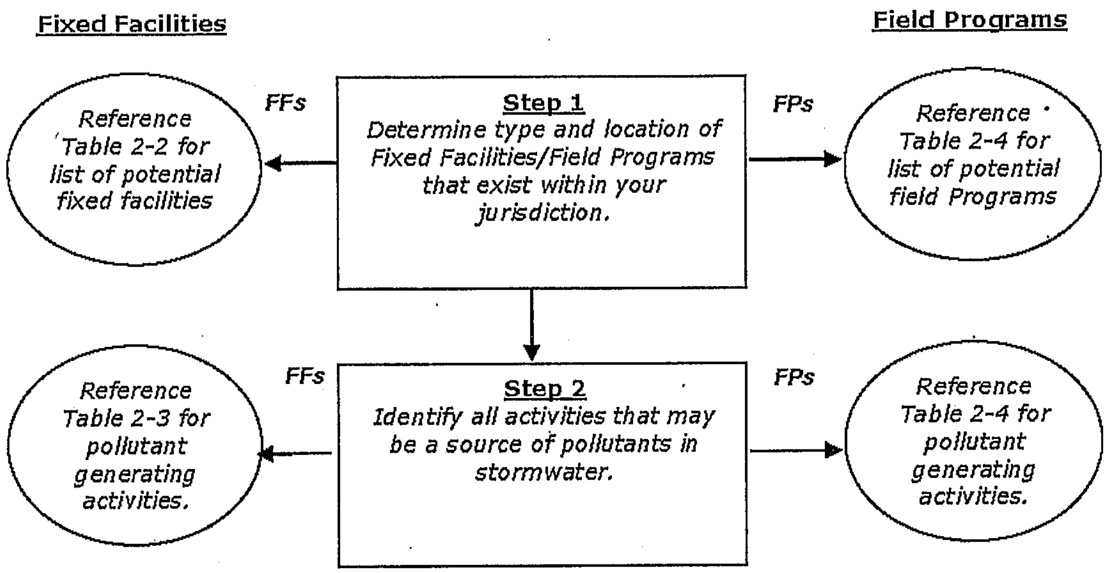


**Figure 2-1**
**Inventory Process for Fixed Facilities and Field Programs**



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### Table 2-1 Inventory Information

**Fixed Facility**

*Facility Type and Location (Step 1)*

- *Facility name/type of facility*
- *Sub-category facility type (see Table 2-2)*
- *Physical Address Information*
- *Watershed and nearby water bodies*
- *GIS Information (longitude and latitude, etc.)*
- *Site Map*

*Facilities Activities and Pollutants (Step 2)*

- *Facility Activities*
- *Potential Pollutants (See Table 2-3)*
- *Pollutants of concern into a 303(d) listed water body or other ESA*
- *List of past significant spills and leaks*
- *List of significant materials and chemicals*
- *Potential non-stormwater discharges*

**Field Program**

*Program Type and Location (Step 1)*

- *Program type*
- *Name and contact information of contractor (if work is contracted out)*
- *Area of coverage*
- *Watershed(s) within coverage area (hydrologic units)*
- *Description of drainage facilities (number, size, length of open channels and closed conduits)*
- *Adjacent to and/or discharge to 303(d) listed water body or other ESA*

*Program Activities and Pollutants (Step 2)*

- *Activities performed (see Table 2-4)*
- *Potential Pollutants (See Table 2-4)*
- *Pollutants of concern into a 303(d) listed water body or other ESA*
- *Potential non-stormwater discharges*

## 2.2.1 Fixed Facility Inventory Procedures

### Step 1 – Determine Fixed Facilities Type and Location

The first step in the inventory process is to identify fixed facilities that are owned and operated or owned and leased by the city (county). Baseline information about the fixed facility needs to be developed including the name, address, type of facility, longitude and latitude, and watershed.

Each fixed facility should be identified with a main and sub-category type within the inventory. The main and sub-category types that typically have the greatest potential for discharging pollutants are listed in Table 2-2.

**Table 2-2 Types of Municipal Fixed Facilities**

| Main Fixed Facility Types | Subcategory of Fixed Facilities |
|---|---|
| Municipal Waste Facilities | Active or Closed Municipal Landfills |
| | Publicly Owned Treatment Facilities |
| | Incinerators |
| | Solid Waste Transfer Facilities |
| | Land Application Sites |
| | Sites for Disposing and Treating Sewage Sludge |
| | Hazardous Waste Treatment, Disposal, and Recovery Facilities |
| | Uncontrolled Sanitary Landfills |
| Corporation Yards | Corporation Yards |
| | Maintenance Yards |
| | Storage Yards for Materials |
| Other Municipal Owned and/or Operated Facilities | Airfields |
| | Parks, Cemeteries & Golf Courses |
| | Public Buildings (Police, Fire, Libraries, etc.) |
| | Stadiums |
| | Stables |
| | Boat/Shipping Yards |
| | Animal Shelters/Services |
| | Public Parking Facilities |
| | Fairgrounds |
| | Other Facilities Identified by the Municipality |

A site map should be prepared for each fixed facility that includes:

- The facility boundaries
- The outline of all stormwater drainage areas
- Portions of the drainage area impacted by run-on from surrounding areas
- Direction of flow of each drainage area
- On-site surface water bodies
- Areas of soil erosion
- Nearby water bodies (such as rivers, lakes, ponds)
- Municipal storm drain inlets where the facility's stormwater discharges
- Stormwater collection and conveyance system, associated points of discharge, and the flow direction



A002978

- Control measures that affect stormwater discharges
- Locations of all catch basins
- Location of authorized non-stormwater discharges to the storm drain
- Outline of all impervious areas of the facility
- Locations where materials are directly exposed to precipitation
- Locations where significant spills or leaks have occurred
- Areas of municipal activities

The inventory should also determine whether the facility is within or adjacent to or discharging directly to an Environmentally Sensitive Area (ESA). For the purposes of this Handbook, "adjacent" is defined as being located within 200 feet of the listed water body. "Discharging directly to" is defined as a discharge from a drainage system servicing the subject facility or activity that flows to the ESA without mixing with other flows (i.e., discharge from an urban area that co-mingles with downstream flows prior to an ESA is not subject to this definition).

An ESA exists if any of the following designations have been applied to the water body of concern:

- Clean Water Act 303(d) listed impaired water body. It should be noted that the 303(d) list is updated on a regular basis by the state and USEPA. Each time that happens, maps showing 303(d) listed water bodies and the inventories will need to be updated.
- Areas designated as Areas of Special Biological Significance (also known as State Water Quality Protection Area) by the SWRCB
- Water bodies designated with the RARE beneficial use by the SWRCB
- Water bodies located within areas designated as preserves or equivalent under the Natural Community Conservation Planning Program
- Areas designated as Critical Aquatic Resources
- Any other equivalent ESAs that contain water bodies which have been identified to be of local concern

An example of an inventory of municipal operations is provided in Appendix A.

## Step 2 – Identify Potential Pollutant Generating Activities

In addition to the identification of the main and subcategories of fixed facility types in Step 1, the potential pollutant generating activities and potential pollutants for each fixed facility should be identified and included in the inventory.

A list of fixed facility activities that have the potential to generate pollutant discharges and the potential pollutants that are associated with those activities is presented in Table 2-3. This list is not inclusive but does provide a good starting point to identify potential pollutants. In addition to these activities, efforts should be made to compile a list of past significant spills and leaks and a list of materials and chemicals stored on-site.

Finally, determine if pollutants associated with identified activities have the potential to discharge into 303 (d) listed water bodies for which the pollutant is listed.

**Table 2-3 Potential Pollutants Likely Associated with Fixed Facility Activities**

| Fixed Facility Activity | Potential Pollutants | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sediment | Nutrients | Trash | Metals | Bacteria | Oil & Grease | Organics | Pesticides | Oxygen Demanding Substances |
| Building and Grounds Maintenance and Repair | X | X | X | X | X | X | X | X | X |
| Parking/Storage Area Maintenance | X | X | X | X | X | X | X | | X |
| Waste Handling and Disposal | X | X | X | X | X | X | X | X | X |
| Vehicle and Equipment Fueling | | | X | X | | X | X | | |
| Vehicle and Equipment Maintenance and Repair | | | | X | | X | X | | |
| Vehicle and Equipment Washing and Steam Cleaning | X | X | X | X | | X | X | | |
| Outdoor Loading and Unloading of Materials | X | X | X | X | | X | X | X | X |
| Outdoor Container Storage of Liquids | | X | | X | | X | X | X | X |
| Outdoor Storage of Raw Materials | X | X | X | | | X | X | X | X |
| Outdoor Process Equipment | X | | X | X | | X | X | | |
| Over water Activities | | | X | X | X | X | X | X | X |
| Landscape Maintenance | X | X | X | | X | | | X | X |



A002980

## 2.2.2 Field Program Inventory Procedures

### Step 1 – Determine Field Program Type and Location

The first step in the inventory process is to identify all field programs conducted by a municipality. The field program and associated activities that have the potential for pollutant discharges are listed in Table 2-4. This list is not inclusive but serves as a starting point for identifying applicable field programs. Baseline information about field programs should be included in the inventory, such as the approximate area of coverage for the field program and an identifier if the performance of the field program is contracted out.

In addition, the watershed where the program occurs should be identified. Most field programs are conducted throughout a political jurisdiction and therefore may affect multiple watersheds. The inventory should reflect all those watersheds in which field programs occur. Mapping the field program infrastructure according to watershed may be useful in this step. As with the fixed facilities inventory information regarding environmentally sensitive areas including location and stressor pollutant should be compiled as part of the inventory effort. See Table 2-1 for a more complete list of information that may be collected during the inventory procedure.

### Step 2 – Identify Potential Pollutant Generating Activities

The potential pollutant generating activities and potential pollutants for each field program must be identified and included in the inventory. A list of field program activities that have the potential to generate pollutant discharges and the potential pollutants that are associated with those activities is presented in Table 2-4.

Although Table 2-4 identifies the primary pollutants typically associated with stormwater runoff there are other environmental conditions that may be applicable to a field program. These include pH, temperature, and toxicity.

**Table 2-4 Field Program Activities and Associated Potential Pollutants**

| Field Programs | Activities | Potential Pollutants: Sediment | Nutrients | Trash | Metals | Bacteria | Oil & Grease | Organics | Pesticides | Oxygen Demanding Substances |
|---|---|---|---|---|---|---|---|---|---|---|
| Roads, Streets, and Highways Operation and Maintenance | Sweeping and Cleaning | X | | X | X | | X | | | X |
| | Street Repair, Maintenance, and Striping /Painting | X | | X | X | | X | X | | |
| | Bridge and Structure Maintenance | X | | X | X | | X | X | | |
| Plaza, Sidewalk, and Parking Lot Maintenance and Cleaning | Surface Cleaning | X | X | | | X | X | | | X |
| | Graffiti Cleaning | X | X | | X | | | X | | |
| | Sidewalk Repair | X | | X | | | | | | |
| | Controlling Litter | X | | X | | X | X | | | X |
| Fountains, Pools, Lakes, and Lagoons Maintenance | Fountain and Pool Draining | | X | | | | | X | | |
| | Lake and Lagoon Maintenance | X | X | X | | X | | | X | X |
| Landscape Maintenance | Mowing/Trimming/Planting | X | X | X | | X | | | X | X |
| | Fertilizer & Pesticide Management | X | X | | | | | | X | |
| | Managing Landscape Wastes | | | X | | | | | X | X |
| | Erosion Control | X | X | | | | | | | |
| Drainage System Operation and Maintenance | Inspection and Cleaning of Stormwater Conveyance Structures | X | X | X | | X | | X | | X |
| | Controlling Illicit Connections and Discharges | X | X | X | X | X | X | X | X | X |
| | Controlling Illegal Dumping | X | X | X | X | X | X | X | X | X |
| | Maintenance of Inlet and Outlet Structures | X | | X | X | | X | | | X |
| Waste Handling and Disposal | Solid Waste Collection | | X | X | X | X | X | X | | X |
| | Waste Reduction and Recycling | | | X | X | | | | | X |
| | Household Hazardous Waste Collection | | | X | X | | X | X | X | |
| | Controlling Litter | | | X | X | X | | X | | X |
| | Controlling Illegal Dumping | X | | X | | X | X | | X | X |
| Water and Sewer Utility Operation and Maintenance | Water line Maintenance | X | | | | X | X | | | |
| | Sanitary Sewer Maintenance | X | | | | X | X | | | X |
| | Spill/Leak/Overflow Control, Response, and Containment | X | X | | | X | | X | | X |

# 2.3 Assessment

This section outlines the procedures for assessing fixed facilities and field programs for BMP selection and implementation. Data gathered during the inventory process should be used to support the assessment process described below.

## 2.3.1 Assessment of Fixed Facilities

The first step in the assessment is to identify BMPs already in place at a facility. These may include pavement sweeping, drain inlet cleaning, covered waste storage bins, and spill prevention and cleanup procedures. This information should be considered when determining which BMPs should be selected and implemented at a site. Worksheet 1 provides a checklist that may be helpful in determining existing BMPs at a site. Other BMPs that were installed for reasons unrelated to stormwater control, such as berming, covered materials storage, and designated wash areas, should also be identified.

Once the existing BMPs have been identified and the inventory completed per Section 2.2, an assessment of all municipal activities and potential pollutant sources should be conducted to determine which areas of the facility are likely sources of pollutants in stormwater and non-stormwater discharges, and which pollutants are likely to be present in stormwater and non-stormwater discharges. Worksheet 1 may help with this task.

Facility operators must then decide whether additional or new BMPs should be implemented to reduce stormwater pollutants to the maximum extent practicable from a site. The municipality should consider and evaluate various factors when performing this assessment, such as:

- effectiveness of current BMPs
- type of activities .
- type and quantities of significant materials handled, produced, stored, or disposed of
- history of spill or leaks
- non-stormwater discharges
- size of facility (including percent impervious)
- proximity to receiving water and/or type of receiving water

The municipality should also consider whether its facility is discharging pollutants identified to be causing impairment in the local water bodies. Appendix B provides an example of a method for assessing a facility for BMP implementation.

## 2.3.2 Assessment of Field Programs

Similar to the effort at a fixed facility a municipality should identify BMPs that are already in place and the extent of their effectiveness. Using this information and the inventory data the municipality can identify the activities with the potential for discharging pollutants, the type of pollutants being discharged, and the extent that the pollutants are being addressed with current procedures or BMPs. The municipality can then assess whether additional or new BMPs are necessary. In considering the need for new or additional BMPs, a municipality should consider:

- effectiveness of current BMPs
- type of field program and pollutants being discharged
- exposure of activities to stormwater
- land use category
- proximity to receiving water and/or type of receiving water

## 2.4 Identify and Select BMPs

Selection of BMPs should focus first on source control BMPs and second on treatment control BMPs. Typically, source control BMPs will serve to reduce pollutants from activities to the maximum extent practicable. Treatment controls BMPs should be considered when source control BMPs have been shown to be ineffective or when special environmental or site conditions warrant a more comprehensive approach. The reader is referred to the New Development and Redevelopment BMP Handbook if treatment control BMPs are determined to be necessary. An example of selecting source control BMPs is provided in Appendix C.

Municipalities can identify and select BMPs from those presented in Section 3 – Source Control BMPs. The BMPs are described in activity-based and field program-based fact sheets that also provide information on the pollutants that can be addressed by the BMP. The BMPs shown in Section 3 are a comprehensive collection and not all may be applicable to the activities or field programs of a particular municipality. In order to be effective, BMPs must be appropriate to the application and properly implemented.

Municipalities must also consider the maintenance requirements of existing treatment control BMPs. In this regard, the municipality should refer to Section 4 –Treatment Control BMPs. The fact sheets in Section 4 are focused on the maintenance requirements of these treatment control BMPs. Proper maintenance is necessary for these controls to operate effectively.

## WORKSHEET 1

Facility Name: Site Address:
Contact Name: Phone:

1. **ACTIVITIES** – In the table below check each activity present at the site and evaluate its **potential for pollutant discharge (PPD):** 1 = high potential, 2= medium potential, 3= low potential

2. **BMP EFFECTIVENESS** – In the table below, provide an effectiveness rating using the provided scale.

| ACTIVITY AND BMP CHECKLIST | APPLICABLE ACTIVITY Yes | No | PPD | EFFECTIVENESS RATING * |
|---|---|---|---|---|
| A. VEHICLE AND EQUIPMENT FUELING<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| B. VEHICLE AND EQUIPMENT WASHING/STEAM CLEANING<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| C. VEHICLE AND EQUIPMENT MAINTENANCE AND REPAIR<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| D. OUTDOOR LOADING/UNLOADING OF MATERIALS<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| E. OUTDOOR CONTAINER STORAGE OF LIQUIDS<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| F. OUTDOOR PROCESS EQUIPMENT OPERATIONS AND MAINTENANCE<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| G. OUTDOOR STORAGE OF RAW MATERIALS<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| H. WASTE HANDLING AND DISPOSAL<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| I. BUILDING AND GROUNDS MAINTENANCE<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| J. PARKING/STORAGE AREA MAINTENANCE<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| K. OVER WATER ACTIVITIES<br>BMPs employed: | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |
| L. OTHER (describe): | [ ] | [ ] | [ ] | ① ② ③ ④ ⑤ |

***① No BMPs used and stormwater pollution likely ② Some BMPs used but not effective ③ Some BMPs used and moderately effective**
**④ Source control BMPs used and very effective/structural BMPs needed ⑤ All necessary BMPs used and very effective**

3. TYPE AND QUANTITY OF MATERIALS USED

| Material | Typical Quantity/Frequency | Is Stored Material Likely to Generate Pollutants |
|---|---|---|

4. HISTORY OF SPILLS AND LEAKS

   *a)* Is there a chronic history of spills and leaks?______________________________________

*b)* Is there no evidence of leaks and drips from equipment and machinery?__________________________
*c)* Is there a spill prevention and response team?______________________________________________________________________
*d)* Are appropriate spill containment and cleanup materials kept on-site and in convenient locations?____________________________________________________________________
*e)* Are cleanup procedures for spills followed regularly and correctly?____________________________
*f)* Are used absorbent materials removed and disposed of in a timely manner? ________________________
*g)* Are personnel regularly trained in the use of spill control materials?__________________________________________________________________

5. NON-STORMWATER DISCHARGES

*a)* Outfall directly observed during assessment____________________________________________________________________
*b)* Are BMPs implemented to prevent, treat, or control non-stormwater discharges?____________________________________________________________________
*c)* Is there a potential for non-stormwater discharges (i.e. non-stormwater sources observed without BMPs implemented)__________________________________________________________________

6. SIZE OF FACILTIY (incorporating the size of a facility serves as a surrogate measure for flow)

*a)* Total area_________
*b)* The impervious area (including parking lot) is ____________

7. PROXIMITY TO RECEIVING WATER

Does the facility discharge directly or adjacent to a 303(d) water body or other environmentally sensitive area?________________________________________________________________________

# Section 3
# Source Control BMPs

## 3.1 Introduction

This section provides a description of specific source control Best Management Practices (BMPs) for activities related to municipal operations. As noted in Sections 1 and 2, municipal fixed facilities conduct activities that have the potential to generate pollutants. The source control BMPs in this section address these activities (see Table 3-1).

In addition, municipalities conduct various field programs where activities may occur and create pollutants. BMPs for these field programs and associated activities are listed in Table 3-2.

**Table 3-1 Municipal Fixed Facility BMPs**

| | |
|---|---|
| **Non-Stormwater Management** | |
| SC-10 | Non-Stormwater Discharges |
| SC-11 | Spill Prevention, Control and Cleanup |
| **Vehicle and Equipment Management** | |
| SC-20 | Vehicle and Equipment Fueling |
| SC-21 | Vehicle and Equipment Cleaning |
| SC-22 | Vehicle and Equipment Repair |
| **Material and Waste Management** | |
| SC-30 | Outdoor Loading/Unloading |
| SC-31 | Outdoor Container Storage |
| SC-32 | Outdoor Equipment Maintenance |
| SC-33 | Outdoor Storage of Raw Materials |
| SC-34 | Waste Handling and Disposal |
| **Building and Grounds Management** | |
| SC-41 | Building and Grounds Maintenance |
| SC-43 | Parking/Storage Area Maintenance |
| **Over Water Activities** | |
| SC-50 | Over Water Activities |
| **General Stormwater Management** | |
| SC-60 | Housekeeping Practices |
| SC-61 | Safer Alternative Products |

**Table 3-2 Municipal Field Program BMPs**

| | |
|---|---|
| SC-70 | Road and Street Maintenance |
| SC-71 | Plaza and Sidewalk Cleaning |
| SC-72 | Fountains & Pools Maintenance |
| SC-73 | Landscape Maintenance |
| SC-74 | Drainage System Maintenance |
| SC-75 | Waste Handling and Disposal |
| SC-76 | Water and Sewer Utility Maintenance |

# 3.2 Fact Sheet Format

Each BMP fact sheet is a short document that gives all the information about a particular BMP. Typically, each fact sheet contains the information outlined in Figure 3-1. Completed fact sheets for each of the activities listed in Tables 3-1 and 3-2 are provided in Section 3.3.

The fact sheets also contain side bar presentations with information on BMP objectives and targeted constituents.

The information provided in each fact sheet is extensive and may not be applicable to all municipal operations. The readers may find it helpful to modify and simplify the BMP fact sheets to better reflect their existing operations.

**SC-xx Example Fact Sheet**

Description of the BMP

Approach

- Pollution Prevention
- Suggested Protocols
- Training
- Spill Response and Prevention
- Other Considerations

Requirements

- Costs
- Maintenance

Supplemental Information

- Further Details on the BMP
- Examples

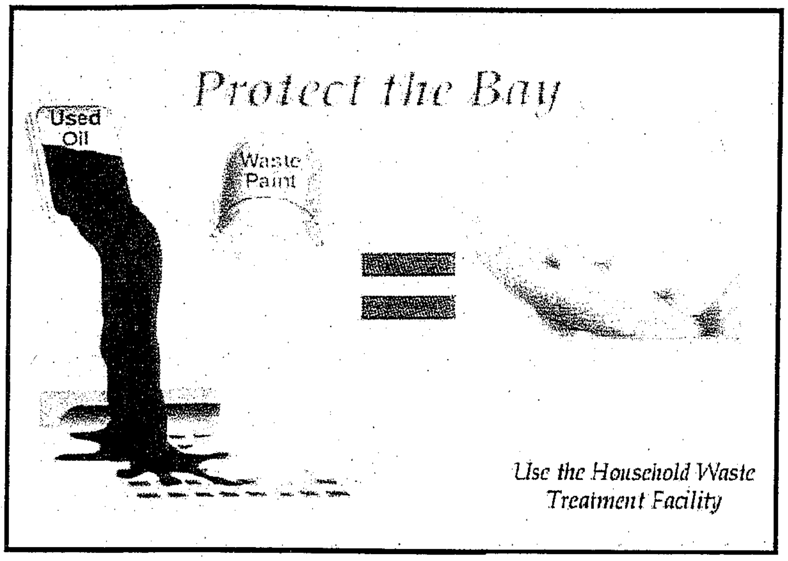
References and Resources

**Figure 3-1**
**Example Fact Sheet**

# 3.3 BMP Fact Sheets

BMP fact sheets for fixed facilities activities and field programs follow. The BMP fact sheets are individually page numbered and are suitable for photocopying and inclusions in stormwater quality management plans. Fresh copies of the fact sheets can be individually downloaded from the California Stormwater BMP Handbook website at http://www.cabmphandbooks.com

# Non-Stormwater Discharges SC-10




Graphic by: Margie Winter

### Objectives

- Contain
- Educate
- Reduce/Minimize

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. For municipalities non-stormwater discharges present themselves in two situations. One is from fixed facilities owned and/or operated by the municipality. The other situation is non-stormwater discharges that are discovered during the normal operation of a field program. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, and surface cleaning. However, there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances (such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants) into storm drains. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges.

## Approach

The municipality must address non-stormwater discharges from its fixed facilities by assessing the types of non-stormwater discharges and implementing BMPs for the discharges determined to pose environmental concern. For field programs

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the field staff must be trained to now what to look for regarding non-stormwater discharges and the procedures to follow in investigating the detected discharges.

***Suggested Protocols***

**Fixed Facility**

*General*

- Post "No Dumping" signs with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Landscaping and beautification efforts of hot spots might also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.

*Illicit Connections*

- Locate discharges from the fixed facility drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Use techniques such as smoke testing, dye testing and television camera inspection (as noted below) to verify physical connections.
- Isolate problem areas and plug illicit discharge points.

*Visual Inspection and Inventory*

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for several days following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

*Review Infield Piping*

- Review the "as-built" piping schematic as a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

*Smoke Testing*

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.

- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

  *Dye Testing*

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

*TV Inspection of Storm Sewer*

- TV Cameras can be employed to visually identify illicit connections to the fixed facility storm drain system.

*Illegal Dumping*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Clean up spills on paved surfaces with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.
- See fact sheet SC-11 Spill Prevention, Control, and Clean Up.

**Field Program**

*General*

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially ones that involve more than one jurisdiction and those that are not classified as hazardous, which are often not responded to as effectively as they need to be.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- See SC-74 Stormwater Drainage System Maintenance for additional information.



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*Field Inspection*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- During routine field program maintenance field staff should look for evidence of illegal discharges or illicit connection:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections and notify appropriate investigating agency.
- If trained, conduct field investigation of non-stormwater discharges to determine whether they pose a threat to water quality.

*Recommended Complaint Investigation Equipment*

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms.
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms

- Educational materials

*Reporting*

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any onsite drainage points observed.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

*Enforcement*

- Educate the responsible party if identified on the impacts of their actions, explain the stormwater requirements, and provide information regarding Best Management Practices (BMP), as appropriate. Initiate follow-up and/or enforcement procedures.
- If an illegal discharge is traced to a commercial, residential or industrial source, conduct the following activities or coordinate the following activities with the appropriate agency:
  - Contact the responsible party to discuss methods of eliminating the non-stormwater discharge, including disposal options, recycling, and possible discharge to the sanitary sewer (if within POTW limits).
  - Provide information regarding BMPs to the responsible party, where appropriate.
  - Begin enforcement procedures, if appropriate.
  - Continue inspection and follow-up activities until the illicit discharge activity has ceased.
- If an illegal discharge is traced to a commercial or industrial activity, coordinate information on the discharge with the jurisdiction's commercial and industrial facility inspection program.

***Training***

- Train technical staff to identify and document illegal dumping incidents.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Train employees to identify non-stormwater discharges and report them to the appropriate departments.
- Train staff who have the authority to conduct surveillance and inspections, and write citations for those caught illegally dumping.

- Train municipal staff responsible for surveillance and inspection in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).
  - OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and federal OSHA 29 CFR 1910.146).
  - Procedural training (field screening, sampling, smoke/dye testing, TV inspection).
- Educate the identified responsible party on the impacts of his or her actions.

***Spill Response and Prevention***

- See SC-11 Spill Prevention Control and Clean Up

***Other Considerations***

- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The cost of fees for dumping at a proper waste disposal facility are often more than the fine for an illegal dumping offense, thereby discouraging people from complying with the law. The absence of routine or affordable pickup service for trash and recyclables in some communities also encourages illegal dumping. A lack of understanding regarding applicable laws or the inadequacy of existing laws may also contribute to the problem.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Many facilities do not have accurate, up-to-date schematic drawings.
- Can be difficult to locate illicit connections especially if there is groundwater infiltration.

## Requirements

***Costs***

- Eliminating illicit connections can be expensive especially if structural modifications are required such re-plumbing cross connections under an existing slab.
- Minor cost to train field crews regarding the identification of non-stormwater discharges. The primary cost is for a fully integrated program to identify and eliminate illicit connections and illegal dumping. However, by combining with other municipal programs (i.e. pretreatment program) cost may be lowered.
- Municipal cost for containment and disposal may be borne by the discharger.

***Maintenance***

Not applicable



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**Supplemental Information**

***Further Detail of the BMP***

*What constitutes a "non-stormwater" discharge?*

- Non-stormwater discharges are discharges not made up entirely of stormwater and include water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, landscape irrigation, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

*Permit Requirements*

- Current municipal NPDES permits require municipalities to effectively prohibit non-stormwater discharges unless authorized by a separate NPDES permit or allowed in accordance with the current NPDES permit conditions. Typically the current permits allow certain non-stormwater discharges in the storm drain system as long as the discharges are not significant sources of pollutants. In this context the following non-stormwater discharges are typically allowed:

  - Diverted stream flows;
  - Rising found waters;
  - Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20));
  - Uncontaminated pumped ground water;
  - Foundation drains;
  - Springs;
  - Water from crawl space pumps;
  - Footing drains;
  - Air conditioning condensation;
  - Flows from riparian habitats and wetlands;
  - Water line and hydrant flushing ;
  - Landscape irrigation;
  - Planned and unplanned discharges from potable water sources;
  - Irrigation water;
  - Individual residential car washing; and
  - Lawn watering.

Municipal facilities subject to industrial general permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The state's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

*Illegal Dumping*

- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties

*Outreach*

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people on the street who are aware of the problem and who have the tools to at least identify the incident, if not correct it. There we a number of ways of accomplishing this:

- Train municipal staff from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report the incidents.
- Deputize municipal staff who may come into contact with illegal dumping with the authority to write illegal dumping tickets for offenders caught in the act (see below).
- Educate the public. As many as 3 out of 4 people do not understand that in most communities the storm drain does not go to the wastewater treatment plant. Unfortunately, with the heavy emphasis in recent years on public education about solid waste management, including recycling and household hazardous waste, the sewer system (both storm and sanitary) has been the likely recipient of cross-media transfers of waste.
- Provide the public with a mechanism for reporting incidents such as a hot line and/or door hanger (see below).
- Help areas where incidents occur more frequently set up environmental watch programs (like crime watch programs).
- Train volunteers to notice and report the presence and suspected source of an observed pollutant to the appropriate public agency.

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- Non-stormwater discharges are discharges not made up entirely of stormwater and include water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, landscape irrigation, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

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  - Uncontaminated pumped ground water;
  - Foundation drains;
  - Springs;
  - Water from crawl space pumps;
  - Footing drains;
  - Air conditioning condensation;
  - Flows from riparian habitats and wetlands;
  - Water line and hydrant flushing ;
  - Landscape irrigation;
  - Planned and unplanned discharges from potable water sources;
  - Irrigation water;
  - Individual residential car washing; and
  - Lawn watering.

Municipal facilities subject to industrial general permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The state's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

*Storm Drain Stenciling*

- Stencil storm drain inlets with a message to prohibit illegal dumpings, especially in areas with waste handling facilities.
- Encourage public reporting of improper waste disposal by a HOTLINE number stenciled onto the storm drain inlet.
- See Supplemental Information section of this fact sheet for further detail on stenciling program approach.

*Oil Recycling*

- Contract collection and hauling of used oil to a private licensed used oil hauler/recycler.
- Comply with all applicable state and federal regulations regarding storage, handling, and transport of petroleum products.
- Create procedures for collection such as; collection locations and schedule, acceptable containers, and maximum amounts accepted.
- The California Integrated Waste Management Board has a Recycling Hotline, (800) 553-2962, that provides information and recycling locations for used oil.

***Household Hazardous Waste***

- Provide household hazardous waste (HHW) collection facilities. Several types of collection approaches are available including permanent, periodic, or mobile centers, curbside collection, or a combination of these systems.

***Training***

- Train municipal employees and contractors in proper and consistent methods for waste disposal.
- Train municipal employees to recognize and report illegal dumping.
- Train employees and subcontractors in proper hazardous waste management.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

### *Other Considerations*

- Federal Regulations (RCRA, SARA, CERCLA) and state regulations exist regarding the disposal of hazardous waste.
- Municipalities are required to have a used oil recycling element and a HHW element within their integrated waste management plan.
- Significant liability issues are involved with the collection, handling, and disposal of HHW.

### *Examples*

The City of Palo Alto has developed a public participation program for reporting dumping violations. When a concerned citizen or public employee encounters evidence of illegal dumping, a door hanger (similar in format to hotel "Do Not Disturb" signs) is placed on the front doors in the neighborhood. The door hanger notes that a violation has occurred in the neighborhood, informs the reader why illegal dumping is a problem, and notes that illegal dumping carries a significant financial penalty. Information is also provided on what citizens can do as well as contact numbers for more information or to report a violation.

The Port of Long Beach has a state of the art database incorporating storm drain infrastructure, potential pollutant sources, facility management practices, and a pollutant tracking system.

The State Department of Fish and Game has a hotline for reporting violations called CalTIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

## References and Resources

http://www.stormwatercenter.net/

California's Nonpoint Source Program Plan http://www.co.clark.wa.us/pubworks/bmpman.pdf

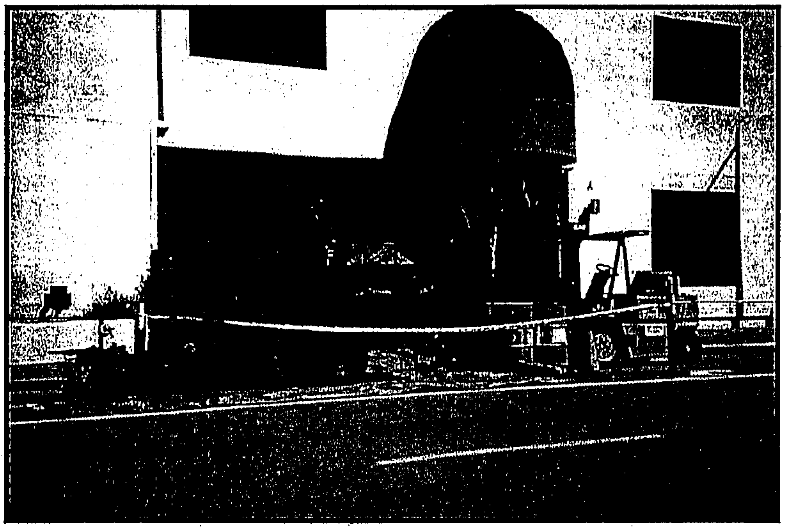
King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Orange County Stormwater Program,
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program
(http://www.projectcleanwater.org)

Santa Clara Valley Urban Runoff Pollution Prevention Program
http://www.scvurppp-w2k.com/pdf%20documents/PS_ICID.PDF

# Spill Prevention, Control & Cleanup SC-11



### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Spills and leaks, if not properly controlled, can adversely impact the storm drain system and receiving waters. Due to the type of work or the materials involved, many activities that occur either at a municipal facility or as a part of municipal field programs have the potential for accidental spills and leaks. Proper spill response planning and preparation can enable municipal employees to effectively respond to problems when they occur and minimize the discharge of pollutants to the environment.

## Approach

- An effective spill response and control plan should include:
  - Spill/leak prevention measures;
  - Spill response procedures;
  - Spill cleanup procedures;
  - Reporting; and
  - Training
- A well thought out and implemented plan can prevent pollutants from entering the storm drainage system and can be used as a tool for training personnel to prevent and control future spills as well.

### *Pollution Prevention*

- Develop and implement a Spill Prevention Control and Response Plan. The plan should include:

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- A description of the facility, the address, activities and materials involved
- Identification of key spill response personnel
- Identification of the potential spill areas or operations prone to spills/leaks
- Identification of which areas should be or are bermed to contain spills/leaks
- Facility map identifying the key locations of areas, activities, materials, structural BMPs, etc.
- Material handling procedures
- Spill response procedures including:
    - Assessment of the site and potential impacts
    - Containment of the material
    - Notification of the proper personnel and evacuation procedures
    - Clean up of the site
    - Disposal of the waste material and
    - Proper record keeping

- Product substitution – use less toxic materials (i.e. use water based paints instead of oil based paints)
- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of materials that are brought into the facility or into the field.

***Suggested Protocols***

*Spill/Leak Prevention Measures*

- If possible, move material handling indoors, under cover, or away from storm drains or sensitive water bodies.
- Properly label all containers so that the contents are easily identifiable.
- Berm storage areas so that if a spill or leak occurs, the material is contained.
- Cover outside storage areas either with a permanent structure or with a seasonal one such as a tarp so that rain can not come into contact with the materials.
- Check containers (and any containment sumps) often for leaks and spills. Replace containers that are leaking, corroded, or otherwise deteriorating with containers in good condition. Collect all spilled liquids and properly dispose of them.

- Store, contain and transfer liquid materials in such a manner that if the container is ruptured or the contents spilled, they will not discharge, flow or be washed into the storm drainage system, surface waters, or groundwater.

- Place drip pans or absorbent materials beneath all mounted taps and at all potential drip and spill locations during the filling and unloading of containers. Any collected liquids or soiled absorbent materials should be reused/recycled or properly disposed of.

- For field programs, only transport the minimum amount of material needed for the daily activities and transfer materials between containers at a municipal yard where leaks and spill are easier to control.

- If paved, sweep and clean storage areas monthly, do not use water to hose down the area unless all of the water will be collected and disposed of properly.

- Install a spill control device (such as a tee section) in any catch basins that collect runoff from any storage areas if the materials stored are oil, gas, or other materials that separate from and float on water. This will allow for easier cleanup if a spill occurs.

- If necessary, protect catch basins while conducting field activities so that if a spill occurs, the material will be contained.

***Training***

- Educate employees about spill prevention, spill response and cleanup on a routine basis.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employees should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan if one is available.

- Training of staff from all municipal departments should focus on recognizing and reporting potential or current spills/leaks and who they should contact.

- Employees responsible for aboveground storage tanks and liquid transfers for large bulk containers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

***Spill Response and Prevention***

- Identify key spill response personnel and train employees on who they are.

- Store and maintain appropriate spill cleanup materials in a clearly marked location near storage areas; and train employees to ensure familiarity with the site's spill control plan and/or proper spill cleanup procedures.

- Locate spill cleanup materials, such as absorbents, where they will be readily accessible (e.g. near storage and maintenance areas, on field trucks).

# SC-11 Spill Prevention, Control & Cleanup

- Follow the Spill Prevention Control and Countermeasure Plan if one is available.
- If a spill occurs, notify the key spill response personnel immediately. If the material is unknown or hazardous, the local fire department may also need to be contacted.
- If safe to do so, attempt to contain the material and block the nearby storm drains so that the area impacted is minimized. If the material is unknown or hazardous wait for properly trained personnel to contain the materials.
- Perform an assessment of the area where the spill occurred and the downstream area that it could impact. Relay this information to the key spill response and clean up personnel.

*Spill Cleanup Procedures*

- Small non-hazardous spills
  - Use a rag, damp cloth or absorbent materials for general clean up of liquids
  - Use brooms or shovels for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- Large non-hazardous spills
  - Use absorbent materials for general clean up of liquids
  - Use brooms, shovels or street sweepers for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- For hazardous or very large spills, a private cleanup company or Hazmat team may need to be contacted to assess the situation and conduct the cleanup and disposal of the materials.
- Chemical cleanups of material can be achieved with the use of absorbents, gels, and foams. Remove the adsorbent materials promptly and dispose of according to regulations.
- If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

*Reporting*

- Report any spills immediately to the identified key municipal spill response personnel.



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- Report spills in accordance with applicable reporting laws. Spills that pose an immediate threat to human health or the environment must be reported immediately to the Office of Emergency Service (OES)

- Spills that pose an immediate threat to human health or the environment may also need to be reported within 24 hours to the Regional Water Quality Control Board.

- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour)

- After the spill has been contained and cleaned up, a detailed report about the incident should be generated and kept on file (see the section on Reporting below). The incident may also be used in briefing staff about proper procedures

### *Other Considerations*

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure Plan (SPCC) Plan (Health & Safety Code Chapter 6.67).

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, if permitted to do so, prohibiting any hard connections to the storm drain.

## Requirements

### *Costs*

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of wastes, contaminated soil and water is very expensive

### *Maintenance*

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs

## Supplemental Information

### *Further Detail of the BMP*

*Reporting*

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the response and containment of a spill. A good record keeping system helps the municipality minimize incident recurrence, correctly respond with appropriate containment and cleanup activities, and comply with legal requirements.

A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm drain.

# SC-11 Spill Prevention, Control & Cleanup

These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

***Examples***

The City of Palo Alto includes spill prevention and control as a major element of its highly effective program for municipal vehicle maintenance shops.

### References and Resources

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

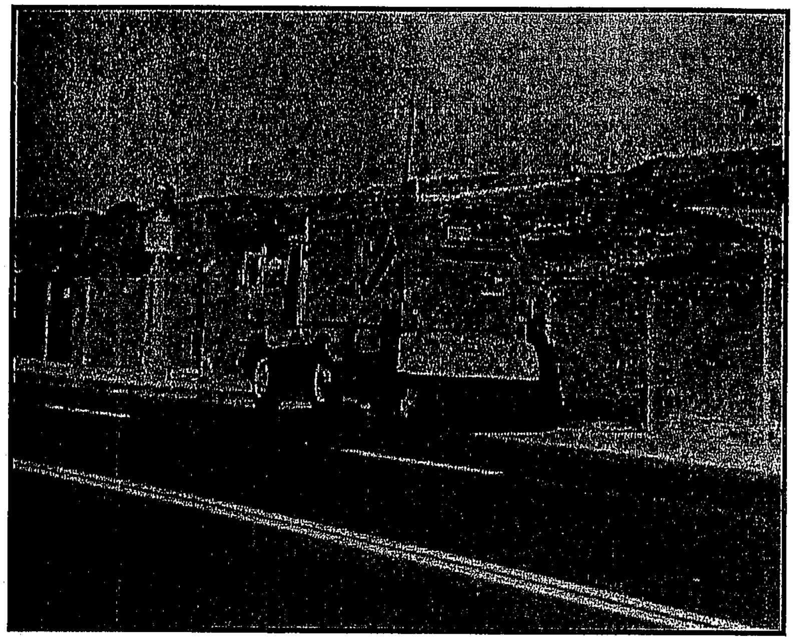
Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf



A003005

# Vehicle and Equipment Fueling SC-20



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | |

## Description

Spills and leaks that occur during vehicle and equipment fueling can contribute hydrocarbons, oil and grease, as well as heavy metals to stormwater runoff. Implementing the following management practices can help prevent fuel spills and leaks.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *Pollution Prevention*

- Use properly maintained offsite fueling stations whenever possible. These businesses are better equipped to handle fuel and spills properly.
- Educate employees about pollution prevention measures and goals
- Focus pollution prevention activities on containment of spills and leaks, most of which may occur during liquid transfers.

### *Suggested Protocols*

*General*

- "Spot clean" leaks and drips routinely. Leaks are not cleaned up until the absorbent is picked up and disposed of properly.

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- Label drains within the facility boundary, by paint/stencil (or equivalent), to indicate whether they flow to an oil/water separator, directly to the sewer, or to a storm drain. Labels are not necessary for plumbing fixtures directly connected to the sanitary sewer but may be useful to help eliminate confusion about where the drain leads.
- Post signs to remind employees not to top off the fuel tank when filling and signs that ban employees from changing engine oil or other fluids at that location.
- Report leaking vehicles to fleet maintenance.
- Install inlet catch basin equipped with a small sedimentation basin or grit chamber to remove large particles from stormwater in highly impervious areas. Proper maintenance of these devices is necessary.
- Accumulated non-contaminated stormwater (e.g., in a secondary containment) should be released prior to next storm.
- Ensure the following safeguards are in place:
  - Overflow protection devices on tank systems to warn the operator to automatically shutdown transfer pumps when the tank reaches full capacity.
  - Protective guards around tanks and piping to prevent vehicle or forklift damage.
  - Clearly tagging or labeling all valves to reduce human error.
  - Automatic shut off for severed fuel hoses.

*Fuel Dispensing Areas*

- Maintain clean fuel-dispensing areas using dry cleanup methods such as sweeping for removal of litter and debris, or use of rags and absorbents for leaks and spills. Do not wash down areas with water.
- Fit underground storage tanks with spill containment and overfill prevention systems meeting the requirements of Section 2635(b) of Title 23 of the California Code of Regulations.
- Fit fuel dispensing nozzles with "hold-open latches" (automatic shutoffs) except where prohibited by local fire departments.
- Post signs at the fuel dispenser or fuel island warning vehicle owners/operators against "topping off" of vehicle fuel tanks.
- Design fueling area to prevent stormwater runoff and spills.
- Cover fueling area with an overhanging roof structure or canopy so that precipitation cannot come in contact with the fueling area and if possible use a perimeter drain or slope pavement inward with drainage to a blind sump (must be properly maintained and water properly disposed of); pave area with concrete rather than asphalt.

- Apply a suitable sealant that protects the asphalt from spilled fuels in areas where covering is infeasible and the fuel island is surrounded by pavement.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Cover storm drains in the vicinity during transfer.

*Outdoor Waste Receptacle Area*

- Spot clean leaks and drips routinely to prevent runoff of spillage.
- Minimize the possibility of stormwater pollution from outside waste receptacles by using an effective combination of the following:
  - use only watertight waste receptacle(s) and keep the lid(s) closed, or
  - grade and pave the waste receptacle area to prevent runon of stormwater, or
  - install a roof over the waste receptacle area, or
  - install a low containment berm around the waste receptacle area, or
  - use and maintain drip pans under waste receptacles. Containment areas and drip pans must be properly maintained and collected water disposed of properly (e.g., to sanitary sewer). Several drip pans should be stored in a covered location near outdoor waste receptacle area so that they are always available, yet protected from precipitation when not in use.
- Post "no littering" signs.

*Air/Water Supply Area*

- Minimize the possibility of stormwater pollution from air/water supply areas by implementing an effective combination of the following:
  - spot clean leaks and drips routinely to prevent runoff of spillage, or
  - grade and pave the air/water supply area to prevent runon of stormwater, or
  - install a roof over the air/water supply area, or
  - install a low containment berm around the air/water supply area. Maintain containment areas and dispose of contaminated water properly (e.g., to sanitary sewer).

*Inspection*

- Aboveground Tank Leak and Spill Control:
  - Check for external corrosion and structural failure.

- Check for spills and overfills due to operator error.
- Check for failure of piping system.
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.
- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Periodically, integrity testing should be conducted by a qualified professional.

■ Inspect and clean, if necessary, storm drain inlets and catch basins within the facility boundary before October 1 each year.

***Training***

■ Train all employees upon hiring and annually thereafter on proper methods for handling and disposing of waste. Make sure that all employees understand stormwater discharge prohibitions, wastewater discharge requirements, and these best management practices.

■ Train employees on proper fueling and cleanup procedures.

■ Use a training log or similar method to document training.

■ Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.

***Spill Response and Prevention***

■ Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.

■ Place stockpiles of spill cleanup materials where they are readily accessible.

■ Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly and dispose properly.

■ Store portable absorbent booms (long flexible shafts or barriers made of absorbent material) in unbermed fueling areas.

■ Report spills promptly.

■ Install an oil/water separator and connect to the sanitary sewer (if allowed), if a dead-end sump is not used to collect spills.

***Other Considerations***

■ Carry out all federal and state requirements regarding underground storage tanks, or install above ground tanks.

## Requirements

### *Costs*

- The retrofitting of existing fueling areas to minimize stormwater exposure or spill runoff can be expensive. Good design must occur during the initial installation.
- Extruded curb along the "upstream" side of the fueling area to prevent stormwater runon is of modest cost.

### *Maintenance*

- Clean oil/water separators at appropriate intervals.
- Keep ample supplies of spill cleanup materials onsite.
- Inspect fueling areas, storage tanks, catch basin inserts, containment areas, and drip pans on a regular schedule.

## Supplemental Information

### *Design Considerations*

*Designing New Installations*

The elements listed below should be included in the design and construction of new or substantially remodeled facilities.

Fuel Dispensing Areas

- Fuel dispensing areas must be paved with Portland cement concrete (or, equivalent smooth impervious surface), with a 2% to 4% slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents runon of stormwater to the extent practicable. The fuel dispensing area is defined as extending 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less. The paving around the fuel dispensing area may exceed the minimum dimensions of the "fuel dispensing area" stated above.
- The fuel dispensing area must be covered, and the cover's minimum dimensions must be equal to or greater than the area within the grade break or the fuel dispensing area, as defined above. The cover must not drain onto the fuel dispensing area.
- If necessary install and maintain an oil control device in the appropriate catch basin(s) to treat runoff from the fueling area.

Outdoor Waste Receptacle Area

- Grade and pave the outdoor waste receptacle area to prevent runon of stormwater to the extent practicable.

Air/Water Supply Area

- Grade and pave the air/water supply area to prevent runon of stormwater to the extent practicable.

*Designated Fueling Area*

- If your facility has large numbers of mobile equipment working throughout the site and you currently fuel them with a mobile fuel truck, consider establishing a designated fueling area. With the exception of tracked equipment such as bulldozers and perhaps small forklifts, most vehicles should be able to travel to a designated area with little lost time. Place temporary "caps" over nearby catch basins or manhole covers so that if a spill occurs it is prevented from entering the storm drain.

### *Examples*

The Spill Prevention Control and Countermeasure (SPCC) Plan, which is required by law for some facilities, is an effective program to reduce the number of accidental spills and minimize contamination of stormwater runoff.

The City of Palo Alto has an effective program for commercial vehicle service facilities. Many of the program's elements, including specific BMP guidance and lists of equipment suppliers, are also applicable to industrial facilities.

## References and Resources

Best Management Practice Guide for Retail Gasoline Outlets, California Stormwater Quality Task Force. 1997.

King County Stormwater Pollution Control Manual –
http//www.dnr.metrokc.gov/wlr/dss/spcm.htm

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

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)

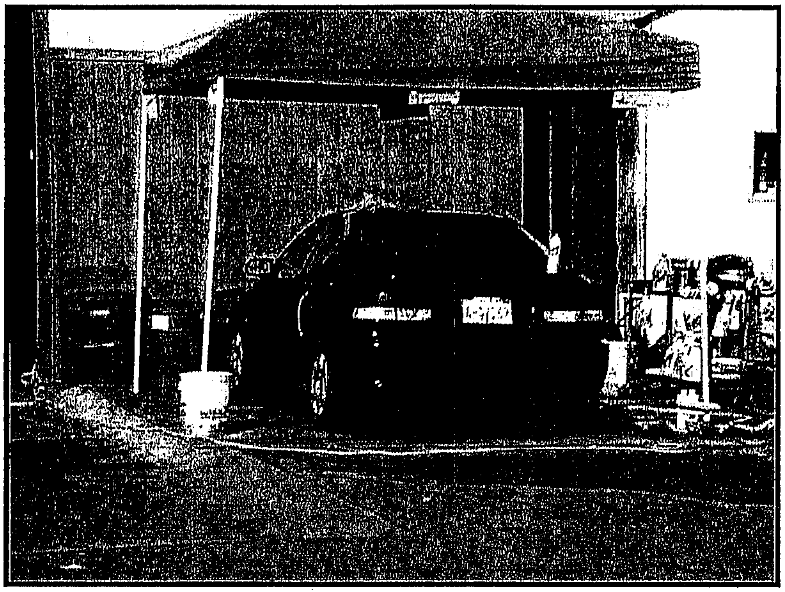

Photo Credit: Geoff Brosseau

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | |

## Description

Wash water from vehicle and equipment cleaning activities performed outdoors or in areas where wash water flows onto the ground can contribute toxic hydrocarbons and other organic compounds, oils and greases, nutrients, phosphates, heavy metals, and suspended solids to stormwater runoff. Use of the procedures outlined below can prevent or reduce the discharge of pollutants to stormwater during vehicle and equipment cleaning.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives

### *Pollution Prevention*

- If possible, use properly maintained off-site commercial washing and steam cleaning businesses whenever possible. These businesses are better equipped to handle and properly dispose of the wash waters.
- Good housekeeping practices can minimize the risk of contamination from wash water discharges.

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***Suggested Protocols***

*General*

- Use biodegradable, phosphate-free detergents for washing vehicles as appropriate.
- Mark the area clearly as a wash area.
- Post signs stating that only washing is allowed in wash area and that discharges to the storm drain are prohibited.
- Provide a trash container in wash area.
- Map on-site storm drain locations to avoid discharges to the storm drain system.
- Emphasize the connection between the storm drain system and runoff and help reinforce that car washing activities can have an affect on local water quality. This can be accomplished through storm drain stenciling programs.

*Vehicle and Equipment Cleaning*

- Design wash areas to properly collect and dispose of wash water when engine cleaning is conducted and when chemical additives, solvents, or degreasers are used. This may include installation of sumps or drain lines to collect wash water or construction of a berm around the designated area and grading of the area to collect wash water as well as prevent stormwater run-on.
- Consider washing vehicles and equipment inside the building if washing/cleaning must occur on-site. This will help to control the targeted constituents by directing them to the sanitary sewer.
- If washing must occur on-site and outdoor:
  - Use designated paved wash areas. Designated wash areas must be well marked with signs indicating where and how washing must be done. This area must be covered or bermed to collect the wash water and graded to direct the wash water to a treatment or disposal facility.
  - Oil changes and other engine maintenance cannot be conducted in the designated washing area. Perform these activities in a place designated for such activities.
  - Cover the wash area when not in use to prevent contact with rain water.
- Use hoses with nozzles that automatically turn off when left unattended.
- Perform pressure cleaning and steam cleaning off-site to avoid generating runoff with high pollutant concentrations. If done on-site, no pressure cleaning and steam cleaning should be done in areas designated as wellhead protection areas for public water supply.

*Disposal*

- Consider filtering and recycling wash water.

- Discharge equipment wash water to the sanitary sewer, a holding tank, or a process treatment system, regardless of the washing method used.
- Discharge vehicle wash water to (1) the sanitary sewer, a holding tank, or process treatment system or (2) an enclosed recycling system.
- Discharge wash water to sanitary sewer only after contacting the local sewer authority to find out if pretreatment is required.

*Training*

- Train employees on proper cleaning and wash water disposal procedures and conduct "refresher" courses on a regular basis.
- Train staff on proper maintenance measures for the wash area.
- Train employees and contractors on proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

*Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control and Cleanup.
- Keep your Spill Prevention Control and Counter Measure (SPCC) Plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Clean up spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

*Other Considerations (Limitations and Regulations)*

- Some municipalities may require pretreatment and monitoring of wash water discharges to the sanitary sewer.
- Steam cleaning can generate significant pollutant concentrations requiring that careful consideration be given to the environmental impacts and compliance issues related to steam cleaning.
- Most car washing best management practices are inexpensive, and rely more on good housekeeping practices (where vehicles are washed, planning for the collection of wash water) than on expensive technology. However, the construction of a specialized area for vehicle washing can be expensive for municipal facilities. Also, for facilities that cannot recycle their wash water the cost of pre-treating wash water through either structural practices or planning for collection and hauling of contaminated water to sewage treatment plants can represent a cost limitation.

## Requirements

*Costs*

- Capital costs vary depending on measures implemented

- Low cost ($500-1,000) for berm construction,
- Medium cost ($5,000-20,000) for plumbing modifications (including re-routing discharge to sanitary sewer and installing simple sump).
- High cost ($30,000-150,000) for on-site treatment and recycling.

- O&M costs increase with increasing capital investment.

*Maintenance*

- Berm repair and patching.
- Sweep washing areas frequently to remove solid debris.
- Inspect and maintain sumps, oil/water separators, and on-site treatment/recycling units.

## Supplemental Information

***Design Considerations***

*Designated Cleaning Areas*

- Washing operations outside should be conducted in a designated wash area having the following characteristics:
  - Paved with Portland cement concrete,
  - Covered and bermed to prevent contact with stormwater and contain wash water,
  - Sloped for wash water collection,
  - Equipped with an oil/water separator, if necessary.

***Examples***

The City of Palo Alto has an effective program for commercial vehicle service facilities. Many of the program's elements, including specific BMP guidance and lists of equipment suppliers, are applicable to industrial vehicle service facilities.

The U.S. Postal Service in West Sacramento has a new vehicle wash system that collects, filters, and recycles the wash water.

## References and Resources

http://www.stormwatercenter.net/

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

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

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Photo Credit: Geoff Brosseau

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | |

## Description

Vehicle or equipment maintenance and repair is potentially a significant source of stormwater pollution, due to the use of materials and wastes created that are harmful to humans and the environment. Engine repair and service (e.g. parts cleaning), replacement of fluids (e.g. oil change), and outdoor equipment storage and parking (dripping engines) can impact water quality if stormwater runoff from areas with these activities occurring on them becomes polluted by a variety of contaminants. Implementation of the following activities will prevent or reduce the discharge of pollutants to stormwater from vehicle and equipment maintenance and repair activities.

## Approach

### *Pollution Prevention*

- Keep accurate maintenance logs to evaluate materials use.
- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Minimize use of solvents. Clean parts without using solvents whenever possible.
- Keep an accurate, up-to-date inventory of materials.
- Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.

### *Suggested Protocols*

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*General*

- Move maintenance and repair activities indoors whenever feasible.
- Store idle equipment containing fluids under cover.
- Use a vehicle maintenance area designed to prevent stormwater pollution - minimize contact of stormwater with outside operations through berming and appropriate drainage routing.
- Avoid hosing down your work areas. If work areas are washed, collect and direct wash water to sanitary sewer.
- Paint signs on storm drain inlets to indicate that they are not to receive liquid or solid wastes.
- Post signs at sinks to remind employees, not to pour hazardous wastes down drains.
- Clean yard storm drain inlets(s) regularly.
- Do not pour materials down drains or hose down work areas; use dry sweeping.
- Cover the work area so as to limit exposure to the rain
- Place curbs around the immediate boundaries of the process equipment.
- Build a shed or temporary roof over areas where you park cars awaiting repair or salvage, especially if you handle wrecked vehicles. Build a roof over vehicles you keep for parts.

*Material and Waste Handling*

- Store materials and wastes under cover whenever possible.
- Designate a special area to drain and replace motor oil, coolant, and other fluids. This area should not have any connections to the storm drain or the sanitary sewer and should allow for easy clean up of drips and spills.
- Drain all fluids from wrecked vehicles immediately. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).
- Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- Do not dispose of used or leftover cleaning solutions, solvents, and automotive fluids and oil in the sanitary sewer.
- Dispose of all waste materials according to applicable laws and regulations.
- Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.

- Promptly transfer used fluids to the proper waste or recycling drums and store in an appropriately designed area that can contain spills. Don't leave drip pans or other open containers lying around.
- Do not dispose of oil filters in trash cans or dumpsters, which may leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Most municipalities prohibit or discourage disposal of these items in solid waste facilities. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.
- Store cracked and/or dead batteries in a non-leaking covered secondary container and dispose of properly at recycling or household hazardous waste facilities..

*Maintenance and Repair Activities*

- Provide a designated area for vehicle maintenance.
- Keep equipment clean, don't allow excessive build-up of oil and grease.
- If temporary work is being conducted outside: Use a tarp, ground cloth, or drip pans beneath the vehicle or equipment to capture all spills and drips., The collected drips and spills must be disposed, reused, or recycled properly.
- If possible, perform all vehicle fluid removal or changing inside or under cover to prevent the runon of stormwater and the runoff of spills:
  - Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, or remove other parts. Use a drip pan under any vehicle that might leak while you work on it to keep splatters or drips off the shop floor.
  - Promptly transfer used fluids to the proper waste or recycling drums. Don't leave drip pans or other open containers lying around.
  - Keep drip pans or containers under vehicles or equipment that might drip during repairs.
  - Do not change motor oil or perform equipment maintenance in non-appropriate areas.
- If equipment (e.g., radiators, axles) is to be stored outdoors, oil and other fluids should be drained first. This is also applicable to vehicles being stored and not used on a regular basis.
- Monitor parked vehicles closely for leaks and place pans under any leaks to collect the fluids for proper disposal or recycling.

*Parts Cleaning*

- Clean vehicle parts without using liquid cleaners wherever possible to reduce waste.
- Do all liquid cleaning at a centralized station so the solvents and residues stay in one area.

- Discharge wastewater generated from steam cleaning and pressure washing to an appropriate treatment control that is connected to a blind sump. Non-caustic detergents should be used instead of caustic cleaning agents, detergent-based or water-based cleaning systems in place of organic solvent degreasers, and non-chlorinated solvent in place of chlorinated organic solvents for parts cleaning. Refer to SC-21 for more information on steam cleaning.

- Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

*Inspection*

- Regularly inspect vehicles and equipment for leaks, and repair immediately.

- Make sure incoming vehicles are checked for leaking oil and fluids. Apply controls accordingly.

***Training***

- Train employees and contractors in the proper handling and disposal of engine fluids and waste materials.

- Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures (You can use reusable cloth rags to clean up small drips and spills instead of disposables; these can be washed by a permitted industrial laundry. Do not clean them at home or at a coin-operated laundry business). The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

- Use a training log or similar method to document training.

***Spill Response and Prevention***

- Refer to SC-11 Spill Prevention, Control & Cleanup for more information.

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date, and implement accordingly.

- Place adequate stockpiles of spill cleanup materials where they are readily accessible.

- Clean leaks, drips, and other spills with as little water as possible. Use rags for small spills, a damp mop for general cleanup, and dry absorbent material for larger spills. Use the following three-step method for cleaning floors:

  - Clean spills with rags or other absorbent materials

  - Sweep floor using dry absorbent material

  - Mop the floor. Mop water may be discharged to the sanitary sewer via a toilet or sink.

- Remove absorbent materials used for cleaning small spills promptly and properly.

- Do not saturate rags or absorbent material to eliminate need for disposal of spilled material as hazardous waste.

*Other Considerations*

- Space and time limitations may preclude all work being conducted indoors.
- It may not be possible to contain and clean up spills from vehicles/equipment brought onsite after working hours.
- Drain pans (usually 1 ft. x 1 ft.) are generally too small to contain antifreeze, so drip pans (3 ft. x 3 ft.) may have to be purchased or fabricated.
- Identification of engine leaks may require some use of solvents, which may require disposal as hazardous waste.
- Installation of structural treatment practices for pretreatment controls of wastewater discharges can be expensive.
- Prices for recycled materials and fluids may be higher than those of non-recycled materials.
- Some facilities can be limited by a lack of providers of recycled materials, and by the absence of businesses to provide services such as hazardous waste removal, structural treatment practice maintenance or solvent equipment and solvent recycling.

## Requirements

*Costs*

- Should be low, but will vary depending on the size of the facility.

*Maintenance*

- Sweep the maintenance area weekly, if it is paved, to collect loose particles, and wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

## Supplemental Information

*Further Detail of the BMP*

*Recycling*

Separating wastes allows for easier recycling and may reduce treatment costs. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents (e.g., 1,1,1-trichloroethane) separate from non-chlorinated solvents (e.g., kerosene and mineral spirits).

Many products made of recycled (i.e., refined or purified) materials are available. Engine oil, transmission fluid, antifreeze, and hydraulic fluid are available in recycled form. Buying recycled products supports the market for recycled materials.

- Recycling is always preferable to disposal of unwanted materials.
- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.
- Label and track the recycling of waste material (e.g. used oil, spent solvents, batteries).

- Purchase recycled products to support the market for recycled materials.

*Safer Alternatives*

If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

- Use non-caustic detergents instead of caustic cleaning for parts cleaning.
- Use detergent-based or water-based cleaning systems in place of organic solvent degreasers. Wash water may require treatment before it can be discharged to the sewer.
- Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
- Choose cleaning agents that can be recycled.
- Refer to SC-61 Safer Alternative Products fact sheet for more information.

## References and Resources


DTSC Doc. No. 619a Switching to Water Based Cleaners

DTSC Doc. No. 621 http://www.stormwatercenter.net/

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

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

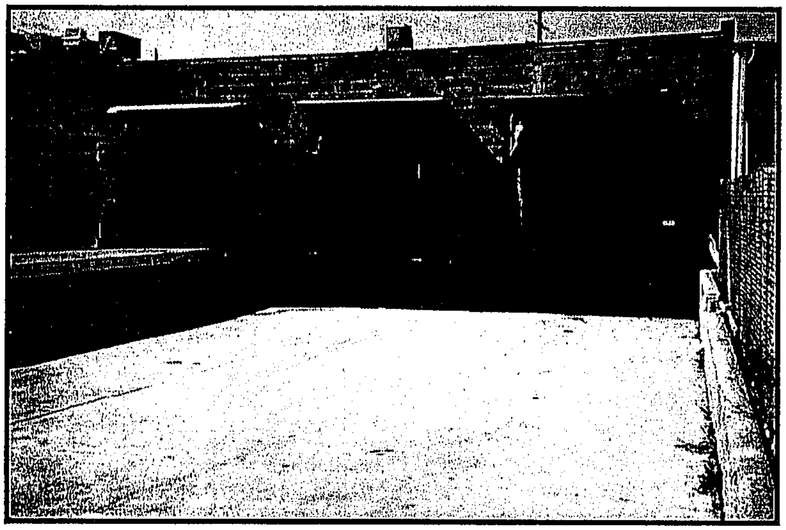
Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf




A003021

# Outdoor Loading/Unloading SC-30



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Loading and unloading of material may include package products, barrels, and bulk products. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Approach

### *Pollution Prevention*

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of materials with the potential to contaminate stormwater.
- Prevent stormwater runon.
- Regularly check equipment for leaks.

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***Suggested Protocols***

*Loading and Unloading – General Guidelines*

- Develop an operations plan that describes procedures for loading and/or unloading.
- Do not conduct loading and unloading during wet weather, whenever possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- A seal or door skirt between delivery vehicles and building can reduce or prevent exposure to rain.
- Design loading/unloading area to prevent stormwater runon which would include grading or berming the area, and positioning roof downspouts so they direct stormwater away from the loading/unloading areas.
- If feasible, load and unload all materials and equipment in covered areas such as building overhangs at loading docks.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm he loading/ unloading area to a drain that is connected to a dead-end sump.

*Inspection*

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

***Training***

- Train employees (e.g. fork lift operators) and contractors on proper spill containment and cleanup.
- Employees trained in spill containment and cleanup should be present during the loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.

- Make sure forklift operators are properly trained on loading and unloading procedures.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your spill prevention Control and countermeasure (SPCC) Plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

***Other Considerations***

- Space, material characteristics and/or time limitations may preclude all transfers from being performed indoors or under cover.

## Requirements

***Costs***

- Should be low except when covering a large loading/unloading area.

***Maintenance***

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Regular broom dry-sweeping of area.
- Conduct major clean-out of loading and unloading area and sump prior to October 1 of each year.

## Supplemental Information

***Further Detail of the BMP***

*Special Circumstances for Indoor Loading/Unloading of Materials*

As appropriate loading or unloading of liquids should occur indoors so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - Transfer area should be designed to prevent runon of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

  - Transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer (if allowed). A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:

  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles, Use drip pans when making and breaking connections.

  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

**References and Resources**

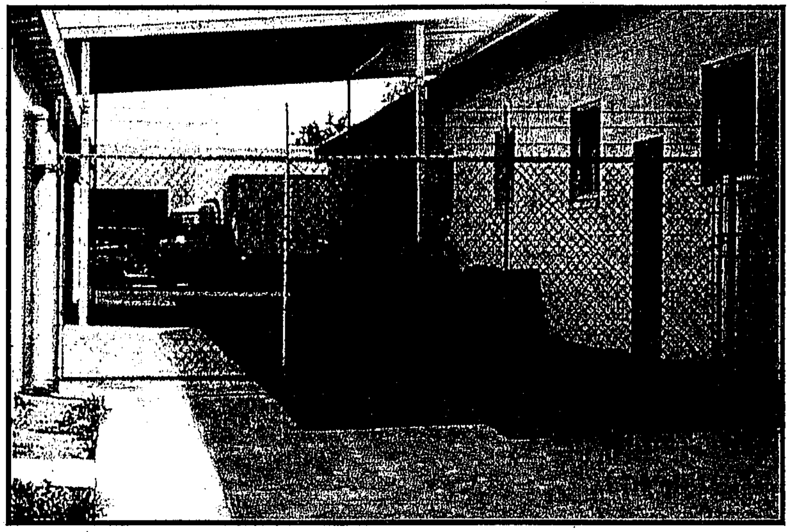
http://www.stormwatercenter.net/

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

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

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

# Outdoor Container Storage — SC-31



### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

Accidental releases of materials from above ground liquid storage tanks, drums, and dumpsters present the potential for contaminating stormwaters with many different pollutants. Tanks may store many potential stormwater runoff pollutants, such as gasoline, aviation gas, diesel fuel, ammonia, solvents, syrups, etc. Materials spilled, leaked, or lost from storage tanks may accumulate in soils or on other surfaces and be carried away by rainfall runoff. These source controls apply to containers located outside of a building used to temporarily store liquid materials and include installing safeguards against accidental releases, installing secondary containment, conducting regular inspections, and training employees in standard operating procedures and spill cleanup techniques.

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Approach

### *Pollution Prevention*

- Educate employees about pollution prevention measures and goals

- Keep an accurate, up-to-date inventory of the materials delivered and stored on-site. Re-evaluate inventory needs and consider purchasing alternative products. Properly dispose of outdated products.

- Try to keep chemicals in their original containers, and keep them well labeled.

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***Suggested Protocols***

*General*

- Develop an operations plan that describes procedures for loading and/or unloading. Refer to SC-30 Outdoor Loading/Unloading for more detailed BMP information pertaining to loading and unloading of liquids.
- Protect materials from rainfall, runon, runoff, and wind dispersal:
  - Cover the storage area with a roof.
  - Minimize stormwater runon by enclosing the area or building a berm around it.
  - Use a "doghouse" structure for storage of liquid containers.
  - Use covered dumpsters for waste product containers.
- Employ safeguards against accidental releases:
  - Provide overflow protection devices to warn operator or automatic shut down transfer pumps.
  - Provide protection guards (bollards) around tanks and piping to prevent vehicle or forklift damage, and
  - Provide clear tagging or labeling, and restricting access to valves to reduce human error.
- Berm or surround tank or container with secondary containment system using dikes, liners, vaults, or double walled tanks.
- Contact the appropriate regulatory agency regarding environmental compliance for facilities with "spill ponds" designed to intercept, treat, and/or divert spills.
- Have registered and specifically trained professional engineers can identify and correct potential problems such as loose fittings, poor welding, and improper or poorly fitted gaskets for newly installed tank systems.

*Storage Areas*

- Provide storage tank piping located below product level with a shut-off valve at the tank; ideally this valve should be an automatic shear valve with the shut-off located inside the tank.
- Provide barriers such as posts or guard rails, where tanks are exposed, to prevent collision damage with vehicles.
- Provide secure storage to prevent vandalism.
- Place tight-fitting lids on all containers.
- Enclose or cover the containers where they are stored.

- Raise the containers off the ground by use of pallet or similar method, with provisions for spill control and secondary containment.
- Contain the material in such a manner that if the container leaks or spills, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters or groundwater.
- Place drip pans or absorbent materials beneath all mounted container taps, and at all potential drip and spill locations during filling and unloading of containers. Drip pans must be cleaned periodically, and all collected liquids and soiled absorbent materials must be reused/recycled or properly disposed.
- Ensure that any underground or aboveground storage tanks shall be designed and managed in accordance with applicable regulations, be identified as a potential pollution source, have secondary containment, such as a berm or dike with an impervious surface.
- Rainfall collected in secondary containment system must not contain pollutants for discharge to storm drain system.

*Container Management*

- Keep containers in good condition without corrosion or leaky seams.
- Place containers in a lean-to structure or otherwise covered to keep rainfall from reaching the drums.
- Replace containers if they are deteriorating to the point where leakage is occurring. Keep all containers undercover to prevent the entry of stormwater. Employees should be made aware of the importance of keeping the containers free from leaks.
- Keep waste container drums in an area such as a service bay. Drums stored outside must be stored in a lean-to type structure, shed or walk-in container.

*Storage of Hazardous Materials*

- Storage of reactive, ignitable, or flammable liquids must comply with the fire and hazardous waste codes.
- Place containers in a designated area that is paved, free of cracks and gaps, and impervious in order to contain leaks and spills. The area should also be covered.
- Surround stored hazardous materials and waste with a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain and a dead-end sump should be installed in the drain.

*Inspection*

- Provide regular inspections:
  - Inspect storage areas regularly for leaks or spills.

- Conduct routine inspections and check for external corrosion of material containers. Also check for structural failure, spills and overfills due to operator error, failure of piping system.

- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installations for loose fittings, poor welding, and improper or poorly fitted gaskets.

- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.

- Replace containers that are leaking, corroded, or otherwise deteriorating with ones in good condition. If the liquid chemicals are corrosive, containers made of compatible materials must be used instead of metal drums.

- Label new or secondary containers with the product name and hazards.

***Training***

- Train employees (e.g. fork lift operators) and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

- Train employees in proper storage measures.

- Use a training log or similar method to document training.

***Spill Response and Prevention***

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date, and implement accordingly.

- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills.

- Collect all spilled liquids and properly dispose of them.

- Employees trained in emergency spill cleanup procedures should be present when dangerous waste, liquid chemicals, or other wastes are delivered.

- Operator errors can be prevented by using engineering safe guards and thus reducing accidental releases of pollutant.

- Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area.

- See Aboveground Tank Leak and Spill Control section of the Spill Prevention, Control & Cleanup fact sheet (SC-11) for additional information.

### *Other Considerations*

- Storage sheds often must meet building and fire code requirements.
- The local fire district must be consulted for limitations on clearance of roof covers over containers used to store flammable materials.
- All specific standards set by federal and state laws concerning the storage of oil and hazardous materials must be met.
- Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code.
- Storage of oil and hazardous materials must meet specific federal and state standards including:
  - Spill Prevention Control and Countermeasure Plan (SPCC) Plan
  - Secondary containment
  - Integrity and leak detection monitoring
  - Emergency preparedness plans

## Requirements

### *Costs*

- Will vary depending on the size of the facility and the necessary controls, such as berms or safeguards against accidental controls.

### *Maintenance*

- Conduct weekly inspection.
- Sweep and clean the storage area regularly if it is paved, do not hose down the area to a storm drain.

## Supplemental Information

- The most common causes of unintentional releases are:
  - Installation problems,
  - Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves),
  - External corrosion and structural failure,
  - Spills and overfills due to operator error, and
  - Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

***Further Detail of the BMP***

*Dikes*

One of the best protective measures against contamination of stormwater is diking. Containment dikes are berms or retaining walls that are designed to hold spills. Diking is an effective pollution prevention measure for above ground storage tanks and railcar or tank truck loading and unloading areas. The dike surrounds the area of concern and holds the spill, keeping spill materials separated from the stormwater side of the dike area. Diking can be used in any industrial or municipal facility, but it is most commonly used for controlling large spills or releases from liquid storage areas and liquid transfer areas.

- For single-wall tanks, containment dikes should be large enough to hold the contents of the storage tank for the facility plus rain water.
- For trucks, diked areas should be capable of holding an amount equal to the volume of the tank truck compartment. Diked construction material should be strong enough to safely hold spilled materials.
- Dike materials can consist of earth, concrete, synthetic materials, metal, or other impervious materials.
- Strong acids or bases may react with metal containers, concrete, and some plastics.
- Where strong acids or bases or stored, alternative dike materials should be considered. More active organic chemicals may need certain special liners for dikes.
- Dikes may also be designed with impermeable materials to increase containment capabilities.
- Dikes should be inspected during or after significant storms or spills to check for washouts or overflows.
- Regular checks of containment dikes to insure the dikes are capable of holding spills should be conducted.
- Inability of a structure to retain stormwater, dike erosion, soggy areas, or changes in vegetation indicate problems with dike structures. Damaged areas should be patched and stabilized immediately.
- Accumulated stormwater in the containment are should be analyzed for pollutants before it is released to surface waters. If pollutants are found or if stormwater quality is not determined, then methods other than discharging to surface waters should be employed (e.g., discharge to sanitary sewer if allowed).
- Earthen dikes may require special maintenance of vegetation such as mulching and irrigation.



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*Curbing*

Curbing is a barrier that surrounds an area of concern. Curbing is similar to containment diking in the way that it prevents spills and leaks from being released into the environment. The curbing is usually small scaled and does not contain large spills like diking. Curbing is common at many facilities in small areas where handling and transfer liquid materials occur. Curbing can redirect stormwater away from the storage area. It is useful in areas where liquid materials are transferred from one container to another. Asphalt is a common material used for curbing; however, curbing materials include earth, concrete, synthetic materials, metal, or other impenetrable materials.

- Spilled materials should be removed immediately from curbed areas to allow space for future spills.
- Curbs should have manually-controlled pump systems rather than common drainage systems for collection of spilled materials.
- The curbed area should be inspected regularly to clear clogging debris.
- Maintenance should also be conducted frequently to prevent overflow of any spilled materials as curbed areas are designed only for smaller spills.
- Curbing has the following advantages:
  - Excellent runon control,
  - Inexpensive,
  - Ease of installment,
  - Provides option to recycle materials spilled in curb areas, and
  - Common industry practice.

***Examples***

The "doghouse" design has been used to store small liquid containers. The roof and flooring design prevent contact with direct rain or runoff. The doghouse has two solid structural walls and two canvas covered walls. The flooring is wire mesh about secondary containment. The unit has been used successfully at Lockheed Missile and Space Company in Sunnyvale.

**References and Resources**

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000
http://www.nalms.org/bclss/storage.html

King County Stormwater Pollution Control Manual –
http://dnr.metrokc.gov/wlr/dss/spcm.htm

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) - http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

# Outdoor Equipment Maintenance SC-32

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | |

## Description

Outside process equipment operations and maintenance can contaminate stormwater runoff. Activities, such as grinding, painting, coating, sanding, degreasing or parts cleaning, landfills and waste piles, solid waste treatment and disposal, are examples of process operations that can lead to contamination of stormwater runoff. Source controls for outdoor process equipment operations and maintenance include reducing the amount of waste created, enclosing or covering all or some of the equipment, installing secondary containment, and training employees.

## Approach

### *Pollution Prevention*

- Perform the activity during dry periods.
- Use non-toxic chemicals for maintenance and minimize or eliminate the use of solvents.

### *Suggested Protocols*

- Consider enclosing the activity in a building and connecting the floor drains to the sanitary sewer.
- Cover the work area with a permanent roof.
- Minimize contact of stormwater with outside process equipment operations through berming and drainage routing (runon prevention). If allowed, connect process equipment area to public sewer.
- Dry clean the work area regularly.

### *Training*

- Train employees to perform the activity during dry periods only and to use less or non-toxic materials.
- Train employee and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

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*Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your spill prevention control and countermeasure (SPCC) plan up-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

*Other Considerations*

- Space limitations may preclude enclosing some equipment.
- Storage sheds often must meet building and fire code requirements.

## Requirements

*Costs*

- Costs vary depending on the complexity of the operation and the amount of control necessary for stormwater pollution control.
- Providing cover may be expensive.

*Maintenance*

- Conduct routine preventive maintenance, including checking process equipment for leaks.
- Clean the storm drain system regularly.

## Supplemental Information

*Further Detail of the BMP*

*Hydraulic/Treatment Modifications*

In some cases it may be necessary to capture and treat polluted stormwater. If the municipality does not have its own process wastewater treatment system, consider discharging to the public sewer system. Use of the public sewer might be allowed under the following conditions:

- If the activity area is very small (less than a few hundred square feet), the local sewer authority may be willing to allow the area to remain uncovered with the drain connected to the public sewer.
- It may be possible under unusual circumstances to connect a much larger area to the public sewer, as long as the rate of stormwater discharges does not exceed the capacity of the wastewater treatment plant. The stormwater could be stored during the storm and then transferred to the public sewer when the normal flow is low, such as at night.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

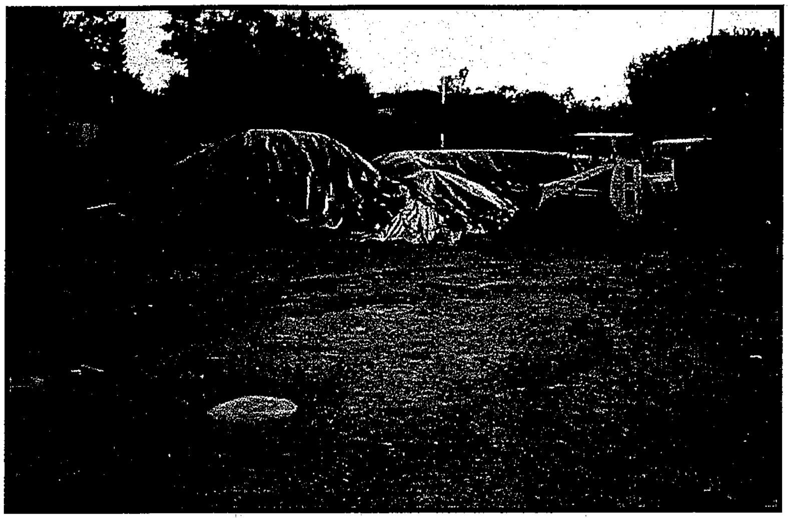
Clark County Stormwater Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Stormwater Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

# Outdoor Storage of Raw Materials SC-33



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Raw materials, by-products, finished products, containers, and material storage areas exposed to rain and/or runoff can pollute stormwater. Stormwater can become contaminated when materials wash off or dissolve into water or are added to runoff by spills and leaks. Improper storage of these materials can result in accidental spills and the release of materials. To prevent or reduce the discharge of pollutants to stormwater from material delivery and storage, pollution prevention and source control measures, such as minimizing the storage of hazardous materials on-site, enclosing or covering materials, storing materials in a designated area, installing secondary containment, conducting regular inspections, preventing stormwater runon and runoff, and training employees and subcontractors must be implemented.

## Approach

### *Pollution Prevention*

- Employee education is paramount for successful BMP implementation.
- Minimize inventory of raw materials.
- Keep an accurate, up-to-date inventory of the materials delivered and stored on-site.
- Try to keep chemicals in their original containers, and keep them well labeled.

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***Suggested Protocols***

*General*

- Store all materials inside. If this is not feasible, then all outside storage areas should be covered with a roof, and bermed, or enclosed to prevent stormwater contact. At the very minimum, a temporary waterproof covering made of polyethylene, polypropylene or hypalon should be used over all materials stored outside.
- Cover and contain the stockpiles of raw materials to prevent stormwater from running into the covered piles. The covers must be in place at all times when work with the stockpiles is not occurring. (applicable to small stockpiles only).
- If the stockpiles are so large that they cannot feasibly be covered and contained, implement erosion control practices at the perimeter of your site and at any catch basins to prevent erosion of the stockpiled material off site,
- Keep liquids in a designated area on a paved impervious surface within a secondary containment.
- Keep outdoor storage containers in good condition.
- Keep storage areas clean and dry.
- Design paved areas to be sloped in a manner that minimizes the pooling of water on the site, particularly with materials that may leach pollutants into stormwater and/or groundwater, such as compost, logs, and wood chips. A minimum slope of 1.5 percent is recommended.
- Secure drums stored in an area where unauthorized persons may gain access to prevent accidental spillage, pilferage, or any unauthorized use.
- Cover wood products treated with chromated copper arsenate, ammonical copper zinc arsenate, creosote, or pentachlorophenol with tarps or store indoors.

*Raw Material Containment*

- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items in secondary containers if applicable.
- Prevent the run-on of uncontaminated stormwater from adjacent areas as well as runoff of stormwater from the stockpile areas, by placing a curb along the perimeter of the area. The area inside the curb should slope to a drain. Liquids should be drained to the sanitary sewer if allowed. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Tanks should be bermed or surrounded by a secondary containment system.
- Release accumulated stormwater in petroleum storage areas prior to the next storm. At a minimum, water should pass through an oil/water separator and, if allowed, discharged to a sanitary sewer.



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*Inspection*

- Conduct regular inspections of storage areas so that leaks and spills are detected as soon as possible.
- Conduct routine inspections and check for external corrosion of material containers. Also check for structural failure, spills and overfills due to operator error, failure of piping system.
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.
- Visually inspect new tank or container installations for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.

***Training***

- Employees should be well trained in proper material storage.
- Train employees and contractors in proper techniques for spill containment and cleanup.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.
- Have employees trained in spill containment and cleanup present during loading/unloading of dangerous waste, liquid chemicals and other potentially hazardous materials.

***Other Considerations***

- Storage sheds often must meet building and fire code requirements. Storage of reactive, ignitable, or flammable liquids must comply with the Uniform Fire Code and the National Electric Code.
- Space limitations may preclude storing some materials indoors.
- Some municipalities require that secondary containment areas (regardless of size) be connected to the sanitary sewer, prohibiting any hard connections to the storm drain. Storage sheds often must meet building and fire code requirements.
- The local fire district must be consulted for limitations on clearance of roof covers over containers used to store flammable materials.

# SC-33 Outdoor Storage of Raw Materials

## Requirements

### *Costs*

- Costs will vary depending on the size of the facility and the necessary controls. They should be low except where large areas may have to be covered.

### *Maintenance*

- Accurate and up-to-date inventories should be kept of all stored materials.
- Berms and curbs may require periodic repair and patching.
- Parking lots or other surfaces near bulk materials storage areas should be swept periodically to remove debris blown or washed from storage area.
- Sweep paved storage areas regularly for collection and disposal of loose solid materials, do not hose down the area to a storm drain or conveyance ditch.
- Keep outdoor storage areas in good condition (e.g. repair roofs, floors, etc. to limit releases to runoff).

## Supplemental Information

### *Further Detail of the BMP*

*Raw Material Containment*

Paved areas should be sloped in a manner that minimize the pooling of water on the site, particularly with materials that may leach pollutants into stormwater and/or groundwater, such as compost, logs, and wood chips. A minimum slope of 1.5 percent is recommended.

- Curbing should be placed along the perimeter of the area to prevent the runon of uncontaminated stormwater from adjacent areas as well as runoff of stormwater from the stockpile areas.
- The storm drainage system should be designed to minimize the use of catch basins in the interior of the area as they tend to rapidly fill with manufacturing material.
- The area should be sloped to drain stormwater to the perimeter where it can be collected or to internal drainage alleyways where material is not stockpiled.
- If the raw material, by-product, or product is a liquid, more information for outside storage of liquids can be found under SC-31, Outdoor Container Storage.

### *Examples*

The "doghouse" design has been used to store small liquid containers. The roof and flooring design prevent contact with direct rain or runoff. The doghouse has two solid structural walls and two canvas covered walls. The flooring is wire mesh about secondary containment. The unit has been used successively at Lockheed Missile and Space Company in Sunnyvale.

## References and Resources

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm



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

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

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

**Objectives**

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

**Targeted Constituents**

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, re-use, and recycling; and preventing runon and runoff.

## Approach

### *Pollution Prevention*

- Reduction in the amount of waste generated can be accomplished using the following source controls such as:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

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### *Suggested Protocols*

*General*

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater runon and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

*Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

*Waste Collection*

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage or leaks regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Place waste containers under cover if possible.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be

disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

*Good Housekeeping*

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g. sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Stencil storm drains on the facility's property with prohibitive message regarding waste disposal.

*Chemical/Hazardous Wastes*

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers protected from vandalism, and in compliance with fire and hazardous waste codes.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

*Runon/Runoff Prevention*

- Prevent stormwater runon from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent the waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

*Inspection*



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- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.
- Repair leaking equipment including valves, lines, seals, or pumps promptly.

*Training*

- Train staff pollution prevention measures and proper disposal methods.
- Train employees and contractors proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.
- Train employees and subcontractors in proper hazardous waste management.

*Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.
- Vehicles transporting waste should have spill prevention equipment that can prevent spills during transport. The spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

*Other Considerations*

- Hazardous waste cannot be re-used or recycled; it must be disposed of by a licensed hazardous waste hauler.

## Requirements

*Costs*

- Capital and operation and maintenance costs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

*Maintenance*

- None except for maintaining equipment for material tracking program.



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## Supplemental Information

### *Further Detail of the BMP*

*Land Treatment System*

- Minimize the runoff of polluted stormwater from land application of municipal waste on-site by:
  - Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, there is a closed drainage system.
  - Avoiding application of waste to the site when it is raining or when the ground is saturated with water.
  - Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site.
  - Maintaining adequate barriers between the land application site and the receiving waters. Planted strips are particularly good.
  - Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins.
  - Performing routine maintenance to ensure the erosion control or site stabilization measures are working.

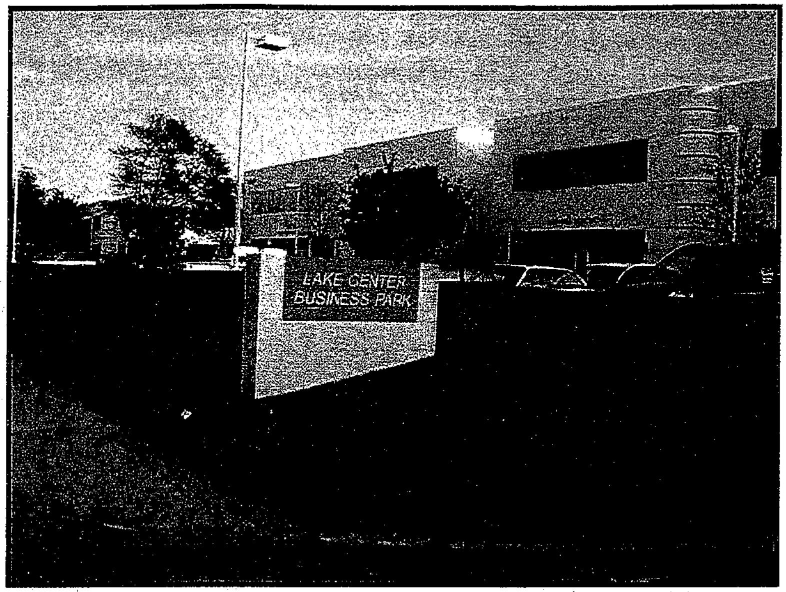
## References and Resources

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

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

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Associations (BASMAA). On-line: http://www.basmaa.org

# Building & Grounds Maintenance SC-41




**Objectives**

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

**Targeted Constituents**

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, and abnormal pH. Utilizing the following protocols will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

## Approach

### *Pollution Prevention*

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.
- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

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***Suggested Protocols***

*Pressure Washing of Buildings, Rooftops, and Other Large Objects*

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a waste water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

- If soaps or detergents are not used, and the surrounding area is paved, wash water runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in he catch basin to trap the particles in wash water runoff.

- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement. Ensure that this practice does not kill grass.

*Landscaping Activities*

- Do not apply any chemicals (insecticide, herbicide, or fertilizer) directly to surface waters, unless the application is approved and permitted by the state.

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures on exposed soils.

- Check irrigation schedules so pesticides will not be washed away and to minimize non-stormwater discharge.

*Building Repair, Remodeling, and Construction*

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.

- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.

- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

- Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. In which case you should direct the water through hay bales and filter fabric or use other sediment filters or traps.

- Store toxic material under cover with secondary containment during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

*Mowing, Trimming, and Planting*

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures when soils are exposed.

- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Consider an alternative approach when bailing out muddy water; do not put it in the storm drain, pour over landscaped areas.

- Use hand or mechanical weeding where practical.

*Fertilizer and Pesticide Management*

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Follow manufacturers' recommendations and label directions. Pesticides must never be applied if precipitation is occuring or predicted. Do not apply insecticides within 100 feet of surface waters such as lakes, ponds, wetlands, and streams.

- Use less toxic pesticides that will do the job, whenever possible. Avoid use of copper-based pesticides if possible.

- Do not use pesticides if rain is expected.

- Do not mix or prepare pesticides for application near storm drains.

- Use the minimum amount needed for the job.

- Calibrate fertilizer distributors to avoid excessive application.

- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.
- Work fertilizers into the soil rather than dumping or broadcasting them onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.
- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

*Inspection*

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.

***Training***

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

***Other Considerations***

- Alternative pest/weed controls may not be available, suitable, or effective in many cases.



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## Requirements

### *Costs*

- Overall costs should be low in comparison to other BMPs.

### *Maintenance*

- Sweep paved areas regularly to collect loose particles, and wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

## Supplemental Information

### *Further Detail of the BMP*

*Fire Sprinkler Line Flushing*

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping but it is subject to rusting and results in lower quality water. Initially the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time, typically a year, between flushes and may accumulate iron, manganese, lead, copper, nickel and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

## References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

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

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASSMA) http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basmaa.org/

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

# Parking/Storage Area Maintenance SC-43

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The following protocols are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

## Approach

### *Pollution Prevention*

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook).
- Keep accurate maintenance logs to evaluate BMP implementation.

### *Suggested Protocols*

*General*

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

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- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

*Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel and dispose of litter in the trash.

*Surface cleaning*

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- If water is used follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

*Surface Repair*

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

*Inspection*

- Have designated personnel conduct inspections of the parking facilities and stormwater conveyance systems associated with them on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

***Training***

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, nad implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

***Other Considerations***

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

## Requirements

***Costs***

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

***Maintenance***

- Sweep parking lot to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

# SC-43 Parking/Storage Area Maintenance

## Supplemental Information

***Further Detail of the BMP***

*Surface Repair*

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Use only as much water as necessary for dust control, to avoid runoff.

## References and Resources

http://www.stormwatercenter.net/

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

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

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

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basma.org

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Over-water activities occur at boat and ship repair yards, marinas, and yacht clubs. The discharge of pollutants to receiving waters during these activities can be prevented or reduced by minimizing over-water maintenance, keeping wastes out of the water, cleaning up spills and wastes immediately, and educating tenants and employees.

## Approach

### *Pollution Prevention*

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Minimize use of solvents. Clean parts without using solvents whenever possible.
- Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible

### *Suggested Protocols*

*General*

- Perform paint and solvent mixing, fuel mixing, and similar handling of liquids on-shore, to avoid spillage directly in surface water bodies.
- Post signs to indicate proper use and disposal of residual paints, rags, used oil, and other engine fluids.

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- Sweep dry docks before flooding.

*On Board Maintenance*

- Move maintenance and repair activities on-shore if possible. This action reduces some of the potential for direct pollution on water bodies.
- Used antifreeze should be stored in a separate, labeled drum and recycled.
- Fuel tank vents should have valves to prevent fuel overflows or spills.
- Boats with inboard engines should have oil absorption pads in bilge areas that should be changed when no longer useful or at least once a year.
- Careful consideration must be given to fueling boat engines, recycling used oil, and discarding worn motor parts into proper receptacles to prevent spills.
- Keeping boat motors well-tuned prevents fuel and lubricant leaks and improves fuel efficiency.

*Cleaning, Chipping, and Painting*

- Shelter any blasting and spray painting activities by hanging wind blocking tarps to prevent sand blasting dust and overspray from escaping.
- Use secondary containment on paint cans.
- Limit over-water hull surface maintenance to sanding and minor painting.
- Major hull resurfacing should occur on land.
- Use ground cloths when painting boats on land.
- Paint mixing should not occur on the dock
- Vacuuming up loose paint chips and paint dust can help to prevent paint and other chemical substances from entering waters.
- Properly dispose of surface chips, used blasting sand, residual paints, and other materials. Use temporary storage containment that is not exposed to rain.
- Use phosphate-free and biodegradable detergents for hull washing.
- Select nontoxic cleaning products that do not harm humans or aquatic life

*Disposal of Bilge Water, Ballast Water, and Wastewater*

- Collect bilge and ballast water that has an oily sheen on the surface for proper disposal rather than dumping in water or on land.
- Collect and properly dispose of wash water from washing painted boat hulls. Consider taking the boat to a local boat yard that is equipped to collect and treat wash water.

- Pump bilge water discharged at sea through an oil/water separator first and store the oil for discharge into storage tanks on shore for treatment.
- Pump bilge water into storage tanks on shore for analysis, treatment and proper disposal.
- Properly dispose of domestic wastewater and ballast water. DO NOT ALLOW discharge of treated or untreated sewage from vessels to harbors.
- Fecal matter and other solid waste should be contained in a U.S. Coast Guard-approved marine sanitation device (MSD).
- Portable toilets should be emptied into approved shore side waste handling facilities, and MSDs should be discharged into approved pump out stations.
- Avoid the intake of ballast water in shallow water or areas where bottom sediments are suspended.
- Avoid the intake of ballast water where there is an algal bloom in progress.
- Use as fine a filter as is practical on the ballast water intake ports to eliminate as many organisms and as much particulate matter as possible. Tests have been conducted using 300 micron followed by a 25 micron filter on intakes to see how well they work and hold up in practice.
- Dump estuarine or harbour ballast water at sea and take in fresh high salinity water to eliminate both pollutants and estuarine organisms.
- Ballast water may be discharged into large tanks on shore where it is treated, although the large volumes involved make this a very expensive and logistically difficult option.
- Ballast water may also be discharged into specially oufitted tanker ships which meet incoming ships and take in their ballast water for treatment and discharge of the clean water. The sludge produced would still have to be taken ashore for treatment or disposal. This is also an expensive and logistically difficult process.
- Carry out physical or chemical sterilization or neutralization of ballast water in situ, and subsequent neutralization of the sterilant, if required, before discharge.

### *Training*

- Provide regular training to employees and/or contractors regarding stormwater BMPs for over water activities.
- Train employees and contractors in proper techniques for spill containment and cleanup.



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*Spill Response and Prevention*

- Refer to Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date, and implement accordingly.
- Place an adequate stockpile of spill cleanup materials where it will be readily accessible. Clean leaks, drips, and other spills with as little water as possible. Use rags for small spills, a damp mop for general cleanup, and dry absorbent material for larger spills.
- Store and maintain appropriate spill cleanup materials in a location known to all; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
- Clean up spills on docks or boats immediately.

*Other Considerations*

- Private tenants at marinas may resist restrictions on shipboard painting and maintenance. Existing contracts with tenants may not allow the owner to require that tenants abide by new rules that benefit water quality. Even biodegradable cleaning agents have been found to be toxic to fish.

## Requirements

*Costs*

- Most of the BMPs are of low and modest cost. Exceptions are stations for temporary storage of residual paints and engine fluids, and wastewater pumpout facilities.

*Maintenance*

- Sweep maintenance yard areas, docks and boat ramps weekly to collect sandblasting material, paint chips, oils, and other loose debris, do not hose down the area to the water or a storm drain.

## Supplemental Information

*Further Detail of the BMP*

- Best management practices for ballast water generally fall into three main categories:
  - Preventing Uptake at the Source - Generally harbors are a poor place to take in ballast water since they are often polluted and when shallow are high in suspended sediments. Open ocean water in a better source of ballast water.
  - Killing or Neutralization During the Voyage - The current fleet of cargo vessels are not built to carry out these processes. New ships should be designed for these kinds of activities but retrofitting may be impossible, difficult or expensive. Any residues or sludges arising from these procedures would have to be separated from the water and discharged on shore for treatment. Many of these processes would render the ballast tanks lethal to the crew and require them to be absolutely airtight and provisions would be necessary for purging and re-introducing a safe breathable atmosphere into the tanks.



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- Treatment at the Destination - A further way to reduce the movement of alien organisms in ballast water is to avoid discharge of the ballast water into the destination environment.

### References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000.
http://www.nalms.org/bclss/bmphome.html#bmp

King County Stormwater Pollution Control Manual
http://www.dnr.metrokc.gov/wlr/dss/spcm.htm

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

# Housekeeping Practices SC-60

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

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## Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

## Approach

### *Pollution Prevention*

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.

- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

### *Suggested Protocols*

*General*

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.

- Dispose of wash water, sweepings, and sediments, properly.

- Recycle or dispose of fluids properly.

- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.

- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).

- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.



A003061

- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

### *Training*

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

### *Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) plant up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

### *Other Considerations*

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

## Requirements

### *Costs*

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

### *Maintenance*

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

## Supplemental Information

### *Further Detail of the BMP*

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

### *Examples*

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

## References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000. http://www.nalms.org/bclss/bmphome.html#bmp

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

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

Orange County Stormwater Program http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Mateo STOPPP - (http://stoppp.tripod.com/bmp.html)



A003063

### Descriptions
Promote the use of less harmful products. Alternatives exist for most product classes including chemical fertilizers, pesticides, cleaning solutions, janitorial chemicals, automotive and paint products, and consumables (batteries, fluorescent lamps).

### Approach
Develop a comprehensive program based on:

- The "Precautionary Principle," which is an alternative to the "Risk Assessment" model that says it's acceptable to use a potentially harmful product until physical evidence of its harmful effects are established and deemed too costly from an environmental or public health perspective. For instance, a risk assessment approach might say it's acceptable to use a pesticide until there is direct proof of an environmental impact. The Precautionary Principle approach is used to evaluate whether a given product is safe, whether it is really necessary, and whether alternative products would perform just as well.
- Environmentally Preferable Purchasing Program to minimize the purchase of products containing hazardous ingredients used in the facility's custodial services, fleet maintenance, and facility maintenance in favor of using alternate products that pose less risk to employees and to the environment.
- Integrated Pest Management (IPM) or Less-Toxic Pesticide Program, which uses a pest management approach that minimizes the use of toxic chemicals and gets rid of pests by methods that pose a lower risk to employees, the public, and the environment.
- Energy Efficiency Program including no-cost and low-cost energy conservation and efficiency actions that can reduce both energy consumption and electricity bills, along with long-term energy efficiency investments.

Consider the following mechanisms for developing and implementing a comprehensive program:

- Policies
- Procedures
  - Standard operating procedures (SOPs)
  - Purchasing guidelines and procedures

### Objectives
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | |

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A003064

  - Bid packages (services and supplies)
- Materials
  - Preferred or approved product and supplier lists
  - Product and supplier evaluation criteria
  - Training sessions and manuals
  - Fact sheets for employees

*Training*
- Employees who handle potentially harmful materials in the use of safer alternatives.
- Purchasing departments should be encouraged to procure less hazardous materials and products that contain little or no harmful substances or TMDL pollutants.

*Regulations*
This BMP has no regulatory requirements. Existing regulations already encourage facilities to reduce the use of hazardous materials through incentives such as reduced:
- Specialized equipment storage and handling requirements,
- Stormwater runoff sampling requirements,
- Training and licensing requirements, and
- Record keeping and reporting requirements.

*Equipment*
- There are no major equipment requirements to this BMP.

*Limitations*
- Alternative products may not be available, suitable, or effective in every case.

## Requirements

*Costs*
- The primary cost is for staff time to: 1) develop new policies and procedures and 2) educate purchasing departments and employees who handle potentially harmful materials about the availability, procurement, and use of safer alternatives.
- Some alternative products may be slightly more expensive than conventional products.

## Supplemental Information

Employees and contractors / service providers can both be educated about safer alternatives by using information developed by a number of organizations including the references and resources listed below.

The following discussion provides some general information on safer alternatives. More specific information on particular hazardous materials and the available alternatives may be found in the references and resources listed below.

- Automotive products – Less toxic alternatives are not available for many automotive products, especially engine fluids. But there are alternatives to grease lubricants, car polishes, degreasers, and windshield washer solution. Rerefined motor oil is also available.
- Vehicle/Trailer lubrication – Fifth wheel bearings on trucks require routine lubrication. Adhesive lubricants are available to replace typical chassis grease.
- Cleaners – Vegetables-based or citrus-based soaps are available to replace petroleum-based soaps/detergents.
- Paint products – Water-based paints, wood preservatives, stains, and finishes are available.
- Pesticides – Specific alternative products or methods exist to control most insects, fungi, and weeds.
- Chemical Fertilizers – Compost and soil amendments are natural alternatives.
- Consumables – Manufacturers have either reduced or are in the process of reducing the amount of heavy metals in consumables such as batteries and fluorescent lamps. All fluorescent lamps contain mercury, however low-mercury containing lamps are now available from most hardware and lighting stores. Fluorescent lamps are also more energy efficient than the average incandescent lamp.
- Janitorial chemicals – Even biodegradable soap can harm fish and wildlife before it biodegrades. Biodegradable does not mean non-toxic. Safer products and procedures are available for floor stripping and cleaning, as well as carpet, glass, metal, and restroom cleaning and disinfecting.

### *Examples*

There are a number of business and trade associations, and communities with effective programs. Some of the more prominent are listed below in the references and resources section.

### References and Resources

Note: Many of these references provide alternative products for materials that typically are used inside and disposed to the sanitary sewer as well as alternatives to products that usually end up in the storm drain.

#### *General Sustainable Practices and Pollution Prevention Including Pollutant-Specific Information*

California Department of Toxic Substances Control (www.dtsc.ca.gov)

California Integrated Waste Management Board (www.ciwmb.ca.gov)

City of Santa Monica (www.santa-monica.org/environment)

City of Palo Alto (www.city.palo-alto.ca.us/cleanbay)

City and County of San Francisco, Department of the Environment (www.ci.sf.ca.us/sfenvironment)

Earth 911 (www.earth911.org/master.asp)

Environmental Finance Center Region IX (www.greenstart.org/efc9)

Flex Your Power (www.flexyourpower.ca.gov)

GreenBiz.com (www.greenbiz.com)

Green Business Program (www.abag.org/bayarea/enviro/gbus/gb.html)

Pacific Industrial and Business Association (www.piba.org)

Sacramento Clean Water Business Partners (www.sacstormwater.org)

USEPA BMP fact sheet – Alternative products (http://cfpub.epa.gov/npdes/stormwater/menuofbmps/poll_2.cfm)

USEPA Region IX Pollution Prevention Program (www.epa.gov/region09/p2)

Western Regional Pollution Prevention Network (www.westp2net.org)

***Metals (mercury, copper)***

National Electrical Manufacturers Association - Environment, Health and Safety (www.nema.org)

Sustainable Conservation (www.suscon.org)

Auto Recycling Project

Brake Pad Partnership

***Pesticides and Chemical Fertilizers***

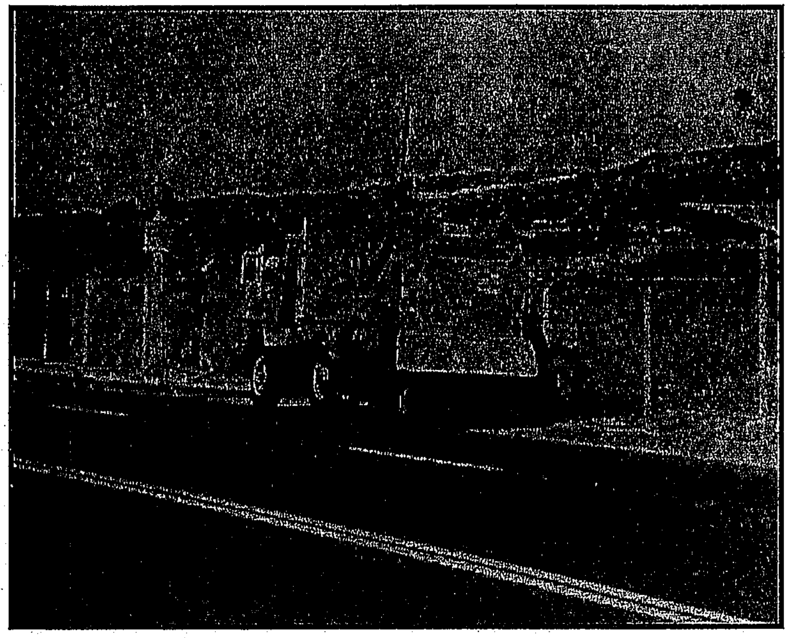
Bio-Integral Resource Center (www.birc.org)

California Department of Pesticide Regulation (www.cdpr.ca.gov)

University of California Statewide IPM Program (www.ipm.ucdavis.edu/default.html)

***Dioxins***

Bay Area Dioxins Project (http://dioxin.abag.ca.gov/)



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Streets, roads, and highways are significant sources of pollutants in stormwater discharges, and operation and maintenance (O&M) practices, if not conducted properly, can contribute to the problem. Stormwater pollution from roadway and bridge maintenance should be addressed on a site-specific basis. Use of the procedures outlined below, that address street sweeping and repair, bridge and structure maintenance, and unpaved roads will reduce pollutants in stormwater.

## Approach

### *Pollution Prevention*

- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal)
- Recycle paint and other materials whenever possible.
- Enlist the help of citizens to keep yard waste, used oil, and other wastes out of the gutter.

### *Suggested Protocols*

*Street Sweeping and Cleaning*

- Maintain a consistent sweeping schedule. Provide minimum monthly sweeping of curbed streets.
- Perform street cleaning during dry weather if possible.

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A003068

- Avoid wet cleaning or flushing of street, and utilize dry methods where possible.
- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc. For example:
  - Increase the sweeping frequency for streets with high pollutant loadings, especially in high traffic and industrial areas.
  - Increase the sweeping frequency just before the wet season to remove sediments accumulated during the summer.
  - Increase the sweeping frequency for streets in special problem areas such as special events, high litter or erosion zones.
- Maintain cleaning equipment in good working condition and purchase replacement equipment as needed. Old sweepers should be replaced with new technologically advanced sweepers (preferably regenerative air sweepers) that maximize pollutant removal.
- Operate sweepers at manufacturer requested optimal speed levels to increase effectiveness.
- To increase sweeping effectiveness consider the following:
  - Institute a parking policy to restrict parking in problematic areas during periods of street sweeping.
  - Post permanent street sweeping signs in problematic areas; use temporary signs if installation of permanent signs is not possible.
  - Develop and distribute flyers notifying residents of street sweeping schedules.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- If available use vacuum or regenerative air sweepers in the high sediment and trash areas (typically industrial/commercial).
- Keep accurate logs of the number of curb-miles swept and the amount of waste collected.
- Dispose of street sweeping debris and dirt at a landfill.
- Do not store swept material along the side of the street or near a storm drain inlet.
- Keep debris storage to a minimum during the wet season or make sure debris piles are contained (e.g. by berming the area) or covered (e.g. with tarps or permanent covers).

*Street Repair and Maintenance*

*Pavement marking*

- Schedule pavement marking activities for dry weather.



A003069

- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.
- Provide drop cloths and drip pans in paint mixing areas.
- Properly maintain application equipment.
- Street sweep thermoplastic grindings. Yellow thermoplastic grindings may require special handling as they may contain lead.
- Paints containing lead or tributyltin are considered a hazardous waste and must be disposed of properly.
- Use water based paints whenever possible. If using water based paints, clean the application equipment in a sink that is connected to the sanitary sewer.
- Properly store leftover paints if they are to be kept for the next job, or dispose of properly.

*Concrete installation and repair*

- Schedule asphalt and concrete activities for dry weather.
- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- When making saw cuts in pavement, use as little water as possible and perform during dry weather. Cover each storm drain inlet completely with filter fabric or plastic during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site. Alternatively, a small onsite vacuum may be used to pick up the slurry as this will prohibit slurry from reaching storm drain inlets.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

*Patching, resurfacing, and surface sealing*

- Schedule patching, resurfacing and surface sealing for dry weather.
- Stockpile materials away from streets, gutter areas, storm drain inlets or watercourses. During wet weather, cover stockpiles with plastic tarps or berm around them if necessary to prevent transport of materials in runoff.
- Pre-heat, transfer or load hot bituminous material away from drainage systems or watercourses.
- Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and maintenance holes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from covered maintenance holes and storm drain inlets when the job is complete.
- Prevent excess material from exposed aggregate concrete or similar treatments from entering streets or storm drain inlets. Designate an area for clean up and proper disposal of excess materials.
- Use only as much water as necessary for dust control, to avoid runoff.
- Sweep, never hose down streets to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

*Equipment cleaning maintenance and storage*

- Inspect equipment daily and repair any leaks. Place drip pans or absorbent materials under heavy equipment when not in use.
- Perform major equipment repairs at the corporation yard, when practical.
- If refueling or repairing vehicles and equipment must be done onsite, use a location away from storm drain inlets and watercourses.
- Clean equipment including sprayers, sprayer paint supply lines, patch and paving equipment, and mud jacking equipment at the end of each day. Clean in a sink or other area (e.g. vehicle wash area) that is connected to the sanitary sewer.

*Bridge and Structure Maintenance*

*Paint and Paint Removal*

- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Do not transfer or load paint near storm drain inlets or watercourses.

- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- Plug nearby storm drain inlets prior to starting painting where there is significant risk of a spill reaching storm drains. Remove plugs when job is completed.
- If sand blasting is used to remove paint, cover nearby storm drain inlets prior to starting work.
- Perform work on a maintenance traveler or platform, or use suspended netting or tarps to capture paint, rust, paint removing agents, or other materials, to prevent discharge of materials to surface waters if the bridge crosses a watercourse. If sanding, use a sander with a vacuum filter bag.
- Capture all clean-up water, and dispose of properly.
- Recycle paint when possible (e.g. paint may be used for graffiti removal activities). Dispose of unused paint at an appropriate household hazardous waste facility.

*Graffiti Removal*

- Schedule graffiti removal activities for dry weather.
- Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.
- When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal above.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a landscaped or dirt area. If such an area is not available, filter runoff through an appropriate filtering device (e.g. filter fabric) to keep sand, particles, and debris out of storm drains.
- If a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound), plug nearby storm drains and vacuum/pump wash water to the sanitary sewer.
- Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

*Repair Work*

- Prevent concrete, steel, wood, metal parts, tools, or other work materials from entering storm drains or watercourses.
- Thoroughly clean up the job site when the repair work is completed.
- When cleaning guardrails or fences follow the appropriate surface cleaning methods (depending on the type of surface) outlined in SC-71 Plaza & Sidewalk Cleaning fact sheet.

- If painting is conducted, follow the painting and paint removal procedures above.
- If graffiti removal is conducted, follow the graffiti removal procedures above.
- If construction takes place, see the Construction Activity BMP Handbook.
- Recycle materials whenever possible.

*Unpaved Roads and Trails*

- Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes.
- For roadside areas with exposed soils, the most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. Native vegetation should be used if possible.
- If vegetation cannot be established immediately, apply temporary erosion control mats/blankets; a comma straw, or gravel as appropriate.
- If sediment is already eroded and mobilized in roadside areas, temporary controls should be installed. These may include: sediment control fences, fabric-covered triangular dikes, gravel-filled burlap bags, biobags, or hay bales staked in place.

*Non-Stormwater Discharges*

Field crews should be aware of non-stormwater discharges as part of their ongoing street maintenance efforts.

- Refer to SC-10 Non-Stormwater Discharges
- Identify location, time and estimated quantity of discharges.
- Notify appropriate personnel.

***Training***

- Train employees regarding proper street sweeping operation and street repair and maintenance.
- Instruct employees and subcontractors to ensure that measures to reduce the stormwater impacts of roadway/bridge maintenance are being followed.
- Require engineering staff and/or consulting A/E firms to address stormwater quality in new bridge designs or existing bridge retrofits.
- Use a training log or similar method to document training.
- Train employees on proper spill containment and clean up, and in identifying non-stormwater discharges.

*Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

*Other Considerations*

- Densely populated areas or heavily used streets may require parking regulations to clear streets for cleaning.
- No currently available conventional sweeper is effective at removing oil and grease. Mechanical sweepers are not effective at removing finer sediments.
- Limitations may arise in the location of new bridges. The availability and cost of land and other economic and political factors may dictate where the placement of a new bridge will occur. Better design of the bridge to control runoff is required if it is being placed near sensitive waters.

## Requirements

*Costs*

- The maintenance of local roads and bridges is already a consideration of most community public works or transportation departments. Therefore, the cost of pollutant reducing management practices will involve the training and equipment required to implement these new practices.
- The largest expenditures for street sweeping programs are in staffing and equipment. The capital cost for a conventional street sweeper is between $60,000 and $120,000. Newer technologies might have prices approaching $180,000. The average useful life of a conventional sweeper is about four years, and programs must budget for equipment replacement. Sweeping frequencies will determine equipment life, so programs that sweep more often should expect to have a higher cost of replacement.
- A street sweeping program may require the following.
  - Sweeper operators, maintenance, supervisory, and administrative personnel are required.
  - Traffic control officers may be required to enforce parking restrictions.
  - Skillful design of cleaning routes is required for program to be productive.
  - Arrangements must be made for disposal of collected wastes.

- If investing in newer technologies, training for operators must be included in operation and maintenance budgets. Costs for public education are small, and mostly deal with the need to obey parking restrictions and litter control. Parking tickets are an effective reminder to obey parking rules, as well as being a source of revenue.

***Maintenance***
- Not applicable

## Supplemental Information

***Further Detail of the BMP***

*Street sweeping*

There are advantages and disadvantages to the two common types of sweepers. The best choice depends on your specific conditions. Many communities find it useful to have a compliment of both types in their fleet.

Mechanical Broom Sweepers - More effective at picking up large debris and cleaning wet streets. Less costly to purchase and operate. Create more airborne dust.

Vacuum Sweepers - More effective at removing fine particles and associated heavy metals. Ineffective at cleaning wet streets. Noisier than mechanical broom sweepers which may restrict areas or times of operation. May require an advance vehicle to remove large debris.

Street Flushers - Not affected by biggest interference to cleaning, parked cars. May remove finer sediments, moving them toward the gutter and stormwater inlets. For this reason, flushing fell out of favor and is now used primarily after sweeping. Flushing may be effective for combined sewer systems. Presently street flushing is not allowed under most NPDES permits.

*Cross-Media Transfer of Pollutants*

The California Air Resources Board (ARB) has established state ambient air quality standards including a standard for respirable particulate matter (less than or equal to 10 microns in diameter, symbolized as PM10). In the effort to sweep up finer sediments to remove attached heavy metals, municipalities should be aware that fine dust, that cannot be captured by the sweeping equipment and becomes airborne, could lead to issues of worker and public safety.

*Bridges*

Bridges that carry vehicular traffic generate some of the more direct discharges of runoff to surface waters. Bridge scupper drains cause a direct discharge of stormwater into receiving waters and have been shown to carry relatively high concentrations of pollutants. Bridge maintenance also generates wastes that may be either directly deposited to the water below or carried to the receiving water by stormwater. The following steps will help reduce the stormwater impacts of bridge maintenance:

- Site new bridges so that significant adverse impacts to wetlands, sensitive areas, critical habitat, and riparian vegetation are minimized.

- Design new bridges to avoid the use of scupper drains and route runoff to land for treatment control. Existing scupper drains should be cleaned on a regular basis to avoid sediment/debris accumulation.
- Reduce the discharge of pollutants to surface waters during maintenance by using suspended traps, vacuums, or booms in the water to capture paint, rust, and paint removing agents. Many of these wastes may be hazardous. Properly dispose of this waste by referring to CA21 (Hazardous Waste Management) in the Construction Handbook.
- Train employees and subcontractors to reduce the discharge of wastes during bridge maintenance.

*De-icing*

- Do not over-apply deicing salt and sand, and routinely calibrate spreaders.
- Near reservoirs, restrict the application of deicing salt and redirect any runoff away from reservoirs.
- Consider using alternative deicing agents (less toxic, biodegradable, etc.).

### References and Resources

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

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

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

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Fresh Concrete and Mortar Application Best Management Practices for the Construction Industry. June.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 2001. Roadwork and Paving Best Management Practices for the Construction Industry. June.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Roadway and Bridge Maintenance. On-line http://www.epa.gov/npdes/menuofbmps/poll_13.htm

# Plaza and Sidewalk Cleaning SC-71

### Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. This fact sheet describes good housekeeping practices that can be incorporated into the municipality's existing cleaning and maintenance program.

## Approach

***Pollution Prevention***

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).

***Suggested Protocols***

*Surface Cleaning*

- Regularly broom (dry) sweep sidewalk, plaza and parking lot areas to minimize cleaning with water.
- Dry cleanup first (sweep, collect, and dispose of debris and trash) when cleaning sidewalks or plazas, then wash with or without soap.
- Block the storm drain or contain runoff when cleaning with water. Discharge wash water to landscaping or collect water and pump to a tank or discharge to sanitary sewer if allowed. (Permission may be required from local sanitation district.)

- Block the storm drain or contain runoff when washing parking areas, driveways or drive-throughs. Use absorbents to pick up oil; then dry sweep. Clean with or without soap. Collect water and pump to a tank or discharge to sanitary sewer if allowed. Street Repair and Maintenance.

*Graffiti Removal*

- Avoid graffiti abatement activities during rain events.
- Implement the procedures under Painting and Paint Removal in SC-70 Roads, Streets, and Highway Operation and Maintenance fact sheet when graffiti is removed by painting over.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a dirt or landscaped area after treating with an appropriate filtering device.
- Plug nearby storm drain inlets and vacuum/pump wash water to the sanitary sewer if authorized to do so if a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound). Ensure that a non-hazardous cleaning compound is used or dispose as hazardous waste, as appropriate.

*Surface Removal and Repair*

- Schedule surface removal activities for dry weather if possible.
- Avoid creating excess dust when breaking asphalt or concrete.
- Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up as much material as possible.
- Designate an area for clean up and proper disposal of excess materials.
- Remove and recycle as much of the broken pavement as possible to avoid contact with rainfall and stormwater runoff.
- When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet completely with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site.
- Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Wash water should be directed to landscaping or collected and pumped to the sanitary sewer if allowed.

*Concrete Installation and Repair*

- Schedule asphalt and concrete activities for dry weather.

- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- Protect applications of fresh concrete from rainfall and runoff until the material has dried.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

*Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.
- Clean parking lots on a regular basis with a street sweeper.

***Training***

- Provide regular training to field employees and/or contractors regarding surface cleaning and proper operation of equipment.
- Train employee and contractors in proper techniques for spill containment and cleanup.
- Use a training log or similar method to document training.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

*Other Considerations*

- Limitations related to sweeping activities at large parking facilities may include current sweeper technology to remove oil and grease.
- Surface cleaning activities that require discharges to the local sewering agency will require coordination with the agency.
- Arrangements for disposal of the swept material collected must be made, as well as accurate tracking of the areas swept and the frequency of sweeping.

## Requirements

*Costs*

- The largest expenditures for sweeping and cleaning of sidewalks, plazas, and parking lots are in staffing and equipment. Sweeping of these areas should be incorporated into street sweeping programs to reduce costs.

*Maintenance*

Not applicable

## Supplemental Information

*Further Detail of the BMP*

Community education, such as informing residents about their options for recycling and waste disposal, as well as the consequences of littering, can instill a sense of citizen responsibility and potentially reduce the amount of maintenance required by the municipality.

Additional BMPs that should be considered for parking lot areas include:

- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Structural BMPs such as storm drain inlet filters can be very effective in reducing the amount of pollutants discharged from parking facilities during periods of rain.

## References and Resources

Bay Area Stormwater Management Agencies Association (BASMAA). 1996. Pollution From Surface Cleaning Folder http://www.basmaa.org

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

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

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

Santa Clara Valley Urban Runoff Pollution Prevention Program. Maintenance Best Management Practices for the Construction Industry. Brochures: Landscaping, Gardening, and Pool; Roadwork and Paving; and Fresh Concrete and Mortar Application. June 2001.

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

# Fountain & Pool Maintenance SC-72

## Description

The primary pollutant of concern in municipal swimming pool water is chlorine or chloramine used as a disinfectant. This water, if discharged to the storm drain system, can be toxic to aquatic life. In lakes, lagoons, and fountains, the pollutants of concern are chemical algaecides that are added to control algae mainly for aesthetic reasons (visual and odor). Following the procedures noted in this fact sheet will reduce the pollutants in this discharge.

## Approach

### *Pollution Prevention*

- Prevent algae problems with regular cleaning, consistent adequate chlorine levels, and well-maintained water filtration and circulation systems.
- Manage pH and water hardness to minimize corrosion of copper pipes.

### *Suggested Protocols*

*Pools and Fountains*

- Do not use copper-based algaecides. Control algae with chlorine or other alternatives, such as sodium bromide.
- Do not discharge water to a street or storm drain when draining pools or fountains; discharge to the sanitary sewer if permitted to do so. If water is dechlorinated with a neutralizing chemical or by allowing chlorine to dissipate for a few days (do not use the facility during this time), the water may be recycled/reused by draining it gradually onto a landscaped area. Water must be tested prior to discharge to ensure that chlorine is not present.
- Prevent backflow if draining a pool to the sanitary sewer by maintaining an "air gap" between the discharge line and the sewer line (do not seal the connection between the hose and sewer line). Be sure to call the local wastewater treatment plant for further guidance on flow rate restrictions, backflow prevention, and handling special cleaning waste (such as acid wash). Discharge flows should be kept to the low levels typically possible through a garden hose. Higher flow rates may be prohibited by local ordinance.
- Provide drip pans or buckets beneath drain pipe connections to catch leaks. This will be especially pertinent if pool or spa water that has not been dechlorinated is pumped through piping to a discharge location.

### Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | |
| Bacteria | ☑ |
| Oil and Grease | |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

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- Never clean a filter in the street or near a storm drain.
- Rinse cartridge filters onto a dirt area, and spade filter residue into soil.
- Backwash diatomaceous earth filters onto dirt. Dispose of spent diatomaceous earth in the garbage. Spent diatomaceous earth cannot be discharged to surface waters, storm drainage systems, septic systems, or on the ground.
- If there is not a suitable dirt area discharge filter backwash or rinsewater to the sanitary sewer if permitted to do so by the local sewering agency.

*Lakes and Lagoons*

- Reduce fertilizer use in areas around the water body. High nitrogen fertilizers can produce excess growth requiring more frequent mowing or trimming, and may contribute to excessive algae growth.
- To control bacteria, discourage the public from feeding birds and fish (i.e. place signs that prohibit feeding of waterfowl).
- Consider introducing fish species that consume algae. Contact the California Department of Fish and Game for more information on this issue.
- Mechanically remove pond scum (blue-green algae) using a 60 micron net.
- Educate the public on algae and that no controls are necessary for certain types of algae that are beneficial to the water body.
- Control erosion by doing the following:
  - Maintain vegetative cover on banks to prevent soil erosion. Apply mulch or leave clippings to serve as additional cover for soil stabilization and to reduce the velocity of stormwater runoff.
  - Areas should be designed (sloped) to prevent runoff and erosion and to promote better irrigation practices.
  - Provide energy dissipaters (e.g. riprap) along banks to minimize potential for erosion.
  - Confine excavated materials to surfaces away from lakes. Material must be covered if rain is expected.
- Conduct inspections to detect illegal dumping of clippings/cuttings in or near a lake. Materials found should be picked up and properly disposed of.
- Avoid landscape wastes in and around lakes should be avoided by either using bagging equipment or by manually picking up the material. Collect trash and debris from within water bodies where feasible
- Provide and maintain trash receptacles near recreational water bodies to hold refuse generated by the public.



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- Increase trash collection during peak visitation months (generally June, July and August).

*Training*

- Train maintenance personnel to test chlorine levels and to apply neutralizing chemicals.
- Train personnel regarding proper maintenance of pools, ponds and lakes.

*Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

*Other Considerations*

- Managers of pools located in sensitive areas or adjacent to shorelines should check with the appropriate authorities to determine if code requirements apply.
- Cleanup activities at lakes and lagoons may create a slight disturbance for local aquatic species. If the lake is recognized as a wetland, many activities, including maintenance, may be subject to regulation and permitting.

## Requirements

*Costs*

- The maintenance of pools and lakes is already a consideration of most municipal public works departments. Therefore the cost associated with this BMP is minimal and only reflects an increase in employee training and public outreach.

*Maintenance*

Not applicable

## Supplemental Information

*Further Detail of the BMP*

When dredging is conducted, adhere to the following:

- Dredge with shovels when laying/maintaining pipes.
- To determine amount to dredge, determine rate of volume loss due to sediments.
- For large lakes, dredge every 10 years.
- When dredging small lakes, drain lake.
- When dredging large lakes, use vacuum equipment.
- After dredging test sediment piles for proper disposal. Dredged sediment can be used as fill, or may have to be land filled.



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## References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

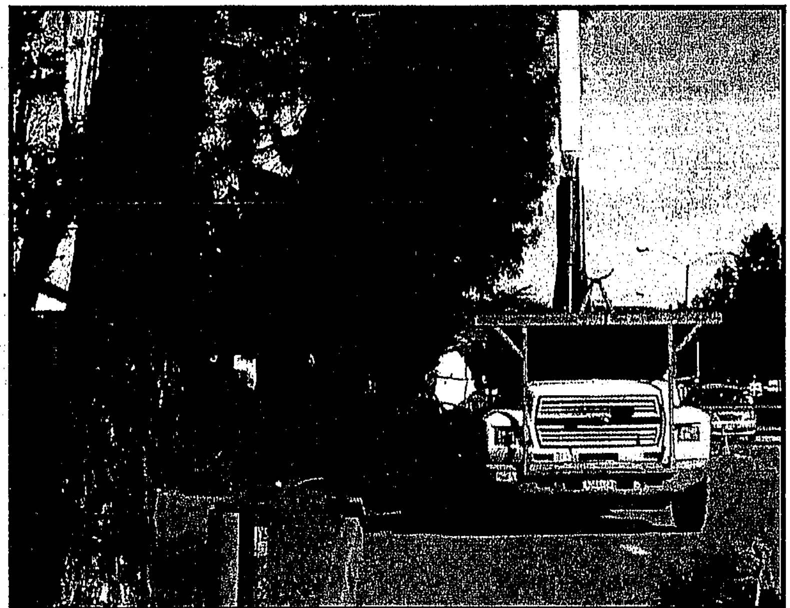
Los Angeles County Stormwater Quality. Public Agency Activities Model Program. On-line: http://ladpw.org/wmd/npdes/public_TC.cfm

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

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

Santa Clara Valley Urban Runoff Pollution Prevention Program. Maintenance Best Management Practices for the Construction Industry. Brochures: Landscaping, Gardening, and Pool; Roadwork and Paving; and Fresh Concrete and Mortar Application. June 2001.

# Landscape Maintenance SC-73



### Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |
| Oxygen Demanding | ☑ |

## Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

## Approach

### *Pollution Prevention*

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.

- Choose low water using flowers, trees, shrubs, and groundcover.

- Consider alternative landscaping techniques such as naturescaping and xeriscaping.

- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

***Suggested Protocols***

*Mowing, Trimming, and Weeding*

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

***Planting***

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

***Waste Management***

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

### *Irrigation*

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

### *Fertilizer and Pesticide Management*

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

*Inspection*

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

***Training***

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.



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- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.

- Use a training log or similar method to document training.

### *Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a know in location

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

### *Other Considerations*

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.

- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.

- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

## Requirements

### *Costs*

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

### *Maintenance*

Not applicable

## Supplemental Information

***Further Detail of the BMP***

*Waste Management*

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

*Contractors and Other Pesticide Users*

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

## References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

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

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

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

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

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm

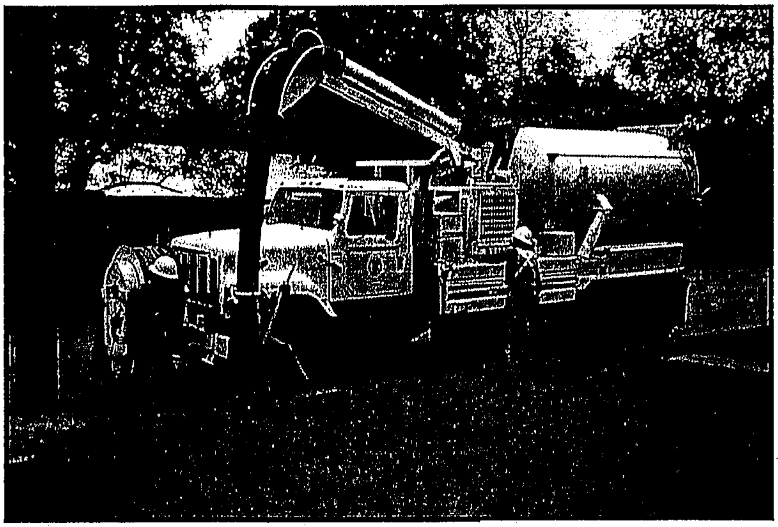

Photo Credit Geoff Brosseau

### Objectives

- Contain
- Educate
- Reduce/Minimize

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

## Approach

***Suggested Protocols***

*Catch Basins/Inlet Structures*

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

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- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

*Storm Drain Conveyance System*

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

*Pump Stations*

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

*Open Channel*

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

*Illicit Connections and Discharges*

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

*Illegal Dumping*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).
- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

### *Training*

- Train crews in proper maintenance activities, including record keeping and disposal.
- Only properly trained individuals are allowed to handle hazardous materials/wastes.
- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.
- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.
- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

### *Spill Response and Prevention*

- Refer to SC-11, Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

### *Other Considerations*

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

## Requirements

### *Costs*

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from "environmental fees" or special assessment districts to fund their illicit connection elimination programs.

### *Maintenance*

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

## Supplemental Information

### *Further Detail of the BMP*

*Storm Drain flushing*

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

*Flow Management*

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

*Stream Corridor Planning*

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to he reclaimed.

***Examples***

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank aid watershed instability arid floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

## References and Resources

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A003100

# Waste Handling and Disposal SC-75


## Objectives

- Cover
- Contain
- Educate
- Reduce/Reuse

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

It is important to control litter to eliminate trash and other materials in stormwater runoff. Waste reduction is a major component of waste management and should be encouraged through training and public outreach. Management of waste once it is collected may involve reuse, recycling, or proper disposal.

## Approach

### *Pollution Prevention*

- Reuse products when possible.
- Encourage recycling programs with recycling bins, used oil collection, etc.

### *Suggested Protocols*

*Solid Waste Collection*

- Implement procedures, where applicable, to collect, transport, and dispose of solid waste at appropriate disposal facilities in accordance with applicable federal, state, and local laws and regulations.
- Include properly designed trash storage areas. If feasible provide cover over trash storage areas.
- Regularly inspect solid waste containers for structural damage. Repair or replace damaged containers as necessary.

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- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).
- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.
- Refer to SC-34 Waste Handling and Disposal for more information regarding solid waste facilities.

*Waste Reduction and Recycling*

- Recycle wastes whenever possible. Many types of waste can be recycled, recycling options for each waste type are limited. All gasoline, antifreeze, waste oil, and lead-acid batteries can be recycled. Latex and oil-based paint can be reused, as well as recycled. Materials that cannot be reused or recycled should either be incinerated or disposed of at a properly permitted landfill.
- Recycling is always preferable to disposal of unwanted materials.
- Recycling bins for glass, metal, newspaper, plastic bottles and other recyclable household solid wastes should be provided at public facilities and/or for residential curbside collection.

*Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Clean out and cover litter receptacles frequently to prevent spillage.

*Illegal Dumping*

Substances illegally dumped on streets and into the storm drain system and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clipping, and pet wastes.

- Post "No Dumping" signs with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Landscaping and beautification efforts of hot spots might also discourage future dumping.
- See SC-74 Drainage System Maintenance, and SC-10 Non-Stormwater Discharges.

## Requirements

*Costs*

- The costs for a solid waste source control program vary depending on the type of method. The cost of a community education program or a plan to increase the number of trash receptacles can be very minimal. Costs for structural controls such as trash racks, bar screens, and silt traps can be quite costly ranging from $250,000 to $900,000.
- A collection facility or curbside collection for used oil may result in significant costs. Commercial locations (automobile service stations, quick oil change centers, etc.) as collection points eliminate hauling and recycling costs.
- Collection and disposal of hazardous waste can be very expensive and requires trained operators; laboratory and detection equipment; and extensive record keeping including dates, types, and quantities.
- Use of volunteer work forces can lower storm drain stenciling program costs. Stenciling kits require procurement of durable/disposable items. The stenciling program can aid in the cataloging of the storm drain system. One municipality from the state of Washington has estimated that stenciling kits cost approximately $50 each. Stencils may cost about $8 each including the die cost on an order of 1,000. Re-orders cost about $1/stencil. Stencil designs may be available from other communities. Stencil kits should be provided on a loan basis to volunteer groups free of charge with the understanding that kit remnants are to be returned.

*Maintenance*

- The primary staff demand for stenciling programs is for program setup to provide marketing and training. Ongoing/follow-up staff time is minimal because of volunteer services.
- Staffing requirements are minimal for oil recycling programs if collection/recycling is contracted out to a used oil hauler/recycler or required at commercial locations.
- Staff requirements for maintaining good housekeeping BMPs at waste handling sites is minimal.

## Supplemental Information

***Further Detail of the BMP***

*Waste Reduction*

An approach to reduce stormwater pollution from waste handling and disposal is to assess activities and reduce waste generation. The assessment is designed to find situations where waste can be eliminated or reduced and emissions and environmental damage can be minimized. The assessment involves collecting process specific information, setting pollution prevention targets, and developing, screening and selecting waste reduction options for further study. Starting a waste reduction program is economically beneficial because of reduced raw material purchases and lower waste disposal fees.



A003103

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

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

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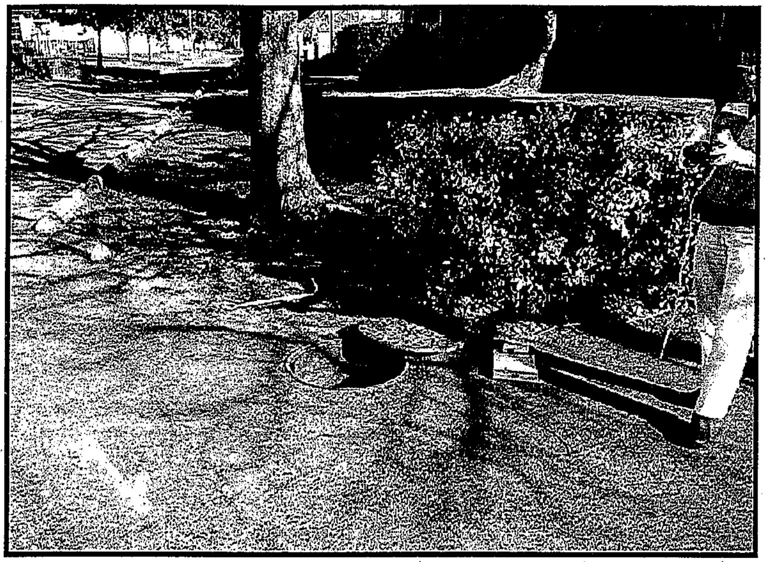
A003104

# Water & Sewer Utility Maintenance SC-76



### Objectives

- Contain
- Educate
- Reduce/Minimize

### Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | |
| Metals | |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |
| Oxygen Demanding | ☑ |

## Description

Although the operation and maintenance of public utilities are not considered chronic sources of stormwater pollution, some activities and accidents can result in the discharge of pollutants that can pose a threat to both human health and the quality of receiving waters if they enter the storm drain system. Sewage incident response and investigation may involve a coordinated effort between staff from a number of different departments/agencies. Cities that do not provide maintenance of water and sewer utilities must coordinate with the contracting agency responsible for these activities and ensure that these model procedures are followed.

## Approach

### *Pollution Prevention*

Inspect potential non-stormwater discharge flow paths and clear/cleanup any debris or pollutants found (i.e. remove trash, leaves, sediment, and wipe up liquids, including oil spills).

### *Suggested Protocols*

*Water Line Maintenance and Cleaning*

Procedures can be employed to reduce pollutants from discharges associated with water utility operation and maintenance activities. Planned discharges may include fire hydrant testing, flushing water supply mains after new construction, flushing lines due to complaints of taste and odor, dewatering mains for maintenance work. Unplanned discharges from treated, recycled water, raw water, and groundwater systems operation and maintenance activities can occur from water main

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breaks, sheared fire hydrants, equipment malfunction, and operator error.

*Planned discharges*

- Identify a suitable discharge option in the following order of preference:
  - Apply to the land.
  - Reuse water for dust suppression, irrigation, or construction compaction.
  - Discharge to a sanitary sewer system with approval.
  - Discharge to the storm drain system using applicable pollution control measures. (Only available to clean water discharges such as water main/ water storage tank/water hydrant flushing).
- If water is discharged to a storm drain, control measures must be put in place to control potential pollutants (i.e. sediment, chlorine, etc.). Examples of some storm drain protection options include:
  - Silt fence – appropriate where the inlet drains a relatively flat area.
  - Gravel and wire mesh sediment filter – Appropriate where concentrated flows are expected.
  - Wooden weir and fabric – use at curb inlets where a compact installation is desired.
- Prior to discharge, inspect discharge flow path and clear/cleanup any debris or pollutants found (i.e. remove trash, leaves, sediment, and wipe up liquids, including oil spills).
- General Design considerations for inlet protection devices include the following:
  - The device should be constructed such that cleaning and disposal of trapped sediment is made easy, while minimizing interference with discharge activities.
  - Devices should be constructed so that any standing water resulting from the discharge will not cause excessive inconvenience or flooding/damage to adjacent land or structures.
- The effectiveness of control devices must be monitored during the discharge period and any necessary repairs or modifications made.

*Unplanned Discharges*

- Stop the discharge as quickly as possible.
- Inspect flow path of the discharged water:
  - Identify erodible areas which may need to be repaired or protected during subsequent repairs or corrective actions

- Identify the potential for pollutants to be washed into the waterway

- If repairs or corrective action will cause additional discharges of water, select the appropriate procedures for erosion control, chlorine residual, turbidity, and chemical additives. Prevent potential pollutants from entering the flow path.

*Sanitary Sewer Maintenance*

Applicable to municipalities who own and operated a sewage collection system. Facilities that are covered under this program include sanitary sewer pipes and pump stations owned and operated by a municipality. The owner of the sanitary sewer facilities is the entity responsible for carrying out this prevention and response program.

- Clean sewer lines on a regular basis to remove grease, grit, and other debris that may lead to sewer backups.

- Establish routine maintenance program. Cleaning should be conducted at an established minimum frequency and more frequently for problem areas such as restaurants that are identified

- Cleaning activities may require removal of tree roots and other identified obstructions.

- During routine maintenance and inspection note the condition of sanitary sewer structures and identify areas that need repair or maintenance. Items to note may include the following:
  - Cracked/deteriorating pipes
  - Leaking joints/seals at manhole
  - Frequent line plugs
  - Line generally flows at or near capacity
  - Suspected infiltration or exfiltration.

- Prioritize repairs based on the nature and severity of the problem. Immediate clearing of blockage or repair is required where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, sewer line blockages). These repairs may be temporary until scheduled or capital improvements can be completed.

- Review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure.

*Spills and Overflows*

- Identify and track sanitary sewer discharges. Identify dry weather infiltration and inflow first. Wet weather overflow connections are very difficult to locate.

- Locate wet weather overflows and leaking sanitary sewers using conventional source identification techniques such as monitoring and field screening. Techniques used to identify other illicit connection sources can also be used for sewer system evaluation surveys (see SC74 Drainage System Operation and Maintenance).
- Implement community awareness programs for monitoring sanitary sewer wet weather overflows. A citizen's hotline for reporting observed overflow conditions should be established to supplement field screening efforts.
- Establish lead department/agency responsible for spill response and containment. Provide coordination within departments.
- When a spill, leak, and/or overflow occurs and when disinfecting a sewage contaminated area, take every effort to ensure that the sewage, disinfectant and/or sewage treated with the disinfectant is not discharged to the storm drain system or receiving waters. Methods may include:
  - Blocking storm drain inlets and catch basins
  - Containing and diverting sewage and disinfectant away from open channels and other storm drain fixtures (using sandbags, inflatable dams, etc.)
  - Removing the material with vacuum equipment
- Record required information at the spill site.
- Perform field tests as necessary to determine the source of the spill.
- Develop notification procedures regarding spill reporting.

*Septic Systems*

- Ensure that homeowners, installers, and inspectors are educated in proper maintenance of septic systems. This may require coordination with staff from other departments. Outreach to homeowners should include inspection reminders informing then that inspection and perhaps maintenance is due for their systems. Recommend that the system be inspected annually and pumped-out regularly.
- Programs which seek to address failing septic systems should consider using field screening to pinpoint areas where more detailed onsite inspection surveys are warranted.

***Training***

- Conduct annual training of water utility personnel and service contractors. (field screening, sampling, smoke/dye testing, TV inspection).
- OSHA-required Health and Safety Training 29 CFR 1910.120 plus annual Refresher Training (as needed).
- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and federal OSHA 29 CFR 1910.146).



A003108

*Spill Response and Prevention*

- See previous section regarding spills and overflows.
- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

*Other Considerations*

- Enact ordinance granting "right-of-entry" to locate potentially responsible parties for sewer overflows.
- Reliance on individual onsite inspection to detect failed septic systems can be a major limitation. The individual onsite inspection is very labor-intensive and requires access to private property to pinpoint the exact location of the failing system.
- A significant limitation to correcting failing septic systems is the lack of techniques available for detecting individual failed septic systems.

## Requirements

*Costs*

- Departmental cooperation recommended for sharing or borrowing staff resources and equipment from municipal wastewater department.
- Infiltration, inflow, and wet weather overflows from sanitary sewers are very labor and equipment intensive to locate.
- The costs associated with detecting and correcting septic system failures are subject to a number of factors, including availability of trained personnel, cost of materials, and the level of follow-up required to fix the system problems.

*Maintenance*

- Minimum 2-person teams to perform field screening and associated sampling.
- Larger teams required for implementing other techniques (i.e. zinc chloride smoke testing, fluorometric dye testing, television camera inspection and physical inspection with confined space entry) to identify sewer system leaks.
- Program coordination required for handling emergencies, record keeping, etc.
- Many of the problems associated with improper use of septic systems may be attributed to lack of user knowledge on operation and maintenance. Educational materials for homeowners and training courses for installers and inspectors can reduce the incidence of pollution from these widespread and commonly used pollution control devices.

## Supplemental Information

### *Further Detail of the BMP*

*Onsite Sewage Disposal Systems*

New onsite sewage disposal systems should be designed, located, and installed away from open waterbodies and sensitive resources such as wetlands and floodplains. A protective separation between the OSDS and groundwater should also be established. OSDSs should be operated and maintained to prevent surface water discharges and reduce pollutant loadings to groundwater. Inspection of OSDSs should occur regularly and repairs made immediately. New or replacement plumbing fixtures should be of the high efficiency type.

*Typical Sanitary Sewer Problems*

- Old and deteriorated main and lateral pipes - Sewers range in age from 30 to 100 years with an average age of 50 years.
- Cracked sewer pipes - Existing sewers are mostly clay pipes which can crack as they deteriorate with age and also by earth movement.
- Misaligned and open pipe joints - Most of the mortar used to seal the joints between sections of clay pipe has deteriorated.
- Undersized sewer pipe - The existing sewer system is overloaded due to new sewer hook-ups, underground water infiltration, and illegal roof and/or yard drain connections.
- Defective manholes - Old manholes are made of bricks. Typical problems associated with brick manholes are loose bricks, missing bricks, and misaligned manholes.
- Missing and/or unrecorded sewer pipes and manholes - This problem is typical in the easement/backline sewer. Sewer pipe locations shown on the sewer record map are different from the actual sewer location.
- Sewer main under houses and other improvements - Complaints of sewer main alignment crossing the house and other improvements. A solution to this problem requires an agreement with the property owner for a new sewer easement at a relocated line.

*Causes of Sanitary Sewer Backups*

- Root infiltration - Tree roots are a major cause of backups.
- Water inflow/infiltration - Rain water entering the sewer pipe causes overflows.
- Solids - Typical solids that buildup in the pipe and cause backups are grease, dirt, bones, tampons, paper towels, diapers, broken dishware, garbage, concrete, and debris.
- Structural defects in pipes and manholes - Sags in the line, cracks, holes, protruding laterals, misaligned pipe, offset joints are all possible causes of backups.



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*Design Considerations*

Sanitary sewer overflows can often be reduced or eliminated by a number of practices, in addition to sewer system cleaning and maintenance, including the following:

- Reducing infiltration and inflow through rehabilitation and repair of broken or leaking sewer lines.
- Enlarging or upgrading the capacity of sewer lines, pump stations, or sewage treatment plants.
- Constructing wet weather storage and treatment facilities to treat excess flows.
- Addressing SSOs during sewer system master planning and facilities planning.

*Septic Systems*

Two field screening techniques that have been used with success at identifying possible locations of failing septic systems are the brightener test and color infrared (CIR) aerial photography. The first involves the use of specific phosphorus-based elements found in many laundry products, often called brighteners, as an indicator of the presence of failing onsite wastewater systems. The second technique uses color infrared (CIR) aerial photography to characterize the performance of septic systems. This method has been found to be a quick and cost-effective method for assessing the potential impacts of failing systems and uses variations in vegetative growth or stress patterns over septic system field lines to identify those systems that may potentially be malfunctioning. Then a more detailed onsite visual and physical inspection will confirm whether the system has truly failed and the extent of the repairs needed. These inspections may be carried out by county health departments or other authorized personnel.

## References and Resources

Alameda Countywide Clean Water Program on-line
http://www.ci.berkeley.ca.us/pw/Storm/stormala.html

Los Angeles County Stormwater Quality. Public Agency Activities Model Program. On-line: http://ladpw.org/wmd/npdes/public_TC.cfm

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# Section 4
# Treatment Control BMPs

## 4.1 Introduction

This section discusses the inspection and maintenance requirements for treatment control BMPs shown in Table 4-1. The specific design requirements, performance specifications, and limitations of each of these BMPs are discussed in detail in the New Development and Redevelopment BMP Handbook. Inspection and maintenance requirements are necessary to verify that each treatment control BMP performs efficiently throughout its design life. Although specific inspection and maintenance frequencies are presented in the following fact sheets, these are only suggested and should be adapted to each site situation to best accommodate environmental, economic, and local regulatory concerns.

For the purpose of this Handbook, treatment control BMPs have been classified according to whether they are public domain or proprietary controls. Public domain controls, as the name implies, are controls that are available to the general public, while proprietary controls are typically patented devices and are purchased from a vendor.

| Table 4-1 | Treatment Control BMPs |
|---|---|
| **Public Domain** | |
| TC-10 | Infiltration Trench |
| TC-11 | Infiltration Basin |
| TC-12 | Retention/Irrigation |
| TC-20 | Wet Pond |
| TC-21 | Constructed Wetland |
| TC-22 | Extended Detention Basin |
| TC-30 | Vegetated Swale |
| TC-31 | Vegetated Buffer Strip |
| TC-32 | Bioretention |
| TC-40 | Media Filter |
| TC-50 | Water Quality Inlet |
| TC-60 | Multiple Systems |
| **Manufactured (Proprietary)** | |
| MP-20 | Wetland |
| MP-40 | Media Filter |
| MP-50 | Wet Vault |
| MP-51 | Vortex Separator |
| MP-52 | Drain Inlet |

## 4.2 Fact Sheet Format

A BMP fact sheet is a short document that gives pertinent maintenance and inspection information about a particular treatment control BMP. Typically, each fact sheet contains the information outlined in Figure 4-1. Completed fact sheets for each of the treatment control BMPs shown in Table 4-1 are provided in Section 4.3.

The fact sheets also contain side bar presentations with information on BMP maintenance concerns, objectives, and goals; targeted constituents; and removal effectiveness if known.

**TC-xx Example Maintenance Fact Sheet**

General Description

Inspection/Maintenance Considerations

Inspection Activities

Maintenance Activities

Additional Information

References

**Figure 4-1**
**Example Fact Sheet**



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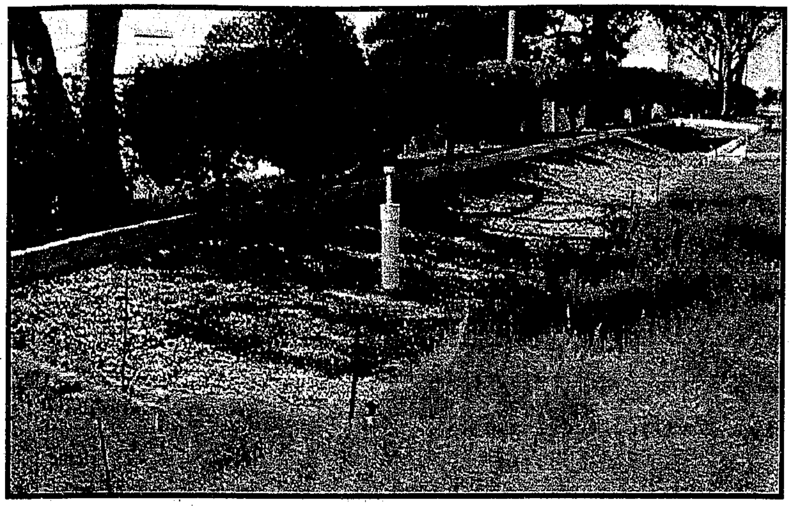
# 4.3 BMP Fact Sheets

Maintenance BMP fact sheets for public domain and manufactured BMPs follow. The BMP fact sheets are individually page numbered and are suitable for photocopying and inclusion in stormwater quality management plans. Fresh copies of the fact sheets can be individually downloaded from the California Stormwater BMP Handbook website at www.cabmphandbooks.com . As noted previously, the reader should refer to the New Development and Redevelopment BMP Handbook for details regarding BMP design, performance, and installation. In addition to the references at the end of each fact sheet, the 1993 version of the California Stormwater BMP Handbook was used as a general reference and starting point for the preparation of the maintenance fact sheets that follow.

In addition, it is worth noting that there are numerous proprietary treatment control devices available. Manufacturers typically have recommended inspection schedules and maintenance requirements for each device. If your facility utilizes proprietary treatment control devices for stormwater runoff, a maintenance agreement and detailed maintenance plan should be developed to ensure that they are well maintained, and operate according to design specifications. For many manufactured devices, municipalities can contract with the manufacturer or representative to provide maintenance services.

# Infiltration Trench





### Maintenance Concerns, Objectives, and Goals

- Accumulation of Metals
- Clogged Soil Outlet Structures
- Vegetation/Landscape Maintenance

### Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ■ |
| ☑ | Nutrients | ■ |
| ☑ | Trash | ■ |
| ☑ | Metals | ■ |
| ☑ | Bacteria | ■ |
| ☑ | Oil and Grease | ■ |
| ☑ | Organics | ■ |
| ☑ | Oxygen Demanding | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

## General Description

An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Pretreatment using buffer strips, swales, or detention basins is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective.

## Inspection/Maintenance Considerations

Frequency of clogging is dependant on effectiveness of pretreatment, such as vegetated buffer strips, at removing sediments. See appropriate maintenance factsheets for associated pretreatment. If the trench clogs, it may be necessary to remove and replace all or part of the filter fabric and possibly the coarse aggregate. Clogged infiltration trenches with surface standing water can become a nuisance due to mosquito breeding. Maintenance efforts associated with infiltration trenches should include frequent inspections to ensure that water infiltrates into the subsurface completely at a recommended infiltration rate of 72 hours or less to prevent creating mosquito and other vector habitats. Most of the maintenance should be concentrated on the pretreatment practices, such as buffer strips and swales upstream of the trench to ensure that sediment does not reach the infiltration trench. Regular inspection should determine if the sediment removal structures require routine maintenance. Infiltration trenches should not be put into operation until the upstream tributary area is stabilized.

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after every major storm for the first few months to ensure proper functioning. Drain times should be observed to confirm that designed drain times has been achieved. | After construction |
| ■ Inspect facility for signs of wetness or damage to structures, signs of petroleum hydrocarbon contamination, standing water, trash and debris, sediment accumulation, slope stability, standing water, and material buildup.<br>■ Check for standing water or, if available, check observation wells following 3 days of dry weather to ensure proper drain time.<br>■ Inspect pretreatment devices and diversion structures for damage, sediment buildup, and structural damage. | Semi-annual and after extreme events |
| ■ Trenches with filter fabric should be inspected for sediment deposits by removing a small section of the top layer. If inspection indicates that the trench is partially or completely clogged, it should be restored to its design condition. | Annual |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Repair undercut and eroded areas at inflow and outflow structures.<br>■ Remove sediment, debris, and oil/grease from pretreatment devices and overflow structures. | Standard maintenance (as needed) |
| ■ Remove trash, debris, grass clippings, trees, and other large vegetation from the trench perimeter and dispose of properly.<br>■ Mow and trim vegetation to prevent establishment of woody vegetation, and for aesthetic and vector reasons. | Semi-annual, more often as needed |
| ■ Clean out sediment traps, forebays, inlet/outlet structures, overflow spillway, and trenches if necessary.<br>■ Remove grass clippings, leaves, and accumulated sediment from the surface of the trench. Replace first layer of aggregate and filter fabric if clogging appears only to be at the surface.<br>■ Clean trench when loss of infiltrative capacity is observed. If drawdown time is observed to have increased significantly over the design drawdown time, removal of sediment may be necessary. This is an expensive maintenance activity and the need for it can be minimized through prevention of upstream erosion. | Annual |
| ■ If bypass capability is available, it may be possible to regain the infiltration rate in the short term by providing an extended dry period.<br>■ Seed or sod to restore ground cover. | 5-year maintenance |
| ■ Total rehabilitation of the trench should be conducted to maintain storage capacity within 2/3 of the design treatment volume and 72-hour exfiltration rate limit.<br>■ Trench walls should be excavated to expose clean soil.<br>■ All of the stone aggregate and filter fabric or media must be removed. Accumulated sediment should be stripped from the trench bottom. At this point the bottom may be scarified or tilled to help induce infiltration. New fabric and clean stone aggregate should be refilled. | Upon failure |



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## Additional Information

Infiltration practices have historically had a high rate of failure compared to other stormwater management practices. One study conducted in Prince George's County, Maryland (Galli, 1992), revealed that less than half of the infiltration trenches investigated (of about 50) were still functioning properly, and less than one-third still functioned properly after 5 years. Many of these practices, however, did not incorporate advanced pretreatment. By carefully selecting the location and improving the design features of infiltration practices, their performance should improve.

It is absolutely critical that settleable particles and floatable organic materials be removed from runoff water before it enters the infiltration trench. The trench will clog and become nonfunctional if excessive particulate matter is allowed to enter the trench.

Cold climate considerations – see http://www.cwp.org/cold-climates.htm

## References

EPA, Stormwater Technology Fact Sheet - Infiltration Trench. EPA 832-F-99-019. September, 1999.

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

Michigan Department of Environmental Quality. Infiltration Trench Factsheet. Available at: http://www.deq.state.mi.us/documents/deq-swq-nps-it.pdf

Montgomery County Department of Environmental Protection. Maintaining Urban Stormwater Facilities - A Guidebook for Common Ownership Communities. Available at: http://www.montgomerycountymd.gov/mc/services/dep/Stormwater/maintain.htm

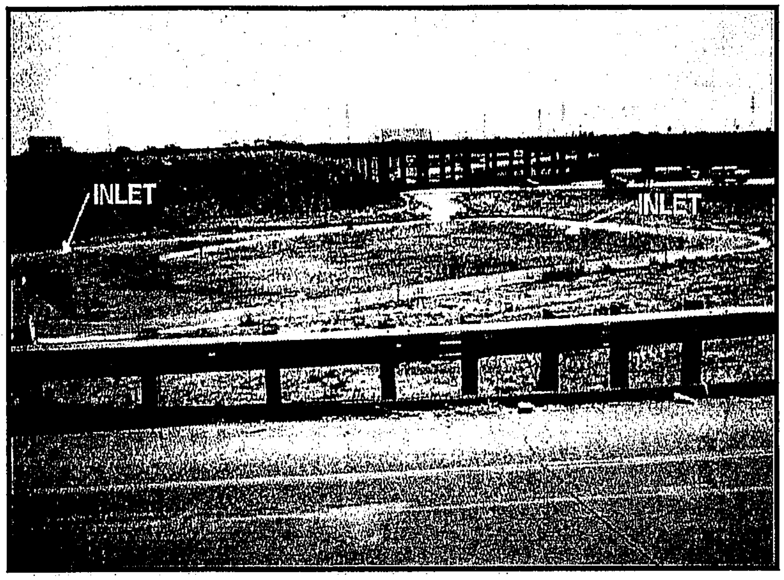
Stormwater Managers Resource Center, Manual Builder. Available at: http://www.stormwatercenter.net/intro_manual.htm

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

U.S. Department of Agriculture, Natural Resources Conservation Service. Illinois Urban Manual: A Technical Manual Designed for Urban Ecosystem Protection and Enhancement, 1995.

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.




## Maintenance Concerns, Objectives, and Goals

- Vector Control
- Clogged soil or outlet structures
- Vegetation/Landscape Maintenance
- Groundwater contamination
- Accumulation of metals
- Aesthetics

## Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ■ |
| ☑ | Nutrients | ■ |
| ☑ | Trash | ■ |
| ☑ | Metals | ■ |
| ☑ | Bacteria | ■ |
| ☑ | Oil and Grease | ■ |
| ☑ | Organics | ■ |
| ☑ | Oxygen Demanding | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

## General Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually infiltrates into the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

## Inspection/Maintenance Considerations

Infiltration basins perform better in well-drained permeable soils. Infiltration basins in areas of low permeability can clog within a couple years, and require more frequent inspections and maintenance. The use and regular maintenance of pretreatment BMPs will significantly minimize maintenance requirements for the basin. Spill response procedures and controls should be implemented to prevent spills from reaching the infiltration system.

Scarification or other disturbance should only be performed when there are actual signs of clogging or significant loss of infiltrative capacity, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a light tractor. This BMP may require groundwater monitoring. Basins cannot be put into operation until the upstream tributary area is stabilized.

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Clogged infiltration basins with surface standing water can become a breeding area for mosquitoes and midges. Maintenance efforts associated with infiltration basins should include frequent inspections to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Observe drain time for a storm after completion or modification of the facility to confirm that the desired drain time has been obtained.<br>■ Newly established vegetation should be inspected several times to determine if any landscape maintenance (reseeding, irrigation, etc.) is necessary. | Post construction |
| ■ Inspect for the following issues: differential accumulation of sediment, signs of wetness or damage to structures, erosion of the basin floor, dead or dying grass on the bottom, condition of riprap, drain time, signs of petroleum hydrocarbon contamination, standing water, trash and debris, sediment accumulation, slope stability, pretreatment device condition | Semi-annual and after extreme events |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Factors responsible for clogging should be repaired immediately.<br>■ Weed once monthly during the first two growing seasons. | Post construction |
| ■ Stabilize eroded banks.<br>■ Repair undercut and eroded areas at inflow and outflow structures.<br>■ Maintain access to the basin for regular maintenance activities.<br>■ Mow as appropriate for vegetative cover species.<br>■ Monitor health of vegetation and replace as necessary.<br>■ Control mosquitoes as necessary.<br>■ Remove litter and debris from infiltration basin area as required. | Standard maintenance (as needed) |
| ■ Mow and remove grass clippings, litter, and debris.<br>■ Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.<br>■ Replant eroded or barren spots to prevent erosion and accumulation of sediment. | Semi-annual |
| ■ Scrape bottom and remove sediment when accumulated sediment reduces original infiltration rate by 25-50%. Restore original cross-section and infiltration rate. Properly dispose of sediment.<br>■ Seed or sod to restore ground cover.<br>■ Disc or otherwise aerate bottom.<br>■ Dethatch basin bottom. | 3-5 year maintenance |



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### Additional Information

In most cases, sediment from an infiltration basin does not contain toxins at levels posing a hazardous concern. Studies to date indicate that pond sediments are generally below toxicity limits and can be safely landfilled or disposed onsite. Onsite sediment disposal is always preferable (if local authorities permit) as long as the sediments are deposited away from the shoreline to prevent their reentry into the pond and away from recreation areas, where they could possibly be ingested by young children. Sediments should be tested for toxicants in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed. Sediments containing high levels of pollutants should be disposed of properly.

Light equipment, which will not compact the underlying soil, should be used to remove the top layer of sediment. The remaining soil should be tilled and revegetated as soon as possible.

Sediment removal within the basin should be performed when the sediment is dry enough so that it is cracked and readily separates from the basin floor. This also prevents smearing of the basin floor.

### References

King County, Stormwater Pollution Control Manual – Best Management Practices for Businesses. July, 1995 Available at: ftp://dnr metrokc.gov/wlr/dss/spcm/SPCM.HTM

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

# Retention/Irrigation TC-12

## General Description

Retention/irrigation refers to the capture of stormwater runoff in a holding pond and subsequent use of the captured volume for irrigation of landscape or natural pervious areas. This technology is very effective as a stormwater quality practice in that, for the captured water quality volume, it provides virtually no discharge to receiving waters and high stormwater constituent removal efficiencies. This technology mimics natural undeveloped watershed conditions wherein the vast majority of the rainfall volume during smaller rainfall events is infiltrated through the soil profile. Their main advantage over other infiltration technologies is the use of an irrigation system to spread the runoff over a larger area for infiltration. This allows them to be used in areas with low permeability soils.

Capture of stormwater can be accomplished in almost any kind of runoff storage facility, ranging from dry, concrete-lined ponds to those with vegetated basins and permanent pools. The pump and wet well should be automated with a rainfall sensor to provide irrigation only during periods when required infiltration rates can be realized. Generally, a spray irrigation system is required to provide an adequate flow rate for distributing the water quality volume (LCRA, 1998). Collection of roof runoff for subsequent use (rainwater harvesting) also qualifies as a retention/irrigation practice.

## Inspection/Maintenance Considerations

Pollutant removal rates are estimated to be nearly 100% for all pollutants in the captured and irrigated stormwater volume. However, relatively frequent inspection and maintenance is necessary to verify proper operation of these facilities.

### Maintenance Concerns, Objectives, and Goals

- Sediment Accumulation
- Mechanical malfunction
- Vector Control

### Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ■ |
| ☑ | Nutrients | ■ |
| ☑ | Trash | ■ |
| ☑ | Metals | ■ |
| ☑ | Bacteria | ■ |
| ☑ | Oil and Grease | ■ |
| ☑ | Organics | ■ |
| ☑ | Oxygen Demanding | ■ |

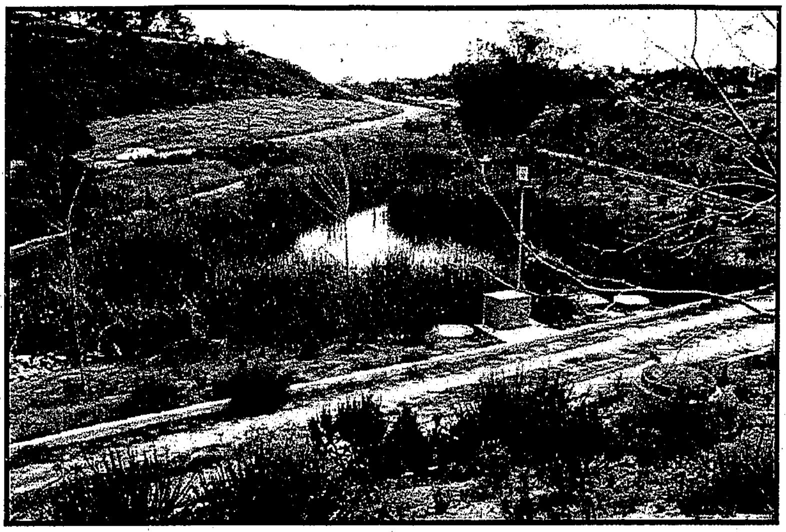
Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ The irrigation system should be inspected and tested (or observed while in operation) to verify proper operation multiple times annually. Two of these inspections should occur during or immediately following wet weather. Any leaks, broken spray heads, or other malfunctions with the irrigation system should be repaired immediately. | Frequently (3-6 times per year) |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ The upper stage, side slopes, and embankment of a retention basin must be mowed regularly to discourage woody growth and control weeds. | Frequently |
| ■ Remove sediment from inlet structure/sediment forebay, and from around the sump area at least 2 times annually or when depth reaches 3 inches. When sediment in other areas of the basin fills the volume allocated for sediment accumulation, all sediment should be removed and disposed of properly.<br>■ Grass areas in and around basins must be mowed at least twice annually to limit vegetation height to 18 inches. More frequent mowing to maintain aesthetic appeal may be necessary in landscaped areas. When mowing is performed, a mulching mower should be used, or grass clippings should be caught and removed.<br>■ Debris and litter will accumulate near the basin pump and should be removed during regular mowing operations and inspections. Particular attention should be paid to floating debris that can eventually clog the irrigation system. | Semi-annual |
| ■ The pond side slopes and embankment may periodically suffer from slumping and erosion, although this should not occur often if the soils are properly compacted during construction. Regrading and revegetation may be required to correct the problems. | Infrequently |



### Maintenance Concerns, Objectives, and Goals

- Vegetation/Landscape Maintenance
- Endangered Species Habitat Creation
- Pollutant Removal Efficiency
- Clogging of the Outlet
- Invasive/exotic Plant Species
- Vector Control

### Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ■ |
| ☑ | Nutrients | ▲ |
| ☑ | Trash | ■ |
| ☑ | Metals | ■ |
| ☑ | Bacteria | ■ |
| ☑ | Oil and Grease | ■ |
| ☑ | Organics | ■ |
| ☑ | Oxygen Demanding | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

## General Description

Wet ponds (a.k.a. stormwater ponds, retention ponds, wet extended detention ponds) are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from constructed wetlands primarily in having a greater average depth. Ponds treat incoming stormwater runoff by settling and biological uptake. The primary removal mechanism is settling as stormwater runoff resides in this pool, but pollutant uptake, particularly of nutrients, also occurs to some degree through biological activity in the pond. Wet ponds are among the most widely used stormwater practices. While there are several different versions of the wet pond design, the most common modification is the extended detention wet pond, where storage is provided above the permanent pool in order to detain stormwater runoff and promote settling. The schematic diagram is of an on-line pond that includes detention for larger events, but this is not required in all areas of the state.

## Inspection/Maintenance Considerations

In order to maintain the pond's design capacity, sediment must be removed occasionally and adequate resources must be committed to properly maintain peripheral aquatic vegetation, control vector production, and to maintain effective pool volume. Wet ponds can become a nuisance due to mosquito and midge breeding unless carefully designed and maintained. A proactive and routine preventative maintenance plan (which can vary according to location) is crucial to minimizing vector habitat. A vegetated buffer should be preserved around the pond to protect the banks from erosion and provide some pollutant removal before runoff enters the pond by overland flow.

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after several storm events to confirm that the drainage system functions, and bank stability and vegetation growth are sufficient. | Post construction |
| ■ Inspect for invasive vegetation, trash and debris, clogging of inlet/outlet structures, excessive erosion, sediment buildup in basin or outlet, cracking or settling of the dam, bank stability, tree growth on dam or embankment, vigor and density of the grass turf on the basin side slopes and floor, differential settlement, leakage, subsidence, damage to the emergency spillway, mechanical component condition, and graffiti. | Semi-annual, after significant storms, or more frequent as needed |
| ■ Inspect condition of inlet and outlet structures, pipes, sediment forebays, basin, and upstream and downstream channel conditions. Monitor drain times, and check for algal growth, signs of pollution such as oil sheens, discolored water, or unpleasant odors, and signs of flooding. | Annual inspection |
| ■ During inspections, note changes to the wet pond or the contributing watershed as these may affect basin performance. | |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Introduce mosquito fish, *Gambusia* spp., (where permitted by the Department of Fish and Game or other agency regulations) to enhance natural mosquito and midge control and regularly maintain emergent and shoreline vegetation to provide access for vector inspectors and facilitate vector control if needed. | Post construction |
| ■ Perform vector control, if necessary.<br>■ Remove sediment from outlet structure. Dispose of properly.<br>■ Remove accumulated trash and debris in the basin, inlet/outlet structures, side slopes, and collection system as required.<br>■ Repair undercut areas and erosion to banks and basin. | Semi annual, after significant storm events |
| ■ Maintain protected vegetated buffer around pond. Mow side slopes and maintain vegetation in and around basin to prevent any erosion or aesthetic problems. Minimize use of fertilizers and pesticides. Reseed if necessary.<br>■ Manage and harvest wetland plants.<br>■ Structural repair or replacement, as needed. | Annual maintenance (if needed) |
| ■ Remove sediment from the forebay and regrade when the accumulated sediment volume exceeds 10-20% of the forebay volume. Clean in early spring so vegetation damaged during cleaning has time to re-establish. | 5- to 7-year maintenance |
| ■ Remove sediment when the permanent pool volume has become reduced significantly (sediment accumulation exceeds 25% of design depth), resuspension is observed, or the pond becomes eutrophic. | >5 year maintenance |

## Additional Information

In most cases, sediment from wet ponds do not contain toxins at levels posing a hazardous concern. Studies to date indicate that pond sediments are generally below toxicity limits and can be safely landfilled or disposed onsite. Onsite sediment disposal is always preferable (if local authorities permit) as long as the sediments are deposited away from the shoreline to prevent their reentry into the pond and away from recreation areas, where they could possibly be ingested by young children.

Sediments should be tested for toxicants in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed. Sediments containing high levels of pollutants should be disposed of properly.

For the best water quality benefit, the pond should hold water for at least 24 hours. It should drain down to the permanent water level within 72 hours of a storm event to avoid conditions which might increase water temperatures, deplete oxygen, promote vector growth, and/or cause odors.

## References

King County, Stormwater Pollution Control Manual – Best Management Practices for Businesses. July, 1995 Available at: ftp://dnr.metrokc.gov/wlr/dss/spcm/SPCM.HTM

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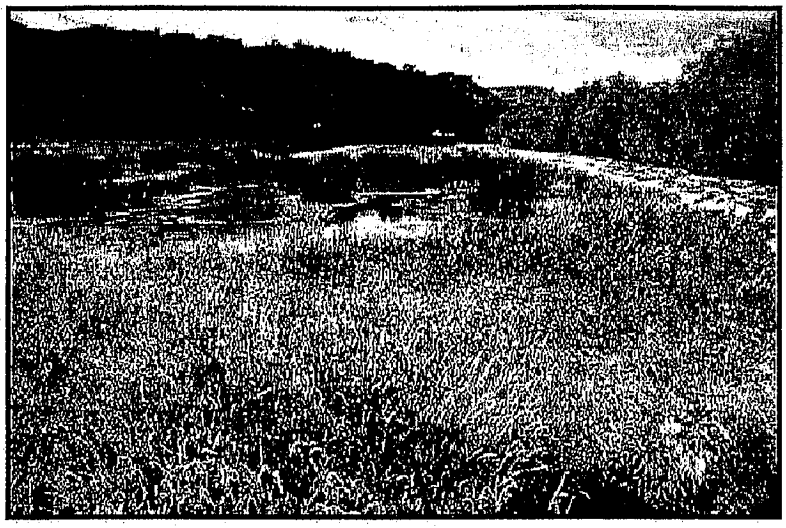

**Maintenance Concerns, Objectives, and Goals**

- Vector/Pest Control
- Sediment and Trash Removal
- Vegetation/Landscape Maintenance
- Invasive Species Management
- Bank Erosion
- Nutrient Release During Winter
- Clogging of the Outlet

**Targeted Constituents**

| | | |
|---|---|---|
| ☑ | Sediment | ■ |
| ☑ | Nutrients | ▲ |
| ☑ | Trash | ■ |
| ☑ | Metals | ■ |
| ☑ | Bacteria | ■ |
| ☑ | Oil and Grease | ■ |
| ☑ | Organics | ■ |
| ☑ | Oxygen Demanding | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

## General Description

Constructed wetlands are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from wet ponds primarily in being shallower and having greater vegetation coverage.

A distinction should be made between using a constructed wetland for storm water management and diverting storm water into a natural wetland. The latter practice is not recommended and in all circumstances, natural wetlands should be protected from the adverse effects of development, including impacts from increased storm water runoff. This is especially important because natural wetlands provide storm water and flood control benefits on a regional scale.

Wetlands are among the most effective stormwater practices in terms of pollutant removal and they also offer aesthetic value. As stormwater runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake within the wetland. Flow through the root systems forces the vegetation to remove nutrients and dissolved pollutants from the stormwater.

## Inspection/Maintenance Considerations

Wetlands need a continuous base flow to maintain aquatic plants. Salts and scum can accumulate in wetlands and, unless properly designed and managed, can be flushed out during larger storms. Wetlands can also release nutrients during the non-growing season. Wetlands can become a breeding area for mosquitoes and midges unless carefully designed and maintained. A proactive and routine preventative maintenance plan (which can vary according to location) is crucial to minimizing vector habitat.

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To maximize wetland removal of pollutants, the vegetation must be harvested frequently. Harvesting is particularly important with respect to the removal of phosphorus and metals, less so for nitrogen. Harvesting should occur by mid-summer before the plants begin to transfer phosphorus from the aboveground foliage to subsurface roots, or begin to lose metals that desorb during plant die off. While not stated by the manufacturer, it is also desirable that every few years the entire plant mass including roots be harvested. This is because the below-ground biomass constitutes a significant reservoir (possibly half) of the nutrients and metals that are removed from the stormwater by plants (Minton, 2002).

If pretreatment is provided then maintenance consideration must be given to the build up of debris and floatables.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after several storm events for bank stability, vegetation growth, drainage system functioning, and structural damage. | After construction |
| ■ Inspect for invasive vegetation, differential settlement, cracking; erosion, leakage, or tree growth on the embankment; the condition of the riprap in the inlet, outlet, and pilot channels; sediment accumulation in the basin; clogging of outlet; and the vigor and density of the vegetation on the basin side slopes and floor. Correct observed problems as necessary. | Semi-annual inspection |
| ■ Inspect for damage to the embankment and inlet/outlet structures. Repair as necessary.<br>■ Note signs of hydrocarbon buildup such as floating oil on water surface.<br>■ Monitor for sediment accumulation in the facility and forebay.<br>■ Examine inlet and outlet devices to ensure they are free of debris and are operational. | Annual inspection |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Replace wetland vegetation to maintain at least 50% surface area coverage in wetland plants after the second growing season. | One-time |
| ■ Repair undercut areas, erosion to banks, and bottom as required.<br>■ Where permitted by the Department of Fish and Game or other agency regulations, stock constructed wetlands regularly with mosquito fish (*Gambusia* spp.) to enhance natural mosquito and midge control | As needed maintenance |
| ■ Clean and remove debris from inlet and outlet structures.<br>■ Mow side slopes and remove grass clippings.<br>■ Remove litter and debris from banks, basin bottom, trash racks, outlet structures, and valves as required. | Frequent (3-4 times/year) maintenance |
| ■ Supplement wetland plants if a significant portion have not established (at least 50% of the surface area).<br>■ Remove nuisance plant species. | Annual maintenance (if needed) |
| ■ Clean forebay to avoid accumulation in main wetland area to minimize when the main wetland area needs to be cleaned. | 5- to 7-year maintenance |
| ■ Harvest plant species if vegetation becomes too thick causing flow backup and flooding. More frequent plant harvesting may be required by local vector control agencies. | 5- to 7-year maintenance (or more frequently as required) |
| ■ Monitor sediment accumulations, and remove sediment when the accumulated sediment volume exceeds 10-20% of the basin volume, plants are "choked" with sediment, or the wetland becomes eutrophic. It is suggested that the main area be cleaned one half at a time with at least one growing season in between cleanings. This will help to preserve the vegetation and enable the wetland to recover more quickly from the cleaning. | As needed maintenance (20- to 50-years) |

### Additional Information

The following observations should be made during the inspections:

- Type and distribution of dominant wetland plants in the marsh
- The presence and distribution of planted wetland species
- The presence and distribution of invasive wetland species
- Signs that invasive species are replacing the planted wetland species
- Percentage of unvegetated standing water (excluding the deep water cells which are not suitable for emergent plant growth)
- The maximum elevation and the vegetative condition in this zone, if the design elevation of the normal pool is being maintained for wetlands with extended zones
- Stability of the original depth zones and the microtopographic features, accumulation of sediment in the forebay and micropool, and survival rate of plants in the wetland buffer.

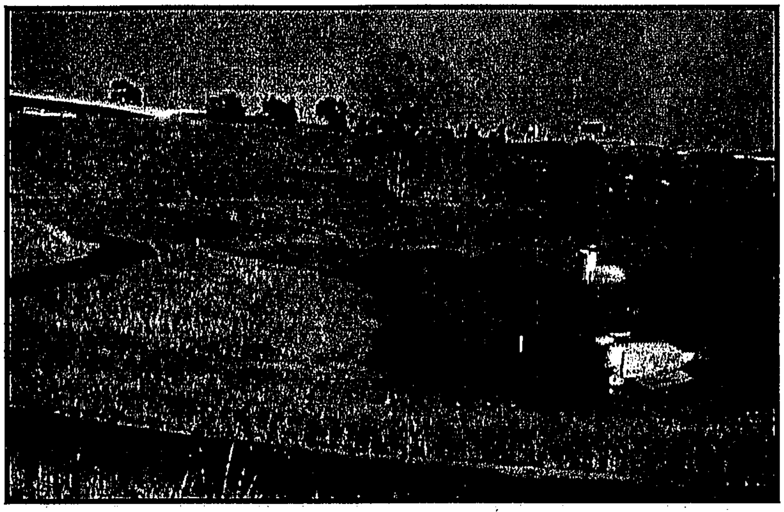
### References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

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

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.



## Maintenance Concerns, Objectives, and Goals

- Vector/Pest Control
- Sediment and Trash Removal
- Vegetation/Landscape Maintenance
- Re-suspension of settled material
- Clogging of the Outlet

## General Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 72 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

## Inspection/Maintenance Considerations

Inspections should be conducted semi-annually and after significant storm events to identify potential problems early. Most maintenance efforts will need to be directed toward vegetation management and vector control, which may focus on basic housekeeping practices such as removal of debris accumulations and vegetation management to ensure that the basin dewaters completely (recommended 72 hour residence time or less) to prevent creating mosquito and other vector habitats.

## Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ▲ |
| ☑ | Nutrients | ● |
| ☑ | Trash | ■ |
| ☑ | Metals | ▲ |
| ☑ | Bacteria | ▲ |
| ☑ | Oil and Grease | ▲ |
| ☑ | Organics | ▲ |
| ☑ | Oxygen Demanding | ▲ |

**Legend** *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after several storm events for bank stability, vegetation growth, and to determine if the desired residence time has been achieved.<br>■ Inspect outlet structure for evidence of clogging or outflow release velocities that are greater than design flow. | Post construction |
| ■ Inspect for the following issues: differential settlement, cracking; erosion of pond banks or bottom, leakage, or tree growth on the embankment; the condition of the riprap in the inlet, clogging of outlet and pilot channels; standing water, slope stability, presence of burrows; sediment accumulation in the basin, forebay, and outlet structures; trash and debris, and the vigor and density of the grass turf on the basin side slopes and floor. | Semi-annual, after significant storms, or more frequent |
| ■ Inspect for the following issues: subsidence, damage to the emergency spillway; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel, accumulated sediment volume, and semi-annual inspection items. | Annual |
| ■ During inspections, changes to the extended storage pond or the contributing watershed should be noted, as these may affect basin performance. | Annual inspection |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ If necessary, modify the outlet orifice to achieve design values if inspection indicates modifications are necessary.<br>■ Repair undercut or eroded areas.<br>■ Mow side slopes.<br>■ Manage pesticide and nutrients.<br>■ Remove litter and debris.<br>■ Control vectors as necessary. | As needed |
| ■ Remove accumulated trash and debris from the basin, around the riser pipe, side slopes, embankment, emergency spillway, and outflow trash racks. The frequency of this activity may be altered to meet specific site conditions.<br>■ Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons. | Semi-annual, or more frequent, as needed |
| ■ Seed or sod to restore dead or damaged ground cover.<br>■ Repair erosion to banks and bottom as required. | Annual maintenance (as needed) |
| ■ Supplement wetland plants if a significant portion have not been established (at least 50% of the surface area).<br>■ Remove nuisance plant species. | Annual maintenance (if needed) |
| ■ Remove sediment from the forebay to reduce frequency of main basin cleaning. | 3- to 5-year maintenance |
| ■ Monitor sediment accumulation and remove accumulated sediment and regrade about every 10 years or when the accumulated sediment volume exceeds 10-20% of the basin volume, or when accumulation reaches 6 inches or if resuspension is observed. Clean in early spring so vegetation damaged during cleaning has time to re-establish. | Every 10-25 years |



A003131

### Additional Information

In most cases, sediment from extended detention basin does not contain toxins at levels posing a hazardous concern. Studies to date indicate that pond sediments are likely to meet toxicity limits and can be safely landfilled or disposed of onsite. Onsite sediment disposal is always preferable (if local authorities permit it) as long as the sediments are deposited away from the shoreline to prevent their re-entry into the pond.

Sediments should be tested for toxin in compliance with current disposal requirements if land uses in the catchment include commercial or industrial zones, or if visual or olfactory indications of pollution are noticed.

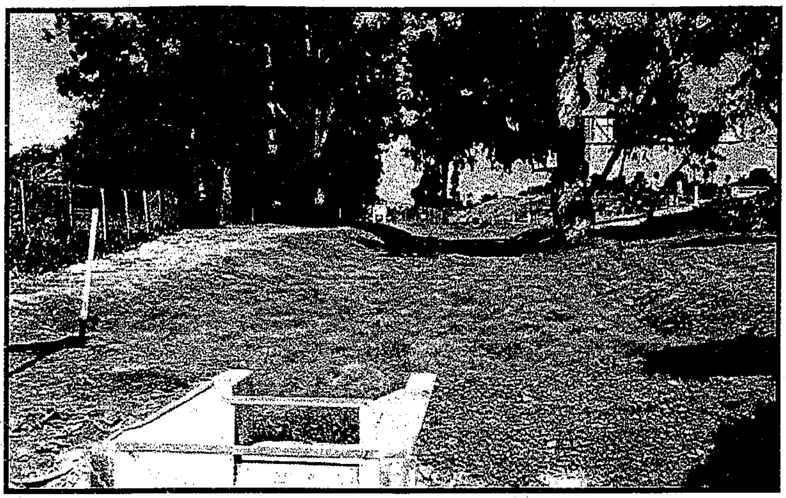
### References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

# Vegetated Swale **TC-30**



### Maintenance Concerns, Objectives, and Goals

- Channelization
- Vegetation/Landscape Maintenance
- Vector Control
- Aesthetics
- Hydraulic and Removal Efficacy

### Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ▲ |
| ☑ | Nutrients | ● |
| ☑ | Trash | ● |
| ☑ | Metals | ▲ |
| ☑ | Bacteria | ● |
| ☑ | Oil and Grease | ▲ |
| ☑ | Organics | ▲ |
| ☑ | Oxygen Demanding | ▲ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

## General Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems. Therefore, swales are best suited for residential, industrial, and commercial areas with low flow and smaller populations.

## Inspection/Maintenance Considerations

It is important to consider that a thick vegetative cover is needed for vegetated swales to function properly. Usually, swales require little more than normal landscape maintenance activities such as irrigation and mowing to maintain pollutant removal efficiency. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g., debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained. The application of fertilizers and pesticides should be minimized.

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after seeding and after first major storms for any damages. | Post construction |
| ■ Inspect for signs of erosion, damage to vegetation, channelization of flow, debris and litter, and areas of sediment accumulation. Perform inspections at the beginning and end of the wet season. Additional inspections after periods of heavy runoff are desirable. | Semi-annual |
| ■ Inspect level spreader for clogging, grass along side slopes for erosion and formation of rills or gullies, and sand/soil bed for erosion problems. | Annual |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Mow grass to maintain a height of 3–4 inches, for safety, aesthetic, or other purposes. Litter should always be removed prior to mowing. Clippings should be composted.<br>■ Irrigate swale during dry season (April through October) or when necessary to maintain the vegetation.<br>■ Provide weed control, if necessary to control invasive species. | As needed (frequent, seasonally) |
| ■ Remove litter, branches, rocks blockages, and other debris and dispose of properly.<br>■ Maintain inlet flow spreader (if applicable).<br>■ Repair any damaged areas within a channel identified during inspections. Erosion rills or gullies should be corrected as needed. Bare areas should be replanted as necessary. | Semi-annual |
| ■ Declog the pea gravel diaphragm, if necessary.<br>■ Correct erosion problems in the sand/soil bed of dry swales.<br>■ Plant an alternative grass species if the original grass cover has not been successfully established. Reseed and apply mulch to damaged areas. | Annual (as needed) |
| ■ Remove all accumulated sediment that may obstruct flow through the swale. Sediment accumulating near culverts and in channels should be removed when it builds up to 3 in. at any spot, or covers vegetation, or once it has accumulated to 10% of the original design volume. Replace the grass areas damaged in the process.<br>■ Rototill or cultivate the surface of the sand/soil bed of dry swales if the swale does not draw down within 48 hours. | As needed (infrequent) |

## Additional Information

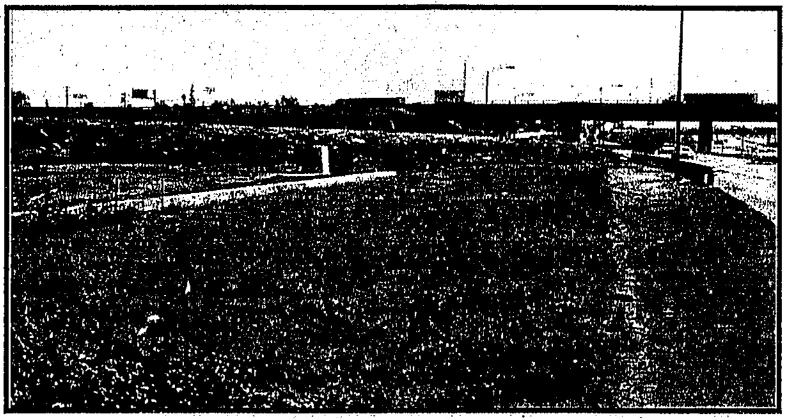
Recent research (Colwell et al., 2000) indicates that grass height and mowing frequency have little impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.



**Maintenance Concerns, Objectives, and Goals**

- Clogged Soil or Outlet Structures
- Invasive Species Management
- Vegetation/Landscape Maintenance
- Erosion
- Channelization of Flow
- Aesthetics

## General Description

Grassed buffer strips (vegetated filter strips, filter strips, and grassed filters) are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and allowing sediment and other pollutants to settle and by providing some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice and have more recently evolved into an urban practice. With proper design and maintenance, filter strips can provide relatively high pollutant removal. In addition, the public views them as landscaped amenities and not as stormwater infrastructure. Consequently, there is little resistance to their use.

## Inspection/Maintenance Considerations

Vegetated buffer strips require frequent landscape maintenance. In many cases, vegetated buffer strips initially require intense maintenance, but less maintenance is needed over time. In many cases, maintenance tasks can be completed by a landscaping contractor. Maintenance requirements typically include grass or shrub-growing activities such as irrigation, mowing, trimming, removal of invasive species, and replanting when necessary. Buffer strips require more tending as the volume of sediment increases. Vegetated buffer strips can become a nuisance due to mosquito breeding in level spreaders (unless designed to dewater completely in 72 hours or less) and/or if proper drainage slopes are not maintained.

**Targeted Constituents**

| | | |
|---|---|---|
| ☑ | Sediment | ■ |
| ☑ | Nutrients | ● |
| ☑ | Trash | ▲ |
| ☑ | Metals | ■ |
| ☑ | Bacteria | ● |
| ☑ | Oil and Grease | ■ |
| ☑ | Organics | ▲ |
| ☑ | Oxygen Demanding | ▲ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Once the vegetated buffer strip is established, inspect at least three times per year. Repair all damage immediately.<br>Inspect buffer strips after seeding and repair as needed. | Post construction |
| ■ Inspect buffer strip and repair all damage immediately.<br>■ Inspect soil and repair eroded areas. | After major storms |
| ■ Inspect for erosion or damage to vegetation, preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the strips are ready for winter. However, additional inspection after periods of heavy runoff is desirable.<br>■ Inspect pea-gravel diaphragm/level spreader for clogging and effectiveness and remove built-up sediment.<br>■ Inspect for rolls and gullies. Immediately fill with topsoil, install erosion control blanket and seed or sod.<br>■ Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket.<br>■ Check for debris and litter, and areas of sediment accumulation. | Semi-annual |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Water plants daily for 2 weeks after construction. | Post construction |
| ■ Mow regularly to maintain vegetation height between 2 - 4 inches, and to promote thick, dense vegetative growth. Cut only when soil is dry to prevent tracking damage to vegetation, soil compaction and flow concentrations. Clippings are to be removed immediately after mowing.<br>■ Remove all litter, branches, rocks, or other debris. Damaged areas of the filter strip should be repaired immediately by reseeding and applying mulch.<br>■ Regularly maintain inlet flow spreader.<br>■ Irrigate during dry season (April through October) when necessary to maintain the vegetation. | Frequently, as needed |
| ■ Remulch void areas.<br>■ Treat diseased trees and shrubs, remove dead vegetation. | Semi-annual |
| ■ Remove sediment and replant in areas of buildup. Sediment accumulating near culverts and in channels should be removed when it builds up to 3 in. at any spot, or covers vegetation.<br>■ Limit fertilizer applications based on plant vigor and soil test results.<br>■ Rework or replant buffer strip if concentrated flow erodes a channel through the strip. | Annual |



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## Additional Information

Recent research (Colwell et al., 2000) indicates that grass height and mowing frequency have little impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

## Maintenance Concerns, Objectives, and Goals

- Clogged Soil or Outlet Structures
- Invasive Species
- Vegetation/Landscape Maintenance
- Erosion
- Channelization of Flow
- Aesthetics

## Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ■ |
| ☑ | Nutrients | ▲ |
| ☑ | Trash | ■ |
| ☑ | Metals | ■ |
| ☑ | Bacteria | ■ |
| ☑ | Oil and Grease | ■ |
| ☑ | Organics | ■ |
| ☑ | Oxygen Demanding | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

## General Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through a sand bed and is subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

## Inspection/Maintenance Considerations

Bioretention requires frequent landscaping maintenance, including measures to ensure that the area is functioning properly, as well as maintenance of the landscaping on the practice. In many cases, bioretention areas initially require intense maintenance, but less maintenance is needed over time. In many cases, maintenance tasks can be completed by a landscaping contractor, who may already be hired at the site. In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect soil and repair eroded areas. | Monthly |
| ■ Inspect for erosion or damage to vegetation, preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the strips are ready for winter. However, additional inspection after periods of heavy runoff is desirable. | Semi-annual inspection |
| ■ Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket. | |
| ■ Check for debris and litter, and areas of sediment accumulation. | |
| ■ Inspect health of trees and shrubs. | |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Water plants daily for 2 weeks. | At project completion |
| ■ Remove litter and debris. | Monthly |
| ■ Remove sediment. | As needed |
| ■ Remulch void areas. | |
| ■ Treat diseased trees and shrubs. | |
| ■ Mow turf areas. | |
| ■ Repair erosion at inflow points. | |
| ■ Repair outflow structures. | |
| ■ Unclog underdrain. | |
| ■ Regulate soil pH regulation. | |
| ■ Remove and replace dead and diseased vegetation. | Semi-annual |
| ■ Add mulch. | Annual |
| ■ Replace tree stakes and wires. | |
| ■ Mulch should be replaced every 2 to 3 years or when bare spots appear. Remulch prior to the wet season. | Every 2-3 years, or as needed |

## Additional Information

Landscaping is critical to the function and aesthetic value of bioretention areas. It is preferable to plant the area with native vegetation, or plants that provide habitat value, where possible. Another important design feature is to select species that can withstand the hydrologic regime they will experience. At the bottom of the bioretention facility, plants that tolerate both wet and dry conditions are preferable. At the edges, which will remain primarily dry, upland species will be the most resilient. It is best to select a combination of trees, shrubs, and herbaceous materials.

## References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

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

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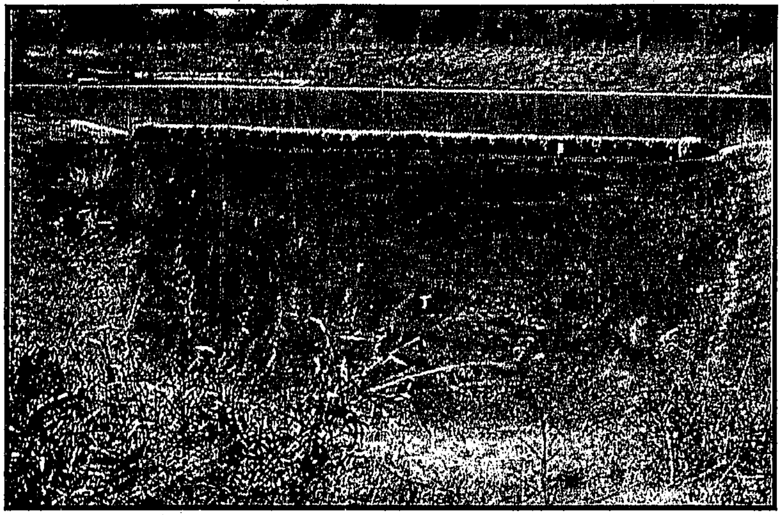

## Maintenance Concerns, Objectives, and Goals

- Pollutant Breakthrough
- Clogged of Sand Media
- Trash and Debris Accumulation

## Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ■ |
| ☑ | Nutrients | ● |
| ☑ | Trash | ■ |
| ☑ | Metals | ■ |
| ☑ | Bacteria | ▲ |
| ☑ | Oil and Grease | ■ |
| ☑ | Organics | ■ |
| ☑ | Oxygen Demanding | ■ |

**Legend** ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

## General Description

Stormwater media filters are usually two-chambered including a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as stormwater flows through the filtering media in the second chamber. There are a number of design variations including the Austin sand filter, Delaware sand filter, and multi-chambered treatment train (MCTT).

## Inspection/Maintenance Considerations

Media filters may exhibit decreased effectiveness after a few years of operation, depending on the activities occurring in the drainage area. Media filters clog easily when subjected to high sediment loads. Sediment reducing pretreatment practices, such as vegetated buffer strips or vegetated swales, placed upstream of the filter should be maintained properly to reduce sediment loads into filter. Media filters can become a nuisance due to mosquito or midge breeding if not properly designed and maintained. Installations should dewater completely (recommended 72 hour or less residence time) to prevent creating mosquito and other vector habitats. Maintenance efforts will need to focus on basic housekeeping practices such as removal of debris accumulations and vegetation management (in filter media) to prevent clogs and/or pods of standing water. To minimize the potential for clogging, frequent maintenance and inspection practices are required. Waste sand, gravel, filter cloth, or filter media must be disposed of properly and in accordance with all applicable laws.

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ During the first year of operation, inspect chambers quarterly to ensure that the system is functioning properly.<br>■ Inspect sand filters after every major storm in the first few months after construction to ensure that the system is functioning properly. | Post construction |
| ■ Ensure that filter surface, inlets, and outlets are clear of debris.<br>■ Ensure that the contributing area is stabilized and mowed, with clippings removed.<br>■ Check to ensure that the filter surface is not clogging.<br>■ Ensure that activities in the drainage area minimize oil/grease and sediment entry to the system.<br>■ Inspect the facility once during the wet season after a large rain event to determine whether the facility is draining completely within 72 hr. | Quarterly, and after major storms |
| ■ Inspect for standing water, sediment, trash and debris, structural damage, and to identify potential problems. | Semi-annual |
| ■ Check to see that the filter bed is clean of sediments and the sediment chamber contains no more than six inches of sediment.<br>■ Make sure that there is no evidence of deterioration of concrete structures.<br>■ Inspect grates (if used).<br>■ Inspect inlets, outlets, and overflow spillway to ensure good condition and no evidence of erosion.<br>■ Ensure that flow is not bypassing the facility.<br>■ Ensure that no noticeable odors are detected outside the facility. | Annual |

| Maintenance Activities | Suggested Frequency |
|---|---|
| ■ Remove trash and debris from the sedimentation basin (Austin design), the riser pipe, and the filter bed as needed.<br>■ Prevent grass clippings from washing into the filter.<br>■ Remove trash from inlet grates to maintain the inflow capacity of the media filter.<br>■ Upstream vegetation should be maintained as needed. | Frequently (as needed) |
| ■ Clean filter surface semiannually; or more often if watershed is excessively erosive.<br>■ Replace sorbent pillows (Multi-Chamber Treatment Train only). | Semi-annual |
| ■ Repair or replace any damaged structural parts.<br>■ Stabilize any eroded areas. | Annual |
| ■ Remove accumulated sediment in the sedimentation chamber every 10 years or when the sediment occupies 10-20% of the basin volume or accumulates to a depth of six inches, whichever is less.<br>■ Remove top 2 in. of media filter and landfill if facility drain time exceeds 72 hr. Restore media depth to 18 in. when overall media depth drops to 12 in.). | As needed |



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**References**

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: http://www.cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

# Water Quality Inlet TC-50

## General Description

Water quality inlets (WQIs), also commonly called trapping catch basins, oil/grit separators or oil/water separators, consist of one or more chambers that promote sedimentation of coarse materials and separation of free oil (as opposed to emulsified or dissolved oil) from stormwater. Some WQIs also contain screens to help retain larger or floating debris, and many of the newer designs also include a coalescing unit that helps promote oil/water separation.

These devices are appropriate for capturing hydrocarbon spills, but provide very marginal sediment removal and are not very effective for treatment of stormwater runoff. WQIs typically capture only the first portion of runoff for treatment and are generally used for pretreatment before discharging to other best management practices (BMPs).

## Inspection/Maintenance Considerations

High sediment loads can interfere with the ability of the WQI to effectively separate oil and grease from the runoff. During periods of high flow, sediment can be resuspended and released from the WQI into surface waters. Maintenance of WQIs can be easily neglected because they are underground. Establishment of a maintenance schedule is helpful for ensuring proper maintenance occurs. The required maintenance effort will be site-specific due to variations in sediment and hydrocarbon loading. Since WQI residuals contain hydrocarbon by-products, they may require disposal as hazardous waste. Many WQI owners coordinate with waste haulers to collect and dispose of these residuals.

### Maintenance Concerns, Objectives, and Goals

- High Sediment Loads
- Hazardous Waste
- Vector Control

### Targeted Constituents

| | | |
|---|---|---|
| ☑ | Sediment | ● |
| ☑ | Nutrients | ● |
| ☑ | Trash | ▲ |
| ☑ | Metals | ● |
| ☑ | Bacteria | ● |
| ☑ | Oil and Grease | ▲ |
| ☑ | Organics | ● |
| ☑ | Oxygen Demanding | ● |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Inspect after every storm event to determine if maintenance is required. | Monthly during the wet season, or after significant rain events |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Clean out and dispose of accumulated oil, grease, and sediments. Remove accumulated trash and debris. The clean out and disposal techniques should be environmentally acceptable and in accordance with local regulations. | Annual, before the wet season, or more frequent as needed |

## Additional Information

Since WQIs can be relatively deep, they may be designated as confined spaces. Caution should be exercised to comply with confined space entry safety regulations if it is required.

## References

http://www.co.pierce.wa.us/pc/services/home/environ/water/swm/sppman/bmptl.htm



A003146

# Multiple Systems

# TC-60

## General Description

A multiple treatment system uses two or more BMPs in series. Some examples of multiple systems include: settling basin combined with a sand filter; settling basin or biofilter combined with an infiltration basin or trench; extended detention zone on a wet pond.

## Inspection/Maintenance Considerations

Each of the separate treatment processes will require maintenance as described in the previous fact sheets. For example, multiple system comprises of a biofilter combined with an infiltration basin would require the inspection and maintenance considerations outlined on the fact sheet for each process.

| Inspection Activities | Suggested Frequency |
|---|---|
| ■ Refer to individual treatment control factsheets | As needed |
| **Maintenance Activities** | **Suggested Frequency** |
| ■ Refer to individual treatment control factsheets | As needed |

### Maintenance Concerns, Objectives, and Goals

May include the following:

- Accumulation of Metals
- Aesthetics
- Channelization of Flow
- Clogging of the Outlet
- Endangered Species Habitat Creation
- Erosion
- Groundwater Contamination
- Hazardous Waste
- Hydraulic and Removal Efficiency
- Invasive Species Management
- Mechanical Malfunction
- Pollutant Breakthrough
- Re-suspension of settled material
- Sediment and Trash Removal
- Sedimentation
- Vector/Pest Control
- Vegetation harvesting
- Vegetation/Landscape Maintenance

### Targeted Constituents

| | |
|---|---|
| ☑ Sediment | ■ |
| ☑ Nutrients | ● |
| ☑ Trash | ■ |
| ☑ Metals | ■ |
| ☑ Bacteria | ▲ |
| ☑ Oil and Grease | ■ |
| ☑ Organics | ■ |
| ☑ Oxygen Demanding | ■ |

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

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# Section 5
# BMP Implementation and Evaluation
## 5.1 Introduction

As noted in Section 1 each municipality regulated under stormwater NPDES permits, whether categorized as a Phase I or Phase II municipality, is required to implement a stormwater management program and to assess the effectiveness of the program. Although specific program requirements and the level of implementation required differ between Phase I and Phase II municipalities, both prohibit non-stormwater discharges into storm drains, and require controls to reduce the discharge of pollutants to the maximum extent practicable (MEP). As part of the program, the municipalities are required to address public agency (municipal) operations to reduce the discharge of pollutants and to assess these efforts. Section 2 provides information on some of the necessary elements and steps involved in identifying BMPs for municipal activities occurring at fixed facilities and in field programs, whereas this Section discusses the components necessary to successfully implement a BMP and evaluate its effectiveness.

## 5.2 BMP Implementation

Municipal employees perform numerous municipal activities that have the potential to discharge pollutants. Staff should consistently implement the procedures or BMPs applicable to these activities. Some municipal activities are contracted to other parties. For example, many municipalities contract out street sweeping or waste collection. Similarly, many municipalities lease city-owned facilities to other parties, at which activities take place that have the potential to discharge pollutants. To ensure measures are taken to reduce pollutants while contractors or lessees perform such activities, contract and lease language should explicitly specify requirements to comply with all BMP specifications. Sample contract/lease language is presented in Appendix D.

Successful implementation of a BMP is dependent on the following components:

- Effective training of municipal and contract employees working in both fixed facilities and field programs.
- Regular inspections of fixed facilities, field programs, and treatment controls.
- Maintenance of treatment controls as needed to ensure proper functioning.
- Periodic evaluation/monitoring of BMP performance consistent with NPDES permit requirements.
- Follow-up action to correct deficiencies in BMP implementation noted during inspections.
- Accurate record keeping to track training, inspections, monitoring, and BMP maintenance.
- Submittal of an annual report to the applicable RWQCB regarding the effectiveness of the municipal efforts to reduce pollutants from fixed facilities and field programs.

- For Phase II Programs, documentation showing how the municipality has met its measurable goals, or revisions to those goals with supporting documentation.

## 5.3 Staff Training

Education and training is the key to the success of BMP implementation. Typically, municipalities provide annual training sessions. In addition to municipally sponsored training, staff may also attend local, regional, statewide, or national training seminars or workshops related to stormwater management and water quality conducted by other organizations.

In general, a municipality should consider a training program for employees working in fixed facilities and/or field programs. The training program should address the following subjects:

- Maintenance Procedure Implementation and Inspection – In this training effort, proper procedures for performing municipal activities that may adversely affect stormwater quality are addressed. Maintenance procedures cover a wide range of municipal activities and the training may address either all maintenance procedures applicable to the municipality or a specific procedure (e.g. fertilizer and pesticide use). This training can be conducted in either a formal or a tailgate-style format.

- Pollution Prevention/Spill Awareness – This training addresses the general techniques municipal staff may implement to prevent pollution, as well as to respond to spills once they have occurred. Training can be tailored to management and other municipal staff who oversee pollution prevention measures, to field staff conducting activities that may result in spills, or to field staff who may encounter spills or illicit discharges.

## 5.4 Site Inspections

Inspections of municipal fixed facilities and field programs should be performed to verify that BMPs are being implemented, that they are appropriate for that facility or program, and that they continue to reduce the discharge of pollutants. Inspections generally consist of the following:

- Fixed Facilities – Inspections are typically performed by a combination of stormwater program staff and on-site fixed facility managers. The inspection of a fixed facility may include spot checks of the facility and activities being performed at the facility, and interviews with key line staff.

- Field Programs– Inspections are typically performed by a combination of stormwater program staff and field program supervisors. The inspection of a field program may include spot checks of activities being performed, and interviews with key staff.

- Contracted Activities – Inspections are typically performed by municipal staff to supplement and check on self-inspections and reporting by the management staff of the contract firm performing the activity. Performance should be checked against contract/lease language (see Appendix D).

- Leased Facilities – Inspections are typically performed by municipal staff to supplement and check on self-inspections and reporting by the management staff of the lessor (see Appendix D).

### 5.4.1 Inspection Frequencies

Fixed facility or field program inspection frequency depends on the nature of the facility or program. Annual inspection is typical, with a more frequent schedule for facilities/activities that pose a greater threat to discharge pollutants (e.g. corporation yards). In the event of an observed problem, such as ineffective maintenance procedures or detected non-stormwater discharges, the inspection frequency should be increased as appropriate to facilitate correction of the problem (see section 5.7 for discussion regarding follow-up enforcement).

### 5.4.2 Inspection Documentation Procedures

Inspection forms may be developed and used to properly document all inspections and gather the necessary information for record keeping and annual reporting. Examples include:

- General Inspection Forms – These primary forms provide for a general characterization of the fixed facility or field program being inspected, including the type of facility or program, the reason for inspection, activities that may take place, and BMPs applicable for the facility. A general form for all inspections and a single fixed facility specific form should be completed.

- Activity Specific Inspection Forms – These secondary forms include a series of questions or checklist items about specific activities taking place at a fixed facility or as part of a field program, as well as a list of suggested corrective action plans that can be implemented should a problem be found. All forms applicable to the activities being performed at a fixed facility or field program should be completed.

## 5.5 Treatment Control BMP Maintenance

Maintenance of treatment controls and drainage conveyance systems (e.g. detention and retention basins, infiltration devices, catch basins) including regular inspections as presented in Section 4, is needed to maintain efficient pollutant reduction. If treatment control BMPs are not properly maintained, BMP effectiveness is reduced and water quality deteriorates. Training should be provided where needed. Maintenance schedules should be periodically reviewed and updated as needed to maintain BMP effectiveness. Where regular scheduled maintenance is not appropriate, regular inspections should be scheduled to determine when repairs, cleaning, or replacement are necessary. See Section 4 for a comprehensive discussion regarding maintenance of treatment control BMPs.

Where municipal contractors are responsible for maintenance of treatment controls, special attention should be directed toward ensuring proper maintenance procedures are implemented. Contract and lease language should include recommended maintenance procedures and schedules. Regularly scheduled inspections of facilities or programs operated by the contractor should include compliance with BMP maintenance requirements.

## 5.6 Analytical Monitoring

Although expensive, stormwater monitoring is a valuable way to assess long-term BMP effectiveness and cost-effectiveness of selected BMPs at reducing pollutants to the "maximum extent practicable". For Phase I municipalities, specific monitoring requirements depend on the individual NPDES permits issued. Phase II municipalities are covered by the Phase II General NPDES Permit and are not explicitly required to conduct chemical monitoring. Monitoring activities can include source identification, and chemical characterization of effluent/runoff, and non-stormwater discharges.

It is beyond the scope of this handbook to describe specific sampling and analytical techniques. For guidance on conventional stormwater sampling techniques and protocol, the reader should refer to NPDES Stormwater Sampling Guidance Document, 1992, published by the USEPA, or Caltrans' Guidance Manual: Stormwater Monitoring Protocols, 2000.

## 5.7 Enforcement

To ensure proper BMP performance, enforcement procedures and mechanisms should be established for the municipal fixed facilities and field programs. Enforcement actions may occur as a result of a problem found during an inspection or in response to a complaint that is received. Several different types of enforcement mechanisms and penalties can be utilized to ensure compliance. The internal enforcement procedures, directed toward municipal staff, include initial verbal warnings, written warnings, and more serious disciplinary actions if verbal and written warnings do not result in appropriate action. External enforcement procedures which pertain to municipal contractors may be undertaken primarily by the municipality's inspectors, managers, and supervisors who possess enforcement authority through established policies and procedures or ordinances. Depending on the severity of the violation, enforcement could range from the issuance of a notice of noncompliance to the loss of a contract or lease, or a fine.

## 5.8 Recordkeeping

As applicable, the municipality should maintain records demonstrating successful implementation of BMPs. Recordkeeping may include training, site inspection and maintenance, and if applicable, monitoring.

### Training and Workshops

Records of all training sessions provided to staff should be maintained to allow for:

- determining which staff requires which training;
- determining when training sessions must be conducted; and
- documenting training activities for enforcement and compliance purposes.

Municipal staff may attend training sessions or workshops sponsored by non-Permittees such as local or national organizations. For these sessions, the following information should be recorded:

- Name of Workshop/Training
- Sponsoring Organization
- General Description of the Subject Matter
- Location
- Date
- Attendee information (name, title, department, phone and/or email)

## Site Inspection and BMP Maintenance

Inspection reports should be kept to track frequency and results of inspections, BMPs implemented, condition of BMPs inspected, and follow-up actions taken. It is also important to keep a record of maintenance activities or any other BMPs that are of an "action" nature. It is easy to demonstrate that a BMP that involves a physical change, such as berming or covering, has been accomplished. However, actions that relate to good housekeeping can only be demonstrated by recordkeeping. Besides demonstrating compliance, records can assist in BMP management. Keeping a record of catch basin cleaning, for example, also provides insight into how long it takes for the catch basin sump to refill.

## Monitoring

Records of all stormwater monitoring information, inspections and visual observations, certifications, corrective actions and follow-up activities, and copies of all reports must be retained for a period of at least five years. These records shall include at a minimum, when applicable:

- Date, place, and time of sampling, visual observations, and/or measurements.
- Individual(s) who performed the sampling, visual observations, and or measurements.
- Visual observation records for storm events.
- Visual observations and inspections of non-stormwater discharges.
- Calibration and maintenance records of on-site instruments used.
- Visual observations and sample collection exception records,
- Date and approximate time of analyses.
- Individual who performed the analyses.
- Analytical results, method detection limits, and the analytical techniques or methods used.
- Quality assurance/quality control records and results.

- Sampling and analysis exemption and reduction certifications and supporting documentation.
- Records of any corrective actions and follow-up activities that resulted from the visual observations.

## 5.9 Reporting

Phase I municipalities are required to submit annual reports documenting BMP implementation, with due dates varying depending on individual NPDES permit requirements. Specific reporting requirements differ between individual permits. Typically, they include, but are not limited to, the following:

- Program implementation status.
- Summary of stormwater activities performed.
- Stormwater monitoring results summary and analysis.
- Assessment of the effectiveness of selected control measures or BMPs.
- Changes or suggested changes to the BMP that will improve overall effectiveness of the program.

Phase II municipalities will be required under the Phase II General NDPES Permit, beginning in 2004, to submit annual reports to the appropriate RWQCB by August 15th of each year, or as otherwise required by the RWQCB executive officer. Specific reporting requirements will include:

- Program implementation status.
- Summary of stormwater activities performed.
- Results of information collected, such as monitoring data.
- Summary of proposed stormwater activities for the next reporting cycle.
- Changes made in BMP selection.
- Changes in stormwater management personnel.
- Changes made in program or measurable goals.

# Section 6
# Glossary and List of Acronyms
## 6.1 Glossary

***303(d) Listed:*** Water bodies listed as impaired as per Section 303(d) of the 1972 Clean Water Act.

***Best Management Practices (BMPs):*** Includes schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent, eliminate, or reduce the pollution of waters of the receiving waters. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

***Catch Basin (Also known as Inlet):*** Box-like underground concrete structure with openings in curbs and gutters designed to collect runoff from streets and pavement.

***Clean Water Act (CWA):*** (33 U.S.C. 1251 et seq.) requirements of the NPDES program are defined under Sections 307, 402, 318 and 405 of the CWA.

***Construction Activity:*** Includes clearing, grading, excavation, and contractor activities that result in soil disturbance.

***Construction General Permit:*** A National Pollutant Discharge Elimination System (NPDES) permit issued by the State Water Resources Control Board for the discharge of stormwater associated with construction activity from soil disturbance of five acres or more. Threshold lowered to one acre beginning October 10, 2003. Construction General Permit No. CAS000002.

***Denuded:*** Land stripped of vegetation or land that has had its vegetation worn down due to the impacts from the elements or humans.

***Detention:*** The capture and subsequent release of stormwater runoff from the site at a slower rate than it is collected, the difference being held in temporary storage.

***Discharge:*** A release or flow of stormwater or other substance from a conveyance system or storage container. Broader – includes release to storm drains, etc.

***Effluent Limits:*** Limitations on amounts of pollutants that may be contained in a discharge. Can be expressed in a number of ways including as a concentration, as a concentration over a time period (e.g., 30-day average must be less than 20 mg/l), or as a total mass per time unit, or as a narrative limit.

***Erosion:*** The wearing away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, new development, redevelopment, road building, or timber cutting.

***Facility:*** Is a collection of industrial processes discharging stormwater associated with industrial activity within the property boundary or operational unit.

***Grading:*** The cutting or filling of the land surface to a desired slope or elevation.

***Hazardous Waste:*** A waste or combination of wastes that, because of its quantity, concentration, or physical, chemical or infectious characteristics, may either cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity) or appears on special EPA or state lists. Regulated under the federal Resource Conservation and Recovery Act and the California Health and Safety Code.

***Illicit Discharges:*** Any discharge to a municipal separate storm sewer that is not in compliance with applicable laws and regulations as discussed in this document.

***Industrial General Permit:*** A National Pollutant Discharge Elimination System (NPDES) Permit (No. CAS000001) issued by the State Water Resources Control Board for discharge of stormwater associated with industrial activity. Board Order 97-03-DWQ.

***Inlet:*** An entrance into a ditch, storm drain, or other waterway.

***Integrated Pest Management (IPM):*** An ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism.

***Municipal Separate Storm Sewer System (MS4):*** A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) designed or used for collecting or conveying storm water; (ii) which is not a combined sewer; and (iii) which is not part of a Publicly Owned Treatment Works (POTW) as defined at Title 40 of the Code of Federal Regulations (CFR) 122.2. A "Small MS4" is defined as an MS4 that is not a permitted MS4 under the Phase I regulations. This definition of a Small MS4 applies to MS4 operated within cities and counties as well as governmental facilities that have a system of storm sewers.

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

***Nonpoint Source Pollution:*** Pollution that does not come from a point source. Nonpoint source pollution originates from aerial diffuse sources that are mostly related to land use.

***Notice of Intent (NOI):*** A formal notice to SWRCB submitted by the owner of an industrial site or construction site that said owner seeks coverage under a General Permit for discharges associated with industrial and construction activities. The NOI provides information on the

owner, location, type of project, and certifies that the owner will comply with the conditions of the construction General Permit.

***Notice of Termination (NOT):*** Formal notice to SWRCB submitted by owner/ developer that a construction project is complete.

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

***Outfall:*** The end point where storm drains discharge water into a waterway.

***Point Source:*** Any discernible, confined, and discrete conveyance from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff.

***Pollutant:*** Generally, any substance introduced into the environment that adversely affects the usefulness of a resource.

***Pollution Prevention (P2):*** Practices and actions that reduce or eliminate the generation of pollutants.

***Precipitation:*** Any form of rain or snow.

***Pretreatment:*** Treatment of waste stream before it is discharged to a collection system.

***Reclaim (water reclamation):*** Planned use of treated effluent that would otherwise be discharged without being put to direct use.

***Retention:*** The storage of stormwater to prevent it from leaving the development site.

***Reuse (water reuse):*** (see Reclaim)

***Runoff:*** Water originating from rainfall, melted snow, and other sources (e.g., sprinkler irrigation) that flows over the land surface to drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands.

***Run-on:*** Off site stormwater surface flow or other surface flow which enters your site.

***Scour:*** The erosive and digging action in a watercourse caused by flowing water.

***Secondary Containment:*** Structures, usually dikes or berms, surrounding tanks or other storage containers, designed to catch spilled materials from the storage containers.

***Sedimentation:*** The process of depositing soil particles, clays, sands, or other sediments that were picked up by runoff.

***Sediments:*** Soil, sand, and minerals washed from land into water, usually after rain, that collect in reservoirs, rivers, and harbors, destroying fish nesting areas and clouding the water, thus preventing sunlight from reaching aquatic plants. Farming, mining, and building activities without proper implementation of BMPs will expose sediment materials, allowing them to be washed off the land after rainfalls.

***Significant Materials:*** Includes, but not limited to, raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designed under Section 101(14) of CERLCA; any chemical the facility is required to report pursuant to Section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with stormwater discharges.

***Significant Quantities:*** The volume, concentrations, or mass of a pollutant in stormwater discharge that can cause or threaten to cause pollution, contamination, or nuisance that adversely impact human health or the environment and cause or contribute to a violation of any applicable water quality standards for receiving water.

***Source Control BMPs:*** Operational practices that reduce potential pollutants at the source.

***Source Reduction (also source control):*** The technique of stopping and/ or reducing pollutants at their point of generation so that they do not come into contact with stormwater.

***Storm Drains:*** Above- and below-ground structures for transporting stormwater to streams or outfalls for flood control purposes.

***Stormwater:*** Defined as urban runoff and snowmelt runoff consisting only of those discharges, which originate from precipitation events. Stormwater is that portion of precipitation that flows across a surface to the storm drain system or receiving waters.

***Stormwater Discharge Associated with Industrial Activity:*** Discharge from any conveyance which is used for collecting and conveying stormwater from an area that is directly related to manufacturing, processing, or raw materials storage activities at an industrial plant.

***Stormwater Pollution Control Plan (SWPCP):*** A less formal plan than the SWPPP that addresses the implementation of BMPs at facilities/businesses not covered by a general permit but that have the potential to discharge pollutants.

***Stormwater Pollution Prevention Plan (SWPPP):*** A written plan that documents the series of phases and activities that, first, characterizes your site, and then prompts you to select and carry out actions which prevent the pollution of stormwater discharges.

***Treatment Control BMPs:*** Treatment methods to remove pollutants from stormwater.

***Toxicity:*** Adverse responses of organisms to chemicals or physical agents ranging from mortality to physiological responses such as impaired reproduction or growth anomalies.

***Turbidity:*** Describes the ability of light to pass through water. The cloudy appearance of water caused by suspended and colloidal matter (particles).

## 6.2 Acronyms

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| AC | Asphalt Concrete |
| ADL | Aerially Deposited Lead |
| AIMP | Impervious Area |
| AINF | Infiltration Area |
| ANSI | American National Standards Institute |
| APHA | American Public Health Association |
| APWA | American Public Works Association |
| ARS | Agricultural Research Service |
| AQMD | Air Quality Management District |
| ASTM | American Society for Testing Materials |
| AWWA | American Water Works Association |
| BAT | Best Available Technology (economically available) |
| BCT | Best Conventional Technology (pollution control) |
| BFP | Bonded Fiber Matrix |
| BMPs | Best Management Practices |
| BOD | Biological Oxygen Demand |
| CA | Contractor Activities |
| CAL-EPA | California Environmental Protection Agency |
| CAL-OSHA | California Division of Occupational Safety and Health Administration |
| CASQA | California Stormwater Quality Association |
| CCR | California Code of Regulations |

| | |
|---|---|
| CCS | Cellular Confinement System |
| CEQA | California Environmental Quality Act |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| CFR | Code of Federal Register |
| CMA | Congestion Management Program |
| COE | U.S. Army Corps of Engineers |
| CPI | Coalescing Plate Interceptor |
| CWA | Clean Water Act (Federal Water Pollution Control Act of 1972 as amended in 1987) |
| DCIA | Directly Connected Impervious Area |
| DTSC | California Department of Toxic Substances Control |
| EEC | Effect Effluent Concentration |
| EIR | Environmental Impact Report |
| EMC | Event Mean Concentration |
| EOS | Equivalent Opening Size |
| ESA | Environmentally Sensitive Area |
| ESC | Erosion and Sedimentation Control |
| FEMA | Federal Emergency Management Agency |
| FHWA | Federal Highway Administration |
| GIS | Geographical Information System |
| Hazmat | Hazardous Material |
| HSG | Hydrologic Soil Groups |
| IPM | Integrated Pest Management |
| JURMP | Jurisdictional Urban Runoff Management Program |
| MEP | Maximum Extent Practicable |



A003159

| | |
|---|---|
| MS4 | Municipal Separate Storm Sewer System |
| MSDS | Material Safety Data Sheet |
| MSHA | Mine Safety and Health Administration |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanographic and Atmospheric Administration |
| NOI | Notice of Intent |
| NPDES | National Pollution Discharge Elimination System |
| NPS | Nonpoint Source |
| NRC | National Response Center |
| NRCS | Natural Resources Conservation Service |
| NSF | National Science Foundation |
| NURP | National Urban Runoff Program |
| O&G | Oil and Grease |
| O&M | Operations and Maintenance |
| OSDS | On-site Disposal System |
| OSHA | Occupational Safety and Health Administration |
| P2 | Pollution Prevention |
| PAHs | Polyaromatic Hydrocarbons |
| PAM | Polyacrylamide |
| PCBs | Polychlorinated Biphenyls |
| PCC | Portland Concrete Cement |
| PPT | Pollution Prevention Team |
| POTW | Publicly Owned Treatment Works |
| PSD | Particle Size Distribution |
| RCRA | Resource Conservation and Recovery Act |

| | |
|---|---|
| RWQCB | Regional Water Quality Control Board |
| SAP | Sampling and Analysis Plan |
| SARA | Superfund Amendments and Reauthorization Act |
| SIC | Standard Industrial Classification |
| SPCC | Spill Prevention Control and Countermeasure |
| SUSMP | Standard Urban Stormwater Mitigation Plan |
| SWMP | Stormwater Management Program |
| SWPCP | Stormwater Pollution Control Plan |
| SWPPP | Stormwater Pollution Prevention Plan |
| SWRCB | State Water Resource Control Board |
| TMDL | Total Maximum Daily Load |
| TOC | Total Organic Carbon |
| TSS | Total Suspended Solids |
| UFC | Uniform Fire Code |
| USACE | United States Army Corps of Engineers |
| USDA | United States Department of Agriculture |
| USDOT | United States Department of Transportation |
| USEPA | United States Environmental Protection Agency |
| WEF | Water Environment Federation |



A003161

# Appendix A
# Inventory of Municipal Operations

This appendix provides an example of an inventory database. The purpose of this example is to illustrate the types of data that should be collected for municipal operations and how these data can be organized into a database that can be used for other steps of a municipality's stormwater management program. Specifically, the information gathered in the inventory process should be used to assess municipal operations for BMP implementation (Appendix B) and for BMP selection (Appendix C).

The example provided here was adapted from the inventory database developed by the County of Orange Stormwater Program for fixed facilities. The field program inventory database should include similar information (see Section 2).

## Step 1 Facility and Location

| Facility Physical Address Information* | | | | | | | | | | Watershed Identification | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Facility Name | Street Number | Street Name | Street Suffix | City | Zip | Business Phone Number | Business Fax Number | Facility Contact Name | Facility Size (Total Square Feet of Facility) | Watershed (Identify if possible) | Longitude (X) | Latitude (Y) |
| County Yard | 1200 | Pine | Road | Anaheim | 92933 | (714) 555-6363 | (111) 222-3333 | Ron Jones | 400,000 | E - Lower Santa Ana River | 133.49.55 | 34.34.45 |
| City Service Center | 645 | Main | Street | Brea | 92821 | (714) 555-1234 | (123) 456-7890 | Joe Smith | 200,000 | A - San Gabriel River/Coyote Creek | 102.48.50 | 33.34.44 |

* Add facility mailing address information if different from physical address

## Step 2 Potential Pollutant Generating Activities

| Identify all activities that apply for each facility and associated pollutants | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Facility Name | Vehicle and Equipment Fueling | Vehicle and Equipment Washing & Steam Cleaning | Vehicle & Equipment Maintenance and Repair | Outdoor Loading/ Unloading of Materials | Outdoor Container Storage of Liquids | Outdoor Process Equipment Operations & Maintenance | Outdoor Storage of Raw Materials | Waste Handling and Disposal | Building and Grounds Maintenance | Parking/ Storage Area Maintenance | Over Water Activities |
| County yard | Metals, O&G, Org., Trash | Sed., Nut., Trash, Metals, O&G, Org. | Metals, O&G, Org. | Sed., Nut., Metals, O&G | | | Sed., Nut., Metals, O&G | | | Sed., Nut., Trash, Metals, Bact., O&G, Org., Oxy | |
| City Service Center | Metals, O&G, Org., Trash | Sed., Nut., Trash, Metals, O&G, Org. | Metals, O&G, Org. | Sed., Nut., Metals, O&G | | | Sed., Nut., Metals, O&G | | Sed., Nut., Trash, Metals, Bact., O&G, Org., Pest., Oxy | Sed., Nut., Trash, Metals, Bact., O&G, Org., Oxy | |

A003163

# Appendix B
# Assessment of Municipal Operations

This appendix provides an example assessment worksheet that can be used for evaluating fixed facilities to determine the level of BMP implementation. The results of this assessment process can then be used as the basis for BMP selection (see Appendix C).

# WORKSHEET 1

Facility Name: County yard
Contact Name: Ron Jones

Site Address: 1200 Pine Rd., Anaheim, CA 92933
Phone: (111) 222-3333

**1. ACTIVITIES** – In the table below check each activity present at the site and evaluate its **potential for pollutant discharge (PPD):** 1 = high potential, 2= medium potential, 3= low potential

**2. BMP EFFECTIVENESS** – In the table below provide an effectiveness rating using the provided scale.

| ACTIVITY AND BMP CHECKLIST | APPLICABLE ACTIVITY Yes | No | PPD | EFFECTIVENESS RATING * |
|---|---|---|---|---|
| A. VEHICLE AND EQUIPMENT FUELING<br>BMPs employed:<br>▪ Employees trained in proper fueling and cleanup procedures.<br>▪ "Shut-off" valves installed on nozzles.<br>▪ "Topping off" of fuel tanks is discouraged.<br>▪ Adsorbent materials used on spills as opposed to hosing down.<br>▪ Drains labeled within the facility boundary, by stencil to indicate whether they flow to an oil/water separator, directly to the sewer, or to a storm drain.<br>▪ Fueling area designed to prevent storm water runoff and spills.<br>▪ Fueling area covered with an overhanging roof structure. | [ x ] | [ ] | [ 1 ] | ① ② ❸ ④ ⑤ |
| B. VEHICLE AND EQUIPMENT WASHING/STEAM CLEANING<br>BMPs employed:<br>▪ Vehicles and equipment are washed at an off-site commercial washing location whenever possible.<br>▪ On-site washing area is clearly marked as a wash area.<br>▪ Signs are posted stating that only washing is allowed in wash area and that discharges to the storm drain are prohibited.<br>▪ Trash containers are provided in wash area.<br>▪ A map of on-site storm drain locations exists to avoid discharges to the storm drain system. | [ x ] | [ ] | [ 2 ] | ① ② ③ ❹ ⑤ |
| C. VEHICLE AND EQUIPMENT MAINTENANCE AND REPAIR<br>BMPs employed:<br>▪ Idle equipment is stored under cover.<br>▪ Drip pans are used for leaking vehicle/equipment.<br>▪ Vehicle maintenance area is designed to prevent storm water pollution (area contains berming and appropriate drainage routing).<br>▪ Signs are painted on storm drain inlets to indicate that they are not to receive liquid or solid wastes.<br>▪ The work area is covered to limit exposure to the rain. | [ x ] | [ ] | [ 1 ] | ① ② ❸ ④ ⑤ |
| D. OUTDOOR LOADING/UNLOADING OF MATERIALS<br>BMPs employed: | [ ] | [ x ] | [ ] | ① ② ③ ④ ⑤ |
| E. OUTDOOR CONTAINER STORAGE OF LIQUIDS<br>BMPs employed: | [ ] | [ x ] | [ ] | ① ② ③ ④ ⑤ |
| F. OUTDOOR PROCESS EQUIPMENT OPERATIONS AND MAINTENANCE<br>BMPs employed: | [ ] | [ x ] | [ ] | ① ② ③ ④ ⑤ |
| G. OUTDOOR STORAGE OF RAW MATERIALS<br>BMPs employed:<br>▪ Materials are stored inside when feasible.<br>▪ All outside storage areas are covered with a roof or enclosed to prevent stormwater contact.<br>▪ Outdoor storage containers are kept in good condition.<br>▪ Lids are secured on waste barrels and containers.<br>▪ Drums are stored in a secure area where unauthorized persons cannot gain access. | [ x ] | [ ] | [ 2 ] | ① ② ③ ❹ ⑤ |
| H. WASTE HANDLING AND DISPOSAL<br>BMPs employed: | [ ] | [ x ] | [ - ] | ① ② ③ ④ ⑤ |
| I BUILDING AND GROUNDS MAINTENANCE<br>BMPs employed: | [ ] | [ x ] | [ - ] | ① ② ③ ④ ⑤ |
| J PARKING/STORAGE AREA MAINTENANCE<br>BMPs employed:<br>▪ Parking and storage areas are kept clean and orderly.<br>▪ Site is designed to allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.<br>▪ Rooftop drains are arranged to prevent drainage directly onto paved surfaces.<br>▪ Lot is designed to include semi-permeable hardscape. | [ ] | [ x ] | [ - ] | ① ② ❸ ④ ⑤ |
| K. OVER WATER ACTIVITIES<br>BMPs employed: | [ ] | [ x ] | [ - ] | ① ② ③ ④ ⑤ |
| L. OTHER (describe): | [ ] | [ x ] | [ - ] | ① ② ③ ④ ⑤ |

*① No BMPs used and stormwater pollution likely ② Some BMPs used but not effective ③ Some BMPs used and moderately effective
④ Source control BMPs used and very effective/structural BMPs needed ⑤ All necessary BMPs used and very effective

3. **TYPE AND QUANTITY OF MATERIALS USED**

| Material | Typical Quantity/Frequency | Is Stored Material Likely to Generate Pollutants |
|---|---|---|
| Gasoline | 250 gal/day | yes |
| Motor oil | 90 gal/wk | yes |
| Detergents | 40 lb/wk | no |
| | | |

4. **HISTORY OF SPILLS AND LEAKS**
   *a)* Is there a chronic history of spills and leaks? *no*
   *b)* Is there no evidence of leaks and drips from equipment and machinery? *drip pans in place*
   *c)* Is there a spill prevention and response team? *yes*
   *d)* Are appropriate spill containment and cleanup materials kept on-site and in convenient locations? *materials present, but need to be placed near fueling areas.*
   *e)* Are cleanup procedures for spills followed regularly and correctly? *yes*
   *f)* Are used absorbent materials removed and disposed of in a timely manner? *stored spill clean up materials observed on-site, proper disposal required.*
   *g)* Are personnel regularly trained in the use of spill control materials? *yes*

5. **NON-STORMWATER DISCHARGES**
   *a)* Outfall directly observed during assessment *no*
   *b)* Are BMPs implemented to prevent, treat, or control non-stormwater discharges? *yes, but could use improvement (see BMP selection recommendations).*
   *c)* Is there a potential for non-stormwater discharges (i.e. non-stormwater sources observed without BMPs implemented) *yes, (see BMP selection recommendations)*

6. **SIZE OF FACILTIY** (incorporating the size of a facility serves as a surrogate measure for flow)
   *a)* Total area *400,000 square feet.*
   *b)* The impervious area (including parking lot) is *320,000 square feet (80% impervious)*

7. **PROXIMITY TO RECEIVING WATER**
   Does the facility discharge directly or adjacent to a 303(d) water body or other environmentally sensitive area? *no*

# Appendix C
# BMP Selection Process

The purpose of this appendix is to illustrate the process of selecting BMPs for an example fixed facility. Information necessary for this process includes use of the results from the inventory (Appendix A) and assessment (Appendix B) processes.

The BMPs listed in the example checklist below are the required measures to control the discharge of pollutants to the stormwater drainage system for the activities identified during the assessment process (Appendix B). The BMPs listed include both those that were currently being implemented at the site as well as recommended BMPs based on the facility assessment. The BMP fact sheets presented in Section 3 should be used to identify recommended BMPs for municipal operations, however, note that not all BMPs listed in the fact sheets may be applicable to a given facility. You are encouraged to employ additional BMPs if they will control pollutants in an effective manner.

Facility Name: County Yard Site Address: 1200 Pine Rd., Anaheim, CA

Contact Name: Ron Jones Phone: (111) 222-3333

**APPLICABLE BMPs**

## A. VEHICLE AND EQUIPMENT FUELING (Fact Sheet SC-20)

Current

- Employees trained in proper fueling and cleanup procedures.
- "Shut-off" valves installed on nozzles.
- "Topping off" of fuel tanks is discouraged.
- Adsorbent materials used on spills as opposed to hosing down.
- Drains labeled within the facility boundary, by stencil to indicate whether they flow to an oil/water separator, directly to the sewer, or to a storm drain.
- Fueling area designed to prevent storm water runoff and spills.
- Fueling area covered with an overhanging roof structure.

Recommended

- Spot clean" leaks and drips routinely. Leaks are not cleaned up until the absorbent is picked up and disposed of properly.
- Install covered spill kits next to fueling area.

## B. VEHICLE AND EQUIPMENT WASHING/STEAM CLEANING (Fact Sheet SC-21)

Current

- Vehicles and equipment are washed at an off-site commercial washing location whenever possible.
- On-site washing area is clearly marked as a wash area.
- Signs are posted stating that only washing is allowed in wash area and that discharges to the storm drain are prohibited.
- Trash containers are provided in wash area.
- A map of on-site storm drain locations exists to avoid discharges to the storm drain system.

Recommended

- Use biodegradable, phosphate-free detergents for washing vehicles as appropriate.
- Consider washing vehicle equipment inside the building to control the targeted constituents by directing them to the sanitary sewer.

## C. VEHICLE AND EQUIPMENT MAINTENANCE AND REPAIR (Fact Sheet SC22)

Current

- Idle equipment is stored under cover.
- Drip pans are used for leaking vehicle/equipment.
- Vehicle maintenance area is designed to prevent storm water pollution (area contains berming and appropriate

drainage routing).

- Signs are painted on storm drain inlets to indicate that they are not to receive liquid or solid wastes.
- The work area is covered to limit exposure to the rain.

Recommended

- Avoid hosing down your work areas; use dry sweeping.
- Post signs at sinks to remind employees not to pour hazardous wastes down drains.
- Clean yard storm drain inlets(s) regularly and especially after large storms.

D. OUTDOOR LOADING/UNLOADING OF MATERIALS (Fact Sheet SC-30) N/A

E. OUTDOOR CONTAINER STORAGE OF LIQUIDS (Fact Sheet SC-31) N/A

F. OUTDOOR PROCESS EQUIPMENT OPERATIONS AND MAINTENANCE (Fact Sheet SC-32) N/A

G. OUTDOOR STORAGE OF RAW MATERIALS (Fact Sheet SC-33)

Current

- Materials are stored inside when feasible.
- All outside storage areas are covered with a roof or enclosed to prevent stormwater contact.
- Outdoor storage containers are kept in good condition.
- Lids are secured on waste barrels and containers.
- Drums are stored in a secure area where unauthorized persons cannot gain access.

Recommended

- All materials stored outside should have some type of secondary containment system in case of spills or leaks.

H. WASTE HANDLING AND DISPOSAL (Fact Sheet SC-34) N/A

I. BUILDING AND GROUNDS MAINTENANCE (Fact Sheet SC-41) N/A

J. PARKING/STORAGE AREA MAINTENANCE (Fact Sheet SC-43)

Current

- Parking and storage areas are kept clean and orderly.
- Site is designed to allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Rooftop drains are arranged to prevent drainage directly onto paved surfaces.
- Lot is designed to include semi-permeable hardscape.

Recommended

- Remove debris in a timely fashion.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

K. OVER WATER ACTIVITIES (Fact Sheet SC-50) N/A

L. OTHER (describe):

# Appendix D
# Example Contract/Lease Language for BMP Implementation

## Appendix D Example Contract/Lease Language for BMP Implementation

**Example Lease Language for Fixed Facilities**
Following is example language that can be inserted into municipal leases:

The ___________ Regional Water Quality Control Board (RWQCB) has issued a permit that governs stormwater and non-stormwater discharges resulting from municipal activities performed by or for the City of ________. The RWQCB Permit is National Pollutant Discharge Elimination System (NPDES) Permit No. ______. Copy of the RWQCB Permit is available for review.

In order to comply with the Permit requirements, the City has developed Best Management Practices (BMPs) that parties leasing municipal owned properties must adhere to. These BMPs contain pollution prevention and source control techniques to minimize the impact of those activities upon dry-weather urban runoff, stormwater runoff, and receiving water quality.

Activities performed at the facility leased under this agreement shall conform to the Permit and BMPs, and must be performed as described within all applicable BMPs. The holder of this agreement shall fully understand the BMPs applicable to activities conducted at the facility leased under this agreement prior to conducting them and maintain copies of the BMPs at the leased facility throughout the agreement duration. The applicable BMPs are included as Exhibit ___ of this agreement.

Evaluation of activities subject to Permit performed at the facility leased under this agreement will be conducted by the city to verify compliance with BMP requirements and may be required through lessor self-evaluation as determined by the city.

**Example Contract Language for Field Programs**
Following is example language that can be inserted into municipal field program contracts:

The __________ Regional Water Quality Control Boards (RWQCB) has issued a permit that governs stormwater and non-stormwater discharges resulting from areas owned and operated by the City of ________. The RWQCB Permit is National Pollutant Discharge Elimination System (NPDES) Permit No. ________. Copy of the RWQCB Permit is available for review.

In order to comply with the Permit requirements, the City has developed Best Management Practices (BMPs) that parties conducting the municipal activities must adhere to. These BMPs apply to any party conducting municipal activities and contain pollution prevention and source control techniques to minimize the impact of those activities upon dry-weather urban runoff, stormwater runoff, and receiving water quality.

Work performed under this CONTRACT shall conform to the Permit requirements, and BMPs, and must be performed as described within all applicable BMPs. The CONTRACTOR shall fully understand the BMPs applicable to activities that are being conducted under this CONTRACT prior to conducting them and maintain copies of the BMPs throughout the CONTRACT duration. The applicable BMPs are included as Exhibit ___ of this CONTRACT.

Evaluation of activities subject to BMPs performed under this CONTRACT will be conducted to verify compliance with BMP requirements and may be required through CONTRACTOR self-evaluation as determined by the city.

California Regional Water Quality Control Board
Los Angeles Region
(50 Years Serving Coastal Los Angeles and Ventura Counties)

Winston H. Hickox
*Secretary for Environmental Protection*

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640
Internet Address: http://www.swrcb.ca.gov/rwqcb4

Gray Davis
*Governor*

January 26, 2001

Vicki Musgrove
Ventura Countywide Stormwater Quality Management Program
800 South Victoria Avenue, L #1600
Ventura, CA 93009

**VENTURA COUNTY MUNICIPAL STORM WATER NPDES PERMIT (BOARD ORDER No. 00-108; NPDES PERMIT No. CAS004002)—REQUEST FOR TIME EXTENSION AND REVISIONS TO THE PERMIT AND STORM WATER QUALITY URBAN IMPACT MITIGATION PLAN (SQUIMP)**

Dear Vicki Musgrove:

Thank you for your letter of November 30, 2000, requesting permit revisions to the Ventura County Municipal Storm Water Permit. A similar request was received from the City of Port Hueneme on December 5, 2000. We have reviewed your request for permit revisions to apply to the Ventura County Storm Water NPDES Permit. You requested changes to the Ventura County Permit and Storm Water Quality Urban Impact Mitigation Plan (SQUIMP) following the State Board's decision (WQ2000-11) regarding changes to Standard Urban Storm Water Mitigation Plans (SUSMPs) in Los Angeles County. Following are our comments based on our review.

As you indicated in your letter, language in the Ventura permit states "The terms and requirements in the Storm Water Quality Urban Impact Mitigation Plan (SQUIMP) may be amended by the Regional Board Executive Officer to conform with the State Board's decision in: In Re: *The Consolidated Petitions of Cities of Bellflower et al. (Review of January 26, 2000, Action of the Regional Board and its Executive Officer Pursuant to Board Order No. 96-054)* or any subsequent ruling on the matter by a court of law" (Ventura Permit, Part 4.H.1, page 21). Therefore, I hereby revise the permit to conform to State Board Order WQ2000-11. Designated revisions include:

- Addition of Retail Gasoline Outlets to "Limited Exclusion" in the SQUIMP section on "Design Standards for Structural or Treatment Control BMPs" (Attachment A, page A-10).

- Remove the reference to a specific number of SQUIMP categories—the sentence prior to the list of categories will be changed from:

"All projects that fall into one of eight categories are identified in the Ventura Countywide Municipal Permit as requiring SQUIMPs", to:
" All projects that fall into one of the following categories are subject to these SQUIMPs" (Attachment A, page A-2)

- Deletion of the paragraph about storm water mitigation funding (Ventura Permit, Attachment A, page A-15, first full paragraph). The State Board's decision (Order WQ2000-11) to remove this provision was primarily based on the lack of existing mechanisms to efficiently implement this program in Los Angeles County. Storm water mitigation funding is a resource that can be utilized to improve water quality and we strongly support efforts to initiate this program in Ventura County if an appropriate implementation mechanism exists.

In late August, 2000, RWQCB staff met with representatives from the Ventura Countywide Stormwater Management Program to discuss another language modification in the Ventura Permit. It was discovered that one sentence in the "Receiving Water Limitations" section did not conform with similar language in the Long Beach Municipal Storm Water Permit (NPDES Permit No. CAS004003). This language inconsistency was a typographic omission. We will therefore make the following correction:

- Replace "the permit" with "Part 1 and Part 2 of the permit", in the first sentence of Part 2.C (Ventura Permit, page 9).

Under Regional Board Order No. 00-108 (Ventura Permit), the Regional Board Executive Officer may choose to retain permit language if the State Board's decision allows it. We believe the State Board's decision allows us to retain ESAs, and to retain the requirement that both discretionary and non-discretionary projects are subject to the SQUIMP. These points are elaborated upon below:

- Requirements related to Environmentally Sensitive Areas (ESAs) will remain as they are in the Ventura Permit and the SQUIMP. The State Board recognized that more stringent controls are appropriate for ESAs, but decided to remove references to ESAs from SUSMPs because the category was not established in the permit in 1996 and a threshold was not identified (WQ2000-11, page 24-25) for developments in ESAs. The Regional Board supported ESA determinations during adoption of the Ventura Permit, and ESA requirements in the Ventura Permit are consistent with the permit for the City of Long Beach. You may consider including a threshold for development in ESAs with your submittal of the ESA list.

- Discretionary and non-discretionary projects will remain subject to the SQUIMP. We believe the State and Regional Boards support the broader description of development projects reflected in the present language of the Ventura Permit (as adopted July 27, 2000). The State Board did not allow inclusion of non-discretionary projects in the SUSMPs because of due process considerations, and suggested that these projects would be included when the SUSMPs are reissued (WQ2000-11, page 26). At the July 27, 2000 meeting of the Regional Board, the matter of discretionary v. non-discretionary projects was discussed with regard to the Ventura MS4 Permit. The Regional Board decided that there should be no distinction between discretionary and non-discretionary projects. Accordingly, the word "discretionary" will be deleted from Part 4.C.4 (Ventura Permit, page 16). This was a typographic oversight that was overlooked during the permit adoption process.

Finally, please be advised that we propose to take the Ventura Permit before the Regional Board following adoption of the renewed Los Angeles County MS4 Permit. The Los Angeles Permit will be renewed in the next 3 – 5 months, and our intent is to propose that the Regional Board adopt a permit that includes a requirement (and a threshold) for RGOs to be subject to SUSMPs, among other issues. We would like to make the Ventura Permit conform with the renewed Los Angeles Permit.

Should you have any questions, please do not hesitate to call me at (213) 576-6605 or Ejigu Solomon at (213) 576-6727.

Sincerely,

Dennis Dickerson
Executive Officer

Vicki appreciate your patience with us a we move forward on these issues
Deni

cc: Jorge Leon, State Water Resources Control Board, Office of Chief Counsel
Eugene Bromley, USEPA Region IX
Mark Capelli, California Coastal Conservancy
Robert L. Hunt, City of Port Hueneme
Cliff Finley, City of Port Hueneme
Ernie Villasenor, City of Camarillo
Lynn Cole, City of Fillmore
Bert Rapp, City of Fillmore
Ken Gilbert, City of Moorpark
Bill Frank, City of Ojai
Sally Coleman, City of Oxnard
Carrie Mattingly, City of Port Hueneme
Mark Watkins, City of San Buenaventura
Anthony Emmert, City of Santa Paula

Anne Schubert, City of Simi Valley
JoAnne Kelly, City of Thousand Oaks
Steve Fleischli, Santa Monica Baykeeper
Mark Gold, Heal the Bay
Vicki Clark, Environmental Defense Center
Jessie Altstatt, Santa Barbara ChannelKeeper
Paul Jenkins, Surfrider Foundation
Dee Zink, BIA of Southern California
Ray Pearl, BIA, Greater LA and Ventura Chapter
Richard J. Lambros, Executive Vice President, BIA
Neil Barnsdale, PE, Associated Water Engineers
Ronald Wilkniss, Western States Petroleum
Ray Prueter, Ventura County Contractors Association
Richard Watson, R. Watson & Associates
Alan Eide, ASL Consulting Engineers
Jim Edmundson, Cal Trout
Rufus C. Young, Esq.
Lindon Garcia

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Winston H. Hickox
*Secretary for Environmental Protection*

Gray Davis
*Governor*

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640
Internet Address: http://www.swrcb.ca.gov/rwqcb4

August 28, 2002

Ms. Sally Coleman, Division Manager
Water Quality/Environmental Services
Ventura County Flood Control District
800 South Victoria Avenue
Ventura, CA 93009-1600

Certified Mail
Return Receipt Requested
Claim No. 7001 2510 0001 4662 1713

**COMMENTS ON THE TECHNICAL GUIDANCE MANUAL FOR STORMWATER QUALITY CONTROL, SUBMITTED JULY 18, 2002.**

Dear Ms. Coleman:

Thank you for the submittal of the Technical Guidance Manual (Manual) as required under the Ventura County Municipal Storm Water NPDES Permit (NPDES Permit No. CAS 004002). We have reviewed the Manual and the following are our comments based on our review.

The Manual is well written and the style of presentation provides a clear description of the approved devices. Factors to consider when selecting a particular best management practice (BMP) are well described in most cases, with listings of advantages and disadvantages, and warnings about applications that would be inappropriate. As you suggested, we think the Manual will be a useful resource in the implementation of requirements under the Stormwater Quality Urban Impact Mitigation Plan (SQUIMP). However there are a few areas we believe need improvement or clarification as follows:

**Maintenance agreements**

You have included suggested maintenance requirements for the various BMPs, and included templates for actual maintenance agreements in the Appendices. Maintenance is such a key requirement for the long-term effectiveness of these devices, we request that you go one step further and reach an agreement with the Co-permittees urging/requiring them to require maintenance agreements as part of the plan check and approval process.

**Infiltration Basins**

For infiltration basins, the Manual mentions the potential for groundwater contamination, but does not mention the vulnerability of unconfined aquifers or suggest consultation with local agencies to identify the location of sensitive aquifers. The Manual also suggests a minimum separation of five vertical feet from the historical high water table—this is not consistent with the SQUIMP. We request that you more fully address these points in the Manual.

The Manual also mentions the reduced pollutant attenuation effectiveness of coarse soils, and the potential for groundwater monitoring (e.g., p. 5-74, paragraph 5). These statements are followed by a sentence regarding stabilization of the tributary area upstream from the infiltration basin. This sentence is out of place; it should be placed in the fourth paragraph as it relates to siting and installation, rather than groundwater issues.

**Peak discharge rate control**

The section regarding control of peak storm water runoff discharge rates suggests design criteria for control of the 2-year frequency storm event, so that post-development peak discharge rates do not exceed pre-development peak discharge rates. The Manual also limits the application of this standard to those projects "that directly discharge to unlined receiving streams" (p. 3-4).

We understand the difficulty in developing criteria to meet the requirement in the SQUIMP for peak storm water runoff discharge rates (Requirement 1, p. A-5). We have discussed the issue with your staff at several meetings, and have provided funding to conduct a local study to support development of effective criteria for erosion protection (the Urbanization and Stream Erosion Prevention (USEP) project). From our previous discussions we expected the Manual to contain interim criteria for stream erosion and habitat protection. These criteria would be subject to modification depending on the findings of the USEP study (or other relevant research findings).

We believe that the peak discharge criteria as presented in the manual need further modification.

First, the suggested standard only applies if the development project directly discharges to an "unlined channel". We can imagine situations where runoff from a project could contribute to erosion or habitat loss in a natural or unlined channel, even though it might not be directly connected to the channel. This is not consistent with the SQUIMP requirement.

Second, it is not clear that the criteria are interim measures. The Manual does mention that a "modeling procedure" is being developed to establish peak flow design criteria, but does not say whether anyone will be required to use the model, or that the interim criteria are subject to revision.

Finally, the suggested criteria do not consider the increased duration of runoff that would result from detaining runoff to reduce the peak discharge rate. Numerous peer-reviewed journal articles have linked the increase in runoff duration to increased stream erosion, even though the peak rate was controlled by detention facilities.

To be acceptable, the interim criteria must address the points listed above and more clearly fulfil the SQUIMP requirement.

We conditionally accept the technical manual, provided you can accommodate our concerns and make modifications or revisions as appropriate. We request that you submit a response letter that addresses our concerns by October 15, 2002.

If you have any questions concerning this matter, please call me at (213) 620-2120.

Sincerely,

Ejigu Solomon
Ventura Storm Water Chief

Tracy

# California Regional Water Quality Control Board

## Los Angeles Region

Winston H. Hickox
*Secretary for Environmental Protection*

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640
Internet Address: http://www.swrcb.ca.gov/~rwqcb4

**Gray Davis**
*Governor*

September 18, 2003

Ms. Sally Coleman, Program Manager
Water Quality/Environmental Services
Ventura County Watershed Protection District
800 South Victoria Avenue
Ventura, CA 93009-1600

**NOTIFICATION OF APPROVAL OF VENTURA COUNTY'S ESA DELINEATION MAP (COUNTY OF VENTURA MUNICIPAL STORM WATER NPDES PERMIT; BOARD ORDER NO. 00-108; NPDES NO. CAS004002)**

Dear Ms. Coleman:

The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) adopted the Ventura County Municipal Storm Water Discharge Permit (Ventura MS4 Permit) on July 27, 2000. A requirement of the Ventura MS4 Permit is the submittal of an Environmentally Sensitive Area (ESA) Delineation Map, based on the Regional Board's ESA definition (Page 16(C)- Programs for Planing and Land Development of the Ventura MS4 Permit), for approval by the Executive Officer. This process has been completed and we have approved the ESA Map.

An important use of the ESA map is to ensure that each Permittee implement the Storm Water Quality Urban Impact Mitigation Plan (SQUIMP) provisions for projects that are either located in or discharging directly to an ESA, create 2,500 square feet or more of impervious surface area, and will discharge storm water and urban runoff that is likely to impact sensitive biological species or habitat. Areas subject to SQUIMP provisions include the following categories:

- 303(d) listed waterbodies in all unimproved drainage systems;
- Regional Board's areas listed in the Basin Plan as supporting the "Rare, Threatened, or Endangered species (RARE)" Beneficial use; and
- California Coastal Commission's Environmentally Sensitive Habitat Areas.

An area that will be exempt from the storm water mitigation includes the following category:

- Development and/or re-development of a single family home.

Should you have any questions regarding this matter, please contact Tracy Woods at (213) 620-2095.

Sincerely,

Dennis A. Dickerson
Executive Officer

cc: Ms. Pamela Barksdale, State Water Resources Control Board

California Regional Water Quality Control Board
Los Angeles Region
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Recipient of the 2001 *Environmental Leadership Award* from Keep California Beautiful

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*Governor*

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640 - Internet Address: http://www.swrcb.ca.gov/rwqcb4

October 14, 2004

Mr. Jeff Pratt, P.E., Director
Ventura County Watershed Protection District
800 South Victoria Avenue
Ventura, CA 93009-1600

**NOTICE TO USE STANDARDIZED DATA TRANSFER FORMATS FOR MUNICPAL STORM WATER MONITORING DATA.**

Dear Mr. Pratt:

The Southern California Municipal Storm Water Monitoring Coalition (SMC), of which the County of Los Angeles is a member, is a cooperative partnership of Southern California Municipal Storm Water Permittees the Southern California Coastal Water Research Project (SCCWRP) and the Regional Water Quality Control Boards to develop and promote methodologies and assessment tools to more effectively understand urban storm water impacts to receiving waters. The SMC recently developed a Standardized Data Transfer Formats (SDTFs) for use by member agencies for electronic recording and transfer of storm water monitoring data. The SDTFs will facilitate the sharing of data among agencies for research, programmatic, regulatory, and public information purposes, and was made possible by a grant from the State Water Resources Control Board.

We provide notice that all Municipal Storm Water Permit programs within the jurisdiction of the Los Angeles Regional Water Quality Control Board are to use the SMC's SDTF beginning with the 2004/2005 Storm Water Monitoring Program Year for data recording and transfer. SCCWRP has kindly agreed to provide technical assistance if problems are encountered when setting up the SDTF.

Please contact Ken Schiff at 714/ 894-2222 for technical assistance. The SDTF document can be viewed at or downloaded from the weblink ftp://ftp.sccwrp.org/pub/download/PDFs/421_smc_sdtf.pdf. If you have any additional questions, please have your staff contact Tracy Woods of my staff at 213.620-2095.

Sincerely,

Jonathan Bishop, P.E.
Executive Officer
Los Angeles Regional Water Quality Control Board

cc: Mr. Bruce Fujimoto, Division of Water Quality, State Water Resources Control Board
Mr. Lawrence Jackson, Division Manager, Ventura County Watershed Protection District
Ms. Darla Wise, Ventura County Watershed Protection District
Mr. Chris Crompton, Chair, Storm Water Monitoring Coalition
Mr. Ken Schiff, Southern California Coastal Water Research Project

Alan C. Lloyd, Ph.D.
*Agency Secretary*

320 W. 4th Street, Suite 200, Los Angeles, California 90013
Phone (213) 576-6600 FAX (213) 576-6640 - Internet Address: http://www.waterboards.ca.gov/losangeles

Arnold Schwarzenegger
*Governor*

September 23, 2005

Mr. Mark D. Watkins
City of Thousand Oaks
2100 Thousand Oaks Blvd.
Thousand Oaks, CA 91362-2903

KEVIN STREET RISING GROUNDWATER MITIGATION

Dear Mr. Watkins:

Thank you for your letter dated July 27, 2005 in response to our letter of June 29, 2005. In your letter you request that the RWQCB reconsider its decision and allow the discharge of shallow groundwater from a subdrain collection system into the existing City storm drain system without an individual NPDES permit. You also add that we make the finding that this type of non-storm water discharge (natural springs and rising groundwater) is specifically exempted under the Ventura County Municipal Storm Water NPDES Permit, Part 1.A.2.a.

Clean Water Act Section 402(p)(3)(B)(ii) includes a requirement to effectively prohibit non-storm water discharges to municipal separate storm sewer systems (MS4). This requirement is extensively discussed by the USEPA in its Final Rule Notice (55 FR 222 48036). USEPA states that it "does not interpret the effective prohibition on non-storm water discharges to [MS4s] to apply to discharges that are not composed entirely of storm water, as long as such discharge has been issued a separate NPDES permit". As USEPA further clarifies, the effective prohibition does not require MS4 permits to prohibit certain discharges or flows of non-storm water to the MS4, if they are not identified as a source of pollutants by the MS4 permittees. These categories of non-storm water discharges are expressly listed at 40 CFR 122.26(d)(2)(iv)(B)(1), and appropriately authorized in Board Order 00-108.

Thus, rising groundwater at Kevin Street and other streets in the City would have been an authorized discharge had it not been polluted. You have reported that chloride concentrations in the rising groundwater exceed 650 mg/L as compared to in-stream chloride concentration of 250 mg/L, and the applicable water quality objective of 150 mg/L. That rising groundwater exceeds applicable water quality objectives (even if due to naturally occurring causes) is not a mitigating factor to make a legal exception for this discharge. The release of polluted water (e.g. 652 mg/L of chloride from Kevin St. into North Fork Arroyo Conejo with 249 mg/L of chloride) is considered a discharge of waste. Per the requirements of the Clean Water Act as outlined above, polluted rising groundwater in your City normally requires a separate NPDES permit to be discharged into the City's storm drain system.

The Calleguas Creek Watershed Management Plan, of which you are an active member, has requested the opportunity to develop its own plan to manage salts across the watershed in surface and groundwater and this work has been underway for several years. This issue, along with similar issues in other parts of the watershed, is most appropriately addressed as part of the Calleguas Creek Watershed Management Plan effort. The primary goal is the overall reduction of salts in the watershed such that water quality and water supplies are both preserved and restored for the future.

Please consult with the Calleguas Creek Watershed Management Plan Committee and report back to me by November 15, 2005 to specifically assess the short-term and long-term impacts of this discharge on downstream surface water chloride concentrations, and how the Management Plan's regional solution would address this impact. We would be scheduling an information item to the Regional Board during the next few months, to allow the Management Plan Committee to update the Board on their progress, and we expect that the update will address the proposed Kevin Street rising groundwater discharge. In addition, please provide a written update addressed to my attention by November 15, 2005 providing at least a conceptual proposal for addressing the increased chloride loading to the North Fork Arroyo Conejo.

We are more than happy to meet with you to further discuss this issue, and please call Melinda Becker at (213) 576-6681 or Ejigu Solomon at (213) 620-2237 to arrange a meeting.

Sincerely,

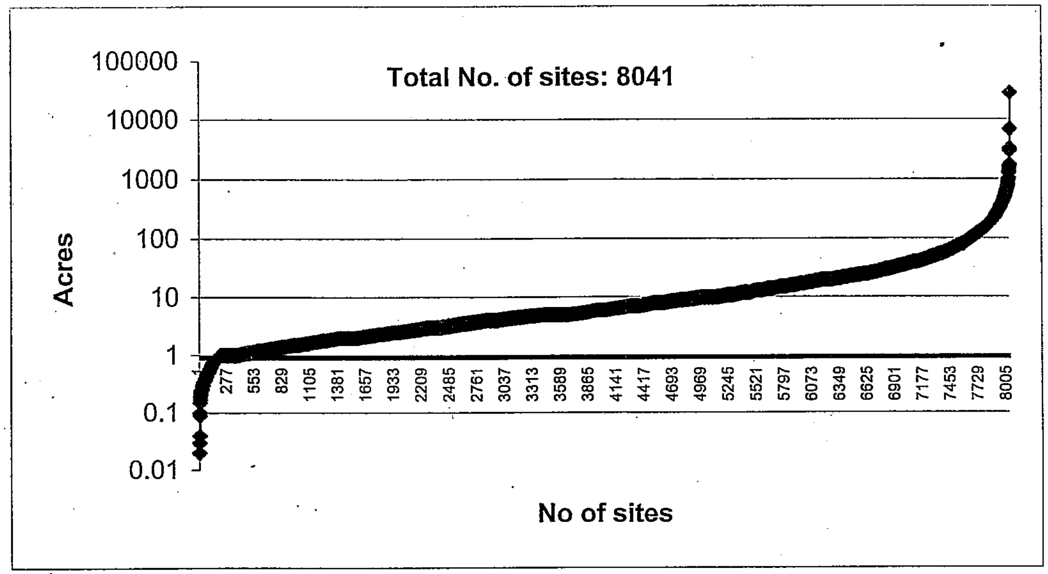
Jonathan S. Bishop
Executive Officer

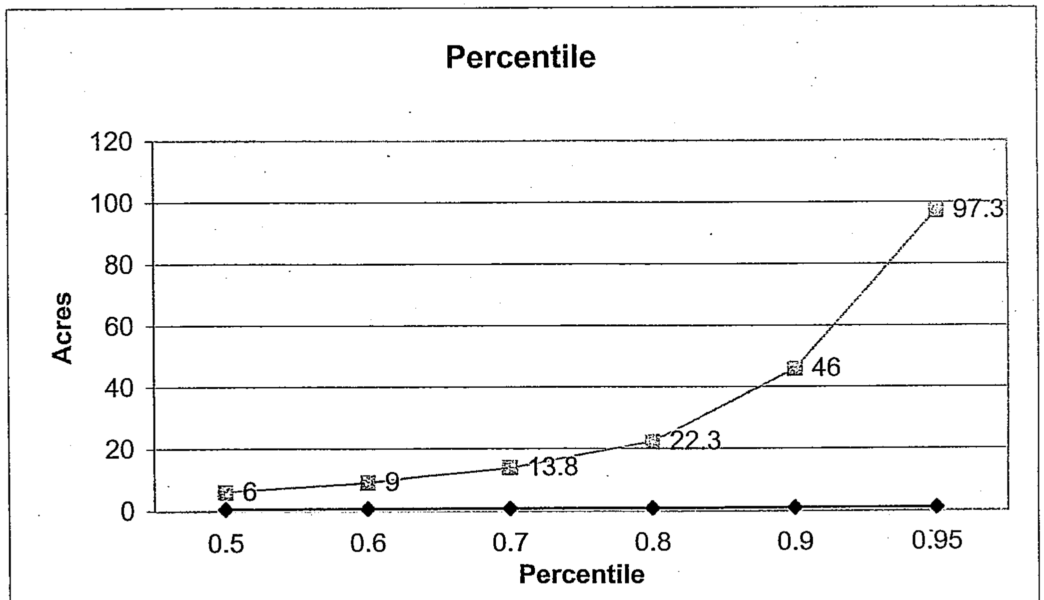
| TotalSize |
|---|
| 0.02 |
| 0.03 |
| 0.04 |
| 0.04 |
| 0.09 |
| 0.1 |
| 0.15 |
| 0.17 |
| 0.17 |
| 0.19 |
| 0.2 |
| 0.2 |
| 0.21 |
| 0.21 |
| 0.23 |
| 0.24 |
| 0.24 |
| 0.25 |
| 0.25 |
| 0.25 |
| 0.25 |
| 0.25 |
| 0.25 |
| 0.25 |
| 0.25 |
| 0.25 |
| 0.26 |
| 0.26 |
| 0.29 |
| 0.3 |
| 0.3 |
| 0.3 |
| 0.3 |
| 0.3 |
| 0.3 |
| 0.32 |
| 0.33 |
| 0.33 |
| 0.33 |
| 0.33 |
| 0.33 |

1376 sites less than 2 ac

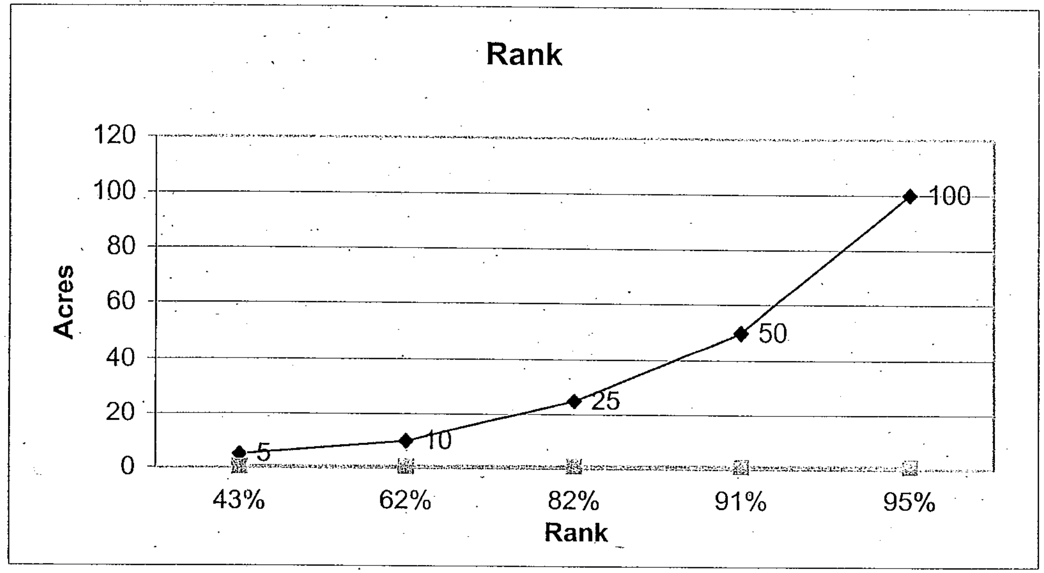
| Percentile | Acres |
|---|---|
| 0.5 | 6 |
| 0.6 | 9 |
| 0.7 | 13.8 |
| 0.8 | 22.3 |
| 0.9 | 46 |
| 0.95 | 97.3 |

| Acres | Rank |
|---|---|
| 5 | 43% |
| 10 | 62% |
| 25 | 82% |
| 50 | 91% |
| 100 | 95% |



| |
|---|
| 0.34 |
| 0.35 |
| 0.35 |
| 0.35 |
| 0.35 |
| 0.35 |
| 0.35 |
| 0.35 |
| 0.36 |
| 0.36 |
| 0.36 |
| 0.36 |
| 0.37 |
| 0.38 |
| 0.38 |
| 0.38 |
| 0.38 |
| 0.4 |
| 0.4 |
| 0.4 |
| 0.4 |
| 0.4 |
| 0.41 |
| 0.41 |
| 0.42 |
| 0.42 |
| 0.42 |
| 0.42 |
| 0.43 |
| 0.44 |
| 0.46 |
| 0.46 |
| 0.47 |
| 0.48 |
| 0.48 |
| 0.48 |
| 0.48 |
| 0.49 |
| 0.49 |
| 0.5 |
| 0.5 |
| 0.5 |



| SiteCity | SiteZip | TotalSize | Size Unit | County Code | ProgramGroup | RegionOfficeCode | FilingStatus | OriginDate |
|---|---|---|---|---|---|---|---|---|
| Camarillo | 93012 | 0.03 | Acres | 56 | Construction | 4 | Active | 10/28/92 0:00 |
| Los Angeles | 90066 | 0.04 | Acres | 19 | Construction | 4 | Active | 11/5/03 0:00 |
| Thousand Oaks | 91361 | 0.04 | Acres | 56 | Construction | 4 | Active | 10/18/92 0:00 |
| Alhambra | 91801- | 0.17 | Acres | 19 | Construction | 4 | Active | 6/29/05 0:00 |
| Stevenson Ranch | 91381- | 0.19 | Acres | 19 | Construction | 4 | Active | 7/26/04 0:00 |
| Calabasas | 91302-2984 | 0.21 | Acres | 19 | Construction | 4 | Active | 11/12/04 0:00 |
| Valencia | 91355 | 0.24 | Acres | 19 | Construction | 4 | Active | 5/26/04 0:00 |
| Santa Clarita | 91355- | 0.24 | Acres | 19 | Construction | 4 | Active | 12/16/04 0:00 |
| Valencia | 91381 | 0.25 | Acres | 19 | Construction | 4 | Active | 11/5/03 0:00 |
| Valencia | 91381- | 0.25 | Acres | 19 | Construction | 4 | Active | 6/4/04 0:00 |
| Valencia | 91380- | 0.25 | Acres | 19 | Construction | 4 | Active | 3/23/05 0:00 |
| Valencia | | 0.25 | Acres | 19 | Construction | 4 | Active | 5/16/05 0:00 |
| Inglewood | 90303- | 0.25 | Acres | 19 | Construction | 4 | Active | 8/15/05 0:00 |
| Valencia | 91381- | 0.26 | Acres | 19 | Construction | 4 | Active | 10/26/04 0:00 |
| Downey | 90241- | 0.26 | Acres | 19 | Construction | 4 | Active | 8/15/05 0:00 |
| Valencia | 91381 | 0.29 | Acres | 19 | Construction | 4 | Active | 12/11/03 0:00 |
| Beverly Hills | 90211- | 0.3 | Acres | 19 | Construction | 4 | Active | 3/4/05 0:00 |
| Valencia | 91381- | 0.3 | Acres | 19 | Construction | 4 | Active | 3/29/05 0:00 |
| Diamond Bar | 91765- | 0.3 | Acres | 19 | Construction | 4 | Active | 4/1/05 0:00 |
| Valencia | 91387- | 0.3 | Acres | 19 | Construction | 4 | Active | 5/2/05 0:00 |
| Canyon Country | 91351- | 0.33 | Acres | 19 | Construction | 4 | Active | 8/2/04 0:00 |
| Valencia | | 0.33 | Acres | 19 | Construction | 4 | Active | 11/24/04 0:00 |
| Valencia | 91318- | 0.33 | Acres | 19 | Construction | 4 | Active | 5/23/05 0:00 |
| Santa Paula | | 0.33 | Acres | 56 | Construction | 4 | Active | 5/24/05 0:00 |
| Beverly Hills | 90210- | 0.34 | Acres | 19 | Construction | 4 | Active | 5/2/05 0:00 |
| Valencia | 91381- | 0.35 | Acres | 19 | Construction | 4 | Active | 3/29/05 0:00 |
| Valencia | 91381- | 0.35 | Acres | 19 | Construction | 4 | Active | 5/13/05 0:00 |
| Valencia | 91381- | 0.35 | Acres | 19 | Construction | 4 | Active | 5/18/05 0:00 |
| Oxnard | 93030- | 0.35 | Acres | 56 | Construction | 4 | Active | 10/31/05 0:00 |
| Santa Clarita | 91381 | 0.38 | Acres | 19 | Construction | 4 | Active | 10/29/03 0:00 |
| San Dimas | 91773- | 0.38 | Acres | 19 | Construction | 4 | Active | 11/2/04 0:00 |
| Valencia | 91381- | 0.38 | Acres | 19 | Construction | 4 | Active | 11/9/04 0:00 |
| San Dimas | 91773- | 0.38 | Acres | 19 | Construction | 4 | Active | 11/23/04 0:00 |
| Valencia | 91355 | 0.4 | Acres | 19 | Construction | 4 | Active | 12/22/03 0:00 |
| Valencia | 91381- | 0.4 | Acres | 19 | Construction | 4 | Active | 3/29/05 0:00 |

| Percentile | Acres |
|---|---|
| 0.5 | 4.41 |
| 0.6 | 6.22 |
| 0.7 | 9.33 |
| 0.8 | 15 |
| 0.9 | 33 |
| 0.95 | 80 |

| Acres | Rank |
|---|---|
| 5 | 53% |
| 10 | 71% |
| 25 | 87% |
| 50 | 93% |
| 100 | 96% |

A003188

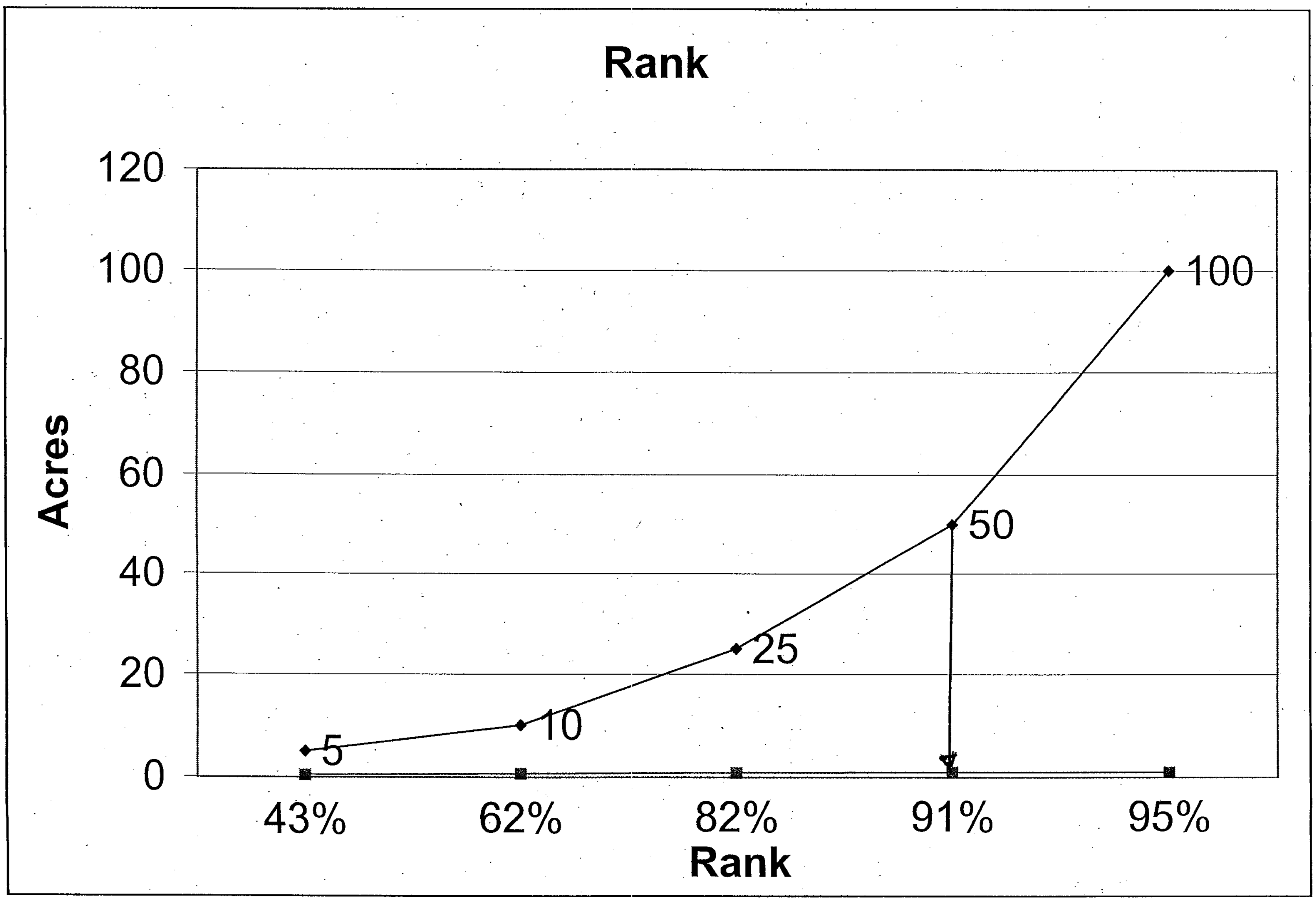
| WDID | TotalSize | SizeUnit | CountyCode | CountyName | ProgramGroup | RegionOfficeCode | FilingStatus | OriginDate |
|---|---|---|---|---|---|---|---|---|
| 8 30C328332 | 1.7 | Acres | 30 | Orange | Construction | 8 | Active | 6/24/04 0:00 |
| 8 33C326029 | 3 | Acres | 33 | Riverside | Construction | 8 | Active | 2/25/04 0:00 |
| 8 36C334126 | 4.8 | Acres | 36 | San Bernardino | Construction | 8 | Active | 5/13/05 0:00 |
| 8 33C333091 | 6 | Acres | 33 | Riverside | Construction | 8 | Active | 3/21/05 0:00 |
| 8 33C324850 | 0.75 | Acres | 33 | Riverside | Construction | 8 | Active | 11/25/03 0:00 |
| 8 30C328212 | 5.98 | Acres | 30 | Orange | Construction | 8 | Active | 6/21/04 0:00 |
| 8 36C331843 | 4.75 | Acres | 36 | San Bernardino | Construction | 8 | Active | 1/7/05 0:00 |
| 8 33C334786 | 1.05 | Acres | 33 | Riverside | Construction | 8 | Active | 6/14/05 0:00 |
| 8 33C332429 | 1.9 | Acres | 33 | Riverside | Construction | 8 | Active | 2/16/05 0:00 |
| 8 33C337616 | 3 | Acres | 33 | Riverside | Construction | 8 | Active | 11/7/05 0:00 |
| 8 33C327085 | 1.6 | Acres | 33 | Riverside | Construction | 8 | Active | 4/19/04 0:00 |
| 8 36C325806 | 96 | Acres | 36 | San Bernardino | Construction | 8 | Active | 2/6/04 0:00 |
| 8 36C325803 | 153 | Acres | 36 | San Bernardino | Construction | 8 | Active | 2/6/04 0:00 |
| 8 30C335984 | 1.34 | Acres | 30 | Orange | Construction | 8 | Active | 8/10/05 0:00 |
| 8 33C329956 | 5.19 | Acres | 33 | Riverside | Construction | 8 | Active | 9/21/04 0:00 |
| 8 36C332525 | 1.15 | Acres | 36 | San Bernardino | Construction | 8 | Active | 2/18/05 0:00 |
| 8 33C336853 | 1.9 | Acres | 33 | Riverside | Construction | 8 | Active | 9/28/05 0:00 |
| 8 36C327546 | 1.03 | Acres | 36 | San Bernardino | Construction | 8 | Active | 5/14/04 0:00 |
| 8 33C320902 | 4 | Acres | 33 | Riverside | Construction | 8 | Active | 4/4/03 0:00 |
| 8 33C337681 | 3.05 | Acres | 33 | Riverside | Construction | 8 | Active | 11/8/05 0:00 |
| 8 33C335096 | 40.65 | Acres | 33 | Riverside | Construction | 8 | Active | 6/28/05 0:00 |
| 8 33C338355 | 3 | Acres | 33 | Riverside | Construction | 8 | Active | 12/19/05 0:00 |
| 8 36C331975 | 2.63 | Acres | 36 | San Bernardino | Construction | 8 | Active | 1/14/05 0:00 |
| 8 36C331491 | 5 | Acres | 36 | San Bernardino | Construction | 8 | Active | 12/15/04 0:00 |
| 8 36C326322 | 2.41 | Acres | 36 | San Bernardino | Construction | 8 | Active | 3/12/04 0:00 |
| 8 30C330380 | 0.94 | Acres | 30 | Orange | Construction | 8 | Active | 10/8/04 0:00 |
| 8 33C311890 | 29 | Acres | 33 | Riverside | Construction | 8 | Active | 10/19/99 0:00 |
| 8 36C328896 | 2.4 | Acres | 36 | San Bernardino | Construction | 8 | Active | 7/22/04 0:00 |
| 8 33C332487 | 1.7 | Acres | 33 | Riverside | Construction | 8 | Active | 2/17/05 0:00 |
| 8 33C332486 | 1.7 | Acres | 33 | Riverside | Construction | 8 | Active | 2/17/05 0:00 |
| 8 33C326215 | 10.02 | Acres | 33 | Riverside | Construction | 8 | Active | 3/5/04 0:00 |
| 8 30C310611 | 500 | Acres | 30 | Orange | Construction | 8 | Active | 3/3/99 0:00 |
| 8 30C314931 | 147 | Acres | 30 | Orange | Construction | 8 | Active | 1/29/01 0:00 |
| 8 30C331249 | 149.7 | Acres | 30 | Orange | Construction | 8 | Active | 11/24/04 0:00 |
| 8 36C318877 | 6 | Acres | 36 | San Bernardino | Construction | 8 | Active | 9/11/02 0:00 |



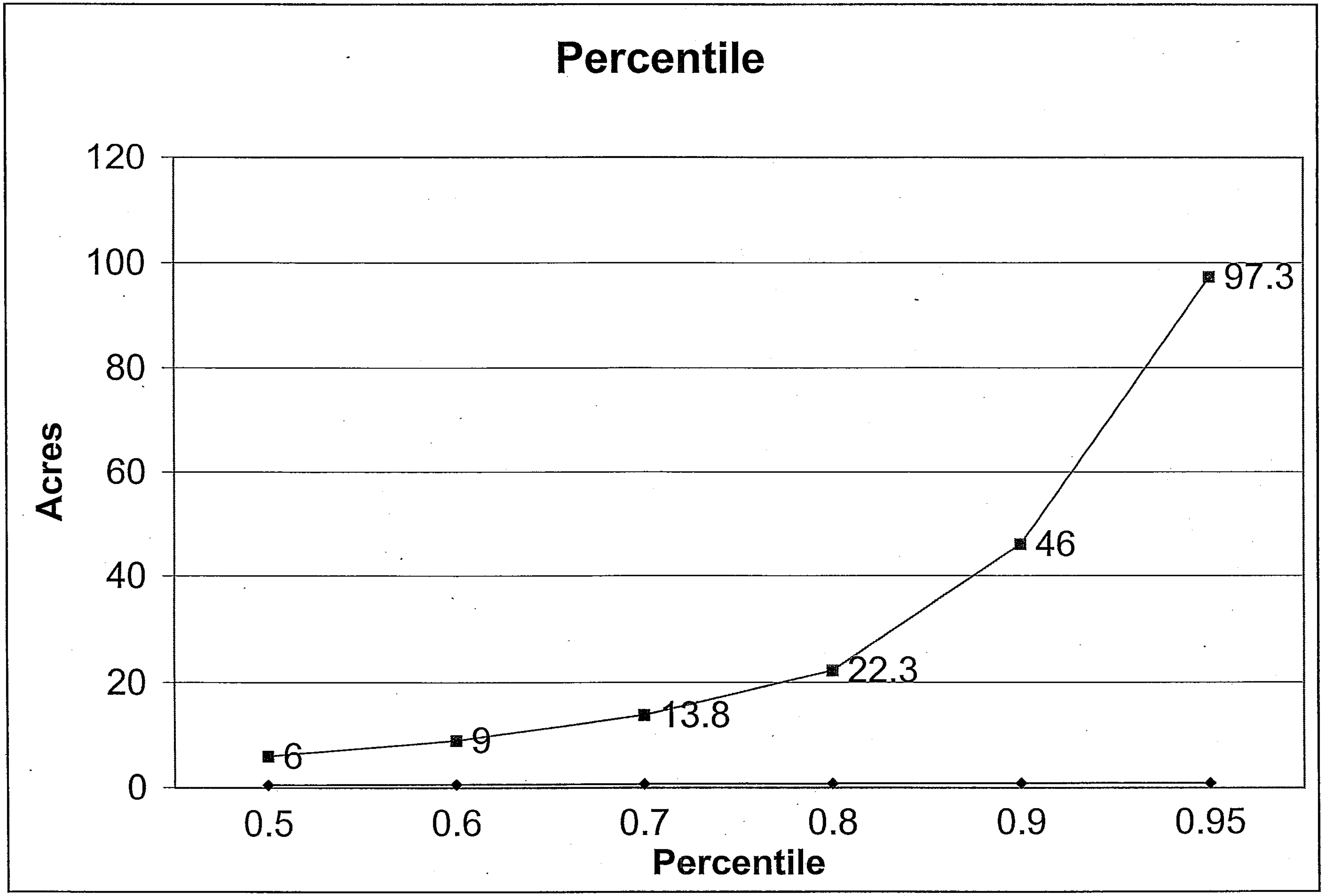
A003189

| WDID | TotalSize | SizeUnit | CountyCode | CountyName | ProgramGroup | RegionOfficeCode | FilingStatus | OriginDate | |
|---|---|---|---|---|---|---|---|---|---|
| 9 37C328067 | 1 | Acres | 37 | San Diego | Construction | 9 | Active | 6/14/04 0:00 | |
| 9 37C330299 | 4.78 | Acres | 37 | San Diego | Construction | 9 | Active | 10/7/04 0:00 | |
| 9 33C312488 | 5 | Acres | 33 | Riverside | Construction | 9 | Active | 1/25/00 0:00 | |
| 9 37C338002 | 5.12 | Acres | 37 | San Diego | Construction | 9 | Active | 11/23/05 0:00 | |
| 9 33C333323 | 8.9 | Acres | 33 | Riverside | Construction | 9 | Active | 3/30/05 0:00 | |
| 9 33C329490 | 3.86 | Acres | 33 | Riverside | Construction | 9 | Active | 8/23/04 0:00 | |
| 9 37C325946 | 7.08 | Acres | 37 | San Diego | Construction | 9 | Active | 2/20/04 0:00 | |
| 9 37C316136 | 509 | Acres | 37 | San Diego | Construction | 9 | Active | 7/24/01 0:00 | |
| 9 37C322830 | 25.16 | Acres | 37 | San Diego | Construction | 9 | Active | 8/6/03 0:00 | |
| 9 37C323689 | 61.5 | Acres | 37 | San Diego | Construction | 9 | Active | 9/29/03 0:00 | |
| 9 37C324691 | 3.05 | Acres | 37 | San Diego | Construction | 9 | Active | 11/14/03 0:00 | |
| 9 37C310532 | 17 | Acres | 37 | San Diego | Construction | 9 | Active | 2/11/99 0:00 | |
| 9 37C317382 | 187 | Acres | 37 | San Diego | Construction | 9 | Active | 2/8/02 0:00 | |
| 9 37C329896 | 132 | Acres | 37 | San Diego | Construction | 9 | Active | 9/15/04 0:00 | |
| 9 37C325787 | 132 | Acres | 37 | San Diego | Construction | 9 | Active | 2/6/04 0:00 | |
| 9 37C332667 | 4 | Acres | 37 | San Diego | Construction | 9 | Active | 2/28/05 0:00 | |
| 9 37C319530 | 22 | Acres | 37 | San Diego | Construction | 9 | Active | 11/26/02 0:00 | |
| 9 33C335847 | 9.3 | Acres | 33 | Riverside | Construction | 9 | Active | 8/3/05 0:00 | |
| 9 37C336292 | | Acres | 37 | San Diego | Construction | 9 | Active | 8/30/05 0:00 | |
| 9 33C326388 | 1.89 | Acres | 33 | Riverside | Construction | 9 | Active | 3/16/04 0:00 | |
| 9 33C318189 | 3 | Acres | 33 | Riverside | Construction | 9 | Active | 6/4/02 0:00 | |
| 9 37C338032 | 3 | Acres | 37 | San Diego | Construction | 9 | Active | 11/28/05 0:00 | |
| 9 37C333591 | 4.97 | Acres | 37 | San Diego | Construction | 9 | Active | 4/13/05 0:00 | |
| 9 33C319168 | 21 | Acres | 33 | Riverside | Construction | 9 | Active | 10/25/02 0:00 | |
| 9 33C328747 | 4.6 | Acres | 33 | Riverside | Construction | 9 | Active | 7/15/04 0:00 | |
| 9 33C330476 | 2.53 | Acres | 33 | Riverside | Construction | 9 | Active | 10/15/04 0:00 | |
| 9 33C326143 | 1.51 | Acres | 33 | Riverside | Construction | 9 | Active | 3/1/04 0:00 | |
| 9 37C314239 | 10 | Acres | 37 | San Diego | Construction | 9 | Active | 10/16/00 0:00 | |
| 9 37C305891 | 9 | Acres | 37 | San Diego | Construction | 9 | Active | 5/15/96 0:00 | |
| 9 30C331979 | 148 | Acres | 30 | Orange | Construction | 9 | Active | 1/18/05 0:00 | |
| 9 37C321898 | 1.3 | Acres | 37 | San Diego | Construction | 9 | Active | 6/4/03 0:00 | |
| 9 37C338168 | 1.98 | Acres | 37 | San Diego | Construction | 9 | Active | 12/5/05 0:00 | |
| 9 37C330933 | 2.9 | Acres | 37 | San Diego | Construction | 9 | Active | 11/12/04 0:00 | |
| 9 33C324183 | 2.17 | Acres | 33 | Riverside | Construction | 9 | Active | 10/20/03 0:00 | |
| 9 33C317451 | 21 | Acres | 33 | Riverside | Construction | 9 | Active | 2/14/02 0:00 | |

A003190

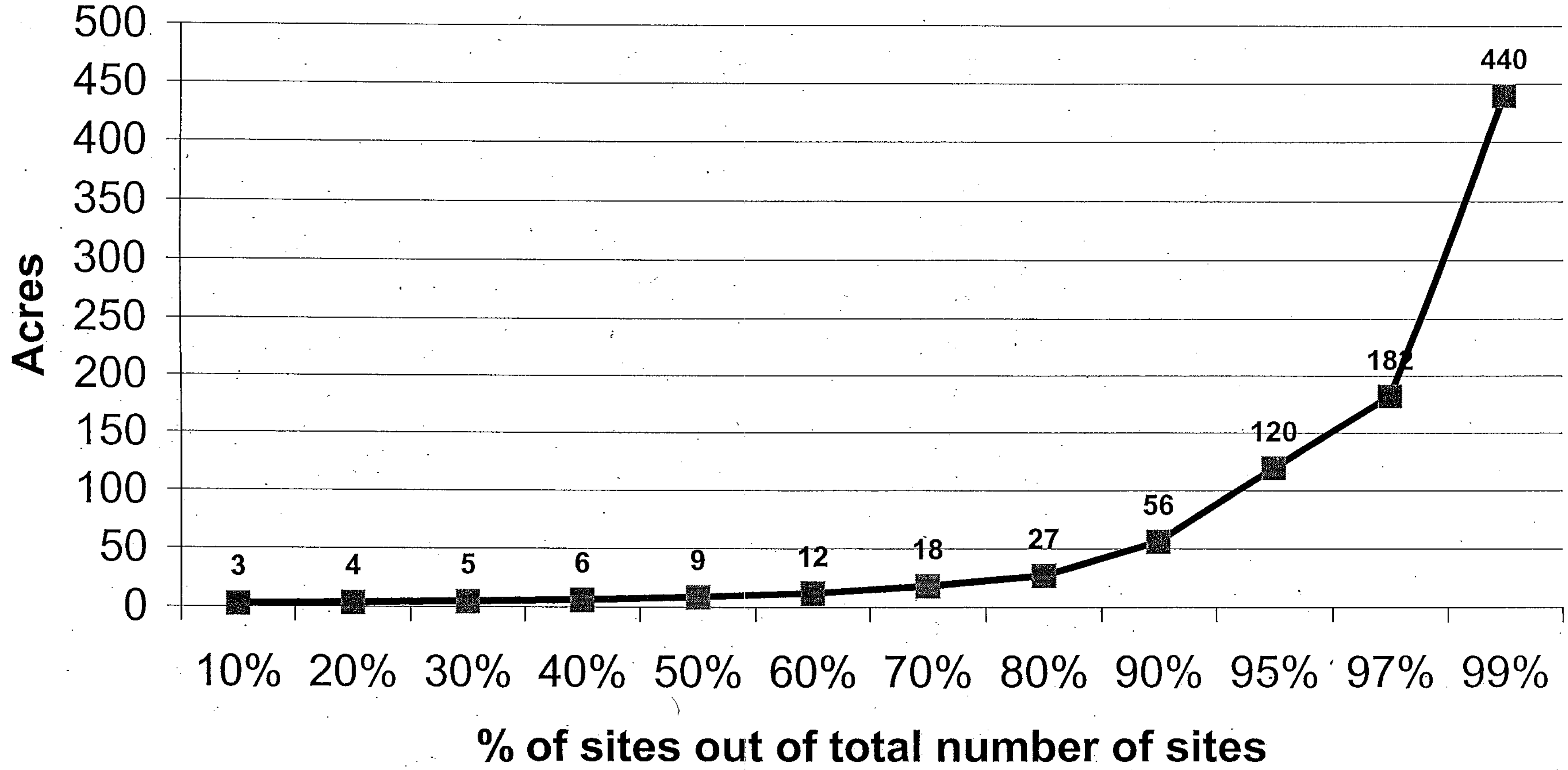


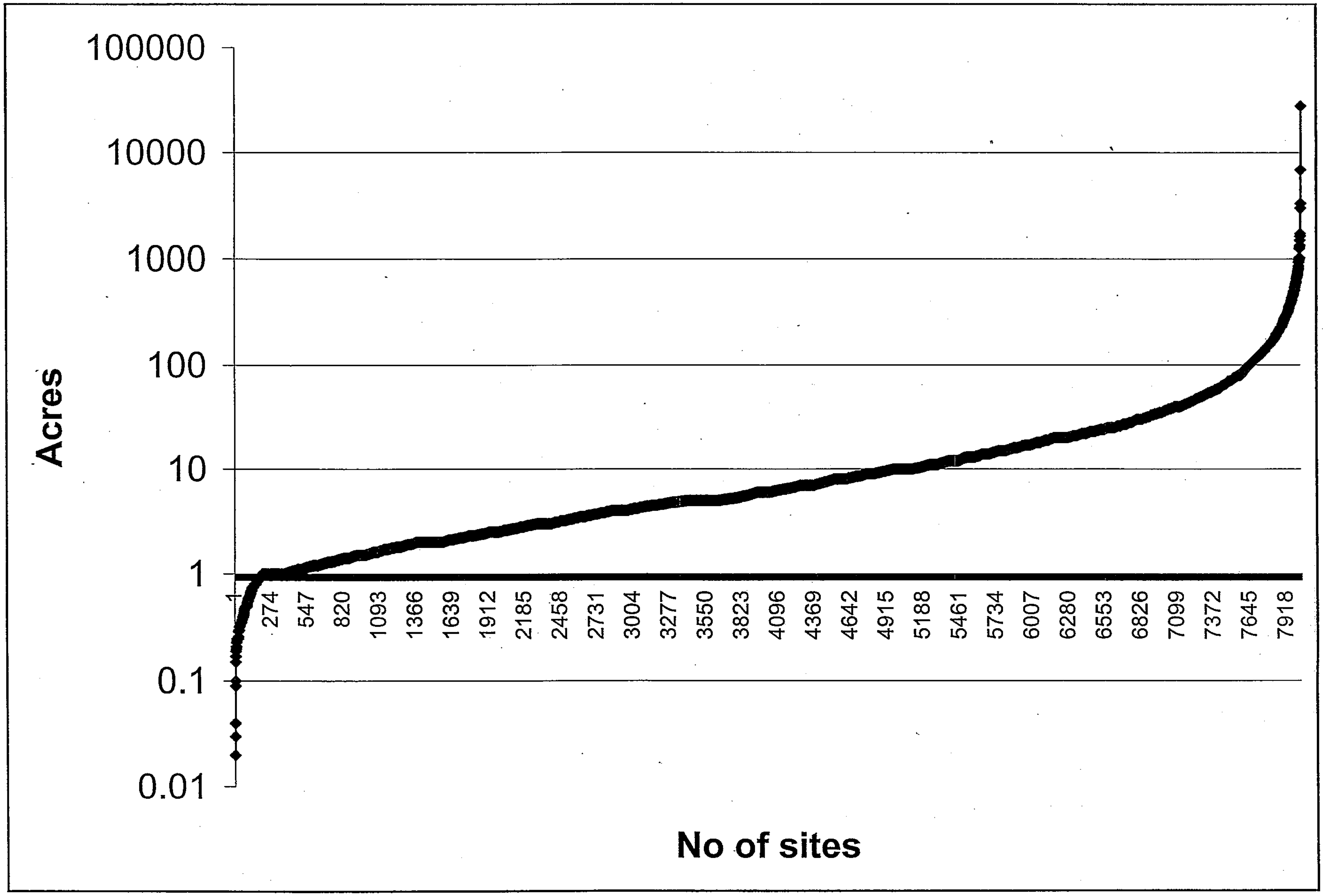
Rank
Acres
120
100
80
60
40
20
0
5
10
25
50
100
43%
62%
82%
91%
95%
Rank


Percentile
Acres
120
100
80
60
40
20
0
6
9
13.8
22.3
46
97.3
0.5
0.6
0.7
0.8
0.9
0.95
Percentile

A003192

**Rank in size analysis Southern California**
**Total number of sites: 6,611**
**December 5, 2005**





100000
10000
1000
100
10
1
0.1
0.01
Acres
1
274
547
820
1093
1366
1639
1912
2185
2458
2731
3004
3277
3550
3823
4096
4369
4642
4915
5188
5461
5734
6007
6280
6553
6826
7099
7372
7645
7918
No of sites



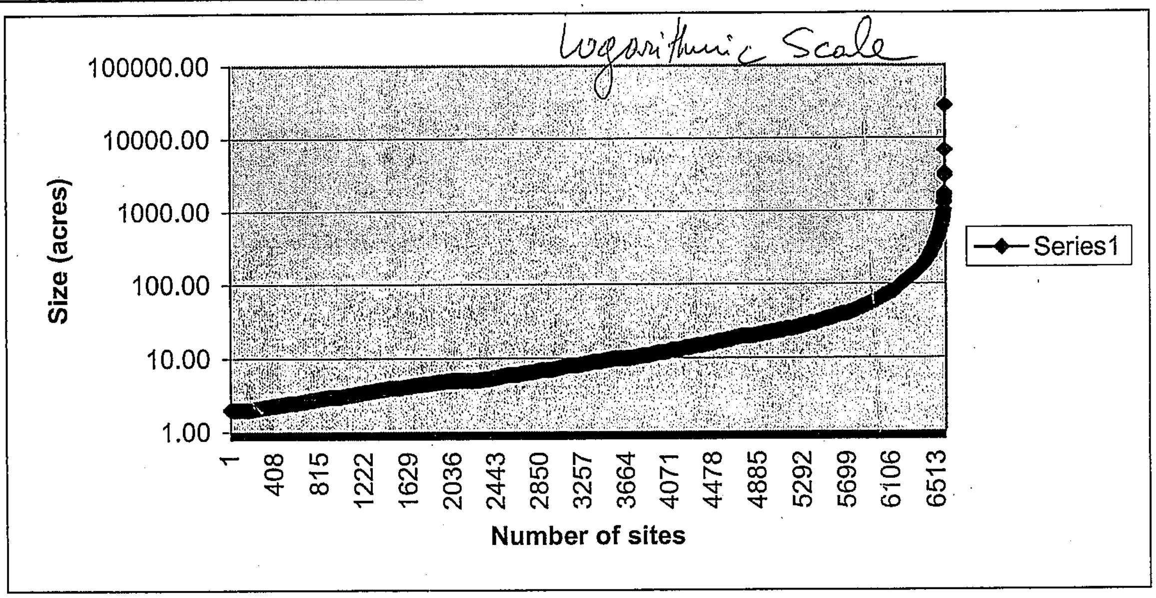

A003194

| **5-Dec-05** | | | Rank | Acres |
|---|---|---|---|---|
| Percentile | Acres | | 10% | 2.6 |
| 8% | 2.5 | | 20% | 3.65 |
| 14% | 3 | | 30% | 4.9 |
| 31% | 5 | | 40% | 6 |
| 39% | 6 | | 50% | 8.5 |
| 54% | 10 | | 60% | 11.8 |
| 78% | 25 | | 70% | 17.8 |
| 90% | 55 | | 80% | 27 |
| 95% | 120 | | 90% | 56 |
| 99% | 440 | | 95% | 120 |
| | | | 97% | 182.39 |
| | | | 99% | 439.9 |

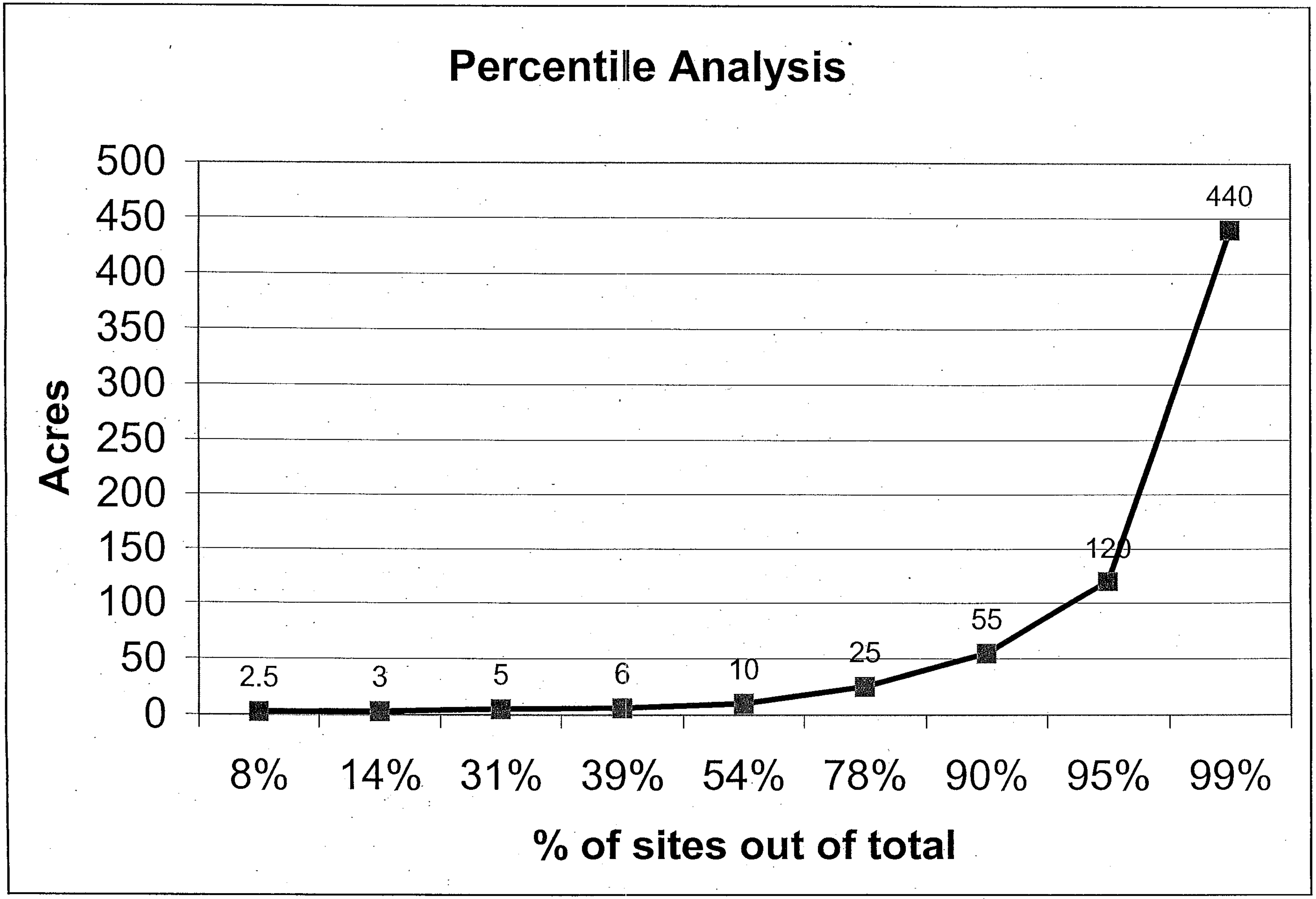
| | | |
|---|---|---|
| 8.52 | Acres | 50th percentile |
| 11.848 | Acres | 60th percentile |
| 18 | Acres | 70th percentile |
| 27 | Acres | 80th percentile |
| 56 | Acres | 90th percentile |
| 120.6 | Acres | 95th percentile |
| 183.032 | Acres | 97th percentile |
| 440.24 | Acres | 99th percentile |

| | | |
|---|---|---|
| 53.9% | 10 | Acres |
| 78.0% | 25 | Acres |
| 89.6% | 55 | Acres |
| 94.9% | 120 | Acres |
| 97.9% | 250 | Acres |

Rank




A003196


Percentile Analysis
Acres
500
450
400
350
300
250
200
150
100
50
0
2.5
3
5
6
10
25
55
120
440
8%
14%
31%
39%
54%
78%
90%
95%
99%
% of sites out of total

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## Wal-Mart

**Antioch, IL March 2004**

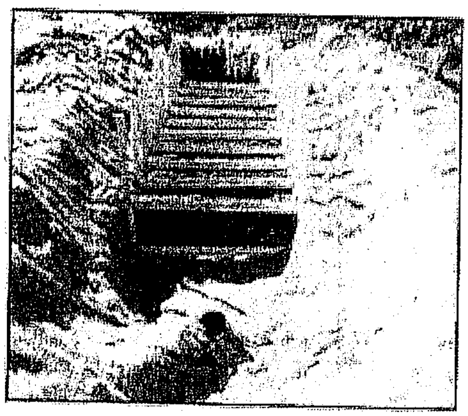
Local ordinances required construction of a large detention basin to control the storm water release rate leaving this new, 25 acre Wal-Mart facility. In addition, this 330' x 180' basin served as a sediment control trap during mass grading, utility installation and site development operations. Water exited the basin through a conventional perforated standpipe with gravel pack. These erosion/sediment management practices met local ordinance mandates.

Spring snow melt coupled with early rains sent turbid water into the completed basin. Since the basin was not stabilized prior to winter shutdown, the raw soil side slopes and bottom contributed additional suspended solids into the water column. Even with the large basin size, the colloidal [fine clay] suspensions would not clarify by gravity. Further, wind generated currents churned near-surface sediments and waves eroded bank soils, contributing to continuous high turbidity water condition.

Water exiting the basin drained into the environmentally sensitive wetlands surrounding the East and West Loon Lakes. The gravel packed standpipe performed the expected functions of filtering debris and sand, but offered little relief from the chocolate-brown colloidal and silt suspension; water leaving the basin did not pass Lake County Storm Water Management [LCSWM] nor Illinois Environmental Protection Agency [IEPA] requirements.

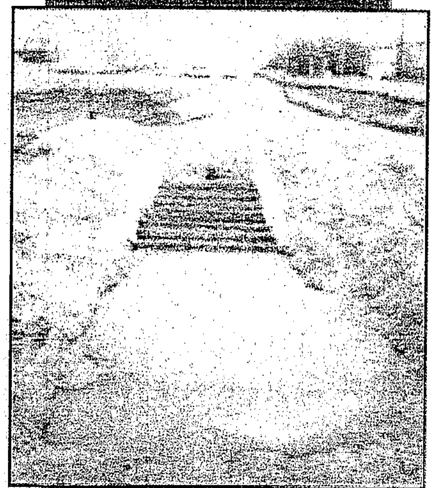
Both LCSWM and IEPA took due-process steps to ensure that water leaving the site met their quality standards. As a result, the excavating contractor, *Thelen Sand & Gravel, Inc.* of Antioch, IL, called erosion/sediment control material distributor *Ero-Tex* to determine if and what systems could be used to clarify the storm water prior to off-site discharge. After reviewing site conditions and hydraulic requirements, *Ero-Tex* suggested the use of a storm water treatment system that would flocculate and chelate [chemical processes] suspended solids from the water, leaving discharges significantly clarified.

To ready the system, *Thelen* excavated a sump within the southwest basin that consisted of two parts, a 'grit pit' into which an existing 15" pipe would discharge and the heavy soil fractions and floc would settle by gravity. The second system part, a 'baffle grid', would then filter finer floc and chelate formations still moving within the water column. The pit measured approximately



Foreground: effluent pipe
Middle: baffle grid
Background: grit pit

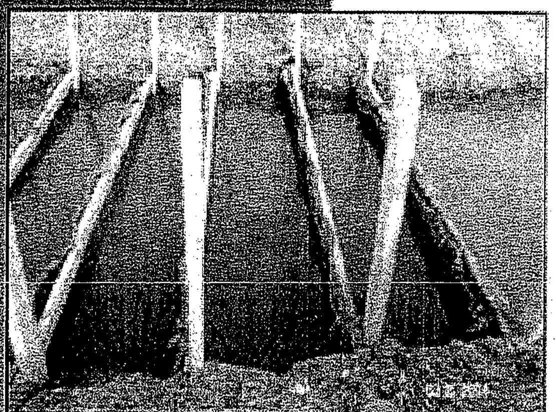
A003198



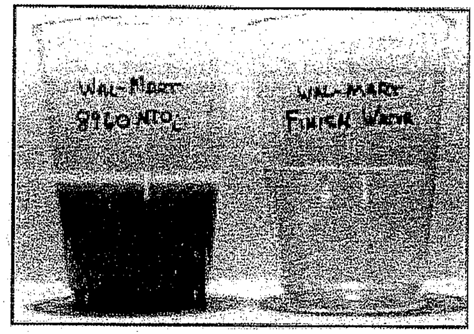
8' wide, 6' deep and 10' long while the downstream grid was 8' wide, 30' long and 2' deep. Both the pit and grid were stabilized using *Applied Polymer Systems, Inc.* [APS] ***Silt Stop® 705*** polyacrylamide [PAM] blend and jute fabric. Within the grid, 10 jute baffles were constructed, allowing the flowing water to pass through the jute to the discharge pipe. *Thelen* placed 16 *APS* ***706b Floc Logs®*** [semi-hydrated PAM blends] into the upper portions of the 1000' long, 15" pipe. The ***Floc Logs*** offered a passive method to introduce the appropriate flocculant-chelant into the treatment system.

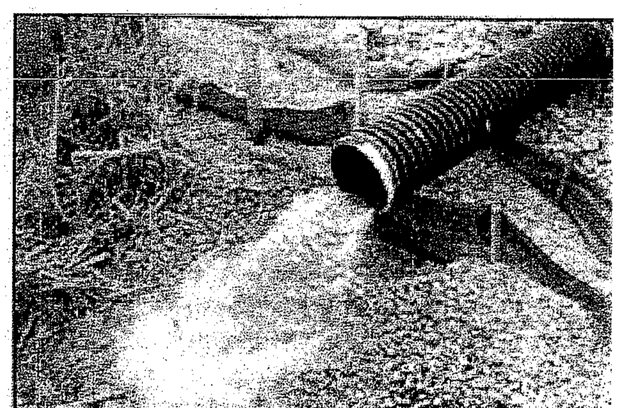
Water passing over and around the ***Floc Logs*** dissolved the polymer in trace quantities. Down pipe movement enabled the suspended solids to attach to the polymer charge sites, causing floc and chelate formation. With the discharge entering the quiescent pit, most floc and chelates [and, thus, suspended soil particles] settled immediately. The remaining lighter floc fraction was 'filtered' by the jute baffles, rendering significantly improved storm water clarity prior to discharge to the off-site location.

During Operation



Initial and treated water samples





Discharge Water – At Conclusion of Baffle Grid

*Silt Stop* and *Floc Log* are trademarks of Applied Polymer Systems, Inc.

**Water entering 15" pipe = 8960 NTU**
**Water passing first baffle = 2.3 NTU**
**Discharge water = 1.8 NTU**

**This simple, cost effective system, using *APS Floc Logs*, provided a 3+ order of magnitude improvement in storm water clarity !!**

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**Wyoming: 800.248.8230**

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# Post-Construction Storm Water Management in New Development and Redevelopment

## Regulatory Text

- You must develop, implement, and enforce a program to address storm water runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into your small MS4. Your program must ensure that controls are in place that would prevent or minimize water quality impacts.

- You must:

    - Develop and implement strategies which include a combination of structural and/or non-structural best management practices (BMPs) appropriate for your community;

    - Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State, Tribal or local law;

    - Ensure adequate long-term operation and maintenance of BMPs.

### Guidance

If water quality impacts are considered from the beginning stages of a project, new development and potentially redevelopment provide more opportunities for water quality protection. EPA recommends that the BMPs chosen: be appropriate for the local community; minimize water quality impacts; and attempt to maintain pre-development runoff conditions. In choosing appropriate BMPs, EPA encourages you to participate in locally-based watershed planning efforts which attempt to involve a diverse group of stakeholders including interested citizens. When developing a program that is consistent with this measure's intent, EPA recommends that you adopt a planning process that identifies the municipality's program goals (e.g., minimize water quality impacts resulting from post-construction runoff from new development and redevelopment), implementation strategies (e.g., adopt a combination of structural and/or non-structural BMPs), operation and maintenance policies and procedures, and enforcement procedures. In developing your program, you should consider assessing existing ordinances, policies, programs and studies that address storm water runoff quality. In addition to assessing these existing documents and programs, you should provide opportunities to the public to participate in the development of the program. Non-structural BMPs are preventative actions that involve management and source controls such as: policies and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space (including a dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation; policies or ordinances that encourage infill development in higher density urban areas, and areas with existing infrastructure; education programs for developers and the public about project designs that minimize water quality impacts; and measures such as minimization of percent impervious area after development and minimization of directly connected impervious areas. Structural BMPs include: storage practices such as wet ponds and extended-detention outlet structures; filtration practices such as grassed swales, sand filters and filter strips; and infiltration practices such as infiltration basins and infiltration trenches. EPA recommends that you ensure the appropriate implementation of the structural BMPs by considering some or all of the following: pre-construction review of BMP designs; inspections during construction to verify BMPs are built as designed; post-construction inspection and maintenance of BMPs; and penalty provisions for the noncompliance with design, construction or operation and maintenance. Storm water technologies are constantly being improved, and EPA recommends that your requirements be responsive to these changes, developments or improvements in control technologies.

**BMP Fact Sheets**

***Structural BMPs***

*Ponds*

Dry extended detention ponds

Wet ponds

*Infiltration practices*

Infiltration basin

Infiltration trench

Porous pavement

*Filtration practices*

Bioretention

Sand and organic filters

*Vegetative practices*

Storm water wetland

Grassed swales

Grassed filter strip

*Runoff pretreatment practices*

Catch basin

In-line storage

Manufactured products for storm water inlets

***Nonstructural BMPs***

*Experimental practices*

Alum injection

*On-lot Treatment*

On-Lot treatment

*Better site design*

Buffer zones

Open space design

Urban forestry

Conservation easements

Infrastructure planning

Narrower residential streets

Eliminating curbs and gutters

Green parking

Alternative turnarounds

Alternative pavers

BMP inspection and maintenance

Ordinances for postconstruction runoff

Zoning

**Additional Fact Sheets**

Bioretention

Hydrodynamic Separators

Infiltration Drainfields

Infiltration Trench

Modular Treatment System

Porous Pavement

Sand Filters

Storm Water Wetlands

# *Structural BMPs*

## *Ponds*

### Dry Extended Detention Pond

### Postconstruction Storm Water Management in New Development and Redevelopment

**Description**

A dry extended detention pond is designed to temporarily detain runoff during storm events

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the storm water runoff from a water quality design storm for some minimum time (e.g., 24 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. However, they are often designed with small pools at the inlet and outlet of the basin. They can also be used to provide flood control by including additional flood detention storage.

**Applicability**

Dry extended detention ponds are among the most widely applicable storm water management practices. Although they have limited applicability in highly urbanized settings, they have few other restrictions.

*Regional Applicability*

Dry extended detention ponds can be applied in all regions of the United States. Some minor design modifications might be needed, however, in cold or arid climates or in regions with karst (i.e. limestone) topography.

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface is present. It is difficult to use dry extended detention ponds in the ultra-urban environment because of the land area each pond consumes. They can, however, be used in an ultra-urban environment if a relatively large area is available downstream of the pond.

*Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. Dry extended detention ponds can accept runoff from storm water hot spots, but they need significant separation from ground water if they will be used for this purpose.

*Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Dry extended detention ponds are very useful storm water retrofits, and they have two primary applications as a retrofit design. In many communities in the past, detention basins have been designed for flood control. It is possible to modify these facilities to incorporate features that encourage water quality control and/or channel protection. It is also possible to construct new dry ponds in open areas of a watershed to capture existing drainage.

*Cold Water (Trout) Streams*

A study in Prince George's County, Maryland, found that storm water management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain storm water for a relatively short time (i.e., less than 12 hours) to minimize the amount of warming that occurs in the practice.

## Siting and Design Considerations

*Siting Considerations*

Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

Drainage Area

In general, dry extended detention ponds should be used on sites with a minimum area of 10 acres. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale (see Cost Considerations).

Slope

Dry extended detention basins can be used on sites with slopes up to about 15 percent. The local slope needs to be relatively flat, however, to maintain reasonably flat side slopes in the practice. There is no minimum slope requirement, but there does need to be enough elevation drop from the pond inlet to the pond outlet to ensure that flow can move through the system.

Soils / Topography

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of karst topography or in rapidly percolating soils such as sand. In these areas, extended detention ponds should be designed with an impermeable liner to prevent ground water contamination or sinkhole formation.

Ground Water

Except for the case of hot spot runoff, the only consideration regarding ground water is that the base of the extended detention facility should not intersect the ground water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

*Design Considerations*

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community. Some features, however, should be incorporated into most dry extended detention pond designs. These design features can be divided into five basic categories: pretreatment, treatment, conveyance, maintenance reduction, and landscaping.

Pretreatment

Pretreatment incorporates design features that help to settle out coarse sediment particles. By removing these particles from runoff before they reach the large permanent pool, the maintenance burden of the pond is reduced. In ponds, pretreatment is achieved with a sediment forebay, which is a small pool (typically about 10 percent of the volume of water to be treated for pollutant removal).

Treatment

Treatment design features help enhance the ability of a storm water management practice to remove pollutants. Designing dry ponds with a high length-to-width ratio (i.e., at least 1.5:1) and incorporating other design features to maximize the flow path effectively increases the detention time in the system by eliminating the potential of flow to short-circuit the pond. Designing ponds with relatively flat side slopes can also help to lengthen the effective flow path. Finally, the pond should be sized to detain the volume of runoff to be treated for between 12 and 48 hours.

Conveyance

Conveyance of storm water runoff into and through a storm water management practice is a critical component of any such practice. Storm water should be conveyed to and from practices safely in a manner that minimizes erosion potential. The outfall of pond systems should always be stabilized to prevent scour. To convey low flows through the system, designers should provide a pilot channel. A pilot channel is a surface channel that should be used to convey low flows through the pond. In addition, an emergency spillway should be provided to safely convey large flood events. To help mitigate warming at the outlet channel, designers should provide shade around the channel at the pond outlet.

Maintenance Reduction

In addition to regular maintenance activities needed to maintain the function of storm water practices, some design features can be incorporated to ease the maintenance burden of each practice. In dry extended detention ponds, a "micropool" at the outlet can prevent resuspension of sediment and outlet clogging. A good design includes maintenance access to the forebay and micropool.

Another design feature that can reduce maintenance needs is a non-clogging outlet. Typical examples include a reverse-slope pipe or a weir outlet with a trash rack. A reverse slope pipe draws from below the permanent pool extending in a reverse angle up to the riser and determines the water elevation of the micropool. Because these outlets draw water from below the level of the permanent pool, they are less likely to be clogged by floating debris.

Landscaping

Designers should maintain a vegetated buffer around the pond and should select plants within the extended detention zone (i.e., the portion of the pond up to the elevation where storm water is detained) that can withstand both wet and dry periods. The side slopes of dry ponds should be relatively flat to reduce safety risks.

*Design Variations*

Dry Detention Ponds

Dry detention ponds are similar in design to extended detention ponds, except that they do not incorporate features to improve water quality. In particular, these practices do not detain storm water from small-flow events. Therefore, detention ponds provide almost no pollutant removal. However, dry ponds can help to meet flood control, and sometimes channel protection, objectives in a watershed.

Tank Storage

Another variation of the dry detention pond design is the use of tank storage. In these designs, storm water runoff is conveyed to large storage tanks or vaults underground. This practice is most often used in the ultra-urban environment, on small sites where no other opportunity is available to provide flood control. Tank storage is provided on small areas because providing underground storage for a large drainage area would generally be cost-prohibitive. Because the drainage area contributing to tank storage is typically small, the outlet diameter needed to reduce the flow from very small storms would very small. A very small outlet diameter, along with the underground location of the tanks, creates the potential for debris being caught in the outlet and resulting maintenance problems. Since it is necessary to control small runoff events (such as the runoff from a 1-inch storm) to improve water quality, it is generally infeasible to use tank storage for water quality and generally impractical to use it to protect stream channels.

*Regional Variations*

Arid or Semi-Arid Climates

In arid and semi-arid regions, some modifications might be needed to conserve scarce water resources. Any landscaping plans should prescribe drought-tolerant vegetation wherever possible. In addition, the wet forebay can be replaced with an alternative dry pretreatment, such as a detention cell. One opportunity in regions with a distinct wet and dry season, as in many arid regions, is to use regional extended detention ponds as a recreation area such as a ball field during the dry season.

### Cold Climates

In cold climates, some additional design features can help to treat the spring snowmelt. One such modification is to increase the volume available for detention to help treat this relatively large runoff event. In some cases, dry facilities may be an option as a snow storage facility to promote some treatment of plowed snow. If a pond is used to treat road runoff or is used for snow storage, landscaping should incorporate salt-tolerant species. Finally, sediment might need to be removed from the forebay more frequently than in warmer climates (see Maintenance Considerations for guidelines) to account for sediment deposited as a result of road sanding.

## Limitations

Although dry extended detention ponds are widely applicable, they have some limitations that might make other storm water management options preferable:

- Dry extended detention ponds have only moderate pollutant removal when compared to other structural storm water practices, and they are ineffective at removing soluble pollutants (See Effectiveness).
- Dry extended detention ponds may become a nuisance due to mosquito breeding.
- Habitat destruction may occur during construction if the practice is designed in-stream or within the stream buffer.
- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home (see Cost Considerations).

Dry extended detention ponds on their own only provide peak flow reduction and do little to control overall runoff volume, which could result in adverse downstream impacts.

## Maintenance Considerations

In addition to incorporating features into the pond design to minimize maintenance, some regular maintenance and inspection practices are needed. Table 1 outlines some of these practices.

## Effectiveness

Structural management practices can be used to achieve four broad resource protection goals: flood control, channel protection, ground water recharge, and pollutant removal. Dry extended detention basins can provide flood control and channel protection, as well as some pollutant removal.

### *Flood Control*

One objective of storm water management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most extended detention ponds.

Table 1. Typical maintenance activities for dry ponds (Source: Modified from WMI, 1997)

| Activity | Schedule |
|---|---|
| • Note erosion of pond banks or bottom | Semiannual inspection |
| • Inspect for damage to the embankment<br>• Monitor for sediment accumulation in the facility and forebay<br>• Examine to ensure that inlet and outlet devices are free of debris and operational | Annual inspection |
| • Repair undercut or eroded areas<br>• Mow side slopes<br>• Manage pesticide and nutrients<br>• Remove litter and debris | Standard maintenance |
| • Seed or sod to restore dead or damaged ground cover | Annual maintenance (as needed) |
| • Remove sediment from the forebay | 5- to 7-year maintenance |
| • Monitor sediment accumulations, and remove sediment when the pond volume has been reduced by 25 percent | 25- to 50-year maintenance |

*Channel Protection*

One result of urbanization is the geomorphic changes that occur in response to modified hydrology. Traditionally, dry extended detention basins have provided control of the 2-year storm (i.e., the storm that occurs, on average, once every 2 years) for channel protection. It appears that this control has been relatively ineffective, and recent research suggests that control of a smaller storm might be more appropriate (MacRae, 1996). Slightly modifying the design of dry extended detention basins to reduce the flow of smaller storm events might make them effective tools in reducing downstream erosion.

*Pollutant Removal*

Dry extended detention basins provide moderate pollutant removal, provided that the design features described in the Siting and Design Considerations section are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. A few studies are available on the effectiveness of dry extended detention ponds. Typical removal rates, as reported by Schueler (1997), are as follows:

Total suspended solids: 61%
Total phosphorus: 19%
Total nitrogen: 31%
Nitrate nitrogen: 9%
Metals: 26%–54%

There is considerable variability in the effectiveness of ponds, and it is believed that properly designing and maintaining ponds may help to improve their performance. The siting and design criteria presented in this sheet reflect the best current information and experience to improve the performance of wet ponds. A recent joint project of the American Society of Civil Engineers (ASCE) and the USEPA Office of Water might help to isolate specific design features that can improve performance. The National Storm Water Best Management Practice (BMP) database is a compilation of storm water practices that includes both design information and performance data for various practices. As the database expands, inferences about the extent to which specific design criteria influence pollutant removal may be made. For more information on this database, access the ASCE web page at http://www.asce.org.

**Cost Considerations**

Dry extended detention ponds are the least expensive storm water management practice, on the basis of cost per unit area treated. The construction costs associated with these facilities range considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation

$C = 12.4V^{0.760}$

where:

C = Construction, design, and permitting cost, and

V = Volume needed to control the 10-year storm ($ft^3$).

Using this equation, typical construction costs are

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the cost of wet ponds on a cost per total volume basis. Dry extended detention ponds are generally less expensive on a given site, however, because they are usually smaller than a wet pond design for the same site.

Ponds do not consume a large area compared to the total area treated (typically 2 to 3 percent of the contributing drainage area). It is important to note, however, that each pond is generally large. Other practices, such as filters or swales, may be "squeezed in" on relatively unusable land, but ponds need a relatively large continuous area.

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost. Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Finally, ponds are long-lived facilities (typically longer than 20 years). Thus, the initial investment into pond systems can be spread over a relatively long time period.

Another economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

## References

*Design References:*


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*Other References:*


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Emmerling-Dinovo, C. 1995. Storm Water Detention Basins and Residential Locational Decisions. *Water Resources Bulletin* 31(3): 515–521

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Santana, F., J. Wood, R. Parsons, and S. Chamberlain. 1994. *Control of Mosquito Breeding in Permitted Storm Water Systems*. Prepared for Southwest Florida Water Management District, Brooksville, FL.

Schueler, T. 1997. Influence of Ground Water on Performance of Storm Water Ponds in Florida. *Watershed Protection Techniques* 2(4):525–528.


## Information Resources


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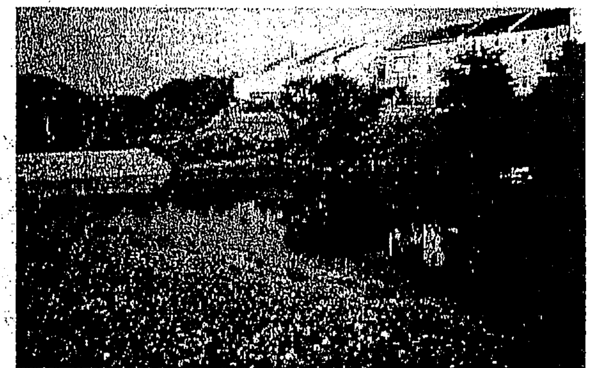
# Wet Ponds

## Postconstruction Storm Water Management in New Development and Redevelopment

## Description



The primary functions of a wet pond are to detain storm water and facilitate pollutant removal through settling and biological uptake

Wet ponds (a.k.a. storm water ponds, retention ponds, wet extended detention ponds) are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). Ponds treat incoming storm water runoff by settling and algal uptake. The primary removal mechanism is settling as storm water runoff resides in this pool, and pollutant uptake, particularly of nutrients, also occurs through biological activity in the pond. Wet ponds are among the most cost-effective and widely used storm water practices. While there are several different versions of the wet pond design, the most common modification is the extended detention wet pond, where storage is provided above the permanent pool in order to detain storm water runoff in order to provide settling.

## Applicability

Wet ponds are widely applicable storm water management practices. Although they have limited applicability in highly urbanized settings and in arid climates, they have few other restrictions.

*Regional Applicability*

Wet extended detention ponds can be applied in most regions of the United States, with the exception of arid climates. In arid regions, it is difficult to justify the supplemental water needed to maintain a permanent pool because of the scarcity of water. Even in semi-arid Austin, Texas, one study found that 2.6 acre-feet per year of supplemental water was needed to maintain a permanent pool of only 0.29 acre-feet (Saunders and Gilroy, 1997). Other modifications and design variations are needed in semi-arid and cold climates, and karst (i.e., limestone) topography.

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface exists. It is difficult to use wet ponds in the ultra-urban environment because of the land area each pond consumes. They can, however, be used in an ultra-urban environment if a relatively large area is available downstream of the site.

*Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. A typical example is a gas station. Wet ponds can accept runoff from storm water hot spots, but need significant separation from ground water if they will be used for this purpose.

*Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Wet ponds are very useful storm water retrofits and have two primary applications as a retrofit design. In many communities, detention ponds have been designed for flood control in the past. It is possible to modify these facilities to develop a permanent wet pool to provide water quality control (see Treatment under Design Considerations), and modify the outlet structure to provide channel protection. Alternatively, wet ponds may be designed in-stream, or in open areas as a part of a retrofit study.

*Cold Water (Trout) Streams*

Wet ponds pose a risk to cold water systems because of their potential for stream warming. When water remains in the permanent pool, it is heated by the sun. A study in Prince George's County, Maryland, found that storm water wet ponds heat storm water by about 9°F from the inlet to the outlet (Galli, 1990).

## Siting and Design Considerations

*Siting Considerations*

In addition to the restrictions and modifications to adapting wet ponds to different regions and land uses, designers need to ensure that this management practice is feasible at the site in question. The following section provides basic guidelines for siting wet ponds.

Drainage Area

Wet ponds need sufficient drainage area to maintain the permanent pool. In humid regions, this is typically about 25 acres, but a greater area may be needed in regions with less rainfall.

Slope

Wet ponds can be used on sites with an upstream slope up to about 15 percent. The local slope should be relatively shallow, however. Although there is no minimum slope requirement, there does need to be enough elevation drop from the pond inlet to the pond outlet to ensure that water can flow through the system.

Soils / Topography

Wet ponds can be used in almost all soils and geology, with minor design adjustments for regions of karst topography (see Design Considerations).

Ground Water

Unless they receive hot spot runoff, ponds can often intersect the ground water table. However, some research suggests that pollutant removal is reduced when ground water contributes substantially to the pool volume (Schueler, 1997b).

*Design Considerations*

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community. There are some features, however, that should be incorporated into most wet pond designs. These design features can be divided into five basic categories: pretreatment, treatment, conveyance, maintenance reduction, and landscaping.

Pretreatment

Pretreatment incorporates design features that help to settle out coarse sediment particles. By removing these particles from runoff before they reach the large permanent pool, the maintenance burden of the pond is reduced. In ponds, pretreatment is achieved with a sediment forebay. A sediment forebay is a small pool (typically about 10 percent of the volume of the permanent pool). Coarse particles remain trapped in the forebay, and maintenance is performed on this smaller pool, eliminating the need to dredge the entire pond.

Treatment

Treatment design features help enhance the ability of a storm water management practice to remove pollutants. The purpose of most of these features is to increase the amount of time that storm water remains in the pond.

One technique of increasing the pollutant removal of a pond is to increase the volume of the permanent pool. Typically, ponds are sized to be equal to the water quality volume (i.e., the volume of water treated for pollutant removal). Designers may consider using a larger volume to meet specific watershed objectives, such as phosphorous removal in a lake system. Regardless of the pool size, designers need to conduct a water balance analysis to ensure that sufficient inflow is available to maintain the permanent pool.

Other design features do not increase the volume of a pond, but can increase the amount of time storm water remains in the practice and eliminate short-circuiting. Ponds should always be designed with a length-to-width ratio of at least 1.5:1. In addition, the design should incorporate features to lengthen the flow path through the pond, such as underwater berms designed to create a longer route through the pond. Combining these two measures helps ensure that the entire pond volume is used to treat storm water. Another feature that can improve treatment is to use multiple ponds in series as part of a "treatment train" approach to pollutant removal. This redundant treatment can also help slow the rate of flow through the system.

Conveyance

Storm water should be conveyed to and from all storm water management practices safely and to minimize erosion potential. The outfall of pond systems should always be stabilized to prevent scour. In addition, an emergency spillway should be provided to safely convey large flood events. To help mitigate warming at the outlet channel, designers should provide shade around the channel at the pond outlet.

Maintenance Reduction

In addition to regular maintenance activities needed to maintain the function of storm water practices, some design features can be incorporated to ease the maintenance burden of each practice. In wet ponds, maintenance reduction features include techniques to reduce the amount of maintenance needed, as well as techniques to make regular maintenance activities easier.

One potential maintenance concern in wet ponds is clogging of the outlet. Ponds should be designed with a non-clogging outlet such as a reverse-slope pipe, or a weir outlet with a trash rack. A reverse-slope pipe draws from below the permanent pool extending in a reverse angle up to the riser and establishes the water elevation of the permanent pool. Because these outlets draw water from below the level of the permanent pool, they are less likely to be clogged by floating debris. Another general rule is that no orifice should be less than 3 inches in diameter. (Smaller orifices are more susceptible to clogging).

Design features are also incorporated to ease maintenance of both the forebay and the main pool of ponds. Ponds should be designed with a maintenance access to the forebay to ease this relatively routine (5–7 year) maintenance activity. In addition, ponds should generally have a pond drain to draw down the pond for the more infrequent dredging of the main cell of the pond.

Landscaping

Landscaping of wet ponds can make them an asset to a community and can also enhance the pollutant removal of the practice. A vegetated buffer should be preserved around the pond to protect the banks from erosion and provide some pollutant removal before runoff enters the pond by overland flow. In addition, ponds should incorporate an aquatic bench (i.e., a shallow shelf with wetland plants) around the edge of the pond. This feature may provide some pollutant uptake, and it also helps to stabilize the soil at the edge of the pond and enhance habitat and aesthetic value.

*Design Variations*

There are several variations of the wet pond design. Some of these design alternatives are intended to make the practice adaptable to various sites and to account for regional constraints and opportunities.

Wet Extended Detention Pond

The wet extended detention pond combines the treatment concepts of the dry extended detention pond and the wet pond. In this design, the water quality volume is split between the permanent pool and detention storage provided above the permanent pool. During storm events, water is detained above the permanent pool and released over 12 to 48 hours. This design has similar pollutant removal to a traditional wet pond and consumes less space. Wet extended detention ponds should be designed to maintain at least half the treatment volume of the permanent pool. In addition, designers need to carefully select vegetation to be planted in the extended detention zone to ensure that the selected vegetation can withstand both wet and dry periods.

Pocket Pond

In this design alternative, a pond drains a smaller area than a traditional wet pond, and the permanent pool is maintained by intercepting the ground water. While this design achieves less pollutant removal than a traditional wet pond, it may be an acceptable alternative on sites where space is at a premium, or in a retrofit situation.

Water Reuse Pond

Some designers have used wet ponds to act as a water source, usually for irrigation. In this case, the water balance should account for the water that will be taken from the pond. One study conducted in Florida estimated that a water reuse pond could provide irrigation for a 100-acre golf course at about one-seventh the cost of the market rate of the equivalent amount of water ($40,000 versus $300,000).

*Regional Adaptations*

Semi-Arid Climates

In arid climates, wet ponds are not a feasible option (see Applicability), but they may possibly be used in semi-arid climates if the permanent pool is maintained with a supplemental water source, or if the pool is allowed to vary seasonally. This choice needs to be seriously evaluated, however. Saunders and Gilroy (1997) reported that 2.6 acre-feet per year of supplemental water were needed to maintain a permanent pool of only 0.29 acre-feet in Austin, Texas.

Cold Climates

Cold climates present many challenges to designers of wet ponds. The spring snowmelt may have a high pollutant load and a large volume to be treated. In addition, cold winters may cause freezing of the permanent pool or freezing at inlets and outlets. Finally, high salt concentrations in runoff resulting from road salting, and sediment loads from road sanding, may impact pond vegetation as well as reduce the storage and treatment capacity of the pond.

One option to deal with high pollutant loads and runoff volumes during the spring snowmelt is the use of a seasonally operated pond to capture snowmelt during the winter, and retain the permanent pool during warmer seasons. In this option, proposed by Oberts (1994), the pond has two water quality outlets, both equipped with gate valves. In the summer, the lower outlet is closed. During the fall and throughout the winter, the lower outlet is opened to draw down the permanent pool. As the spring melt begins, the lower outlet is closed to provide detention for the melt event. This method can act as a substitute for using a minimum extended detention storage volume. When wetlands preservation is a downstream objective, seasonal manipulation of pond levels may not be desired. An analysis of the effects on downstream hydrology should be conducted before considering this option. In addition, the manipulation of this system requires some labor and vigilance; a careful maintenance agreement should be confirmed.

Several other modifications may help to improve the performance of ponds in cold climates. Designers should consider planting the pond with salt-tolerant vegetation if the facility receives road runoff. In order to counteract the effects of freezing on inlet and outlet structures, the use of inlet and outlet structures that are resistant to frost, including weirs and larger diameter pipes, may be useful. Designing structures on-line, with a continuous flow of water through the pond, will also help prevent freezing of these structures. Finally, since freezing of the permanent pool can reduce the effectiveness of pond systems, it may be useful to incorporate extended detention into the design to retain usable treatment area above the permanent pool when it is frozen.

Karst Topography

In karst (i.e., limestone) topography, wet ponds should be designed with an impermeable liner to prevent ground water contamination or sinkhole formation, and to help maintain the permanent pool.

## Limitations

Limitations of wet ponds include:

- If improperly located, wet pond construction may cause loss of wetlands or forest.
- Although wet ponds consume a small amount of space relative to their drainage areas, they are often inappropriate in dense urban areas because each pond is generally quite large.
- Their use is restricted in arid and semi-arid regions due to the need to supplement the permanent pool.
- In cold water streams, wet ponds are not a feasible option due to the potential for stream warming.
- Wet ponds may pose safety hazards.

## Maintenance Considerations

In addition to incorporating features into the pond design to minimize maintenance, some regular maintenance and inspection practices are needed. The table below outlines these practices.

Table 1. Typical maintenance activities for wet ponds (Source: WMI, 1997)

| Activity | Schedule |
|---|---|
| • If wetland components are included, inspect for invasive vegetation. | Semi-annual inspection |
| • Inspect for damage.<br>• Note signs of hydrocarbon build-up, and deal with appropriately.<br>• Monitor for sediment accumulation in the facility and forebay.<br>• Examine to ensure that inlet and outlet devices are free of debris and operational. | Annual inspection |
| • Repair undercut or eroded areas. | As needed maintenance |
| • Clean and remove debris from inlet and outlet structures.<br>• Mow side slopes. | Monthly maintenance |
| • Manage and harvest wetland plants. | Annual maintenance (if needed) |
| • Remove sediment from the forebay. | 5- to 7-year maintenance |
| • Monitor sediment accumulations, and remove sediment when the pool volume has become reduced significantly or the pond becomes eutrophic. | 20-to 50-year maintenance |

## Effectiveness

Structural storm water management practices can be used to achieve four broad resource protection goals. These include flood control, channel protection, ground water recharge, and pollutant removal. Wet ponds can provide flood control, channel protection, and pollutant removal.

*Flood Control*

One objective of storm water management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Wet ponds can easily be designed for flood control by providing flood storage above the level of the permanent pool.

*Channel Protection*

When used for channel protection, wet ponds have traditionally controlled the 2-year storm. It appears that this control has been relatively ineffective, and recent research suggests that control of a smaller storm may be more appropriate (MacRae, 1996).

*Ground Water Recharge*

Wet ponds cannot provide ground water recharge. Infiltration is impeded by the accumulation of debris on the bottom of the pond.

*Pollutant Removal*

Wet ponds are among the most effective storm water management practices at removing storm water pollutants. A wide range of research is available to estimate the effectiveness of wet ponds. Table 2 summarizes some of the research completed on wet pond removal efficiency. Typical removal rates, as reported by Schueler (1997a) are:

Total Suspended Solids: 67%

Total Phosphorous: 48%

Total Nitrogen: 31%

Nitrate Nitrogen: 24%

Metals: 24–73%

Bacteria: 65%

Table 2. Wet pond percent removal efficiency data

| Wet Pond Removal Efficiencies | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Study** | **TSS** | **TP** | **TN** | **$NO_3$** | **Metals** | **Bacteria** | **Practice Type** |
| City of Austin, TX 1991. Woodhollow, TX | 54 | 46 | 39 | 45 | 69–76 | 46 | wet pond |
| Driscoll 1983. Westleigh, MD | 81 | 54 | 37 | - | 26–82 | - | wet pond |
| Dorman et al., 1989. West Pond, MN | 65 | 25 | - | 61 | 44–66 | - | wet pond |
| Driscoll, 1983. Waverly Hills, MI | 91 | 79 | 62 | 66 | 57–95 | - | wet pond |
| Driscoll, 1983. Unqua, NY | 60 | 45 | - | - | 80 | 86 | wet pond |
| Cullum, 1985. Timber Creek, FL | 64 | 60 | 15 | 80 | - | - | wet pond |
| City of Austin, TX 1996. St. Elmo, TX. | 92 | 80 | 19 | -17 | 2–58 | 89-91 | wet pond |
| Horner, Guedry, and Kortenhoff, 1990. SR 204, WA | 99 | 91 | - | - | 88–90 | - | wet pond |
| Horner, Guedry, and Kortenhoff, 1990. Seattle, WA | 86.7 | 78.4 | - | - | 65–67 | - | wet pond |
| Kantrowitz and Woodham, 1995. Saint Joe's Creek, FL | 45 | 45 | - | 36 | 38–82 | - | wet pond |
| Wu, 1989. Runaway Bay, NC | 62 | 36 | - | - | 32–52 | - | wet pond |
| Driscoll 1983. Pitt-AA, MI | 32 | 18 | - | 7 | 13–62 | - | wet pond |
| Bannerman and Dodds, 1992. Monroe Street, WI | 90 | 65 | - | - | 65–75 | 70 | wet pond |
| Horner, Guedry, and Kortenhoff, 1990. Mercer, WA | 75 | 67 | - | - | 23–51 | - | wet pond |
| Oberts, Wotzka, and Hartsoe 1989. McKnight, MN | 85 | 48 | 30 | 24 | 67 | - | wet pond |
| Yousef, Wanielista, and Harper 1986. Maitland, FL | [illegible] | - | - | 87 | 77–96 | - | wet pond |
| Wu, 1989. Lakeside Pond, NC | 93 | 45 | - | - | 80–87 | - | wet pond |
| Oberts, Wotzka, and Hartsoe, 1989. Lake Ridge, MN | 90 | 61 | 41 | 10 | 73 | - | wet pond |

Table 2. (continued)

| Wet Pond Removal Efficiencies | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Study** | **TSS** | **TP** | **TN** | **$NO_3$** | **Metals** | **Bacteria** | **Practice Type** |
| Driscoll, 1983. Lake Ellyn, IL | 84 | 34 | - | - | 71-78 | - | wet pond |
| Dorman et al., 1989. I-4, FL | 54 | 69 | - | 97 | 47–74 | - | wet pond |
| Martin, 1988. Highway Site, FL | 83 | 37 | 30 | 28 | 50–77 | - | wet pond |
| Driscoll, 1983. Grace Street, MI | 32 | 12 | 6 | -1 | 26 | - | wet pond |
| Occoquan Watershed Monitoring Laboratory, 1983. Farm Pond, VA | 85 | 86 | 34 | - | - | - | wet pond |
| Occoquan Watershed Monitoring Laboratory, 1983. Burke, VA | -33.3 | 39 | 32 | - | 38–84 | - | wet pond |
| Dorman et al., 1989. Buckland, CT | 61 | 45 | - | 22 | -25 to -51 | - | wet pond |
| Holler, 1989. Boynton Beach Mall, FL | 91 | 76 | - | 87 | - | - | wet pond |
| Urbonas, Carlson, and Vang 1994. Shop Creek, CO | 78 | 49 | -12 | -85 | 51–57 | - | wet pond |
| Oberts and Wotzka, 1988. McCarrons, MN | 91 | 78 | 85 | - | 90 | - | wet pond |
| Gain, 1996. FL | 54 | 30 | 16 | 24 | 42–73 | - | wet pond |
| Ontario Ministry of the Environment, 1991. Uplands, Ontario | 82 | 69 | - | - | - | 97 | wet extended detention pond |
| Borden et al., 1996. Piedmont, NC | 19.6 | 36.5 | 35.1 | 65.9 | -4 to-97 | -6 | wet extended detention pond |
| Holler, 1990. Lake Tohopekaliga District, FL | - | 85 | - | - | - | - | wet extended detention pond |
| Ontario Ministry of the Environment 1991. Kennedy-Burnett, Ontario | 98 | 79 | 54 | - | 21–39 | 99 | wet extended detention pond |
| Ontario Ministry of the Environment 1991. East Barrhaven, Ontario | 52 | 47 | - | - | - | 56 | wet extended detention pond |
| Borden et al., 1996. Davis, NC | 60.4 | 46.2 | 16 | 18.2 | 15–51 | 48 | wet extended |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | detention pond |

There is considerable variability in the effectiveness of ponds, and it is believed that properly designing and maintaining ponds may help to improve their performance. The siting and design criteria presented in this sheet reflect the best current information and experience to improve the performance of wet ponds. A recent joint project of the American Society of Civil Engineers (ASCE) and the USEPA Office of Water may help to isolate specific design features that can improve performance. The National Stormwater Best Management Practice (BMP) database is a compilation of storm water practices which includes both design information and performance data for various practices. As the database expands, inferences about the extent to which specific design criteria influence pollutant removal may be made. More information on this database is available from the ASCE web page at *www.asce.org*.

**Cost Considerations**

Wet ponds are relatively inexpensive storm water practices. The construction costs associated with these facilities range considerably. A recent study (Brown and Schueler, 1997) estimated the cost of a variety of storm water management practices. The study resulted in the following cost equation, adjusting for inflation:

$$C = 24.5V^{0.705}$$

where:

C = Construction, design and permitting cost;

V = Volume in the pond to include the 10-year storm ($ft^3$).

Using this equation, typical construction costs are:

$45,700 for a 1 acre-foot facility

$232,000 for a 10 acre-foot facility

$1,170,000 for a 100 acre-foot facility

Ponds do not consume a large area (typically 2–3 percent of the contributing drainage area). Therefore, the land consumed to design the pond will not be very large. It is important to note, however, that these facilities are generally large. Other practices, such as filters or swales, may be "squeezed" into relatively unusable land, but ponds need a relatively large continuous area.

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost. Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Ponds are long-lived facilities (typically longer than 20 years). Thus, the initial investment info pond systems may be spread over a relatively long time period.

In addition to the water resource protection benefits of wet ponds, there is some evidence to suggest that they may provide an economic benefit by increasing property values. The results of one study suggest that "pond front" property can increase the selling price of new properties by about 10 percent (USEPA, 1995). Another study reported that the perceived value (i.e., the value estimated by residents of a community) of homes was increased by about 15 to 25 percent when located near a wet pond (Emmerling-Dinovo, 1995).

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*Infiltration practices*

**Infiltration Basin**

**Postconstruction Storm Water Management in New Development and Redevelopment**

## Description

An infiltration basin is a shallow impoundment which is designed to infiltrate storm water into the ground water. This practice is believed to have a high pollutant removal efficiency and can also help recharge the ground water, thus restoring low flows to stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

Infiltration basins are designed to collect storm water from impervious areas and provide pollutant removal benefits through detention and filtration

## Applicability

Infiltration basins have select applications. Their use is often sharply restricted by concerns over ground water contamination, soils, and clogging at the site.

*Regional Applicability*

Infiltration basins can be utilized in most regions of the country, with some design modifications in cold and arid climates. In regions of karst (i.e., limestone) topography, these storm water management practices may not be applied due to concerns of sink hole formation and ground water contamination.

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface exists. In these areas, few storm water practices can be easily applied due to space limitations. Infiltration basins can rarely be applied in the ultra-urban environment. Two features that can restrict their use are the potential of infiltrated water to interfere with existing infrastructure, and the relatively poor infiltration capacity of most urban soils. In addition, while they consume only the space of the infiltration basin site itself, they need a continuous, relatively flat area. Thus, it is more difficult to fit them into small unusable areas on a site.

*Storm Water Hot Spots*

A storm water hot spot is an area where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. Infiltration basins should never receive runoff from storm water hot spots, unless the storm water has already been treated by another practice. This caution is due to potential ground water contamination.

*Storm Water Retrofit*

A storm water retrofit is a storm water practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Infiltration basins have limited applications as a storm water retrofit. Their use is restricted by three factors. First, infiltration basins should be used to treat small sites (less than 5 acres). Practices that are applied to small sites, such as infiltration basins, are generally a high-cost retrofit option in terms of construction cost and the maintenance burden associated with the large number of practices needed to retrofit a watershed. Second, it is often difficult to find areas where soils are appropriate for infiltration in an already urban or suburban environment. Finally, infiltration basins are best applied to small sites, yet need a flat, relatively continuous area. It is often difficult to find sites with this type of area available.

*Cold Water (Trout) Streams*

Infiltration basins are an excellent option for cold water streams because they encourage infiltration of storm water and maintain dry weather flow. Because storm water travels underground to the stream, it has little opportunity to increase in temperature.

**Siting and Design Considerations**

When designing infiltration basins, designers need to carefully consider both the restrictions on the site and design features to improve the long-term performance of the practice.

*Siting Considerations*

Infiltration practices need to be located extremely carefully. In particular, designers need to ensure that the soils on the site are appropriate for infiltration, and that designs minimize the potential for ground water contamination and long-term maintenance problems.

Drainage Area

Infiltration basins have historically been used as regional facilities, serving for both quantity and quality control. In some regions of the country, this practice is feasible, particularly if the soils are particularly sandy. In most areas, however, infiltration basins experience high rates of failure when used in this manner. In general, the practice is best applied to relatively small drainage areas (i.e., less than 10 acres).

Slope

The bottom of infiltration basins needs to be completely flat to allow infiltration throughout the entire basin bottom.

Soils/Topography

Soils and topography are strongly limiting factors when locating infiltration practices. Soils must be significantly permeable to ensure that the practice can infiltrate quickly enough to reduce the potential for clogging, and soils that infiltrate too rapidly may not provide sufficient treatment, creating the potential for ground water contamination. The infiltration rate should range between 0.5 and 3 inches per hour. In addition, the soils should have no greater than 20 percent clay content, and less than 40 percent silt/clay content (MDE, 2000). Finally, infiltration basins may not be used in regions of karst topography, due to the potential for sinkhole formation or ground water contamination.

Ground Water

Designers always need to provide significant separation distance (2 to 5 feet) from the bottom of the infiltration basin and the seasonally high ground water table, to reduce the risk of contamination. Infiltration practices should also be separated from drinking water wells.

*Design Considerations*

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community. There are some features, however, that should be incorporated into most infiltration basin designs. These design features can be divided into five basic categories: pretreatment, treatment, conveyance, maintenance reduction, and landscaping.

Pretreatment

Pretreatment refers to design features that provide settling of large particles before runoff reaches a management practice, easing the long-term maintenance burden. Pretreatment is important for all structural management practices, but it is particularly important for infiltration practices. In order to ensure that pretreatment mechanisms are effective, designers should incorporate "multiple pretreatment," using practices such as grassed swales, sediment basins, and vegetated filter strips in series.

Treatment

Treatment design features enhance the pollutant removal of a practice. For infiltration practices, designers need to stabilize upland soils to ensure that the basin does not become clogged with sediment. In addition, the facility needs to be sized so that the volume of water to be treated infiltrates through the bottom in a given amount of time. Because infiltration basins are designed in this manner, infiltration basins designed on less permeable soils should be significantly larger than those designed on more permeable soils.

Conveyance

Storm water needs to be conveyed through storm water management practices safely and in a way that minimizes erosion. Designers need to be particularly careful in ensuring that channels leading to an infiltration practice are designed to minimize erosion. In general, infiltration basins should be designed to treat only small storms (i.e., only for water quality). Thus, these practices should be designed "off-line," using a flow separator to divert only small flows to the practice.

Maintenance Reduction

In addition to regular maintenance activities, designers also need to incorporate features into the design to ensure that the maintenance burden of a practice is reduced. These features can make regular maintenance activities easier or reduce the need to perform maintenance. In infiltration basins, designers need to provide access to the basin for regular maintenance activities. Where possible, a means to drain the basin, such as an underdrain, should be provided in case the bottom becomes clogged. This feature allows the basin to be drained and accessed for maintenance in the event that the water has ponded in the basin bottom or the soil is saturated.

Landscaping

Landscaping can enhance the aesthetic value of storm water practices or improve their function. In infiltration basins, the most important purpose of vegetation is to reduce the tendency of the practice to clog. Upland drainage needs to be properly stabilized with a thick layer of vegetation, particularly immediately following construction. In addition, providing a thick turf at the basin bottom helps encourage infiltration and prevent the formation of rills in the basin bottom.

*Design Variations*

Some modifications may be needed to ensure the performance of infiltration basins in arid and cold climates.

Arid or Semi-Arid Climates

In arid regions, infiltration practices are often highly recommended because of the need to recharge the ground water. In arid regions, designers need to emphasize pretreatment even more strongly to ensure that the practice does not clog, because of the high sediment concentrations associated with storm water runoff in areas such as the Southwest. In addition, the basin bottom may be planted with drought-tolerant species and/or covered with an alternative material such as sand or gravel.

Cold Climates

In extremely cold climates (i.e., regions that experience permafrost), infiltration basins may be an infeasible option. In most cold climates, infiltration basins can be a feasible practice, but there are some challenges to its use. First, the practice may become inoperable during some portions of the year when the surface of the basin becomes frozen. Other design features also may be incorporated to deal with the challenges of cold climates. One such challenge is the volume of runoff associated with the spring snowmelt event. The capacity of the infiltration basin might be increased to account for snowmelt volume.

Another option is the use of a seasonably operated facility (Oberts, 1994). A seasonally operated infiltration/detention basin combines several techniques to improve the performance of infiltration practices in cold climates. Two features, the underdrain system and level control valves, are useful in cold climates. These features are used as follows: At the beginning of the winter season, the level control valve is opened and the soil is drained. As the snow begins to melt in the spring, the underdrain and the level control valves are closed. The snowmelt is infiltrated until the capacity of the soil is reached. Then, the facility acts as a detention facility, providing storage for particles to settle.

Other design features can help to minimize problems associated with winter conditions, particularly concerns that chlorides from road salting may contaminate ground water. The basin may be disconnected during the winter to ensure that chlorides do not enter the ground water in areas where this is a problem, or if the basin is used to treat roadside runoff. Designers may also want to reconsider application of infiltration practices on parking lots or roads where deicing is used, unless it is confirmed that the practice will not cause elevated chloride levels in the ground water. If the basin is used for snow storage, or to treat roadside or parking lot runoff, the basin bottom should be planted with salt-tolerant vegetation.

### Limitations

Although infiltration basins can be useful practices, they have several limitations. Infiltration basins are not generally aesthetic practices, particularly if they clog. If they clog, the soils become saturated, and the practice can be a source of mosquitoes. In addition, these practices are challenging to apply because of concerns over ground water contamination and sufficient soil infiltration. Finally, maintenance of infiltration practices can be burdensome, and they have a relatively high rate of failure.

### Maintenance Considerations

Regular maintenance is critical to the successful operation of infiltration basins (see Table 1). Historically, infiltration basins have had a poor track record. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. This trend may not be the same in soils with high infiltration rates, however. A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years.

Table 1. Typical maintenance activities for infiltration basins (Source: Modified from WMI, 1997)

| Activity | Schedule |
|---|---|
| • Inspect facility for signs of wetness or damage to structures<br>• Note eroded areas.<br>• If dead or dying grass on the bottom is observed, check to ensure that water percolates 2–3 days following storms.<br>• Note signs of petroleum hydrocarbon contamination and handle properly. | Semi-annual inspection |
| • Mow and remove litter and debris.<br>• Stabilize of eroded banks.<br>• Repair undercut and eroded areas at inflow and outflow structures. | Standard maintenance (as needed) |
| • Disc or otherwise aerate bottom.<br>• Dethatch basin bottom. | Annual maintenance |
| • Scrape bottom and remove sediment. Restore original cross-section and infiltration rate.<br>• Seed or sod to restore ground cover. | 5-year maintenance |

## Effectiveness

Structural management practices can be used to achieve four broad resource protection goals. These include flood control, channel protection, ground water recharge, and pollutant removal. Infiltration basins can provide ground water recharge and pollutant removal.

### *Ground Water Recharge*

Infiltration basins recharge the ground water because runoff is treated for water quality by filtering through the soil and discharging to ground water.

### *Pollutant Removal*

Very little data are available regarding the pollutant removal associated with infiltration basins. It is generally assumed that they have very high pollutant removal because none of the storm water entering the practice remains on the surface. Schueler (1987) estimated pollutant removal for infiltration basins based on data from land disposal of wastewater. The average pollutant removal, assuming the infiltration basin is sized to treat the runoff from a 1-inch storm, is:

TSS 75%

Phosphorous 60–70%

Nitrogen 55–60%

Metals 85–90%

Bacteria 90%

These removal efficiencies assume that the infiltration basin is well designed and maintained. The information in the Siting and Design Considerations and Maintenance Considerations sections represent the best available information on how to properly design these practices. The design references below also provide additional information.

## Cost Considerations

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft$^3$ (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). Infiltration basins typically consume about 2 to 3 percent of the site draining to them, which is relatively small. Maintenance costs are estimated at 5 to 10 percent of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate (see Maintenance Considerations). Thus, it may be necessary to replace the basin after a relatively short period of time.

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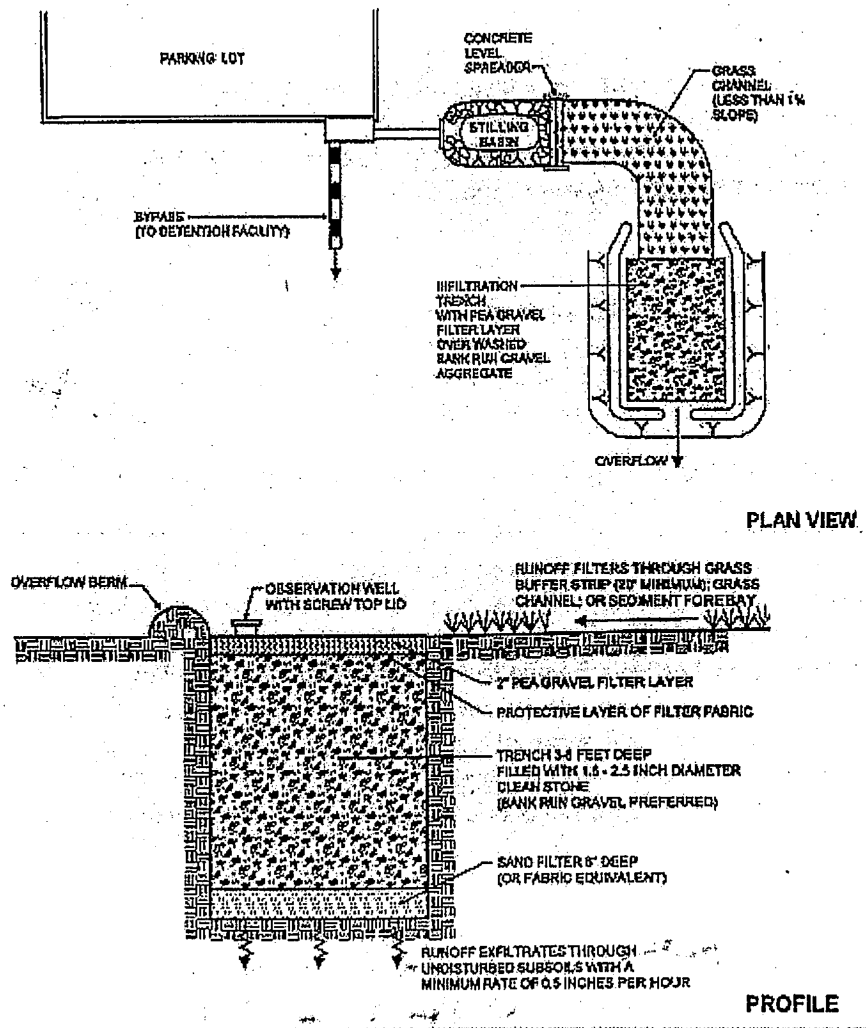
## Infiltration Trench

### Postconstruction Storm Water Management in New Development and Redevelopment

## Description

An infiltration trench (a.k.a. infiltration galley) is a rock-filled trench with no outlet that receives storm water runoff. Storm water runoff passes through some combination of pretreatment measures, such as a swale and detention basin, and into the trench. There, runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. The primary pollutant removal mechanism of this practice is filtering through the soil.




A schematic of an infiltration trench (Source: MDE, 2000)

## Applicability

Infiltration trenches have select applications. While they can be applied in most regions of the country, their use is sharply restricted by concerns due to common site factors, such as potential ground water contamination, soils, and clogging.

*Regional Applicability*

Infiltration trenches can be utilized in most regions of the country, with some design modifications in cold and arid climates. In regions of karst (i.e., limestone) topography, these storm water management practices may not be applied due to concerns of sink hole formation and ground water contamination.

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface exists. Infiltration trenches can sometimes be applied in the ultra-urban environment. Two features that can restrict their use are the potential of infiltrated water to interfere with existing infrastructure, and the relatively poor infiltration of most urban soils.

*Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. Infiltration trenches should not receive runoff from storm water hot spots, unless the storm water has already been treated by another storm water management practice, because of potential ground water contamination.

*Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Infiltration trenches may be used as a storm water retrofit. Their use is somewhat restricted, however, by two factors. First, infiltration trenches should be used to treat small sites (less than 5 acres). Small site storm water management practices are generally a high cost retrofit option in terms of construction cost and the maintenance burden associated with the number of small site practices. Second, it is often difficult to find areas where soils are appropriate for infiltration in an already urban or suburban environment.

*Cold Water (Trout) Streams*

Infiltration trenches are an excellent option for cold water streams because they encourage infiltration of storm water. This storm water does not warm as it travels underground to the receiving stream, lessening the temperature impacts commonly associated with urbanization.

## Siting and Design Considerations

Infiltration trenches have select applications. Although they can be applied in a variety of situations, the use of infiltration trenches is restricted by concerns over ground water contamination, soils, and clogging.

*Siting Considerations*

Infiltration practices need to be sited extremely carefully. In particular, designers need to ensure that the soils on site are appropriate for infiltration and that designs minimize the potential for ground water contamination and long-term maintenance.

<u>Drainage Area</u>

Infiltration trenches generally can be applied to relatively small sites (less than 5 acres), with relatively high impervious cover. Application to larger sites generally causes clogging, resulting in a high maintenance burden.

<u>Slope</u>

Infiltration trenches should be placed on flat ground, but the slopes of the site draining to the practice can be as steep as 15 percent.

<u>Soils/Topography</u>

Soils and topography are strongly limiting factors when locating infiltration practices. Soils must be significantly permeable to ensure that the storm water can infiltrate quickly enough to reduce the potential for clogging. In addition, soils that infiltrate too rapidly may not provide sufficient treatment, creating the potential for ground water contamination. The infiltration rate should range between 0.5 and 3 inches per hour. In addition, the soils should have no greater than 20-percent clay content, and less than 40-percent silt/clay content (MDE, 2000). The infiltration rate and textural class of the soil need to be confirmed in the field; designers should not rely on more generic information such as a soil survey. Finally, infiltration trenches may not be used in regions of karst topography, due to the potential for sinkhole formation or ground water contamination.

<u>Ground Water</u>

Designers always need to provide significant separation (2 to 5 feet) from the bottom of the infiltration trench and the seasonally high ground water table, to reduce the risk of contamination. In addition, infiltration practices should be separated from drinking water wells.

*Design Considerations*

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community. There are some features, however, that should be incorporated into most infiltration trench designs. These design features can be divided into five basic categories: pretreatment, treatment, conveyance, maintenance reduction, and landscaping.

<u>Pretreatment</u>

Pretreatment refers to design features that provide settling of large particles before runoff reaches a management practice, easing the long-term maintenance burden. Pretreatment is important for all structural storm water management practices, but it is particularly important for infiltration practices. To ensure that pretreatment mechanisms are effective, designers should incorporate "multiple pretreatment," using practices such as grassed swales, vegetated filter strips, detention, or a plunge pool in series.

Treatment

Treatment design features enhance the pollutant removal of a practice. During the construction process, the upland soils of infiltration trenches need to be stabilized to ensure that the trench does not become clogged with sediment. Furthermore, the practice should be filled with large clean stones that can retain the volume of water to be treated in their voids. Like infiltration basins, this practice should be sized so that the volume to be treated can infiltrate out of the trench bottom in 24 hours.

Conveyance

Storm water needs to be conveyed through storm water management practices safely, and in a way that minimizes erosion. Designers need to be particularly careful in ensuring that channels leading to an infiltration practice are designed to minimize erosion. Infiltration trenches should be designed to treat only small storms, (i.e., only for water quality). Thus, these practices should be designed "off-line," using a structure to divert only small flows to the practice. Finally, the sides of an infiltration trench should be lined with a geotextile fabric to prevent flow from causing rills along the edge of the practice.

Maintenance Reduction

In addition to regular maintenance activities, designers also need to incorporate features into the design to ensure that the maintenance burden of a practice is reduced. These features can make regular maintenance activities easier or reduce the need to perform maintenance. As with all management practices, infiltration trenches should have an access path for maintenance activities. An observation well (i.e., a perforated PVC pipe that leads to the bottom of the trench) can enable inspectors to monitor the drawdown rate. Where possible, trenches should have a means to drain the practice if it becomes clogged, such as an underdrain. An underdrain is a perforated pipe system in a gravel bed, installed on the bottom of filtering practices to collect and remove filtered runoff. An underdrain pipe with a shutoff valve can be used in an infiltration system to act as an overflow in case of clogging.

Landscaping

In infiltration trenches, there is no landscaping on the practice itself, but it is important to ensure that the upland drainage is properly stabilized with thick vegetation, particularly following construction.

*Regional Variations*

Arid or Semi-Arid Climates

In arid regions, infiltration practices are often highly recommended because of the need to recharge the ground water. One concern in these regions is the potential of these practices to clog, due to relatively high sediment concentrations in these environments. Pretreatment needs to be more heavily emphasized in these dryer climates.

Cold Climates

In extremely cold climates (i.e., regions that experience permafrost), infiltration trenches may be an infeasible option. In most cold climates, infiltration trenches can be a feasible management practice, but there are some challenges to their use. The volume may need to be increased in order to treat snowmelt. In addition, if the practice is used to treat roadside runoff, it may be desirable to divert flow around the trench in the winter to prevent infiltration of chlorides from road salting, where this is a problem. Finally, a minimum setback from roads is needed to ensure that the practice does not cause frost heaving.

## Limitations

Although infiltration trenches can be a useful management practice, they have several limitations. While they do not detract visually from a site, infiltration trenches provide no visual enhancements. Their application is limited due to concerns over ground water contamination and other soils requirements. Finally, maintenance can be burdensome, and infiltration practices have a relatively high rate of failure.

## Maintenance Considerations

In addition to incorporating features into the design to minimize maintenance, some regular maintenance and inspection practices are needed. Table 1 outlines some of these practices.

Table 1. Typical maintenance activities for infiltration trenches (Source: Modified from WMI, 1997)

| Activity | Schedule |
|---|---|
| • Check observation wells following 3 days of dry weather. Failure to percolate within this time period indicates clogging.<br>• Inspect pretreatment devices and diversion structures for sediment build-up and structural damage. | Semi-annual inspection |
| • Remove sediment and oil/grease from pretreatment devices and overflow structures. | Standard maintenance |
| • If bypass capability is available, it may be possible to regain the infiltration rate in the short term by using measures such as providing an extended dry period. | 5-year maintenance |
| • Total rehabilitation of the trench should be conducted to maintain storage capacity within 2/3 of the design treatment volume and 72-hour exfiltration rate limit.<br>• Trench walls should be excavated to expose clean soil. | Upon failure |

Infiltration practices have historically had a high rate of failure compared to other storm water management practices. One study conducted in Prince George's County, Maryland (Galli, 1992), revealed that less than half of the infiltration trenches investigated (of about 50) were still functioning properly, and less than one-third still functioned properly after 5 years. Many of these practices, however, did not incorporate advanced pretreatment. By carefully selecting the location and improving the design features of infiltration practices, their performance should improve.

## Effectiveness

Structural storm water management practices can be used to achieve four broad resource protection goals. These include flood control, channel protection, ground water recharge, and pollutant removal. Infiltration trenches can provide ground water recharge, pollutant control, and can help somewhat to provide channel protection.

*Ground Water Recharge*

Infiltration trenches recharge the ground water because runoff is treated for water quality by filtering through the soil and discharging to ground water.

*Pollutant Removal*

Very little data are available regarding the pollutant removal associated with infiltration trenches. It is generally assumed that they have very high pollutant removal, because none of the storm water entering the practice remains on the surface. Schueler (1987) estimated pollutant removal for infiltration trenches based on data from land disposal of wastewater. The average pollutant removal, assuming the infiltration trench is sized to treat the runoff from a 1-inch storm, is:

TSS 75%

Phosphorous 60–70%

Nitrogen 55–60%

Metals 85–90%

Bacteria 90%

These removal efficiencies assume that the infiltration trench is well designed and maintained. The information in the Siting and Design Considerations and Maintenance Considerations sections represent the best available information on how to properly design these practices. The design references below provide additional information.

## Cost Considerations

Infiltration trenches are somewhat expensive, when compared to other storm water practices, in terms of cost per area treated. Typical construction costs, including contingency and design costs, are about $5 per ft$^3$ of storm water treated (SWRPC, 1991; Brown and Schueler, 1997).

Infiltration trenches typically consume about 2 to 3 percent of the site draining to them, which is relatively small. In addition, infiltration trenches can fit into thin, linear areas. Thus, they can generally fit into relatively unusable portions of a site.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration trenches have a high failure rate (see Maintenance Considerations). In general, maintenance costs for infiltration trenches are estimated at between

5 percent and 20 percent of the construction cost. More realistic values are probably closer to the 20-percent range, to ensure long-term functionality of the practice.

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## Porous Pavement

## Postconstruction Storm Water Management in New Development and Redevelopment

### Description

A porous pavement parking lot (Source: Invisible Structures, no date)

Porous pavement is a permeable pavement surface with an underlying stone reservoir to temporarily store surface runoff before it infiltrates into the subsoil. This porous surface replaces traditional pavement, allowing parking lot storm water to infiltrate directly and receive water quality treatment. There are a few porous pavement options, including porous asphalt, pervious concrete, and grass pavers. Porous asphalt and pervious concrete appear to be the same as traditional pavement from the surface, but are manufactured without "fine" materials, and incorporate void spaces to allow infiltration. Grass pavers are concrete interlocking blocks or synthetic fibrous gridded systems with open areas designed to allow grass to grow within the void areas. Other alternative paving surfaces can help reduce the runoff from paved areas but do not incorporate the stone trench for temporary storage below the pavement (see Green Parking fact sheet). While porous pavement has the potential to be a highly effective treatment practice, maintenance has been a concern in past applications of the practice.

### Application

The ideal application for porous pavement is to treat low-traffic or overflow parking areas. Porous pavement may also have some application on highways, where it is currently used as a surface material to reduce hydroplaning.

*Regional Applicability*

Porous pavement can be applied in most regions of the country, but the practice has unique challenges in cold climates. Porous pavement cannot be used where sand is applied to the pavement surface because the sand will clog the surface of the material. Care also needs to be taken when applying salt to a porous pavement surface as chlorides from road salt may migrate into the ground water. For block pavers, plowing may be challenging because the edge of the snow plow blade can catch the edge of the blocks, damaging the surface. This difficulty does not imply that it is impossible to use porous pavement in cold climates. Another concern in cold climates is that infiltrating runoff below pavement may cause frost heave, although design modifications can reduce this risk. Porous pavement has been used successfully in Norway (Stenmark, 1995), incorporating design features to reduce frost heave. Furthermore, some experience suggests that snow melts faster on a porous surface because of rapid drainage below the snow surface (Cahill Associates, 1993).

### *Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface exists. Porous pavements are a good option in these areas because they consume no space. They are not ideal for high-traffic areas, however, because of the potential for failure due to clogging (Galli, 1992).

### *Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. These areas include commercial nurseries, auto recycle facilities, commercial parking lots, fueling stations, storage areas, industrial rooftops, marinas, outdoor container storage of liquids, outdoor loading/unloading facilities, public works storage areas, hazardous materials generators (if containers are exposed to rainfall), vehicle service and maintenance areas, and vehicle and equipment washing/steam cleaning facilities. Since porous pavement is an infiltration practice, it should not be applied on storm water hot spots due to the potential for ground water contamination.

### *Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Since porous pavement can only be applied to relatively small sites, using porous pavement as a primary tool for watershed retrofitting would be expensive. The best application of porous pavement for retrofits is on individual sites where a parking lot is being resurfaced.

### *Cold Water (Trout) Streams*

Porous pavement can help to reduce the increased temperature commonly associated with increased impervious cover. Storm water ponds on the surface of conventional pavement, and is subsequently heated by the sun and hot pavement surface. By rapidly infiltrating rainfall, porous pavement reduces the time that storm water is exposed to the sun and heat.

## Siting and Design Considerations

### *Siting Considerations*

Porous pavement has the same siting considerations as other infiltration practices (see Infiltration Trench fact sheet). The site needs to meet the following criteria:

- Soils need to have a permeability between 0.5 and 3.0 inches per hour.
- The bottom of the stone reservoir should be completely flat so that infiltrated runoff will be able to infiltrate through the entire surface.
- Porous pavement should be sited at least 2 to 5 feet above the seasonally high ground water table, and at least 100 feet away from drinking water wells.
- Porous pavement should be sited on low-traffic or overflow parking areas, which are not sanded for snow removal.

*Design Considerations*

Some basic features should be incorporated into all porous pavement practices. These design features can be divided into five basic categories: pretreatment, treatment, conveyance, maintenance reduction, and landscaping.

1. *Pretreatment*. In porous pavement designs, the pavement itself acts as pretreatment to the stone reservoir below. Because the surface serves this purpose, frequent maintenance of the surface is critical to prevent clogging. Another pretreatment item can be the incorporation of a fine gravel layer above the coarse gravel treatment reservoir. Both of these pretreatment measures are marginal, which is one reason that these systems have a high failure rate.

2. *Treatment*. The stone reservoir below the pavement surface should be composed of layers of small stone directly below the pavement surface, and the stone bed below the permeable surface should be sized to attenuate storm flows for the storm event to be treated. Typically, porous pavement is sized to treat a small event, such as a water quality storm (i.e., the storm that will be treated for pollutant removal), which can range from 0.5 to 1.5 inches. As in infiltration trenches, water can be stored only in the void spaces of the stone reservoir.

*Conveyance*. Water is conveyed to the stone reservoir through the surface of the pavement and infiltrates into the ground through the bottom of this stone reservoir. A geosynthetic liner and sand layer should be placed below the stone reservoir to prevent preferential flow paths and to maintain a flat bottom. Designs also need some method to convey larger storms to the storm drain system. One option is to use storm drain inlets set slightly above the elevation of the pavement. This would allow for some ponding above the surface, but would bypass flows that are too large to be treated by the system or when the surface clogs.

3. *Maintenance Reduction*. One nonstructural component that can help ensure proper maintenance of porous pavement is the use of a carefully worded maintenance agreement that provides specific guidance, including how to conduct routine maintenance and how the surface should be repaved. Ideally, signs should be posted on the site identifying porous pavement areas.

   One design option incorporates an "overflow edge," which is a trench surrounding the edge of the pavement. The trench connects to the stone reservoir below the surface of the pavement. Although this feature does not in itself reduce maintenance requirements, it acts as a backup in case the surface clogs. If the surface clogs, storm water will flow over the surface and into the trench, where some infiltration and treatment will occur.

4. *Landscaping*. For porous pavement, the most important landscaping feature is a fully stabilized upland drainage. Reducing sediment loads entering the pavement can help to prevent clogging.

*Design Variations*

In one design variation, the stone reservoir below the filter can also treat runoff from other sources such as rooftop runoff. In this design, pipes are connected to the stone reservoir to direct flow throughout the bottom of the storage reservoir (Cahill Associates, 1993; Schueler, 1987). If used to treat off-site runoff, porous pavement should incorporate pretreatment, as with all structural management practices.

*Regional Adaptations*

In cold climates, the base of the stone reservoir should be below the frost line. This modification will help to reduce the risk of frost heave.

## Limitations

In addition to the relatively strict siting requirements of porous pavement, a major limitation to the practice is the poor success rate it has experienced in the field. Several studies indicate that, with proper maintenance, porous pavement can retain its permeability (e.g., Goforth et al., 1983; Gburek and Urban, 1980; Hossain and Scofield, 1991). When porous pavement has been implemented in communities, however, the failure rate has been as high as 75 percent over 2 years (Galli, 1992).

## Maintenance Considerations

Porous pavement requires extensive maintenance compared with other practices. In addition to owners not being aware of porous pavement on a site, not performing these maintenance activities is the chief reason for failure of this practice. Typical requirements are shown in Table 1.

Table 1. Typical maintenance activities for porous pavement (Source: WMI, 1997)

| Activity | Schedule |
|---|---|
| • Avoid sealing or repaving with non-porous materials. | N/A |
| • Ensure that paving area is clean of debris.<br>• Ensure that paving dewaters between storms.<br>• Ensure that the area is clean of sediments. | Monthly |
| • Mow upland and adjacent areas, and seed bare areas.<br>• Vacuum sweep frequently to keep the surface free of sediment. | As needed (typically three to four times per year). |
| • Inspect the surface for deterioration or spalling. | Annual |

## Effectiveness

Porous pavement can be used to provide ground water recharge and to reduce pollutants in storm water runoff. Some data suggest that as much as 70 to 80 percent of annual rainfall will go toward ground water recharge (Gburek and Urban, 1980). These data will vary depending on design characteristics and underlying soils. Two studies have been conducted on the long-term pollutant removal of porous pavement, both in the Washington, DC, area. They suggest high pollutant removal, although it is difficult to extrapolate these results to all applications of the practice. The results of the studies are presented in Table 2.

Table 2. Effectiveness of porous pavement pollutant removal (Schueler, 1987)

| | Pollutant Removal (%) | | | | |
|---|---|---|---|---|---|
| **Study** | **TSS** | **TP** | **TN** | **COD** | **Metals** |
| Prince William, VA | 82 | 65 | 80 | - | - |
| Rockville, MD | 95 | 65 | 85 | 82 | 98–99 |

## Cost Considerations

Porous pavement is significantly more expensive than traditional asphalt. While traditional asphalt is approximately \$0.50 to \$1.00 per ft$^2$, porous pavement can range from \$2 to \$3 per ft$^2$, depending on the design (CWP, 1998; Schueler, 1987). Subtracting the cost of traditional pavement, this amounts to approximately \$45,000 and \$100,000 per impervious acre treated, which would be quite expensive. In addition, the cost of vacuum sweeping may be substantial if a community does not already perform vacuum sweeping operations. Finally, the practice life may be very short because the risk of clogging is high.

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*Filtration practices*

## Bioretention

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description

Bioretention areas are landscaping features adapted to provide on-site treatment of storm water runoff. They are commonly located in parking lot islands or within small pockets of residential land uses. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. During storms, runoff ponds above the mulch and soil in the system. Runoff from larger storms is generally diverted past the facility to the storm drain system. The remaining runoff filters through the mulch and prepared soil mix. Typically, the filtered runoff is collected in a perforated underdrain and returned to the storm drain system.


Bioretention areas can be used in parking areas to collect and treat storm water (Source: University of Maryland, 2000)

### Applicability

Bioretention systems are generally applied to small sites and in a highly urbanized setting. Bioretention can be applied in many climatological and geologic situations, with some minor design modifications.

*Regional Applicability*

Bioretention systems are applicable almost everywhere in the United States. In arid or cold climates, however, some minor design modifications may be needed.

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface exists. Bioretention facilities are ideally suited to many ultra-urban areas, such as parking lots. While they consume a fairly large amount of space (approximately 5 percent of the area that drains to them), they can be fit into existing parking lot islands or other landscaped areas.

*Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. A typical example is a gas station or convenience store parking lot. Bioretention areas can be used to treat storm water hot spots as long as an impermeable liner is used at the bottom of the filter bed.

*Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Bioretention can be used as a storm water retrofit, by modifying existing landscaped areas, or if a parking lot is being resurfaced. In highly urbanized areas, this is one of the few retrofit options that can be employed. However, it is very expensive to retrofit an entire watershed or subwatershed using storm water management practices designed to treat small sites.

*Cold Water (Trout) Streams*

Some species in cold water streams, notably trout, are extremely sensitive to changes in temperature. In order to protect these resources, designers should avoid treatment practices that increase the temperature of the storm water runoff they treat. Bioretention is a good option in cold water streams because water ponds in them for only a short time, decreasing the potential for stream warming.

**Siting and Design Considerations**

In addition to the broad applicability concerns described above, designers need to consider conditions at the site level. In addition, they need to incorporate design features to improve the longevity and performance of the practice, while minimizing the maintenance burden.

*Siting*

Some considerations for selecting a storm water management practice are the drainage area the practice will need to treat, the slopes both at the location of the practice and the drainage area, soil and subsurface conditions, and the depth of the seasonably high ground water table. Bioretention can be applied on many sites, with its primary restriction being the need to apply the practice on small sites.

Drainage Area

Bioretention areas should usually be used on small sites (i.e., 5 acres or less). When used to treat larger areas, they tend to clog. In addition, it is difficult to convey flow from a large area to a bioretention area.

Slope

Bioretention areas are best applied to relatively shallow slopes (usually about 5 percent). However, sufficient slope is needed at the site to ensure that water that enters the bioretention area can be connected with the storm drain system. These storm water management practices are most often applied to parking lots or residential landscaped areas, which generally have shallow slopes.

Soils/Topography

Bioretention areas can be applied in almost any soils or topography, since runoff percolates through a man-made soil bed and is returned to the storm water system.

Ground Water

Bioretention should be separated somewhat from the ground water to ensure that the ground water table never intersects with the bed of the bioretention facility. This design consideration prevents possible ground water contamination.

*Design Considerations*

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community. There are some features, however, that should be incorporated into most bioretention area designs. These design features can be divided into five basic categories: pretreatment, treatment, conveyance, maintenance reduction, and landscaping.

Pretreatment

Pretreatment refers to features of a management practice that cause coarse sediment particles and their associated pollutants to settle. Incorporating pretreatment helps to reduce the maintenance burden of bioretention and reduces the likelihood that the soil bed will clog over time. Several different mechanisms can be used to provide pretreatment in bioretention facilities. Often, runoff is directed to a grass channel or filter strip to filter out coarse materials before the runoff flows into the filter bed of the bioretention area. Other features may include a pea gravel diaphragm, which acts to spread flow evenly and drop out larger particles.

Treatment

Treatment design features help enhance the ability of a storm water management practice to remove pollutants. Several basic features should be incorporated into bioretention designs to enhance their pollutant removal. The bioretention system should be sized between 5 and 10 percent of the impervious area draining to it. The practice should be designed with a soil bed that is a sand/soil matrix, with a mulch layer above the soil bed. The bioretention area should be designed to pond a small amount of water (6–9 inches) above the filter bed.

Conveyance

Conveyance of storm water runoff into and through a storm water practice is a critical component of any storm water management practice. Storm water should be conveyed to and from practices safely and to minimize erosion potential. Ideally, some storm water treatment can be achieved during conveyance to and from the practice.

Bioretention practices are designed with an underdrain system to collect filtered runoff at the bottom of the filter bed and direct it to the storm drain system. An underdrain is a perforated pipe system in a gravel bed, installed on the bottom of the filter bed. Designers should provide an overflow structure to convey flow from storms that are not treated by the bioretention facility to the storm drain.

Maintenance Reduction

In addition to regular maintenance activities needed to maintain the function of storm water practices, some design features can be incorporated to reduce the required maintenance of a practice. Designers should ensure that the bioretention area is easily accessible for maintenance.

Landscaping

Landscaping is critical to the function and aesthetic value of bioretention areas. It is preferable to plant the area with native vegetation, or plants that provide habitat value, where possible. Another important design feature is to select species that can withstand the hydrologic regime they will experience. At the bottom of the bioretention facility, plants that tolerate both wet and dry conditions are preferable. At the edges, which will remain primarily dry, upland species will be the most resilient. Finally, it is best to select a combination of trees, shrubs, and herbaceous materials.

*Design Variations*

One design alternative to the traditional bioretention practice is the use of a "partial exfiltration" system, used to promote ground water recharge. Other design modifications may make this practice more effective in arid or cold climates.

Partial Exfiltration

In one design variation of the bioretention system, the underdrain is only installed on part of the bottom of the bioretention system. This design alternative allows for some infiltration, with the underdrain acting as more of an overflow. This system can be applied only when the soils and other characteristics are appropriate for infiltration (see Infiltration Trench and Infiltration Basin).

Arid Climates

In arid climates, bioretention areas should be landscaped with drought-tolerant species.

Cold Climates

In cold climates, bioretention areas can be used as snow storage areas. If used for this purpose, or if used to treat runoff from a parking lot where salt is used as a deicer, the bioretention area should be planted with salt-tolerant, nonwoody plant species.

**Limitations**

Bioretention areas have a few limitations. Bioretention areas cannot be used to treat a large drainage area, limiting their usefulness for some sites. In addition, although the practice does not consume a large amount of space, incorporating bioretention into a parking lot design may reduce the number of parking spaces available. Finally, the construction cost of bioretention areas is relatively high compared with many other management practices (see Cost Considerations).

## Maintenance Considerations

Bioretention requires frequent landscaping maintenance, including measures to ensure that the area is functioning properly, as well as maintenance of the landscaping on the practice. In many cases, bioretention areas initially require intense maintenance, but less maintenance is needed over time. In many cases, maintenance tasks can be completed by a landscaping contractor, who may already be hired at the site.

Table 1. Typical maintenance activities for bioretention areas (Source: ETA and Biohabitats, 1993)

| Activity | Schedule |
|---|---|
| • Remulch void areas<br>• Treat diseased trees and shrubs<br>• Mow turf areas | As needed |
| • Water plants daily for 2 weeks | At project completion |
| • Inspect soil and repair eroded areas<br>• Remove litter and debris | Monthly |
| • Remove and replace dead and diseased vegetation | Twice per year |
| • Add mulch<br>• Replace tree stakes and wires | Once per year |

## Effectiveness

Structural storm water management practices can be used to achieve four broad resource protection goals. These include flood control, channel protection, ground water recharge, and pollutant removal. In general, bioretention areas can provide only pollutant removal.

*Flood Control*

Bioretention areas are not designed to provide flood control. These larger flows must be diverted to a detention pond that can provide flood peak reduction.

*Channel Protection*

Bioretention areas are generally not designed to provide channel protection because at the scale at which they are typically installed they are not able to infiltrate large volumes. (They are typically designed to treat and infiltrate the first inch of runoff and are bypassed by larger flows that can erode channels.) Channel protection must be provided by other means, such as ponds or other volume control practices.

*Ground Water Recharge*

Bioretention areas do not usually recharge the ground water, except in the case of the partial exfiltration design (see Design Variations).

*Pollutant Removal*

Little pollutant removal data have been collected on the pollutant removal effectiveness of bioretention areas. A field and laboratory analysis of bioretention facilities conducted by Davis et al. (1997), showed very high removal rates (roughly 95 percent for copper, 98 percent for phosphorus, 20 percent for nitrate, and 50 percent for total Kjeldhal nitrogen (TKN). Table 2 shows data from two other studies of field bioretention sites in Maryland.

Table 2. Pollutant removal effectiveness of two bioretention areas in Maryland (USEPA, 2000).

| Pollutant | Pollutant Removal |
|---|---|
| Copper | 43%–97% |
| Lead | 70%–95% |
| Zinc | 64%–95% |
| Phosphorus | 65%–87% |
| TKN | 52–67% |
| $NH_4^+$ | 92% |
| $NO_3^-$ | 15%–16% |
| Total nitrogen (TN) | 49% |
| Calcium | 27% |

Assuming that bioretention systems behave similarly to swales, their removal rates are relatively high. The negative removal rate for bacteria may reflect sampling errors, such as failure to account for bacterial sources in the practice. Alternatively, these data may be the result of bacteria reproduction in the moist soils of swale systems.

There is considerable variability in the effectiveness of bioretention areas, and it is believed that properly designing and maintaining these areas may help to improve their performance. The siting and design criteria presented in this sheet reflect the best current information and experience to improve the performance of bioretention areas. A recent joint project of the American Society of Civil Engineers (ASCE) and the EPA Office of Water may help to isolate specific design features that can improve performance. The National Stormwater Best Management Practice (BMP) database is a compilation of storm water practices which includes both design information and performance data for various practices. As the database expands, inferences about the extent to which specific design criteria influence pollutant removal might be made. More information on this database is accessible on the ASCE web page at http://www.asce.org.

**Cost Considerations**

Bioretention areas are relatively expensive. A recent study (Brown and Schueler, 1997) estimated the cost of a variety of storm water management practices. The study resulted in the following cost equation for bioretention areas, adjusting for inflation:

$$C = 7.30\ V^{0.99}$$

where:

C = Construction, design, and permitting cost ($); and

V = Volume of water treated by the facility ($ft^3$).

An important consideration when evaluating the costs of bioretention is that this practice replaces an area that most likely would have been landscaped. Thus, the true cost of the practice is less than the construction cost reported. Similarly, maintenance activities conducted on bioretention areas are not very different from maintenance of a landscaped area. The land consumed by bioretention areas is relatively high compared with other practices (about 5 percent of the drainage area). Again, this area should not necessarily be considered lost, since the practice may only be slightly larger than a traditional landscaped area. Finally, bioretention areas can improve upon existing landscaping and can therefore be an aesthetic benefit.

## References

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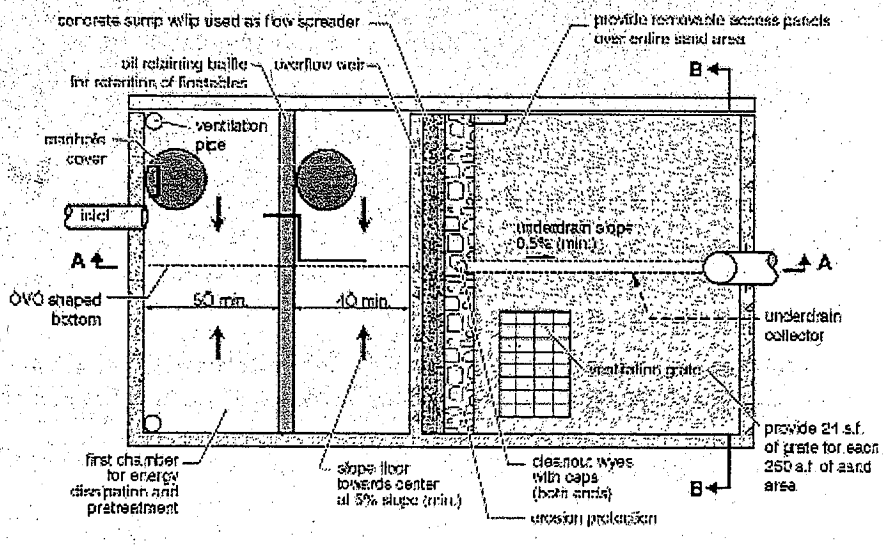
## Sand and Organic Filters

### Postconstruction Storm Water Management in New Development and Redevelopment

## Description

Sand filters are usually two-chambered storm water practices; the first is a settling chamber, and the second is a filter bed filled with sand or another filtering media. As storm water flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as storm water flows through the filtering medium. There are several modifications of the basic sand filter design, including the surface sand filter, underground sand filter, perimeter sand filter, organic media filter, and Multi-Chamber Treatment Train. All of these filtering practices operate on the same basic principle. Modifications to the traditional surface sand filter were made primarily to fit sand filters into more challenging design sites (e.g., underground and perimeter filters) or to improve pollutant removal (e.g., organic media filter).




**PLAN VIEW**
NTS

Schematic of a sand filter (Source: King County, Washington, 2000)

## Applicability

Sand filters can be applied in most regions of the country and on most types of sites. Some restrictions at the site level, however, might restrict the use of sand filters as a storm water management practice (see Siting and Design Considerations).

*Regional Applicability*

Although sand filters can be used in both cold and arid climates, some design modifications might be necessary (See Siting and Design Considerations).

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface is present. Sand filters in general are good options in these areas because they consume little space. Underground and perimeter sand filters in particular are well suited to the ultra-urban setting because they consume no surface space.

*Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. These areas include commercial nurseries, auto recycle facilities, commercial parking lots, fueling stations, storage areas, industrial rooftops, marinas, outdoor container storage of liquids, outdoor loading/unloading facilities, public works storage areas, hazardous materials generators (if containers are exposed to rainfall), vehicle service and maintenance areas, and vehicle and equipment washing/steam cleaning facilities. Sand filters are an excellent option to treat runoff from storm water hot spots because storm water treated by sand filters has no interaction with, and thus no potential to contaminate, the groundwater.

*Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Sand filters are a good option to achieve water quality goals in retrofit studies where space is limited because they consume very little surface space and have few site restrictions. It is important to note, however, that sand filters cannot treat a very large drainage area. Using small-site BMPs in a retrofit may be the only option for a retrofit study in a highly urbanized area, but it is expensive to treat the drainage area of an entire watershed using many small-site practices, as opposed to one larger facility such as a pond.

*Cold Water (Trout) Streams*

Some species in cold water streams, notably trout, are extremely sensitive to changes in temperature. To protect these resources, designers should avoid treatment practices that increase the temperature of the storm water runoff they treat. Sand filters can be a good treatment option for cold water streams. In some storm water treatment practices, particularly wet ponds, runoff is warmed by the sun as it resides in the permanent pool. Surface sand filters are typically not designed with a permanent pool, although there is ponding in the sedimentation chamber and above the sand filter. Designers may consider shortening the detention time in cold water watersheds. Underground and perimeter sand filter designs have little potential for warming because these practices are not exposed to the sun.

## Siting and Design Considerations

In addition to the broad applicability issues described above, designers need to consider conditions at the site level and need to incorporate design features to improve the longevity and performance of the practice, while minimizing the maintenance burden.

*Siting Considerations*

Some considerations when selecting a storm water management practice are the drainage area the practice will need to treat, the slopes both at the location of the practice and draining to it, soil and subsurface conditions, and the depth of the seasonably high ground water table. Although sand filters are relatively versatile, some site restrictions such as available head might limit their use.

Drainage Area

Sand filters are best applied on relatively small sites (up to 10 acres for surface sand filters and closer to 2 acres for perimeter or underground filters [MDE, 2000]). Filters have been used on larger drainage areas, of up to 100 acres, but these systems can clog when they treat larger drainage areas unless adequate measures are provided to prevent clogging, such as a larger sedimentation chamber or more intensive regular maintenance.

Slope

Sand filters can be used on sites with slopes up to about 6 percent. It is challenging to use most sand filters in very flat terrain because they require a significant amount of elevation drop, or head (about 5 to 8 feet), to allow flow through the system. One exception is the perimeter sand filter, which can be applied with as little as 2 feet of head.

Soils/Topography

When sand filters are designed as a stand-alone practice, they can be used on almost any soil because they can be designed so that storm water never infiltrates into the soil or interacts with the ground water. Alternatively, sand filters can be designed as pretreatment for an infiltration practice, where soils do play a role.

Ground Water

Designers should provide at least 2 feet of separation between the bottom of the filter and the seasonally high ground water table. This design feature prevents both structural damage to the filter and possibly, though unlikely, ground water contamination.

*Design Considerations*

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community. Some features, however, should be incorporated into most designs. These design features can be divided into five basic categories: pretreatment, treatment, conveyance, maintenance reduction, and landscaping.

Pretreatment

Pretreatment is a critical component of any storm water management practice. In sand filters, pretreatment is achieved in the sedimentation chamber that precedes the filter bed. In this chamber, the coarsest particles settle out and thus do not reach the filter bed. Pretreatment reduces the maintenance burden of sand filters by reducing the potential of these sediments to clog the filter. Designers should provide at least 25 percent of the water quality volume in a dry or wet sedimentation chamber as pretreatment to the filter system. The water quality volume is the amount of runoff that will be treated for pollutant removal in the practice. Typical water quality volumes are the runoff from a 1-inch storm or ½ inch of runoff over the entire drainage area to the practice.

The area of the sedimentation chamber may be determined based on the Camp-Hazen equation, as adapted by the Washington State Department of Ecology (Washington State DOE, 1992). This equation can be expressed as:

$A_s = (Q_o/W) ln(1-E)$

where:

$A_s$ = surface area ($ft^2$);

$Q_o$ = discharge rate from basin (water quality volume/detention time);

W = particle settling velocity (ft/s);

*[CWP (1996) used a settling of 0.0004 ft/s for drainage areas greater than 75% impervious and 0.0033 ft/s for drainage areas less than or equal to 75% impervious to account for the finer particles that erode from pervious surfaces.]*

E = removal efficiency fraction (usually assumed to be about 0.9(90%)).

Using the simplifying assumption of a 24-hour detention time, CWP (1996) reduced the above equation to

$A_s = 0.066WTV$ (>75%)

$A_s = 0.0081WTV$ (< or = 75%)

where

WTV = water quality volume ($ft^3$), or the volume of storm water to be treated by the practice.

<u>Treatment</u>

Treatment design features help enhance the ability of a storm water management practice to remove pollutants. In filtering systems, designers should provide at least 75 percent of the water quality volume in the practice (including both the sand chamber and the sediment chamber). In sand filters, designers should select a medium sand as the filtering medium.

The filter bed should be sized using Darcy's Law, which relates the velocity of fluids to the hydraulic head and the coefficient of permeability of a medium. The resulting equation, as derived by the city of Austin, Texas, (1996), is

AF = WTV d/[k t (h+d)]

where

AF = area of the filter bed ($ft^2$);

d = depth of the filter bed (ft; usually about 1.5 feet, depending on the design);

k = coefficient of permeability of the filtering medium (ft/day);

t = time for the water quality volume to filter through the system (days; usually assumed to be 1.67 days); and

h = average water height above the sand bed (ft; assumed to be one-half of the maximum head).

Typical values for k, as assembled by CWP (1996), are shown in Table 1.

Table 1: Coefficient of permeability values for storm water filtering practices (CWP, 1996)

| Filter Medium | Coefficient of Permeability (ft/day) |
|---|---|
| Sand | 3.5 |
| Peat/Sand | 2.75 |
| Compost | 8.7 |

Conveyance

Conveyance of storm water runoff into and through a storm water practice is a critical component of any storm water management practice. Storm water should be conveyed to and from practices safely and in a manner that minimizes erosion potential. Ideally, some storm water treatment can be achieved during conveyance to and from the practice.

Typically, filtering practices are designed as "off-line" systems, meaning that they have the smaller water quality volume diverted to them only during larger storms, using a flow splitter, which is a structure that bypasses larger flows to the storm drain system or to a stabilized channel. One exception is the perimeter filter; in this design, all flows enter the system, but larger flows overflow to an outlet chamber and are not treated by the practice.

All filtering practices, with the exception of exfilter designs (see Design Variations) are designed with an under drain below the filtering bed. An under drain is a perforated pipe system in a gravel bed, installed on the bottom of filtering practices and used to collect and remove filtered runoff.

Maintenance Reduction

In addition to regular maintenance activities needed to maintain the function of storm water practices, some design features can be incorporated to ease the maintenance burden of each practice. Designers should provide maintenance access to filtering systems. In underground sand filters, confined space rules defined by the Occupational Safety and Health Administration (OSHA) need to be addressed.

Landscaping

Landscaping can add to both the aesthetic value and the treatment ability of storm water practices. In sand filters, little landscaping is generally used on the practice, although surface sand filters and organic media filters may be designed with a grass cover on the surface of the filter. In all filters, designers need to ensure that the contributing drainage has dense vegetation to reduce sediment loads to the practice.

*Design Variations*

As mentioned earlier in this fact sheet, there are five basic storm water filter designs--surface sand filter, underground filter, perimeter filter (also known as the "Delaware" filter), organic media filter, and Multi-Chamber Treatment Train. Other design variations can incorporate design features to recharge ground water or to meet the design challenges of cold or arid climates.

Surface Sand Filter

The surface sand filter is the original sand filter design. In this practice both the filter bed and the sediment chamber are aboveground. The surface sand filter is designed as an off-line practice, where only the water quality volume is directed to the filter. The surface sand filter is the least expensive filter option and has been the most widely used.

Underground Sand Filter

The underground sand filter is a modification of the surface sand filter, where all of the filter components are underground. Like the surface sand filter, this practice is an off-line system that receives only the smaller water quality events. Underground sand filters are expensive to construct but consume very little space. They are well suited to highly urbanized areas.

Perimeter Sand Filter

The perimeter sand filter also includes the basic design elements of a sediment chamber and a filter bed. In this design, however, flow enters the system through grates, usually at the edge of a parking lot. The perimeter sand filter is the only filtering option that is on-line, with all flows entering the system but larger events bypassing treatment by entering an overflow chamber. One major advantage to the perimeter sand filter design is that it requires little hydraulic head and thus is a good option in areas of low relief.

Organic Media Filter

Organic media filters are essentially the same as surface filters, with the sand medium replaced with or supplemented by another medium. Two examples are the peat/sand filter (Galli, 1990) and the compost filter system (CSF, 1996). The assumption is that these systems will have enhanced pollutant removal for many compounds because of the increased cation exchange capacity achieved by increasing the organic matter.

Multi-Chamber Treatment Train

The Multi-Chamber Treatment Train (Robertson et al., 1995) is essentially a "deluxe sand filter." This underground system consists of three chambers. Storm water enters into the first chamber, where screening occurs, trapping large sediments and releasing highly volatile materials. The second chamber provides settling of fine sediments and further removal of volatile compounds and also floatable hydrocarbons through the use of fine bubble diffusers and sorbent pads. The final chamber provides filtration by using a sand and peat mixed medium for reduction of the remaining pollutants. The top of the filter is covered by a filter fabric that evenly distributes the water volume and prevents channelization. Although this practice can achieve very high pollutant removal rates, it might be prohibitively expensive in many areas and has been implemented only on an experimental basis.

Exfiltration/Partial Exfiltration

In exfilter designs, all or part of the under drain system is replaced with an open bottom that allows infiltration to the ground water. When the under drain is present, it is used as an overflow device in case the filter becomes clogged. These designs are best applied in the same soils where infiltration practices are used (see Infiltration Basin and Infiltration Trench fact sheets).

*Regional Variations*

Arid Climates

Filters have not been widely used in arid climates. In these climates, however, it is probably necessary to increase storage in the sediment chamber to account for high sediment loads. Designers should consider increasing the volume of the sediment chamber to up to 40 percent of the water quality volume.

Cold Climates

In cold climates, filters can be used, but surface or perimeter filters will not be effective during the winter months, and unintended consequences might result from a frozen filter bed. Using alternative conveyance measures such as a weir system between the sediment chamber and filter bed may avoid freezing associated with the traditional standpipe. Where possible, the filter bed should be below the frost line. Some filters, such as the peat/sand filter, should be shut down during the winter. These media will become completely impervious during freezing conditions. Using a larger under drain system to encourage rapid draining during the winter months may prevent freezing of the filter bed. Finally, the sediment chamber should be larger in cold climates to account for road sanding (up to 40 percent of the water quality volume).

## Limitations

Sand filters can be used in unique conditions where many other storm water management practices are inappropriate, such as in karst (i.e., limestone) topography or in highly urbanized settings. There are several limitations to these practices, however. Sand filters cannot control floods and generally are not designed to protect stream channels from erosion or to recharge the ground water. In addition, sand filters require frequent maintenance, and underground and perimeter versions of these practices are easily forgotten because they are out of sight. Perhaps one of the greatest limitations to sand filters is that they cannot be used to treat large drainage areas. Finally, surface sand filters are generally not aesthetically pleasing management practices. Underground and perimeter sand filters are not visible, and thus do not add or detract from the aesthetic value of a site.

## Maintenance Considerations

Intense and frequent maintenance and inspection practices are needed for filter systems. Table 2 outlines some of these requirements.

Table 2: Typical maintenance/inspection activities for filtration systems (Adapted from WMI, 1997; CWP, 1997)

| Activity | Schedule |
|---|---|
| • Ensure that contributing area, filtering practice, inlets, and outlets are clear of debris.<br>• Ensure that the contributing area is stabilized and mowed, with clippings removed.<br>• Check to ensure that the filter surface is not clogging (also after moderate and major storms).<br>• Ensure that activities in the drainage area minimize oil/grease and sediment entry to the system.<br>• If a permanent pool is present, ensure that the chamber does not leak and that normal pool level is retained. | Monthly |
| • Replace sorbent pillows (Multi-Chamber Treatment Train only). | Biannual |
| • Check to see that the filter bed is clean of sediments, and the sediment chamber is no more than one-half full of sediment. Remove sediment if necessary.<br>• Make sure that there is no evidence of deterioration, sailing, or cracking of concrete.<br>• Inspect grates (if used).<br>• Inspect inlets, outlets, and overflow spillway to ensure good condition and no evidence of erosion.<br>• Repair or replace any damaged structural parts.<br>• Stabilize any eroded areas.<br>• Ensure that flow is not bypassing the facility.<br>• Ensure that no noticeable odors are detected outside the facility. | Annual |

## Effectiveness

Structural storm water management practices can be used to achieve four broad resource protection goals: flood control, channel protection, ground water recharge, and pollutant removal. Filtering practices are for the most part adapted only to provide pollutant removal.

### *Ground Water Recharge*

In exfilter designs, some ground water recharge can be provided; however, none of the other sand filter designs can provide recharge.

*Pollutant Removal*

Sand filters are effective storm water management practices for pollutant removal. Removal rates for all sand filters and organic filters are presented in Table 3. With the exception of nitrates, which appear to be exported from filtering systems, they perform relatively well at removing pollutants. The export of nitrates from filters may be caused by mineralization of organic nitrogen in the filter bed. Table 3 shows typical removal efficiencies for sand filters.

Table 3: Sand filter removal efficiencies (percent)

| | Sand Filters (Schueler, 1997) | Peat/Sand Filter (Curran, 1996) | Compost Filter System | | Multi-Chamber Treatment Train | | |
|---|---|---|---|---|---|---|---|
| | | | Stewart, 1992 | Leif, 1999 | Pitt et al., 1997 | Pitt, 1996 | Greb et al., 1998 |
| TSS | 87 | 66 | 95 | 85 | 85 | 83 | 98 |
| TP | 51 | 51 | 41 | 4 | 80 | - | 84 |
| TN | 44 | 47 | - | - | - | - | - |
| Nitrate | -13 | 22 | -34 | -95 | - | 14 | - |
| Metals | 34-80 | 26-75 | 61-88 | 44-75 | 65-90 | 91-100 | 83-89 |
| Bacteria | 55 | - | - | - | - | - | - |

From the few studies available, it is difficult to determine if organic filters necessarily have higher removal efficiencies than sand filters. The Multi-Chamber Treatment Train appears to have high pollutant removal for some constituents, although these data are based on only a handful of studies. The siting and design criteria presented in this fact sheet reflect the best current information and experience to improve the performance of sand filters. A recent joint project of the American Society of Civil Engineers (ASCE) and the U.S. EPA Office of Water may help to isolate specific design features that can improve performance. The National Stormwater Best Management Practice (BMP) database is a compilation of storm water practices that includes both design information and performance data for various practices. As the database expands, inferences about the extent to which specific design criteria influence pollutant removal may be made. For more information on this database, access the ASCE web page at http://www.asce.org.

## Cost Considerations

There are few consistent data on the cost of sand filters, largely because, with the exception of Austin, Texas, Alexandria, Virginia, and Washington, D.C., they have not been widely used. Furthermore, filters have such varied designs that it is difficult to assign a cost to filters in general. A study by Brown and Schueler (1997) was unable to find a statistically valid relationship between the volume of water treated in a filter and the cost of the practice, but typical total cost of installation ranged between $2.50 and $7.50 per cubic foot of storm water treated, with an average cost of about $5 per cubic foot. (This estimate includes approximately 25 percent contingency costs beyond the construction costs reported). The cost per impervious acre treated varies considerably depending on the region and design used (see Table 4). It is important to note that, although underground and perimeter sand filters can be more expensive than surface sand filters, they consume no surface space, making them a relatively cost-effective practice in ultra-urban areas where land is at a premium.

Table 4: Construction costs for various sand filters (Source: Schueler, 1994)

| Region (Design) | Cost/Impervious Acre |
|---|---|
| Delaware (Perimeter) | $10,000 |
| Alexandria, VA (Perimeter) | $23,500 |
| Austin, TX (<2 acres) (Surface) | $16,000 |
| Austin, TX (>5 acres) (Surface) | $3,400 |
| Washington, DC (underground) | $14,000 |
| Denver, CO | $30,000–$50,000 |
| Multi-Chamber Treatment Train | $40,000–$80,000 |

## Information Resources

Center for Watershed Protection (CWP). 1997. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for U.S. EPA Office of Wetlands, Oceans and Watersheds, Washington, DC, by the Center for Watershed Protection, Ellicott City, MD.

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Appendix I. Filter removal efficiency data

| Filter Removal Efficiencies | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Study** | **TSS** | **TP** | **TN** | **$NO_3$** | **Metals** | **Bacteria** | **Practice Type** |
| Bell et al., 1995 | 79 | 65.5 | 47 | -53.3 | 25–91 | - | perimeter sand filter |
| Horner and Horner, 1995 | 83 | 46.3 | - | - | 22–33 | - | perimeter sand filter |
| Horner and Horner, 1995 | 8 | 20 | - | - | 31–69 | - | perimeter sand filter |
| Harper and Herr, 1993 | 98 | 61 | - | 27 | 37–89 | - | surface sand filter |
| Welborn and Veenhuis, 1987 | 78 | 27 | 27 | -100 | 33–60 | 81 | surface sand filter |
| City of Austin, TX, 1990 | 75 | 59 | 44 | -13 | 34–67 | 36 | surface sand filter |
| City of Austin, TX, 1990 | 92 | 80 | 71 | 23 | 84–91 | 83 | surface sand filter |
| City of Austin, TX, 1990 | 86 | 19 | 31 | -5 | 33–71 | 37 | surface sand filter |
| City of Austin, TX, 1990 | 87 | 61 | 32 | -79 | 60-86 | 37 | surface sand filter |
| Barton Springs/Edwards Aquifer Conservation District, 1996 | 81 | 39 | 13 | -11 | 58–79 | - | vertical sand filter |
| Barton Springs/Edwards Aquifer Conservation District, 1996 | 55 | 45 | 15 | -87 | 58–60 | - | vertical sand filter |
| Stewart, 1992 | 95 | 41 | - | -34 | 61–87 | - | organic filter |
| Curran, 1996 | 66 | 51 | 47 | 22 | 26–75 | - | organic filter |

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## Storm Water Wetland

## Postconstruction Storm Water Management in New Development and Redevelopment

### Description

A storm water wetland detains storm water, removes pollutants, and provides habitat and aesthetic benefits (Source: The Bioengineering Group, Inc., no date)

Storm water wetlands (a.k.a. constructed wetlands) are structural practices similar to wet ponds (see Wet Pond fact sheet) that incorporate wetland plants into the design. As storm water runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake within the practice. Wetlands are among the most effective storm water practices in terms of pollutant removal and they also offer aesthetic value. Although natural wetlands can sometimes be used to treat storm water runoff that has been properly pretreated, storm water wetlands are fundamentally different from natural wetland systems. Storm water wetlands are designed specifically for the purpose of treating storm water runoff, and typically have less biodiversity than natural wetlands in terms of both plant and animal life. Several design variations of the storm water wetland exist, each design differing in the relative amounts of shallow and deep water, and dry storage above the wetland.

A distinction should be made between using a constructed wetland for storm water management and diverting storm water into a natural wetland. The latter practice is not recommended because altering the hydrology of the existing wetland with additional storm water can degrade the resource and result in plant die-off and the destruction of wildlife habitat. In all circumstances, natural wetlands should be protected from the adverse effects of development, including impacts from increased storm water runoff. This is especially important because natural wetlands provide storm water and flood control benefits on a regional scale.

### Applicability

Constructed wetlands are widely applicable storm water management practices. While they have limited applicability in highly urbanized settings and in arid climates, wetlands have few other restrictions.

*Regional Applicability*

Storm water wetlands can be applied in most regions of the United States, with the exception of arid climates. In arid and semi-arid climates, it is difficult to design any storm water practice that has a permanent pool. Because storm water wetlands are shallow, a relatively large area is subject to evaporation relative, to the volume of the practice. This makes maintaining the permanent pool in wetlands both more challenging and more important than maintaining the pool of a wet pond (see Wet Pond fact sheet).

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface exists. It is difficult to use wet ponds in the ultra-urban environment because of the land area each wetland consumes. They can, however, be used in an ultra-urban environment if a relatively large area is available downstream of the site.

*Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. A typical example is a gas station. Wetlands can accept runoff from storm water hot spots, but need significant separation from ground water if they will be used for this purpose. Caution also needs to be exercised, if these practices are designed to encourage wildlife use, to ensure that pollutants in storm water runoff do not work their way through the food chain of organisms living in or near the wetland.

*Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. When retrofitting an entire watershed, storm water wetlands have the advantage of providing both educational and habitat value. One disadvantage to wetlands, however, is the difficulty of storing large amounts of runoff without consuming a large amount of land. It is also possible to incorporate wetland elements into existing practices, such as wetland plantings (see Wet Pond and Dry Extended Detention Pond fact sheets)

*Cold Water (Trout) Streams*

Wetlands pose a risk to cold water systems because of their potential for stream warming. When water remains in the permanent pool, it is heated by the sun. A study in Prince George's County, Maryland, investigated the thermal impacts of a wide range of storm water management practices (Galli, 1990). In this study, only one wetland was investigated, which was an extended detention wetland (see Design Variations). The practice increased the average temperature of storm water runoff that flowed through the practice by about 3°F. As a result, it is likely that wetlands increase water temperature.

## Siting and Design Considerations

In addition to the broad applicability concerns described above, designers need to consider conditions at the site level. In addition, they need to incorporate design features to improve the longevity and performance of the practice, while minimizing the maintenance burden.

*Siting Considerations*

In addition to the restrictions and modifications to adapting storm water wetlands to different regions and land uses, designers need to ensure that this management practice is feasible at the site in question. The following section provides basic guidelines for siting wetlands.

Drainage Area

Wetlands need sufficient drainage area to maintain the permanent pool. In humid regions, this is typically about 25 acres, but a greater area may be needed in regions with less rainfall.

Slope

Wetlands can be used on sites with an upstream slope of up to about 15 percent. The local slope should be relatively shallow, however. While there is no minimum slope requirement, there does need to be enough elevation drop from the inlet to the outlet to ensure that hydraulic conveyance by gravity is feasible (generally about 3 to 5 feet).

Soils/Topography

Wetlands can be used in almost all soils and geology, with minor design adjustments for regions of karst (i.e. limestone) topography (see Design Considerations).

Ground Water

Unless they receive hot spot runoff, wetlands can often intersect the ground water table. Some research suggests that pollutant removal is reduced when ground water contributes substantially to the pool volume (Schueler, 1997b). It is assumed that wetlands would have a similar response.

*Design Considerations*

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community. There are some features, however, that should be incorporated into most wetland designs. These design features can be divided into five basic categories: pretreatment, treatment, conveyance, maintenance reduction, and landscaping.

Pretreatment

Pretreatment incorporates design features that help to settle out coarse sediment particles. By removing these particles from runoff before they reach the large permanent pool, the maintenance burden of the pond is reduced. In wetlands, pretreatment is achieved with a sediment forebay. A sediment forebay is a small pool (typically about 10 percent of the volume of the permanent pool). Coarse particles remain trapped in the forebay, and maintenance is performed on this smaller pool, eliminating the need to dredge the entire pond.

Treatment

Treatment design features help enhance the ability of a storm water management practice to remove pollutants. The purpose of most of these features is to increase the amount of time and flowpath by which storm water remains in the wetland. Some typical design features include

- The surface area of wetlands should be at least 1 percent of the drainage area to the practice.
- Wetlands should have a length-to-width ratio of at least 1.5:1. Making the wetland longer than it is wide helps prevent "short circuiting" of the practice.
- Effective wetland design displays "complex microtopography." In other words, wetlands should have zones of both very shallow (<6 inches) and moderately shallow (<18 inches) wetlands incorporated, using underwater earth berms to create the zones. This design will

provide a longer flow path through the wetland to encourage settling, and it provides two depth zones to encourage plant diversity.

Conveyance

Conveyance of storm water runoff into and through a storm water management practice is a critical component of any practice. Storm water should be conveyed to and from practices safely and to minimize erosion potential. The outfall of pond systems should always be stabilized to prevent scour. In addition, an emergency spillway should be provided to safely convey large flood events. To help mitigate warming at the outlet channel, designers should provide shade around the channel at the pond outlet.

Maintenance Reduction

In addition to regular maintenance activities needed to maintain the function of storm water practices, some design features can be incorporated to ease the maintenance burden of each practice. In wetlands, maintenance reduction features include techniques to reduce the amount of maintenance needed, as well as techniques to make regular maintenance activities easier.

One potential maintenance concern in wet ponds is clogging of the outlet. Wetlands should be designed with a nonclogging outlet such as a reverse-slope pipe or a weir outlet with a trash rack. A reverse-slope pipe draws from below the permanent pool extending in a reverse angle up to the riser and establishes the water elevation of the permanent pool. Because these outlets draw water from below the level of the permanent pool, they are less likely to be clogged by floating debris. Another general rule is that no orifice should be less than 3 inches in diameter. Smaller orifices are generally more susceptible to clogging, without specific design considerations to reduce this problem. Another feature that can help reduce the potential for clogging of the outlet is to incorporate a small pool, or "micropool" at the outlet.

Design features are also incorporated to ease maintenance of both the forebay and the main pool of wetlands. Wetlands should be designed with a maintenance access to the forebay to ease this relatively routine (5- to 7-year) maintenance activity. In addition, the permanent pool should have a pond drain to draw down the pond for the more infrequent dredging of the main cell of the wetland.

Landscaping

Landscaping of wetlands can make them an asset to a community and can also enhance the pollutant removal of the practice. In wetland systems, landscaping is an integral part of the design. To ensure the establishment and survival of wetland plants, a landscaping plan should provide detailed information about the plants selected, when they will be planted, and a strategy for maintaining them. The plan should detail wetland plants, as well as vegetation to be established adjacent to the wetland.

A variety of techniques can be used to establish wetland plants. The most effective techniques are the use of nursery stock as dormant rhizomes, live potted plants, and bare rootstock. A "wetland mulch," soil from a natural wetland or a designed "wetland mix," can be used to supplement wetland plantings or alone to establish wetland vegetation. Wetland mulch carries with it the seed bank from the original wetland, and can help to enhance diversity in the wetland. The least expensive option to establish wetlands is to allow the wetland to colonize itself. One disadvantage to this last technique is that invasive species such as cattails or Phragmites may dominate the wetland.

When developing a plan for wetland planting, care needs to be taken to ensure that plants are established in the proper depth and within the planting season. This season varies regionally, and is generally between 2 and 3 months long in the spring to early summer. Plant lists are available for various regions of the United States through wetland nurseries, extension services, and conservation districts.

*Design Variations*

There are several variations of the wetland design. The designs are characterized by the volume of the wetland in deep pool, high marsh, and low marsh, and whether the design allows for detention of small storms above the wetland surface. Other design variations help to make wetland designs practical in cold climates.

<u>Shallow Marsh</u>

In the shallow marsh design, most of the wetland volume is in the relatively shallow high marsh or low marsh depths. The only deep portions of the shallow wetland design are the forebay at the inlet to the wetland and the micropool at the outlet. One disadvantage to this design is that, since the pool is very shallow, a large amount of land is typically needed to store the water quality volume (i.e., the volume of runoff to be treated in the wetland).

<u>Extended Detention Wetland</u>

This design is the same as the shallow marsh, with additional storage above the surface of the marsh. Storm water is temporarily ponded above the surface in the extended detention zone for between 12 and 24 hours. This design can treat a greater volume of storm water in a smaller space than the shallow wetland design. In the extended detention wetland option, plants that can tolerate wet and dry periods should be specified in the extended detention zone.

<u>Pond/Wetland System</u>

The pond/wetland system combines the wet pond (see <u>Wet Pond</u> fact sheet) design with a shallow marsh. Storm water runoff flows through the wet pond and into the shallow marsh. Like the extended detention wetland, this design requires less surface area than the shallow marsh because some of the volume of the practice is in the relatively deep (i.e., 6–8 feet) pond.

<u>Pocket Wetland</u>

This design is very similar to the pocket pond (see <u>Wet Pond</u> fact sheet). In this design, the bottom of the wetland intersects the ground water, which helps to maintain the permanent pool. Some evidence suggests that ground water flows may reduce the overall effectiveness of storm water management practices (Schueler, 1997b). This option may be used when there is not significant drainage area to maintain a permanent pool.

<u>Gravel-Based Wetlands</u>

In this design, runoff flows through a rock filter with wetland plants at the surface. Pollutants are removed through biological activity on the surface of the rocks, as well as by pollutant uptake of the plants. This practice is fundamentally different from other wetland designs because, while most wetland designs behave like wet ponds with differences in grading and landscaping, gravel-based wetlands are more similar to a filtering system.

*Regional Variations*

Cold Climates

Cold climates present many challenges to designers of wetlands. During the spring snowmelt, a large volume of water runs off in a short time, carrying a relatively high pollutant load. In addition, cold winter temperatures may cause freezing of the permanent pool or freezing at inlets and outlets. Finally, high salt concentrations in runoff resulting from road salting, as well as sediment loads from road sanding, may impact wetland vegetation.

One of the greatest challenges of storm water wetlands, particularly shallow marshes, is that much of the practice is very shallow. Therefore, much of the volume in the wetland can be lost as the surface of the practice freezes. One study found that the performance of a wetland system was diminished during the spring snowmelt because the outlet and surface of the wetland had frozen. Sediment and pollutants in snowmelt and rainfall events "skated" over the surface of the wetland, depositing at the outlet of the wetland. When the ice melted, this sediment was washed away by storm events (Oberts, 1994). Several design features can help minimize this problem, including:

- "On-line" designs allowing flow to move continuously can help prevent outlets from freezing.
- Wetlands should be designed with multiple cells, with a berm or weir separating each cell. This modification will help to retain storage for treatment above the ice layer during the winter season.
- Outlets that are resistant to freezing should be used. Some examples include weirs or pipes with large diameters.

The salt and sand used to remove ice from roads and parking lots may also create a challenge to designing wetlands in cold climates. When wetlands drain highway runoff, or parking lots, salt-tolerant vegetation, such as pickle weed or cord grass should be used. (Contact a local nursery or extension agency for more information in your region). In addition, designers should consider using a large forebay to capture the sediment from road sanding.

Karst Topography

In karst (i.e., limestone) topography, wetlands should be designed with an impermeable liner to prevent ground water contamination or sinkhole formation, and to help maintain the permanent pool.

## Limitations

Some features of storm water wetlands that may make the design challenging include the following:

- Each wetland consumes a relatively large amount of space, making it an impractical option on many sites.
- Improperly designed wetlands can become a breeding area for mosquitoes.
- Wetlands require careful design and planning to ensure that wetland plants are sustained after the practice is in place.
- It is possible that storm water wetlands may release nutrients during the nongrowing season.
- Designers need to ensure that wetlands do not negatively impact natural wetlands or forest during the design phase.
- Wetlands consume a large amount of land. This characteristic may limit their use in areas where land values are high.

## Maintenance Considerations

In addition to incorporating features into the wetland design to minimize maintenance, some regular maintenance and inspection practices are needed. Table 1 outlines these practices.

Table 1. Regular maintenance activities for wetlands (Source: Adapted from WMI, 1997, and CWP, 1998)

| Activity | Schedule |
|---|---|
| • Replace wetland vegetation to maintain at least 50% surface area coverage in wetland plants after the second growing season. | One-time |
| • Inspect for invasive vegetation and remove where possible. | Semi-annual inspection |
| • Inspect for damage to the embankment and inlet/outlet structures. Repair as necessary.<br>• Note signs of hydrocarbon build-up, and deal with appropriately.<br>• Monitor for sediment accumulation in the facility and forebay.<br>• Examine to ensure that inlet and outlet devices are free of debris and are operational. | Annual inspection |
| • Repair undercut or eroded areas. | As needed maintenance |
| • Clean and remove debris from inlet and outlet structures.<br>• Mow side slopes. | Frequent (3–4 times/year) maintenance |
| • Supplement wetland plants if a significant portion have not established (at least 50% of the surface area).<br>• Harvest wetland plants that have been "choked out" by sediment build-up. | Annual maintenance (if needed) |
| • Remove sediment from the forebay. | 5- to 7-year maintenance |
| • Monitor sediment accumulations, and remove sediment when the pool volume has become reduced significantly, plants are "choked" with sediment, or the wetland becomes eutrophic. | 20- to 50-year maintenance |

## Effectiveness

Structural storm water management practices can be used to achieve four broad resource protection goals. These include flood control, channel protection, ground water recharge, and pollutant removal. Wetlands can provide flood control, channel protection, and pollutant removal.

*Flood Control*

One objective of storm water management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Wetlands can easily be designed for flood control by providing flood storage above the level of the permanent pool.

*Channel Protection*

When used for channel protection, wetlands have traditionally controlled the 2-year storm. It appears that this control has been relatively ineffective, and recent research suggests that control of a smaller storm may be more appropriate (MacRae, 1996).

*Ground Water Recharge*

Wetlands cannot provide ground water recharge. The build-up of debris at the bottom of the wetland prevents the movement of water into the subsoil.

*Pollutant Removal*

Wetlands are among the most effective storm water management practices at removing storm water pollutants. A wide range of research is available to estimate the effectiveness of wetlands. Wetlands have high pollutant removal rates, and are more effective than any other practice at removing nitrate and bacteria. Table 2 provides pollutant removal data derived from the Center for Watershed Protections's National Pollutant Removal Database for Stormwater Treatment Practices (Winer, 2000).

The effectiveness of wetlands varies considerably, but many believe that proper design and maintenance might help to improve their performance. The siting and design criteria presented in this sheet reflect the best current information and experience to improve the performance of wetlands. A recent joint project of the American Society of Civil Engineers (ASCE) and the U.S. EPA Office of Water may help to isolate specific design features that can improve performance. The National Stormwater Best Management Practice (BMP) database is a compilation of storm water practices which includes both design information and performance data for various practices. As the database expands, inferences about the extent to which specific design criteria influence pollutant removal may be made. More information on this database is available on the ASCE web page at http://www.asce.org.

Table 2. Typical Pollutant Removal Rates of Wetlands (%) (Winer, 2000)

| Pollutant | Stormwater Treatment Practice Design Variation | | | |
|---|---|---|---|---|
| | Shallow Marsh | ED Wetland[1] | Pond/Wetland System | Submerged Gravel Wetland[1] |
| TSS | 83±51 | 69 | 71±35 | 83 |
| TP | 43±40 | 39 | 56±35 | 64 |
| TN | 26±49 | 56 | 19±29 | 19 |
| NOx | 73±49 | 35 | 40±68 | 81 |
| Metals | 36–85 | (-80)–63 | 0–57 | 21–83 |
| Bacteria | 76[1] | NA | NA | 78 |

[1]Data based on fewer than five data points

## Cost Considerations

Wetlands are relatively inexpensive storm water practices. Construction cost data for wetlands are rare, but one simplifying assumption is that they are typically about 25 percent more expensive than storm water ponds of an equivalent volume. Using this assumption, an equation developed by Brown and Schueler (1997) to estimate the cost of wet ponds can be modified to estimate the cost of storm water wetlands using the equation:

$C = 30.6V^{0.705}$

where:

C = Construction, design, and permitting cost;

V = Wetland volume needed to control the 10-year storm ($ft^3$).

Using this equation, typical construction costs are the following:

$ 57,100 for a 1 acre-foot facility

$ 289,000 for a 10 acre-foot facility

$ 1,470,000 for a 100 acre-foot facility

Wetlands consume about 3 to 5 percent of the land that drains to them, which is relatively high compared with other storm water management practices. In areas where land value is high, this may make wetlands an infeasible option.

For wetlands, the annual cost of routine maintenance is typically estimated at about 3 percent to 5 percent of the construction cost. Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Wetlands are long-lived facilities (typically longer than 20 years). Thus, the initial investment into these systems may be spread over a relatively long time period.

Although no studies are available on wetlands in particular, there is some evidence to suggest that wet ponds may provide an economic benefit by increasing property values. The results of one study suggest that "pond frontage" property can increase the selling price of new properties by about 10 percent (USEPA, 1995). Another study reported that the perceived value (i.e., the value estimated by residents of a community) of homes was increased by about 15 to 25 percent when located near a wet pond (Emmerling-Dinovo, 1995). It is anticipated that well-designed wetlands, which incorporate additional aesthetic features, would have the same benefit.

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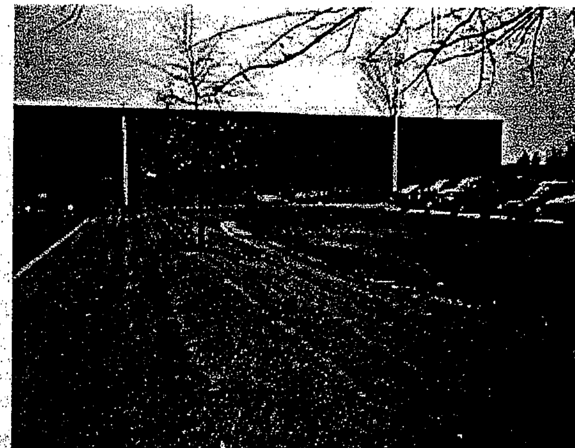
# Grassed Swales

## Postconstruction Storm Water Management in New Development and Redevelopment

### Description

The term swale (a.k.a. grassed channel, dry swale, wet swale, biofilter) refers to a series of vegetated, open-channel management practices designed specifically to treat and attenuate storm water runoff for a specified water quality volume. As storm water runoff flows through these channels, it is treated through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Variations of the grassed swale include the grassed channel, dry swale, and wet swale. The specific design features and methods of treatment differ in each of these designs, but all are improvements on the traditional drainage ditch. These designs incorporate modified geometry and other features for use of the swale as a treatment and conveyance practice.



Grassed swales can be used along roadsides and parking lots to collect and treat storm water runoff

### Applicability

Grassed swales can be applied in most situations with some restrictions. Swales are very well suited for treating highway or residential road runoff because they are linear practices.

*Regional Applicability*

Grassed swales can be applied in most regions of the country. In arid and semi-arid climates, however, the value of these practices needs to be weighed against the water needed to irrigate them.

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface exists. Grassed swales are generally not well suited to ultra-urban areas because they require a relatively large area of pervious surfaces.

*Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. A typical example is a gas station or convenience store. With the exception of the dry swale design (see Design Variations), hot spot runoff should not be directed toward grassed channels. These practices either infiltrate storm water or intersect the ground water, making use of the practices for hot spot runoff a threat to ground water quality.

*Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. One retrofit opportunity using grassed swales modifies existing drainage ditches. Ditches have traditionally been designed only to convey storm water away from roads. In some cases, it may be possible to incorporate features to enhance pollutant removal or infiltration such as check dams (i.e., small dams along the ditch that trap sediment, slow runoff, and reduce the longitudinal slope). Since grassed swales cannot treat a large area, using this practice to retrofit an entire watershed would be expensive because of the number of practices needed to manage runoff from a significant amount of the watershed's land area.

*Cold Water (Trout) Streams*

Grassed channels are a good treatment option within watersheds that drain to cold water streams. These practices do not pond water for a long period of time and often induce infiltration. As a result, standing water will not typically be subjected to warming by the sun in these practices.

**Siting and Design Considerations**

In addition to the broad applicability concerns described above, designers need to consider conditions at the site level. In addition, they need to incorporate design features to improve the longevity and performance of the practice, while minimizing the maintenance burden.

*Siting Considerations*

In addition to considering the restrictions and adaptations of grassed swales to different regions and land uses, designers need to ensure that this management practice is feasible at the site in question because some site conditions (i.e., steep slopes, highly impermeable soils) might restrict the effectiveness of grassed channels.

<u>Drainage Area</u>

Grassed swales should generally treat small drainage areas of less than 5 acres. If the practices are used to treat larger areas, the flows and volumes through the swale become too large to design the practice to treat storm water runoff through infiltration and filtering.

<u>Slope</u>

Grassed swales should be used on sites with relatively flat slopes of less than 4 percent slope; 1 to 2 percent slope is recommended. Runoff velocities within the channel become too high on steeper slopes. This can cause erosion and does not allow for infiltration or filtering in the swale.

<u>Soils / Topography</u>

Grassed swales can be used on most soils, with some restrictions on the most impermeable soils. In the dry swale (see Design Variations) a fabricated soil bed replaces on-site soils in order to ensure that runoff is filtered as it travels through the soils of the swale.

Ground Water

The depth to ground water depends on the type of swale used. In the dry swale and grassed channel options, designers should separate the bottom of the swale from the ground water by at least 2 ft to prevent a moist swale bottom, or contamination of the ground water. In the wet swale option, treatment is enhanced by a wet pool in the practice, which is maintained by intersecting the ground water.

*Design Considerations*

Although there are different design variations of the grassed swale (see Design Variations), there are some design considerations common to all three. One overriding similarity is the cross-sectional geometry of all three options. Swales should generally have a trapezoidal or parabolic cross section with relatively flat side slopes (flatter than 3:1). Designing the channel with flat side slopes maximizes the wetted perimeter. The wetted perimeter is the length along the edge of the swale cross section where runoff flowing through the swale is in contact with the vegetated sides and bottom of the swale. Increasing the wetted perimeter slows runoff velocities and provides more contact with vegetation to encourage filtering and infiltration. Another advantage to flat side slopes is that runoff entering the grassed swale from the side receives some pretreatment along the side slope. The flat bottom of all three should be between 2–8 ft wide. The minimum width ensures a minimum filtering surface for water quality treatment, and the maximum width prevents braiding, the formation of small channels within the swale bottom.

Another similarity among all three designs is the type of pretreatment needed. In all three design options, a small forebay should be used at the front of the swale to trap incoming sediments. A pea gravel diaphragm, a small trench filled with river run gravel, should be used as pretreatment for runoff entering the sides of the swale.

Two other features designed to enhance the treatment ability of grassed swales are a flat longitudinal slope (generally between 1 percent and 2 percent) and a dense vegetative cover in the channel. The flat slope helps to reduce the velocity of flow in the channel. The dense vegetation also helps reduce velocities, protect the channel from erosion, and act as a filter to treat storm water runoff. During construction, it is important to stabilize the channel before the turf has been established, either with a temporary grass cover or with the use of natural or synthetic erosion control products.

In addition to treating runoff for water quality, grassed swales need to convey larger storms safely. Typical designs allow the runoff from the 2-year storm (i.e., the storm that occurs, on average, once every two years) to flow through the swale without causing erosion. Swales should also have the capacity to pass larger storms (typically a 10-year storm) safely.

*Design Variations*

The following discussion identifies three different variations of open channel practices, including the grassed channel, the dry swale, and the wet swale.

Grassed Channel

Of the three grassed swale designs, grassed channels are the most similar to a conventional drainage ditch, with the major differences being flatter side slopes and longitudinal slopes, and a slower design velocity for water quality treatment of small storm events. Of all of the grassed swale options, grassed channels are the least expensive but also provide the least reliable pollutant removal. The best application of a grassed channel is as pretreatment to other structural storm water practices.

One major difference between the grassed channel and most of the other structural practices is the method used to size the practice. Most storm water management water quality practices are sized by volume. This method sets the volume available in the practice equal to the water quality volume, or the volume of water to be treated in the practice. The grassed channel, on the other hand, is a flow-rate-based design. Based on the peak flow from the water quality storm (this varies from region to region, but a typical value is the 1-inch storm), the channel should be designed so that runoff takes, on average, 10 minutes to flow from the top to the bottom of the channel. A procedure for this design can be found in *Design of Storm Water Filtering Systems* (CWP, 1996).

Dry Swales

Dry swales are similar in design to bioretention areas (see Bioretention fact sheet). These designs incorporate a fabricated soil bed into their design. The existing soil is replaced with a sand/soil mix that meets minimum permeability requirements. An underdrain system is used under the soil bed. This system is a gravel layer that encases a perforated pipe. Storm water treated in the soil bed flows through the bottom into the underdrain, which conveys this treated storm water to the storm drain system. Dry swales are a relatively new design, but studies of swales with a native soil similar to the man-made soil bed of dry swales suggest high pollutant removal.

Wet Swales

Wet swales intersect the ground water and behave almost like a linear wetland cell (see Storm Water Wetland fact sheet). This design variation incorporates a shallow permanent pool and wetland vegetation to provide storm water treatment. This design also has potentially high pollutant removal. One disadvantage to the wet swale is that it cannot be used in residential or commercial settings because the shallow standing water in the swale is often viewed as a potential nuisance by homeowners and also breeds mosquitos.

*Regional Variations*

Cold Climates

In cold or snowy climates, swales may serve a dual purpose by acting as both a snow storage/treatment and a storm water management practice. This dual purpose is particularly relevant when swales are used to treat road runoff. If used for this purpose, swales should incorporate salt-tolerant vegetation, such as creeping bentgrass.

Arid Climates

In arid or semi-arid climates, swales should be designed with drought-tolerant vegetation, such as buffalo grass. As pointed out in the Applicability section, the value of vegetated practices for water quality needs to be weighed against the cost of water needed to maintain them in arid and semi-arid regions.

### Limitations

Grassed swales have some limitations, including the following:

- Grassed swales cannot treat a very large drainage area.
- Wet swales may become a nuisance due to mosquito breeding.
- If designed improperly (e.g., if proper slope is not achieved), grassed channels will have very little pollutant removal.
- A thick vegetative cover is needed for these practices to function properly.

### Maintenance Considerations

Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are included in Table 1.

Table 1. Typical maintenance activities for grassed swales (Source: Adapted from CWP, 1996)

| Activity | Schedule |
|---|---|
| • Inspect pea gravel diaphragm for clogging and correct the problem.<br>• Inspect grass along side slopes for erosion and formation of rills or gullies and correct.<br>• Remove trash and debris accumulated in the inflow forebay.<br>• Inspect and correct erosion problems in the sand/soil bed of dry swales.<br>• Based on inspection, plant an alternative grass species if the original grass cover has not been successfully established.<br>• Replant wetland species (for wet swale) if not sufficiently established. | Annual (semi-annual the first year) |
| • Rototill or cultivate the surface of the sand/soil bed of dry swales if the swale does not draw down within 48 hours.<br>• Remove sediment build-up within the bottom of the swale once it has accumulated to 25 percent of the original design volume. | As needed (infrequent) |
| • Mow grass to maintain a height of 3–4 inches | As needed (frequent seasonally) |

**Effectiveness**

Structural storm water management practices can be used to achieve four broad resource protection goals. These include flood control, channel protection, ground water recharge, and pollutant removal. Grassed swales can be used to meet ground water recharge and pollutant removal goals.

*Ground Water Recharge*

Grassed channels and dry swales can provide some ground water recharge as infiltration is achieved within the practice. Wet swales, however, generally do not contribute to ground water recharge. Infiltration is impeded by the accumulation of debris on the bottom of the swale.

*Pollutant Removal*

Few studies are available regarding the effectiveness of grassed channels. In fact, only 9 studies have been conducted on all grassed channels designed for water quality (Table 2). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorous. One study of available performance data (Schueler, 1997) estimates the removal rates for grassed channels as:

Total Suspended Solids: 81%

Total Phosphorous: 29%

Nitrate Nitrogen: 38%

Metals: 14% to 55%

Bacteria: -50%

Table 2. Grassed swale pollutant removal efficiency data

| Removal Efficiencies (% Removal) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Study** | **TSS** | **TP** | **TN** | **$NO_3$** | **Metals** | **Bacteria** | **Type** |
| Goldberg 1993 | 67.8 | 4.5 | - | 31.4 | 42–62 | -100 | grassed channel |
| Seattle Metro and Washington Department of Ecology 1992 | 60 | 45 | - | -25 | 2–16 | -25 | grassed channel |
| Seattle Metro and Washington Department of Ecology, 1992 | 83 | 29 | - | -25 | 46–73 | -25 | grassed channel |
| Wang et al., 1981 | 80 | - | - | - | 70–80 | - | dry swale |
| Dorman et al., 1989 | 98 | 18 | - | 45 | 37–81 | - | dry swale |
| Harper, 1988 | 87 | 83 | 84 | 80 | 88–90 | - | dry swale |
| Kercher et al., 1983 | 99 | 99 | 99 | 99 | 99 | - | dry swale |
| Harper, 1988. | 81 | 17 | 40 | 52 | 37–69 | - | wet swale |
| Koon, 1995 | 67 | 39 | - | 9 | -35 to 6 | - | wet swale |
| Occoquan Watershed Monitoring Lab, 1983 | -100 | 100 | 100 | - | -100 | - | drainage channel |

Table 2. (continued)

| Removal Efficiencies (% Removal) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Study** | **TSS** | **TP** | **TN** | **$NO_3$** | **Metals** | **Bacteria** | **Type** |
| Yousef et al., 1985 | - | 8 | 13 | 11 | 14–29 | - | drainage channel |
| Occoquan Watershed Monitoring Lab, 1983 | -50 | -9.1 | 18.2 | - | -100 | - | drainage channel |
| Yousef et al., 1985 | - | 19.5 | 8 | 2 | 41–90 | - | drainage channel |
| Occoquan Watershed Monitoring Lab, 1983 | 31 | -23 | 36.5 | - | -100 to 33 | - | drainage channel |
| Welborn and Veenhuis, 1987 | 0 | -25 | -25 | -25 | 0 | - | drainage channel |
| Yu et al., 1993 | 68 | 60 | - | - | 74 | - | drainage channel |
| Dorman et al., 1989 | 65 | 41 | - | 11 | 14-55 | - | drainage channel |
| Pitt and McLean, 1986 | 0 | - | 0 | - | 0 | 0 | drainage channel |
| Oakland, 1983 | 33 | -25 | - | - | 20–58 | 0 | drainage channel |
| Dorman et al., 1989 | -85 | 12 | - | -100 | 14–88 | - | drainage channel |

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although wet swales appear to export soluble phosphorous (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils. Another is that studies have not accounted for some sources of bacteria, such as local residents walking dogs within the grassed swale area.

## Cost Considerations

Little data are available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately \$0.25 per $ft^2$. This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most storm water management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately \$0.50 per $ft^2$, which compares favorably with other storm water management practices.

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# Grassed Filter Strip

## Postconstruction Storm Water Management in New Development and Redevelopment

## Description

Grassed filter strips protect water quality by filtering pollutants before they reach the water (Source: USDA, 1997)

Grassed filter strips (vegetated filter strips, filter strips, and grassed filters) are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice, and have more recently evolved into an urban practice. With proper design and maintenance, filter strips can provide relatively high pollutant removal. One challenge associated with filter strips, however, is that it is difficult to maintain sheet flow, so the practice may be "short circuited" by concentrated flows, receiving little or no treatment.

## Applicability

Filter strips are applicable in most regions, but are restricted in some situations because they consume a large amount of space relative to other practices. Filter strips are best suited to treating runoff from roads and highways, roof downspouts, very small parking lots, and pervious surfaces. They are also ideal components of the "outer zone" of a stream buffer (see Buffer Zones fact sheet), or as pretreatment to a structural practice. This recommendation is consistent with recommendations in the agricultural setting that filter strips are most effective when combined with another practice (Magette et al., 1989). In fact, the most recent storm water manual for Maryland does not consider the filter strip as a treatment practice, but does offer storm water volume reductions in exchange for using filter strips to treat some of a site.

*Regional Applicability*

Filter strips can be applied in most regions of the country. In arid areas, however, the cost of irrigating the grass on the practice will most likely outweigh its water quality benefits.

*Ultra-Urban Areas*

Ultra-urban areas are densely developed urban areas in which little pervious surface exists. Filter strips are impractical in ultra-urban areas because they consume a large amount of space.

*Storm Water Hot Spots*

Storm water hot spots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in storm water. A typical example is a gas station. Filter strips should not receive hot spot runoff, because the practice encourages infiltration. In addition, it is questionable whether this practice can reliably remove pollutants, so it should definitely not be used as the sole treatment of hot spot runoff.

*Storm Water Retrofit*

A storm water retrofit is a storm water management practice (usually structural), put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other specific objectives. Filter strips are generally a poor retrofit option because they consume a relatively large amount of space and cannot treat large drainage areas.

*Cold Water (Trout) Streams*

Some cold water species, such as trout, are sensitive to changes in temperature. While some treatment practices, such as wet ponds (see Wet Ponds fact sheet), can warm storm water substantially, filter strips do not warm pond water on the surface for long periods of time and are not expected to increase storm water temperatures. Thus, these practices are good for protection of cold-water streams.

## Siting and Design Considerations

*Siting Considerations*

In addition to the restrictions and modifications to adapting filter strips to different regions and land uses, designers need to ensure that this management practice is feasible at the site in question. The following section provides basic guidelines for siting filter strips.

Drainage Area

Typically, filter strips are used to treat very small drainage areas. The limiting design factor, however, is not the drainage area the practice treats but the length of flow leading to it. As storm water runoff flows over the ground's surface, it changes from sheet flow to concentrated flow. Rather than moving uniformly over the surface, the concentrated flow forms rivulets which are slightly deeper and cover less area than the sheet flow. When flow concentrates, it moves too rapidly to be effectively treated by a grassed filter strip. As a rule, flow concentrates within a maximum of 75 feet for impervious surfaces, and 150 feet for pervious surfaces (CWP, 1996). Using this rule, a filter strip can treat one acre of impervious surface per 580-foot length.

Slope

Filter strips should be designed on slopes between 2 and 6 percent. Greater slopes than this would encourage the formation of concentrated flow. Except in the case of very sandy or gravelly soil, runoff would pond on the surface on slopes flatter than 2 percent, creating potential mosquito breeding habitat.

Soils /Topography

Filter strips should not be used on soils with a high clay content, because they require some infiltration for proper treatment. Very poor soils that cannot sustain a grass cover crop are also a limiting factor.

Ground Water

Filter strips should be separated from the ground water by between 2 and 4 ft to prevent contamination and to ensure that the filter strip does not remain wet between storms.

*Design Considerations*

Filter strips appear to be a minimal design practice because they are basically no more than a grassed slope. However, some design features are critical to ensure that the filter strip provides some minimum amount of water quality treatment.

- A pea gravel diaphragm should be used at the top of the slope. The pea gravel diaphragm (a small trench running along the top of the filter strip) serves two purposes. First, it acts as a pretreatment device, settling out sediment particles before they reach the practice. Second, it acts as a level spreader, maintaining sheet flow as runoff flows over the filter strip.
- The filter strip should be designed with a pervious berm of sand and gravel at the toe of the slope. This feature provides an area for shallow ponding at the bottom of the filter strip. Runoff ponds behind the berm and gradually flows through outlet pipes in the berm. The volume ponded behind the berm should be equal to the water quality volume. The water quality volume is the amount of runoff that will be treated for pollutant removal in the practice. Typical water quality volumes are the runoff from a 1-inch storm or ½-inch of runoff over the entire drainage area to the practice.
- The filter strip should be at least 25 feet long to provide water quality treatment.
- Designers should choose a grass that can withstand relatively high velocity flows and both wet and dry periods.
- Both the top and toe of the slope should be as flat as possible to encourage sheet flow and prevent erosion.

*Regional Variations*

In cold climates, filter strips provide a convenient area for snow storage and treatment. If used for this purpose, vegetation in the filter strip should be salt-tolerant, (e.g., creeping bentgrass), and a maintenance schedule should include the removal of sand built up at the bottom of the slope. In arid or semi-arid climates, designers should specify drought-tolerant grasses (e.g., buffalo grass) to minimize irrigation requirements.

**Limitations**

Filter strips have several limitations related to their performance and space consumption:

- The practice has not been shown to achieve high pollutant removal.
- Filter strips require a large amount of space, typically equal to the impervious area they treat, making them often infeasible in urban environments where land prices are high.
- If improperly designed, filter strips can become a mosquito breeding ground.

- Proper design requires a great deal of finesse, and slight problems in the design, such as improper grading, can render the practice ineffective in terms of pollutant removal.

### Maintenance Considerations

Filter strips require similar maintenance to other vegetative practices (see Grassed Swales fact sheet). These maintenance needs are outlined below. Maintenance is very important for filter strips, particularly in terms of ensuring that flow does not short circuit the practice.

Table 1. Typical maintenance activities for grassed filter strips (Source: CWP, 1996)

| Activity | Schedule |
|---|---|
| • Inspect pea gravel diaphragm for clogging and remove built-up sediment.<br>• Inspect vegetation for rills and gullies and correct. Seed or sod bare areas.<br>• Inspect to ensure that grass has established. If not, replace with an alternative species. | Annual inspection (semi-annual the first year) |
| • Mow grass to maintain a 3–4 inch height | Regular (frequent) |
| • Remove sediment build-up within the bottom when it has accumulated to 25% of the original capacity. | Regular (infrequent) |

### Effectiveness

Structural storm water management practices can be used to achieve four broad resource protection goals. These include flood control, channel protection, ground water recharge, and pollutant removal. The first two goals, flood control and channel protection, require that a storm water practice be able to reduce the peak flows of relatively large storm events (at least 1- to 2-year storms for channel protection and at least 10- to 50-year storms for flood control). Filter strips do not have the capacity to detain these events, but can be designed with a bypass system that routes these flows around the practice entirely.

Filter strips can provide a small amount of ground water recharge as runoff flows over the vegetated surface and ponds at the toe of the slope. In addition, it is believed that filter strips can provide modest pollutant removal. Studies from agricultural settings suggest that a 15-foot-wide grass buffer can achieve a 50 percent removal rate of nitrogen, phosphorus, and sediment, and that a 100-foot buffer can reach closer to 70 percent removal of these constituents (Desbonette et al., 1994). It is unclear how these results can be translated to the urban environment, however. The characteristics of the incoming flows are radically different both in terms of pollutant concentration and the peak flows associated with similar storm events. To date, only one study (Yu et al., 1992) has investigated the effectiveness of a grassed filter strip to treat runoff from a large parking lot. The study found that the pollutant removal varied depending on the length of flow in the filter strip. The narrower (75-foot) filter strip had moderate removal for some pollutants and actually appeared to export lead, phosphorus, and nutrients (See Table 2).

Table 2. Pollutant removal of an urban vegetated filter strip (Source: Yu et al., 1993)

| | Pollutant Removal (%) | |
|---|---|---|
| | 75-Ft Filter Strip | 150-Ft Filter Strip |
| Total suspended solids | 54 | 84 |
| Nitrate+nitrite | -27 | 20 |
| Total phosphorus | -25 | 40 |
| Extractable lead | -16 | 50 |
| Extractable zinc | 47 | 55 |

## Cost Considerations

Little data are available on the actual construction costs of filter strips. One rough estimate can be the cost of seed or sod, which is approximately 30¢ per $ft^2$ for seed or 70¢ per $ft^2$ for sod. This amounts to between $13,000 and $30,000 per acre for a filter strip, or the same amount per impervious acre treated. This cost is relatively high compared with other treatment practices. However, the grassed area used as a filter strip may have been seeded or sodded even if it were not used for treatment. In these cases, the only additional costs are the design, which is minimal, and the installation of a berm and gravel diaphragm. Typical maintenance costs are about $350/acre/year (adapted from SWRPC, 1991). This cost is relatively inexpensive and, again, might overlap with regular landscape maintenance costs.

The true cost of filter strips is the land they consume, which is higher than for any other treatment practice. In some situations this land is available as wasted space beyond back yards or adjacent to roadsides, but this practice is cost-prohibitive when land prices are high and land could be used for other purposes.

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*Runoff pretreatment practices*

## Catch Basin

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description

A catch basin (a.k.a. storm drain inlet, curb inlet) is an inlet to the storm drain system that typically includes a grate or curb inlet and a sump to capture sediment, debris, and associated pollutants. They are also used in combined sewer overflow (CSO) watersheds to capture floatables and settle some solids. Catch basins act as pretreatment for other treatment practices by capturing large sediments. The performance of catch basins at removing sediment and other pollutants depends on the design of the catch basin (e.g., the size of the sump) and maintenance procedures to retain the storage available in the sump to capture sediment.

A worker inserts a catch basin insert for oil and grease, trash, debris, and sediment removal from storm water as it enters the storm drainage system (Source: AbTech Industries, 2001)

### Applicability

Catch basins are used in drainage systems throughout the United States. However, many catch basins are not ideally designed for sediment and pollutant capture. Ideal application of catch basins is as pretreatment to another storm water management practice. Retrofitting existing catch basins may help to improve their performance substantially. A simple retrofit option is to ensure that all catch basins have a hooded outlet to prevent floatable materials, such as trash and debris, from entering the storm drain system.

### Limitations

Catch basins have three major limitations, including:

- Even ideally designed catch basins cannot remove pollutants as well as structural storm water management practices, such as wet ponds, sand filters, and storm water wetlands.
- Unless frequently maintained, catch basins can become a source of pollutants through resuspension.
- Catch basins cannot effectively remove soluble pollutants or fine particles.

### Siting and Design Considerations

The performance of catch basins is related to the volume in the sump (i.e., the storage in the catch basin below the outlet). Lager et al. (1997) described an "optimal" catch basin sizing criterion, which relates all catch basin dimensions to the diameter of the outlet pipe (D):

- The diameter of the catch basin should be equal to 4D.
- The sump depth should be at least 4D. This depth should be increased if cleaning is infrequent or if the area draining to the catch basin has high sediment loads.
- The top of the outlet pipe should be 1.5 D from the bottom of the inlet to the catch basin.

Catch basins can also be sized to accommodate the volume of sediment that enters the system. Pitt et al. (1997) propose a sizing criterion based on the concentration of sediment in storm water runoff. The catch basin is sized, with a factor of safety, to accommodate the annual sediment load in the catch basin sump. This method is preferable where high sediment loads are anticipated, and where the optimal design described above is suspected to provide little treatment.

The basic design should also incorporate a hooded outlet to prevent floatable materials and trash from entering the storm drain system. Adding a screen to the top of the catch basin would not likely improve the performance of catch basins for pollutant removal, but would help capture trash entering the catch basin (Pitt et al., 1997).

A variety of other materials may also be used to filter runoff entering the catch basin. These products are known as "catch basin inserts." There are two basic catch basin insert varieties. One insert option consists of a series of trays, with the top tray serving as an initial sediment trap, and the underlying trays composed of media filters. Another option uses filter fabric to remove pollutants from storm water runoff. These devices have a very small volume, compared to the volume of the catch basin sump, and would typically require very frequent sediment removal. Bench test studies found that a variety of options showed little removal of total suspended solids, partially due to scouring from relatively small (6-month) storm events (ICBIC, 1995).

One design adaptation of the standard catch basin is to incorporate infiltration through the catch basin bottom. Two challenges are associated with this design. The first is potential ground water impacts, and the second is potential clogging, preventing infiltration. Infiltrating catch basins should not be used in commercial or industrial areas, because of possible ground water contamination. While it is difficult to prevent clogging at the bottom of the catch basin, it might be possible to incorporate some pretreatment into the design.

### Maintenance Considerations

Typical maintenance of catch basins includes trash removal if a screen or other debris capturing device is used, and removal of sediment using a vactor truck. Operators need to be properly trained in catch basin maintenance. Maintenance should include keeping a log of the amount of sediment collected and the date of removal. Some cities have incorporated the use of GIS systems to track sediment collection and to optimize future catch basin cleaning efforts.

One study (Pitt, 1985) concluded that catch basins can capture sediments up to approximately 60 percent of the sump volume. When sediment fills greater than 60 percent of their volume, catch basins reach steady state. Storm flows can then resuspend sediments trapped in the catch basin, and will bypass treatment. Frequent clean-out can retain the volume in the catch basin sump available for treatment of storm water flows.

At a minimum, catch basins should be cleaned once or twice per year (Aronson et al., 1993). Two studies suggest that increasing the frequency of maintenance can improve the performance of catch basins, particularly in industrial or commercial areas. One study of 60 catch basins in Alameda County, California, found that increasing the maintenance frequency from once per year to twice per year could increase the total sediment removed by catch basins on an annual basis (Mineart and Singh, 1994). Annual sediment removed per inlet was 54 pounds for annual cleaning, 70 pounds for semi-annual and quarterly cleaning, and 160 pounds for monthly cleaning. For catch basins draining industrial uses, monthly cleaning increased total annual sediment collected to six times the amount collected by annual cleaning (180 pounds versus 30 pounds). These results suggest that, at least for industrial uses, more frequent cleaning of catch basins may improve efficiency. However, the cost of increased operation and maintenance costs needs to be weighed against the improved pollutant removal.

In some regions, it may be difficult to find environmentally acceptable disposal methods for collected sediments. The sediments may not always be land-filled, land-applied, or introduced into the sanitary sewer system due to hazardous waste, pretreatment, or ground water regulations. This is particularly true when catch basins drain runoff from hot spot areas.

### Effectiveness

What is known about the effectiveness of catch basins is limited to a few studies. Table 1 outlines the results of some of these studies.

Table 1. Pollutant removal of catch basins (percent).

| Study | Notes | TSS[a] | COD[a] | BOD[a] | TN[a] | TP[a] | Metals |
|---|---|---|---|---|---|---|---|
| Pitt et al., 1997 | – | 32 | – | | – | – | – |
| Aronson et al., 1983 | Only very small storms were monitored in this study. | 60–97 | 10–56 | 54–88 | – | – | – |
| Mineart and Singh, 1994 | Annual load reduction estimated based on concentrations and mass of catch basin sediment. | – | – | – | – | – | For Copper: 3–4% (Annual cleaning) 15% (Monthly cleaning) |

[a] TSS=total suspended solids; COD=chemical oxygen demand; BOD=biological oxygen demand; TN=total nitrogen; TP=total phosphorus

### Cost Considerations

A typical pre-cast catch basin costs between $2,000 and $3,000. The true pollutant removal cost associated with catch basins, however, is the long-term maintenance cost. A vactor truck, the most common method of catch basin cleaning, costs between $125,000 and $150,000. This initial cost may be high for smaller Phase II communities. However, it may be possible to share a vactor truck with another community. Typical vactor trucks can store between 10 and 15 cubic yards of material, which is enough storage for three to five catch basins with the "optimal" design and an 18-inch inflow pipe. Assuming semi-annual cleaning, and that the vactor truck could be filled and material disposed of twice in one day, one truck would be sufficient to clean between 750 and 1,000 catch basins. Another maintenance cost is the staff time needed to operate the truck. Depending on the regulations within a community, disposal costs of the sediment captured in catch basins may be significant.

## References

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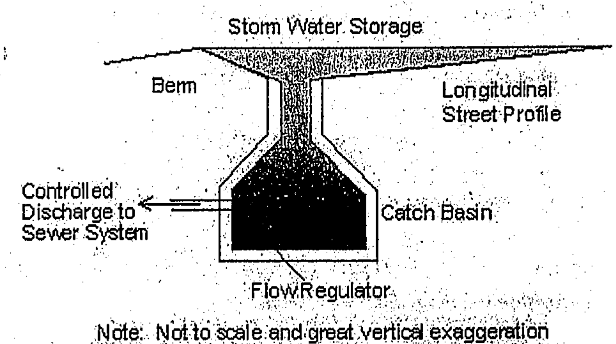
# In-Line Storage

## Postconstruction Storm Water Management in New Development and Redevelopment

### Description

In-line storage refers to a number of practices designed to use the storage within the storm drain system to detain flows. While these practices can reduce storm peak flows, they are unable to improve water quality or protect downstream channels. Storage is achieved by placing devices in the storm drain system to restrict the rate of flow. Devices can slow the rate of flow by backing up flow, as in the case of a dam or weir, or through the use of vortex valves, devices that reduce flow rates by creating a helical flow path in the structure. A description of various flow regulators is included in Urbonas and Stahre (1990).




Catch basins can be equipped with flow restrictors to temporarily detain storm water in the conveyance system

### Applicability

In-line storage practices serve the same purpose as traditional detention basins (see Dry Extended Detention Pond). These practices can act as a surrogate for aboveground storage when little space is available for aboveground storage facilities.

### Limitations

In-line storage has several limitations, including:

- In-line storage practices only control flow, and thus are not able to improve the water quality of storm water runoff.
- If improperly designed, these practices may cause upstream flooding.

### Siting and Design Considerations

Flow regulators cannot be applied to all storm drain systems. In older cities, the storm drainpipes may not be oversized, and detaining storm water within them would cause upstream flooding. Another important issue in siting these practices is the slope of the pipes in the system. In areas with very flat slopes, restricting flow within the system is likely to cause upstream flooding because introducing a regulator into the system will cause flows to back up a long distance before the regulator. In steep pipes, on the other hand, a storage flow regulator cannot utilize much of the storage available in the storm drain system.

## Maintenance Considerations

Flow regulators require very little maintenance, because they are designed to be "self cleaning," much like the storm drain system. In some cases, flow regulators may be modified based on downstream flows, new connections to the storm drain, or the application of other flow regulators within the system. For some designs, such as check dams, regulations will require only moderate construction in order to modify the structure's design.

## Effectiveness

The effectiveness of in-line storage practices is site-specific and depends on the storage available in the storm drain system. In one study, a single application was able to reduce peak flows by approximately 50 percent (VDCR, 1999).

## Cost Considerations

Flow regulators are relatively low cost options, particularly since they require little maintenance and consume little surface area.

## References

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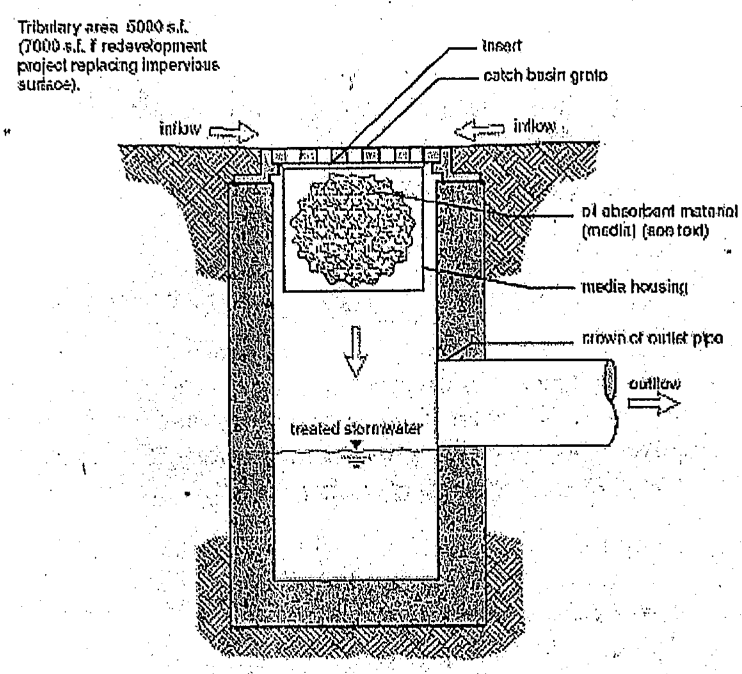
## Manufactured Products for Storm Water Inlets

### Postconstruction Storm Water Management in New Development and Redevelopment




The typical design of a catch basin insert is a set of filters that are specifically chosen to address the pollutants expected at that site (Source: King County, Washington, 2000)

## Description

A variety of products for storm water inlets known as swirl separators, or hydrodynamic structures, have been widely applied in recent years. Swirl separators are modifications of the traditional oil-grit separator and include an internal component that creates a swirling motion as storm water flows through a cylindrical chamber. The concept behind these designs is that sediments settle out as storm water moves in this swirling path. Additional compartments or chambers are sometimes present to trap oil and other floatables. There are several different types of proprietary separators, each of which incorporates slightly different design variations, such as off-line application. Another common manufactured product is the catch basin insert. These products are discussed briefly in the Catch Basin fact sheet.

## Applicability

Swirl separators are best installed on highly impervious sites. Because little data are available on their performance, and independently conducted studies suggest marginal pollutant removal, swirl separators should not be used as a stand-alone practice for new development. The best application of these products is as pretreatment to another storm water device, or in a retrofit situation where space is limited.

## Limitations

Limitations to swirl separators include:

- Very little data are available on the performance of these practices, and independent studies suggest only moderate pollutant removal. In particular, these practices are ineffective at removing fine particles and soluble pollutants.
- The practice has a high maintenance burden (i.e., frequent cleanout).
- Swirl concentrators are restricted to small and highly impervious sites.

## Siting and Design Considerations

The specific design of swirl concentrators is specified by product literature available from each manufacturer. For the most part, swirl concentrators are a rate-based design. That is, they are sized based on the peak flow of a specific storm event. This design contrasts with most other storm water management practices, which are sized based on capturing and storing or treating a specific volume. Sizing based on flow rate allows the practice to provide treatment within a much smaller area than other storm water management practices.

## Maintenance Considerations

Swirl concentrators require frequent maintenance (typically quarterly). Maintenance is performed using a vactor truck, as is used for catch basins (see Catch Basin). In some regions, it may be difficult to find environmentally acceptable disposal methods. The sediments may not always be land-filled, land-applied, or introduced into the sanitary sewer system due to hazardous waste, pretreatment, or groundwater regulations. This is particularly true when catch basins drain runoff from hot spot areas.

## Effectiveness

While manufacturers' literature typically reports removal rates for swirl separator design, there is actually very little independent data to evaluate the effectiveness of these products. Two studies investigated one of these products. Both studies reported moderate pollutant removal. While the product outperforms oil/grit separators, which have virtually no pollutant removal (Schueler, 1997), the removal rates are not substantially different from the standard catch basin. One long-term advantage of these products over catch basins is that, if they incorporate an off-line design, trapped sediment will not become resuspended. Data from two studies are presented below. Both of these studies are summarized in a Claytor (1999).

Table 1. Effectiveness of manufactured products for storm water inlets

| Study | Greb et al., 1998 | Labatiuk et al., 1997 |
|---|---|---|
| Notes | Investigated 45 precipitation events over a 9-month period. Percent removal rates reflect overall efficiency, accounting for pollutants in bypassed flows. | Data represent the mean percent removal rate for four storm events. |
| TSS[a] | 21 | 51.5 |
| TDS[a] | -21 | - |
| TP[a] | 17 | - |
| DP[a] | 17 | - |
| Pb[a] | 24 | 51.2 |
| Zn[a] | 17 | 39.1 |
| Cu[a] | - | 21.5 |
| PAH[a] | 32 | - |
| $NO_2$+$NO_3$[a] | 5 | - |

[a] TSS=total suspended solids; TDS=total dissolved solids; TP=total phosphorus; DP=dissolved phosphorus; Pb=lead; Zn=zinc; Cu=copper; PAH=polynuclear aromatic hydrocarbons; $NO_2$+$NO_3$=nitrite+nitrate-nitrogen

## Cost Considerations

A typical swirl separator costs between $5,000 and $35,000, or between $5,000 and $10,000 per impervious acre. This cost is within the range of some sand filters, which also treat highly urbanized runoff (see Sand Filters). Swirl separators consume very little land, making them attractive in highly urbanized areas.

The maintenance of these practices is relatively expensive. Swirl concentrators typically require quarterly maintenance, and a vactor truck, the most common method of cleaning these practices, costs between $125,000 and $150,000. This initial cost may be high for smaller Phase II communities. However, it may be possible to share a vactor truck with another community. Depending on the rules within a community, disposal costs of the sediment captured in swirl separators may be significant.

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Labatiuk, C., V. Natal, and V. Bhardwaj. 1997. Field evaluation of a pollution abatement device for stormwater quality improvement. In *Proceedings of the 1997 CSCE-ASCE Environmental Engineering Conference, Edmonton, Alberta.* Canadian Society for Civil Engineering, Montréal, Québec, and American Society of Civil Engineers, Reston, VA.

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# *Nonstructural BMPs*

## *Experimental practices*

### Alum Injection

### Postconstruction Storm Water Management in New Development and Redevelopment

#### Description

Alum injection is the addition of alum (an aluminum sulfate salt) solution to storm water, causing fine particles to flocculate (i.e., gather together to form larger particles) and settle out. Other pollutants also can be scavenged. Alum injection can help meet downstream pollutant concentration loads by reducing the concentrations of fine particles and soluble phosphorus. Alum treatment systems generally consist of a flow-weighted dosing system designed to fit inside a storm sewer manhole, remotely located storage tanks to provide the doser with alum, and a downstream pond which allows the alum, pollutants, and sediments to settle out (Kurz, 1998). When alum is injected into storm water it forms harmless precipitates, aluminum phosphate and aluminum hydroxide. These precipitates combine with heavy metals and phosphorus, causing them to be deposited into the sediments in a stable, inactive state (WEF, 1992). The collected mass of alum precipitates, pollutants, and sediments is commonly referred to as floc.

#### Applicability

The injection of liquid alum into storm sewers has been used to reduce the water quality impacts of storm water runoff to lakes and receiving waterbodies, particularly to reduce high phosphorus levels. Because of high installation and operation costs, alum injection is best applied in situations where a large volume of water is stored in one area, as in the case of combined sewer overflow (CSO) storage areas at wastewater treatment plants. Alum treatment can also be implemented as a pretreatment step to further reduce turbidity and total suspended solids (TSS) (Kurz, 1998).

#### Siting and Design Considerations

Alum injection systems need to incorporate several design features to properly apply alum and dispose of the floc formed during the process. Dosage rates, which range from 5 to 10 mg of Al per liter, are determined on a flow-weighted basis during storm events (Harper, 1996). Other chemicals, such as lime, may also be added during the process to enhance the pollutant settling. (Often, the pH is raised to between 8 and 11). The design needs to incorporate a doser system, as well as sufficient chemical storage in tanks to minimize the frequency with which they need to be refilled.

Disposal of the floc that settles in the downstream basin is critical, because of the concentration of dissolved chemicals, and also because bacteria and viruses remain viable in the floc layer (Kurz, 1998). In addition to the settling pond, a separate floc collection pump-out facility should be installed to further reduce the chance of resuspension and transport of floc to receiving waterbodies. The pump disposes the floc into the sanitary sewer system or onto nearby upland areas or sludge drying beds. A permit will be required to pump to the sanitary sewer, however. The quantity of sludge produced at a site can be as much as 0.5 percent of the volume of water treated (Gibb et al., 1991).

## Limitations

While alum shows some potential as a storm water treatment practice, it has several limitations, including:

- Alum injection is an experimental practice, and little is known about its long-term performance.
- In addition to maintenance, alum injection requires ongoing operation, unlike most other post-construction storm water treatment practices.
- While alum injection can reduce pollutant loads, it cannot control flows or protect downstream channels from erosion.
- Chemicals added during the alum injection process may have negative impacts on downstream waters.
- The precipitates from the alum increase the solids that must be disposed of from the treatment.

## Maintenance Considerations

Operation and maintenance for alum treatment is critical. Some typical items include:

- There must be routine inspection and repair of equipment, including the doser and pump-out facility.
- A trained operator should be on-site to adjust the dosage of alum and other chemicals, and possibly to regulate flows through the basin.
- If floc is stored on-site in drying beds, it will need to be disposed of on a regular basis.
- The settling basin will need to be dredged periodically to dispose of accumulated floc.

## Effectiveness

Limited performance data of alum injection is available in Table 1. One study (Harper and Herr, 1996) found high removal rates for TSS and fecal coliform bacteria. This study and another (Carr, 1998) showed mixed results on total phosphorus and ortho-phosphorus.

Table 1. Alum injection removal rates

| Study | TSS | TP | Ortho-phosphorus | TN | Fecal Coliform Bacteria | Heavy Metals | Zinc | Ammonia |
|---|---|---|---|---|---|---|---|---|
| Harper and Herr, 1996 | 95–99 | 85–95 | 90–95 | 60–70 | ]99 | 50–90 | - | - |
| Carr, 1998 | - | 37 | 42 | 52.2 | - | - | 41 | 24.5 |

## Cost Considerations

Alum injection is a relatively expensive practice. Construction costs for alum treatment systems range from $135,000 to $400,000; the cost depends on the watershed size and the number of outfall locations treated. Generally, alum treatment is applied to large drainage areas. In one study (Kurz, 1998), an alum treatment system was a successful storm water retrofit for a 460-acre urbanized watershed in downtown Tampa. Operation and maintenance costs, which include routine and chemical inspections, range from $6,500 to $25,000 per year (Harper and Herr, 1996).

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*On-lot Treatment*

## On-Lot Treatment

## Postconstruction Storm Water Management in New Development and Redevelopment

### Description


A rain barrel is used to collect rooftop runoff using a gutter/downspout system

The term "on-lot treatment" refers to a series of practices that are designed to treat runoff from individual residential lots. The primary purpose of most on-lot practices is to manage rooftop runoff and, to a lesser extent, driveway and sidewalk runoff. Rooftop runoff, and particularly residential rooftop runoff, generally has low pollutant concentrations compared with other urban sources (Schueler, 1994b). The primary advantage of managing runoff from rooftops is to disconnect these impervious surfaces, reducing the effective impervious cover in a watershed. Many of the impacts of urbanization on the habitat and water quality of streams are related to the fundamental change in the hydrologic cycle caused by the increase of impervious cover in the landscape (Schueler, 1994a).

Although there are a wide variety of on-lot treatment options, they can all be classified into one of three categories: 1) practices that infiltrate rooftop runoff; 2) practices that divert runoff or soil moisture to a pervious area; and 3) practices that store runoff for later use. The best option depends on the goals of a community, the feasibility at a specific site, and the preferences of the homeowner.

The practice most often used to infiltrate rooftop runoff is the dry well. In this design, the storm drain is directed to an underground rock-filled trench that is similar in design to an infiltration trench (see Infiltration Trench fact sheet). French drains or Dutch drains can also be used for this purpose. In these designs, the relatively deep dry well is replaced with a long trench with a perforated pipe within the gravel bed to distribute flow throughout the length of the trench.

Runoff can be diverted to a pervious area or to a treatment area using site grading, or channels and berms. Treatment options can include grassed swales, bioretention, or filter strips. The bioretention design can be simplified for an on-lot application by limiting the pre-treatment filter and in some cases eliminating the underdrain (see Bioretention fact sheet). Alternatively, rooftop runoff can simply be diverted to pervious lawn areas, as opposed to flowing directly to the street and thus to the storm drain system.

Practices that store rooftop runoff, such as cisterns and rain barrels, are the simplest in design of all of the on-lot treatment systems. Some of these practices are available commercially and can be applied in a wide variety of site conditions. Cisterns and rain barrels are particularly valuable in the arid southwest, where water is at a premium, rainfall is infrequent, and reuse for irrigation can save homeowners money.

## Application

Some sort of on-lot treatment can be applied to almost all sites, with very few exceptions (e.g., very small lots or lots with no landscaping). Traditionally, on-site treatment of residential storm water runoff has been encouraged, but has not generally been an option to meet storm water requirements. There are currently at least two jurisdictions, however, who offer "credits" in exchange for the application of on-site storm water management practices. In Denver, Colorado, sites designed with methods to reduce "directly connected impervious cover," including disconnection of downspout runoff from the storm system, are permitted to use a lower site impervious area when computing the required storage of storm water facilities (DUDFCD, 1992). Similarly, new regulations for Maryland allow designers to subtract each rooftop that is disconnected from the total site impervious cover when calculating required storage in storm water management practices (MDE, 2000).

## Siting and Design Considerations

Although most residential lots can incorporate on-lot treatment, the best option for a site depends on site design constraints and the preferences of the homeowner. On-lot infiltration practices have the same restrictions regarding soils as other infiltration practices (see Infiltration Basin and Infiltration Trench fact sheets). If other design practices are used, such as bioretention or grassed swales, they need to meet the siting requirements of those practices (see Bioretention and Grassed Swale fact sheets). Of all of the practices, cisterns and rain barrels have the fewest site constraints. In order for the practice to be effective, however, homeowners need to have a use for the water stored in the practice, and the design must accommodate overflow and winter freezing conditions. These practices are best suited to an individual who has some active interest in gardening or landscaping.

Although these practices are simple compared with many other post construction storm water practices, the design needs to incorporate the same basic elements of any storm water practice. Pretreatment is important for all of these practices to ensure that they do not become clogged with leaf debris. Infiltration practices may be preceded by a settling tank or, at a minimum, a grate or filter in the downspout to trap leaves and other debris. Rain barrels and cisterns also often incorporate some sort of pretreatment, such as a mesh filter at the top of the barrel or cistern.

Both infiltration practices and storage practices typically incorporate some type of bypass so that larger storms flow away from the house. In rain barrels or cisterns, this bypass may be a hose set at a high level of the practice and directed away from the practice and building foundation. These practices also include a hose set at the elevation of the bottom of the practice. The homeowner can use the practice to irrigate landscaping or for other uses by attaching this hose to a standard garden hose, and controlling flow with an adjustable valve. In infiltration practices the bypass may be an aboveground opening of the downspout. As on-lot practices, grassed swales and bioretention can be designed on-line. The design directs all flows to the management practice, but larger flows generally flow over the practice and are not treated.

One important design feature of infiltration practices is that the infiltration area must be located sufficiently far from the house's foundation to prevent undermining of the foundation or seepage into basements. The infiltration area should be separated from the house by at least 10 feet to prevent these problems.

**Limitations**

There are some limitations to the use of on-lot practices, including the following:

- These practices require some maintenance and require some effort on the part of the homeowner.
- For homeowners who do not enjoy landscaping, it may be difficult for them to find a use for water stored in a rain barrel or cistern, since the water is not potable.
- On small lots, some of these practices may be impractical.
- Even if applied to every home in a watershed, these practices would only treat a relatively small portion of the watershed imperviousness, which is largely composed of roads and parking areas (see Narrower Residential Streets and Green Parking fact sheets).

**Maintenance Considerations**

Bioretention areas, filter strips, and grassed swales require regular maintenance to ensure that the vegetation remains in good condition (see Bioretention; Grassed Filter Strip; and Grassed Swale fact sheets). Infiltration practices require regular removal of sediment and debris settled in the pretreatment area, and the media might need to be replaced if it becomes clogged (see Infiltration Trench fact sheet). Rain barrels and cisterns require minimal maintenance, but the homeowner needs to ensure that the hose remains elevated during the winter to prevent freezing and cracking. In addition, the tank needs to be cleaned out approximately once per year.

**Effectiveness**

Although the practices used for on-lot applications can have relatively high pollutant removals (see Infiltration Trench; Bioretention; Grassed Filter Strip; and Grassed Swale fact sheets), it is not clear that these pollutant removal rates can be realized with the relatively low pollutant concentrations entering the practices. Some data suggest that, at least for storm water ponds, there may be an "irreducible concentration" below which no further pollutant removal can be achieved (Schueler, 1996). Another benefit of many on-lot practices is that they generally promote ground water recharge, either directly through infiltration or indirectly by applying or directing runoff to pervious areas.

**Cost Considerations**

On a cost per unit area treated, on-lot practices are relatively expensive compared with other storm water treatment options. It is difficult to make this comparison, however, because the cost burden of on-lot practices is born directly by homeowners. Typical costs are $100 for a rain barrel and $200 for a dry well or French drain. For many of these practices, homeowners can reduce costs by making their own on-lot practice rather than purchasing a commercial product.

Some treatment practices, such as rain barrels and on-lot bioretention, offer additional benefits to the homeowner that may offset the cost of applying the practice. Similarly, maintenance costs are essentially free, with the exception of replacement of a dry well system, which may require outside help.

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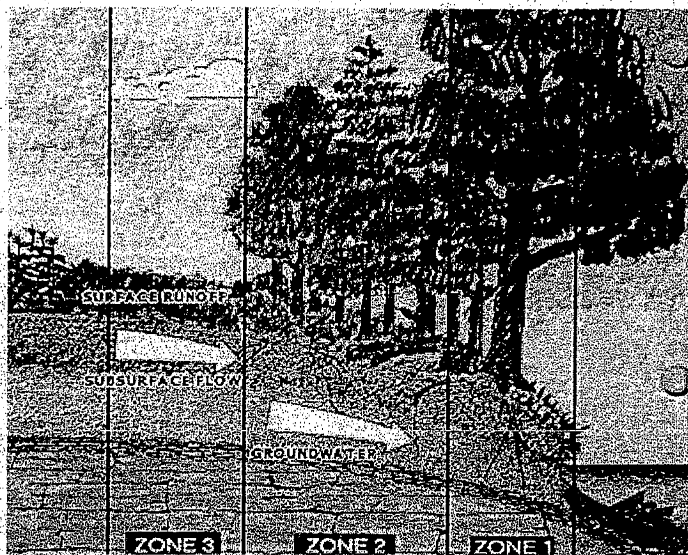
*Better site design*

## Buffer Zones

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description

An aquatic buffer is an area along a shoreline, wetland, or stream where development is restricted or prohibited. The primary function of aquatic buffers is to physically protect and separate a stream, lake, or wetland from future disturbance or encroachment. If properly designed, a buffer can provide storm water management and act as a right-of-way during floods, sustaining the integrity of stream ecosystems and habitats. Technically, aquatic buffers are one type of conservation area that function as an integral part of the aquatic ecosystem and can also function as part of an urban forest.



Sketch of a typical riparian forest buffer (Source: Chesapeake Bay Program, 2000)

The three types of buffers are water pollution hazard setbacks, vegetated buffers, and engineered buffers. Water pollution hazard setbacks are areas that separate a potential pollution hazard from a waterway. By providing setbacks from these areas in the form of a buffer, the potential for pollution can be reduced. Vegetated buffers are any number of natural areas that exist to divide land uses or provide landscape relief. Engineered buffers are areas specifically designed to treat storm water before it enters into a stream, lake, or wetland.

### Applicability

Buffers can be applied to new development by establishing specific preservation areas and sustaining management through easements or community associations. For existing developed areas, an easement may be needed from adjoining landowners. A local ordinance can help set specific criteria for buffers to achieve storm water management goals.

In many regions of the country, the benefits of buffers are amplified if they are managed in a forested condition. In some settings, buffers can remove pollutants traveling in storm water or ground water. Shoreline and stream buffers situated in flat soils have been found to be effective in removing sediment, nutrients, and bacteria from storm water runoff and septic system effluent in a wide variety of rural and agricultural settings along the East Coast and with some limited capability in urban settings. Buffers can also provide wildlife habitat and recreation, and can be reestablished in urban areas as part of an urban forest.

**Siting and Design Considerations**

There are ten key criteria to consider when establishing a stream buffer:

- Minimum total buffer width
- Three-zone buffer system
- Mature forest as a vegetative target
- Conditions for buffer expansion or contraction
- Physical delineation requirements
- Conditions where buffer can be crossed
- Integrating storm water and storm water management within the buffer
- Buffer limit review
- Buffer education, inspection, and enforcement
- Buffer flexibility.

In general, a minimum base width of at least 100 feet is recommended to provide adequate stream protection. The three-zone buffer system, consisting of inner, middle, and outer zones, is an effective technique for establishing a buffer. The zones are distinguished by function, width, vegetative target, and allowable uses. The inner zone protects physical and ecological integrity and is a minimum of 25 feet plus wetland and critical habitats. The vegetative target consists of mature forest, and allowable uses are very restricted (flood controls, utility right-of-ways, footpaths, etc.).

The middle zone provides distance between upland development and the inner zone and is typically 50 to 100 feet, depending on stream order, slope, and 100-year floodplain. The vegetative target for this zone is managed forest, and usage is restricted to some recreational uses, some storm water BMPs, and bike paths. The outer zone functions to prevent encroachment and filter backyard runoff. The width is at least 25 feet and, while forest is encouraged, turfgrass can be a vegetative target. Uses for the outer zone are unrestricted and can include lawn, garden, compost, yard wastes, and most storm water BMPs.

For optimal storm water treatment, the following buffer designs are recommended. The buffer should be composed of three lateral zones: a storm water depression area that leads to a grass filter strip that in turn leads to a forested buffer. The storm water depression is designed to capture and store storm water during smaller storm events and bypass larger stormflows directly into a channel. The captured runoff within the storm water depression can then be spread across a grass filter designed for sheetflow conditions for the water quality storm. The grass filter then discharges into a wider forest buffer designed to have zero discharge of surface runoff to the stream (i.e., full infiltration of sheetflow).

Stream buffers must be highly engineered in order to satisfy these demanding hydrologic and hydraulic conditions. In particular, simple structures are needed to store, split, and spread surface runoff within the storm water depression area. Although past efforts to engineer urban stream buffers were plagued by hydraulic failures and maintenance problems, recent experience with similar bioretention areas has been much more positive (Claytor and Schueler, 1996). Consequently, it may be useful to consider elements of bioretention design for the first zone of an urban stream buffer (shallow ponding depths, partial underdrains, drop inlet bypass, etc).

## Limitations

Only a handful of studies have measured the ability of stream buffers to remove pollutants from storm water. One limitation is that urban runoff concentrates rapidly on paved and hard-packed turf surfaces and often crosses the buffer as channel flow, effectively shortcutting through the buffer. To achieve optimal pollutant removal, the engineered buffer should be carefully designed with a storm water depression area, grass filter, and forested strip.

## Maintenance Considerations

An effective buffer management plan should include establishment, management, and distinctions of allowable and unallowable uses in the buffer zones. Buffer boundaries should be well defined and visible before, during, and after construction. Without clear signs or markers defining the buffer, boundaries become invisible to local governments, contractors, and residents. Buffers designed to capture storm water runoff from urban areas will require more maintenance if the first zone is designated as a bioretention or other engineered depression area.

## Effectiveness

The pollutant removal effectiveness of buffers depends on the design of the buffer; while water pollution hazard setbacks are designed to prevent possible contamination from neighboring land uses, they are not designed for pollutant removal during a storm. With vegetated buffers, some pollutant removal studies have shown that they range widely in effectiveness (Table 1). Proper design of buffers can help increase the pollutant removal from storm water runoff (Table 2).

Table 1: Pollutant removal rates in buffer zones

| Reference | Buffer Vegetation | Buffer Width (meters) | Total % TSS Removal | Total % Phosphorous Removal | Total % Nitrogen Removal |
|---|---|---|---|---|---|
| Dillaha et al., 1989 | Grass | 4.6–9.1 | 63–78 | 57–74 | 50–67 |
| Magette et al., 1987 | Grass | 4.6–9.2 | 72–86 | 41–53 | 17–51 |
| Schwer and Clausen, 1989 | Grass | 26 | 89 | 78 | 76 |
| Lowrance et al., 1983 | Native hardwood forest | 20–40 | — | 23 | — |
| Doyle et al., 1977 | Grass | 1.5 | — | 8 | 57 |
| Barker and Young, 1984 | Grass | 79 | — | — | 99 |
| Lowrance et al., 1984 | Forested | — | — | 30–42 | 85 |
| Overman and Schanze, 1985 | Grass | — | 81 | 39 | 67 |

Table 2: Factors that enhance/reduce buffer pollutant removal performance

| Factors that Enhance Performance | Factors that Reduce Performance |
|---|---|
| Slopes less than 5% | Slopes greater than 5% |
| Contributing flow lengths <150 feet. | Overland flow paths over 300 feet |
| Water table close to surface | Ground water far below surface |
| Check dams/level spreaders | Contact times less than 5 minutes |
| Permeable but not sandy soils | Compacted soils |
| Growing season | Nongrowing season |
| Long length of buffer or swale | Buffers less than 10 feet |
| Organic matter, humus, or mulch layer | Snowmelt conditions, ice cover |
| Small runoff events | Runoff events >2 year event. |
| Entry runoff velocity less than 1.5 feet/sec | Entry runoff velocity more than 5 feet/sec |
| Swales that are routinely mowed | Sediment buildup at top of swale |
| Poorly drained soils, deep roots | Trees with shallow root systems |
| Dense grass cover, 6 inches tall | Tall grass, sparse vegetative cover |

## Cost Considerations

Several studies have documented the increase of property values in areas adjacent to buffers. At the same time, the real costs of instituting a buffer program for local government involve the extra staff and training time to conduct plan reviews, and to provide technical assistance, field delineation, construction, and ongoing buffer education programs. To implement a stream buffer program, a community will need to adopt an ordinance, develop technical criteria, and invest in additional staff resources and training. The adoption of a buffer program also requires an investment in training for the plan reviewer and the consultant alike. Manuals, workshops, seminars, and direct technical assistance are needed to explain the new requirements to all the players in the land development business. Lastly, buffers need to be maintained, and resources should include systematic inspection of the buffer network before and after construction and work to increase resident awareness about buffers.

One way to relieve some of the significant financial hardships for developers is to provide flexibility through buffer averaging. Buffer averaging allows developers to narrow the buffer width at some points if the average width of the buffer and the overall buffer area meet the minimum criteria. Variances can also be granted if the developer or landowner can demonstrate severe economic hardship or unique circumstances that make compliance with the buffer ordinance difficult.

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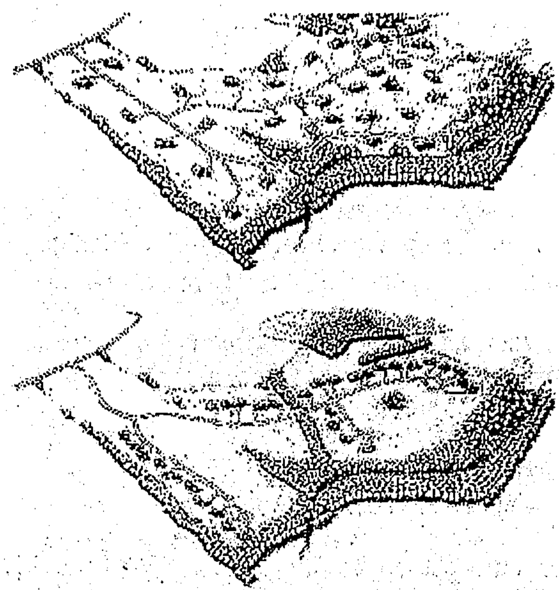
# Open Space Design

## Postconstruction Storm Water Management in New Development and Redevelopment

### Description

Open space design, also known as conservation development or cluster development, is a better site design technique that concentrates dwelling units in a compact area in one portion of the development site in exchange for providing open space and natural areas elsewhere on the site. The minimum lot sizes, setbacks and frontage distances for the residential zone are relaxed in order to create the open space at the site. Open space designs have many benefits in comparison to the conventional subdivisions that they replace: they can reduce impervious cover, storm water pollutants, construction costs, grading, and the loss of natural areas. However, many communities lack zoning ordinances to permit open space development, and even those that have enacted ordinances might need to revise them to achieve greater water quality and environmental benefits.



A site developed using open space design principles (bottom) maintains more undeveloped common space than the conventional development plan (top) (Source: Arendt, 1996)

The benefits of open space design can be amplified when it is combined with other better site design techniques such as narrow streets, open channels, and alternative turnarounds (see Narrower Residential Streets, Eliminating Curbs and Gutters, and Alternative Turnarounds).

### Applicability

The codes and ordinances that govern residential development in many communities do not allow developers to build anything other than conventional subdivisions. Consequently, it may be necessary to enact a new ordinance or revise current development regulations to enable developers to pursue this design option. Model ordinances and regulations for open space design can be found on http://www.cwp.org and in *Better Site Design: A Handbook for Changing Development Rules in Your Community* (CWP, 1998).

Open space design is widely applicable to most forms of residential development. The greatest storm water and pollutant reduction benefits typically occur when open space design is applied to residential zones that have larger lots (less than two dwelling units per acre). In these types of large lot zones, a great deal of natural or community open space can be created by shrinking lot sizes. However, open space design may not always be a viable option for high-density residential zones, redevelopment, or infill development, where lots are small to begin with and clustering will yield little open space. In rural areas, open space design may need to be adapted, especially in communities where shared septic fields are not currently allowed by public health authorities.

Open space design can be employed in nearly all geographic regions of the country, with the result of different types of open space being conserved (forest, prairie, farmland, chaparral, or desert).

**Siting and Design Conditions**

Several site planning techniques have been proposed for designing effective open space developments (Arendt, 1996, and DE DNREC, 1997). Often, a necessary first step is adoption of a local ordinance that allows open space design within conventional residential zones. Such ordinances specify more flexible and smaller lot sizes, setbacks, and frontage distances for the residential zone, as well as minimum requirements for open space and natural area conservation. Other key elements of effective open space ordinances include requirements for the consolidation and use of open space, as well as enforceable provisions for managing the open space on a common basis.

**Limitations**

A number of real and perceived barriers hinder wider acceptance of open space designs by developers, local governments, and the general public. For example, despite strong evidence to the contrary, some developers still feel that open space designs are less marketable than conventional residential subdivisions. In other cases, developers contend that the review process for open space design is more lengthy, costly, and potentially controversial than that required for conventional subdivisions, and thus, not worth the trouble.

Local governments may be concerned that homeowner associations lack the financial resources, liability insurance, or technical competence to maintain open space adequately. Finally, the general public is often suspicious of cluster or open space development proposals, feeling that they are a "Trojan Horse" for more intense development, traffic, and other local concerns. At the regional level, open space design policies and ordinances need to be carefully constructed and implemented so as not to lead to "leap-frogging," which is the creation of additional development in already built-up areas. An open space development that requires new infrastructure, such as roads, water and sewer lines, and commercial areas, can actually create more imperviousness at the regional level than it saves at the site level.

In reality, many of these misconceptions can be directly addressed through a clear open space ordinance and by providing training and incentives to the development and engineering community. The Natural Resources Defense Council presents several examples of successful conservation-oriented developments in *Stormwater Strategies: Community Responses to Runoff Pollution* (1999).

**Maintenance Considerations**

Once established, common open space and natural conservation areas must be managed by a responsible party able to maintain the areas in a natural state in perpetuity. Typically, the open space is protected by legally enforceable deed restrictions, conservation easements, and maintenance agreements. In most communities, the authority for managing open space falls to a homeowner or community association or a land trust. Annual maintenance tasks for open space managed as natural areas are almost non-existent, and the annual maintenance cost for managing an acre of natural area is less than $75 (CWP, 1998). It may be useful to develop a habitat plan for natural areas that may require periodic management actions.

**Effectiveness**

Recent redesign research indicates that open space design can provide impressive pollutant reduction benefits compared to the conventional subdivisions they replace. For example, the Center for Watershed Protection (1998) reported that nutrient export declined by 45 percent to 60 percent when two conventional subdivisions were redesigned as open space subdivisions. Other researchers have reported similar levels of pollutant reductions when conventional subdivisions were replaced by open space subdivisions (Maurer, 1996; DE DNREC, 1997; Dreher and Price, 1994; and SCCCL, 1995). In all cases, the reduction in pollutants was due primarily to the sharp drop in runoff caused by the lower impervious cover associated with open space subdivisions. In the redesign studies cited above, impervious cover declined by an average of 34 percent when open space designs were utilized.

Along with reduced imperviousness, open space designs provide a host of other environmental benefits lacking in most conventional designs. These developments reduce potential pressure to encroach on resource and buffer areas because enough open space is usually reserved to accommodate resource protection areas. As less land is cleared during the construction process, the potential for soil erosion is also greatly diminished. Perhaps most importantly, open space design reserves 25 to 50 percent of the development site in green space that would not otherwise be protected, preserving a greater range of landscapes and habitat "islands" that can support considerable diversity in mammals, songbirds, and other wildlife.

**Cost Considerations**

Open space developments can be significantly less expensive to build than conventional subdivisions. Most of the cost savings are due to savings in road building and storm water management conveyance costs. In fact, the use of open space design techniques at a residential development in Davis, California, provided an estimated infrastructure construction costs savings of $800 per home (Liptan and Brown, 1996). Other examples demonstrate infrastructure costs savings ranging from 11 to 66 percent. Table 1 lists some of the projected construction cost savings generated by the use of open space redesign at several residential sites.

While open space developments are frequently less expensive to build, developers find that these properties often command higher prices than homes in more conventional developments. Several regional studies estimate that residential properties in open space developments garner premiums that are 5 to 32 percent higher than conventional subdivisions and moreover, sell or lease at an increased rate. In Massachusetts, cluster developments were found to appreciate 12 percent faster than conventional subdivisions over a 20-year period (Lacey and Arendt, 1990). In Atlanta, Georgia, the presence of trees and natural areas measurably increased the residential property tax base (Anderson and Cordell, 1982).

Table 1. Projected construction cost savings for open space designs from redesign analyses

| Residential Development | Construction Savings | Notes |
|---|---|---|
| Remlik Hall [1] | 52% | Includes costs for engineering, road construction, and obtaining water and sewer permits |
| Duck Crossing [2] | 12% | Includes roads, storm water management, and reforestation |
| Tharpe Knoll [3] | 56% | Includes roads and storm water management |
| Chapel Run [3] | 64% | Includes roads, storm water management, and reforestation |
| Pleasant Hill [3] | 43% | Includes roads, storm water management, and reforestation |
| Rapahannock [2] | 20% | Includes roads, storm water management, and reforestation |
| Buckingham Greene [3] | 63% | Includes roads and storm water management |
| Canton, Ohio [4] | 66% | Includes roads and storm water management |

Sources: [1] Maurer, 1996; [2] CWP, 1998; [3] DE DNREC, 1997; [4] NAHB, 1986

In addition to being aesthetically pleasing, the reduced impervious cover and increased tree canopy associated with open space development reduce the size and cost of downstream storm water treatment facilities. The resulting cost savings can be considerable, as the cost to treat the quality and quantity of storm water from a single impervious acre can range from $2,000 to a staggering $50,000. The increased open space within a cluster development also provides a greater range of locations for more cost-effective storm water practices. Clearly, open space developments are valuable from an economic as well as an environmental standpoint.

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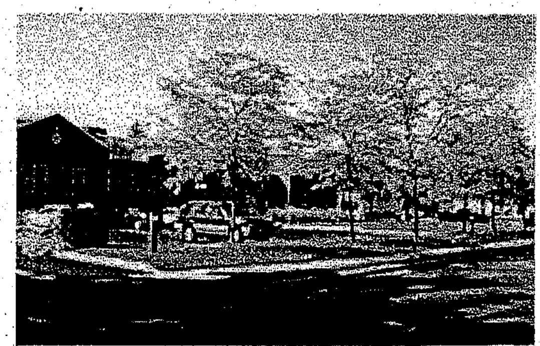
# Urban Forestry

## Postconstruction Storm Water Management in New Development and Redevelopment

## Description



Trees can be incorporated into urban landscapes for water quality benefits in addition to aesthetic and shade benefits (Source: Tree City USA, no date)

Urban forestry is the study of trees and forests in and around towns and cities. Since trees absorb water, patches of forest and the trees that line streets can help provide some of the storm water management required in an urban setting. Urban forests also help break up a landscape of impervious cover, provide small but essential green spaces, and link walkways and trails.

Successful urban forestry requires a conservation plan for individual trees as well as forest areas larger than 10,000 $feet^2$. A local forest or tree ordinance is one technique for achieving conservation, and when specific measures to protect and manage these areas are included, urban forests and trees can also help reduce storm water management needs in urban areas.

## Applicability

From a stream preservation perspective, it is ideal to retain as much contiguous forest as possible. At the same time, this may not be an option in many urban areas. If forested areas are fragmented, it is ideal to retain the closest fragments together.

In rapidly urbanizing areas, where clearing and grading are important, tree preservation areas should be clearly marked. Delineating lines along a critical root zone (CRZ) rather than a straight line is essential to preserving trees and can help reduce homeowner complaints about tree root interference into sewer or septic lines.

## Implementation

The concept of the CRZ is essential to a proper management plan. The CRZ is the area around a tree required for the tree's survival. Determined by the tree size and species, as well as soil conditions, for isolated specimen trees, the CRZ can be estimated as 1-1/2 feet of radial distance for every inch of tree diameter. In larger areas of trees, the CRZ of forests can be estimated at 1 foot of radial distance for every inch of tree diameter, or a minimum of 8 feet.

An urban forestry plan should include measures to establish, conserve, and/or reestablish preservation areas. A forest preservation ordinance is one way to set design standards outlining how a forest should be preserved and managed. The ordinance should outline some basic management techniques and should contain some essential elements. The following is a list of some typical elements of a forest conservation plan:

- A map and narrative description of the forest and the surrounding area that includes topography, soils, streams, current forested and unforested areas, tree lines, critical habitats, and 100-year flood plain.
- An assessment that establishes preservation, reforestation, and afforestation areas.
- A forest conservation map that outlines forest retention areas, reforestation, afforestation, protective devices, limits of disturbance, and stockpile areas.
- A schedule of any additional construction in and around the forest area.
- A specific management plan, including tree and forest protection measures.
- A reforestation and afforestation plan.

An ordinance can also be developed that addresses tree preservation at the site level both during construction and after construction is complete. This type of ordinance can be implemented on a smaller scale and can be integrated with a proposed development's erosion and sediment control and storm water pollution prevention plans, which many communities require of new developments.

American Forests, a non-profit organization dedicated to preserving and restoring forests in the United States, adopted an ecosystem restoration and maintenance agenda in 1999 to assist communities in planning and implementing tree and forest actions to restore and maintain healthy ecosystems and communities (American Forests, 2000). The agenda presents the organization's core values and policy goals as the basis for policy statements and as information to help community-based partners to prepare their own policy statements. Key policy goals include

- Increasing public and private sector investment in ecosystem restoration and maintenance activities
- Promoting an ecosystem workforce through training and apprenticeship programs and new job opportunities
- Building support for innovative monitoring systems to ensure collaborative learning and adaptive management
- Encouraging a "civic science" approach to ecosystem research that respects local knowledge, seeks community participation, and provides accessible information for communities.

### Limitations

One of the biggest limitations to urban forestry is development pressure. Ordinances, conservation easements, and other techniques that are designed into a management program can help alleviate future development pressures. The size of the land may also limit the ability to protect individual trees. In these areas, a tree ordinance may be a more practical approach.

Forests may also harbor undesirable wildlife elements including insects and other pests. If forests border houses, this may be a concern for residents.

## Maintenance Considerations

Maintenance considerations for urban forests may require fringe landscaping and trash pick-up. By using native vegetation and keeping the area as natural as possible, maintenance efforts can be minimized.

## Effectiveness

There are numerous environmental and storm water benefits to urban forestry. These include the absorption of carbon dioxide by trees, reduction of temperature, and provision of habitat for urban wildlife. Urban forests can also act as natural storm water management areas by filtering particulate matter (pollutants, some nutrients, and sediment) and by absorption of water. Urban forestry also reduces noise levels, provides recreational benefits, and increases property values.

Urban forests and trees are known to have numerous environmental benefits, including pollutant removal. Trees can absorb water, pollutant gases, airborne particulates, sediment, nitrogen, phosphorous, and pesticides.

There are numerous economic benefits to urban forests, including proven increases in property values. In addition, by preserving trees and forests, clearing and grading as well as erosion and sediment costs are saved during construction. Maintenance costs are also minimized by keeping areas as natural as possible (Table 1).

Table 1: Annual maintenance costs of different types of green spaces (Adapted from Brown et al., 1998)

| Land Use | Approximate Annual Maintenance Costs | Source |
|---|---|---|
| Natural Open Space:<br>Only minimum maintenance, trash/debris cleanup | $75/acre/year | NPS, 1995 |
| Lawns:<br>Regular mowing | $270 to $240/acre/year | WHEC, 1992 |
| Passive Recreation | $200/acre/year | NPS, 1995 |

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## Conservation Easements

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description

Conservation easements are voluntary agreements that allow an individual or group to set aside private property to limit the type or amount of development on their property. The conservation easement can cover all or a portion of a property and can either be permanent or last for a specified time. The easement is typically described in terms of the resource it is designed to protect (e.g., agricultural, forest, historic, or open space easements) and explains and mandates the restrictions on the uses of the particular property. Easements relieve property owners of the burden of managing these areas by shifting responsibility to a private organization (land trust) or government agency better equipped to handle maintenance and monitoring issues.

Conservation easements are thought to make a contribution to protecting water quality, mostly in an indirect way. Land set aside in a permanent conservation easement is land that will have a prescribed set of uses or activities, generally restricting future development.

The location of the land held in a conservation easement may also determine if it will provide water quality benefits. Property along stream corridors and shorelines can act as a vegetated buffer that may filter out pollutants from storm water runoff. The ability of a conservation easement to function as a stream buffer is related to the width of the easement and in what vegetated state the easement is maintained (see Buffer Zones fact sheet).

### Applicability

Conservation easements are typically done to preserve agricultural lands and natural areas that are facing development pressure on the suburban-rural fringe. For rapidly urbanizing areas, conservation easements may be a way to preserve open space before land prices make the purchase of land containing important cultural and natural features impractical for governmental agencies with limited budgets. Conservation easements are not often used in ultra-urban areas, due to both the lack of available open space for purchase and the high cost of undeveloped land. In addition, private land trusts may limit the size and type of the land that they are willing to manage as conservation easements.

### Implementation

Conservation easements are designed to assure that the land is preserved in its current state long after the original owners no longer control the property. By agreeing to give up or restrict the development rights for a parcel of land, a landowner can guarantee that their property will remain in a prescribed state for perpetuity while receiving tax benefits. Often, state agencies and private land trusts have specific qualifications for a property before they will enter into an easement agreement with land owners. Table 1 contains examples of criteria that are used by private land trusts to determine if a property is worth managing in a conservation easement.

Table 1: Typical criteria that land trusts use to determine feasibility of entering into conservation easement agreement

| Criteria | Details |
|---|---|
| Natural resource value | Does the property provide a critical habitat or important environmental aspects worth preserving? |
| Uniqueness of the property | Does the property have unique traits worth preserving? |
| Size of land | Is the land large enough to have a natural resource or conservation value? |
| Financial considerations | Are funds available to meet all financial obligations? |
| Perpetuity | Is the conservation agreement a perpetual one? |
| Land trust's mission | Does the property align with the land trust's mission and the organization's specific criteria? |

Conservation easements have been used in all parts of the country, and many private groups, both nationally and locally, exist to preserve natural lands and manage conservation easements. States also use conservation easements and land purchase programs to protect significant environmental features and tracts of open space. Maryland is one state that has been nationally recognized for its programs that provide funding for state and local parks and conservation areas. The state is one of the first to use real estate transfer taxes to pay for land conservation programs. Several programs are funded through this transfer tax of one-half of one percent ($5 per thousand) of the purchase price of a home or land, or other state funding programs. Conservation programs include:

- *Program Open Space*. This program is responsible for acquiring 150,000 acres of open space for state parks and natural resource areas and more than 25,000 acres of local park land. Every county must create a Land Preservation and Recreation Plan that outlines acquisition and development goals in order to receive a portion of the 50 percent that is granted to local governments (MDNR, no date).
- *Maryland Environmental Trust*. This trust is a state-funded agency that helps citizen groups form and operate local land trusts and offers the land trusts technical assistance, training, grants for land protection projects and administrative expenses, and participation in the Maryland Land Trust Alliance (MDNR, 2001a).
- *Rural Legacy Program*. This program is a Smart Growth Initiative that redirects existing state funds into a focused and dedicated land preservation program specifically designed to limit the adverse impacts of sprawl on agricultural lands and natural resources. The program purchases conservation easements for large contiguous tracts of agricultural, forest, and natural areas subject to development pressure, and purchases fee interests in open space where public access and use is needed (MDNR, 2001b).

Regardless of whether a conservation easement is held by a government agency or a private land trust, certain management responsibilities must be addressed by the easement holder. The following is a list of some of these management duties:

- Ensure that the language of the easement is clear and enforceable.
- Develop maps, descriptions and baseline documentation of the property's characteristics.
- Monitor the use of the land on a regular basis.
- Provide information regarding the easement to new or prospective property owners.
- Establish a review and approval process for land activities stipulated in the easement.
- Enforce the restrictions of the easement through the legal system if necessary.
- Maintain property/easement-related records.

**Limitations**

A number of limitations exist for using conservation easements as a storm water management tool. One is that there is no hard evidence that conservation easements actually do protect water quality. Another is that conservation easements are often not an option in more urbanized areas, where the size, quality, and cost of land can restrict the use of easements. Easements might also not be held in perpetuity, which means that land could still face development pressure in the future. Easements also may not provide for the filtering of pollutants from concentrated flows. More information on the filtering potential of stream buffers can be found in the Buffer Zones fact sheet.

**Maintenance Considerations**

The responsibility for maintenance of property in a conservation easement depends on the individual agreement with a land trust or agency. While many organizations assume the responsibility for managing and monitoring a property, some land trusts leave maintenance responsibilities to the landowner and act only to monitor that the terms of the easement are met.

**Effectiveness**

The pollutant removal efficiency of a conservation area will depend on how much is conserved, the techniques used to conserve it, and the specific nature of the easement. Conservation easements are assumed to contribute water quality benefits, but no national studies proving this have been released.

## Cost Considerations

Table 2 summarizes the costs of maintaining green spaces with different types of uses.

Table 2: Annual maintenance costs of different types of green space uses (Adapted from CWP, 1998)

| Land Use | Approximate Annual Maintenance Costs |
|---|---|
| Natural open space<br>Only minimum maintenance, trash/debris cleanup | $75/acre/year |
| Lawns<br>Regular mowing | $270 to $240/acre/year |
| Passive recreation | $200/acre/year |

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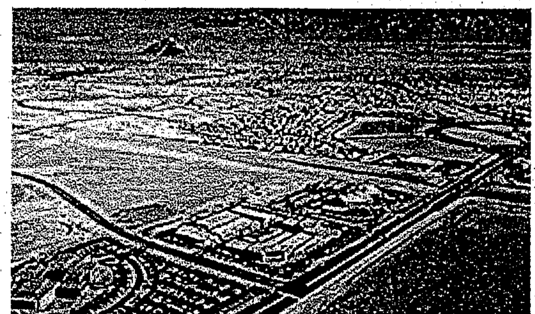
## Infrastructure Planning

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description



Developers can design streets and pedestrian paths to maximize convenience and safety while at the same time minimizing impervious surface area (Source: The Rouse Company, no date).

This practice requires changes in the regional growth planning process to contain sprawl development. Sprawl development is the expansion of low-density development into previously undeveloped land. The American Farmland Trust has estimated that the United States is losing about 50 acres an hour to suburban and exurban development (Longman, 1998). This sprawl development requires local governments to extend public services to new residential communities whose tax payments often do not cover the cost of providing those services. For example, in Prince William County, Virginia, officials have estimated that the costs of providing services to new residential homes exceeds what is brought in from taxes and other fees by $1,600 per home (Shear and Casey, 1996).

Infrastructure planning makes wise decisions to locate public services—water, sewer, roads, schools, and emergency services—in the suburban fringe and direct new growth into previously developed areas, discouraging low-density development. Generally, this is done by drawing a boundary or envelope around a community, beyond which major public infrastructure investments are discouraged or not subsidized. Meanwhile, economic and other incentives are provided within the boundary to encourage growth in existing neighborhoods. By encouraging housing growth in areas that are already provided with public services—water, sewer, roads, schools, and emergency services—communities not only save infrastructure development costs, but reduce the impacts of sprawl development on urban streams and water quality.

Sprawl development negatively impacts water quality in several ways. The most significant impact comes from the increase in impervious cover that is associated with sprawl growth. In addition to rooftop impervious area from new development, extension of road systems and additions of paved surface from driveways create an overall increase in imperviousness. This increase in the impervious cover level of an area directly influences local streams and water quality by increasing the volume of storm water runoff. These elevated runoff levels impact urban streams in several ways, including enlarging stream channels, increasing sediment and pollutant loads, degrading stream habitat, and reducing aquatic diversity (Schueler, 1995). Sprawl has been reported to generate 43 percent more runoff that contains three times greater sediment loads than traditional development (SCCCL, 1995).

Sprawl development influences water quality in other ways. This type of development typically occurs in areas not served by centralized sewer or water services. For example, over 80 percent of the land developed in the state of Maryland in the last decade has been outside the sewer and water "envelope." This requires new housing developments to use septic systems or another form of on-site wastewater disposal to treat household sewage. These on-site treatment systems can represent a significant source of nutrients and bacteria that affect both surface waters and groundwater. More information about septic systems is contained in the fact sheets in both the Illicit Discharge Detection and Elimination Category and the Pollution Prevention Category.

## Applicability

Sprawl development occurs in all regions of the country and has recently become the subject of many new programs to counteract its impacts. These programs seldom focus on the water quality implications of sprawl growth, instead concentrating on economic and transportation issues. Even so, methods such as infrastructure planning can reduce the impact of new development. Promoting the infill and redevelopment of existing urban areas in combination with other better site design techniques (see the other fact sheets in this category) will decrease impervious cover levels and lessen the amount of pollution discharged to urban streams.

## Siting and Design Conditions

Various techniques have been used to manage urban growth while conserving resources. Although none of these techniques specifically concentrates on infrastructure planning, each of the techniques recognizes that directing growth to areas that have been previously developed or promoting higher density development in areas where services exist prevents sprawl development and helps communities to mitigate the water quality impacts of economic growth. Among the techniques that have been used are:

- *Urban Growth Boundaries*. This planning tool establishes a dividing line that defines where a growth limit is to occur and where agricultural or rural land is to be preserved. Often, an urban services area is included in this boundary that creates a zone where public services will not be extended.

- *Infill/Community Redevelopment*. This practice encourages new development in unused or underutilized land in existing urban areas. Communities may offer tax breaks or other economic incentives to developers to promote the redevelopment of properties that are vacant or damaged.

The State of Maryland has been one of the states that has recently passed legislation to control growth. This "Smart Growth" legislation allows the State to direct its programs and funding to support locally-designated growth areas and protect rural and natural areas. The central component of this legislative package is the "Priority Funding Areas" legislation that limits most state infrastructure funding and economic development program monies to areas that local governments designate for growth and that meet guidelines for intended use, availability of plans for sewer and water systems, and permitted residential density (MOP, no date).

The other bills in the legislative package also support development of existing areas and preservation of undeveloped land. A brownfields program encourages revitalization of existing neighborhoods and industrial areas and establishes a brownfield revitalization incentive program that provides grants and low-interest loans to fund brownfield redevelopment. A new "Live Near Your Work" pilot program supports this effort by providing cash contributions to workers buying homes in certain older neighborhoods. The "Rural Legacy Program" spurs preservation of undeveloped land by providing financial resources for the protection of farm and forest lands from development and for the conservation of these essential rural resources from development.

## Limitations

Intense development of existing areas can create a new set of challenges for storm water program managers. Storm water management solutions are often more difficult and complex in ultra-urban areas than in suburban areas. The lack of space for structural storm water controls and the high cost of available land where structural controls could be installed are just two problems that program managers will face in managing storm water in intensely developed areas.

Infrastructure planning is often done on a regional scale and requires a cooperative effort between all the communities within a given region in order to be successful. Phase II program managers will need to develop lines of communication with other state and local agencies and community leaders to ensure that infrastructure plans direct growth to those areas that will have the least impacts on watersheds and water quality.

## Effectiveness

The effectiveness of infrastructure planning at protecting water quality is currently unknown. Although studies exist detailing the economic benefits of infrastructure planning, how this translates to storm water pollutant reductions is difficult if not impossible to calculate. However, a relationship does exist between impervious cover levels and urban stream characteristics, and one can assume that tools such as infrastructure planning that help control imperviousness have a positive impact on water quality.

Compact development benefits program managers in numerous ways. One benefit is that compact development can preserve prime agricultural land and sensitive areas while reducing costly construction of new infrastructure (Pelley, 1997). Less new land developed translates into less need for new infrastructure and public services.

## Cost Considerations

The economic benefits of reducing costly construction of new infrastructure and providing new services can be quite substantial. The following is a list of examples of the projected savings of limiting sprawl through managed growth (APA, no date):

- New Jersey's plan for managed growth will save the state $700 million in road costs, $562 million in sewer and water costs, $178 million in school costs, and up to $380 million in operating costs per year.
- Fifteen years of continued sprawl would cost Maryland $10 billion more than a more compact pattern of growth.
- A 1989 Florida study demonstrated that planned, concentrated growth would cost the taxpayer 50 percent to 75 percent less than continued sprawl.
- The Cities of Minneapolis-St. Paul will spend $3.1 billion by the year 2020 for new water and sewer services to accommodate sprawl.
- Since 1980 the City of Fresno, California, has added $56 million in yearly revenues but has added $123 million in service costs.

Other studies have found that planned development consumes about 45 percent less land and costs 25 percent less for roads, 15 percent less for utilities, 5 percent less for housing, and 2 percent less for other fiscal impacts (Burchell and Listokin, 1995, as cited in Pelley, 1997).

The control of sprawl development through legislation and "Smart Growth" programs is currently being implemented in a number of states and counties across the U.S. As these programs mature and begin to influence development patterns in urban areas, local governments should begin to see the positive impacts of condensed growth on the aquatic environment and water quality of local streams.

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## Narrower Residential Streets

## Postconstruction Storm Water Management in New Development and Redevelopment

### Description


A narrow street in a residential neighborhood. Cars can be parked in driveways or along the road shoulder

This better site design practice promotes the use of narrower streets to reduce the amount of impervious cover created by new residential development and, in turn, reduce the storm water runoff and associated pollutant loads. Currently, many communities require wide residential streets that are 32, 36, and even 40 feet wide. These wide streets provide two parking lanes and two moving lanes, but provide much more parking than is actually necessary. In many residential settings, streets can be as narrow as 22 to 26 feet wide without sacrificing emergency access, on-street parking or vehicular and pedestrian safety. Even narrower access streets or shared driveways can be used when only a handful of homes need to be served. However, developers often have little flexibility to design narrower streets, as most communities require wide residential streets as a standard element of their local road and zoning standards. Revisions to current local road standards are often needed to promote more widespread use of narrower residential streets.

### Applicability

Narrower streets can be used in residential development settings that generate 500 or fewer average daily trips (ADT), which is generally about 50 single family homes, and may sometimes also be feasible for streets that are projected to have 500 to 1,000 ADT. However, narrower streets are not feasible for arterials, collectors, and other street types that carry greater traffic volumes or are not expected to have a constant traffic volume over time.

In most communities, existing local road standards will need to be modified to permit the use of narrower streets. Several communities have successfully implemented narrower streets, including Portland, OR; Bucks County, PA; Boulder, CO; and throughout New Jersey. In addition, there are numerous examples of communities where developers have successfully narrowed private streets within innovative subdivisions.

### Siting and Design Conditions

Residential street design requires a careful balancing of many competing objectives: design, speed, traffic volume, emergency access, parking, and safety. Communities that want to change their road standards to permit narrower streets need to involve all the stakeholders who influence street design in the revision process. Several excellent references on narrow street design are provided at the end of this fact sheet.

## Limitations

A number of real and perceived barriers hinder wider acceptance of narrower streets at the local level. Advocates for narrower streets will need to respond to the concerns of many local agencies and the general public. Some of the more frequent concerns about narrower streets are listed below.

- *Inadequate On-Street Parking*. Recent research and local experience have demonstrated that narrow streets can easily accommodate residential parking demand. A single family home typically requires 2 to 2.5 parking spaces. In most residential zones, this parking demand can be easily satisfied by one parking lane on the street and driveways.

- *Car and Pedestrian Safety*. Recent research indicates that narrow streets have lower accident rates than wide streets. Narrow streets tend to lower the speed of vehicles and act as traffic calming devices.

- *Emergency Access*. When designed properly, narrower streets can easily accommodate fire trucks, ambulances and other emergency vehicles.

- *Large Vehicles*. Field tests have shown that school buses, garbage trucks, moving vans, and other large vehicles can generally safely negotiate narrower streets, even when cars are parked on both sides of the street. In regions with high snowfall, streets may need to be slightly wider to accommodate snowplows and other equipment.

- *Utility Corridors*. It is often necessary to place utilities underneath the street rather than in the right of way.

In addition, local communities may lack the authority to change road standards when the review of public roads is retained by state agencies. In these cases, street narrowing can be accomplished only on private streets (i.e., maintained by residents rather than a local or state agency).

## Maintenance Considerations

Narrower streets should slightly reduce road maintenance costs for local communities, since they present a smaller surface area to maintain and repair.

## Effectiveness

Since streets constitute the largest share of impervious cover in residential developments (about 40 to 50 percent), a shift to narrower streets can result in a 5 to 20 percent overall reduction in impervious area for a typical residential subdivision (Schueler, 1995). As nearly all the pollutants deposited on street surfaces or trapped along curbs are delivered to the storm drain system during storm events, this reduced imperviousness translates directly into less storm water runoff and pollutant loadings from the development. From the standpoint of storm water quality, residential streets rank as a major source area for many storm water pollutants, including sediment, bacteria, nutrients, hydrocarbons, and metals (Bannerman, 1994).

## Cost Considerations

Narrower streets cost less to build than wider streets. Considering that the cost of paving a road averages $15 per square yard, shaving even a mere four feet from existing street widths can yield cost savings of more than $35,000 per mile of residential street. In addition, since narrower streets produce less impervious cover and runoff, additional savings can be realized in the reduced size and cost of downstream storm water management facilities.

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## Eliminating Curbs and Gutters

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description

This better site design practice involves promoting the use of grass swales as an alternative to curbs and gutters along residential streets. Curbs and gutters are designed to quickly convey runoff from the street to the storm drain and, ultimately, to the local receiving water. Consequently, curbs and gutters provide little or no removal of storm water pollutants. Indeed, curbs often act as a pollutant trap where deposited pollutants are stored until they are washed out in the next storm. Many communities require curb and gutters as a standard element of their road sections, and discourage the use of grass swales. Revisions to current local road and drainage regulations are needed to promote greater use of grass swales along residential streets, in the appropriate setting. The storm water management and pollutant removal benefits of grass swales are documented in detail in the Grassed Swales fact sheet.

Developers can eliminate curbs and gutters to disconnect impervious surfaces and promote infiltration of storm water on vegetated areas (such as this grass-lined channel in a residential neighborhood)

### Applicability

The use of engineered swales in place of curbs and gutters should be encouraged in low- and medium-density residential zones where soils, slope and housing density permit. However, eliminating curbs and gutters is generally not feasible for streets with high traffic volume or extensive on-street parking demand (i.e., commercial and industrial roads), nor is it a viable option in arid and semi-arid climates where grass cannot grow without irrigation. Moreover, the use of grass swales may not be permitted by current local or state street and drainage standards.

### Siting and Design Conditions

A series of site factors must be evaluated to determine whether a grass swale is a viable replacement for curbs and gutters at a particular site.

*Contributing drainage area.* Most individual swales cannot accept runoff from more than 5 acres of contributing drainage area, and typically serve 1–2 acres each.

*Slope.* Swales generally require a minimum slope of 1 percent and a maximum slope of 5 percent.

*Soils*. The effectiveness of swales is greatest when the underlying soils are permeable (hydrologic soil groups A and B). The swale may need more engineering if soils are less permeable.

*Water Table*. Swales should be avoided if the seasonally high water table is within 2 feet of the proposed bottom of the swale.

*Development Density*. The use of swales is often difficult when development density becomes more intense than four dwelling units per acre, simply because the number of driveway culverts increases to the point where the swale essentially becomes a broken-pipe system. Typically, grass swales are designed with a capacity to handle the peak flow rate from a 10-year storm, and fall below erosive velocities for a 2-year storm.

**Limitations**

A number of real and perceived limitations hinder the use of grass swales as an alternative to curb and gutters:

- *Snowplow operation can be more difficult without a defined road edge*. However, on the plus side, roadside swales increase snow storage at the road edge, and smaller snowplows may be adequate.

- *The pavement edge along the swale can experience more cracking and structural failure, increasing maintenance costs*. The potential for pavement failure at the road/grass interface can be alleviated by "hardening" the interface with grass pavers or geo-synthetics placed beneath the grass. Other options include placing a low-rising concrete strip along the pavement edge.

- *The shoulder and open channel will require more maintenance*. In reality, maintenance requirements for grass channels are generally comparable to those of curb and gutter systems. The major requirements involve turf mowing, debris removal, and periodic inspections.

- *Some grass swales can have standing water, which make them difficult to mow, and can cause nuisance problems such as odors, discoloration, and mosquitoes*. In reality, grass channels are not designed to retain water for any appreciable period of time, and the potential for snakes and other vermin can be minimized by frequent mowing.

Other concerns involve fears about utility installation and worries that the grass edge along the pavement will be torn up by traffic and parking. While utilities will need to be installed below the paved road surface instead of the right of way, most other concerns can frequently be alleviated through the careful design and integration of the open channels along the residential street. (Consult the Grassed Swales fact sheet for details on design variations that can reduce these problems.)

**Maintenance Considerations**

The major maintenance requirement for grass swales involves mowing during the growing season, a task usually performed by homeowners. In addition, sediment deposits may need to be removed from the bottom of the swale every ten years or so, and the swale may need to be tilled and re-seeded periodically. Occasionally, erosion of swale side slopes may need to be stabilized. The overall maintenance burden of grass swales is low in relation to other storm water practices, and is usually within the competence of the individual homeowner. The only major maintenance problem that might arise pertains to "problem" swales that have standing water and are too wet to mow. This particular problem is often alleviated by the installation of an underground storm drain system.

## Effectiveness

Under the proper design conditions, grass swales can be effective in removing pollutants from urban storm water (Schueler, 1996). More information on the pollutant removal capability of various grass swale designs can be found in the Grassed Swales fact sheet.

## Cost Considerations

Engineered swales are a much less expensive option for storm water conveyance than the curb and gutter systems they replace. Curbs and gutters and the associated underground storm sewers frequently cost as much as $36 per linear foot, which is roughly twice the cost of a grass swale (Schueler, 1995, and CWP, 1998). Consequently, when curbs and gutters can be eliminated, the cost savings can be considerable.

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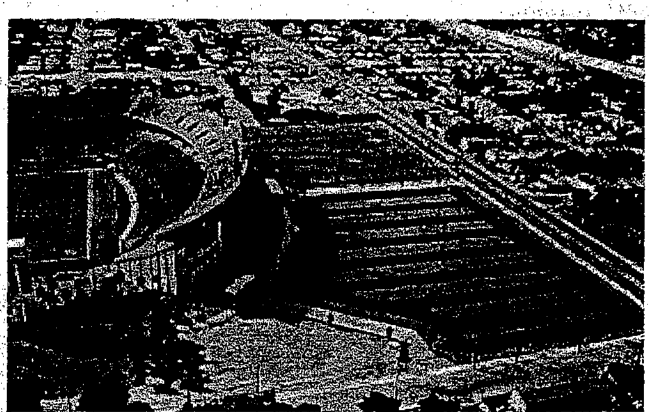
## Green Parking

### Postconstruction Storm Water Management in New Development and Redevelopment

## Description


A green parking lot at the Orange Bowl in Miami, Florida (Source: Invisible Structures, no date)

Green parking refers to several techniques applied together to reduce the contribution of parking lots to the total impervious cover in a lot. From a storm water perspective, application of green parking techniques in the right combination can dramatically reduce impervious cover and, consequently, the amount of storm water runoff. Green parking lot techniques include setting maximums for the number of parking lots created, minimizing the dimensions of parking lot spaces, utilizing alternative pavers in overflow parking areas, using bioretention areas to treat storm water, encouraging shared parking, and providing economic incentives for structured parking.

## Applicability

All of the green parking techniques can be applied in new developments and some can be applied in redevelopment projects, depending on the extent and parameters of the project. In urban areas, application of some techniques, like encouraging shared parking and providing economic incentives for structured parking, can be very practical and necessary. Commercial areas can have excessively high parking ratios, and application of green parking techniques in various combinations can dramatically reduce the impervious cover of a site.

## Implementation

Many parking lot designs result in far more spaces than actually required. This problem is exacerbated by a common practice of setting parking ratios to accommodate the highest hourly parking during the peak season. By determining average parking demand instead, a lower maximum number of parking spaces can be set to accommodate most of the demand. Table 1 provides examples of conventional parking requirements and compares them to average parking demand.

Table 1: Conventional minimum parking ratios (Source: ITE, 1987; Smith, 1984; Wells, 1994)

| Land Use | Parking Requirement | | Actual Average Parking Demand |
|---|---|---|---|
| | Parking Ratio | Typical Range | |
| Single family homes | 2 spaces per dwelling unit | 1.5–2.5 | 1.11 spaces per dwelling unit |
| Shopping center | 5 spaces per 1000 $ft^2$ GFA | 4.0–6.5 | 3.97 per 1000 $ft^2$ GFA |
| Convenience store | 3.3 spaces per 1000 $ft^2$ GFA | 2.0–10.0 | – |
| Industrial | 1 space per 1000 $ft^2$ GFA | 0.5–2.0 | 1.48 per 1000 $ft^2$ GFA |
| Medical/ dental office | 5.7 spaces per 1000 $ft^2$ GFA | 4.5–10.0 | 4.11 per 1000 $ft^2$ GFA |
| GFA = Gross floor area of a building without storage or utility spaces. | | | |

Another green parking lot technique is to minimize the dimensions of the parking spaces. This can be accomplished by reducing both the length and width of the parking stall. Parking stall dimensions can be further reduced if compact spaces are provided. While the trend toward larger sport utility vehicles (SUVs) is often cited as a barrier to implementing stall minimization technique, stall width requirements in most local parking codes are much larger than the widest SUVs (CWP, 1998).

Utilizing alternative pavers is also an effective green parking technique. They can replace conventional asphalt or concrete in both new developments and redevelopment projects. Alternative pavers can range from medium to relatively high effectiveness in meeting storm water quality goals. The different types of alternative pavers include gravel, cobbles, wood mulch, brick, grass pavers, turf blocks, natural stone, pervious concrete, and porous asphalt. In general, alternate pavers require proper installation and more maintenance than conventional asphalt or concrete. For more specific information on alternate pavers, refer to the Alternative Pavers fact sheet.

Bioretention areas can effectively treat storm water leaving a parking lot. Storm water is directed into a shallow, landscaped area and temporarily detained. The runoff then filters down through the bed of the facility and is infiltrated into the subsurface or collected into an underdrain pipe for discharge into a stream or another storm water facility. Bioretention facilities can be attractively integrated into landscaped areas and can be maintained by commercial landscaping firms. For detailed design specifications of bioretention areas, refer to the Bioretention fact sheet.

Shared parking in mixed-use areas and structured parking also are green parking techniques that can further reduce the conversion of land to impervious cover. A shared parking arrangement could include usage of the same parking lot by an office space that experiences peak parking demand during the weekday with a church that experiences parking demands during the weekends and evenings. Costs may dictate the usage of structured parking, but building upward or downward can help minimize surface parking.

## Limitations

Some limitations to applying green parking techniques include applicability, cost, and maintenance. For example, shared parking is only practical in mixed use areas, and structured parking may be limited by the cost of land versus construction. Alternative pavers are currently only recommended for overflow parking because of the considerable cost of maintenance. Bioretention areas increase construction costs.

The pressure to provide excessive parking spaces can come from fear of complaints as well as requirements of bank loans. These factors can pressure developers to construct more parking than necessary and present possible barriers to providing the greenest parking lot possible.

## Effectiveness

Applied together, green parking techniques can effectively reduce the amount of impervious cover, help to protect local streams, result in storm water management cost savings, and visually enhance a site. Proper design of bioretention areas can help meet storm water management and landscaping requirements while keeping maintenance costs at a minimum.

Utilizing green parking lots can dramatically reduce the amount of impervious cover created. The level of the effectiveness depends on how much impervious cover is reduced as well as the combination of techniques utilized to provide the greenest parking lot. While the pollutant removal rates of bioretention areas have not been directly measured, their capability is considered comparable to a dry swale, which removes 91 percent of total suspended solids, 67 percent of total phosphorous, 92 percent of total nitrogen, and 80–90 percent of metals (Claytor and Schueler, 1996).

An excellent example of the multiple benefits of rethinking parking lot design is the Fort Bragg vehicle maintenance facility parking lot in North Carolina (NRDC, 1999). This redesign reduced impervious cover by 40 percent, increased parking by 20 percent, and saved $1.6 million (20 percent) on construction costs over the original, conventional design. Stormwater management features, such as detention basins located within grassed islands and an onsite drainage system that took advantage of existing sandy soils, were incorporated into the parking lot design as well.

## Cost Considerations

Setting maximums for parking spaces, minimizing stall dimensions, and encouraging shared parking can result in considerable construction cost savings. At the same time, implementing green parking techniques can also reduce storm water management costs.

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## Alternative Turnarounds

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description

Alternative turnarounds are designs for end-of-street vehicle turnaround that replace cul-de-sacs and reduce the amount of impervious cover created in residential neighborhoods. Cul-de-sacs are local access streets with a closed circular end that allows for vehicle turnarounds. Many of these cul-de-sacs can have a radius of more than 40 feet. From a storm water perspective, cul-de-sacs create a huge bulb of impervious cover, increasing the amount of storm water runoff. For this reason, reducing the size of cul-de-sacs through the use of alternative turnarounds or eliminating them altogether can reduce the amount of impervious cover created at a site.

Rather than having a fully paved cul-de-sac bulb, site designers can incorporate pervious circles with vegetation that reduce the site's overall impervious area

Numerous alternatives create less impervious cover than the traditional 40-foot cul-de-sac. These alternatives include reducing cul-de-sacs to a 30-foot radius and creating hammerheads, loop roads, and pervious islands in the cul-de-sac center.

### Applicability

Alternative turnarounds can be applied in the design of residential, commercial, and mixed-use developments. Combined with alternative pavers, green parking, curb elimination, and other techniques, the total reduction to site impervious cover can be dramatic, reducing the amount of storm water runoff from the site. With proper designs, much of the remaining storm water can be treated on site.

### Implementation

Sufficient turnaround area is a significant factor to consider in the design of cul-de-sacs. In particular, the types of vehicles entering into the cul-de-sac should be considered. Fire trucks, service vehicles, and school buses are often cited as examples for increased turning radii. However, research shows that some fire trucks are designed for smaller turning radii. In addition, many new larger service vehicles are designed using a tri-axle, and school buses usually do not enter individual cul-de-sacs.

Implementation of alternative turnarounds will also have to address local regulations and marketing issues. Communities may have specific design criteria for cul-de-sacs and other alternative turnarounds. Also, although cul-de-sacs are often featured as highly marketable, actual research on market preference is not widely available.

### Limitations

Local regulations often dictate requirements for turnaround radii, and some of the alternatives may not be allowed by local codes. In addition, marketing perceptions may also dictate designs, particularly in residential areas. While changing local codes is no small effort, by initiating a local site planning roundtable, communities can change some of these regulations through a cluster ordinance or through a collective effort to review local codes to promote better site design.

### Maintenance Considerations

If islands are constructed as part of a turnaround, these areas will need to be maintained. Kept as a natural area, the costs could be minimal. Bioretention areas will also require maintenance. The other options create less asphalt to repave, and maintenance will remain the same and cost less.

### Effectiveness

In comparisons of several different turnaround options, hammerheads were found to create the least amount of impervious cover, as shown in Table 1.

Table 1. Impervious cover created by each turnaround option (Schueler, 1995)

| Turnaround Option | Impervious Area (square feet) |
|---|---|
| 40-foot radius | 5,024 |
| 40-foot radius with island | 4,397 |
| 30-foot radius | 2,826 |
| 30-foot radius with island | 2,512 |
| Hammerhead | 1,250 |

### Costs

Since alternative turnarounds reduce the amount of impervious cover created, construction savings can be an incentive (asphalt costs $0.50–$1.00 per square foot in materials alone). Bioretention is estimated at $6.40 per cubic foot, and while it costs more than providing naturally vegetated areas, it can help reduce overall storm water management costs.

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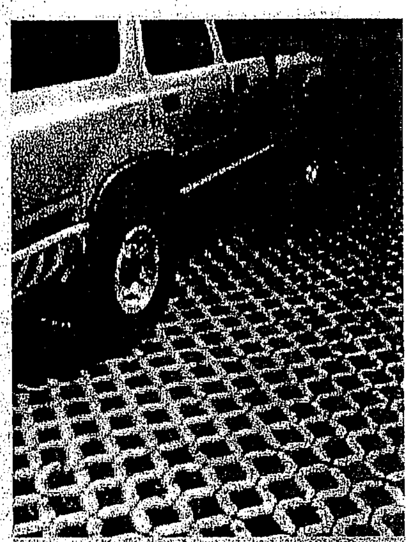
# Alternative Pavers

## Postconstruction Storm Water Management in New Development and Redevelopment

## Description



One type of alternative paver consists of a concrete lattice structure for support with grass growing in the void spaces (Source: Lo Gioco Landscaping, Inc., no date)

Alternative pavers are permeable surfaces that can replace asphalt and concrete and can be used for driveways, parking lots, and walkways. From a storm water perspective, this is important because alternative pavers can replace impervious surfaces, creating less storm water runoff. The two broad categories of alternative pavers are paving blocks and other surfaces, including gravel, cobbles, wood, mulch, brick, and natural stone. While porous pavement is an alternative paver, as an engineered storm water management practice it is discussed in detail in the Porous Pavement fact sheet.

Paving Blocks

Paving blocks are concrete or plastic grids with gaps between them. Paving blocks make the surface more rigid and gravel or grass planted inside the holes allows for infiltration. Depending on the use and soil types, a gravel layer can be added underneath to prevent settling and allow further infiltration.

Other Alternative Surfaces

Gravel, cobbles, wood, and mulch also allow varying degrees of infiltration. Brick and natural stone arranged in a loose configuration allow for some infiltration through the gaps. Gravel and cobbles can be used as driveway material, and wood and mulch can be used to provide walking trails.

## Applicability

Alternative pavers can replace conventional asphalt or concrete in parking lots, driveways, and walkways. At the same time, traffic volume and type can limit application. For this reason, alternative pavers for parking are recommended only for overflow areas. In residential areas, alternative surfaces can be used for driveways and walkways, but are not ideal for areas that require handicap accessibility.

## Siting and Design Criteria

Accessibility, climate, soil type, traffic volume, and long-term performance should be considered, along with costs and storm water quality controls, when choosing paving materials. Use of alternative pavers in cold climates will require special consideration, as snow shovels are not practical for many of these surfaces. Sand is particularly troublesome if used with paving blocks, as the sand that ends up between the blocks cannot effectively wash away or be removed.

In addition, salt used to de-ice can also infiltrate directly into the soil and cause potential ground water pollution.

Soil types will affect the infiltration rates and should be considered when using alternative pavers. Clayey soils (D soils) will limit the infiltration on a site. If ground water pollution is a concern, use of alternative pavers with porous soils should be carefully considered.

The durability and maintenance cost of alternative pavers also limits use to low-traffic-volume areas. At the same time, alternative pavers can abate storm water management costs. Used in combination with other better-site-design techniques, the cumulative effect on storm water can be dramatic.

## Limitations

Alternative pavers are not recommended for high-traffic volumes for durability reasons. Access for wheelchairs is limited with alternative pavers. In addition, snow removal is difficult since plows cannot be used, sand can cause the system to clog, and salt can be a potential pollutant.

## Maintenance Considerations

Alternative pavers require periodic maintenance, and costs increase when the permeable surface must be restored.

## Effectiveness

The most obvious benefit of utilizing alternative pavers includes reduction or elimination of other storm water management techniques. Applied in combination with other techniques such as bioretention and green parking, pollutant removal and storm water management can be further improved. (see Bioretention and Green Parking fact sheets for more information.)

Alternative pavers all provide better water quality improvement than conventional asphalt or concrete, and the range of improvement depends on the type of paver used. Table 1 provides a list of pavers and the range of water quality improvement achievable by different types of alternative pavers.

Table 1. Water quality improvement of various pavers (Source: BASMAA, 1997)

| Material | Water Quality Effectiveness |
|---|---|
| Conventional Asphalt/ Concrete | Low |
| Brick (in a loose configuration) | Medium |
| Natural Stone | Medium |
| Gravel | High |
| Wood Mulch | High |
| Cobbles | Medium |

## Cost Considerations

The range of installation and maintenance costs of various pavers is provided in Table 2. Depending on the material used, installation costs can be higher or lower for alternative pavers than for conventional asphalt or concrete, but maintenance costs are almost always higher.

Table 2. Installation and maintenance costs for various pavers (Source: BASMAA, 1997)

| Material | Installation Cost | Maintenance Cost |
|---|---|---|
| Conventional Asphalt/Concrete | Medium | Low |
| Brick (in a loose configuration) | High | Medium |
| Natural Stone | High | Medium |
| Gravel | Low | Medium |
| Wood Mulch | Low | Medium |
| Cobbles | Low | Medium |

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## BMP Inspection and Maintenance

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description

Regular inspection and maintenance of storm water best management practices is important to ensure that the practices are functioning properly and to remove trash and organic debris

To maintain the effectiveness of postconstruction storm water control best management practices (BMPs), regular inspection of control measures is essential. Generally, inspection and maintenance of BMPs can be categorized into two groups—expected routine maintenance and nonroutine (repair) maintenance. Routine maintenance refers to checks performed on a regular basis to keep the BMP in good working order and aesthetically pleasing. In addition, routine inspection and maintenance is an efficient way to prevent potential nuisance situations (odors, mosquitoes, weeds, etc.), reduce the need for repair maintenance, and reduce the chance of polluting storm water runoff by finding and correcting problems before the next rain.

In addition to maintaining the effectiveness of storm water BMPs and reducing the incidence of pests, proper inspection and maintenance is essential to avoid the health and safety threats inherent in BMP neglect (Skupien, 1995). The failure of structural storm water BMPs can lead to downstream flooding, causing property damage, injury, and even death.

### Applicability

Under the proposed Storm Water Phase II rule, owners and operators of small municipal separate storm sewer system (MS4) facilities would be responsible for implementing BMP inspection and maintenance programs and having penalties in place to deter infractions (USEPA, 1999). All storm water BMPs should be inspected for continued effectiveness and structural integrity on a regular basis. Generally, all BMPs should be checked after each storm event in addition to these regularly scheduled inspections. Scheduled inspections will vary among BMPs. Structural BMPs such as storm drain drop inlet protection may require more frequent inspection to ensure proper operation. During each inspection, the inspector should document whether the BMP is performing correctly, any damage to the BMP since the last inspection, and what should be done to repair the BMP if damage has occurred.

### Siting and Design Considerations

In the case of vegetative or other infiltration BMPs, inspection of storm water management practices following a storm event should occur after the expected drawdown period for a given

BMP. This allows the inspector to see whether detention and infiltration devices are draining correctly.

Inspection checklists should be developed for use by BMP inspectors. Checklists might include each BMP's minimum performance expectations, design criteria, structural specifications, date of implementation, and expected life span. In addition, the maintenance requirements for each BMP should be listed on the inspection checklist. This will aid the inspector in determining whether a BMP's maintenance schedule is adequate or needs revision. Also, a checklist will help the inspector determine renovation or repair needs.

**Limitations**

Routine maintenance materials such as shovels, lawn mowers, and fertilizer may be easily obtained on short notice with little effort. Unfortunately, not all materials that may be needed for emergency structural repairs are obtained with such ease. Thought should be given to stockpiling essential materials in case immediate repairs must be made to safeguard against property loss and to protect human health.

**Maintenance Considerations**

It is important that routine maintenance and nonroutine repair of storm water BMPs be done according to schedule or as soon as a problem is discovered. Because many BMPs are rendered ineffective for runoff control if not installed and maintained properly, it is essential that maintenance schedules are maintained and repairs are made promptly. In fact, some cases of BMP neglect can have detrimental effects on the landscape and increase the potential for erosion. However, "routine" maintenance, such as mowing grasses, should be flexible enough to accommodate the fluctuations in need based on relative weather conditions. For example, more harm than good may be caused by mowing during an extremely dry period or immediately following a storm event.

**Effectiveness**

The effectiveness of BMP inspection will be a function of the familiarity of the inspector with each particular BMP's location, design specifications, maintenance procedures, and performance expectations. Documentation should be kept regarding the dates of inspection, findings, and maintenance and repairs that result from the findings of an inspector. Such records are helpful in maintaining an efficient inspection and maintenance schedule and providing evidence of ongoing inspection and maintenance.

Because maintenance work for storm water BMPs is usually not technically complicated (mowing, removal of sediment, etc.), workers can be drawn from a large labor pool. As structural BMPs increase in their sophistication, however, more specialized maintenance training might be needed to sustain BMP effectiveness.

**Cost Considerations**

Mowing of vegetated and grassed areas may be the costliest routine maintenance consideration (WEF, 1998). Management practices using relatively weak materials (such as filter fabric and wooden posts) may mean more frequent replacement and therefore increased costs. The use of more sturdy materials (such as metal posts) where applicable may increase the life of certain BMPs and reduce replacement cost. However, the disposal requirements of all materials should be investigated before BMP implementation to ensure proper handling after the BMP has become ineffective or when it needs to be disposed of after the site has reached final stabilization. Table 1 shows maintenance costs, specific activities, and schedules for several postconstruction runoff BMPs.

Table 1. Maintenance costs, activities, and schedules for urban management practices (Adapted from CWP, 1998)

| Type of Practice | Management Practice | Annual Maintenance Cost (% of Construction Cost) | Maintenance Cost for a "Typical" Application | Maintenance Activity | Schedule |
|---|---|---|---|---|---|
| *Detention/ Retention Practices* | Ponds/ wetlands | 3%–6% | $3,000 to $6,000 | • Cleaning and removal of debris after major storm events; (>f rainfall)<br>• Harvest vegetation when a 50% reduction in the original open water surface area occurs<br>• Repair of embankment and side slopes<br>• Repair of control structure | Annual or as needed |
| | | | | • Removal of accumulated sediment from forebays or sediment storage areas when 60% of the original volume has been lost | 5-year cycle |
| | | | | • Removal of accumulated sediment from main cells of pond once 50% of the original volume has been lost | 20-year cycle |
| | Dry Ponds | ~1% | $1,200 | See above | |
| | Wetlands | ~2% | $3,800 | See above | |
| *Infiltration Facilities* | Infiltration Trench | 5%–20% | $2,300 to $9,000 | • Cleaning and removal of debris after major storm events; (>2" rainfall)<br>• Mowing and maintenance of upland vegetated areas<br>• Sediment cleanout<br>• Repair or replacing of stone aggregate<br>• Maintenance of inlets and outlets | Annual or as needed |
| | | | | • Removal of accumulated sediment from forebays or sediment storage areas when 50% of the original volume has been lost | 4-year cycle |
| | Infiltration Basin | 1%–10% | $150–$1,500 | • Cleaning and removal of debris after major storm events; (>2" rainfall)<br>• Mowing and maintenance of upland vegetated areas<br>• Sediment cleanout | Annual or as needed |
| | | | | • Removal of accumulated sediment from forebays or sediment storage areas when 50% of the original volume has been lost | 3- to 5-year cycle |

Table 1. (continued)

| Type of Practice | Management Practice | Annual Maintenance Cost (% of Construction Cost) | Maintenance Cost for a "Typical" Application | Maintenance Activity | Schedule |
|---|---|---|---|---|---|
| *Filtration Practices* | Sand Filters | 11%–13% | $2,200 | • Removal of trash and debris from control openings<br>• Repair of leaks from the sedimentation chamber or deterioration of structural components<br>• Removal of the top few inches of sand, and cultivation of the surface, when filter bed is clogged | Annual or as needed |
| | | | | • Clean out of accumulated sediment from filter bed chamber once depth exceeds approximately ½ inch, or when the filter layer will no longer draw down within 24 hours<br>• Clean out of accumulated sediment from sedimentation chamber once depth exceeds 12 inches | 3- to 5-year cycle |
| | Dry Swales, Grassed Channels, Biofilters | 5%–7% | $200 to $2,000 | • Mowing and litter/debris removal<br>• Stabilization of eroded side slopes and bottom<br>• Nurtient and pesticide use management<br>• Dethatching swale bottom and removal of thatching<br>• Discing or aeration of swale bottom | Annual or as needed |
| | | | | • Scraping swale bottom and removal of sediment to restore original cross section and infiltration rate<br>• Seeding or sodding to restore ground cover (use proper erosion and sediment control) | 5-year cycle |
| | Filter Strips | $320/acre (maintained) | $1,000 | • Mowing and litter/debris removal<br>• Nutrient and pesticide use management<br>• Aeration of soil on the filter strip<br>• Repair of eroded or sparse grass areas | Annual or as needed |
| | Bioretention | 5%–7% | $3,000 to $4,000 | • Repair of erosion areas<br>• Mulching of void areas<br>• Removal and replacement of all dead and diseased vegetation<br>• Watering of plant material | Biannual or as needed |
| | | | | • Removal of mulch and application of a new layer | Annual |

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# Ordinances for Postconstruction Runoff

## Postconstruction Storm Water Management in New Development and Redevelopment

### Description

The management of storm water runoff from sites after the construction phase is vital to controlling the impacts of development on urban water quality. The increase in impervious surfaces such as rooftops, roads, parking lots, and sidewalks due to land development can have a detrimental effect on aquatic systems. Heightened levels of impervious cover have been associated with stream warming and loss of aquatic biodiversity in urban areas. Runoff from impervious areas can also contain a variety of pollutants that are detrimental to water quality, including sediment, nutrients, road salts, heavy metals, pathogenic bacteria, and petroleum hydrocarbons.

An ordinance promotes the public welfare by guiding, regulating, and controlling the design, construction, use, and maintenance of any development or other activity that disturbs or breaks the topsoil or results in the movement of earth on land. The goal of a storm water management ordinance for postconstruction runoff is to limit surface runoff volumes and reduce water runoff pollutant loadings.

### Applicability

These ordinances are applicable to all major subdivisions in a municipality. The size of the development to which postconstruction storm water management runoff control applies varies, but many communities opt for a size limit of 5,000 square feet or more. Applicability should be addressed in more detail in the ordinance itself. It is important to note that all plans must be reviewed by local environmental protection officials to ensure that established water quality standards will be maintained during and after development of the site and that postconstruction runoff levels are consistent with any local and regional watershed plans.

Several resources are available to assist in developing an ordinance. EPA's (2000) postconstruction model ordinance web site (*http://www.epa.gov/nps/ordinance/postcons.htm*) provides a model ordinance and examples of programs currently being implemented. In addition, the Stormwater Managers Resource Center (*http://www.stormwatercenter.net*), which was created by the Center for Watershed Protection (no date) and sponsored by the U.S. Environmental Protection Agency, provides information to storm water management program managers in Phase II communities to assist in meeting the requirements of the National Pollutant Discharge Elimination System Phase II regulations.

### Siting and Design Considerations

The purpose of the postconstruction ordinance is to establish storm water management requirements and controls to protect and safeguard the general health, safety, and welfare of the public residing in watersheds within a jurisdiction. The following paragraphs provide the general language and concepts that can be included in your ordinance.

*General Provisions*

This section should identify the purpose, objectives, and applicability of the ordinance. The size of the development to which postconstruction runoff controls apply varies, but many communities opt for a size limit of 5,000 square feet or more. This section can also contain a discussion of the development of a storm water design manual. This manual can include a list of acceptable storm water treatment practices and may include the specific design criteria for each storm water practice. In addition, local communities should select the minimum water quality performance standards they will require for storm water treatment practices, and place them in the design manual.

*Definitions*

It is important to define the terms that will be used throughout the ordinance to assist the reader and prevent misinterpretation.

*Permit Procedures and Requirements*

This section should identify the permit required; the application requirements, procedures, and fees; and the permit duration. The intent of the permit should be to ensure that no activities that disturb the land are issued permits prior to review and approval. Communities may elect to issue a storm water management permit separate from any other land development permits required, or, as in this ordinance, to tie the issuing of construction permits to the approval of a final storm water management plan.

*Waivers to Storm Water Management Requirements*

This section should discuss the process for requesting a waiver and to whom this waiver would be applicable. Alternatives such as fees or other provisions for those requesting a waiver should be addressed as well.

*General Performance Criteria for Storm Water Management*

The performance criteria that must be met should be discussed in this section. The performance criteria can include the following:

- All sites must establish storm water practices to control the peak flow rates of storm water discharge associated with specified design storms and reduce the generation of storm water.

- New development may not discharge untreated storm water directly into a jurisdictional wetland or local waterbody without adequate treatment.

- Annual groundwater recharge rates must be maintained by promoting infiltration through the use of structural and non-structural methods.

- For new development, structural sewage treatment plants must be designed to remove a certain percentage of the average annual postdevelopment total suspended solids (TSS) load.

*Basic Storm Water Management Design Criteria*

Rather than place specific storm water design criteria into an ordinance, it is often preferable to fully detail these requirements in a storm water design manual. This approach allows specific design information to be changed over time as new information or techniques become available without requiring the formal process needed to change ordinance language. The ordinance can then require those submitting any development application to consult the current storm water design manual for the exact design criteria for the storm water management practices appropriate for their site. Topics in the manual can include minimum control requirements, site design feasibility, conveyance issues, pretreatment requirements, and maintenance agreements.

*Requirements for Storm Water Management Plan Approval*

The requirements for a storm water management plan to be approved should be addressed in this section. This can be accomplished by including a submittal checklist in the storm water design manual. A checklist is particularly beneficial because changes in submittal requirements can be made as needed without needing to revisit and later revise the original ordinance.

*Construction Inspection*

This section should include information on the notice of construction commencement, as-built plans, and landscaping and stabilization requirements.

*Maintenance and Repair of Storm Water Facilities*

Maintenance agreements, failure to maintain practices, maintenance covenants, right-of-entry for inspection, and records of installation and maintenance activities should be addressed in this section.

*Enforcement and Penalties*

This section should include information regarding violations, notices of violation, stop work orders, and civil and criminal penalties.

## Limitations

Site inspections are required for a postconstruction storm water ordinance to be effective. In addition, an adequate staff must be available to review permit applications and proposed plans.

## Maintenance Considerations

The operation and maintenance language in a storm water ordinance can ensure that designs facilitate easy maintenance and that regular maintenance activities are completed. In the "Maintenance and Repair of Storm Water Facilities" section of your ordinance, it is important to include language regarding a maintenance agreement, failure to maintain practices, maintenance covenants, right-of-entry for inspection, and records of installation and maintenance activities.

## Effectiveness

If a storm water management ordinance for existing development is properly implemented and enforced, the community can effectively achieve the following:

- Minimize increases in storm water runoff from any development to reduce flooding, siltation, and streambank erosion and to maintain the integrity of stream channels.

- Minimize increases in nonpoint source pollution caused by storm water runoff from development that would otherwise degrade local water quality.

- Minimize the total annual volume of surface water runoff that flows from any specific site during and following development so as not to exceed the predevelopment hydrologic regime to the maximum extent practicable.

- Reduce storm water runoff rates and volumes, soil erosion, and nonpoint source pollution, wherever possible, through storm water management controls and ensure that these management controls are properly maintained and pose no threat to public safety.

## Cost Considerations

Municipalities that implement and enforce postconstruction ordinances must budget for the drafting and enforcement of the regulation.

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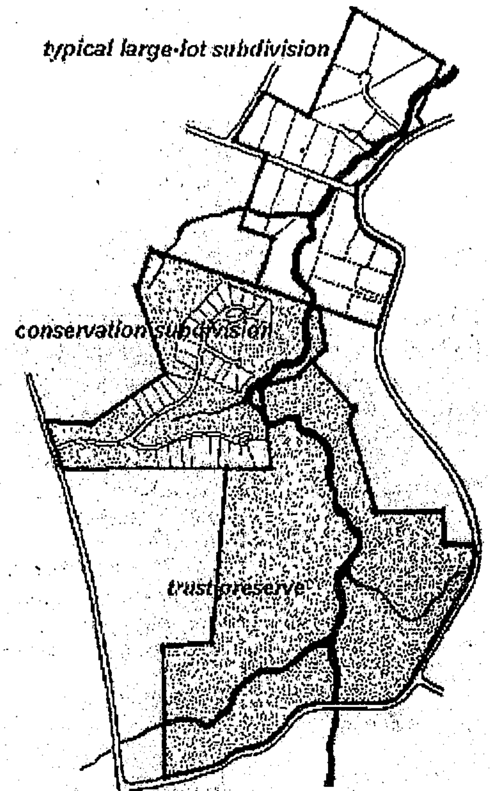
## Zoning

### Postconstruction Storm Water Management in New Development and Redevelopment

### Description

Zoning is a classification scheme for land use planning. Zoning can serve numerous functions and can help mitigate storm water runoff problems by facilitating better site designs. By correctly applying the right zoning technique, development can be targeted into specific areas, limiting development in other areas and providing protection for the most important land conservation areas.

There are numerous types of zoning techniques for better site design, including watershed-based zoning, overlay zoning, floating zones, incentive zoning, performance zoning, urban growth boundaries, large lot zoning, infill/community redevelopment, transfer of development rights, and limiting infrastructure extensions. Table 1 describes each of these zoning techniques and its utility.




Property boundaries differ widely between traditional large-lot zoning, which maximizes the acreage of individual properties, and conservation zoning, which maximizes the amount of shared open space (Source: Arendt, 1996)

### Applicability

The type of zoning to apply will depend on management goals. If water or land quality is a primary goal of the zoning technique, then watershed-based zoning can provide a comprehensive approach. At the same time, incentive zoning, performance zoning, and transfer of development rights can be used as protection measures for specific conservation areas.

### Implementation

Watershed-Based Zoning: Watershed-based zoning can employ a mixture of land use and zoning options to achieve desired results. A watershed-based zoning approach should include the following nine steps:

- Conduct a comprehensive stream inventory.
- Measure current levels of impervious cover.
- Verify impervious cover/stream quality relationships.
- Project future levels of impervious cover.

Table 1. Zoning techniques (Source: Caraco et al., 1998)

| Land Use Planning Technique | Description | Utility as a Watershed Protection Technique |
|---|---|---|
| Watershed-Based Zoning | Watershed and subwatershed boundaries are the foundation for land use planning. | Protects receiving water quality on the subwatershed scale by relocating development out of particular subwatersheds. |
| Overlay Zoning | Superimposes additional regulations or specific development criteria within specific mapped districts. | Requires development restrictions or allows alternative site design techniques in specific areas. |
| Impervious Overlay Zoning | Specific overlay zoning that limits total impervious cover within mapped districts. | Protects receiving water quality at both the subwatershed and site level. |
| Floating Zones | Applies a special zoning district without identifying the exact location until land owner specifically requests the zone. | Obtains proffers or other watershed protective measures that accompany specific land uses within the district. |
| Incentive Zoning | Applies bonuses or incentives to encourage creation of amenities or environmental protection. | Encourages development within a particular subwatershed or to obtain open space in exchange for a density bonus at the site level. |
| Performance Zoning | Specifies a performance requirement that accompanies a zoning district. | Requires additional levels of performance within a subwatershed or at the site level. |
| Urban Growth Boundaries | Establishes a dividing line that defines where a growth limit is to occur and where agricultural or rural land is to be preserved. | Used in conjunction with natural watershed or subwatershed boundaries to protect specific water bodies. |
| Large Lot Zoning | Zones land at very low densities. | Decreases impervious cover at the site or subwatershed level, but may have an adverse impact on regional or watershed imperviousness. |
| Infill/Community Redevelopment | Encourages new development and redevelopment within existing developed areas. | Used in conjunction with watershed-based zoning or other zoning tools to restrict development in sensitive areas and foster development in areas with existing infrastructure. |
| Transfer of Development Rights (TDRs) | Transfers potential development from a designated "sending area" to a designated "receiving area." | Used in conjunction with watershed-based zoning to restrict development in sensitive areas and encourage development in areas capable of accommodating increased densities. |
| Limiting Infrastructure Extensions | A conscious decision is made to limit or deny extending infrastructure (such as public sewer, water, or roads) to designated areas to avoid increased development in these areas. | A temporary method to control growth in a targeted watershed or subwatershed. Usually delays development until the economic or political climate changes. |

- Classify subwatersheds-based on stream management "templates" and current impervious cover.
- Modify master plans/zoning to correspond to subwatershed impervious cover targets and other management strategies identified in Subwatershed Management Templates.
- Incorporate management priorities from larger watershed management units such as river basins or larger watersheds (see discussion later in this fact sheet).
- Adopt specific watershed protection strategies for each subwatershed.
- Conduct long-term monitoring over a prescribed cycle to assess watershed status.

Overlay Zoning: The advantage of overlay zones is that specific criteria can be applied to isolated areas without the threat of being considered spot zoning. Overlay districts are not necessarily restricted by the limits of the underlying base zoning. An overlay zone may take up only a part of an underlying zone or may even encompass several underlying zones. Often the utilization of an overlay zone is optional.

Impervious Overlay Zoning: This type of overlay zoning limits future impervious areas. The environmental impacts of future impervious cover are estimated and a limit is set on the maximum imperviousness within a given planning area. Site development proposals are then reviewed in the context of an imperviousness cap. Subdivision layout options must then conform to the total impervious limit of the planning area.

Floating Zones: Normally, a parcel of land will not qualify for the application of the floating zone district unless it is large enough to allow the buffering of its development from the surrounding area. It is important to note that the existence of a floating zone district does not automatically grant rezoning to each landowner whose property complies with the prescribed conditions. Each property owner must have his or her application for rezoning reviewed and approved by the local governing body to determine if it is consistent with a comprehensive development plan.

Incentive Zoning: This planning technique relies on bonuses or incentives for developers to encourage the creation of certain amenities or land use designs. A developer is granted the right to build more intensively on a property or given some other bonus in exchange for an amenity or a design that the community considers beneficial. Developers stand to gain an increase in profits from the more intensive use of the property, while a community might use incentive zoning to promote more compact development, encourage open space designs, or generate other desired amenities such as trails, parks, or totlots.

Performance Zoning: Performance zoning is a flexible approach that has been employed in a variety of fashions in several different communities across the country. Some performance factors include traffic or noise generation limits, lighting requirements, storm water runoff quality and quantity criteria, protection of wildlife and vegetation, and even architectural style criteria.

Urban Growth Boundaries: Urban growth boundaries are sometimes called development service districts and include areas where public services are already provided (e.g., sewer, water, roads, police, fire, and schools). The delineation of the boundary is very important. Several important issues to consider in establishing an urban growth boundary include the following:

- Public facilities and services must be nearby and/or can be provided at reasonable cost and in a specific time frame.
- A sufficient amount of land to meet projected growth over the planning period must be provided.
- A mix of land uses must be provided.
- The potential impact of growth within the boundary on existing natural resources should be analyzed.
- The criteria for defining the boundary needs to be fair and should consider natural features (versus man-made features) wherever possible. The use of watershed boundaries as the urban growth boundary is one such natural feature.

Large Lot Zoning: Although large lot zoning does tend to reduce the impervious cover and therefore the amount of storm water runoff at a particular location, it also spreads development over vast areas. The road networks required to connect these large lots can actually increase the total amount of imperviousness created for each dwelling unit (Schueler, 1995). In addition, large lot zoning contributes to regional sprawl. Sprawl-like development increases the expense of providing community services such as fire protection, water and sewer systems, and school transportation.

Infill/Community Redevelopment: Infill and redevelopment can be employed in either large or small projects. Some of the existing impediments to more widespread implementation of these types of projects include the existing condition of a potential redevelopment site in terms of environmental constraints, the restrictive nature of many land use regulations, and pressing social and economic issues. Local governments may need to modify local zoning or building codes to make infill and redevelopment a more inviting attraction to developers. In addition, citizen involvement has been demonstrated to be a vital catalyst for leveraging funding or revising codes. Furthermore, lending institutions must be progressive in their view of funding infill and redevelopment projects. One possibility is to partner with local governments or community organizations.

Transfer of Development Rights (TDRs): The principle of TDRs is based on the premise that ownership of land entails certain property rights. While some of these rights may be restricted by zoning, building codes, and environmental constraints, landowners are "entitled" to use their land for the "highest and best use." TDRs are based on a market-driven incentive program where it is possible to sell development potential (zoned density) without buying or selling land. Landowners in preservation areas are compensated for lost development potential , while conventional down-zoning deprives landowners of this potential value.

## Limitations

Some zoning techniques may be limited by economic and political acceptance and should be evaluated on these criteria as well as storm water management goals.

## Maintenance Considerations

Some maintenance issues to consider for the long term are the following:

- What are the most economically and politically acceptable zoning technique(s) that can be used to shift or reduce impervious cover among the subwatersheds?

- How accurate are the estimates of the amount and location of future impervious cover in the watershed? Are better projections needed?

- Will future increases in impervious cover create unacceptable changes to a watershed and/or subwatershed?

- Which subwatersheds appear capable of absorbing future growth in impervious cover?

## Effectiveness

There are numerous case studies of performance-based zoning used in different communities. Some of these examples are summarized in Table 2.

Table 2. Case examples of performance-based zoning (Source: Porter et al., 1991)

| Location | Performance Zoning Provisions | Notes |
|---|---|---|
| Fort Collins, Colorado | Planned Unit Development (PUD) options are applied to all parcels in city. Developers may choose conventional zoning or the optional PUD. PUD proposals must meet a point value for an absolute criterion and a relative criterion. | Applications are discussed at a conceptual stage where suggestions are made to improve scores. The local planning board has quite a bit of latitude to use discretion to require special conditions. |
| Largo, Florida | The Land Use Plan defines uses and densities. Four overlay "policy"districts (environmental conservation, management, redevelopment, and downtown) define general standards and prohibited uses. Each land use within a policy district falls into a one of three classes (allowable, allowable with special mitigating measures, or prohibited). | A variety of uses are permitted within the 4 policy districts when applying the special mitigating measures. The city also has a five-tiered system of review and approval that facilitates fast reviews for many common applications and a more involved process for projects that require mitigation. |
| Hardin County, Kentucky | The land development ordinance allows agricultural and single family uses by right. All other uses must be evaluated by a three-step process. At the first step, the agricultural and development potential is evaluated using a point system. If the site scores a minimum threshold value, than it moves onto the second step, a compatibility assessment. The final step involves typical review of subdivis ion standards and requirements. | The program places a special emphasis on preserving agricultural uses. The process involves a unique feature that calls on citizen consensus for each step. This decision making process might be considered highly discretionary, but with a widespread interest by most Hardin County citizens in seeing development proceed, there have been few complaints. |
| Bath Charter Township, Michigan | The township's ordinance provides five zoning districts: two traditional districts for rural, low-density residential; and three applied to existing settlements/expected development corridor. These three districts allow a range of uses either "by right" or with special permits for certain uses. | The ordinance is a compromise between complex, inflexible zoning and no zoning at all. The process allows for extensive review and individual decisions for individual controversial cases. |

Table 2. (continued)

| Location | Performance Zoning Provisions | Notes |
|---|---|---|
| Buckingham Township, Pennsylvania | The ordinance contains typical zoning districts but provides cluster and performance standard development provisions. It aims to preserve natural resources by clustering housing on the least environmentally sensitive areas. | Development of cluster and performance standards are "by rights," and as such, do not require public hearings. The sensitivity of natural areas makes the zoning more flexible in unrestricted areas but less flexible than most conventional zoning in placing restrictions for protecting natural areas. |
| Duxbury, Massachusetts | Two new categories of development (planned developments and cluster) were created in addition to existing traditional zoning. Both types are allowed in different portions of the town under a special permit process. | Termed "impact zoning," the ordinance aimed to create incentives for developers to build more diverse and environmentally sensitive housing. Developers are choosing standard subdivisions over the optional techniques to avoid lengthy and complex reviews. |

## Cost Considerations

Subwatershed planning for better site design zoning involves many costs. Mapping, photography, delineations, and involving the public are some of the items typically in such a budget (Table 3).

Table 3. Unit prices for subwatershed planning (Adapted from CWP, 1998)

| Budget Item | Estimated Unit Cost | Assumptions |
|---|---|---|
| Aerial Photography | $500 per photo | Includes aerial flyover and developing of one color photograph. |
| Base Mapping | $500 | For Subwatershed Management Map using USGS 7.5 minute Quad. Sheet. Includes, subwatershed delineation, overlaying land use, monitoring stations, and transportation routes. |
| Base Mapping | $5,000 | For Aquatic Corridor Management Map, using aerial topography at 2' contour interval. Includes, aerial topography at 1" = 200', locating existing utilities, floodplain, wetlands, and riparian cover from existing maps (no field walk and no topo. survey control). |
| Floodplain Delineation | $5,000 | Detailed analysis beyond FEMA, cross-sections plotted at 1000 ft on-center, topo spot-checked, road crossings evaluated, includes report, assumes flow data are available. |
| Geographic Information System (GIS)—start-up | $15,000 | High end work station and software (e.g., ARC/INFO), includes approx. 2 weeks of training for operator. Does not include data layers |
| GIS—Obtain or Digitize Data Layers | – | Data layers include impervious cover, topography (5' C.I.), zoning, utilities, vegetative cover (broad categories) |
| Impervious Cover Measurement—Actual | $3,000 | Uses digital orthophotography, impervious layer clipped at subwatershed boundary, algorithm to calculate impervious area |

Table 3. (continued)

| Budget Item | Estimated Unit Cost | Assumptions |
|---|---|---|
| Impervious Cover Estimation—Land Use | $600 | Uses land use designations or zoning and measured areas compared against tables, requires review of aerial photo (not included) to estimate build-out. |
| Impervious Cover Projection—Based on Future Land Use | $800 | Uses zoning or master plan and measured areas compared against tables, requires assessment of future build-out |
| Public Attitude Survey | $15,000 per survey | 1000 homes contacted by telephone, includes survey questionnaire preparation and data analysis. |
| Stakeholder Involvement Program | $15,000 | Plan and hold four public and four community meetings, direct mail to 20,000 people, staff time and direct expenses included. |

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