City of
SACRAMENTO
Department of Utilities

Administrative and Technical Procedures Manual for Grading and Erosion and Sediment Control

October 2013





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List of Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
ASTM	American Society for Testing and Materials
ATV	All Terrain Vehicle
BFM	Bonded Fiber Matrix
BMP	Best Management Practice
Cal/OSHA	California Division of Occupational Safety and Health
Caltrans	California Department of Transportation
CASQA	California Stormwater Quality Association
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CGP	State Water Resources Control Board Order 2010-011-DWQ, NPDES General Permit for Stormwater Discharges associated with Construction Activity
City	City of Sacramento
DOT	Department of Transportation
EPA	Environmental Protection Agency
ESA	Environmentally Sensitive Area
ESC	Erosion and Sediment Control
HCM	Hydraulic Compost Matrix
HM	Hydraulic Matrix
lb	Pound
LID	Low Impact Development
LUP	Linear Utility Project
MBFM	Mechanically Bonded Fiber Matrix
mph	Miles Per Hour

MS4	Municipal Separate Storm Sewer System
MSDS	Material Safety Data Sheet
MUSLE	Modified Universal Soil Lose Equation
NPDES	National Pollution Discharge Elimination System
PAM	Polyacrylamide
Partnership	Sacramento Stormwater Quality Partnership
PCC	Portland Cement Concrete
PLS	Pure Live Seed
QSP	Qualified SWPPP Practitioner
REAP	Rain Event Action Plan
RECP	Rolled Erosion Control Products
RUSLE	Revised Universal Soil Loss Equation
RWQCB	Regional Water Quality Control Board
SFM	Stabilized Fiber Matrix
SHM	Standard Hydraulic Mulch
SQFT	Square Foot
State Construction General Permit	State Water Resources Control Board Order 2010-011-DWQ, NPDES General Permit for Stormwater Discharges associated with Construction Activity
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TMECC	Test Methods for the Examination of Composting and Compost
USCC	United States Compost Council
UV	Ultraviolet
yd^3	Cubic Yard

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Chapter 1: Introduction and Purpose

SECTION 1: OVERVIEW OF THE MANUAL

A: Introduction and Purpose

This Manual replaces the January 1994 Administrative and Technical Procedures Manual for Grading and Erosion and Sediment Control.

The purpose of this Procedures Manual is to assist project applicants in completing some of the steps necessary to obtain a Grading/Rough Grading/Building Permit and to provide guidance and selected minimum standards to be used in the design and preparation of Improvement Plans and/or Erosion, Sediment, and Pollution Control Plans for construction activity in accordance with the City of Sacramento's Grading, Erosion and Sediment Control Ordinance (Ordinance No. 93-068). For the purpose of this Manual, the term "Improvement Plans" shall be understood to be inclusive of grading design, temporary erosion and sediment control measures to be implemented during construction, as well as post-construction Best Management Practices (BMPs) to be implemented after construction for water quality mitigation and/or enhancement. Improvement Plans are to be submitted in support of application for a Grading/Rough Grading/Building Permit. Chapter 2 of the Manual provides guidance for completing the plan approval and permit issuance processes. Chapter 3 of the Manual provides design standards for grading, and Chapter 4 describes Best Management Practices for controlling soil erosion, sediment transport, and runoff pollution from construction sites. Also included in Appendix 1 of this Manual is the Grading, Erosion and Sediment Control Ordinance.

The City is a member of the Sacramento Stormwater Quality Partnership (Partnership). The Partnership has developed a Stormwater Quality Design Manual to deal specifically with design standards for Low Impact Development and other treatment measures for private development and public improvement projects. That manual has been updated to incorporate new LID and Hydromodification Management standards. The guidance for preparing post-construction, permanent stormwater management plan is included in the updated Stormwater Quality Design Manual. The manual is available at:

http://www.cityofsacramento.org/utilities/media-room/documents/SWQ_DesignManual_May07_062107.pdf

B: Background

Past studies have indicated that sediment runoff rates from construction sites without adequate erosion control measures are up to 100 times greater than that of vegetated lands, or lands with undisturbed top soil.[1] Over a short period of time, construction sites can contribute more sediment to receiving waters than was previously deposited over several decades. In addition, construction debris and toxic substances used on construction sites must be properly managed so that they are not discharged to adjoining private or public properties, or receiving waters via stormwater runoff from the construction site.

On September 11, 2008, an area-wide National Pollution Discharge Elimination System (NPDES) Stormwater Permit regulating the discharge of urban runoff from the Municipal Separate Storm Sewer System (MS4) was issued to the Cities of Citrus Heights, Elk Grove, Folsom, Galt, Rancho Cordova, Sacramento, and the County

[1] Pitt, Robert, Clark, Shirley E., and Lake, Donald. *Construction Site Erosion and Sediment Controls.*

of Sacramento, by the Central Valley Regional Water Quality Control Board (RWQCB). The permit requires the City (and all the "Permittees") to develop programs to control pollutants in urban stormwater runoff discharges. A specific provision of the permit requires the City to develop and implement a program to control and minimize the discharge of pollutants associated with construction activities to receiving waters.

In addition, the State Water Resources Control Board (SWRCB) has adopted a NPDES General Permit for Stormwater Discharges associated with Construction Activity (State Construction General Permit, or CGP) which requires every construction project that disturbs equal to or greater than one (1) acre of land to obtain coverage under the CGP and comply with its requirements. The CGP was adopted and in place as of October 1, 1992, and was most recently renewed on September 2, 2009, and became effective on July 1, 2010. Subsequent modifications to the CGP became effective on February 14, 2011. The requirements of Ordinance No. 93-068 are intended to be similar to those required by the CGP, however these ordinance requirements do not substitute for or take the place of the CGP requirements. Every development project that will disturb one or more acres of land must be covered under the CGP and comply with the requirements of Ordinance No. 93-068, based upon whichever standard is more stringent.

This Manual makes reference to, and is to be used in conjunction with, the Standard Specifications For Public Construction and the Design and Procedures Manual of the City of Sacramento (2009, or latest revision thereof). It is intended to serve as a guide for all City Departments, consulting engineers, developers, contractors and others in the preparation of improvement plans associated with grading and erosion, and sediment and pollution control measures.

In summary, the City's policies and design standards for grading, erosion and sediment control measures are driven collectively by the regulations within the Regional MS4 Permit, as well as Ordinance 93-068 and the City of Sacramento Design and Procedures Manual. The City's policies and design standards are consistent with those in the CGP, but applicants are still required to comply with the CGP if it is applicable to their project. The reader is encouraged to become thoroughly acquainted with each of these documents prior to preparing improvement plans or other items associated with Grading Permit submittal.

Chapter 2: Plan Approval and Permit Issuance

SECTION 1: ADMINISTRATIVE PROCEDURES

A: General

The administrative procedures for any project may be divided into two main categories: 1) The Entitlement Process and 2) The Building Permit Process.

The Entitlement Process refers to all projects which require entitlements, such as rezoning, land subdivision, environmental review (CEQA), tentative/final maps, special permits, variances, and/or other special requirements. The Entitlement Process is inherently preliminary in nature with respect to design issues, and is sometimes not required depending on project the type. Nonetheless, it is recommended that all projects consult with the City's Planning Department at inception to determine which, if any, aspects of the Entitlement Process the project must undergo. Once a project receives all applicable Entitlement Process approval(s), it may progress into the Building Permit Process. For more information on the City's Entitlement Process, refer to:

http://www.cityofsacramento.org/dsd/planning/

All projects, regardless of the Entitlement Process, must go through the Building Permit Process. Any grading approval will be granted to projects under the Building Permit Process through the issuance of the Building Permit from the Community Development Department or, in the case of large commercial developments or major subdivisions, a separate Grading Permit from the Department of Transportation, Development Engineering. In some instances, advanced grading for commercial developments or major subdivisions can be permitted by issuance of a Rough Grading Permit. Rough Grading Permit issuance is usually reserved for projects that involve remedial earthwork, clearing and grubbing, or other construction aspects that can proceed relatively independent of final site construction. Issuance of a Building Permit, a separate Grading Permit, or a Rough Grading Permit can happen only after the plans have been reviewed and approved by the City, and the developer has paid the fees and posted the necessary securities. Additionally, all projects that are subject to requirements under the Statewide Construction General Permit (CGP) must demonstrate proof of coverage prior to Building, Grading, or Rough Grading Permit issuance.

An application and completed plans may be submitted for a Building Permit or, when necessary, a separate Grading Permit, as soon as the applicant has received the necessary entitlements or at any time if entitlements are not required. In some instances, application for a Building Permit or any type of Grading Permit may proceed concurrent with the entitlement approvals at the discretion of the Director of Community Development Department. Applications for a Building Permit or Grading Permit submitted prior to approval of required entitlements are subject to the loss of plan check fees if the entitlements are not approved, or additional plan check fees if plan revisions are required due to any conditions or mitigation measures required as a part of the project entitlement approval.

Pursuant to the City of Sacramento Grading, Erosion and Sediment Control Ordinance, no work whatsoever shall be done (including rough grading) without issuance of the appropriate permit. In general, a Grading Permit is required when either of the following occur:

- The volume of graded material equals or exceeds 50 cubic yards, or
- The depth of a cut or fill exceeds 2 feet vertically.

Work that is exempt from a separate Grading Permit includes the following:

- Single family lots and residential infill projects of less than ½ an acre and not part of a larger common development. Such projects must also fall below the aforementioned 50 cubic yard and 2 foot thresholds.
- Swimming pool excavation
- Grading for agricultural operations
- Exploratory excavation of less than 350 cubic yards
- Routine cemetery excavation
- Emergency work required to protect life or property
- Basement and foundation excavation
- Refuse disposal
- Repair and maintenance of levees and other public works drainage projects

Although the above-listed project types are exempt from Grading Permit requirements, these project types can still have adverse water quality impacts, and good housekeeping measures and appropriate BMPs are required to ensure that pollutants are removed from runoff to the maximum extent practicable.

Refer to Section 15.88.070 of the City of Sacramento Municipal Code, as well as the following link, for more specific information regarding applicability and exemption from Grading Permit requirements:

http://www.qcode.us/codes/sacramento/

Refer also to the following links for more general information regarding the City's Entitlement and Building Permit Processes:

- Planning – Discretionary review, entitlements, design guidelines, etc.

http://portal.cityofsacramento.org/en/Community-Development/Planning.aspx

- Building – Permits, plan review, etc.

http://portal.cityofsacramento.org/en/Community-Development/Building.aspx

- Development Engineering – Review criteria, fee schedule, etc.

http://www.cityofsacramento.org/transportation/engineering/development-engineering/index.html

B: Fees and Securities

1. Forms and Fees

The project applicant will be required to pay fees for plan review and inspection. Fees will be adjusted from time to time to reflect actual costs incurred by the City. An estimate of the amount necessary for an initial deposit, based upon the value of improvements, can be calculated at the following link:

http://www.cityofsacramento.org/transportation/engineering/development-engineering/fee-calculator.cfm

Other helpful forms related to the Department of Transportation, Development Engineering can be found at:

http://www.cityofsacramento.org/transportation/engineering/development-engineering/forms.html

2. Securities

At the discretion of the Director from the Department of Utilities and/or DOT, the applicant may be required to establish a security for the purpose of stabilizing the project site should work be abandoned prior to completion or for the purpose of correcting hazardous conditions relating to soil stability, erosion, water quality or drainage problems. Factors considered in determining the need for securities include, but are not limited to, the following:

- Size of project,
- Proximity to creeks and/or rivers, and
- Time of year.

The amount of the security shall be based upon the project size, in acreage, per the following formula: project size (in acres) x $1,200.

Securities shall be provided in any of the following forms:

- Bond by a duly authorized corporate surety,
- Certificate of deposit,
- Letter of credit, or
- Trustee account.

C: Locations of City Departments

1. Planning Department

300 Richards Boulevard, 3rd Floor

Sacramento, CA 95814

2. Community Development Department

300 Richards Boulevard, 3rd Floor

Sacramento, CA 95814

3. Department of Transportation, Development Engineering

915 I Street Room 2000

Sacramento, California 95814

SECTION 2: ROUGH AND FINAL GRADING PLANS

A: Minimum Standards for Grading Plan Sheets

This section is applicable to all grading plan sheets, including those associated with Rough Grading Permits, Building Permits, and Grading Permits, processed through the Department of Transportation Development (DOT) Engineering Section. Grading plan sheets processed through the DOT are typically packaged within an Improvement Plan set. Grading plan sheets shall be prepared and signed by a California Registered Civil Engineer, except as provided for herein and as specified within the California Professional Engineers Act. Grading plan sheets shall be prepared on standard City sheets (22" x 34") at a scale of 1"=20' or 1"=40', and include the following minimum information:

The plans shall be clear, legible and titled "Rough Grading Plan" or "Grading Plan" as applicable; they shall contain a statement of the purpose of the proposed grading, and shall include all of the following:

GP.1 ☐ A plan titled "Rough Grading Plan" or "Grading Plan" with the name, contact information and signature of the preparer and the date of preparation.

GP.2 ☐ A vicinity map (with or without scale) indicating the location of the site relative to the principal roads, lakes and watercourses in the area.

GP.3 ☐ A site plan indicating the site of the work and any proposed divisions of the land.

GP.4 ☐ The complete site boundaries and locations of any easements and rights-of-way traversing and adjacent to the property, appropriately labeled and dimensioned.

GP.5 ☐ The location of all existing and proposed roads, buildings, wells, pipelines, watercourses and other structures, facilities and natural features of the site, such as drainage courses. Also, show the location of all improvements on adjacent land within 50 feet of the proposed work. Construction details, supporting calculations, and maps should be included as required for proposed improvements.

GP.6 ☐ Location and nature of known or suspected soil or geologic hazard areas.

GP.7 ☐ Contour lines of the existing terrain and proposed finished grade at intervals not greater than one foot, showing all topographic features and drainage patterns throughout the area where proposed grading is to occur, relative to a City benchmark. Temporary benchmarks may be established on-site if they are referenced to a City benchmark. The contour lines shall be extended to a minimum of 50 feet beyond the affected area, and further if needed to define intercepted off-site drainage, and shall be extended a minimum of 100 feet outside of any future road right-of-ways. Direction of flow of drainage within 50 feet of the affected area shall also be shown by the use of arrows.

GP.8 ☐ Location of cut and fill lines and the limits of grading for all the proposed grading work, including borrow and stockpile areas.

GP.9 ☐ Location, width, direction of flow and approximate location of tops and toes of banks of any watercourses.

GP.10 ☐ Approximate boundaries of any areas with a history of flooding.

GP.11 ☐ Proposed provisions for storm drainage control and existing or proposed flood control facilities in the vicinity of the grading.

GP.12 ☐ An erosion and sediment control plan including both temporary and permanent Best Management Practices (BMPs). See Section 3 of this Chapter for erosion and sediment control plan requirements. This requirement may be waived by the Director for sites having no slopes greater than one percent unless the large size of the site, its proximity to sensitive areas or other conditions make an erosion and sediment discharge hazard possible.

GP.13 ☐ North arrow and scale.

GP.14 ☐ General location and character of vegetation covering the site.

GP.15 ☐ Typical cross sections (not less than two) of all existing and proposed graded areas taken at appropriate intervals and at locations of maximum cuts and fills.

GP.16 ☐ An estimate of the quantities of excavation and fill, including quantities to be moved both on and off site.

GP.17 ☐ A projected schedule of operations, including, at a minimum, the dates of:

- Commencement of work.
- Start and finish of rough grading.
- Completion of drainage facilities.
- Completion of work in any watercourse.
- Completion of interim erosion and sediment control facilities.
- Construction of permanent BMPs
- Completion of work of revegetation and landscaping.

GP.18 ☐ Complete construction specifications, and a complete drainage study if required by the Director.

GP.19 ☐ A revegetation plan, including temporary erosion control plantings, permanent slope plantings, replacement of temporary groundcover and irrigation facilities.

GP.20 ☐ Location, size and construction details related to permanent Best Management Practices (BMPs) including:

- Specification and depth of amended soil mix
- Presence, location, size, discharge point and other details related to perforated sub-drains
- Size, location, and elevation of overflow risers
- Location, thickness and other details related to permeable pavement or porous concrete
- Type and location of underground impermeable liners
- Size, location, elevation, material and other relevant details related to proprietary storage or treatment chambers
- Location, slope, width, depth and cross section of vegetated or rock lined swales

Location and other details related to outlet scour protection or placement of riprap. This would include dimension, rock size and thickness, and filter blanket specifications.

GP.21 ☐ Itemized cost estimate of the proposed grading and related work.

The Director may waive the requirement that a Registered Civil Engineer is required to prepare the grading plan sheet if the grading would not endanger the public health, safety or welfare as determined by the Director and would not involve or require any of the following:

- Cuts and fills with a combined total of 350 cubic yards or more.
- An access road serving five or more existing or potential residences.
- A cut or fill that is located so as to cause unduly increased pressure or reduce support upon adjacent structure or property.
- The construction of extensive drainage or sediment control structures, culverts or facilities or substantial alteration of any existing drainage course.
- The creation or aggravation of an unstable slope condition.
- Violate any provision within the California Professional Engineers Act

SECTION 3: MINIMUM STANDARDS FOR EROSION AND SEDIMENT CONTROL PLANS (ESC PLAN)

This section is applicable to all Erosion and Sediment Control Plan sheets, including those associated with Rough Grading Permits, Building Permits, and Grading Permits, processed through the Department of Transportation Development (DOT) Engineering Section. Erosion and Sediment Control Plan sheets processed through the DOT are typically packaged within an Improvement Plan set. Typically, separate Erosion and Sediment Control Plan sheets will serve as a basis of Grading Permit issuance, preparation of the Project Stormwater Pollution Prevention Plan (SWPPP), as well as construction. Erosion and

Sediment Control Plan sheets shall be prepared and signed by a California Registered Civil Engineer, as specified within the California Professional Engineers Act. Erosion and Sediment Control Plan sheets shall be prepared on standard City sheets (22" x 34") and include the following minimum information:

ESC.1	☐	Provide standard details and notes for construction best management practices; http://www.sacstormwater.org/ConstructionandNewDevelopment/Construction/DrawingsandNotes/DrawingsandNotes.html
ESC.2	☐	Identify potential sources of pollutants, including storage and maintenance areas, and identify corresponding BMPs (i.e. dust control, materials management, etc.)
ESC.3	☐	Specify protection measures for existing vegetation that will remain after project completion; refer to Chapter 4 Section 4 BMP Fact Sheet A-1Vegetation and Tree Protection
ESC.4	☐	Provide wind erosion control measures; refer to Chapter 4 Section 4 BMP Fact Sheet E-2 Dust Control
ESC.5	☐	Provide inlet protection; refer to Chapter 4 Section 4 BMP Fact Sheet D-2 Inlet Protection
ESC.6	☐	Provide erosion control measures for exposed areas (including storage areas); refer to Chapter 4 Section 4 BMP Fact Sheets B-1 to B-7.
ESC.7	☐	Provide perimeter sediment control measures; refer to Chapter 4 Section 4 BMP Fact Sheets C-1 to C-7.
ESC.8	☐	Provide stabilized construction entrance(s)/exit(s); refer to Chapter 4 Section 4 BMP Fact Sheet C-7 Stabilized Construction Entrance/Exit
ESC.9	☐	Provide management of all run-on and runoff; refer to Chapter 4 Section 4 BMP Fact Sheets D-1 to D-3.
ESC.10	☐	Specify general housekeeping BMPs; refer to Chapter 4 Section 4 BMP Fact Sheets E-1 to E-11.
ESC.11	☐	Specify final stabilization measures
ESC.12	☐	Specify locations of proposed Post-Construction BMPs and temporary measures necessary to protect them during construction

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Chapter 3: General Design Standards for Grading and Drainage

SECTION 1: EXCAVATIONS

A: General

Excavations shall be conducted and protected so that they do not endanger life or property.

B: Mass Grading

The terrain in the City of Sacramento is generally flat, therefore grading is required to insure proper vertical alignment of building sites to streets and to provide for proper drainage. Grading should be at a scale consistent with the physical characteristics of the site being considered. It is the intent of this provision that all grading shall reflect, to the greatest extent possible, the natural gradient and contours of the site. Grading shall be designed to minimize the appearance of extensive, artificial banks or terraces which may be visible from public streets or other public views. Grading shall also be designed and constructed in such a manner that it does not adversely impact adjacent properties. Grading shall accommodate natural flows from adjacent properties (i.e. shall not impede existing flows, natural ditches, floodways, etc,).

C: Cut Slopes

The slope of cut surfaces of permanent excavations shall not be steeper than two horizontal to one vertical exclusive of terraces and exclusive of roundings described herein. Steeper slopes will be permitted in competent bedrock provided such slope inclinations are in accordance with recommendations contained in a geotechnical or geological report. The bedding planes or principal joint sets in any formation when dipping towards the cut face shall not be daylighted by the cut slope unless the soils and geologic investigations contain recommendations for steeper cut slopes. Cut slopes shall be rounded into the existing terrain to produce a contoured transition from cut face to natural ground.

SECTION 2: FILLS

A: Placement

Fills shall be constructed in layers. The loose thickness of each layer of fill material before compaction shall not exceed eight inches. Completed fills shall be stable masses of well integrated material bonded to adjacent materials and to the materials on which they rest. Fills shall be competent to support anticipated loads and be stable at the design slopes shown on the plans. Proper drainage and other appropriate measures shall be taken to ensure the continuing integrity of fills. Earth materials shall be used which have no more than minor amounts of organic substances and have no rock or similar irreducible material with a maximum dimension greater than twelve (12) inches.

B: Compaction

All fills shall be compacted throughout their full extent to a minimum of 90 percent of maximum density as determined by appropriate City standard method or other alternate methods approved by the Director. Tests to determine the density of compacted fills shall be made on the basis of not less than one test for each two- foot vertical lift of the fill but not less than one test for each 1000 cubic yards of material placed. Additional density tests at a point approximately one-foot below the fill slope surface shall be reasonably uniformly distributed within the fill or fill slope surface. Results of such testing and location of tests shall be presented in the periodic and final reports. Compaction may be less than 90 percent of maximum density, as determined by the above test, within six inches of the slop surface when such surface material is placed and compacted by a method acceptable to the Director for the planting of the slopes. Compaction of temporary storage fills, to be used for a period of not greater than six months, shall not be required, except where the Director determines that compaction is necessary as a safety measure to aid in preventing saturation, sliding, or erosion of the fill.

C: Ground Preparation for Fill Placement

The natural ground surface shall be prepared to receive fill by removing vegetation, non-complying fill, top soil, and other unsuitable material, and where slopes are five horizontal to one vertical or steeper, by benching into competent material in a manner acceptable to the Director. The keyway under the toe, if specified, shall be at least ten feet wide, unless specified otherwise by a civil engineer.

D: Slopes

The slope of permanent fills shall not be steeper than two horizontal to one vertical exclusive of terraces and exclusive of roundings described herein, unless a soils report supports a steeper slope, but shall not exceed 1.5 horizontal to 1 vertical. The Director may require that the fill be constructed with an exposed surface flatter than two horizontal to one vertical or may require such other measures as he deems necessary for stability and safety.

E: Adjacent Structures Protection

Footings which may be affected by any excavation shall be under pinned or otherwise protected against settlement and shall be protected against lateral movement. Fills or other surcharge loads shall not be placed adjacent to any building or structure unless such building or structure is capable of withstanding the additional loads caused by such fill or surcharge.

SECTION 3: SETBACKS

A: General

This Section, along with Figure No. 70-1, Uniform Building Code, latest edition, shall be used for establishing setbacks for property boundaries, buildings and structures other than fences and retaining walls.

SECTION 4: DRAINAGE AND TERRACING

A: General

The drainage structure and devices required by this Chapter shall be designed and constructed in accordance with City standards herein and criteria authorized by the Director. They shall not adversely impact drainage to adjacent properties, and shall accommodate existing flows from adjacent properties.

B: Disposal Requirements

All drainage facilities shall be designed to carry surface and subsurface waters to the nearest adequate street, storm drain, natural water course or other juncture, and shall be subject to the approval of the Director.

C: Water Accumulation

All areas shall be graded and drained so that drainage will not cause erosion or endanger the stability of any cut or fill slope or any building or structure.

D: Drainage Protection of Adjoining Property

When surface drainage is discharged onto any adjoining property, it shall be discharged in such a manner that it will not cause erosion or endanger any cut or fill slope or any building or structure.

E: Terrace Drainage

Terraces at least eight feet in width shall be established at not more than 25 feet in height intervals for all cut and fill slopes exceeding 30 feet in height. Where only one terrace is required, it shall be at approximately mid-height. Suitable access shall be provided to permit proper cleaning and maintenance of terraces and terrace drains. Swales or ditches on terraces shall have a minimum depth of one foot, a minimum longitudinal grade of four percent, and a maximum longitudinal grade of twelve percent. Down-drains or drainage outlets shall be provided at approximately 300-foot intervals along the drainage terrace. Down-drains and drainage outlets shall be of approved materials and of adequate capacity to convey the intercepted waters to the point of disposal. If the drainage discharges onto natural ground, adequate erosion protection shall be provided.

F: Subsurface Drainage

Cut and fill slopes shall be provided with surface and/or subsurface drainage as necessary for stability.

SECTION 5: VEHICULAR WAYS

A: Drainage

Vehicular ways shall be graded and drained in such a manner that will not allow erosion or endanger the stability of any adjacent slope. Surface discharge onto adjoining property shall be controlled in such a manner that it does not cause erosion or endanger existing improvements. Bridges and culverts installed in watercourses shall be approved by the Director.

Chapter 4: Best Management Practices for Construction Activity

SECTION 1: INTRODUCTION

A: Requirements and Regulatory Standards for Stormwater Discharge from Construction Activity

Projects within the City of Sacramento are required to adhere to provisions of the NPDES General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (State Water Resource Control Board Order 2009-009-DWQ, or latest reissuance thereof) as applicable, as well as all provisions within the City of Sacramento Municipal Code.

Order 2009-009-DQG (the CGP), applies to "traditional" projects that disturb one (1) acre or greater of land as well as linear utility projects (LUPs). Traditional projects smaller than 1 acre, but part of a larger plan of common development are also required to obtain NPDES coverage under the CGP. Among other requirements, the CGP establishes minimum best management practices (BMPs) for on-site implementation as a function of project risk. Projects that pose the lowest threat to water quality based upon site and receiving water characteristics are considered to have a "Level 1" Risk. Those with the highest threat to water quality are considered to have a "Level 3" Risk. The standards for inspection and monitoring of BMP function and stormwater discharge are also described within the CGP as a function of project type ("traditional" or "LUP") and risk level. For more detailed information relating to CGP standards and applicability, refer to:
www.waterboards.ca.gov/water_issues/programs/stormwater/docs/constpermits/wqo2009_0009_dwq.pdf

The City of Sacramento has ordinance sections within the Municipal Code that may apply at many, if not all, construction sites. In particular there are provisions relating to:

- Control of Garbage, Rubbish, and Waste Matter (Section 15.40.040)
- Control of Dust and Mud (Section 15.40.050)
- Grading, Erosion, and Sediment Control (Chapter 15.88)
- Water Efficient Landscape Requirements (Chapter 15.92)

For more detailed information relating to the applicability of these and other municipal standards within the City of Sacramento, refer to: http://www.qcode.us/codes/sacramento/

In instances where the City of Sacramento Municipal Code conflicts with applicable provisions within the CGP, the more restrictive (conservative relating to the protection of water quality) shall govern BMP implementation. For engineering standards related to the design of permanent storm drainage and water quality measures, refer to the City of Sacramento Design and Procedures Manual, Chapter 11, the Sacramento Partnership Stormwater Quality Design Manual, and the Sacramento City/County Drainage Design Manual (Volume 2) at:

http://www.cityofsacramento.org/utilities/media-room/documents/section11/Section11.pdf

http://www.beriverfriendly.net/newdevelopment/stormwaterqualitydesignmanual/#SWQ_DesignManual

http://www.msa2.saccounty.net/dwr/Pages/DrainageManualVolume2.aspx

B: Soil Erosion and Sedimentation Processes

Soil erosion is the process by which soil particles are dislodged by wind, water, or gravity and are transported from their original location. Sedimentation is the deposition of such dislodged soil particles. Erosion and sedimentation are natural processes that can be significantly accelerated by construction and land development.

Soil erosion due to water can be categorized as splash/raindrop erosion, sheet erosion, rill erosion, gully erosion, and channel erosion. Splash/raindrop erosion is caused by raindrops or other water drops striking exposed soil, detaching the soil particles, and splashing the soil particles into the air and into shallow overland flows. Sheet erosion is the uniform removal of soil in thin layers by overland water flow. Rill erosion is caused by concentrated water running through little streamlets, which result in wider and deeper rills as the soil detachment continues or as flow increases. Gully erosion is an advanced stage of rill erosion that creates gullies that are too wide and too deep to be tilled across. Channel erosion occurs in larger receiving waters as a result of concentrated flow from the tributary drainage area.[1]

Splash/Raindrop Erosion[2]

Sheet Erosion

Rill Erosion

Gully Erosion

Channel Erosion

[1] National Soil Erosion Research Laboratory, http://milford.nserl.purdue.edu/weppdocs/overview/intro.html, accessed January 2, 2013.
[2] Source: http://www.dot.ca.gov

Soil erosion can also be the result of wind forces exerted against the ground surface. The quantity of soil moved is dependent upon the particle size, the cohesiveness of particles, surface soil moisture and the wind velocity.[1] Wind erosion contributes to air pollution in addition to reducing soil fertility.

C: Factors Influencing Soil Erosion and Runoff

Factors Influencing Soil Erosion[3]

Erosion potential is determined by five main factors: soil erodibility, vegetative or other cover, topography, and climate. The factors are interrelated in determining erosion potential.

Soil erodibility is influenced by the soil structure, texture, and percentage of organic matter. Generally, soils with high proportions of silt and very fine sand are highly erodible. Soil erodibility is decreased by the presence of clay or organic matter. As clays are cohesive, they tend to bind soil particles together, and organic matter helps in maintaining stable soil structure.

Vegetative cover protects soil from the erosive forces of raindrop impact and runoff scour in many ways. Vegetation (top growth) provides a shield over the soil surface, protecting it from raindrop impact, while the root mass of vegetation holds soil particles in place. In addition, vegetative cover moderates the effects of freezing/thawing and shrinking/swelling, which are two forces that can cause the detachment of bare soil particles, thus increasing their availability for transport by overland flow. Furthermore, grass buffer strips provide an opportunity for infiltration and may be used to strain sediment from surface runoff. Grasses also aid in slowing the runoff velocity and help maintain a soil's infiltration capacity. During construction, the most important factors in minimizing erosion are the establishment and maintenance of vegetation.

Topography, including slope length and steepness, greatly influences the volume and velocity of surface runoff. Steep slopes increase runoff velocity and higher volumes of runoff to the base of slopes. Both long slopes and steep slopes enhance the potential for erosion to occur. An increase in slope roughness and shorter slopes can decrease the potential for erosion.

Climate includes rainfall characteristics such as frequency, intensity, and duration. Climate directly influences the amount of runoff generated in an area. As the rainfall frequency increases, water has less opportunity to drain through the soil in between storm events. As soil remains saturated for longer periods of time, storm water runoff volume becomes greater. Thus, erosion risks are high where storm events are intense, frequent, or of long duration.

Construction activities influence soil erosion by exposing potentially erodible soils, altering vegetative cover, and changing site topography.

Factors Influencing Runoff[4]

Runoff volume and flow rate are affected by precipitation (both amount and intensity), time parameters (velocity and travel time), watershed area, ground cover, antecedent moisture conditions, storage in the watershed, and soil permeability.

[3] Certified Professional in Erosion and Sediment Control™ Exam Review Study Guide, February 2007.
[4] Certified Professional in Erosion and Sediment Control™ Exam Review Study Guide, February 2007.

Expected precipitation amounts are provided in the Sacramento City/County Drainage Manual, available at: http://www.msa2.saccounty.net/dwr/Pages/DrainageManualVolume2.aspx.

For time parameters, the shape and steepness of the drainage area are key elements in determining the lengths of time for certain flow segments. Given identically sized drainage areas with identical soil and vegetative cover, the shorter the time for runoff to travel through the drainage area, results in a higher peak discharge rate; the longer the time for runoff to travel through the drainage area, results in lower peak discharge rate.

Ground cover, antecedent moisture conditions, and storage in the watershed affect the rate and volume of runoff. Ground cover can decrease runoff velocity and reduce runoff volume by promoting infiltration. For high antecedent moisture conditions, the ground is already saturated and runoff velocity and volume will increase; however, if the ground is dry (low antecedent moisture) then runoff velocity and volume will be comparatively lower.

For soil permeability, soils are classified into four hydrologic soil groups (A, B, C, and D) which indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. Hydrologic soil group A soils have high infiltration rates and low runoff potential. They mainly consist of deep, well to excessively drained sands or gravels and have a rate of water transmission greater than 0.30 inches/hour. Hydrologic soil group B soils have moderate infiltration rates, consist of moderately fine to moderately coarse textures, and have a water transmission rate of 0.15 to 0.30 inches/hour. Hydrologic soil group C soils have a low infiltration rate and mainly consist of soils with a layer that impedes downward movement of water. The texture of these soils is typically moderately fine to fine, and the soils have a low rate of water transmission at 0.05 to 0.15 inches/hour. Hydrologic soil group D soils have a high runoff potential and very low infiltration rates. These soils typically consist of clay soils with high swelling potential, soils with a high permanent water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. The soils have an extremely low rate of water transmission at 0 to 0.05 inches/hour.

Construction activities influence runoff by exposing potentially erodible soils, altering ground cover, changing topography, and increasing impervious surfaces, thereby resulting in increased flow rates and increased volumes of surface water runoff.

Characteristics of the City of Sacramento Pertinent to Erosion and Sediment Control

The City of Sacramento has a mild climate with sunshine nearly year-round. The majority of the precipitation occurs between November and February with measurable precipitation occurring about ten days per month during this period.

The prevailing wind is southerly, but heat waves in the summer are usually followed within a few days by cool southwest delta breezes. Thunderstorms are infrequent and typically occur in late fall or spring. Snow is extremely rare and is limited to small amounts when it does occur. Dense fog is most common in the winter and can last for several days at a time.

The 10-year, 24-hour storm event for the City of Sacramento has been estimated by National Weather Service at approximately 2.98 inches. This storm depth is significant because it coincides with the typical minimum BMP design event (see Chapter 4 Section 4 BMP Fact Sheets for additional detail about

specific BMPs). All BMPs should comply with Section 11 of the City of Sacramento Design and Procedures Manual.

http://www.cityofsacramento.org/utilities/media-room/documents/section11/Section11.pdf

Soils within the City of Sacramento are generally moderate to highly erodible. Typical K Factors, indicating soil erodibility, range from 0.3 to 0.45. The soil erodibility factor (K), is defined as the erosion rate in tons per acre per unit of an index from a standard plot.

In order to properly select and size BMPs, project-specific soils information should be evaluated. The project soils report should address erodibility, hydrologic soil group, long-term infiltration rate, depth to groundwater, and any other pertinent information needed to appropriately select and size project BMPs.

For more information regarding general and localized topographic, climatic, soils, and precipitation refer to:

http://www.wrh.noaa.gov/sto/CLISAC2010.pdf

http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca

http://soildatamart.nrcs.usda.gov/Manuscripts/CA067/0/sacramento.pdf

http://www.msa2.saccounty.net/dwr/Soil%20Type%20Maps/map08.pdf

D: Pollutant Sources Associated with Construction Activities

Construction activities have many pollutant sources that could contaminate storm water runoff. Potential sources of sediment from construction activities include clearing and grubbing operations, grading operations, exposed soils and slopes, import/export operations, utility excavation operations, and landscaping operations.

In addition to sediment, construction activities can also result in other pollutants and indicators as shown in the table below.

Source	Pollutant(s) or Indicators
Clearing and Grubbing	Organics, sediments
Street Construction, Street Improvements, Street Demolition, other asphalt-related activities	Hydrocarbons
Curb & Gutter, Sidewalks, Foundations, Driveways, Medians, Stuccoing, Grouting, Washouts/Clean Up, other concrete-related activities	pH
Framing, Cabinet Building/Installing	Sawdust
Painting	Paint (when wet)
Dry Walling	Gypsum/Joint Compound
Tiling	Ceramic dust
Plumbing	PVC Glue (when wet) / Plastic
Wiring/Installation of Electrical Utilities	Copper / Plastics / Metals
Installation of Heating/Air Conditioning Systems	Sheet Metal / Fiberglass Wool

Source	Pollutant(s) or Indicators
Landscaping	Containers / Mulch / Soil / Pesticides / Fertilizers
Diesel Fuel	Petroleum distillates, naphthalene, xylene
Gasoline	Benzene, toluene, xylene, MTBE
Hydraulic Oil, Transmission Oil	Mineral oil, trace additives
Engine Oil	Mineral oil, additives, combustion byproducts
Engine Coolant	Ethylene and propylene glycol, heavy metals
Grease, Kerosene	Petroleum hydrocarbons
Fertilizer	Nitrogen, phosphorus
Pesticide	Water-insoluble chlorinated hydrocarbons, organophosphates, carbonates, and pyrethrums.
Herbicide	Chlorinated hydrocarbons, organophosphates
Concrete (wet)	Fly cash, heavy metals, Portland cement
Concrete coring slurry, Concrete sawing slurry	Turbidity and pH
Cement	Aluminum calcium iron oxide, calcium sulfate
Drywall joint compound	Pigment, vinyl acetate
Grout	Silica sand, Portland cement
Paint	Ethylene glycol, titanium oxide, VOC
Sealers	Diacetone alcohol,
Sanitary waste	Human waste, Animal waste
Asphalt	Asphalt fumes, cutback asphalt,
Curing Compounds	Glass Oxide, urea extended phenol
Cleaning Solvents	Perchloroethylene, methylene chloride, TCE
Sediment	Soil, Turbidity, dust
Vegetation	Organic matter
Solid Waste	Floatable and blowable trash and debris

E: Impacts to Water Quality

Erosion and sedimentation can have detrimental impacts to water quality. Erosion increases turbidity of stormwater runoff due to the increase in concentration of suspended solids and, therefore, increases the turbidity of receiving waters. Turbidity refers to the optical property of liquids that measures the absorption and/or scattering of light as a result of material suspended in the liquid solution (i.e., how clear the water is).[5] Increased turbidity results in cloudy water. Low turbidity produces clear water.

An increase in turbidity results in higher costs for water treatment and affects aquatic biota by reducing photosynthetic activity. Increased turbidity can modify light penetration and smother benthic habitats (impacting both eggs and organisms). An increase in suspended solids may damage water supplies and

[5] National Estuarine Research Reserve System, Turbidity and Sedimentation, http://www.nerrs.noaa.gov/doc/siteprofile/acebasin/html/modules/watqual/wmtursed.htm, accessed January 2, 2013.

will affect nesting and feeding habits of creatures in the receiving waters. When light penetration is significantly reduced, macrophyte growth decreases, in turn impacting the organisms that are dependent upon them for food and cover.[6,7]

An increase in sedimentation can cause shallow lakes, bays, or other receiving waters to fill in faster than under natural conditions, reducing their storage volume and potentially causing flood damage. In addition, the deposition of sediments in a channel's stream bottom lowers the survival of fish eggs, damages bottom organisms, destroys aquatic plants, and fills spaces between rocks that could have been used as habitat by aquatic organisms. Increased sedimentation reduces the oxygen available in the water, deteriorates the health of aquatic organisms, and endangers the survival of aquatic organisms.[8,9]

Sedimentation also provides a transport mechanism for particulates bound to the soil particles, including metals, and nutrients. Deposition of metals and nutrients in receiving waters can also impact the aquatic organisms and vegetation as well as aesthetics of the receiving water. Increases in phosphates and other nutrients can cause eutrophication of receiving waters, thus promoting excessive algae growth.[10] Deposition of metals can contribute to both acute and chronic metal toxicity to creatures in the receiving waters.[11]

Nutrients can accelerate the growth of algae and other vegetation which may impair water bodies. Some nutrients can also be toxic to fish. High levels of bacteria and viruses can contaminate stormwater and cause closures of lakes and rivers. Metals, oil, and grease can all be toxic to some organisms, even at low concentrations. Organics found in some cleaners and solvents can harm aquatic life. Pesticides can be toxic to aquatic life. Trash and debris will often harbor pollutants like bacteria, and their presence violates Basin Plan standards. There are a variety of other pollutants that can also adversely impact water quality, as shown within the table in Section 1.D of this chapter. Among others, these include cement, paint, automotive fluids, and fertilizers.

SECTION 2: Tools for Erosion and Runoff Evaluation

A: Erosion Prediction (RUSLE)

The Revised Universal Soil Loss Equation (RUSLE) is a widely utilized tool to estimate the average soil loss in tons per acre per year. Estimated soil loss is determined based on erosivity, soil erodibility, slope length, slope steepness, cover management, and a support practice factor.

[6] Water on the Web – Turbidity, http://www.wateronthewеb.org/under/waterquality/turbidity.html, accessed January 2, 2013.
[7] United States Geological Service – Toxic Substances Hydrology Program, http://toxics.usgs.gov/definitions/eutrophication.html, accessed January 2, 2013.
[8] Water on the Web – Turbidity, http://www.wateronthewеb.org/under/waterquality/turbidity.html, accessed January 2, 2013.
[9] United States Geological Service – Toxic Substances Hydrology Program, http://toxics.usgs.gov/definitions/eutrophication.html, accessed January 2, 2013.
[10] United States Geological Service – Toxic Substances Hydrology Program, http://toxics.usgs.gov/definitions/eutrophication.html, accessed January 2, 2013.
[11] North Carolina Department of Environment and Natural Resources, Water Quality Committee - Overview of Metal Toxicity and Aquatic Life Standards Development, January 2010.

A = R*K*LS*C*P

Where

A = estimated average soil loss in tons per acre per year

R = rainfall-runoff erosivity factor

K = soil erodibility factor

LS = slope length/steepness factor

C = cover-management factor

P = support practice factor

R Factor – The average annual erosivity factor is a summation of erosivity values from individual events. The individual events are calculated as a product of the storm's total energy and the storm's maximum 30-minute intensity.

K Factor – The inherent erodibility of a particular soil; a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff

LS Factor – The slope length and steepness factors are typically calculated together as one variable. It is determined based on the general length and gradient of the ground surface. The factor increases as length or gradient increases.

C Factor – The cover management factor accounts for the effects of soil cover (erosion control). Typically it is assumed to be 1.0 for bare ground condition.

P Factor – Support practices are measures that redirect runoff or reduce its transport capacity (sediment control). Typically it is assumed to be 1.0 for bare ground condition.

B: Runoff Calculations

Construction BMPs should be designed to effectively convey and store (where appropriate) the peak rate and volume associated with the 10-year, 24-hour duration storm. The "Sacramento Method" shall be used for peak flow rate and flow volume determination. The Rational Method can be used to estimate peak flow rate and flow volume for drainage areas less than 100 acres. For drainage areas less than 640 acres, the standard "Sacramento Charts" can also be used to estimate unitized peak flow per acre as a function of percent impervious. All other scenarios require the use of the "Sacramento Method" (HEC1 in conjunction with the SACPRE loss rate pre-processor) to develop BMP peak flow design rates and design volumes associated with the 10-year, 24-hour event. For more information, refer to:

http://www.cityofsacramento.org/utilities/media-room/documents/section11/Section11.pdf

http://www.msa2.saccounty.net/dwr/Pages/DrainageManualVolume2.aspx

SECTION 3: Minimum Site BMP Requirements

A: Site Planning and Management

Effective site planning and management can reduce erosion, prevent sedimentation, and provide for good housekeeping on the site. Site planning and management consists of implementing all applicable best management practices (BMPs) in Section 4.A.

B: Erosion Control

The heart of erosion control is soil stabilization. Soil stabilization is the component that, when combined with runoff management, is the site management practice that limits or controls erosion. Every effort should be made to keep soil in place and limit soil mobilization within the project area, such that the need for sediment control is minimized. In selecting proper erosion control BMPs, it is important to consider soil erodibility, vegetative cover, topography, climate, and season. Erosion control consists of implementing one or more of the BMPs in Section 4.B. Effective soil cover should be provided for all finished slopes, open space, utility backfill, and completed lots as well as any areas that are to remain inactive for at least 14 days. All projects should include effective wind erosion control.

C: Sediment Control

Although every effort may be made to manage runoff and stabilize soils to prevent erosion, it is inevitable that site work will generate sediment. Good sediment control will minimize the amount of sediment that is washed from a site. Sediment controls should be placed as close to the source of sediment as possible. At a minimum, sediment control measures should include a stabilized construction entrance (BMP Fact Sheet C-7), inlet controls (BMP Fact Sheets C-3, C-5, and D-2) and effective perimeter controls. A list of Sediment Control BMPs is provided in Section 4.C.

D: Runoff Controls

Runoff controls are the final effort at a construction site to prevent sediment and excess runoff volume from leaving the site. They use detention to control the peak discharge flow rate and volume. Controlling the rate, quantity, and manner of runoff can reduce the overall amount of erosion occurring downstream of the control. The reduction in erosion will consequently reduce the required size and maintenance frequency for any downstream sediment control BMPs. Additional BMPs are to be installed as appropriate. Section 4.D provides a list of runoff control BMPs. In many cases, runoff controls will also serve as permanent water quality treatment BMPs. In such cases, precautions should be taken during construction so that the long-term function of the facility is not adversely impacted by its use as a runoff control during construction.

E: Good Housekeeping/Material Management

Good housekeeping and material management practices are simply keeping the construction site, including staging areas and stockpiles, in an orderly manner that prevents stormwater precipitation and surface runoff from contacting any construction materials or equipment to the maximum extent practicable. Good housekeeping and material management consists of implementing the applicable BMPs

in Section 4.E. These measures are useful for all types of projects, even those that are exempt from Grading Permit requirements.

F: Final Stabilization

Final stabilization is achieved once the site does not pose any additional sediment discharge risk compared to the pre-construction condition. The following methods can be used to demonstrate that final stabilization has been achieved:

- Provide photos demonstrating that 70% uniform cover has been achieved compared to the pre-construction cover.
- Provide RUSLE or RUSLE2 calculations demonstrating that the estimated soil loss is less than or equal to the pre-construction condition.
- Demonstrate through other means that final stabilization has occurred.

SECTION 4: BEST MANAGEMENT PRACTICES FACT SHEETS

The following pages are fact sheets for select Best Management Practices (BMPs). Each fact sheet includes a description and purpose of the BMP, suitable applications, limitations, implementation considerations, and information on inspections, maintenance, and the anticipated lifespan of the BMP during construction. References for the information in the fact sheets are provided at the end of each fact sheet.

A: Site Planning and Management

A-1: Vegetation and Tree Protection

A-2: Scheduling & Sequencing

B: Erosion Control

B-1: Hydroseed

B-2: Mulching

B-3: Drill Seeding

B-4: Grassy Swales and Buffers

B-5: Rolled Erosion Control Products

B-6: Soil Binders

B-7: Soil Preparation, Roughening

C: Sediment Control

C-1: Silt Fence

C-2: Check Dams

C-3: Sediment Traps

C-4: Sediment Basins

C-5: Fiber Rolls and Compost Socks

C-6: Skimmers

C-7: Stabilized Construction Entrance/Exit

D: Runoff Controls

D-1: Diversions

D-2: Inlet Protection

D-3: Outlet Velocity Protection

E: Good Housekeeping/Material Management

E-1: Concrete Washout Area

E-2: Dust Control

E-3: Materials Management

E-4: Equipment Maintenance, Fueling, and Cleaning

E-5: Sanitary Waste Management

E-6: Spill Prevention and Containment

E-7: Stockpile Management

E-8: Street Sweeping

E-9: Trash Containment

E-10: Concrete Curing and Finishing

E-11: Paving and Pavement Grinding/Cutting

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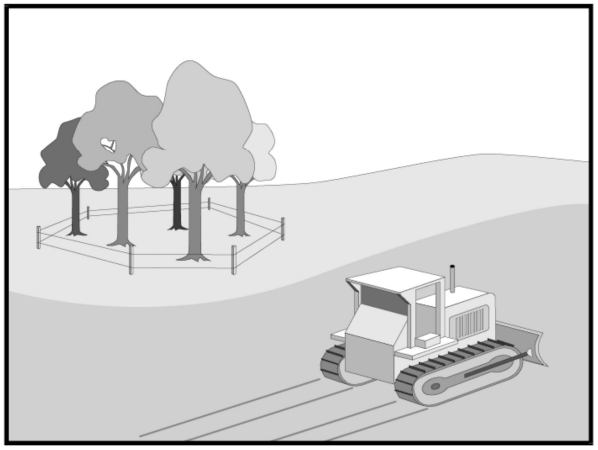
A: SITE PLANNING AND MANAGEMENT

VEGETATION AND TREE PROTECTION A-1



OBJECTIVES

- ✓ Site Planning and Management
- ✓ Erosion Control
- ✓ Sediment Control
- ✓ Runoff Control

Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- ✓ Nutrients

Trash

Metals

Bacteria

Oil and Grease

- ✓ Organics

DESCRIPTION AND PURPOSE

Vegetation and tree protection can minimize the potential of inadvertent removal of or injury to existing trees, shrubs, and grasses during construction. The root systems and ground cover of many species of vegetation and trees have naturally effective runoff reducing properties and soil binding characteristics that assist with erosion prevention and runoff volume reduction.

APPLICATIONS

- Larger projects with multi-phased grading. Refer also to Fact Sheet A-2 Scheduling and Sequencing.
- Areas where the natural vegetation is designated for preservation, such as steep slopes, vernal pools, wetlands and watercourses, etc. Such protected areas are typically designated on the construction plans or are included in the specifications, permits, or environmental documents.
- Critically erodible areas.

LIMITATIONS

- Vegetation and tree protection requires advance planning by the owner, developer, contractor, and design team.
- Vegetation and tree protection may not be possible if project plans do not incorporate existing vegetation into the design of the site.

- Vegetation and tree protection may be difficult and expensive on sites where the project grading significantly diverges from the existing topography.
- Construction fencing to delineate areas for vegetation and tree protection does not provide any erosion or sediment control other than protecting existing vegetation cover.

IMPLEMENTATION CONSIDERATIONS

Site planning and management should include site design and construction phasing to preserve vegetation and protect trees as much as possible. The following implementation measures should be considered:

Orange fencing can be used to separate and protect vegetation from construction areas.

- Several materials may be used to delineate the areas for vegetation and tree protection. The most common and visible material is orange plastic construction fencing. Other options include chain link or stock wire.
- Prior to clearing and grubbing operations or other soil disturbing activities, clearly mark a buffer area around the vegetation and trees to be preserved, such that the vegetation and trees are protected from mechanical or other injury during construction.
    - The buffer area should include sufficient setback to protect roots – confirm with a landscape architect if a dimension is not shown on the plans.
    - At a minimum, the buffer area should prevent construction activity and storage of equipment or materials from occurring within the drip lines of trees.
    - Buffer areas must be well-identified by using fencing that is appropriately installed to maintain the fence in an upright position.
- Consider the impact of grade changes to the existing vegetation and trees and corresponding root zone(s). Do not concentrate runoff into vegetation or eliminate sheet flow to an area that will make the vegetation unsustainable.
- Maintain existing irrigation systems when possible. Temporary irrigation may be necessary if existing irrigation is terminated for construction.
- In the vicinity of major trees, hand-digging may be necessary to prevent root cutting and mangling that may be caused by heavy equipment.

- Plan to trench as far from tree trunks as possible, typically outside of the drip line or canopy. Use curved trenches around trees to avoid large roots or concentrations of roots.
- Consider tunneling under large roots or concentrations of roots. Place tunnels at least 18 inches below ground surface, and do not tunnel below the tree center. Consult with a landscape architect if working in the vicinity of trees.
- Should grading occur beneath drip lines of trees to be preserved, the following procedures should be followed:
    - Major roots (two inches or greater in diameter) of existing trees to be preserved, if encountered during the course of excavation, shall not be cut and shall be kept moist and covered with earth as soon as possible.
    - Minor roots (less than two inches in diameter) of existing trees to be preserved, if encountered during the course of excavation, shall be trimmed, treated with pruning compound, and covered with earth as soon as possible.
- Locate temporary roadways, layout areas, and stockpiles such that they avoid existing trees, shrubs, and grass that are to be preserved.
- Prohibit heavy equipment and vehicular traffic within the protected area.
- Educate employees and subcontractors on the importance of preserving existing vegetation and protecting trees.
- Describe maintenance of existing vegetation and trees in the landscaping plan or other appropriate location in the construction plans and specifications.
- Whenever possible, consult with a qualified landscape architect or arborist prior to construction to identify the need for special measures.

INSPECTIONS

- During construction, the protected areas should remain clearly marked at all times.
- Inspect protected areas monthly to verify the vegetation and trees are not disturbed and that delineation fences are in good repair.

MAINTENANCE

- Immediately restore damaged protection measures.
- Engage an arborist to attend to serious tree injuries.
- Immediately repair damage to the crown, trunk, or root system of an existing tree to be preserved.

- Cover exposed roots with soil as soon as possible. If soil covering is not practical, cover exposed roots with wet burlap or peat moss to maintain root moisture until soil can be applied.
- Remove the ends of damaged roots cleanly with a smooth cut.
- Retain protective measures until all construction activity is complete, including site cleanup and stabilization.
- When filling trenches and tunnels, carefully fill and tamp the soil to eliminate air spaces in the soil that could damage roots.
- To aerate any soil that is compacted over a tree root zone, punch holes 12 inches deep with an iron bar, moving the bar back and forth until the soil is loosened.
- Should bark damage occur, cut back all loosened bark into the undamaged area such that the cut is tapered at the top and bottom and drainage is provided at the base of the wood. Cutting the undamaged area should be limited as much as possible.
- Fertilize existing trees as follows:
    - Stressed or damaged broadleaf trees should be fertilized to aid recovery.
    - Trees should be fertilized in late fall or early spring.
    - Fertilizer should be applied to the soil over the feeder roots in accordance with fertilizer label instructions.
    - Fertilizer should never be applied closer than three feet to the tree trunk.
    - For conifers that have extended root systems, the fertilized area should be increased by one-fourth of the crown area.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

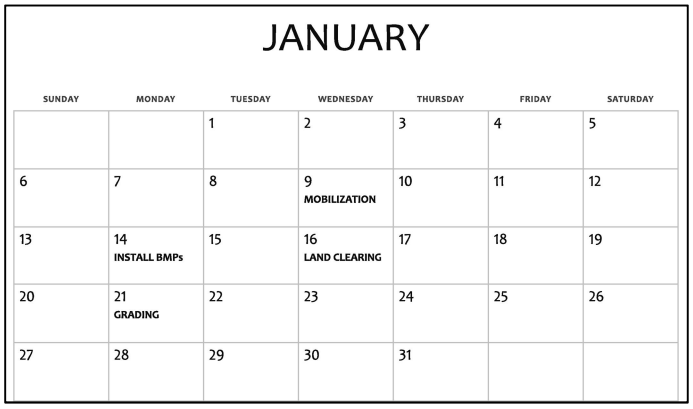
Barrier fence(s) may need replacement during the construction project if damaged or exposed to adverse environmental conditions. The anticipated lifespan of the barrier fence(s) will vary depending on the material and quality of fence used, however if properly constructed and maintained, is expected to last for the duration of most construction projects.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Sacramento County Code, Title 19, Chapter 19.12, Tree Preservation and Protection (http://qcode.us/codes/sacramentocounty, accessed December 18, 2012).

- State Water Resource Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit page 1: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit page 2: RBF Consulting

SCHEDULING & SEQUENCING A-2



OBJECTIVES

- ✓ Site Planning and Management
- ✓ Erosion Control
- ✓ Sediment Control
- ✓ Runoff Control

Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- ✓ Nutrients

Trash

Metals

Bacteria

Oil and Grease

Organics

DESCRIPTION AND PURPOSE

Scheduling and sequencing of construction activities includes the development of a written plan for implementation of Best Management Practices (BMPs) while taking into consideration local climate conditions (rainfall, wind, etc.). The purpose of scheduling and sequencing is to use planning to reduce the amount and duration of soil being exposed to erosion and subsequent transport by wind, runoff, or vehicle tracking.

APPLICATIONS

Scheduling and sequencing is appropriate for all projects, with particular focus on the staging of work through the rainy season.

LIMITATIONS

- Scheduling and sequencing may be constrained by the requirement of pre-construction surveys for sensitive plant or wildlife species (e.g., Swainson's hawk, vernal pool species, burrowing owls, American badger, etc.). Construction delays may also result from discovery of unknown hazardous materials, groundwater contamination, archaeological resources, historic resources, human remains, or inclement weather. Depending on the nature and extent of these discoveries or unanticipated events, construction delays could result for a period of time lasting from days to weeks.

IMPLEMENTATION CONSIDERATIONS

- Prior to the beginning of construction, the general contractor is responsible for including a phasing plan for construction activities in the Storm Water Pollution Prevention Plan (SWPPP) or

Erosion and Sediment Control Plan, as appropriate. This phasing plan becomes part of and is maintained with the SWPPP or Erosion and Sediment Control Plan. If there is any change in the operations schedule, the SWPPP or Erosion and Sediment Control Plan must be updated.

- Record open and closing dates of phases in the pollution prevention plan documents.
- Develop a schedule showing each major phase of construction and how the rainy season relates to each. The major phases of construction that should be identified (as applicable) are:
    - Clearing, Grubbing, and Remedial Grading
    - Rough Grading
    - Street and Utility Work
    - Vertical Construction
    - Landscaping and Final Stabilization
    - Inactive
- Sequence trenching activities such that as many as possible open portions are closed before new trenching commences.
- Include in the schedule staged seeding and re-vegetation of graded slopes as work progresses. Scheduling of seeding or vegetation should consider the need and availability of a reliable water source. Areas that are inactive for 14 days or more need soil cover.
- Include in the schedule details on the implementation and deployment of all construction BMPs. Redeployment of BMPs with a known limit in life span should be considered as appropriate based upon the duration of construction.
- Schedule permanent vegetation establishment during the appropriate planting time for the specified vegetation. The optimum planting time is typically October 15 through April 15. Scheduling of permanent vegetation should consider the need and availability of a reliable water source.
- Include in the schedule dates for activities that may require non-stormwater discharges (e.g., trench or foundation dewatering, grinding, drilling, sawcutting, boring, crushing, blasting, painting, mortar mixing, pavement cleaning, etc.). Non-stormwater discharges may require a separate permit from the Central Valley Regional Water Quality Control Board.
- When practical, schedule major grading operations during expected dry months, allowing enough time before rainfall begins for the soil to become stabilized with vegetation or other means or for sediment trapping devices to be installed.
- Plan for non-active areas to be stabilized as soon as practical after the stoppage of soil-disturbing activities, or, at a minimum, 24 hours prior to the anticipated onset of a predicted precipitation of 50% probability or greater. In all instances, inactive areas should be stabilized within 14 days.

- Monitor the weather forecast for anticipated precipitation. Precipitation of 50% probability or greater should initiate creation and implementation of a Rain Event Action Plan (REAP) which is appropriate for the current phase of work and site condition for Risk Level 2 and 3 projects.
- Be prepared year round to implement erosion and sediment control BMPs as erosion may be caused by un-seasonal rainfall, wind, and vehicle tracking. The can be done most effectively by maintaining an adequate supply of BMP materials on site in a suitable storage area.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect site BMPs before storm events, daily during storm events, and after storm events. Projects shall also conduct quarterly inspections for the presence of non-storm water discharges.
- In general, linear utility projects shall inspect site BMPs daily.

MAINTENANCE

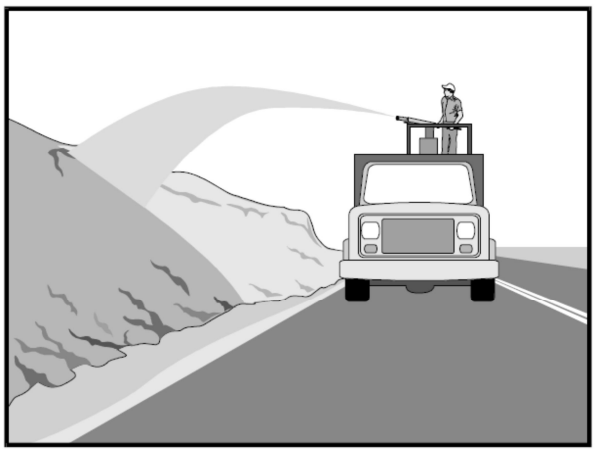
- Adjust the construction activities when rainfall is predicted, to allow for the implementation of soil stabilization, erosion prevention, and sediment treatment controls for all disturbed areas prior to the onset of precipitation.
- Update the schedule to reflect the current status and progress at the site.
- Amend the construction activities, or modify the BMPs as warranted, taking corrective actions if BMPs that have been deployed are not observed to be effective.
- Amend the construction activities before the rainy season to include updated information on the implementation of construction site BMPs based upon current site conditions.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- City of Sacramento Master Environmental Impact Report, Certified March 3, 2009.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.

B: EROSION CONTROL

HYDROSEED/HYDROMULCH B-1



OBJECTIVES

- Site Planning and Management
- ✓ Erosion Control
- Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Hydroseed/hydromulch is used in the mechanical application of a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion, such as acrylic copolymer, guar, or psyllium. Hydromulch is also inclusive of bonded fiber matrices (BFMs). Bonded fiber matrices are a system of fibers and adhesives that dry to form an erosion resistant blanket that also promotes vegetation, and BFMs are typically more durable than wood fiber mulches. Typically, a dye (usually green) is included in the mulch mixture to assist in showing where the material has been applied. Although not as effective as other planting methods (seed drills), hydroseed is an economical means of applying seed and fertilizer. The purpose of hydroseed/hydromulch is to protect exposed soils from erosion by wind and water. Depending on design intent, hydroseed/hydromulch mixtures can act as a temporary or permanent measure. Hydroseed must germinate and provide vegetation cover to be effective for erosion control. Hydromulch is used as a cover for hydroseed to temporarily protect the seeds and seed bed until germination occurs.

APPLICATIONS

- Areas of disturbed soil requiring temporary protection until permanent stabilization is achieved.
- Stockpiles, flat roadside slopes, and inaccessible slopes.
- Flat terrain where there will be very limited sheet flows.
- Areas in which the use of wood chips, bark, "green" mulch, soil binders, or rolled erosion control products is not feasible or practical.
- Slopes that have exposed soil between existing vegetation, such as shrubs or trees.
- Slopes planted with live, container-grown vegetation or plugs.

- Slopes that have been burned by wildfire.
- Inactive areas as necessary to effectively prevent discharge of sediment laden runoff to receiving waters that generally will not be re-disturbed for an extended period of time, or are permanent.
- Other active or inactive areas as necessary to effectively prevent discharge of sediment laden runoff to receiving waters.

LIMITATIONS

- Most hydroseed/hydromulch is not appropriate for slopes greater than 4:1 or 5:1 (H:V) (except BFM).
- Hydroseed/hydromulch usually requires application 24 hours prior to rain to be effective.
- Hydroseed/hydromulch may only be used alone if given adequate time to ensure sufficient vegetation establishment and coverage prior to the onset of rain.
- Hydroseed/hydromulch may require multiple applications to remain effective for an entire rainy season.
- Hydroseed/hydromulch should not be applied to surface waters.
- Hydroseed/hydromulch is not appropriate for areas exposed to concentrated flows.
- Hydroseed may not be appropriate during dry periods without irrigation or other temporary water source.
- Temporary vegetation produced by hydroseed may have to be removed prior to planting of permanent vegetation, or when additional earthwork is required.
- Hydroseed/hydromulch is not appropriate for areas of short-term inactivity.
- Hydroseed/hydromulch is not appropriate for application on non-cohesive soils.
- Hydroseed/hydromulch shall not be applied during high wind or very dry conditions.
- Treatment areas must be accessible by hydroseed/hydromulch equipment.
- Water sources for mixing and application may be limited in remote areas.
- Hydroseed/hydromulch consists of a mixture of several constituents, some of which might by proprietary and come pre-mixed by the manufacturer. The water quality impacts of these mixtures are relatively unknown, and some may have water quality impacts due to their chemical composition. Refer to the Material Safety Data Sheet (MSDS) for specific chemical properties. Hydroseed/hydromulch products should be evaluated for project-specific implementation by the Storm Water Pollution Prevention Plan (SWPPP) Preparer.

IMPLEMENTATION CONSIDERATIONS

- To select the appropriate hydroseed/hydromulch mixture, an evaluation of site conditions is necessary to determine soil conditions, site topography, climate, sensitive adjacent areas, vegetation types, water availability, and plans for permanent vegetation.
- When applying a hydroseed/hydromulch mix, follow the manufacturer's specifications for soil preparation, mixing ratios, coverage areas, application rates, implementation procedures, and equipment cleanup.
- Prior to hydroseed/hydromulch application, soil preparation may include roughening the soil surface by rolling with a crimping or punching type roller to create furrows along the slope contours. Track walking may be used to roughen fill areas and embankments if rolling is impractical. Pre-wetting the treatment area may also be required.
- Apply hydroseed/hydromulch at least 24 hours prior to anticipated rainfall so that the product has sufficient time to dry.
- Apply hydromulch/hydroseed from multiple directions in order to adequately cover the soil; application from a single direction may result in uneven coverage, shadowing, and ultimate failure of the BMP.
- Only apply hydroseed to areas where vegetation is planned for ultimate stabilization. Do not apply hydroseed to areas where the BMP would have to be removed or where the BMP would be incompatible with future earthwork activities.
- Hydroseed/hydromulch should be applied in a two-step process. First, the seed and fertilizer should be applied. Second, cellulose fiber mulch should be applied. With the two-step application process, the amount of water is doubled, which has been demonstrated to aid in germination and establishment. In this two-step process, mulch shall be applied within 24 hours of seed application.
- When applying hydroseed/hydromulch, avoid over spray onto sidewalks, drainage channels, roads, existing vegetation, and other areas.
- In non-windy areas, to keep seeds in place and moderate soil moisture and temperature until the seeds germinate and grow, apply straw mulch to the area that is hydroseeded.
- All seeds in the hydroseed mixture shall be in conformance with the California State Seed Law of the Department of Food and Agriculture (http://www.cdfa.ca.gov/plant/pe/nursery/pdfs/SeedLaw_2011.pdf). Each seed bag shall be clearly marked as to species, purity, percent germination, dealer's guarantee, dates of testing, and amount of Pure Live Seed (PLS). Each seed bag shall be delivered to the site sealed.
- Fertilize as necessary and in compliance with the requirements of the California Food and Agricultural Code. Fertilizer shall be in granular or pelleted form.

- Material Selection: Hydromulch
  - Standard Hydraulic Mulch (SHM)
    - Manufactured containing approximately 5% tackifier (i.e., soil binder), which is usually a plant-derived guar or psyllium type.
    - Generally applied at a rate of 2,000 pounds per acre.
  - Hydraulic Matrices (HM) and Stabilized Fiber Matrices (SFM)
    - Slurries that contain usually 10% or more by weight of tackifiers or soil binders.
    - Generally applied at a rate of 2,500 to 4,000 pounds per acre.
    - Can include a mixture of fibers (e.g., a 50/50 blend of paper and wood fiber).
    - For SFM, the tackifier/soil binder is specified as a polyacrylamide (PAM).
  - Bonded Fiber Matrices (BFM)
    - Hydraulically applied system of fibers, adhesives (usually guar based), and chemical cross-links.
    - The cross-linked adhesive should be biodegradable and should not disperse or dissolve upon re-wetting.
    - Can be used on steep slopes up to 2:1 (H:V).
    - Should be applied typically at a rate of 3,000 to 4,000 pounds per acre based on the manufacturer's specifications.
  - Mechanically Bonded Fiber Matrices (MBFM)
    - Hydraulically applied systems similar to BFM.
    - Use crimped synthetic fibers and polyacrylamide (PAM).
    - Typically applied at a higher application rate than a standard BFM.
  - Hydraulic Compost Matrix (HCM)
    - A field-derived practice whereby finely graded or sifted compost is introduced into the hydraulic mulch slurry.
    - For steeper slope applications, a guar-type tackifier can be added.
    - Specified seed mixtures may also be added.
    - HCM may help accelerate seed germination and growth.
    - Particularly useful as an in-fill for three-dimensional re-vegetation geocomposites, such as turf reinforcement mats.
- Material Selection: Hydroseed
  - Consists of a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion.

- May also include mycorrhizal inoculum. Mycorrhizae consist of fungi that inhabit soil, colonizing and coexisting in a mutually beneficial relationship with plants in the root zone. These fungi attach to plant roots and grow networks of microscopic fibrous tissue throughout soil, effectively multiplying the surface area available to the plant for the absorption of water and adsorption of nutrients. Commercial inoculum is formulated to contain a variety of mycorrhizae species. The inoculum product consists of fungal propagules, semi-dormant particles of the selected fungal species, packaged to be shelf-stable. Typical products will contain an average of 60,000 to 100,000 propagules per pound of product and may contain 5 or more individual species.
- A general hydroseed mixture and application rate for the City of Sacramento is provided in the table on the next page. This assumes soil that is well draining, reasonably fertile, and free of contaminants or pathogens as evaluated by a competent testing laboratory. It also assumes a slope of 4:1 (H:V) or flatter with a flow line grade of 3% or flatter. The mix includes native species that do not need irrigation and are low-growing and tolerant of annual mowing.
- Each project is unique in microclimate, terrain, soil type and properties, specific needs of the engineered BMP facility, and needs and preferences of the client. The information provided here is a place to begin and may not present the best specification for the project at hand.

Green dye is often used to facilitate adequate and even coverage.

Table 1 – Sample Hydroseed Mix for City of Sacramento Construction

BMP SEED MIX				
Species	**Common Name**	**Seeds/Lb.**	**Lbs. Pure Live Seed/Acre**	**Seeds/SQFT**
Asclepias fascicularis	Narrow-leaf Milkweed	130,000	3	9
Carex praegracilis	Field Sedge	464,000	1	11
Deschampsia danthonioides*	Annual Hairgrass	845,000	1	19
Hordeum brachyantherum	Meadow Barley	82,000	6	11
Leymus triticoides	Alkali Rye	130,000	4	12
Mimulus cardinalis	Scarlet Monkey flower	30,000,000	0.1	69
Sisyrinchium bellum	Blue-eyed Grass	380,000	1.5	13
Trifolium fucatum*	Bull Clover	72,000	6	10
**Annual species*		**TOTAL**	**22.6**	**154**

HYDROSEED APPLICATION			
Component	**Application 1**	**Application 2**	**Total**
Wood Fiber	500 to 1000 lb./acre	1,000 to 2,000 lb./acre	1,500 to 3,000 lb./acre
Tackifier	50 to 100 lb./acre	50 to 150 lb./acre	100 to 250 lb./acre
Seed Mix		(see above seed mix)	(see above seed mix)
Mycorrhizal Inoculum		16 to 60 lb./acre	16 to 60 lb./acre
Compost	1 to 2.5 yd^3/acre		1 to 2.5 yd^3/acre

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect site BMPs before storm events, daily during storm events, and after storm events.
- Inspect hydroseeded/hydromulched areas weekly on a year round basis until final stabilization criteria (uniform coverage of 70% of pre-construction coverage) have been achieved.
- If irrigation systems are installed for the hydroseeded areas, inspect irrigation daily while in use. Check for system malfunctions, line breaks, and sufficient coverage of the hydroseeded areas.

MAINTENANCE

- Immediately re-apply hydroseed/hydromulch to areas where erosion is evident, or deploy other equally effective erosion control BMP measures.
- Exercise care to minimize damage to adjacent intact areas when making repairs.
- If seeds fail to germinate (or germinate then die), re-seed, fertilize, and mulch the area within the planting season, using no less than half the original application rates.
- If irrigation systems are installed for the hydroseeded areas and malfunctions or line breaks occur, immediately shut down and repair the system before continuing irrigation.
- If irrigation systems are installed for the hydroseeded areas, adjust the irrigation systems as necessary to maintain complete coverage.
- Maintain an unbroken hydroseed/hydromulch ground cover throughout the construction period during periods of inactivity (14 days or longer), or as otherwise necessary to effectively protect receiving waters from sediment laden runoff.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

Hydroseed/hydromulch is a temporary or permanent erosion control measure consisting of a broad range of products that utilize varying tackifiers, fibers, seed, and/or adhesives. As such, the anticipated lifespan for hydromulch/hydroseed during construction depends on the specific product type as well as soil conditions, slope, and rainfall. Hydromulch/hydroseed is expected to require reapplication after significant storm events. Hydromulch on its own is not anticipated to last longer than one rainy season.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit page 1: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit page 5: RBF Consulting.

MULCHING B-2

OBJECTIVES

- Site Planning and Management
- ✓ Erosion Control
- Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Mulching is the dry application of mulch to disturbed soils. Types of mulches include organic materials, straw, wood chips, bark or other wood fibers. Shredded wood/bark is appropriate ground cover in ornamental or revegetated plantings. Green material mulch is produced by recycling vegetation trimmings, such as grass, shredded shrubs, trees, and other organic material. Crimped straw is a layer of straw mulch that is spread or blown over a seedbed, followed by being mechanically pressed into the soil surface. By rolling a crimping tool over the straw surface, it creates rows of straws that stand up. Straw may also be anchored using a tackifier or stabilizing emulsion.

Mulching is typically applied by hand; however, other pneumatic methods are also available. The primary erosion control objectives of mulching are to protect soil from rainfall impact, increase infiltration, and reduce runoff.

Mulching is different from hydroseed/hydromulch because mulching does not typically include the application of a slurry mixture or stabilizing emulsion, seeds or fertilizer. Refer to Fact Sheet B-1 for information on hydroseed/hydromulch.

APPLICATIONS

- Areas which have been permanently seeded, but have not achieved final stabilization (uniform coverage of 70% of pre-construction coverage).
- Areas which need temporary soil surface protection because seeding cannot occur due to the season.
- Areas of cut or fill slopes with non-cohesive soils.

- Areas in which use of hydraulic mulch, soil binders, or rolled erosion control products is not feasible or practical.
- Areas between trees, shrubs, and certain ground covers.
- Areas where climatic conditions require a soil moisture retention aid and soil temperature modification.
- Other active or inactive areas as necessary to effectively prevent discharge of sediment laden runoff to receiving waters.

LIMITATIONS

- Mulching is not appropriate for use on slopes steeper than 4:1 (H:V); it is best suited for flat areas or gentle slopes of 5:1 (H:V) or flatter.
- Mulch mixtures may introduce unwanted species.
- Mulching is not appropriate for areas exposed to concentrated flows.
- Mulch may need to be removed prior to further earthwork.
- Mulch shall not be applied during high wind conditions (more than 15 miles per hour).
- For straw crimping, soils that are dry and hardened may prevent proper anchoring of the straw and the crimping tool will cut the straw instead of poking it into the ground.
- For straw crimping, straw may be cut up by crimping tools if the disc is too sharp.
- "Punching" of straw does not work in sandy soils, necessitating the use of tackifiers.
- Straw mulch applied by hand is more time intensive and potentially costly.

IMPLEMENTATION CONSIDERATIONS

- Selection of the type of mulch to be used shall be based on the type of application, site conditions, and compatibility with planned or future uses. For erosion control purposes, preferred products are those that are shredded, rather than the "nugget-shaped" pieces, which are more easily displaced. Long-fiber wood mulches are more effective and more durable than chipped bark or straw.
- Straw should be derived from weed-free wheat, barley, or rice. Where required by the plans, specifications, environmental documents, or permits, native grass straw should be used.
- Mulch can be applied as a "stand alone" product, or in combination with seed. If applied in combination with seed, apply mulch within 24 hours of seeding.
- Prior to applying mulch, soil preparation includes roughening the soil surface by rolling with a crimping or punching type roller. Track walking may be used to roughen fill areas and

embankments if rolling is impractical. For straw crimping, the ground may have to be moistened to prevent straw from being cut by the crimping tool.

- Alternatively, tackifier can be used to anchor straw mulch to the soil on slopes, but do not apply straw mulch with tackifier during or immediately before rainfall.
- The procedures for applying mulch vary depending on the type of mulching method used. Three potential methods are:
    - Shredded Wood, which should be applied uniformly across the soil surface to a depth of two to three inches.
    - Green Material, which should be applied uniformly across the soil surface to a depth of not more than two inches.
    - Straw Mulch, which should be applied at a rate of 3,000 to 4,000 pounds per acre, providing 100%, evenly distributed ground cover. A lighter application is used for flat surfaces (2000 lb/ac); a heavier application is used for slopes.
- When applying mulch, avoid mulch placement onto sidewalks, drainage channels, roads, existing vegetation, and other areas.
- Note that straw mulch is flammable, and should not be used adjacent to structures where sparks or flame are being used or generated during construction.

Mulching can be applied by hand or using pneumatic methods (as shown in this photo).

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.

- In general, traditional construction projects shall inspect site BMPs before storm events, daily during storm events, and after storm events.
- Inspect mulched areas weekly on a year round basis.

MAINTENANCE

- Immediately re-apply mulch to areas where erosion is evident, when bare earth becomes visible, or where coverage is observed to be non-uniform or no longer meets the necessary application rate.
- Exercise care to minimize damage to adjacent intact areas when making repairs.
- If seeding has been used in combination with mulching and there has been damage to the seedbed, the damaged areas may need to be re-drilled. For re-drilling, a no-till drill is recommended if crimped straw cover is in place.
- Mulch should be reapplied as necessary when its useful lifespan has been exhausted, or as required otherwise to effectively prevent discharge of sediment laden runoff.
- Maintain an unbroken mulched ground cover throughout the construction period during periods of inactivity (14 days or longer), or as otherwise necessary to effectively protect receiving waters from sediment laden runoff.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of mulch, with proper application and maintenance, is three to four months during construction.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, February 2012.
- City of Sacramento Manual for Grading, Erosion and Sediment Control, January 1994.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit page 1: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit page 3: RBF Consulting

DRILL SEEDING B-3

OBJECTIVES

- Site Planning and Management
- ✓ Erosion Control
- Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Drill seeding is a mechanized technique used mostly in heavy construction to plant seeds for temporary or permanent cover. The process involves creation of shallow furrows, installation of seeds, soil back-cover, and compaction. Unlike hydroseed/hydromulch there is no inherent need for an additional application of a tackifier or mulch; however these products can be used to provide erosion protection prior to vegetation germination. Drill seeding is advantageous from the perspective that the sub-surface installation prevents seeds from blowing away and promotes contact with ground moisture; resulting in increased germination rate compared to broadcast seeding. Drill seeding equipment also provides a means to separate seeds of different size and type, allowing for cost efficient application to large areas.

APPLICATIONS

- All disturbed areas accessible by drill equipment.

LIMITATIONS

- Drilling equipment is generally limited to slope areas 3:1 (H:V) or less.
- Requires the use of a pull vehicle and drill type appropriate for the chosen seed mix. ATVs and tractors are typical choices for pull vehicles.
- Drill seeding applies no surface treatment; therefore, until seedlings emerge, the soil surface is not protected from erosion.

IMPLEMENTATION CONSIDERATIONS

- Drill seeding equipment requires calibration to ensure even and proper distribution of seed.
- Drill seeding equipment places seed directly into soil in rows. The equipment is calibrated per the seed species according to seed size and other physical characteristics and the appropriate planting depth. It is for this reason that seed is generally not mixed prior to application. Where diverse vegetation is desired, consider drill seeding a few species for consistent coverage, then broadcast seed the remaining species.
- Areas that have received drill seeding should be protected from vehicular or pedestrian traffic until vegetation has fully established.
- Certain seed choices may require on-going temporary or permanent irrigation to establish and maintain vegetation. Grass and shrubs should be planted to achieve at least 70% uniform cover of disturbed areas compared to pre-construction coverage.
- A general drill seed mixture and application rate for the City of Sacramento is provided in Table 1. Note that each project is unique in microclimate, terrain, soil type and properties, specific needs of the engineered BMP facility, and needs and preferences of the owner. The information provided herein is a place to start and provides basic performance. Coordinate as needed with the project's Landscape Architect.
- There are several online tools available from public agencies intended to help identify seed species that meet project success criteria and are well suited to a particular geographic/climatic region, including the U.S. Forest Service and the California Department of Transportation (Caltrans) TransPlant seed selection application http://www.dot.ca.gov/hq/LandArch/transplant/).

Table 1 – Sample Drill Seeding Mixes for City of Sacramento Construction

Species	Common Name	Seeds/Lb.	Lbs. Pure Live Seed/Acre	Seeds/SQFT
DRILL SEED – TEMPORARY EROSION CONTROL				
Eschscholzia californica*	California Poppy	275,000	1	6
Trifolium wildenovii*	Tomcat Clover	400,000	1	9
Triticum aestivum x Elytrigia elongate*	Sterile Wheatgrass	13,000	30	9
		TOTAL	**32**	**24**
DRILL SEED – PERMANENT – NATIVE #1				
Achillea millefolium	White Yarro	3,200,000	0.2	15
Bouteloua gracilis	Blue Grama	800,000	0.6	11
Nassella pulchra	Purple Needlegrass	110,000	5	13
Trifolium microcephalum*	Maiden Clover	950,000	0.2	4
		TOTAL	**6**	**43**
DRILL SEED – PERMANENT – NATIVE #2				
Elymus glaucus	Blue Wildrye	134,500	2	6
Eschscholzia californica*	California Poppy	275,000	1	6
Festuca rubra ‘Molate’	Red Fescue	400,000	2	18
Lupinus bicolor	Pigmy-leaf Lupine	75,000	3	5
Plantago erecta	Plantain	100,000	4	9
		TOTAL	**12**	**45**
**Annual species*				

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect site BMPs before storm events, daily during storm events, and after storm events.
- Inspection of areas that have been drill seeded should focus on identification of excessive rilling.

MAINTENANCE

- Areas that have been drill seeded that are experiencing rilling or struggling to germinate should receive additional seed applications and water as necessary to achieve uniform coverage of 70% of pre-construction coverage and as necessary to effectively protect receiving waters from sediment laden runoff. Persistent rilling may necessitate the use of other supplemental runoff control BMPs.

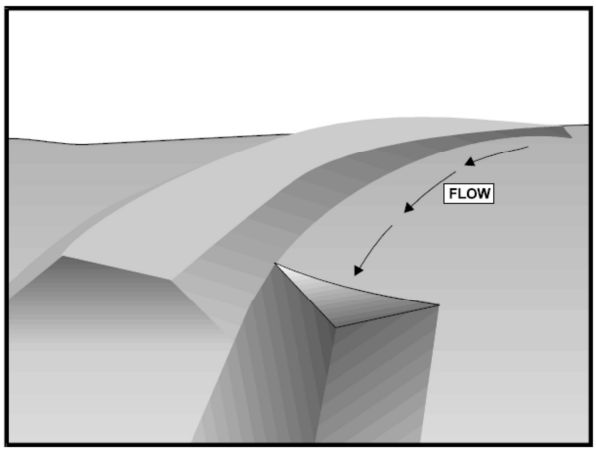
ANTICIPATED LIFESPAN DURING CONSTRUCTION

If properly installed and maintained, the lifespan of areas that have been drill seeded will vary from seasonal to permanent, depending upon the choice of seed used.

REFERENCES

- California Department of Transportation, Drill Seed, http://www.dot.ca.gov/hq/LandArch/ec/plants/drill_seed.htm, accessed January 14, 2013.
- California Department of Transportation, Specifying Seed and Plant Species, http://www.dot.ca.gov/hq/LandArch/ec/plants/seed.htm, accessed January 14, 2013.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Wisconsin Department of Natural Resources Conservation Practice Standard: Seeding for Construction Site Control, November 2003.
- Photo credit: California Department of Transportation, Specifying Seed and Plant Species, http://www.dot.ca.gov/hq/LandArch/ec/plants/seed.htm, accessed January 14, 2013.

GRASS SWALES & BUFFERS B-4



OBJECTIVES

- Site Planning and Management
- ✓ Erosion Control
- Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Grass swales (drainage swales) are temporary drainage swales used to divert off-site runoff around the construction site, divert runoff from stabilized areas around disturbed areas, and direct sediment laden runoff into sediment basins or traps. Grass swales also are used to strain suspended sediment that is being transported with runoff.

Grass buffers (earth dikes) are temporary berms or ridges of compacted soil, seeded with grass. Grass buffers (earth dikes) are used to divert runoff or channel water to a desired location.

APPLICATIONS

- Temporary grass swales (drainage swales) and grass buffers (earth dikes) may be used:
  - To intercept and divert any up-slope runoff around unstabilized or disturbed areas of the construction site in order to prevent slope failures, prevent damage to adjacent property, prevent erosion and transport of sediment into waterways, increase the potential for infiltration, and divert sediment laden runoff into sediment basis or traps.
  - Below steep grades, where runoff may begin to concentrate.
  - At bottom and mid-slope locations to intercept sheet flow, converting it to concentrated flow to be conveyed by the drainage swale.
- Temporary grass swales (drainage swales) and grass buffers (earth dikes) may be used individually or together, where runoff needs to be diverted from one area and conveyed to another area.

- Temporary grass swales (drainage swales) and grass buffers (earth dikes) should be used in other active or inactive areas as necessary to effectively prevent discharge of sediment laden runoff to receiving waters.

LIMITATIONS

- A grass buffer (earth dike) does not itself control erosion or remove sediment from runoff; the grass berm prevents erosion by directing runoff to an erosion control device such as a sediment trap or by directing runoff away from an erodible area. Grass buffers (earth dikes) are not intended to act as velocity check dams.
- Grass buffers (earth dikes) should not be used for drainage areas greater than 10 acres.
- Grass buffers (earth dikes) should not be used along slopes greater than 10 percent.
- Grass buffers (earth dikes) may create additional disturbed area on the site and become barriers to construction equipment.
- Grass buffers (earth dikes) must be stabilized immediately, adding to cost and maintenance concerns. They may require fertilizer and water to stabilize adequately.
- Grass buffers (earth dikes) should not be constructed of easily erodible soils.
- Removal of the grass buffer (earth dike) may add cost in re-grading the site.
- Grass swales (drainage swales) should not be used for drainage areas greater than 5 acres.
- Stormwater diverted by grass buffers (earth dikes) and grass swales (drainage swales) may cause downstream flood damage and should be considered only where there is not potential to adversely impact upstream or downstream properties. Where appropriate, obtain written permission from affected offsite land owners.
- The use of other soil stabilization and sediment controls (e.g., check dams and blankets) may be necessary to prevent scour and erosion in newly graded grass buffers (earth dikes) and grass swales (drainage swales). These measures should be considered when flow velocity is anticipated to exceed 2 feet per second. The maximum permissible velocity for grass varies with the type of grass used. Hydraulic reference texts provide maximum permissible velocity values based on grass type.
- Any grass swale (drainage swale) or grass buffer (earth dike) that conveys sediment-laden runoff must divert runoff into a sediment basin or trap before being discharged from the site.
- Temporary runoff control measures such as berms and swales must be designed by a registered professional engineer, per the California Professional Engineers Act.

IMPLEMENTATION CONSIDERATIONS

- When possible, install and use permanent grass berms (earth dikes) and grass swales (drainage swales) early in the construction process.
- The combination of a temporary grass swale (drainage swale) and a grass buffer (earth dike) at the top of a slope, with the grass buffer (earth dike) on the downhill side, can divert runoff to a location where it can be brought to the bottom of the slope through a slope drain. The combination swale and buffer can be graded by a single pass of a bulldozer or grader and compacted by a second pass of the tracks or wheels over the ridge. Such diversion structures should be implemented when the site is initially graded and shall remain in place until post-construction BMPs are installed and slopes are adequately stabilized to Construction General Permit standards (uniform coverage of 70% of pre-construction coverage).
- Diversion practices, such as grass swales (drainage swales) and grass berms (earth dikes) can concentrate surface runoff, increasing its velocity and erosive force; therefore, the flow out of the BMP must be directed onto a stabilized area or into an energy dissipater, rock rip rap, or other measure capable of providing protection against local scour.

GRASS SWALES (DRAINAGE SWALES)

- Construct the swale with an uninterrupted, positive grade to a stabilized outlet.
- Construct the swale above, not on, a cut and fill slope.
- Swales should be designed to fully contain the 10-year storm peak discharge.
- Swale bottom width should be at least 2 feet with a depth of at least 18 inches. Side slopes of the swale should be 2:1 (H:V) or flatter, and the bottom should be laid at a grade of at least 1 percent but not more than 15 percent.
- Clear the grass swale (drainage swale) of all trees, stumps, obstructions, and other materials when built.
- Compact the fill material along the path of the swale.
- Stabilize all swales immediately:
    - Seed and mulch may be used on swales with velocity less than 3 fps.
    - Rip-rap may be used on swales with velocities greater than 3 fps.
    - For temporary swales, geotextiles or mats may be used to provide immediate stabilization.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.

GRASS BUFFERS (EARTH DIKES)

- All buffers should be compacted by earth-moving equipment.
- All buffers should have positive drainage to an outlet.

- All buffers should have 2:1 (H:V) or flatter side slopes, 18-inches minimum height, and a minimum top width of 24 inches. Top width may be wider and side slopes may be flatter at crossings for construction traffic.
- All buffers shall be stabilized:
    - Buffers with slopes less than 5 percent can be stabilized with seed and mulching.
    - Buffers with slopes in excess of 5 percent shall be stabilized with either rip-rap or sod.
    - Stabilization of the grass buffer (earth dike) shall be completed immediately after construction or prior to the first rain.
- If the channel formed along the toe of the grass buffer (earth dike) is stabilized with riprap, the following typical specifications apply:
    - Channel grade 0.5 to 1.0% requires 4-inch rock riprap stabilization, 12 inches thick.
    - Channel grade 1.1 to 2.0% requires 6-inch rock riprap stabilization, 12 inches thick.
    - Channel grade 2.1 to 4.0% requires 8-inch rock riprap stabilization, 12 inches thick.
    - Channel grade 4.1 to 5.0% requires 8-inch to 12-inch rock riprap stabilization, 12 to 18 inches thick.
- Stone riprap, recycled concrete, or other materials used for stabilization shall be pressed into the soil with construction equipment.
- The buffer outlet must not serve to convey sediment laden runoff. Therefore, diverted runoff should be conveyed to a sediment trapping device (e.g., sediment trap or sediment basin) when either the buffer channel or drainage area above the buffer are not adequately stabilized.
- Filter cloth may be used to cover an earth dike intended for long duration.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect site BMPs before storm events, daily during storm events, and after storm events.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Inspect channel linings, embankments, and beds of swales and buffers for erosion and accumulation of trash, debris, and sediment.
- Inspect swales and buffers for washouts.
- Inspect swales and buffer areas for presence of standing water and potential vector breeding.

MAINTENANCE

- Replace lost riprap, damaged linings, or soil stabilizers as needed.
- Remove debris and sediment and repair linings and embankments as needed.
- Remove sediment from grass swales which builds up and restricts flow capacity.
- Grasses may need to be fertilized, watered, and mowed. Minimize fertilizer application to avoid pollution to downstream receiving waters.
- Completely remove temporary conveyances as soon as the surrounding drainage area has been adequately stabilized or at the completion of construction.
- Maintain all swales and berms as necessary to effectively protect receiving waters from sediment laden runoff.

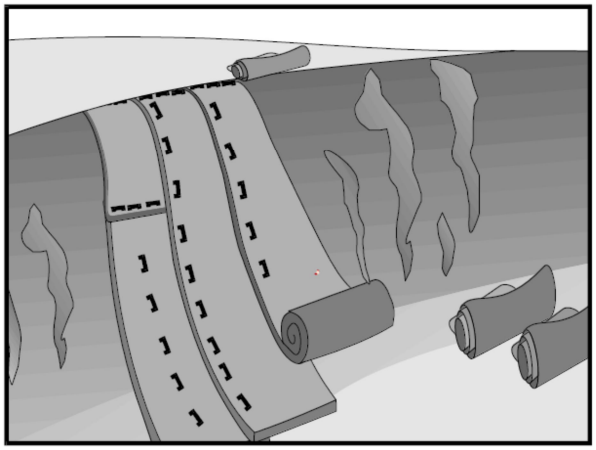
ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of grass swales (drainage swales) and grass buffers (earth dikes), with proper implementation and maintenance, is the full duration of the construction project, or until the swale/dike is removed following stabilization of the surrounding drainage area.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

ROLLED EROSION CONTROL PRODUCTS B-5



OBJECTIVES

- Site Planning and Management
- ✓ Erosion Control
- Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Rolled Erosion Control Products (RECPs) are mattings of a broad range of materials used to cover the soil surface. They reduce erosion from rainfall and wind by absorbing the kinetic energy of rainfall and mechanically holding the soil in place. In general, RECPs can be manufactured from geotextiles, plastics, biodegradable fibers, and non-biodegradable nettings and meshes. The application and limitations of each product is highly specific; therefore, the user should always reference the appropriate literature supplied by the manufacturer in conjunction with this manual. RECPs using plastic are not allowed in or around stream courses, and should generally be avoided.

APPLICATIONS

- Short, steep slopes (steeper than 3:1 [H:V]) where erosion hazard is high and vegetation would be slow to establish.
- In channels to be vegetated where moving water is likely to wash out new vegetation (velocities between 3 feet per second and 6 feet per second).
- Stream banks.
- On disturbed or erosive areas when seeding cannot occur (e.g., late season construction or the arrival of an early rain season).
- Stockpiles.
- Spillways.

- Slopes adjacent to Environmentally Sensitive Areas (ESAs) that would preclude or limit the use of a soil binder.
- Other active or inactive areas as necessary to effectively prevent discharge of sediment laden runoff to receiving waters.

LIMITATIONS

- The high cost of RECPs typically limits the use of this BMP to areas of concentrated channel flow and steep slopes.
- Installation is a critical component of properly implementing RECPs. Experienced contractors are required to install RECPs to ensure continuous contact between the material and the soil. Improper installation can result in "pillowing" (a.k.a. "tenting or bridging") or unobservable sub-surface erosion. Pillowing is a lifting of the RECP from the soil surface by emerging vegetation caused by insufficient anchoring or improper surface preparation.
- RECPs may reduce soil temperature, thereby delaying seed germination.
- RECPs are not generally suitable for excessively rocky sites.
- Non-biodegradable RECPs must be removed and disposed of prior to the application of permanent soil stabilization measures.
- RECPs have maximum flow rate or shear stress limitations based upon manufacturers' specifications. As a general rule of thumb, RECPs should not be subjected to shear stress in excess of 2 pounds per square foot.
- RECPs are not generally suitable for sites where the final vegetation will be mowed, as staples and netting from the RECP installation can catch in mowers.
- RECPs are not suitable for areas with heavy foot traffic as they present tripping hazards.
- RECPs are susceptible to damage from construction vehicles and equipment.
- Birds and small animals may become entangled in RECPs that utilize plastic netting.
- RECPs are generally flammable.

IMPLEMENTATION CONSIDERATIONS

- Keep RECPs rolled within their protective covering and stored until ready for implementation to prevent damage from stormwater, mud, dirt, animals, dust, and debris.
- RECPs can be installed in phases as the project progresses.

ROLLED EROSION CONTROL PRODUCTS B-5

MATERIAL SELECTION

- Material selection should be based on the following considerations:
  - Size of area to be disturbed
  - Slope ratio
  - Surface conditions – rock content, soil moisture conditions, existing vegetation
  - Depth and velocity of flow when used in channels
  - Cost and availability of materials
  - Longevity
  - Exposure to foot traffic, construction equipment, mowing, bird or animal wildlife
  - Needed use of biodegradable materials and "environmental friendliness." The Construction General Permit discourages the use of plastic covers. As such, the use of plastic covers and tarps should be limited to stockpiles and small areas for short periods of time (i.e., one rainfall event). In all cases, plastic covers should withstand photodegradation.

BIODEGRADABLE EROSION CONTROL BLANKETS/MATS

Biodegradable RECPs are composed typically of jute fibers, straw, curled wood fibers, wood fibers, coconut fibers, or a combination of these materials. For an RECP to be 100% biodegradable, the sewing, netting, or adhesive system that holds the mulch fibers together must also be biodegradable. Typically, biodegradable erosion control blankets should be supplied in rolled strips a minimum of 6.5 feet wide, with a minimum length of 80 feet, at a minimum weight of 0.5 lb. /square yard. The blankets should be of a consistent thickness with the material evenly distributed over the product area. Installation is typically performed using U-shaped staples of minimum 11 gauge steel wire, with 8-inch legs and 2-inch crowns. If metal stake pins are to be utilized, they shall be 0.188-inch diameter steel, 8 inches in length, and with a 1.5-inch steel washer at the head of the pin. In all cases, however, the manufacturer's specification should govern the methods and means of installation. The most common examples of biodegradable RECPs are listed below, along with a brief description of their most noteworthy characteristics. Minimum anchorage is one staple per ¾ square yard of RECP.

- **Jute Fibers**
  - Jute is a natural fiber, made into yarn, and loosely woven into a biodegradable mesh.
  - Jute is designed to be used in combination with vegetation. Its effectiveness as a stand-alone BMP is highly limited.

- **Straw**
  - Straw blanket material should be machine-produced mats of straw with a lightweight biodegradable netting top layer.
- **Curled Wood Fibers (Excelsior)**
  - Curled wood fiber blanket material should consist of machine-produced mats of curled wood excelsior such that 80 percent of the fiber is 6 inches or longer.
  - The top layer of the blanket shall be covered with a photodegradable, extruded, plastic mesh.
  - The blanket should be non-toxic, non-injurious to plant and animal life, and smolder resistant without the use of chemical additives.
  - Curled wood fiber blankets should be supplied in rolled strips, a minimum of 48-inches wide, with an average weight of 0.8 pounds per square yard (± 10%), at the time of manufacture.
- **Wood Fiber Blanket**
  - Wood fiber blankets are made of biodegradable fiber mulch and extruded plastic netting that is held together with adhesives.
  - Wood fiber blankets are designed to enhance re-vegetation.
- **Coconut Fiber Blanket**
  - Coconut fiber blanket material should consist of machine-produced mat of 100% coconut fiber with biodegradable netting on the top and bottom.
- **Coconut Fiber Mesh**
  - Coconut fiber mesh is a thin permeable membrane consisting of coconut or corn fiber that is spun into yarn and woven into a biodegradable mat.
  - Coconut fiber mesh is designed to be used along with vegetation.
- **Straw Coconut Fiber Blanket**
  - Straw coconut fiber blankets should be machine-produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top and bottom layer.

NON-BIODEGRADABLE EROSION CONTROL BLANKETS/MATS

Non-biodegradable RECPs are composed typically of polypropylene, nylon, polyethylene, or other synthetic fibers, mesh, or netting. A combination of biodegradable and synthetic fibers is used in some cases to construct the RECP. The netting used to hold these fibers together is typically non-biodegradable. Care should be used in their application, they may be required to be

removed prior to final site stabilization. Some of the most common examples are listed below, along with a short description of their most noteworthy characteristics.

- **Plastic Netting**
  - Plastic netting is photodegradable.
- **Plastic Mesh**
  - Plastic mesh is an open-weave geotextile composed of an extruded synthetic fiber that is woven into a mesh with an opening size less than a quarter inch.
  - Plastic mesh is used with re-vegetation and may be used to secure loose fiber, such as straw, to the ground.
- **Synthetic Fiber with Netting**
  - Synthetic fiber with netting is a mat composed of durable synthetic fibers that are treated to resist chemicals and ultraviolet (UV) light.
  - Synthetic fiber with netting is designed to be re-vegetated and to provide a permanent composite system of soil, roots, and geomatrix.
- **Bonded Synthetic Fibers**
  - Bonded synthetic fibers are composed of a three-dimensional geomatrix synthetic (typically nylon) matting, with more than 90 percent open area. This property aides in root growth and makes them well suited in conditions subject to comparatively higher shear stress. Refer to manufacturer's specification on exact limitations.
  - Bonded synthetic fibers should be installed over prepared soil, followed by seeding into the mat.
- **Combination Synthetic and Biodegradable RECPs**
  - Combination synthetic and biodegradable RECPs are composed of biodegradable fibers (e.g., 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.
  - Combination synthetic and biodegradable RECPs are designed to enhance re-vegetation.

SITE PREPARATION

- Regardless of material selection, site preparation is essential to ensure complete contact of the RECP material with the soil. Other general protocols include:
  - The area of installation shall be graded and shaped. Do not track walk the slope.

- All rocks, vegetation, clods, or other obstructions shall be removed such that the installed RECP materials will have complete, direct contact with the soil.
- To promote direct contact with the soil, any existing rills or gullies shall be filled and compacted to create a relatively smooth surface.
- The seedbed shall be prepared by loosening the top two to three inches of topsoil. Depending on the type of RECP utilized, seeding may be appropriate before blanket installation, after installation, or both. Refer to manufacturer's specifications for further guidance.

- When preparing a channel area for RECP installation, dig an initial anchor trench six inches wide and 12 inches deep. Check slots should be used for installation of RECPs within steep, highly erodible watercourses. Check slots consist of glass fiber strips, excelsior matting strips, or tightly folded jute matting blanket or strips. They are typically placed in 6-inch wide trenches, six to 12 inches deep across the channel, and are left flush with the soil surface. Check slots should be spaced at 25 to 30 foot intervals and should cover the full cross section of the design flow. Check slots are to be installed prior to laying the matting. Cut longitudinal channel anchor trenches (4 inches deep and 4 inches wide) along each side of the installation in order to bury the edges of the matting. In all instances refer to the manufacturer's specifications regarding preparation work within channels and installing check slots.

LAYING, SECURING, AND ANCHORING OF MATTING

- Mechanical or manual equipment for application of the RECP should be capable of handling full rolls of the fabric and of laying the fabric smoothly without folds or wrinkles.
- Mechanical or manual equipment for application of the RECP should meet the fabric manufacturers' specifications or equivalent standards.
- General protocol for laying, securing, and anchoring of matting on moderate and steep slope areas:
  - Start at the top of the slope, anchoring the RECP in a 6-inch deep by 6-inch wide trench. Backfill the trench. Tamp the earth firmly.
  - Unroll the RECP down slope in the direction of water flow (down the fall line).
  - During placement, use temporary weights to prevent movement or damage to the RECP from strong winds.
  - Lay RECPs loosely to maintain direct contact with the soil; do not stretch or twist the RECP.
  - To anchor mats and blankets to the ground surface, U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used.

- Metal stakes, wood stakes, and wire staples shall be driven flush to the soil surface. Staple RECPs sufficiently to anchor the RECP and maintain contact with the soil.
- Place staples down the center and stagger staples placed along the edges.
- Steep slopes (1:1 to 2:1 [H:V]) require a minimum of 2 staples per square yard.
- Moderate slopes (2:1 to 3:1 [H:V]) require a minimum of 1 1/2 staples per square yard.
- Adjacent edges of parallel RECPs shall be overlapped six inches and stapled every three feet.
- If RECPs must be spliced, place RECPs end over end (shingle style) with six inches overlap. Install staples in the overlapped area, approximately 12 inches apart.
- Refer to manufacturer's specifications for more specific technical guidance appropriate for the specific product being used.

- For gentle slopes less than 20 feet long and/or where one width of the RECP roll will cover the entire length of the slope, the RECP can be applied horizontally following the contour. The RECP still must be properly anchored at the top and bottom of the slope.
- General protocol for laying, securing, and anchoring of matting within channel areas:
  - Wherever possible, extend the matting two to three inches above the crest of the channel side slopes.
  - The RECP shall be secured to the ground surface using U-shaped wire staples, geotextile pins, or wooden stakes, per the manufacturer's specifications.
  - Begin 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 the RECP with fastening devices at twelve-inch intervals. Note that the RECP will be upside down initially in the anchor trench.
  - Repeat the same anchoring procedure for additional adjacent RECP rolls to cover the width of the channel. Overlap the preceding roll at a minimum of three inches. Secure these initial ends also at twelve-inch intervals.
  - When the desired width of the channel is covered, backfill and compact the soil.
  - Unroll the center strip of the RECP upstream, stopping at the next check slot or terminal anchor trench.
  - Unroll adjacent mats upstream in a similar manner, maintaining the three-inch minimum overlap.
  - At the transverse check slots, fold and snugly secure all rolls of matting. Lay the RECP in the bottom of the slot, and then fold back against itself. Anchor through both layers of the

RECP at twelve-inch intervals, then backfill and compact the soil. Continue rolling all widths upstream to the next check slot or terminal anchor trench.

- If RECPs must be spliced, place RECPs end over end (shingle style). Install staples in the overlapped area, approximately 12 inches apart.
- Edges of outside RECPs shall be placed in previously excavated longitudinal slots; anchored using the prescribed staple pattern, backfilled, and the soil compacted.
- The upstream end of the RECP shall be anchored, filled, and compacted in a 12-inch by 6-inch terminal trench.

- Special requirements for the installation of turf reinforcement matting:
  - If specified, seed and fill turf reinforcement matting with soil.
  - Avoid any traffic over RECP if loose or wet soil conditions exist.
  - Do not drive any tracked or heavy equipment over RECP.
  - Use shovels, brooms, or rakes for fine grading and touch up.
  - Smooth out soil filling so the top netting of the RECP is barely visible.

<u>INCORRECT APPLICATION</u> – RECP should be installed going down the slope in the direction of flow. It should also be in direct contact with the soil in an area that has been graded and is free of vegetation.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect site BMPs before storm events, daily during storm events, and after storm events.
- Inspect RECPs during and after installation, with focus on the following:
  - Making sure that RECPs are uniformly in contact with the soil.
  - Checking that all lap joints are secure.

- Checking that staples/stakes are flush with the ground.
- Checking that disturbed areas are seeded and are adequately germinating.
- Checking for signs of "pillowing."

MAINTENANCE

- Any erosion, undermining, anchorage failures, pillowing, or other failures must be repaired immediately. If pillowing, washout, or breakage occurs, the material should be re-installed after repairing damage to the slope. Re-installation of RECP requires that the product is entirely removed from the affected area and that emerging vegetation is stripped. The ground surface should prepared again, and the BMP replaced, secured, and re-anchored in a manner more robust than the initial installation.
- Provide additional RECP within other disturbed areas as necessary to effectively protect receiving waters from sediment laden runoff.

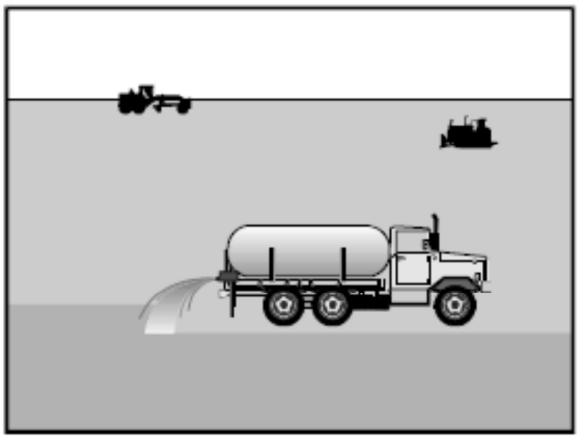
ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of RECPs depends on the material selected, degree of biodegradation, vegetation established, channel flow, and rain conditions (intensity and velocity). With proper implementation and maintenance, jute-based RECPs have longevity of approximately one year while coconut fiber mesh RECPs have longevity of several years.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit page 1: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit page 8: RBF Consulting.

SOIL BINDERS B-6



OBJECTIVES

- Site Planning and Management
- ✓ Erosion Control
- Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Soil binders are a broad category of materials that contain a soil stabilizing agent. Soil binders can be plant based, polymer based, or cement based. Soil binders can be used as a stand-alone BMP, or as part of a hydromulch/hydroseed mix application. Soil binders are applied to exposed soils to temporarily prevent water-induced and wind-induced erosion.

APPLICATIONS

- Disturbed areas requiring short term temporary protection, including areas in which grading has halted and is scheduled to resume. Typically, this application would be as part of a hydromulch/hydroseed mix.
- Stockpiles. This could be as a stand-alone application or as part of a hydromulch/hydroseed mix.
- Temporary haul roads. This would typically be as a stand-alone application.
- Temporary material storage or layout areas. This would typically be as a stand-alone application.
- Other active or inactive areas as necessary to effectively prevent discharge of sediment laden runoff to receiving waters.

LIMITATIONS

- Soil binders are temporary stabilization methods and usually require reapplication, unless the project is not anticipated to last more than 3 months.

- Soil binders require a minimum curing time to become fully effective. Curing times vary by manufacturer and may be 24 hours or longer. The curing process can be adversely impacted by low temperatures and humidity level.
- Soil binders typically experience spot failures during high intensity rainfall events. If runoff does penetrate the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the soil binder and discharge at a point further down the slope.
- Plant-based soil binders are not suitable for areas of high pedestrian or vehicular traffic.
- Soil binders may have limited effectiveness when soils have been compacted.
- Some soil binders do not perform well with low relative humidity; under rainy conditions, some soil binders may become slippery or potentially leach out of the soil.
- Water quality impacts of soil binders are not well known; therefore, some soil binders may have water quality impacts due to their chemical composition.
- As soil binders may be a source of non-visible pollutants, a sampling and analysis plan must be incorporated into the Storm Water Pollution Prevention Plan (SWPPP) or Erosion and Sediment Control (ESC) Plan that considers the project specific use and location of all soil binders.
- Some soil binders have expiration dates. Refer to manufacturer's recommendations.

IMPLEMENTATION CONSIDERATIONS

GENERAL CONSIDERATIONS

- The soil type and texture will dictate the appropriate soil binder to be used. For example, polyacrylamides work well on silts and clays, but not as well on sandy soil. Other factors to consider include the binder's ability to penetrate the soil surface, the likelihood of leaching, and the ability to form a crust on the soil surface.
- A soil binder shall be non-toxic to plant and animal life, easy to apply and maintain, economical, should not stain paved or painted surfaces, and should not pollute stormwater. Refer to manufacturer's specifications for information regarding material safety.
- Soil binders should not be over sprayed onto roads, sidewalks, existing vegetation, drainage channels, etc.
- Soil binders typically require pre-wetting and surface roughening.
- Installation of soil binders requires hydraulic spray equipment and adequate water supply.
- Use of a colored dye within soil binders is a technique that can help ensure an adequate and uniform application.
- Application rates may vary between stand-alone products and those used as part of a hydromulch mix.

- When selecting a soil binder, the following factors should be considered:
  - Cost
  - Resistance to leaching and abrasion
  - Longevity
  - Required curing time
  - Compatibility with other vegetation
  - Degradation mode
  - Crusting properties and reapplication frequency

MATERIAL SELECTION

SHORT-LIVED BINDERS (Plant Material Based)

- Guar
  - Non-toxic, biodegradable, natural galactomannan based hydrocolloid treated with dispersant agents for easy field mixing.
  - Should be mixed with water at the rate of 11 to 15 lb. per 1,000 gallons.
  - Application rates:
    - 1:1 slope 70 lb./acre
    - 2:1 slope 60 lb./acre
    - 3:1 slope 50 lb./acre
    - 4:1 slope 45 lb./acre
    - Flat 40 lb./acre
- Psyllium
  - Composed of the finely ground muciloid coating of plantago seeds and is applied as a dry powder or in a wet slurry.
  - Dries to form a firm but re-wettable membrane that permits germination and growth of seed.
  - Requires 12 to 18 hours drying time.
  - Application rates vary between 80 to 200 lb. /acre, with enough water to allow for a uniform slurry flow.
- Starch
  - Non-ionic, cold water soluble (pre-gelatinized) granular cornstarch.
  - Mixed with water and applied at the rate of 150 lb. /acre.

- Approximate 9 to 12 hours drying time.

LONG-LIVED BINDERS (Plant Material Based)

- Pitch and Rosin Emulsion
  - Typically, a non-ionic pitch and rosin emulsion has a minimum 48% solids content.
  - The rosin should be a minimum of 26% of the total solids content.
  - The soil stabilizer shall 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 applied as follows:
    - Clayey soil 5 parts water to 1 part emulsion
    - Sandy soil 10 parts water to 1 part emulsion
  - Application of the pitch and rosin emulsion may be by water truck or hydraulic seeder, with the emulsion and product mixture applied per the manufacturers' specifications.

POLYMERIC EMULSION BLEND BINDERS

- Acrylic Copolymers and Polymers
  - 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 be implemented past its shelf life or expiration date, as provided by the manufacturer.
  - The soil stabilizer should be readily miscible in water, non-toxic to seed or animal life, non-flammable, and not re-emulsify when cured.
  - The polymeric emulsion should provide surface soil stabilization for various soil types without totally inhibiting water infiltration.
  - The liquid copolymer should be diluted at a rate of 10 parts water to 1 part polymer.
  - The mixture shall be applied to the soil at a rate of 1,175 gallons per acre.
  - The applied compound should air cure within a maximum of 12 to 24 hours.
- Liquid Polymers of Methacrylates and Acrylates
  - Material consisting of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates.
  - An aqueous 100% acrylic emulsion blend of 40% solids by volume.
  - Free of styrene, acetate, vinyl, ethoxylated surfactants, and silicates.

- For soil stabilization, it is diluted with water according to manufacturers' specifications.
- Applied with a hydraulic seeder at a rate of 20 gallons per acre.
- The applied compound should dry between 12 and 18 hours after application.

- Copolymers of Sodium Acrylates and Acrylamides
  - Non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide.
  - Mixed with water and applied to the soil surface by the following rates:
    - Slope Flat to 5:1 3.0 to 5.0 lb./acre
    - Slope 5:1 to 3:1 5.0 to 10.0 lb./acre
    - Slope 2:2 to 1:1 10.0 to 20.0 lb./acre
- Poly-Acrylamide (PAM) and Copolymer of Acrylamide
  - Linear copolymer polyacrylamide (PAM) can be packaged as a dry flowable solid or as a liquid.
  - When used as a stand-alone stabilizer, it is typically diluted at a rate of 11 lb. /1,000 gallons of water and applied at a rate of 5.0 lb. /acre. However, the user should refer to manufacturer's recommendations, as the dilution and application rates can vary depending on product type and whether it is in a solid or liquid format.
  - Slopes stabilized with PAM should flow through a sediment basin or sediment trap prior to discharge to receiving water.
  - PAM formula selected must be anionic and water soluble. All PAM products should be "drinking grade", as certified based upon the specifications of ANSI/NSF Standard 60. Cationic PAM should not be used under any circumstance due to known toxicity issues.
  - The effectiveness of PAM increases dramatically when used as part of a hydromulch mix, when compared to a stand-alone application.
- Hydro-Colloid Polymers
  - Various combinations of dry flowable poly-acrylamides, copolymers, and hydro-colloid polymers, mixed with water.
  - Applied to the soil surface at rates of 55 to 60 lb. /acre.
  - The applied compound should dry within 4 hours of application.

CEMENTITIOUS-BASED BINDERS

- Gypsum
  - A formulated gypsum-based product that readily mixes with mulch and water to form a thin protective crust on the soil surface.

- Composed of high purity gypsum that is grounded, calcined, and processed into calcium sulfate hemihydrate with a minimum 86% purity.
- Mixed in a hydraulic seeder and applied at rates of 4,000 to 12,000 lb. /acre.
- The applied binder should dry within 4 to 8 hours.

APPLICATION OF SOIL BINDERS

- Prior to application, the soil surface must be prepared, including roughening embankment and fill areas and ensuring sufficient moisture to assist the soil binding agent in achieving uniform distribution.
- Follow manufacturers' specifications for application rates, pre-wetting, and cleaning of equipment after use.
- Apply the binder with sufficient time for the selected soil binder to dry prior to rainfall.
- Do not apply soil binders during or immediately before rainfall.
- Avoid overspray of soil binders onto roads, drainage channels, sidewalks, existing vegetation, etc.
- Do not apply soil binders to frozen soil, areas with standing water, or when the temperature is below 40 degrees Fahrenheit during the curing period.
- Often more than one treatment of soil binders is necessary, although the second treatment may be applied at a lower application rate. Follow the manufacturers' specifications.
- For application of liquid soil binders:
  - Crown or slope the ground to prevent ponding.
  - Pre-wet the ground uniformly at a rate of 0.03 to 0.3 gallons per square yard, or in accordance with manufacturer's specifications.
  - Apply the liquid solution under pressure, overlapping the solution six to twelve inches.
  - As necessary, before the first treatment becomes ineffective, apply a second treatment using a 50% application rate.
  - In areas with low humidity, the soil binding chemicals may be reactivated by re-wetting the treated area with water at a rate of 0.1 to 0.2 gallons per square yard.

SUMMARY OF PROPERTIES OF SOIL BINDERS

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 or Manufacturers' Specifications for specific rates.

Table Source: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.


Significant erosion can occur when no soil binders (or perimeter controls) are provided.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect site BMPs before storm events, daily during storm events, and after storm events. Projects shall also conduct quarterly inspections for the presence of non-storm water discharges.
- Projects using soil binders should be inspected for evidence of non-visible pollutant discharge.
- Project using soil binders should be inspected for signs of rilling, spot failures, damage to nearby vegetation, and visible evidence of leaching or other toxicity issues.
- Areas in which soil binders have been applied should be inspected to identify photo or biodegradation.
- When used as part of a hydromulch/hydroseed mix, inspect areas for spotty seed germination.

MAINTENANCE

- Immediately re-apply soil binders to areas where erosion is evident or where the soil binder is observed to have experienced photo or biodegradation.
- Exercise care to minimize damage to adjacent intact areas when making repairs.
- Re-apply soil binders as necessary to effectively protect receiving waters from sediment laden runoff.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

Vegetable-based materials have an anticipated useful lifespan up to 6 months. Some polyacrylamides have an anticipated useful lifespan up to 12 months. These durations may vary depending on the size and frequency of rain events.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 8): City of Sacramento.

SOIL PREPARATION, ROUGHENING B-7

OBJECTIVES

- Site Planning and Management
- ✓ Erosion Control
- Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Soil preparation or roughening is the practice of modifying soil to create a surface that will slow runoff and promote infiltration. Soil roughening is a temporary erosion control measure often employed during grading. The purpose of soil preparation or roughening is to reduce the concentration of runoff, enhance infiltration, and promote soil moisture retention to aid in vegetation establishment. Soil preparation or roughening may also be necessary for the installation of other BMPs, but should not be used with RECPs. In general soil roughening encompasses techniques consisting of stair stepping, grooving, imprinting and track walking, among others.

APPLICATIONS

- Along any disturbed slope, including stockpiles and sediment basins. Most commonly soil roughening would be performed on slopes greater than 3:1 (H: V) and more than 5 feet in height.
- Other areas with highly erodible soils, or areas that are frequently disturbed.
- Soil roughening is a complimentary technique to be used in combination with other BMPs such as hydromulch, mulch, compost, and perimeter controls, among others.

LIMITATIONS

- Do not roughen the surface of slopes with a stable rock face.
- Do not perform surface roughening when the soil is wet.

- Once a surface is roughened, do not drive on or compact the surface in any manner.
- Slope roughening is not effective as a "stand alone" BMP, but will reduce erosion by about 50% compared to a bare smooth slope.
- Typically, soil roughening is only effective for gentle or shallow depth rains, not for high intensity or high volume events.
- Soil roughening is not appropriate in advance of the installation of Rolled Erosion Control Products (RECPs) or erosion control blankets.
- Surface roughening often necessitates the use of increased quantities of mulch to achieve effective stabilization, as this process creates a greater surface area.
- Soil roughening is not considered effective on slopes steeper than 2:1.

IMPLEMENTATION CONSIDERATIONS

- Roughen the soil as soon as possible after any vegetation has been removed from the slope or immediately after grading activities have temporarily or permanently ceased.
- Seed and mulch roughened areas as quickly as possible.
- The method selected for roughening soil depends on the available equipment, slope steepness, mowing requirements, and whether the slope is formed by cutting or filling. In general, track walking, has a more limited effectiveness compared to other roughening techniques.
- Lose material collected at the end of a tracked row or series of grove cuts should be reworked into the slope or placed in a stabilized portion of the site.
- Surface roughening measures include:
    - Stair stepping cut slopes that will not be mowed.
        - Use stair-step grading on any erodible material that may be soft enough to be ripped by a bulldozer. This includes material consisting of soft rock and subsoil.
        - The vertical cut distance shall be less than the horizontal distance and the horizontal portion of the step should be sloped slightly toward the vertical wall.
        - Individual vertical cuts shall be kept less than 2 feet deep in soft materials and less than 3 feet deep in rocky materials.
    - Stair stepping fill slopes that will not be mowed.
        - For gradients steeper than 3:1 (H: V), fill slopes should be placed in lifts less than 8 inches, with each lift properly compacted. Consult with the project

geotechnical engineer for potentially more stringent requirements concerning maximum lift depth and specific compaction requirements.

- The slope face should consist of loose, un-compacted fill 4 to 6 inches deep
- Roughen the face of the slopes, if necessary, by grooving or track walking the slope face as described below.
- The final slope face shall not be bladed or scraped.

- Grooving
  - Groove cuts can be made using normal tilling methods, disking, harrowing equipment, or the teeth of a front-end loader bucket.
  - Grooving cuts should be made to create a series of depressions and ridges that run across (parallel to) the slope contour.
  - Grooves on moderate slopes (3:1 to 2:1) shall be made at least 3 inches deep and less than 15 inches apart. On milder slopes (flatter than 3:1), groove cuts can be shallower, being a minimum 1 inch deep.
  - Grooving is well suited on areas that are to be mowed; however excessive roughening is undesirable.
- Track Walking
  - Limit roughening with tracked machinery only to sandy textured soils, as this will reduce the potential for excessive compaction
  - Operate tracked machinery perpendicularly to the slope such that it leaves horizontal depressions in the soil. Do not "back blade" during final grading operations.

B-7 SOIL PREPARATION, ROUGHENING

Although the track walking was correctly done perpendicular to the slope, it has also created significant vertical ridges from the edges of the tracks that will concentrate flow and increase erosion.

A lack of soil preparation can lead to significant erosion.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect site BMPs before storm events, daily during storm events, and after storm events.
- Inspection should focus on identifying signs of rills and gullies.

MAINTENANCE

- Where signs of riling are evident, fill slightly above original grade and re-seed the area immediately.
- If roughening is washed away in a heavy storm, re-roughen and re-seed the surface immediately.

- Where signs of rilling or erosion are evident, consider the installation of additional stabilization BMPs.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

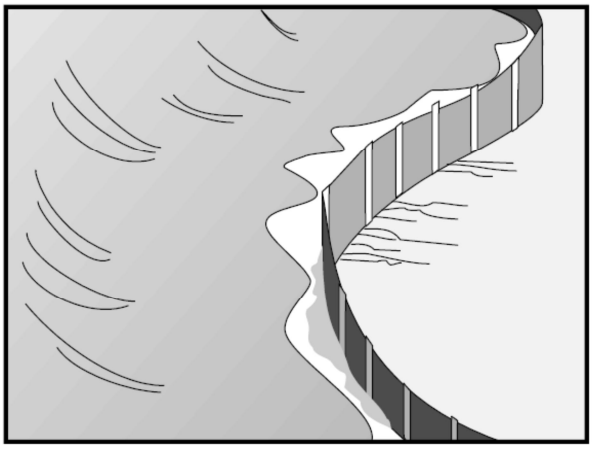
Soil roughening is a temporary erosion control measure. When implemented properly, it is expected to last for one significant rain event without the need for repair.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- United States Environmental Protection Agency, National Pollutant Discharge Elimination System, Menu of BMPs: Soil Roughening (http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cgm?action=browse&Rbutton=detail&bmp-44), accessed January 15, 2013.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (pages 3-4): RBF Consulting

C: SEDIMENT CONTROL

SILT FENCE C-1



OBJECTIVES

- Site Planning and Management
- Erosion Control
- ✓ Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

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 fence for support. The purpose of a silt fence is to detain sediment-laden water, promoting sedimentation behind the fence. Silt fences do not 'filter' runoff; they detain sheet flow so that particulates can settle out.

APPLICATIONS

- Areas subject to sheet flow or shallow overland flows.
- Along the perimeter of the site.
- Along stream and channel bank areas.
- Below the toe of an exposed or erodible slope.
- Around temporary spoil areas and stockpiles.
- Below other small cleared areas.

LIMITATIONS

- Not for use in streams, channels, drain inlets, or anywhere flow is concentrated.
- Not for use in areas where ponded water may cause flooding.
- Must be constructed on, or close to, a contour.
- Not for use under high volume, high velocity flow conditions.

- Does not provide effective sedimentation for fine particles like clays or silts, will not substantially reduce turbidity.
- Proper installation requires soil disturbance.
- Must be trenched and keyed in to be effective.
- Not to be used to divert flow.
- Silt fence is not effective at straining or filtering sediment laden stormwater.
- Not for use below slopes subject to creep, slumping, or landslides.
- Not for use below slopes greater than 1:1 (H: V) or longer than 200'.
- Not for use as mid-slope protection on slopes greater than 4:1 (H: V).
- Most effective when used in combination with erosion controls.

IMPLEMENTATION CONSIDERATIONS

- Construct along, or close to, a level contour, so water does not pond more than 1.5 feet at any point along the silt fence.
- Turn ends of the silt fence uphill to prevent stormwater from flowing around the fence. End lengths should be sufficient to capture and detain 1.5 feet of ponded water.
- To increase the effectiveness of silt fence, install J-Hooks, which have ends turning upslope to break up long runs of fence. These provide multiple storage areas that work like mini-retention areas. They should be placed at 12 to 18 inch vertical intervals along the base of the fence, or in no case greater than 500 feet horizontal.
- Provide sufficient room (3 feet minimum) for sediment removal equipment between the silt fence and toes of slopes or other obstructions.
- Limit the height of a silt fence to 3 feet.
- Leave an undisturbed area or stabilized area immediately down-slope from the fence.
- For construction next to streams and sensitive areas, consider installing redundant lines of silt fences.
- Do not place across live streams or intermittently flowing channels.
- Filter Fabric Material Specifications:
    - Filter fabric should contain ultraviolet inhibitors and stabilizers to provide a minimum of six months of anticipated usable construction life at a temperature range of 0 to 120 degrees Fahrenheit.

- Filter fabric should be woven geotextile with a minimum width of 36 inches and a minimum tensile strength of 100 lb. Filter fabric should have integrated reinforcement and conform to the requirements in ASTM designations D4632 and D4491.
- Purchase filter fabric in a continuous length. Cut to the length of the barrier to avoid the use of joints. If joints are necessary, filter fabric should be spliced together only at a support post, with a minimum six-inch overlap and both ends securely fastened to the post.

- Posts
  - Wood Stakes
    - Should be commercial-quality lumber of the size and shape shown on the erosion and sediment control plans.
    - Should be free from decay, cracks, or splits longer than the thickness of the stake, or other defects that would weaken the stakes or cause the stakes to be structurally unsuitable.
  - Bar Reinforcement
    - Provide end protection for any exposed bar reinforcement based upon OSHA standards.
- Staples and Wire
  - Staples should be not less than 1.75 inches in length and should be made from 15 gauge or heavier wire.
  - The wire used to fasten the tops of stakes together when joining two sections of fence should be 9 gauge or heavier. No galvanizing of the fastening wire is required.
- Standard (Non-Mechanical) Installation
  - Excavate a trench approximately 6 inches wide and 6 inches deep along the line of the silt fence to be installed.
  - Space posts a maximum of 6 feet apart and drive posts securely into the ground a minimum of 18 inches deep or 12 inches below the bottom of the trench. Leave at least 3 feet of post above ground.
  - On the uphill side of the posts, extend the filter fabric into the trench a minimum of 12 inches. This will require folding over the first 6 inches of fabric so that is anchored under the trench backfill material.
  - When using standard strength filter fabric or filter fabric that, per the manufacturer's specifications, does not have bursting strength characteristics for the planned application, reinforce the filter fabric by using a wire mesh support fence:

        - Securely fasten the wire mesh support fence to the up-slope side of the posts using heavy-duty wire staples at least one-inch long, tie wires, or hog rings.
        - Extend the wire mesh support fence into the trench a minimum of four inches.
    - When using extra-strength filter fabric or filter fabric that, per the manufacturer's specifications, does have sufficient bursting strength characteristics for the planned application, staple or wire the fabric directly to the posts.
    - Backfill the trench with 3/4-inch minimum diameter washed gravel or hand-compacted native material.
- Static Slicing (Mechanical) Installation
    - Static slicing is a mechanical method of installing silt fence. It is defined as insertion of a narrow blade pulled behind a tractor, similar to a plow blade, at least 10 inches into the soil while at the same time pulling the silt fence fabric into the ground through the opening created by the blade to the depth of the blade.
    - A second pass with a tractor or other heavy equipment is required to backfill and compact the soil.
    - To complete the installation, the posts are then installed, and the fabric is stapled to the posts.
    - Static slicing will not work with pre-fabricated, wire-backed silt fence.
    - Static slicing will not work in shallow or rocky soils.
    - Complete removal of the geotextile material after use can be difficult.
- Keep silt fences in place until the up-slope or disturbed area has been permanently stabilized.
- For slopes that are steeper than 2:1 (H:V) or that contain a high amount of rocks or large dirt clods that tend to dislodge, installation of additional protection immediately adjacent to the bottom of the slope may be necessary prior to installation of the silt fence. Additional protection may include chain link fencing or cable fencing.

Silt fence can be highly effective when installed correctly along the perimeter of the site.

SILT FENCE C-1

INCORRECT: Slumping silt fence should be repaired or replaced. Filter fabric should be a continuous length. Any joints should be spliced together at a support post, with a minimum six-inch overlap and both ends securely fastened to the post

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect silt fences weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect silt fence daily.
- Silt fence should be inspected for signs of undermining.
- Silt fence should be inspected for over-accumulation of sediment or other inadequate maintenance.
- Silt fence should be inspected for improper installation, including lack of entrenchment, breaches, or end flanking.
- The area uphill of silt fence should be inspected for signs of erosion or rilling. This is an indication of runoff being contributed for a greater than acceptable area or inadequate erosion control.

MAINTENANCE

- Remove and dispose of sediment when it reaches approximately one-third the height of the fence. Repair silt fences that are undercut by re-trenching and compacting.
- Repair or replace split, torn, weathered, or slumping fabric.
- Silt fence should be removed once the uphill area is permanently stabilized.
- Depressions, holes, or other ground disturbance caused by the removal of silt fences should be suitably backfilled, repaired, and stabilized.

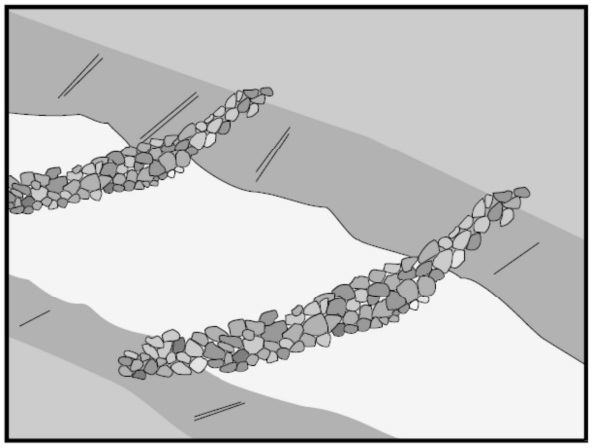
ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated lifespan of silt fence, when appropriately installed and maintained, is generally 5 to 8 months. Improper installation and maintenance will reduce the expected lifespan.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (pages 4-5): RBF Consulting

CHECK DAMS C-2



OBJECTIVES

- Site Planning and Management
- Erosion Control
- ✓ Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Check dams are small barriers constructed across a swale or drainage ditch. The purpose of check dams is to reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch and allowing for sediment capture. Although certain manufactured alternatives exist, check dams are typically constructed from rock, gravel bags, or timber. Check dams can be installed as both a temporary and a permanent measure.

APPLICATIONS

- Small open channels that drain 10 acres or less.
- Steep channels where stormwater runoff velocities exceed 5 feet per second.
- During establishment of grass linings in drainage channels or ditches.
- In temporary ditches where the short term of service does not necessitate establishment of erosion-resistant linings.
- Below spillways to reduce water velocity and erosion.
- As a grade control measure.

LIMITATIONS

- Not for use in live streams or channels with extended base flows.
- Not for use in channels that drain areas greater than 10 acres.
- Usually requires extensive maintenance after high velocity flows.

- Promotes trapping of sediment which can be re-suspended during subsequent storms or during removal of the check dam.
- Implementation of check dams may reduce hydraulic capacity of swales or ditches. Hydraulic analysis of channel performance may be required.
- Water suitable for mosquito production may stand behind check dams, especially if subject to non-stormwater discharge.
- May smother vegetation through long periods of submergence or excessive sedimentation.
- Straw bales, wattles and silt fence are not appropriate for use as check dams.

IMPLEMENTATION CONSIDERATIONS

- Use a series of check dams (as opposed to just one) to increase their effectiveness. Placing a sediment trap immediately upstream will also increase sediment removal efficiency.
- Ensure the check dams are not decreasing the capacity of the swale or ditch such that overtopping may occur. Check dams should maintain adequate hydraulic capacity to convey the 10-year, 24-hour event without overtopping. To restore capacity, increase the width of the swale or ditch.
- The center of the check dam should be at least 6 inches lower than the edges such that the check dam directs flows to the center of the swale or ditch. This also helps avoid flanking of the check dam. High flows (typically a 10-year, 24-hour storm) should flow safely over the check dam center weir without damage to the check dam or an increase in upstream flooding.
- To achieve maximum slope and velocity reduction, design the check dams such that the toe of the upstream dam is the same elevation as the top of the downstream dam.
- Install the first check dam approximately 16 feet from the outfall device. Install subsequent check dams at regular intervals based on slope gradient and soil type. Spacing closer than 20 feet is not recommended in order to allow space for maintenance. The following guide can be used to approximate required spacing:
    - Channel slope of 1%: Check dams spaced 200 feet apart
    - Channel slope of 2%: Check dams spaced 100 feet apart
    - Channel slope of 4%: Check dams spaced 50 feet apart
    - Channel slope of 6%: Check dams spaced 33 feet apart
    - Channel slope of 8%: Check dams spaced 25 feet apart
    - Channel slope of 10%: Check dams spaced 20 feet apart
- Check dams should be installed at a distance and height to allow small pools to form between each check dam.
- Backwater from a downstream check dam should reach the toe of the upstream check dam.

- The check dam must completely span the swale or ditch to prevent washout, typically extending beyond the channel bank by one-third the width of the channel, or 18 inches minimum (whichever is greater).
- Check dams should be located in straight reaches of the swale or ditch, as washout or bank failure is more likely when check dams are installed in channel bends.
- Check dams may be constructed of rock, gravel bags, sand bags, fiber rolls, logs, or lumber. There are also a number of products manufactured specifically for use as check dams, some of which can be removed and reused.
    - Rock check dams are typically constructed of 8 to 12 inch rock that is placed either by hand or mechanically, but never simply dumped into the swale or ditch. The rock used must be large enough to remain in place under the expected design flow of the swale or ditch. Geotextile fabric must be placed under the rock to avoid erosion and to reestablish the natural channel bottom when the check dam is removed.
    - Gravel bag check dams are constructed by tightly stacking the bags across the swale or ditch, shaped such that the edges are higher than the center with a minimum height of 1.5 feet and a maximum height of 3 feet. Upper rows of bags should overlap joints in lower rows.
    - Fiber rolls should not be used as check dams.
    - Log or lumber check dams are typically constructed of 4 to 6 inch diameter logs that are embedded in the soil at least 18 inches. The logs can be bolted or wired to vertical support logs that have been driven or buried into the ground.
    - Manufactured products should be installed according to the manufacturer's specifications.
    - Check dams should have protection extended downstream of the face of the dam to protect the channel invert from overtopping flows. The pad should extend 18 inches from the toe of the dam.
- Where grass is used to line the swale or ditch, the check dams should be removed when the grass has matured sufficiently to protect the swale or ditch.

INCORRECT - The middle portion of the check dam, which functions as a weir, has been flattened during installation and will decrease effectiveness. Fiber rolls have insufficient permeability to act as a check dam.

INSPECTION

- For sites greater than 1 acre or requiring California General NPDES coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect check dams weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect site BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Check dams should be inspected for over-accumulation of sediment on the uphill side.
- Check dams should be inspected for signs of structural deterioration and erosion downstream of the dam. Channel areas should be inspected for signs of erosion and or material deposition (sediment, rock, etc.).
- The area behind check dams should be inspected for signs of vector breeding.

MAINTENANCE

- When the check dam is being used as a sediment capture device, remove sediment when it reaches approximately one-third the height of the check dam. The removed sediment may be incorporated into earthwork onsite or disposed of at an appropriate location.
- Replace missing rock, gravel bags, etc.
- Replace gravel bags that have become damaged or have degraded.
- Remove accumulated sediment before permanent seeding or soil stabilization.

- Protect the area immediately downstream of the check dam if a scour hole develops. Use gravel bags, rock, or additional material from the manufacturer.
- Remove check dams and accumulated sediment when the check dams are no longer necessary.

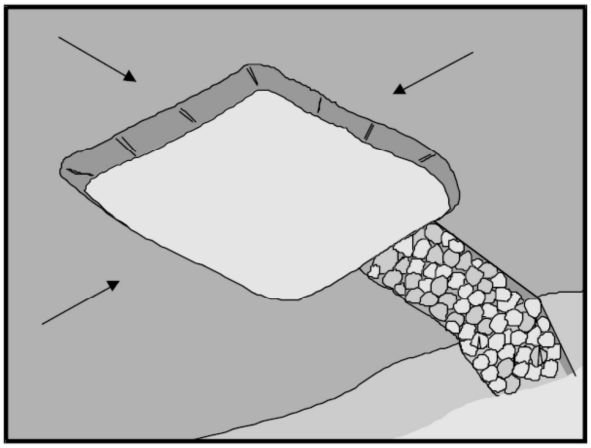
ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of check dams depends on the material selected, vegetation established, and rain conditions (intensity and velocity). The typical lifespan for sand or gravel bags is 6 to 12 months.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 4): City of Sacramento.

SEDIMENT TRAPS C-3



OBJECTIVES

- Site Planning and Management
- Erosion Control
- ✓ Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- ✓ Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

A sediment trap is a temporary containment area where sediment-laden runoff is detained, allowing sediment to settle out before the runoff is discharged. Sediment traps can be formed by excavating or constructing an earthen embankment across a waterway or low drainage area and typically providing a gravel outlet. Sediment traps are similar to sediment basins, but are intended for smaller drainage areas.

APPLICATIONS

- For drainage areas less than 5 acres.
- Around or upstream of storm drain inlets
- As pretreatment before entering infiltration BMPs.
- Any location where sediment-laden runoff would be discharged from the site or into a waterway.

LIMITATIONS

- Requires large surface area to permit infiltration and settling of sediment.
- Not appropriate for drainage areas greater than 5 acres (consider the use of sediment basins for areas greater than 5 acres).
- Only removes large and medium sized particles. Effectiveness of removing fine clays or silt is highly limited without the use of other measures.
- Requires upstream erosion control.

- Attractive and dangerous to children, requiring protective fencing.
- Conducive to vector production.
- Should not be located in live streams.
- Not appropriate to install within areas where failure would introduce risk to life, safety, or property
- Limited design life (six months to one year).
- Requires frequent maintenance.

IMPLEMENTATION CONSIDERATIONS

- Locate sediment traps as close as practical to the source of sediment.
- To discourage entry or restrict access to the site in general, install continuous fencing around the perimeter and provide safety signage and other measures.
- Provide access for maintenance and sediment removal.
- Restrict basin slopes to 2:1 (H:V) or flatter.
- Traps are commonly sized for the volume of water from the 2-year storm event (approximately 0.75 in. of runoff over a 24-hour period). This event equates to a recommended minimum volume of 100 yd^3/acre for the settling zone and 50 yd^3/acre for the sediment storage zone.
- Traps that are constructed above grade should be designed by a Registered Civil Engineer.
- Use 3:1 minimum ratio of length to width; length is measured in the direction of flow. Basins that cannot adhere to this length to width ratio should outlet through a riser outlet.
- When a riser is used, it should have watertight joints, anti-seep collars, and at least the top two-thirds should be perforated with one-half inch diameter holes spaced 8-inches vertically and 10 to 12-inches horizontally. The riser should be securely anchored with concrete or other means to prevent floatation and include an anti-vortex device and trash rack.
- The outlet pipe or spillway should be designed to convey the anticipated peak runoff rate.
- The outlet crest elevation should be at least 1 foot below the top of the embankment.
- Riprap or other suitable outlet protection should be provided to reduce erosion.
- Crushed stone used in the outlet should meet AASHTO M43, size No. 2 or 24, or equivalent. Gravel meeting the above gradation may be used if crushed stone is not available. Filter fabric must be used under all stone.
- Embankment fill material should be free of roots, woody vegetation, oversized rocks, or other objectionable material.
- The trap can be removed once the tributary area has been properly stabilized.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect site sediment traps before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect sediment traps daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Inspect sediment traps with focus on the following:
    - Damage, seepage, or leakage in the surrounding embankment and perimeter area.
    - Damage, scour, or obstructions around or in the outlet structure and spillway.
    - Areas with standing water for more than 96 hours. Recommend removal of water.
    - Scour at the entry or exit points.
    - Vegetation.

MAINTENANCE

- Remove sediment when build up reaches a maximum of one-third of the maximum capacity. Consider the use of cleanout stakes to provide visual reference of this elevation. Sediment should also be removed if the sediment storage zone has less than one foot of available storage depth.
- Remove accumulated litter and debris.
- Repair any scour damage.
- Repair/un-clog drainage outlet if found to be preventing water drawdown within 96 hours.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

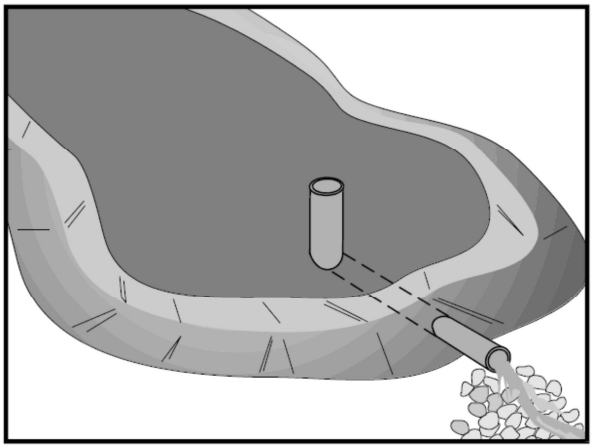
The anticipated useful lifespan is approximately six months to one year.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

SEDIMENT BASINS C-4



OBJECTIVES

- Site Planning and Management
- Erosion Control
- ✓ Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- ✓ Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

A sediment basin is a temporary containment area where sediment-laden runoff is detained, allowing sediment to settle out before the runoff is discharged. Sediment basins can be formed by excavating or constructing an earthen embankment across a waterway or low drainage area. Sediment basins are most effective when used in conjunction with other erosion and sediment control practices to reduce the sediment concentration of the basin influent.

Since sediment basins rely primarily on settling for pollutant removal, they may not significantly reduce turbidity. Methods to improve sediment basin performance include constructing baffles (see: http://www.soil.ncsu.edu/publications/Soilfacts/AGW-439-59/AGW_439_59.pdf) and the use of floating outlets (see: *www.fairclothskimmer.com/).*

APPLICATIONS

- Drainage areas greater than 5 acres.
- The best locations are generally low areas below disturbed areas.
- Any location where sediment-laden runoff would be discharged from the site or into a waterway.
- Recommended where post construction detention basins will be located.
- Locations with relatively low saturated hydraulic conductivity, where infiltration basins are not feasible.

LIMITATIONS

- Requires large surface area to permit settling of sediment.

- Not economical for drainage areas less than 5 acres (consider the use of sediment traps for areas less than 5 acres).
- Only effective in removing sediment down to about the silt size fraction. Effectiveness of removing fine clays is highly limited without use of other "enhancement" measures, such as flow deflection baffles or outlet skimmers.
- Requires upstream erosion control, as well as scour protection at the outlet.
- Attractive and dangerous to children, requiring protective fencing.
- Conducive to vector production when water stands longer than 96 hours.
- Should not be located in live or jurisdictional streams.
- Not appropriate to install within areas where failure would introduce risk to life, safety, or property.
- Inadequate maintenance and/or design flaws may cause particles to be re-suspended and discharged during subsequent runoff events.

IMPLEMENTATION CONSIDERATIONS

- Sediment basins should be installed before any land disturbing activities take place in the drainage area.
- Basin Sizing
  - Sediment basin volume consists of two zones:
    - Sediment storage zone
    - Settling zone
  - Total basin volume should equal or exceed the sum of the sediment storage zone plus the settling zone. A simplified minimum sizing criteria based upon CASQA SE-2 has been provided for use on local sites whose design particle size is 0.02 mm or greater based upon a wet sieve analysis specific for the project site. Note that sediment basins installed on jobsites subject to coverage under the State General Construction Permit must be designed using fact sheet SE-2, or a more conservative approach. Regular maintenance and cleanout after each event is generally needed.
    - Basin sediment storage volume should be based on the Modified Universal Soil Loss Equation (MUSLE) as applied to the 10-year, 24-hour event (approximately 3 inches). The sediment storage zone depth should be 1 foot.
    - Provide a minimum of 3,600 cubic feet of settling volume per acre of drainage. This is the volume that corresponds to the top of the outlet riser elevation.

- The total basin depth should be 4 feet minimum (3 feet of settling zone and sediment storage plus 1foot freeboard above the top of riser).
- Minimum basin bottom surface area should be 1,800 square feet per acre of drainage. The surface area should be proportioned at a 6:1 minimum ratio of length to width; length is measured in the direction of flow.
- Restrict basin slopes to 3:1 (H:V) or flatter. The basin bottom is level.

- Basins that do not adhere to the volume and surface area requirements stated herein, or that would be expected to treat sediment smaller than 0.02 mm will require project-specific engineering backup to support design dimensions, see fact sheet SE-2 at: https://www.casqa.org/store/products/tabid/154/p-171-fact-sheet-se-2.aspx .
- Basins with a height ≥ 25 feet or an impounding capacity ≥ 50 ac-ft. must obtain approval from the California Department of Water Resources Division of Safety of Dams (http://www.water.ca.gov/damsafety/).
- Consider on- and off-site flows as well as potential changes to the drainage area during different phases of construction. In order to minimize changes to the basin design during construction, the designer should use the maximum anticipated drainage area when sizing the basin.

- Basin Primary and Overflow Outlet Design
  - The principal outlet (riser) pipe and overflow outlet (spillway weir) should be designed to convey the anticipated peak runoff rate during a 10-year, 24-hour event.
  - The principle outlet (riser) pipe should have dewatering holes, an anti-vortex device, and a trash rack. A crushed stone rock pile or gravel can serve as alternatives to a debris screen. In these instances, the crushed stone used around the outlet should meet AASHTO M43, size No. 2 or 24, or equivalent. Gravel meeting the above gradation may be used if crushed stone is not available.
  - The principal outlet riser should be constructed on a firm, smooth foundation and should be securely anchored with concrete or other means to prevent floatation. Watertight connections should be provided as well as anti-seep collars on the barrel.
  - The cleanout level should be clearly marked on the riser pipe.
  - Riprap or other suitable outlet protection should be provided to reduce erosion.
  - An emergency spillway must be included. The emergency spillway crest elevation should be at least 1 foot above the top of the riser pipe. It should be constructed of stabilized material such as concrete, asphalt, or riprap. The spillway should be embedded at least 2 feet below the toe of slope, on both the inside and outside portion of the embankment. The spillway should be designed for the peak flow into the facility, using the broad-crested weir equation.
  - The outlet should be designed to drain within 48 to 96 hours. The 48-hour lower limit will ensure the required settling time and the 96-hour upper limit will reduce concerns regarding

vector control. No more than 50 percent of the design volume should drain in one-third of the total drawdown time. Confirm the basin performance by routing the 10-year, 6-hour event through the basin considering the storage volume and outlet design. Since basins are not maintained for infiltration, the infiltration rate should not be considered when designing the hydraulics of the basin and outlet structure.

- Install continuous fencing around the perimeter and provide safety signage and other measures to discourage entry or secure the general site.
- Basins should be located as close as practical to the source of sediment.
- Provide year-round access for maintenance and sediment removal.
- Embankment fill material should be free of roots, woody vegetation, oversized rocks, or other objectionable material. Construct and compact embankments based upon project specific recommendations from the project geotechnical engineer.
- The basin can be removed once the tributary area has been properly stabilized.
- Divert runoff from undisturbed areas away from the basin. Drainage into basins can be improved by the use of dikes and swales.
- Consider the use of a hold and release valve. This valve would allow all flows to be stored for sufficient time for sediment to settle out and then slowly release the water. When the valve is opened, runoff should be released at a rate that does not re-suspend the solids or cause erosion.

NOT APPROPRIATE – No outlet structure or emergency spillway provided.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect sediment basins before storm events, daily during storm events, and after storm events.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.

- Check for damage or leakage within the surrounding embankment and perimeter area.
- Inspect outlet structure and spillway for damage, scour, or obstructions.
- Inspect inlet area for scour or signs of erosion.
- Note areas with standing water for more than 96 hours.
- Identify the presence of emergent vegetation.
- Inspect discharge for signs of re-suspension or scour from rapid drawdown.

MAINTENANCE

- Remove sediment when the sediment storage zone becomes half full. Cleanout stakes or marks on the riser pipe should be used to facilitate proper determination of this need.
- Remove accumulated litter and debris.
- Repair any scour damage.
- Repair/un-clog drainage outlet if found to be preventing water drawdown within 96 hours. If the basin does not drain properly, dewatering should be conducted.
- Remove accumulated floating vegetation during each inspection.
- Remove excessive emergent and perimeter vegetation as needed.
- Notify the project geotechnical engineer if signs of seepage are observed within the embankment area. Basin use should be discontinued until proper remedial work has been performed.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

Lifespan varies based on design volume and maintenance frequency.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

- Photo credit (page 4): RBF Consulting

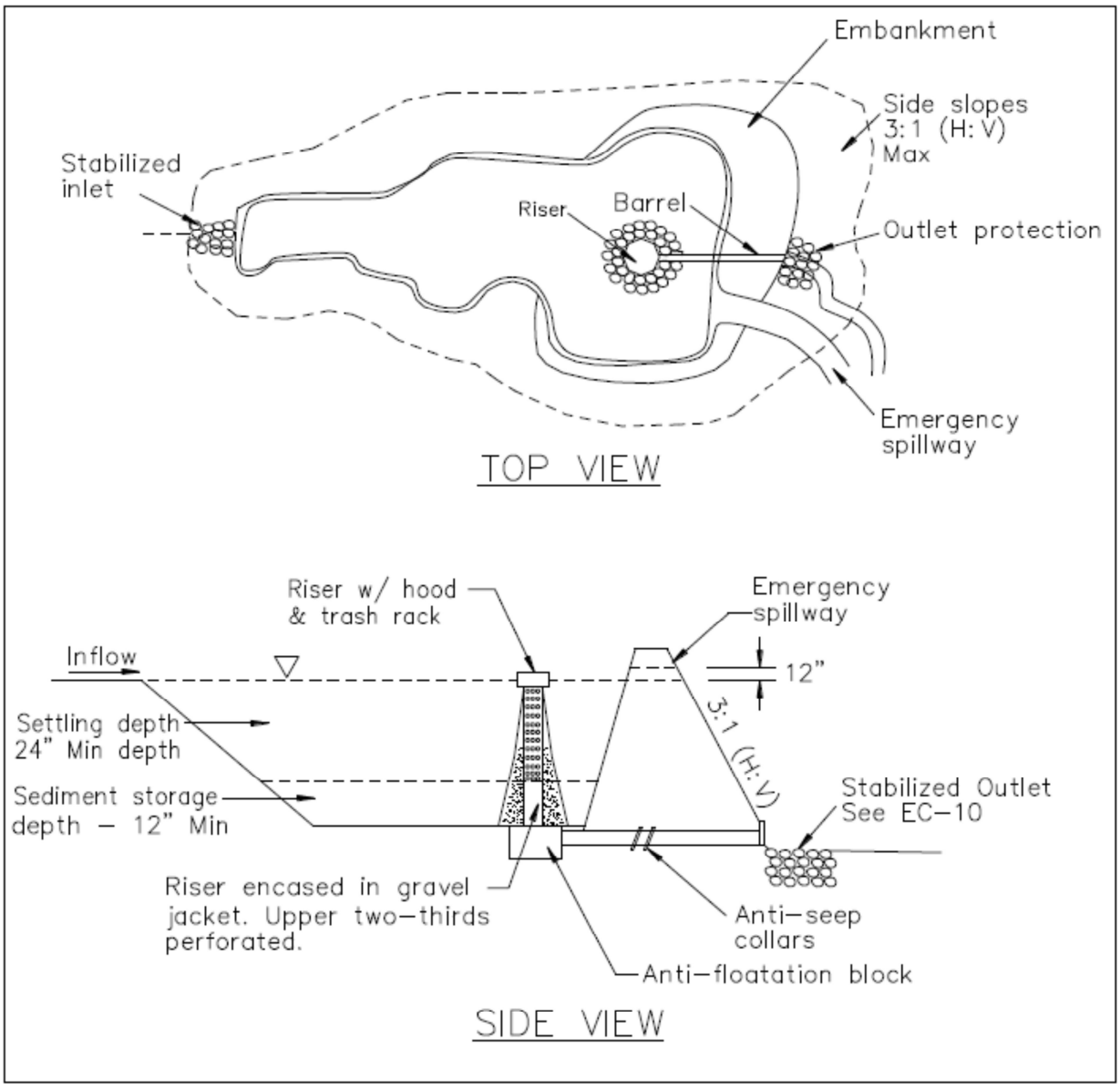


FIGURE 1: TYPICAL TEMPORARY SEDIMENT BASIN
MULTIPLE ORIFICE DESIGN
NOT TO SCALE

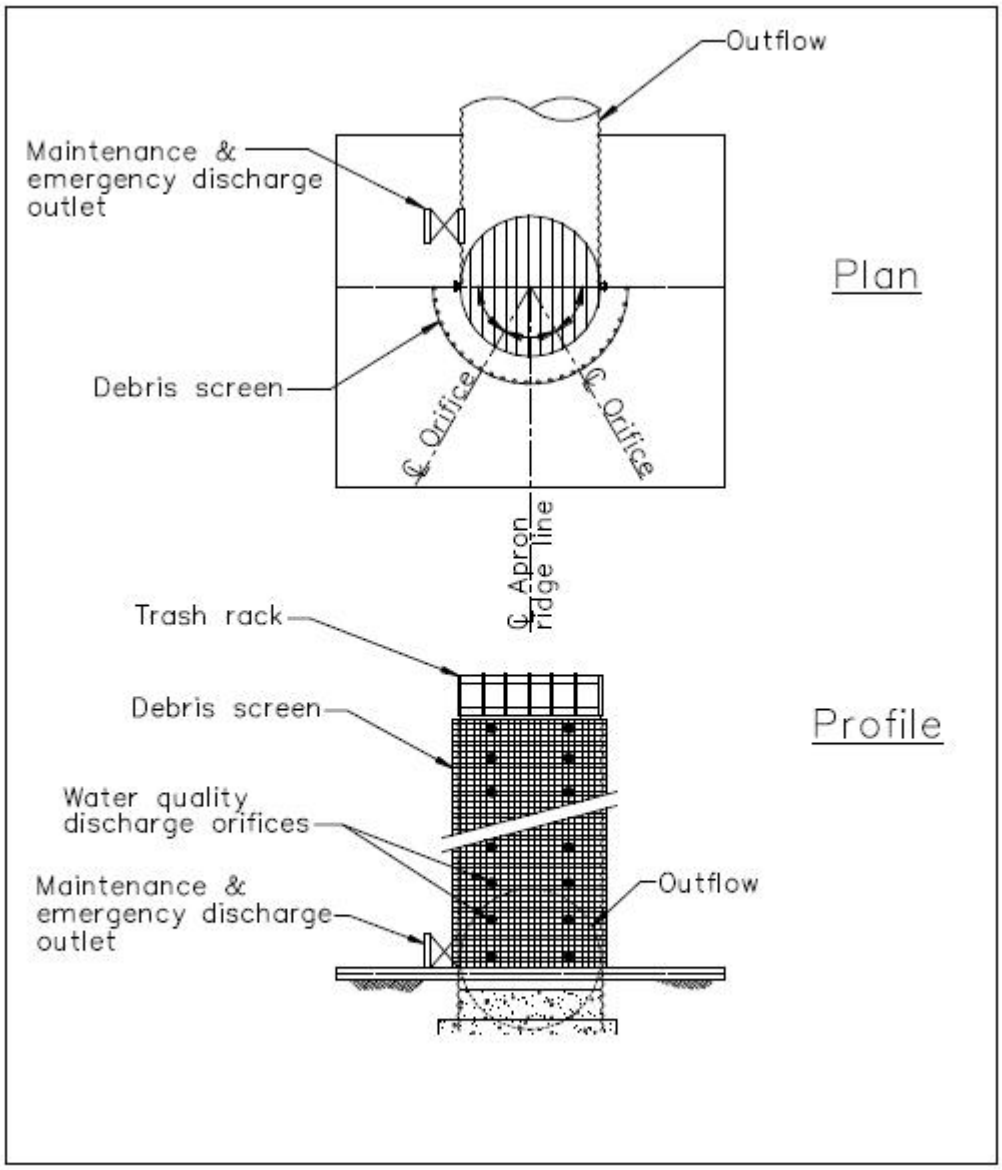


FIGURE 2: MULTIPLE ORIFICE OUTLET RISER
NOT TO SCALE

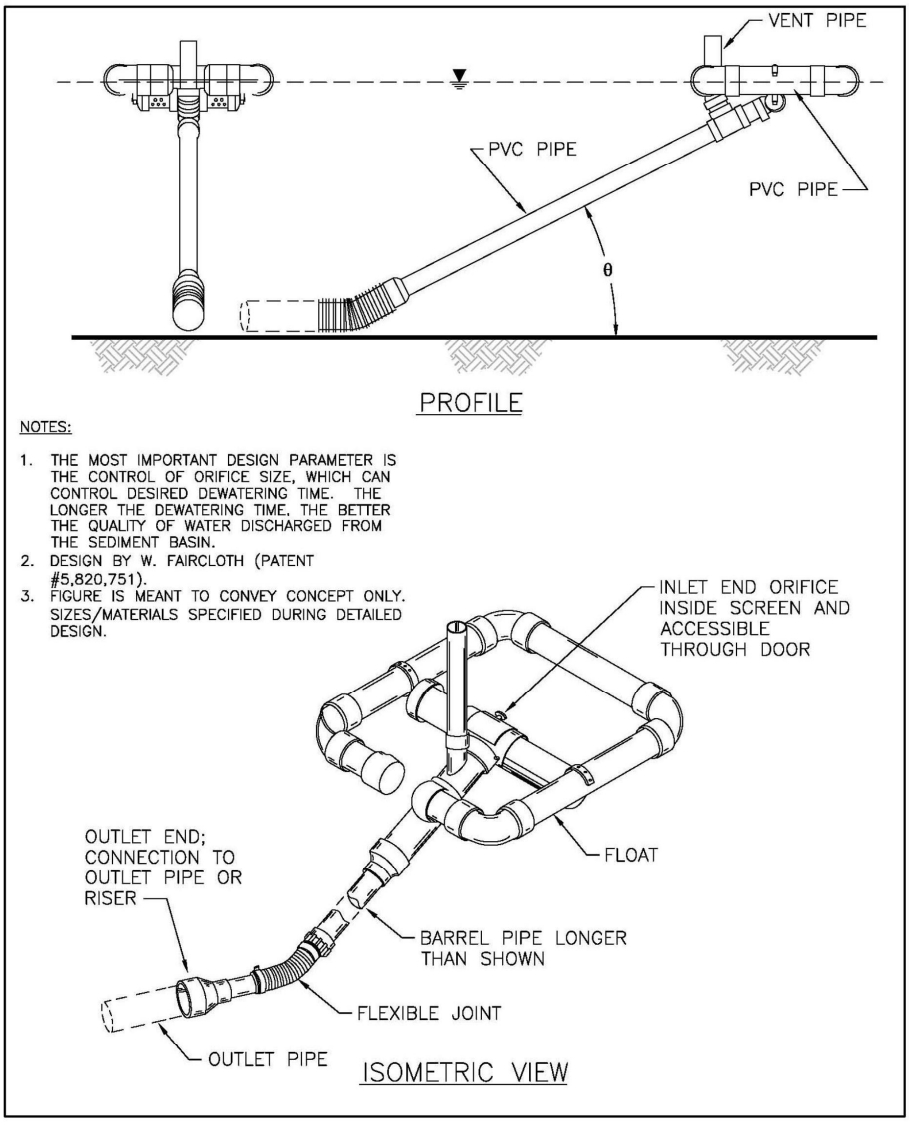


FIGURE 3: TYPICAL SKIMMER
NOT TO SCALE

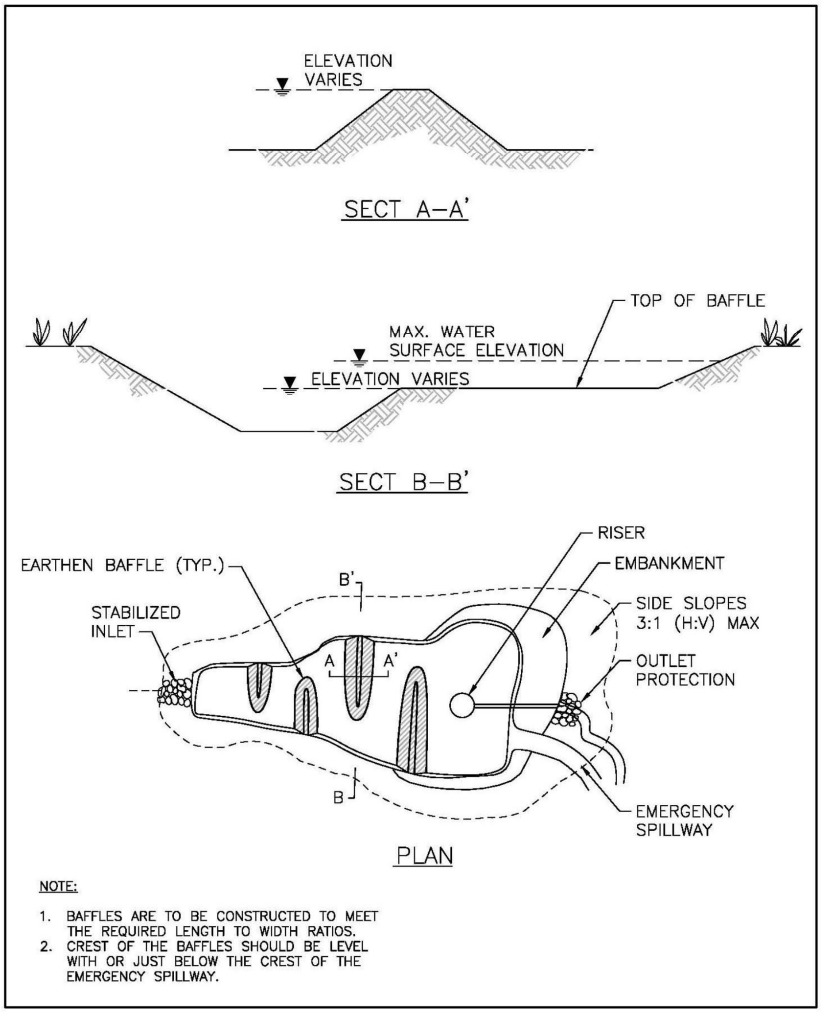
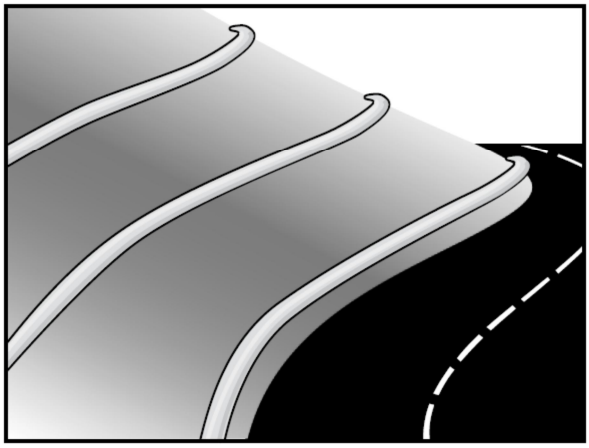


FIGURE 4: TYPICAL TEMPORARY SEDIMENT BASIN WITH BAFFLES
NOT TO SCALE

FIBER ROLLS AND COMPOST SOCKS C-5



OBJECTIVES

Site Planning and Management

✓ Erosion Control

✓ Sediment Control

✓ Runoff Control

Good Housekeeping/ Material Management

TARGET POLLUTANTS

✓ Sediment

Nutrients

Trash

Metals

Bacteria

Oil and Grease

Organics

DESCRIPTION AND PURPOSE

Fiber rolls are typically made of straw, coir, or other biodegradable materials that are bound in a tight, tubular roll by netting. Fiber rolls can also be embedded with gravel or sand for additional weight when staking is not feasible. When placed at the toe or along the face of a slope, fiber rolls can reduce flow velocity and remove sediment from runoff through sedimentation. Fiber rolls can reduce sheet and rill erosion until vegetation can be established. Typical fiber rolls range in diameter from 9 to 20 inches, although larger rolls are available as well.

Compost socks can be used to intercept runoff at the perimeter of the site or on sloped areas. The liner of compost socks is typically mesh filled with compost material, which is often derived from a wide variety of combinations of various materials such as feedstock, bio solids, yard trimmings, green waste, wood, and manure. Compost socks are usually assembled at the site using a pneumatic blower. Compost socks can act as filters, reduce runoff velocities, and possibly aid in establishing vegetation (if a seed mixture is included within the compost). The compost material is organic, biodegradable, and renewable. The exact composition of the compost can be selected based on site-specific objectives for capturing sediment and other pollutants. In addition to trapping sediment, compost can also remove pollutants in storm water, such as heavy metals, oil and grease, and hydrocarbons, by filtration and adhesion, but may release nutrients.

APPLICATIONS

- Along the top, toe, face, or grade breaks of exposed and erodible slopes.
- Along the perimeter of a project.

- As check dams in small, relatively flat ditches.
- As inlet protection for storm drain inlets.
- Around temporary stockpiles.
- Compost socks can be effective over rocky or frozen ground.

LIMITATIONS

- If not properly staked or anchored, fiber rolls can be transported in high flow events. Fiber rolls and compost socks should not be used in channels or concentrated flow. For compost socks, the tributary area should not be more than 0.25 acres per 100 feet interval, and runoff should not exceed 1 cfs per 100-foot interval.
- Difficult to move once saturated.
- Limited sediment capture zone.
- Should not be used on slopes subject to creep, slumping, or landslide.
- Compost can potentially leak nutrients and should not be used directly upstream of nutrient-impaired water bodies.
- Uncertified compost can contain other constituents that are detrimental to water quality. Compost should be obtained from a supplier that is certified by the California Integrated Waste Management Board or should otherwise meet the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.
- Compost socks and fiber rolls should not be used at the base of slopes steeper than 2:1 (H:V).
- Fiber rolls and compost socks are highly susceptible to traffic damage. Regular disturbance will decrease the performance of the fiber rolls or compost socks.

Vehicular traffic will damage fiber rolls and reduce effectiveness.

FIBER ROLLS AND COMPOST SOCKS C-5

IMPLEMENTATION CONSIDERATIONS

- General
  - Turn the ends of the fiber rolls/compost socks upslope (6 inches vertical minimum) to prevent runoff from bypassing around the end of the roll.
  - If more than one fiber roll or compost sock is placed in a row, the rolls should be overlapped (18 inches minimum) and not abutted.
  - Fiber rolls and compost socks should be located on level contours, perpendicular to flow, and with the following general spacing measured along the face of the slope:
    - Slope inclination of 4:1 (H:V) or flatter: Maximum interval = 20 feet
    - Slope inclination between 4:1 and 2:1 (H:V): Maximum interval = 15 feet
    - Slope inclination of 2:1 (H:V) or steeper: Maximum interval = 10 feet
- Fiber Rolls
  - Fiber rolls should be prefabricated. They are generally manufactured in diameters ranging from 9 to 20 inches, although larger ones are possible.
  - In order to increase sediment removal in areas with fine, clayey, or silty soils, fiber rolls can be manufactured with polyacrylamide (PAM). Fiber rolls containing PAM can be significantly more expensive compared to other traditional fiber rolls.
  - Do not use straw-filled fiber rolls or any other product that is not certified as "weed free."
  - Remove rocks, soil clods, etc., so that the fiber roll has direct contact with the soil.
  - Before placing the fiber rolls, dig a small trench across the contour with a depth of 1/4 to 1/3 of the thickness of the roll. The width of the trench should equal the fiber roll diameter. Begin trenching/installation at the bottom of the slope and work toward the top. Excavated material from the trench should be placed and compacted on the uphill side of the fiber roll.
  - Stakes should be placed at each end and spaced a maximum of 4 feet on center. Use wood stakes (0.75 by 0.75 inches and a minimum length of 24 inches). A pilot hole should be created within the fiber roll and underlying ground prior to inserting stakes. This can be accomplished using a straight rebar or other similar product.
  - Gravel bags at 36 inches on center and at each end of the fiber roll can be used as an alternative to stakes. Another alternative to the use of stakes is supplementing the fiber roll core with sand or gravel to provide additional weight.
  - Depending on the type of roll, fiber rolls can be left in place or removed at the end of construction. Permanent fiber rolls are typically encased with a biodegradable material.

Temporary fiber rolls should only be removed once the tributary area has been stabilized, but before vegetation has become so mature that the removal process will disturb more soil and vegetation than necessary.

- Compost Socks
  - Compost socks are generally filled at the project site with a pneumatic blower. If a pneumatic blower is not available on site, a front end loader (or other similar equipment) is necessary to lift and place compost socks. They are generally manufactured at sizes ranging from 12 to 18 inches in diameter.
  - Compost socks are typically heavier than fiber rolls. As such, they do not typically require embedment trenching.
  - Compost socks can be manufactured with biodegradable mesh so that they can remain in place permanently. This option is particularly advantageous near environmentally sensitive areas.
  - Compost socks can be pre-seeded to reproduce native vegetation.
  - Recommended compost medium parameter specifications are shown in Table 1.
  - Compost moisture should typically be 30-50% and organic content should range from 30-65%.

Table 1. Physical/Chemical Requirements of Compost

Property	Test Method	Requirement
pH	*TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0 – 8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0 – 10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- deg C % Wet Weight Basis	30 – 60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30 – 65

Property	Test Method	Requirement
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or Below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	100% Passing, 3 inch 90-100% Passing, 1 inch 65-100% Passing, 3/4 inch 0-75% Passing, 1/4 inch Maximum length 6 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria <1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella <3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass, and Metal % >4mm fraction	Combined Total: <1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % >4mm fraction	None Detected

*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost council (USCC).

Source: Caltrans SSP-10 Erosion Control Blanket (Compost)

FIBER ROLLS AND COMPOST SOCKS

Wood stakes help secure fiber rolls.

Damaged rolls should be repaired or replaced.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect fiber rolls and compost socks before storm events, daily during storm events, and after storm events. In general, linear utility projects shall inspect site fiber rolls and compost socks daily.
- Fiber rolls and compost socks should be inspected for the following:
    - Presence of tears or breaches
    - Slumping due to foot or vehicle traffic
    - Excessive build-up of sediment behind the fiber roll/compost sock

MAINTENANCE

- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- Repair any rills or gullies.
- Remove accumulated sediment along the upstream side of the roll when the depth reaches 1/3 of the designated storage depth. Removal of sediment behind a fiber roll/compost sock when it is performing the function of a grade control is not necessary; however, this application typically necessitates the use of other sediment control BMPs.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of temporary (non-biodegradable) fiber rolls is 12-24 months depending on local climate conditions.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
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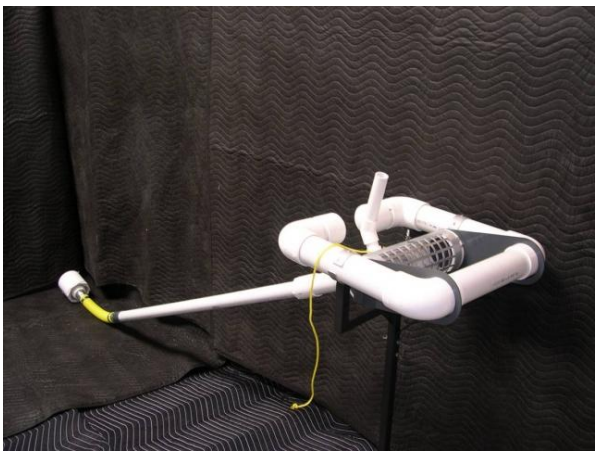
- Photo credit (page 2): City of Sacramento.
- Photo credit (page 6): RBF Consulting

SKIMMERS C-6



OBJECTIVES

- Site Planning and Management
- Erosion Control
- ✓ Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

A floating skimmer is an alternative outlet configuration for a sediment basin that drains water from the upper portion of the basin as opposed to draining from a bottom orifice or perforated riser. Draining water from the top of the basin allows for the cleaner water to be discharged while sediment continues to settle to the bottom of the basin. The skimmer allows the basin to drain slowly at a constant rate, thereby promoting more efficient sedimentation while reducing the potential for local scour at the outlet.

APPLICATIONS

- Alternative outlet structure for a sediment basin (see Fact Sheet C-4 Sediment Basin).
- Sites where basin outlet is exceptionally prone to scour.

LIMITATIONS

- This BMP is not intended to justify basin sizing standards less than that required within this manual (Fact Sheet C-4 Sediment Basin, the California Construction General Permit, and as recommended by CASQA).
- Reduced discharge velocity will likely require increased maintenance frequency and/or increased storage beyond the minimum for a basin with a conventional outlet (see Fact Sheet C-4 Sediment Basin).
- Skimmers are generally limited in application within sediment basins with small catchment areas (i.e., 0.75 acre or less, ideally). Application in basins with larger catchments can necessitate expensive maintenance and sediment removal with a dragline or similar equipment.

- Without implementation of other BMPs, discharge from basins with skimmer outflows should be expected to be turbid. Effectiveness can be increased by utilizing other controls in series and in conjunction with soil stabilization.

Skimmers drain water from the upper portion of the basin as opposed to the bottom, allowing for the cleaner water to be discharged while sediment continues to settle to the bottom of the basin.

IMPLEMENTATION CONSIDERATIONS

- Orifice sizes typically range from 1.5 to 8 inches.
- For a 72 hour drawdown time, the following sizing criteria apply (or as otherwise recommended by manufacturer):
    - Basins up to 5,200 cubic feet = 1.5" Skimmer
    - Basins up to 9,850 cubic feet = 2" Skimmer
    - Basins up to 18,700 cubic feet = 2.5" Skimmer
    - Basins up to 29,300 cubic feet = 3" Skimmer
    - Basins up to 60,300 cubic feet = 4" Skimmer
    - Basins up to 98,500 cubic feet = 5" Skimmer
    - Basins up to 155,500 cubic feet = 6" Skimmer
    - Basins up to 294,000 cubic feet = 8" Skimmer
- Excavate a shallow sediment pit directly under the skimmer.
- Connect a rope to the skimmer for maintenance purposes.
- Connect skimmer to basin outlet structure using a flexible joint to allow the skimmer to rise and fall as the basin fills and empties.
- Skimmer outlets must be protected from re-suspended sediment within the basin using silt fence (or equivalent) baffle structures. Baffles should be located within the basin to facilitate maintenance using a backhoe or other available equipment onsite. Refer to Fact Sheet C-01 Silt Fence for silt fence implementation considerations, inspections, and maintenance.

- Refer always to manufacturer's detailed specifications for implementation, limitations, inspection, and maintenance.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect skimmer BMPs before storm events, daily during storm events, and after storm events.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Inspect system for presence of trash and debris accumulating on the screen or orifice.
- Inspect system for build-up of sediment around the skimmer.
- Inspect plastics for signs of photo degradation.
- Inspect outlet when flowing to ensure discharge rate is appropriate for intended drawdown.

MAINTENANCE

- If the skimmer is clogged with trash or debris, jerk the rope to dislodge debris and restore flow.
- If necessary, use rope to pull skimmer to the side of the basin and remove debris. Remove any debris from the orifice inside of the skimmer.
- If sediment is built up around the skimmer, pull the skimmer to one side and excavate the sediment underneath.
- Replace any portions of the plastics that show signs of photo degradation.
- Adjust outlet as necessary, either through maintenance or a physical change in orifice size, to ensure the discharge rate is appropriate for the intended drawdown time.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

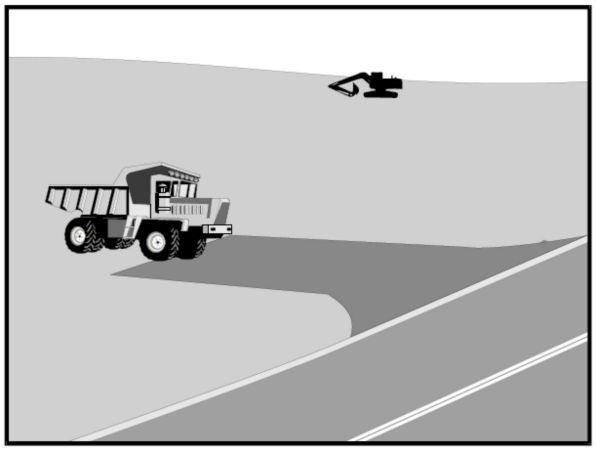
The plastics used in the skimmer are expected to last several years before succumbing to photo degradation. Service life may be shorter in areas with intense sunlight.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

- Faircloth Skimmer, www.fairclothskimmer.com, accessed February 2013.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Photo credit (page 1): Faircloth Skimmer, www.fairclothskimmer.com, accessed February 2013.
- Photo credit (page 2): RBF Consulting

STABILIZED CONSTRUCTION ENTRANCE/EXIT C-7



OBJECTIVES

- Site Planning and Management
- Erosion Control
- ✓ Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Stabilized construction entrance/exit is 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, parking lot, or any paved surface that has a direct connection to the storm drain system. The purpose of the stabilized construction entrance/exit is to reduce or eliminate the tracking of sediment onto public rights-of-way, streets, or impervious surfaces that discharge to storm drains, creeks, or rivers. Reduction in the tracking of sediments and other pollutants onto paved areas also helps prevent deposition of airborne dust.

APPLICATIONS

- All construction sites where vehicles and equipment will leave the construction site and potentially track sediment off site.
- Where dirt or mud can be tracked onto public rights-of-way or paved surfaces.
- Adjacent to water bodies.
- Where poor soils are found.
- Where dust is a problem during dry weather.
- Can be used in combination with street sweeping for higher level of effectiveness.

C-7 STABILIZED CONSTRUCTION ENTRANCE/EXIT

LIMITATIONS

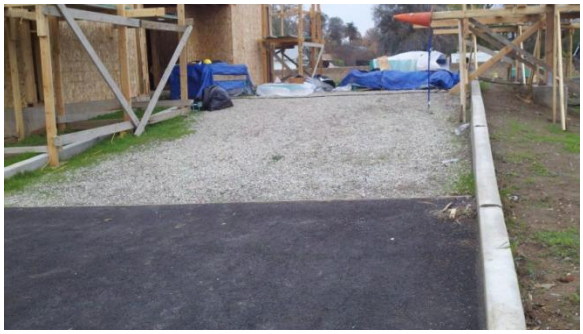
- Will require periodic top dressing with additional stones.
- May be expensive to construct when a wash station is necessary. In such instances, a sediment trap must also be provided to collect wash water runoff.

IMPLEMENTATION CONSIDERATIONS

- Install prior to any site activity.
- Limit construction entrances/exits to one, or as few as practical.
- Ensure that all vehicles, including those of employees, subcontractors, and suppliers, are guided with clearly visible physical barriers to use the construction entrance/exit – prevent by-pass.
- To minimize dust, limit the speed of vehicles entering or exiting the construction site to 5 miles per hour or less.
- Direct runoff from the stabilized entrance/exit or wash station through a sediment trapping device prior to discharge.
- If small amounts of sediment are still discovered to be leaving the project area, then daily sweeping of the connected roadway should be conducted or the entrance length should be increased.
- If there is a high risk that vehicles will track large amounts of sediment off the construction site, consider installing a vehicle/wheel wash station.
- Construction
    - Construct on level ground that is properly graded to prevent runoff from leaving the construction site.
    - Construct to a minimum length of 50 feet and minimum width of 20 feet. If multiple vehicles are expected to enter/exit the project area at the same time, the width of the stabilized construction entrance/exit shall be designed to accommodate two vehicles. Longer lengths may be needed depending on observed performance results.
    - Design the stabilized entrance/exit with a flared transition onto the right-of-way to accommodate vehicle turning radii.
    - Construct with angular, clean, washed gravel 3 to 6 inches in diameter. Increase rock size as equipment size increases.
    - Place geotextile fabric underneath the gravel to prevent it from being pressed into the underlying soil.

  - Place gravel/rock to a minimum depth of 12 inches. Design the stabilized entrance/exit to support the heaviest vehicles and equipment that will utilize it.

- Rumble Strip
  - To be used in conjunction with a rock strip to increase effectiveness.
  - Use grooved metal grates or large stone areas that will remove sediment by agitation.
  - Install rumble strips 20 feet in length, with rock entrances before and after to equal at least 50 feet in total length.
- Cattle Guard
  - Appropriate for areas with heavy (clay) soils.
  - May be a traditional cattle guard grate or may be constructed of railroad ties with crushed stone between the railroad ties. The area under the crushed stone includes an under-drain and perforated pipe that carries water and suspended fines to a sediment trap.
- Vehicle/Wheel Washing
  - Use vehicle/wheel washing in conjunction with rock entrances, rumble strips, or cattle guards when soil removal is not achieved and dirt tracking is evident. Wheel washing may be needed in soils with high clay content.
  - Design vehicle/wheel washing stations to accommodate the anticipated traffic, vehicle weights, and vehicle lengths.
  - Include proper drainage to convey wash runoff to an adequately sized water and sediment trapping device. Wash water must not be discharged offsite or into a storm drain system.
  - To conserve water, recycle the wash water.
  - Construct rock entrances between the vehicle wash station and the pavement or right-of-way to minimize fugitive sediment.
  - Utilize automatic shut-off nozzles to prevent water from being left on.



Construction entrances reduce tracking onto adjacent streets.

C-7 STABILIZED CONSTRUCTION ENTRANCE/EXIT

Although the gravel section exceeds the 50' minimum length and rumble strip has been provided, there are still signs of tracking. Construction entrances/exist should be inspected and modified as necessary to reduce or eliminate tracking.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect stabilized construction entrances/exits daily, before storm events, during storm events, and after storm events.
- In general, linear utility projects shall inspect stabilized construction entrances daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Stabilized construction entrances should be inspected for accumulation of sediment within the rock void area.
- Stabilized construction entrances should be inspected for signs of tracking within the public right of way.
- Inspections should identify any occurrence of fugitive dust.

MAINTENANCE

- If significant amounts of sediment continue to be discovered offsite, the BMP should be re-designed and re-installed or additional measures such as sweeping or a wheel wash station may be used.

- If a gravel entrance becomes clogged with sediment, apply a top dressing of additional rock. If the problem persists, remove the gravel/rocks, separate and dispose of the sediment, and re-install clean gravel/rocks.
- If a rumble strip or cattle guard becomes clogged with sediment, remove and dispose of the accumulated material. If washing with a hose, ensure that runoff is directed to a suitably designed sediment trap prior to discharge. No dry weather flow may discharge offsite or into a storm drain system.
- If construction foot traffic is causing sediment tracking offsite, provide boot scraper stations at all foot traffic entrances/exits.
- Remove gravel/rock, rumble strips/cattle guards, and geotextile filter fabric at the completion of construction.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

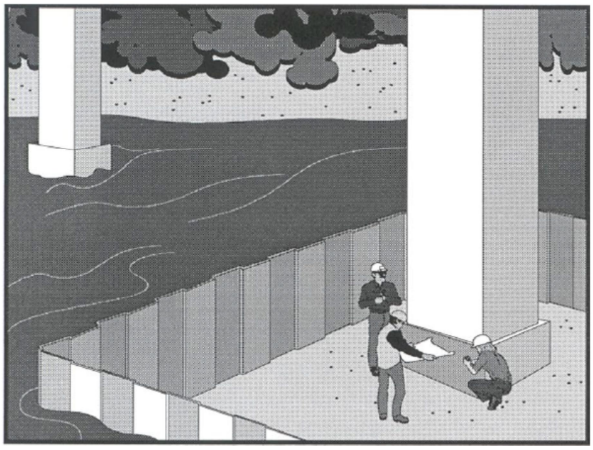
During the rainy season, stabilized rock construction entrances may require a top dressing or replacement of rock after only a few runoff-producing storm events, depending on project size and the amount of construction traffic. Rumble strips would be expected to last the duration of construction activity, but will require maintenance to clear accumulated material.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 3): City of Sacramento.
- Photo credit (page 4): RBF Consulting

D: RUNOFF CONTROLS

DIVERSIONS D-1



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- ✓ Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Diversions are structures and measures that intercept flow upstream of the project and convey it around the work area with minimal water quality degradation from construction operations or the construction of the diversion.

Diversions are often used when construction is to occur in or near a waterway. Structures commonly used include ditches, swales, berms, dikes, gravel bags (sand bags should not be used in rivers or streams), aqua barriers, cofferdams, filter fabric, and turbidity curtains.

APPLICATIONS

Diversions should only be implemented where appropriate permits have been secured for work in a stream or water body.

- Appropriate for construction activities within or near a water body. Such activities may include streambank stabilization or installation of culverts, bridges, piers, or abutments.
- Pumped diversions can be used for streams with low or intermittent flow.
- For streams less than 20 feet wide and with flow rates less than 100 cfs, a temporary bypass channel can be used.

LIMITATIONS

- Diversions often disturb the waterway during installation and removal.

- 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 Wildlife.
- Depending on the permits required, testing and sampling may also be required.
- Diversions may constrict the waterway, which could obstruct flow and cause increased flooding. The impacts to the waterway should be considered before design and installation of the diversion.
- Diversions are not appropriate where there is insufficient flow to support aquatic species in the area that will be dewatered. Diversion should also not be used if the installation, maintenance, or removal will disturb sensitive aquatic species.
- Diversions should not be used in deep water unless designed or reviewed by a registered engineer.
- Diversions should not completely dam stream flow.
- Dewatering may require additional sediment control measures.

IMPLEMENTATION CONSIDERATIONS

- When work areas encroach on flowing streams, diversions should prevent the flow of muddy water into the stream. During construction of the diversion, muddying of streams should be minimized.
- Diversion structures should be designed to account for fluctuation in water depth or flow volume due to tidal influences, storm events, flash floods, etc.
- If heavy equipment is required for installation in wet portions of a water body, the equipment should be clean and sensitive features such as fuel tanks, gearboxes, and axles should be above the water level. If these features are not above the water level, lubricants and fuels should be sealed so that inundation by water will not cause discharge of these pollutants into the water body.
- Excavation machinery should operate from outside the water except as necessary to cross the stream or access the construction site.
- Do not park equipment below the high water mark unless allowed by a permit.
- Minimize disturbance to vegetation during construction, maintenance, and removal of diversions. Replace any disturbed vegetation with appropriate erosion control measures.
- Where possible, impacts should be minimized by scheduling construction and utilizing diversions during periods of low flow. Scheduling should also consider seasonal variations in flow, fish migration and spawning seasons, and crop irrigation demands.
- Diversion structures should be free of pollutants such as sediment, grease, or oil. Use non-toxic and non-hazardous substances.
- Provide velocity dissipation at transitions in the diversion.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect diversion BMPs before storm events, daily during storm events, and after storm events.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Inspect to make sure BMPs are in place prior to commencement of construction activities.
- Pumped diversions require 24-hour monitoring of pumps.
- Inspect diversions for:
    - Gaps or holes that would allow flow to bypass the diversion.
    - Sediment buildup.
    - Damage, debris, sediment buildup, and adequate slope protection.

MAINTENANCE

- Repair any gaps or holes.
- Remove and properly dispose of sediment buildup.
- Remove debris and sediment from diversion channels and repair slope protection as required.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of diversions will vary depending on the type of diversion and the material used. Diversions are typically designed to last as long as necessary with standard maintenance. Since installation and removal of diversions can cause adverse impacts to adjacent water bodies, they should be replaced as infrequently as possible.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit

Photo credit: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

INLET PROTECTION D-2

OBJECTIVES

- Site Planning and Management
- Erosion Control
- ✓ Sediment Control
- Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- ✓ Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Protection for inlets can be accomplished through a variety of means that promote runoff filtration and/or sedimentation prior to storm water entering the storm drain system. Inlet protection is typically provided using such BMPs as gravel bags, and/or proprietary inserts. These BMPs can be aided greatly by working in combination with an excavated sump area to promote sedimentation. The purpose of both is to prevent sediment laden runoff from entering the storm drain system without sealing off the inlet or contributing to significant flow bypass.

APPLICATIONS

- All storm drains receiving runoff from active work areas, both internal and external to the specific construction site. Inlet protection should be used in combination with other erosion and sediment control measures throughout construction sites to prevent sediment laden runoff and non-stormwater discharges from entering the storm drain.
- Where temporary flooding or ponding of storm water will not create traffic management problems or adversely impact adjacent structures.
- Inlets operating prior to the establishment of surrounding areas.

LIMITATIONS

- Drainage area should not exceed one acre. For drainages larger than an acre, runoff shall be diverted to a sediment trapping device designed for larger flows.
- Straw bales should not be used as inlet protection BMPs.
- Frequent maintenance and inspection are required.

- Improper installation or maintenance can lead to flooding downstream or sediment laden discharge to storm drain system.

IMPLEMENTATION CONSIDERATIONS

- General Considerations
  - When selecting a specific inlet protection BMP, consider the project-specific drainage patterns and the impacts created by ponding water and overflow characteristics.
  - Install inlet protection prior to the start of construction or land disturbance activities.
  - Whenever possible, based upon site drainage characteristics, install a graded sump around the inlet to increase efficiency compared to methods reliant solely on filtration. Graded sumps should be 1 to 2 feet deep, with 2:1 (H:V) maximum side slopes. Recommended storage volume is 67 cubic yards per acre of drainage area. For inlets on grade, ponding for sedimentation must occur upstream of the inlet, so that runoff may still enter the on-grade inlet and not completely bypass.
  - In areas of high clay and silt soil characteristics, use a filter fabric and/or geotextile blanket in combination with gravel bags or similar protection means that promote sedimentation.
- When Using Gravel Bags around Street Inlets
  - Leave a gap of one gravel bag along the top row to serve as a controlled spillway – this promotes weir flow and allows sediment to remain trapped behind gravel bags. Gravel bags should be staggered when stacked atop one another.
  - Ensure adequate room has been provided for ponding, without causing flow to elevate beyond the top of curb or encroach into traffic areas.
  - For soils with high silt or fine clay, consider supplementing gravel bags with other filter fabric material.
  - Bio filter bags and compost socks can be used as an alternative to gravel bags.

Inlet protection should be provided to limit sediment discharge to the storm drain system.

Avoid clogging inlets with gravel bags.

This inlet protection provided limited benefit since sediment-laden runoff is passing easily around the ends of the bags.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect inlet protection BMPs before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect inlet protection BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Inlet protection BMPs should be inspected for the following specific issues:
    - Unintended amount of ponding around inlet filter or adverse overflow conditions
    - Proper arrangement of gravel bags
    - Tears, holes, gashes, or clogging of gravel bags
    - Excessive build-up of sediment within ponding areas or behind filters

MAINTENANCE

- Periodically remove all accumulated sediment around the inlet – at a minimum, remove sediment when accumulation reaches one-third the height of the barrier.
- Filter fabric should not be used for inlet protection, except during dry weather. For wet weather, use gravel bags for protection.

- Replace gravel bags at first sign of degradation to prevent gravel from leaking into the storm drain system.
- Ensure trapped sediment is not spilled into the storm drain when replacing/removing gravel bags.
- When using proprietary geotextile inserts, refer to manufacturer's specifications for recommended inspection and maintenance protocol.

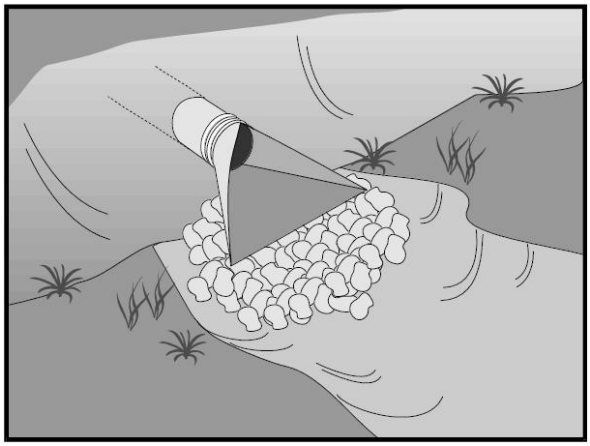
ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of inlet protection BMPs is typically one year. Some proprietary geotextile inserts can last longer. Diligent maintenance can prolong the life of silt fence and gravel bags by reducing the likeliness of clogging, tearing, or other degradation.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): RBF Consulting.
- Photo credit (page 3): City of Sacramento.

OUTLET VELOCITY PROTECTION D-3



OBJECTIVES

- Site Planning and Management
- ✓ Erosion Control
- Sediment Control
- ✓ Runoff Control
- Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Outlet velocity protection is a physical application composed of rock, grouted riprap, or concrete rubble installed immediately downstream of a culvert, conduit, or open channel. The purpose of outlet velocity protection is to prevent local scour and erosion associated with high discharge velocities and concentrated flow.

APPLICATIONS

- Anywhere concentrated flow has the potential to cause erosion.
- Locations where lined conveyances discharge to unlined conveyances.

LIMITATIONS

- Rock can be washed downstream in high flows if not sized properly, leading to adverse structural or life safety impacts.
- Maintenance can be difficult as sediment removal may require removing rock and re-installing.
- Grouted riprap may break up in areas of freeze and thaw.
- Standing pools may be created, leading to vector issues.
- Creation of a relatively flat gradient is required for rock placement area.

D-3 OUTLET VELOCITY PROTECTION

IMPLEMENTATION CONSIDERATIONS

- Velocity outlet protection should be applied during construction and permanently installed once construction is complete.
- Rock size and placement configuration is dependent upon exit flow velocity, pipe diameter or channel width. Rock size and layout dimension should be increased with higher flows. Rock placed within the apron should meet minimum size criteria and be angular in nature.
- The width of the rock apron should be wider than the discharge culvert, conduit, or channel. A good rule of thumb is that the width and length of the apron should be at least 3 to 4 times the diameter of the discharge culvert, with a minimum of 5 feet.
- A filter fabric, or blanket (consisting of gravel and/or sand) is required beneath the outlet protection measure. Care should be taken to avoid tearing the fabric during installation.
- Outlets on slopes steeper than 10 percent should have additional protection such as concrete sills and toe-down protection.
- Outlet protection measures should be designed by a registered Civil Engineer. Guidance should be sought in accordance with generally accepted published sources, such as HEC 14 and Chapter 11 of the City of Sacramento Design and Procedures Manual (http://www.cityofsacramento.org/utilities/media-room/documents/section11/Section11.pdf).

Filter fabric is being utilized, and the length and width meet the minimum recommended dimensions. Care should be taken to avoid tearing the fabric during installation.

Note: The BMP in this photo is in construction and not yet complete. Rock still needs to be added on top of the filter fabric.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.

- In general, traditional construction projects shall inspect outlet velocity protection BMPs before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect outlet velocity protection BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Inspect outlet velocity protection BMPs with focus on the following:
    - Rock displacement and damage to underlying fabric.
    - Scour and/or erosion in the outlet vicinity.
    - Undermining of rock, grouted riprap, or concrete rubble.
    - Sediment over-accumulation or clogging of the rock voids.
    - The presence of trash and debris.
    - Signs of vector breeding and standing water within the riprap apron.

MAINTENANCE

- Periodically remove accumulated sediment, trash, debris, and invasive weeds.
- If displacement has occurred, replace rock and/or filter blanket. Consider upsizing rock or increasing apron dimensions. Consider other measures such as a discharge sill and toe-down protection at the downstream end of the apron.
- Repair eroded areas by grading, re-compaction, and revegetation.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of outlet velocity protection depends on elements such as proper installation, sediment accumulation, and overall frequency of discharge. Diligent maintenance can prolong the life of outlet velocity protection by reducing the likeliness of clogging or significant rock displacement.

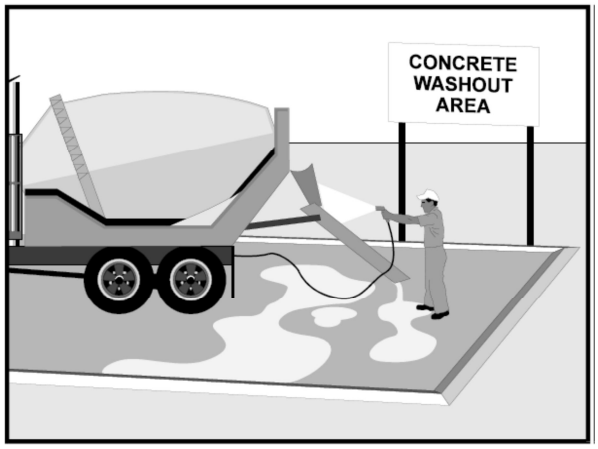
REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 2): RBF Consulting.

E: GOOD HOUSEKEEPING/MATERIAL MANAGEMENT

CONCRETE WASHOUT AREA E-1



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- ✓ Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

A concrete washout area is a designated area, on- or off-site, for the washout/cleaning of equipment and vehicles that have worked with construction materials that have basic chemical properties that can raise pH levels. The purpose of a concrete washout is to prevent and reduce the discharge of pollutants to storm water from construction materials/waste, such as mortar, concrete, stucco, cement, and block. Although washing of concrete waste from construction vehicles may be the most common scenario encountered, the same applications, limitations, and implementation considerations apply to the cleaning of any vehicle, tools or equipment on site that have associated concrete or cement waste.

APPLICATIONS

- Where concrete, mortar, grout, cement, or any other potentially pH-altering materials are used as construction material.
- Where concrete dust and debris may result from demolition activities.
- Where slurries of Portland cement concrete (PCC) is generated, including from coring, grinding, grooving, saw cutting, and hydro-concrete demolition.
- Where concrete-coated equipment/concrete trucks are washed onsite.
- Where mortar-mixing stations exist.
- Where stucco mixing and spraying is conducted.
- In any instance where necessary to achieve compliance with California Construction General Permit standards for pH within stormwater discharge.

E-1 CONCRETE WASHOUT AREA

LIMITATIONS

- Multiple washout areas may be necessary to ensure adequate capacity and to allow for evaporation.
- Washout of concrete wastes at offsite locations may not always be possible.
- Use of phosphate-free and biodegradable soap is toxic prior to degradation. Care must be taken not to allow the discharge of soap-laden water in any circumstance.

IMPLEMENTATION CONSIDERATIONS

- Include requirements for concrete and related waste management into agreements with material suppliers and in specifications for contractors.
- Perform washout of concrete trucks at the plant whenever possible.
- Avoid mixing excess amounts of concrete or cement onsite.
- Do not wash out concrete trucks / equipment into storm drains, streets, open ditches, streams, or onto the ground.
- Conduct wash out of concrete trucks / equipment in designated areas only.
- On-site Concrete Washout Area
    - Locate washout areas away from construction traffic or access areas to prevent disturbance or tracking.
    - Locate washout areas a minimum of 50 feet from storm drain inlets, watercourses, and open drainage facilities.
    - Post signs adjacent to the washout area to inform construction personnel of the proper techniques for washout and waste disposal.
    - Design washout areas to handle the expected volumes of solids, slurries, wash water, and rainfall.
    - Line the washout areas with plastic material to prevent discharge to the underlying ground or surrounding area. Washout areas must be water tight.
    - Dispose of or recycle hardened concrete on a regular basis, in accordance with federal, State, or local regulations.
    - Construct washout areas either above grade or below grade, at the discretion of the contractor.
    - Above Grade Concrete Washout Area
        - Design to a minimum length and width of 10 feet, unless the small size of the construction job allows for a smaller washout area.

- Ensure plastic lining material is a minimum of 10 mil polyethylene sheeting and is free of holes, tears, or other defects that would compromise the impermeability of the plastic material. Wash water will evaporate and remaining solid waste should be disposed of properly.
- Include construction of a two-stacked 2x12 rough wood frame around the concrete washout area, securely fastened with stakes on either side of the wood to hold the wood and plastic lining in place.
- Alternatively, use portable removable containers ("roll-offs") as above grade concrete washouts. Properly seal the roll-off to prevent leakage. Remove and replace the roll-off when it reaches 75% capacity.

o Below Grade Concrete Washout Area

- Design to a minimum length and width of 10 feet.
- Ensure plastic lining material is a minimum of 10 mil polyethylene sheeting and is free of holes, tears, or other defects that would compromise the impermeability of the plastic material. Wash water will evaporate and remaining solid waste should be disposed of properly.
- Ensure the base of the washout area is free of rock or debris that may damage the plastic liner.
- Design the depth of the washout area to 3 feet below grade or less.
- Surround the washout area with a sandbag berm or equivalent.
- Provide lath and flagging of commercial type.

o Removal of On-site Concrete Washout Area

- Remove and properly dispose of or recycle hardened wastes in accordance with federal, State, or local regulations.
- Remove materials used in the construction of the concrete washout area and properly dispose of or recycle the materials in accordance with federal, State, or local regulations.
- Backfill and repair any holes, depressions, or other ground disturbance caused by removal of the concrete washout area.

E-1 CONCRETE WASHOUT AREA

The impermeable plastic liner for this portable above-grade washout will allow water to evaporate while the remaining solid waste will be disposed of properly.

The lack of a concrete washout may lead to high pH in project site runoff.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect washout areas weekly, before storm events, daily during storm events, and after storm events.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Inspect washout for signs of breaches or tears within the bottom lining.
- Inspect structural integrity of the wood frame (or sandbags) and stakes.

CONCRETE WASHOUT AREA E-1

MAINTENANCE

- Maintain concrete washout areas to provide sufficient holding capacity (minimum freeboard of 4 inches for above grade washout areas and 12 inches for below grade washout areas).
- Remove and dispose of hardened concrete regularly to maintain sufficient holding capacity.
- Clean existing concrete washout areas or construct new washout areas when the existing washout area is 75% full.
- Repair any damage immediately (e.g., torn liner, leaks, posted signs, etc.).
- Clean up any spilled material and cement residue and dispose of in covered trash containers.

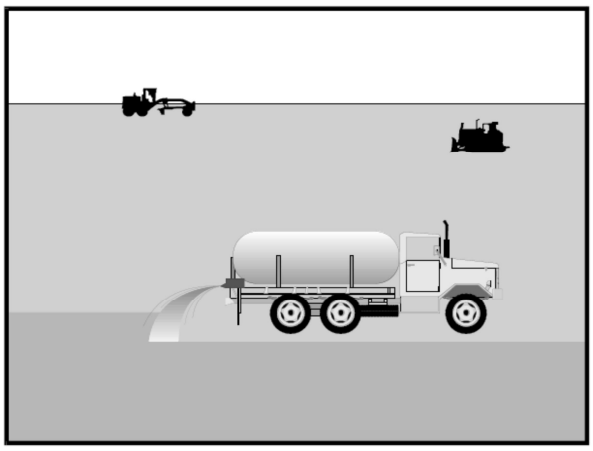
ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of an on-site concrete washout area depends upon the design capacity and frequency/volume of use. The lifespan also depends on the various individual components of the facility. Plastic liners and sandbags are subject to photo degradation, and wood materials in contact with exposed soils will experience biodegradation. Maintenance or replacement of one or more of the components would be anticipated every 6-12 months.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 4): RBF Consulting.

DUST CONTROL E-2



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Dust control includes a suite of BMPs with the purpose of preventing exposed soil or other particulate materials from becoming windborne.

APPLICATIONS

- Construction vehicle traffic on unpaved roads/areas or that stores/haul material in an open bed.
- Drilling/blasting activities.
- Construction and maintenance of soil and material storage piles.
- Batch dropping from front-end loaders.
- Areas of unstabilized soil.
- Final grading / site stabilization.

LIMITATIONS

- Some techniques (e.g., watering) prevent dust only for a short period and may require application daily, or more often, to be effective.
- Some techniques (e.g., watering), if over-applied, may cause erosion and track-out.
- Some techniques (e.g., chemical suppression) may have potential environmental impacts, including surface and groundwater quality deterioration, soil contamination, toxicity to soil and water biota, toxicity to humans during and after application, air pollution from volatile dust suppressant components, accumulation in soils, changes in hydrologic characteristics of the soils, and impacts on native flora and fauna populations.

- Effectiveness depends upon soil, temperature, humidity, wind velocity, and traffic.
- In compacted areas, liquid dust control measures, including watering, may wash sediment or other constituents into the drainage system.

IMPLEMENTATION CONSIDERATIONS

The table below presents dust control BMPs that can be applied to varying site conditions and activities that could potentially create dust. For heavily traveled and disturbed areas, wet suppression (watering), gravel asphalt surfacing, chemical dust suppression, stabilized construction entrances/exits, equipment washout areas, and haul truck covers can be used as dust control measures. For areas of occasional or no construction traffic, permanent or temporary vegetation and mulching can be used as dust control measures.

Site Condition / Activity	Dust Control Practices							
	Permanent Vegetation	Mulching	Wet Suppression (watering)	Chemical Dust Suppression	Gravel or Asphalt	Stabilized Construction Entrance/Exit and Equipment Washout Areas	Synthetic Covers	Minimize Extent of Disturbed Area
Disturbed Areas not Subject to Traffic	✓	✓	✓	✓	✓			✓
Disturbed Areas Subject to Traffic			✓	✓	✓	✓		✓
Material Stockpiles		✓	✓	✓			✓	✓
Demolition			✓			✓	✓	
Clearing/ Excavation			✓	✓				✓
Truck Traffic on Unpaved Roads			✓	✓	✓	✓	✓	
Tracking					✓	✓		

Note: Chemical Dust Suppression may include: mulch and fiber based dust palliatives (e.g., paper mulch with gypsum binder), non-petroleum based organics (e.g., vegetable oil, lignosulfonate), petroleum based organics (e.g., asphalt emulsion, dust oils, petroleum resins), salts and brines (e.g., calcium chloride, magnesium chloride), synthetic polymers (e.g., polyvinyl acetate, vinyls, acrylic), clay additives (e.g., bentonite, montimorillonite), and electrochemical products (e.g., enzymes, ionic products).

Additional preventive measures are as follows:

- General
    - On windy days (sustained wind speeds above 15 mph), limit soil disturbance activities.

- Give special attention to windy or wind-prone areas.
- Schedule construction activities to minimize the area where, and time period when, soils are exposed.
- Quickly stabilize exposed soils using vegetation, mulching, spray-on adhesives, calcium chloride, sprinkling, or stone/gravel layering.
- Stabilize inactive construction site areas using temporary vegetation or chemical stabilization methods.
- Stabilize exposed soil by converting to permanent BMPs as soon as practical.
- Implement dust control measures for material stockpiles, using silt fences, fiber rolls, or waterproof covers.

- Access, Roads, and Vehicle Traffic
  - Identify and stabilize key access points prior to commencement of construction.
  - Limit onsite vehicle traffic to 15 miles per hour or less.
  - Control the number and activity of vehicles onsite at any given time.
  - As practicable, restrict construction traffic to stabilized roadways within the project site.
  - As practicable, plan construction traffic access routes in the same locations as future roads. Pave these roads when appropriate to limit the amount of exposed soil.
  - Provide covers for haul trucks transporting materials that contribute to dust.
  - Stabilize unpaved haul roads, parking, and staging areas.
  - Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.
  - Provide for rapid cleanup of sediments deposited on paved roads through the use of vacuum trucks, streets sweepers, and brooms. Do not use leaf blower machines to move sediment or other material from streets and pathways as it results in increased levels of dust.
  - Furnish stabilized road entrances and vehicle wash-down areas.
- Wet Suppression (Watering)
  - Apply water 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.
  - When water is not supplied via pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.

  - If reclaimed 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.

- Chemical Stabilization
  - Chemicals used for chemical stabilization should not create any adverse effects on stormwater, plant life, or groundwater and should meet all applicable regulatory requirements.
  - Chemical dust suppression should not be used within 100 feet of wetlands or water bodies.
  - If the soil surface has minimal natural moisture, the area to be treated may need to be pre-wetted to allow chemical dust control agents to uniformly penetrate the soil surface.
  - Chemically treated subgrades may make the soil repellant to water, interfering with long-term infiltration and the vegetation or re-vegetation of the site.
  - Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.

Water trucks can be used to evenly distribute water and avoid causing erosion and/or non-stormwater runoff.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.

- Continual monitoring of the site condition during construction on an hourly basis should be conducted; however, inspection time may vary depending on the type of dust control measure used. In addition, traditional construction projects shall inspect dust control measures before storm events, daily during storm events, and after storm events. Linear utility projects shall inspect site BMPs daily.
- Monitor weather forecasts for predictive occurrence of high wind (15 mph or greater).

MAINTENANCE

- If dust control problems are found, remedy them immediately through re-application or additional measures.
- Conduct regular training of construction staff on dust control measures, products, and regulatory requirements.

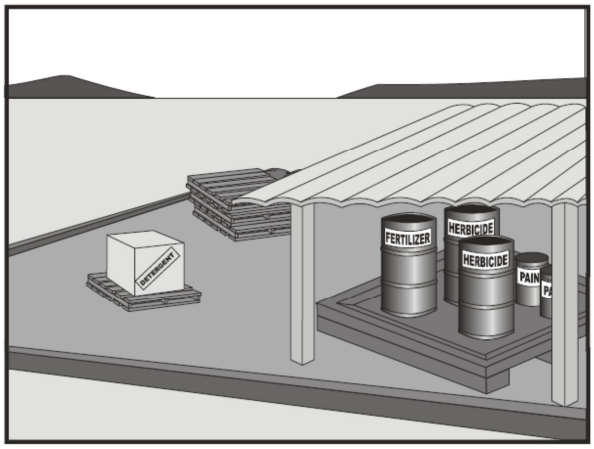
ANTICIPATED LIFESPAN DURING CONSTRUCTION

The anticipated useful lifespan of dust control BMPs vary depending on the method used. Most water-based dust control measures require frequent application, often daily or even multiple times per day. The longevity of chemical dust suppressants varies depending on the chemicals used and application rate.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- U.S. EPA, Potential Environmental Impacts of Dust Suppressants: Avoiding Another Times Beach, EPA/600/R-04/031, March 2004 (www.epa.gov/esd/cmb/pdf/dust.pdf).
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 4): RBF Consulting.

MATERIALS MANAGEMENT E-3



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- ✓ Nutrients
- ✓ Trash
- ✓ Metals
- Bacteria
- ✓ Oil and Grease
- ✓ Organics

DESCRIPTION AND PURPOSE

Materials management includes a suite of BMPs with the purpose of preventing, reducing, or eliminating the discharge of pollutants to the stormwater system or watercourses. The primary objective is to prohibit pollutants from coming in contact with rainfall or runoff. Materials management includes minimizing the storage of materials on-site, storing materials in a designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

APPLICATIONS

- All construction sites with delivery, storage, or use of the following materials:
  - Soil stabilizers and binders
  - Fertilizers
  - Pesticides / herbicides
  - Detergents
  - Plaster
  - Petroleum products, such as oil, fuel, and grease
  - Concrete compounds
  - Asphalt / concrete components
  - Hazardous chemicals, such as acids, glues, adhesives, lime, paints, solvents, and curing compounds

- Other materials that may be detrimental if released into the environment

LIMITATIONS

- Space limitations and project type might preclude indoor storage.
- Storage sheds often must meet fire code and building requirements.

IMPLEMENTATION CONSIDERATIONS

- General
  - Keep an up-to-date inventory of materials delivered and stored onsite.
  - Keep Material Safety Data Sheets (MSDS) available onsite for all materials that have the potential to affect water quality.
  - Train employees and subcontractors on the proper material delivery, use, and storage practices.
  - Post proper storage instructions at all times in an open and conspicuous location.
  - In a conspicuous, labeled area, keep ample spill cleanup supplies appropriate for the materials being stored or use onsite. Refer to Fact Sheet E-6 Spill Prevention and Containment.
  - Have employees trained in emergency spill cleanup procedures present when dangerous materials or liquid chemicals are unloaded.
  - If spills or leaks of materials occur that are not contained and could discharge to surface waters, non-visible sampling of site discharge may be required. Refer to the California General NPDES Construction Permit or to the project-specific Construction Site Monitoring Plan to determine if and where sampling is required.
- Material Use
  - Follow EPA label guidelines for the use of pesticides.
  - Do not over-apply fertilizers, pesticides, and herbicides. Follow manufacturer's recommendations.
  - Mix paint in a containment area. Leftover paint and other associated residuals are hazardous waste and must be disposed of based upon applicable federal and State law.
  - Minimize the use of hazardous materials onsite.
- Containment Facilities/Areas
  - Designate construction site areas for material delivery and storage.

- Store chemicals in a storage shed or in water-tight containers with appropriate secondary containment.
- Materials should be stored indoors within existing structures or completely enclosed storage sheds when feasible.
- To meet material storage requirements, use containment pallets or other practical and available solutions, such as storing materials within newly constructed buildings or garages.
- Line and berm material storage areas if located on bare soil. When available, place material storage areas in paved areas.
- Locate temporary storage areas away from vehicular traffic.
- Locate material delivery and storage areas away from waterways or any place with the potential to come into contact with stormwater runoff.
- Temporary Containment Facilities
    - A temporary containment facility should provide for a spill containment volume capable of containing 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.
    - 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 provide sufficient separation 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.

- Within Containment Facilities/Areas
    - Materials should be stored in original containers with legible original product labels. Damaged or otherwise illegible labels should be replaced immediately.
    - Bagged or boxed materials should be stored on pallets and not be allowed to accumulate on the ground.
    - If the material storage area is not covered by design, then materials should be covered prior to and during rain events.
    - When not in use, contain all fertilizers and other landscape materials.
    - When not in use, stack erodible landscape material on pallets and cover them.
    - Storage of ignitable, reactive, or flammable liquids must comply with the fire codes of the City of Sacramento. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements.

- Petroleum products, liquids, 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.
- Minimize the storage of hazardous materials onsite.
- If significant residual materials remain on the ground after the completion of construction, properly remove and dispose of materials and any contaminated soil.

Gas containers are appropriately stored off the ground and covered to prevent contact with stormwater.

Gas containers and other materials should <u>not</u> be stored in the open where they are subject to contact with precipitation or runoff.

Although these materials are covered, they should have been placed in a location that is not subject to concentrated runoff or sediment accumulation.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect material storage areas weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect site BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.

MAINTENANCE

- Contain and clean up any spill immediately.
- For temporary containment facilities, maintain the facility free of accumulated rainwater and spills. In the event of spills or leaks, collect accumulated rainwater and spills and place into drums. Handle these liquids as hazardous waste unless testing determines them to be non-hazardous. Send all collected liquids or non-hazardous liquids to an approved disposal site.
- Keep storage areas clean and well organized.
- Maintain legible and accurate container labels.
- Repair or replace perimeter controls, containment structures, covers, and liners as necessary to maintain proper function.

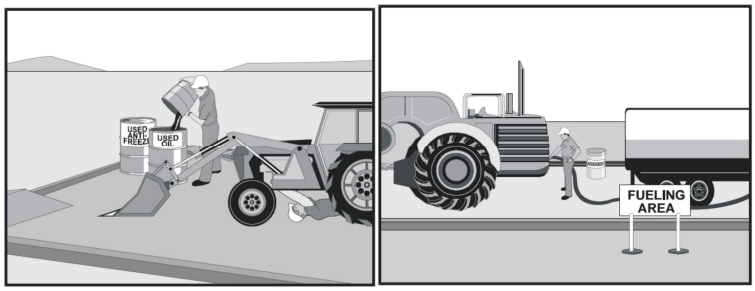
ANTICIPATED LIFESPAN DURING CONSTRUCTION

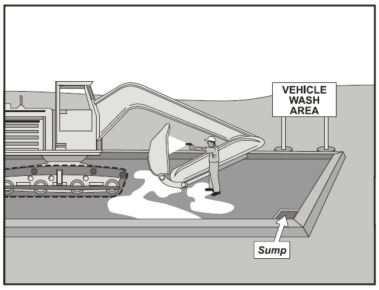
Materials management BMPs should be used for the entirety of the project.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- City of Sacramento Manual for Grading, Erosion and Sediment Control, January 1994.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 4, top 2): RBF Consulting.
- Photo credit (page 4, bottom): City of Sacramento.

EQUIPMENT MAINTENANCE, FUELING, AND CLEANING E-4





OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- ✓ Nutrients
- Trash
- Metals
- Bacteria
- ✓ Oil and Grease
- ✓ Organics

DESCRIPTION AND PURPOSE

Best management practices for equipment maintenance, fueling, and cleaning procedures and practices eliminate or reduce the discharge of pollutants to stormwater from vehicle and equipment maintenance, fueling, and cleaning activities. This may be accomplished through the use of offsite facilities, use of designated areas, providing cover and containment for materials and activities, containing and cleaning up leaks or spills, and training employees and subcontractors.

APPLICATIONS

- All construction sites where vehicle or equipment maintenance, fueling, or cleaning activities are performed.

LIMITATIONS

- Onsite vehicle and equipment fueling, cleaning, and maintenance should only be done when it is impractical to send vehicles and equipment offsite.

E-4 EQUIPMENT MAINTENANCE, FUELING, AND CLEANING

IMPLEMENTATION CONSIDERATIONS

- **Equipment Maintenance.** If maintenance and repair operations must take place onsite, the following measures should be implemented:
    - Locate designated maintenance areas at least 50 feet from downstream drainage facilities and watercourses. Do not situate a maintenance area in a location that will provide a "direct connection" with downstream storm drains or natural channels.
    - Protect dedicated maintenance areas from stormwater run-on through the use of suitably designed stormwater diversion/conveyance facilities or by locating out of the path of concentrated drainage.
    - For long-term projects, consider using portable tents or covers over maintenance areas.
    - Make absorbent spill cleanup materials and spill kits available in maintenance areas.
    - Use drip pans or absorbent pads during equipment maintenance and repair.
    - Promptly transfer used fluids to the proper waste or recycling drums.
    - Keep vehicles and equipment clean; avoid excessive build-up of oil and grease.
    - Consider using new, alternative greases and lubricants, such as adhesive greases, for chassis lubrication and fifth-wheel lubrication.
    - Consider products that are less toxic or less hazardous than traditional products.
    - 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.
    - Do not place used oil in a dumpster or pour into a storm drain or watercourse.
    - Do not bury used tires.
    - Store cracked batteries in a non-leaking secondary container. If a battery is dropped, treat it as if it is cracked.
- **Equipment Fueling.** If fueling operations must take place onsite, the following measures should be implemented:
    - Designate a fueling area at least 50 feet away from downstream drainage facilities and watercourses. Do not situate a fueling area in a location that will provide a "direct connection" with downstream storm drains or natural channels.
    - Locate fueling areas on level-grade areas.

- Protect dedicated fueling areas from stormwater run-on through the use of suitably designed stormwater diversion/conveyance facilities or by locating out of the path of concentrated drainage.
- Make absorbent spill cleanup materials and spill kits available in fueling areas and on fueling trucks.
- Use drip pans or absorbent pads during equipment fueling.
- Avoid mobile fueling of construction equipment; transport the equipment to a designated fueling area.
- Discourage "topping off" of fuel tanks.
- Equip nozzles used in equipment fueling with an automatic shutoff to control drips.
- Do not leave fueling operations unattended.
- Use vapor recovery nozzles to help control drips and air pollution.
- Observe federal, State, and local requirements for any stationary above ground storage tanks.

- **Equipment Cleaning.** If cleaning operations must take place onsite, the following measures should be implemented:
  - Use phosphate-free, biodegradable soaps.
  - Do not permit steam cleaning onsite.
  - Use as little water as possible. Consider using high-pressure sprayers as they may use less water than a hose.
  - Use a positive shutoff valve to minimize water usage.
  - Wastes resulting from cleaning with soap or solvents must be fully contained and properly disposed of.
  - Facility wash racks should discharge to a sanitary sewer, recycle system, or other approved discharge system. Facility wash racks must not discharge to the storm drain system, watercourses, or to groundwater.
  - When equipment cleaning must occur onsite and the operations cannot be located within a structure or building equipped with appropriate disposal facilities, the cleaning area should have the following characteristics:
    - Located away from storm drain inlets, drainage facilities, or watercourses.
    - Paved with concrete or asphalt.
    - Sized to fit the largest vehicle that will use the cleaning area.

- Bermed to contain wash waters and to prevent run-on and runoff (6" minimum).
- Configured with a sump to allow for collection and disposal of wash water.
- Used only when necessary.

- **Education**
  - Have the contractor's superintendent or representative oversee and enforce proper equipment maintenance, fueling, and cleaning procedures and practices.
  - Train employees and subcontractors on pollution prevention measures.
  - Prohibit employees and subcontractors from washing personal vehicles and equipment on the project site.
  - Follow spill cleanup procedures identified in E-6, Spill Prevention and Containment.

Appropriate – Drip pan provided when vehicle not in use.

NOT APPROPRIATE – No drip pan provided. Liquid from the vehicle has come into contact with the ground and could pollute runoff.

EQUIPMENT MAINTENANCE, FUELING, AND CLEANING E-4

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect equipment maintenance, fueling and cleaning BMPs weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect site BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Inspect vehicles and equipment daily at start up for leaks.
- Check incoming vehicles and equipment for leaking oil and fluids. Do not allow leaking vehicles or equipment back onsite until repaired.

MAINTENANCE

- Repair berms and dikes as needed.
- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.
- Repair equipment leaks immediately, or remove problem equipment from the project site.
- Inspect sump regularly and remove liquids and sediment as needed.

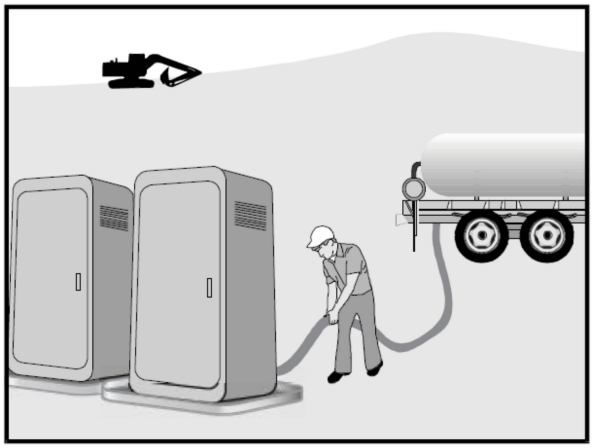
ANTICIPATED LIFESPAN DURING CONSTRUCTION

Equipment maintenance, fueling, and cleaning pollution prevention measures should be implemented for the lifetime of the construction project.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 4): RBF Consulting.

SANITARY WASTE MANAGEMENT E-5



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- Sediment
- ✓ Nutrients
- ✓ Trash
- Metals
- ✓ Bacteria
- Oil and Grease
- ✓ Organics

DESCRIPTION AND PURPOSE

Sanitary waste management prevents the discharge of pollutants to stormwater from sanitary and septic waste by providing convenient, well-maintained facilities and arranging for regular service and disposal.

APPLICATIONS

- All construction sites that use temporary or portable sanitary and septic waste systems.

LIMITATIONS

- None identified.

IMPLEMENTATION CONSIDERATIONS

- Treat and dispose of sanitary or septic wastes in accordance with State and local requirements. In many cases, one contract with a local facility supplier will satisfy this requirement to ensure sanitary and septic wastes are properly disposed of. Only reputable, licensed sanitary and septic waste haulers should be used.
- Locate temporary sanitary facilities in accessible locations for the work crews.
- Locate temporary sanitary facilities such that access for servicing at regular intervals will be possible.

- Place temporary sanitary facilities on level pads.
- Locate temporary sanitary facilities at least 50 feet away from drainage facilities, watercourses, and traffic circulation. Keep sanitary facilities out of the path of concentrated storm flow.
- Secure temporary sanitary facilities to prevent overturning during high winds or by vandals.
- Equip temporary sanitary facilities with containment to prevent discharge of pollutants to the stormwater drainage system or the receiving water.
- Regular waste collection by a licensed hauler should be arranged before sanitary or septic facilities overflow.
- Do not discharge or bury wastewater.
- 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. Temporary sanitary facilities or septic systems that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- Education
    - Train employees, subcontractors, and suppliers on sanitary and septic waste storage and disposal procedures.
    - Educate employees, subcontractors, and suppliers on potential dangers to humans and the environment from sanitary and septic wastes.
    - Train employees, subcontractors, and suppliers in identification of sanitary and septic waste.
    - Incorporate the proper use of sanitary facilities into regular safety meetings.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect sanitary waste management BMPs weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect site BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.

SANITARY WASTE MANAGEMENT E-5

MAINTENANCE

- Arrange for regular waste collection.
- Sanitary and septic facilities should be maintained in good working order by a licensed service.
- If a spill does occur from a temporary sanitary facility, follow federal, State, and local regulations for containment and cleanup.
- If spills or leaks from sanitary or septic facilities are not contained and discharge from the site, then non-visible sampling of the site discharge may be required. Refer to the General Permit or to the project-specific Construction Site Monitoring Plan to determine if and where sampling is required.

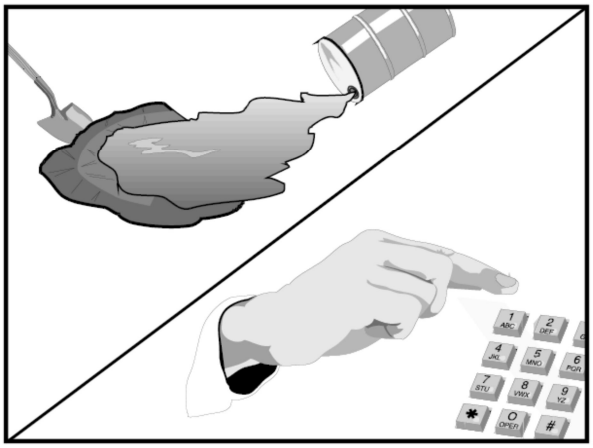
ANTICIPATED LIFESPAN DURING CONSTRUCTION

Sanitary waste management BMPs should be implemented for the lifetime of the construction project.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

SPILL PREVENTION AND CONTAINMENT E-6



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- ✓ Nutrients
- ✓ Trash
- ✓ Metals
- Bacteria
- ✓ Oil and Grease
- ✓ Organics

DESCRIPTION AND PURPOSE

Spill prevention and containment is the prevention and reduction of the discharge of pollutants to stormwater from leaks and spills. This is accomplished by reducing the chance for spills, properly containing and cleaning up spills, properly disposing of spill materials, and training employees.

APPLICATIONS

- All construction sites with delivery and storage of the following materials:
  - Soil stabilizers and binders
  - Dust palliatives
  - Fertilizers
  - Pesticides / herbicides
  - Growth inhibitors
  - Deicing/anti-icing chemicals
  - Petroleum products, such as oil, fuel, and grease
  - Lubricants
  - Hazardous chemicals, such as acids, glues, adhesives, lime, paints, solvents, and curing compounds
  - Other materials that may be detrimental if released into the environment

E-6 SPILL PREVENTION AND CONTAINMENT

LIMITATIONS

- It may be necessary to use a private spill cleanup company in some cases.
- Practices and procedures presented in this BMP sheet are general. Contractor is responsible for identifying appropriate practices for specific materials used or stored onsite.

IMPLEMENTATION CONSIDERATIONS

- This BMP applies to spills caused by the contractor and subcontractors.
- Store hazardous materials and wastes in covered containers, protected from vandalism, children, and animals.
- Keep storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- 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.
- Train employees in spill prevention, containment, and cleanup.
    - Different materials pollute in different amounts. Be sure that each employee knows what a "significant spill" is for each material used and what the appropriate response is for "significant" and "insignificant" spills.
    - Educate employees and subcontractors on potential dangers to people and the environment from spills and leaks.
    - Hold regular meetings to discuss and reinforce appropriate disposal procedures.
- Designate responsible individuals to oversee and enforce spill control measures.
- Keep a list of potential non-visible pollutants at the site. Sample and analyze for non-visible pollutants in the event of a spill or a breach, malfunction, failure, and/or leak of a BMP. Sampling should be done by authorized and trained personnel in accordance with the requirements of the Construction General Permit.
- Spills should be covered and protected from stormwater run-on during rainfall to the extent that covering and protecting the spill does not compromise cleanup activities.
- So long as work can be accomplished safely, spills of oil, petroleum substances listed under 40 CFR parts 110, 117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.

- Do not allow water used for cleaning and decontamination to enter watercourses or storm drains. Collect and dispose of contaminated water properly.
- 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, 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 materials. Sweep up or excavate the material and dispose of properly.
- Minor Spills
    - Typically involve small quantities of oil, paint, gasoline, etc., which can be controlled by the first responder at the discovery of the spill.
    - Use absorbent materials; do not hose down or bury the spill.
    - Promptly remove absorbent materials and dispose of properly.
    - Follow this basic practice for a minor spill:
        - Contain the spread of the spill.
        - Recover spilled materials.
        - Clean the contaminated area.
        - Properly dispose of contaminated materials.
- Semi-Significant Spills
    - Typically can be controlled by the first responder along with the aid of other personnel, such as laborers, foreman, etc. This response may require the stoppage of all other activities.
    - Immediately cleanup spills following these basic practices:
        - Notify the project foreman immediately.
        - If the spill happens on paved or impermeable surfaces, contain the spill by encircling with absorbent materials and do not let the spill spread. Clean up using "dry" methods (absorbent materials, cat litter, rags).
        - If the spill happens 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 the spill with tarps or other material to prevent contaminating runoff.

- Significant/Hazardous Spills
    - These spills cannot be controlled by personnel in the immediate vicinity.
    - It is the contractor's responsibility to have all emergency phone numbers at the construction site.
    - The following steps should be taken:
        - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the Hazardous Materials Response Coordinator, City of Sacramento Fire Department, at (916) 264-7070; they can assist in cleanup.
        - 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.
        - Within the County of Sacramento, also report spills to the Sacramento County Hazardous Materials Division at (916) 386-6160.
        - Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center at (800) 424-8802.
        - Notification should first be made by telephone, and then followed up with a written report.
        - Services of a spills contractor or Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified personnel have arrived at the job site.
        - Other agencies which may need to be consulted include, but are not limited to, 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, and Cal/OSHA.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect spill prevention BMPs weekly, before storm events, daily during storm events, and after storm events.

- In general, linear utility projects shall inspect spill prevention BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-stormwater discharges. In addition, projects shall conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.

MAINTENANCE

- Contain and clean up any spill immediately.
- Update the project spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.
- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Replace or repair perimeter controls, containment structures, covers, and liners as needed to maintain proper function.
- Keep Material Safety Data Sheets (MSDS) up to date.
- Perform periodic staff training on spill prevention and containment issues and techniques.

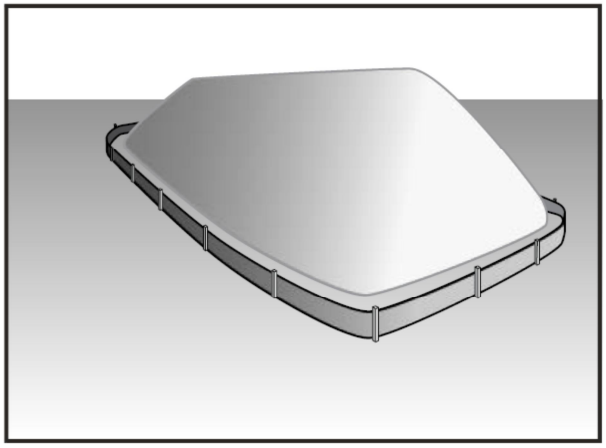
ANTICIPATED LIFESPAN DURING CONSTRUCTION

Spill prevention and containment BMPs should be implemented for the lifetime of the construction project.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Photo credit: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

STOCKPILE MANAGEMENT E-7



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- ✓ Nutrients
- ✓ Trash
- ✓ Metals
- Bacteria
- ✓ Oil and Grease
- ✓ Organics

DESCRIPTION AND PURPOSE

Stockpile management practices and procedures are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, sand, soil amendments, 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 ("cold mix" asphalt), and pressure-treated wood.

APPLICATIONS

- All construction sites that stockpile soil or other loose materials.

LIMITATIONS

- Plastic sheeting is temporary, difficult to manage in windy conditions, and (in some cases) photodegradable.
- Where plastic is used, the use of plastic tarps with nylon reinforcement, rather than standard sheeting, should be considered. Otherwise, the use of plastic materials and photodegradable plastics should be avoided in favor of chemical binders or other non-plastic materials.

IMPLEMENTATION CONSIDERATIONS

- Locate stockpiles a minimum of 50 feet from concentrated flows of stormwater, drainage courses, and inlets, when feasible.
- Protect all stockpiles from stormwater run-on using temporary perimeter sediment barriers or diversion BMPs.

- Ensure that stockpile coverings are installed securely to protect from wind and rain.
- Select cover materials or methods based on anticipated duration of use.
- Place bagged materials on pallets and under cover.
- Non-Active Stockpiles
    - A stockpile is considered non-active if it either is not used for 14 days or it is scheduled not to be used for 14 days or more.
    - Soil stockpiles
        - Cover or protect with soil stabilization measures and a temporary perimeter sediment barrier at all times.
        - Consider temporary vegetation for topsoil piles that will be stockpiled for extended periods.
    - PCC rubble, AC, AC rubble, aggregate base, or aggregate sub base stockpiles
        - Cover and protect with a temporary perimeter sediment barrier at all times.
    - "Cold Mix" asphalt stockpiles
        - Underlay and cover "cold mix" stockpiles with plastic sheeting or comparable material at all times and surround by a berm (i.e., earthen or gravel bag).
    - Fly ash, stucco, hydrated lime stockpiles (and other materials that may raise the pH of runoff)
        - Cover with plastic and surround by a berm (i.e., earthen or gravel bag).
    - Pressure-treated wood
        - Cover with plastic sheeting or comparable material at all times and surround by a berm (i.e., earthen or gravel bag).
- Active Stockpiles
    - Stockpiles are considered active when they are being used or are scheduled to be used within 14 days of the previous use.
    - All stockpiles should be covered and protected with a temporary linear sediment barrier (i.e., berm, fiber rolls, silt fence, etc.) prior to the onset of rain or in conditions of high wind (sustained wind speeds above 15 miles per hour).
    - For stockpiles of "cold mix" asphalt, pressure-treated wood, and materials that may raise the pH of runoff, underlay and cover with plastic sheeting or comparable material and surround by a berm prior to the onset of rain.
    - The downstream perimeter of an active stockpile should be protected with a linear sediment barrier or berm. On the upstream perimeter of an active stockpile, runoff should be diverted around or away from the stockpile.

The stockpile is covered and has gravel bags to hold cover in place. Fiber rolls and silt fence are also being utilized as perimeter controls.

Stockpiles should be covered and have perimeter controls.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect stockpile management BMPs weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect site BMPs daily.
- It may be necessary to inspect stockpiles covered with plastic sheeting more frequently during high winds or extreme heat conditions.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Identify extent of physical deterioration of binders (such as PAM, etc.) used to stabilize stockpile areas.

- Identify signs of erosion or rilling in stockpiles that have been stabilized using vegetative methods.
- Identify physically deteriorated or damaged perimeter sediment controls used at the base of the stockpile.

MAINTENANCE

- Replace plastic sheeting that is torn, photo-degraded, or damaged in any way.
- Repair and/or replace perimeter controls and covers to keep them functioning properly.
- Repair or replace vegetation or binder in areas observed not to be suitably stabilized.
- Remove sediment from the sediment barrier or berm when it reaches one-third of the barrier height.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

Stockpile management BMPs should be implemented for the lifetime of the construction project. Vegetative cover of stockpiles will protect the stockpiles so long as the vegetation provides sufficient coverage and is maintained. The anticipated lifespan of soil binders will vary depending on the type of soil binder selected; refer to Fact Sheet B-06 Soil Binders.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 3, top): RBF Consulting.
- Photo credit (page 3, bottom): City of Sacramento.

STREET SWEEPING E-8

OBJECTIVES

- Site Planning and Management
- Erosion Control
- ✓ Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- ✓ Trash
- Metals
- Bacteria
- ✓ Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Street sweeping is the use of self-propelled or walk-behind equipment to remove sediment from streets and roadways and to clean paved surfaces in preparation for final paving. The purpose of street sweeping is to prevent sediment from the project site from entering storm drains or receiving waters.

APPLICATIONS

- Anywhere sediment is tracked from the project site onto public or private paved roads or streets, usually at points of egress from the project site.
- During preparation of paved surfaces for final paving.
- Anywhere where stabilized construction access proves inadequate.
- Urban areas where construction access points cannot be adequately controlled.

LIMITATIONS

- May not be effective when sediment is wet or tracked soil is caked to the surface, or when sediment is too heavy for street sweeping equipment.
- Sometimes repeat cleanings and/or hand labor are necessary for effective sediment management.
- Limitations relating to "approved" non-stormwater discharge within the California CGP effectively prohibit street washing.
- Effectiveness may be hampered by absence of curb or presence of on-street parking.

IMPLEMENTATION CONSIDERATIONS

- Control the number of points where vehicles can leave the site. This allows street cleaning efforts to be focused, which may save money.
- Perform street cleaning operations on a daily basis during grading operations, or if appropriate, more frequently based upon vehicle traffic, proximity of receiving water, or potential for sediment transport. Small sites (less than 5,000 square feet of pavement area) can usually be managed with hand brooms. Larger sites generally require the use of mechanized sweepers. Mechanized sweepers capable of capturing particles as small as 10 microns are preferable over conventional street sweepers.
- Do not use kick brooms or sweeper attachments as these tend to spread the dirt rather than remove it.
- Be careful not to sweep up any unknown substance or object that may be potentially hazardous.
- If the sediment is not mixed with debris or trash, it may be incorporated back into the project.
- When cleaning is finished, properly dispose of wastes at an approved dumpsite.

Construction sediment and debris should be swept as soon as possible.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect street cleaning BMPs weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect street cleaning BMPs weekly.
- When actively in use, inspect entrance and exit points daily or more frequently.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.

MAINTENANCE

- Adjust brooms frequently to maximize the efficiency of street cleaning operations.

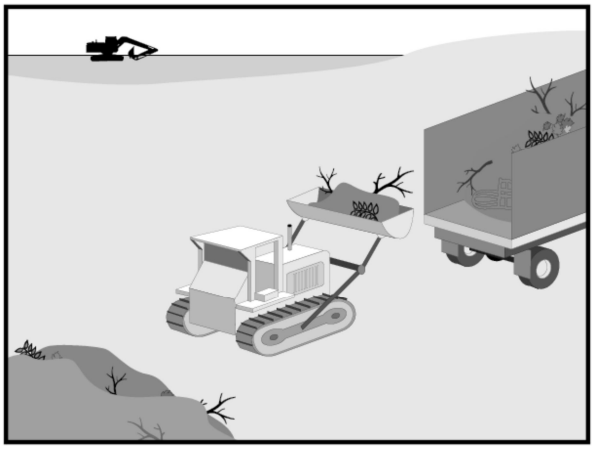
ANTICIPATED LIFESPAN DURING CONSTRUCTION

Street sweeping should be implemented for the lifetime of the construction project.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 2): City of Sacramento.

TRASH CONTAINMENT E-9



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- ✓ Nutrients
- ✓ Trash
- ✓ Metals
- ✓ Bacteria
- ✓ Oil and Grease
- ✓ Organics

DESCRIPTION AND PURPOSE

Trash containment 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.

APPLICATIONS

- Construction sites where the following wastes are generated or stored:
  - Packaging materials, such as wood, paper, and plastic.
  - Solid waste from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction.
  - Scrap or surplus building materials, such as scrap metals, rubber, glass pieces, plastic, and masonry products.
  - Domestic wastes, such as food containers, beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes.
  - Construction wastes, such as brick, mortar, steel and metal scraps, timber, pipe and electrical cuttings, non-hazardous equipment parts, Styrofoam, and other materials used to transport and package construction materials.
  - Highway planting wastes, including vegetative material, packaging materials, and plant containers.

E-9 TRASH CONTAINMENT

LIMITATIONS

- During the non-rainy season, temporary stockpiling of certain construction wastes may not necessitate stringent drainage-related controls.
- The management practices discussed for trash containment are not suitable for use in controlling liquid or hazardous waste from construction sites. Refer to E-03 Materials Management, E-05 Sanitary Waste Management, and E-06 Spill Prevention and Containment.

IMPLEMENTATION CONSIDERATIONS

- Locate trash containment areas in a convenient location within the project area that is level and paved (ideally), providing easy access for servicing. If a suitable location is difficult to identify, request assistance from the waste removal servicer.
- Locate containers in a covered area or in secondary containment.
- Locate containers at least 50 feet from drainage facilities and watercourses. Do not locate containers in areas prone to flooding or ponding.
- Prevent stormwater run-on from contacting trash containment areas through the use of berms, dikes, or other temporary diversion structures, or through the use of measures to elevate trash containers from site surfaces.
- Construction waste visible to the public should be stored or stacked in an orderly manner.
- Inform trash-hauling subcontractors that only watertight dumpsters will be accepted for onsite use.
- Provide trash receptacles in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Provide a sufficient size and number of dumpsters to contain the trash generated by the project.
- Provide an adequate number of trash containers with lids or covers that can be placed over the containers to keep rain out or to prevent the loss of wastes when it is windy.
- Cover trash containers at the end of each work day and whenever it is raining.
- Collect site trash daily, especially during rainy or windy conditions.
- Erosion and sediment control devices tend to collect litter. Remove this solid waste promptly.
- Removal of litter and debris from drainage grates, trash racks, and ditch lines should be a priority to prevent clogging of the storm drain system.
- Plan for additional containers and more frequent pickup during the demolition phase of a project.
- Minimize production of trash whenever possible. Salvage or recycle any useful material.

- Arrange for regular trash collection before containers overflow. Provide for trash removal from the site biweekly or more frequently as needed.
- Ensure that construction trash is collected, removed, and disposed of only at authorized disposal areas.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Ensure that toxic liquid wastes and chemicals are not disposed in dumpsters designated for construction trash. Segregate potentially hazardous waste from non-hazardous construction site waste.
- 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.
- Education
    - Have the contractor's superintendent or representative oversee and enforce proper trash management procedures and practices.
    - Train employees and subcontractors on identification of trash versus hazardous waste.
    - Educate employees and subcontractors on trash storage and disposal procedures.
    - Incorporate discussion of disposal procedures into regular safety meetings.
    - Require that employees and subcontractors follow trash handling and storage procedures.
    - Prohibit littering by employees, subcontractors, and visitors.

Although this large elevated trash container is easily accessible, it should also be covered or have secondary containment measures.

Site trash should be collected daily, especially during rainy or windy conditions.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect trash containment BMPs weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect site BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.
- Trash containment areas should be inspected for the following specific issues:
    - Proper location away from run-on and concentrated flow
    - Evidence of leakage or breach
    - Overflow of trash or debris
    - Evidence that liquid waste or hazardous material is being disposed of in standard trash dumpsters
    - Dumpster lids are consistently closed at the end of each work day and prior to forecasted rain.
    - Proper pickup and transfer practices by trash hauling sub-contractor.
    - Adherence to trash pickup schedule.

MAINTENANCE

- Clean up immediately if a container does spill.
- Arrange for regular trash collection.
- Arrange for regular education of site personnel on trash containment practices.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

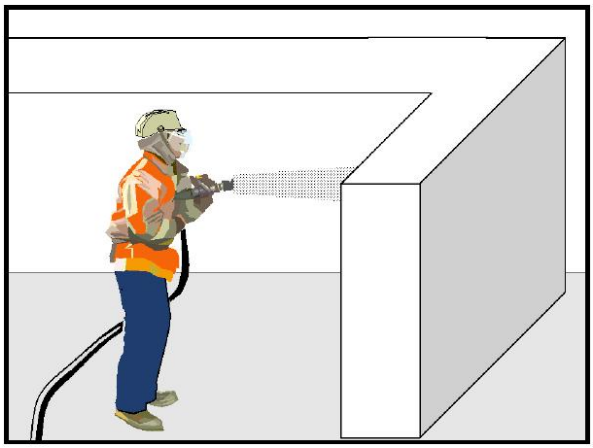
Trash containment should be implemented for the lifetime of the construction project.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.
- Tennessee Department of Transportation Statewide Stormwater Management Program, Manual for Management of Storm Water Discharges Associated with Construction Activities, 2007.
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 3): RBF Consulting.

CONCRETE CURING AND FINISHING E-10



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- ✓ Metals
- Bacteria
- ✓ Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Concrete curing includes both chemical and water methods and is used in the construction of structures such as bridges, pump houses, retaining walls, large slabs, and structured foundations.

Concrete finishing methods include sand blasting, shot blasting, grinding, or high pressure water blasting. Concrete finishing methods are used for bridge deck rehabilitation, curing compound removal, paint removal, and final surface finish appearances.

Proper procedures and care should be taken when conducting concrete curing and finishing to prevent materials from coming into contact with stormwater flows, which could result in a high pH discharge.

APPLICATIONS

- Construction sites where concrete curing and finishing is being performed.

LIMITATIONS

- None identified.

E-10 CONCRETE CURING AND FINISHING

IMPLEMENTATION CONSIDERATIONS

CONCRETE CURING

- Chemical Curing
    - Avoid over spray of curing compounds.
    - Apply curing compounds close to concrete surfaces to avoid drift. Do not allow any runoff of the compound.
    - Use proper storage and handling techniques for concrete curing compounds. Refer to Fact Sheet E-03 Materials Management.
    - Refer to Fact Sheet E-06 Spill Prevention and Containment.
- Water Curing for Bridge Decks, Retaining Walls, and Other Structures
    - Use wet blankets or similar method in order to maintain moisture while minimizing the use and possible discharge of water.

CONCRETE FINISHING

- Direct water from blasting operations away from receiving waters and inlets to collection areas for infiltration or other means of removal (e.g., dewatering).
- Keep blasting nozzle close to the surface in order to minimize the drift of dust and blast material.

GENERAL

- Direct cure water and water from blasting operations away from watercourses and inlets to appropriate collection areas (i.e., concrete waste management area) for evaporation or other means of removal in accordance with all applicable permits. If possible, collect water at the top of slopes and transport in a non-erosive manner. Refer to Fact Sheet E-05 Grassy Swales and Buffers.
- Protect drain inlets prior to curing and finishing activities; refer to Fact Sheet D-02 Inlet Protection.
- Prevent any water that contacts uncured or partly cured concrete from directly or indirectly entering any watercourse or stormwater system.
- Education
    - Educate employees, subcontractors, and suppliers on proper concrete curing and finishing techniques to prevent contact with discharge.
    - Arrange for the Qualified SWPPP Practitioner (QSP) or appropriately trained contractor's superintendent or representative to oversee and enforce concrete curing and finishing procedures.

- Sample non-stormwater discharges and stormwater runoff that contacts concrete dust and debris as required by the California Construction General Permit.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect paving pollution control BMPs weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect paving pollution control BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-stormwater discharges. Projects shall also conduct inspections for the presence of non-stormwater discharges daily while non-stormwater discharges are expected to occur.
- Inspect cure containers and equipment for leaks.

MAINTENANCE

- Sweep or vacuum up debris from sandblasting at the end of each shift.
- Remove and contain liquid and solid waste from containment structures, if any, and from the general work area at the end of each shift.
- Maintain containment structures in good condition.
- Maintain cure containers and spraying equipment to prevent leaks.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

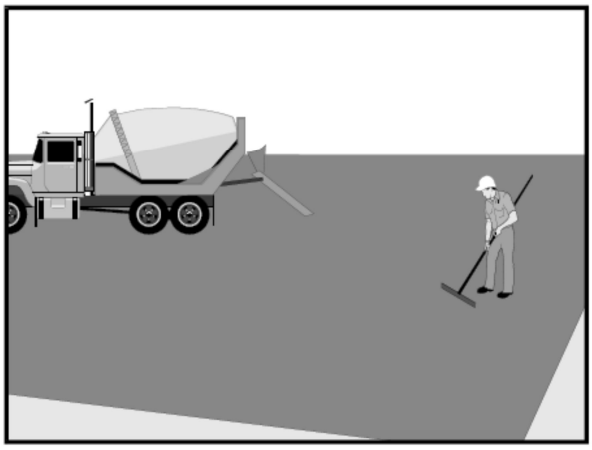
Concrete curing and finishing management practices should be implemented for the lifetime of the construction project.

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Tahoe Regional Planning Agency Best Management Practices Handbook, 2012.

- Photo credit: California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.

PAVING AND PAVEMENT GRINDING/CUTTING E-11



OBJECTIVES

- Site Planning and Management
- Erosion Control
- Sediment Control
- Runoff Control
- ✓ Good Housekeeping/ Material Management

TARGET POLLUTANTS

- ✓ Sediment
- Nutrients
- Trash
- Metals
- Bacteria
- ✓ Oil and Grease
- Organics

DESCRIPTION AND PURPOSE

Paving operations include grinding, surfacing, resurfacing, and/or sawcutting. Many construction materials associated with paving operations, including concrete, mortar, and cement, have basic chemical properties that can raise pH levels outside of the permitted range. The purpose of paving pollution control measures is to prevent or reduce the discharge of pollutants from paving operations, using measures to prevent contact with run-on, properly disposing of wastes, and training employees and subcontractors.

APPLICATIONS

- Construction sites where paving, surfacing, resurfacing, or sawcutting is being performed.

LIMITATIONS

- None identified.

IMPLEMENTATION CONSIDERATIONS

- General
  - When feasible, avoid paving during the wet season.
  - If rain is forecasted, reschedule paving and grinding activities.

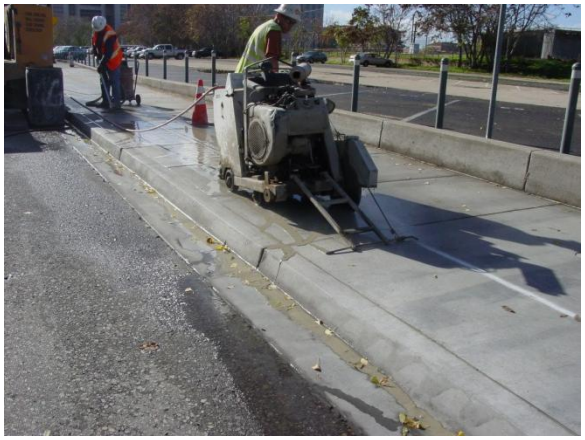
- Train employees and sub-contractors in pollution prevention and reduction.
- Store materials away from drainage courses to prevent contact with stormwater run-on.
- Protect drainage courses, particularly in areas with a grade, by employing BMPs to divert runoff or to trap and filter sediment.
- Install inlet protection and perimeter controls until paving operations are complete, area is stabilized, or permanent controls are in place.
- Collect removed material by mechanical or manual methods. Recycle when possible, else dispose of properly.
- Stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses.
- Clean up spills with absorbent materials and dispose of in accordance with the applicable regulations.

- Sawcutting, Grinding, and Pavement Removal
  - Shovel or vacuum sawcut slurry and remove from site. Cover or barricade storm drains during sawcutting to contain slurry.
  - Do not allow AC grindings, pieces, or chunks used in embankments or shoulder backing to enter any storm drains or watercourses.
  - Residue from grinding operations should be picked up by a vacuum attachment to the grinding machine, or by sweeping, should not be allowed to flow across the pavement, and should not be left on the surface of the pavement.
- Asphaltic Concrete Paving
  - 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 the waste.
- Portland Cement Concrete (PCC) Paving
  - Do not wash sweepings from exposed aggregate concrete into a storm drain system.
  - Allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit or pump the water to the sanitary sewer if authorized by the local wastewater authority.
- Sealing Operations
  - During chip seal application and sweeping operations, petroleum or petroleum-covered aggregate should not be allowed to enter any storm drain or watercourse.

- Apply temporary perimeter controls until structure is stabilized (i.e., all sealing operations are complete and cured and loose materials have been properly removed and disposed).
- Seal coat, tack coat, slurry seal, or fog should not be applied if rainfall is predicted to occur during the application or curing period.

- Paving Equipment
  - Place drip pans or absorbent materials under paving equipment when not in use.
  - Paving equipment parked onsite should be parked over plastic to prevent soil contamination.
  - Substances used to coat asphalt transport trucks and asphalt spreading equipment should not contain soap and should be non-foaming and non-toxic.
  - Clean asphalt coated equipment offsite whenever possible.
- Thermoplastic Striping
  - Inspect thermoplastic striper and pre-heater equipment shutoff valves to ensure that they are working properly to prevent leaking thermoplastic from entering drain inlets, the stormwater drainage system, or watercourses.
  - Fill pre-heaters 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.
  - Do not pre-heat, transfer, or load thermoplastic near drain inlets or watercourses.
  - Clean truck beds daily of loose debris and melted thermoplastic.
- Raised/Recessed Pavement Marker Application and Removal
  - Do not transfer or load bituminous material near drain inlets, the stormwater drainage system, or watercourses.
  - Load melting tanks with care and do not fill beyond six inches from the top to leave room for splashing.
  - To avoid spills when servicing or filling melting tanks, ensure all pressure is released before removing lids.
  - On large-scale projects, use mechanical or manual methods to collect excess bituminous material from the roadway after removal of markers.

E-11 PAVING AND PAVEMENT GRINDING/CUTTING



Slurry should be collected and properly disposed of, and should not be discharged to the storm drain system or to a receiving water.

INSPECTIONS

- For sites greater than 1 acre or requiring California General NPDES Permit coverage, inspections shall be based on project type and the risk level.
- In general, traditional construction projects shall inspect paving pollution control BMPs weekly, before storm events, daily during storm events, and after storm events.
- In general, linear utility projects shall inspect paving pollution control BMPs daily.
- Projects shall conduct quarterly inspections for the presence of non-storm water discharges. Projects shall also conduct inspections for the presence of non-storm water discharges daily while non-stormwater discharges are expected to occur.

MAINTENANCE

- Maintain machinery regularly to minimize leaks and drips.
- Clean up spills immediately.
- Keep ample supplies of drip pans and absorbent materials onsite.

ANTICIPATED LIFESPAN DURING CONSTRUCTION

Paving and pavement grinding/cutting management practices should be implemented for the lifetime of the construction project.

PAVING AND PAVEMENT GRINDING/CUTTING E-11

REFERENCES

- California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- State Water Resources Control Board Order 2010-011-DWQ, Construction General NPDES Permit
- Photo credit (page 1): California Stormwater Quality Association, Stormwater Best Management Practice Handbook – Construction, July 2012.
- Photo credit (page 4): City of Sacramento.

Appendix 1: Ordinance 93-068

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ORDINANCE NO. 93-068

ADOPTED BY THE SACRAMENTO CITY COUNCIL

ON DATE OF DEC 0 7 1993

AN ORDINANCE ADDING CHAPTERS 9.31, 9.32, 9.33, 9.34, AND 9.35 TO TITLE 9 (BUILDING CODE) OF THE SACRAMENTO CITY CODE, RELATING TO PROCEDURES AND REQUIREMENTS FOR GRADING, EROSION, AND SEDIMENT CONTROL

BE IT ENACTED BY THE COUNCIL OF THE CITY OF SACRAMENTO:

SECTION 1:

Chapters 9.31, 9.32, 9.33, 9.34 and 9.35 are hereby added to Title 9 of the Sacramento City Code, to read as follows:

CHAPTER 9.31 GENERAL PROVISIONS AND REQUIREMENTS

9.31.1501 TITLE

Chapters 9.31 - 9.35 shall be known as the Grading, Erosion, and Sediment Control Ordinance of the City of Sacramento, and shall be referred to herein as the " Grading Ordinance."

9.31.1502 PURPOSE

The Grading Ordinance is enacted for the purpose of regulating grading on property within the City limits of the City of Sacramento to safeguard life, limb, health, property and the public welfare; to avoid pollution of watercourses with nutrients, sediments, or other materials generated or caused by surface water runoff; to comply with the City's National Pollution Discharge Elimination System (NPDES) Permit No. CA0082597, Provision D2, issued by the California Regional Water Quality Control Board; and to ensure that the intended use of a graded site within the City limits is consistent with the City of Sacramento General Plan, any Specific Plans adopted thereto and all applicable City ordinances and regulations. The Grading Ordinance is intended to control all aspects of grading operations within the City limits of the City of Sacramento.

9.31.1503 SCOPE

The Grading Ordinance sets forth rules and regulations to control land disturbances, landfill, soil storage, pollution, and erosion and sedimentation resulting from construction activities. The Grading Ordinance establishes procedures for issuance, administration and enforcement of permits for such activities. Any grading within the City limits of the City of Sacramento shall conform to provisions of the Grading Ordinance and other applicable provisions of the City Code, including but not limited to, the latest edition of the City of Sacramento Standard Specifications for Public Works Construction, Sacramento City/County Drainage Manual, and City Manual of Standards and Improvement Standards.

The Director shall adopt a Manual of Standards entitled "Administrative and Technical Procedures Manual for Grading, Erosion, and Sediment Control" setting forth the administrative procedures and technical requirements necessary to implement the provisions of the Grading Ordinance. The Director shall have the authority to change, update or revise this manual as necessary at his/her sole discretion, to implement the provisions of the Grading Ordinance.

9.31.1504 ADMINISTRATION

The Grading Ordinance shall be administered for the City of Sacramento by the Department of Utilities.

9.31.1505 DEFINITIONS

Unless the particular provision or the context otherwise requires, wherever the following terms are used in the Grading Ordinance, they shall have the meaning ascribed to them in this section:

(a) Applicant: Any person seeking or receiving grading approval, in accordance with the terms of the Grading Ordinance, to perform grading after the issuance of a building permit or the approval of improvement plans, or to commence grading prior to such issuance or approval.

(b) Best Management Practices: Any program, technology, technique, process, siting criteria, operating method, measure or device which controls, prevents, removes or reduces pollution, erosion, and sediment transport.

(c) City Council: City Council of the City of Sacramento.

(d) Civil Engineer: A professional engineer registered as a Civil Engineer by the State of California.

(e) Compaction: The increase of density of a soil or rock fill by mechanical means.

(f) Cut (Excavation): The removal of naturally occurring earth materials by manual or mechanical means, and the conditions resulting therefrom.

(g) Director: Director of the Department of Utilities of the City of Sacramento, or his/her authorized designees.

(h) Drainage Waters: Surface waters which collect, or are accumulated, on the ground and which, by means of drainage ways or water courses, flow off the surface to larger rivers, streams, or lakes. Such waters shall include, but are not limited to, natural precipitation and irrigation waters.

(i) Drainage Way: A depression in the earth's surface such as a swale, ravine, gully, slough, draw, hollow, or ditch in which surface water collects for drainage.

(j) Earth Material: Any rock, natural soil or fill and/or any combination thereof.

(k) Embankment (Fill): The deposit of soil, rock or other materials placed by artificial means and the conditions resulting therefrom.

(l) Encroachment Permit: A written permit issued by the Department of Public Works authorizing certain work within a publicly maintained right-of-way.

(m) Engineering Geologist: A registered geologist certified as an Engineering Geologist by the State of California.

(n) Erosion: The washing or wearing away and transportation of earth material as a result of the movement of wind, water, or ice.

(o) Erosion and Sediment Control Plan (ESC Plan): Consists of a set of best management practices or equivalent measures designed to control surface runoff and erosion, retain sediment on a particular site, and prevent pollution of site runoff during the period in which pre-construction and construction related grading and/or soil storage occur, and before final improvements or permanent structures are completed.

(p) Excavation (Cut): The removal of naturally occurring earth materials by manual or mechanical means, and the conditions resulting therefrom.

(q) Existing Grade: The elevation of the ground surface at a given point prior to excavating or filling.

(r) Fill (Embankment): The deposit of soil, rock or other materials placed by artificial means and the conditions resulting therefrom.

(s) Finish Grade: The final grade of the site after excavating or filling which conforms to the approved final grading plan. The finish grade is also the grade at the top of a paved surface.

(t) Geologic Hazard: Any condition in naturally occurring earth materials which may endanger life, health or property.

(u) Geotechnical Engineer: A Civil Engineer registered by the State of California who is qualified in the field of soil mechanics and soil engineering and has the authority to use the title "Soil Engineer."

(v) Grade: The vertical location of the ground surface.

FOR CITY CLERK USE ONLY

ORDINANCE NO.: 93-068

DATE ADOPTED: DEC 0 7 1993

(w) Grading: Any land excavation or filling or combination thereof, or the removal, plowing under or burial of vegetative groundcover.

(x) Grading Plan: A plan prepared in accordance with this Ordinance showing grading and related work.

(y) Manual of Standards: A compilation of administrative procedures, technical standards and design specifications adopted by the City of Sacramento for controlling construction-related grading, surface runoff, erosion and sedimentation. This Manual of Standards shall be titled "Administrative and Technical Procedures Manual for Grading and Erosion and Sediment Control."

(z) Owner: The legal owner of the property where the grading work is to be done, as shown on the latest equalized assessment roll in the Office of the County Assessor.

(aa) Parcel (Lot): The land described as a lot or parcel in a recorded deed or shown as a lot or parcel on a subdivision map or parcel map on file in the Sacramento County Recorder's Office.

(bb) Permit: Either a building permit or a separate grading permit.

(cc) Person: Any person, firm, corporation, or public agency whether principal, agent, employee, or otherwise.

(dd) Post Construction Erosion and Sediment Control Plan (PC Plan): Consists of a set of best management practices or equivalent measures designed to control surface runoff and erosion and to retain sediment on a particular site after all final structures and permanent improvements have been erected or installed.

(ee) Preliminary Grading Plan: A plan that shows the proposed grading work in relation to the existing site prepared and submitted with the application for a grading permit.

(ff) Rainy Season: The period of the year during which there is a substantial risk of rainfall. For the purpose of this Ordinance, the rainy season is defined as from October 1 to April 30, inclusive.

(gg) Rough Grade: The stage at which the grade approximately conforms to the approved plan.

(hh) Sediment: Any material transported or deposited by water, including soil debris or other foreign matter.

(ii) Site: Any lot or parcel of land or combination of contiguous lots or parcels of land, whether held separately or joined together in common ownership or occupancy, where grading is to be performed or has been performed.

(jj) Slope: An inclined ground surface the inclination of which may be expressed as the ratio of horizontal distance to vertical distance.

(kk) Soil: All earth material of any origin that overlies bedrock and may include the decomposed zone of bedrock which can be excavated readily by mechanical equipment.

(ll) Vegetation: Plant life or total plant cover of an area.

(mm) Watercourse: Any natural or manmade channel in which water flows continuously or intermittently in a definite direction and course, or which is used for the holding, delay or storage of waters, or which functions at any time to convey or store stormwater runoff.

9.31.1506 GRADING APPROVAL REQUIRED

Except for the specific exemptions listed hereinafter, no person shall do or permit to be done any grading on any site in the of the City of Sacramento without first obtaining approval of such grading from the Director in accordance with the provisions of the Grading Ordinance.

9.31.1507 EXEMPTIONS

The following grading may be done without obtaining grading approval unless grading approval is required in mitigation monitoring agreements or other conditions of project approval. Exemption from the grading approval requirement shall not be deemed as permission to violate any other provision of this Ordinance.

(a) Minor construction projects which meet all of the following requirements:

1. The volume of material graded is less than 50 cubic yards.
2. The depth of cuts and fills is less than two feet.
3. Any drainageway is not blocked or obstructed and its stormwater carrying capacities are not modified.
4. Slopes are less than ten percent and are not left in an unstable or erodible condition.

(b) Single family residential lots less than 1/2 acre that are not part of a larger common plan and residential infill projects less than ½ acre which also meet the requirements of 9.31.1507(a) above.

(c) Excavations in connection with a swimming pool authorized by a valid building permit.

(d) Grading necessary for agricultural operations unless the failure of any cut or fill created by such grading could endanger any structure intended for human or animal occupancy or any public road, or could obstruct any watercourse or drainageway.

(e) Exploratory excavations of less than 350 cubic yards under the supervision of a Geotechnical Engineer.

(f) Routine cemetery excavations and fills.

(g) Performance of emergency work necessary to protect life or property when an urgent necessity therefor arises. The person performing such emergency work shall notify the Director promptly of the problem and work required.

(h) An excavation below finished grade for basements and footings of a building authorized by a valid building permit.

(i) Refuse disposal sites controlled by Title 23, Chapter 15, of the California Code of Regulations.

(j) The repair and maintenance of levees for river and local drainage control performed by a governmental agency.

9.31.1508 GRADING APPROVAL

Grading approval may be issued by the Director in connection with the issuance of a building permit or the approval of improvement plans, or where grading is commenced prior to such issuance or approval, through the issuance of a separate grading permit.

9.31.1509 CONDITIONS OF GRADING APPROVAL

(a) No grading shall be approved unless the project conforms with the City of Sacramento's General Plan, any specific plans adopted thereto, and applicable City ordinances including the Zoning Ordinance and the Subdivision Ordinance.

(b) Where the California Environmental Quality Act (CEQA) requires the preparation and approval of environmental documents concerning a proposed grading project, no grading shall be approved until all CEQA requirements have been met.

(c) Where a proposed grading project requires the filing of a tentative map or the intended use requires approval of a discretionary zoning permit or variance, grading may also require approval from the City of Sacramento Planning and Development Department.

(d) Work shall be performed in accordance with the provisions of the Grading Ordinance and the applicable criteria set forth in the Manual of Standards.

(e) Grading approval shall be limited to work shown on the grading plans as approved by the Director. The Director may impose any condition deemed necessary to protect the health, safety, and welfare of the public, to prevent the creation of a hazard to public or private property, and/or to assure proper completion of the grading, including but not limited to the following:

1. Mitigation of adverse environmental impacts as disclosed by any environmental document findings.

2. Improvement of any existing grading to comply with the standards of the Grading Ordinance.

3. Requirements for fencing or other protection of grading which would otherwise be hazardous.

4. Requirements for dust, erosion, sediment and noise control, hours of operation and season of work, access roads and haul routes.

5. Requirements for safeguarding watercourses, whether natural or manmade, from excessive deposition of sediment or debris. In no case shall deposition of sediment or debris cause an exceedance of applicable water quality standards.

6. Assurance that the land area in which grading is proposed and for which habitable structures are proposed is not subject to hazards of land slippage or significant settlement or erosion and that the hazards of flooding can be eliminated or adequately reduced.

7. Requirements for safeguarding existing water wells.

9.31.1510 LIABILITY

Neither issuance of grading approval under the provisions of the Grading Ordinance nor compliance with the provisions hereof or with any conditions imposed in a permit issued hereunder shall relieve any person from responsibility for damage to any person or property or impose any liability upon the City of Sacramento for damage to any person or property.

9.31.1511 SCOPE OF APPROVAL

The issuance of grading approval shall not be construed as an approval of any action or condition constituting a violation of the provisions of the Grading Ordinance or of any other applicable laws, ordinances, rules or regulations.

9.31.1512 WATER OBSTRUCTION

No person shall do or permit to be done any grading which may obstruct, impede, or interfere with the natural flow of storm waters, whether such waters are unconfined upon the surface of the land or confined within land depressions, natural drainage ways, unimproved channels, watercourses, improved ditches, channels or conduits, in such manner as to cause flooding where it would not otherwise occur, aggravate any existing flooding condition or cause accelerated erosion except where said grading is in accordance with all applicable laws including, but not limited to, the provisions of the Grading Ordinance.

9.31.1513 LEVEE WORK

No person shall excavate or remove any material from or otherwise alter any levee adjacent to any river, creek, bay, or local drainage control channel, without prior approval of the governmental agency or agencies responsible for the operation and/or maintenance of the levee.

9.31.1514 CONSTRUCTION IN PUBLIC RIGHT-OF-WAYS

No person shall perform any grading work within the right-of-way of a public road or street, or within a public easement, without prior written approval of the Director, and without obtaining a City of Sacramento Encroachment Permit.

9.31.1515 HAZARDS

Whenever the Director determines that any grading on private property constitutes a condition which could endanger persons or property, or could adversely affect the safety, use or stability of adjacent property, or an overhead or underground utility, or any public way, watercourse or drainage channel, or could adversely affect the water quality of any water bodies or watercourses, the owner of the property upon which the condition is located, or other person or agent in possession or control of said property, upon receipt of notice in writing from the Director, shall, within the period specified therein, stop all work. The Director may require the submission of plans, soil or geological reports, detailed construction recommendations, drainage study or other engineering data prior to and in connection with any work or activity proposed or required to correct such condition.

9.31.1516 NOT RETROACTIVE

The provisions of the Grading Ordinance shall not apply to planned or existing construction for which all previously necessary permits and approvals were obtained prior to the effective date of this Ordinance.

CHAPTER 9.32 APPLICATION FOR GRADING APPROVAL

9.32.1601 FILING OF APPLICATION FOR GRADING APPROVAL - PERMIT

Applications for permits shall be obtained from and filed with the Department of Planning and Development, Building Inspections Division. Each application shall include a plan checking fee, the preliminary or final grading plans and a statement of the intended use of the site. Only one application and permit is allowed for grading work to be done on a site. The Director shall determine whether the application is complete in accordance with provisions of Chapter 9.33 herein and may require additional information from the applicant before accepting the application as complete. The applicant shall be notified within ten (10) working days if the application is deemed incomplete, and of the requirements for completing the application.

9.32.1602 IMPROVEMENT PLANS IN LIEU OF APPLICATION FOR PERMIT

Where a subdivision improvement plan is being processed in conjunction with either an approved tentative, parcel, or final map; or a site plan is being processed in accordance with the provisions of this Code, such plan shall also be considered as an application for grading approval. Such plans shall be reviewed and approved, conditionally approved or denied in accordance with the standards and requirements set forth in the Grading Ordinance and other applicable City specifications. If an improvement plan or site plan is approved, then a separate grading permit shall not be required. Approval of the improvement plans constitutes approval of the grading work intended.

9.32.1603 GRADING PRIOR TO ISSUANCE OF BUILDING PERMIT OR APPROVAL OF IMPROVEMENT PLANS

Applicants for a permit to allow grading prior to issuance of a building permit or approval of improvement plans shall meet the following requirements:

(a) Preliminary Grading Plan shall be submitted for review and approval by the Director. This plan shall conform to the requirements of the Grading Ordinance and any applicable conditions placed on the project as a result of any formal discretionary permit process. The applicant shall acknowledge that any additional grading or revisions to work necessitated by conflicts discovered during the improvement plan check or subsequent construction will be corrected at the applicant's expense.

(b) Both Erosion and Sediment Control Plans in accordance with provisions of Chapter 9.33, Plans and Specifications, of the Grading Ordinance shall be submitted for review and approval by the Director.

(c) A Winterization Certification shall be submitted for review and approval by the Director in accordance with Chapter 9.33.1706.

(d) Plan Check and Inspection Fee Deposit shall be required in the amount of the full plan check fee applicable at the time of submittal in accordance with Chapter 9.34.1802.

(e) No grading permit shall be issued until all applicable CEQA requirements have been met.

9.32.1604 REFERRAL TO OTHER PUBLIC AGENCIES

The Director may refer the application to other interested public agencies for their recommendations.

9.32.1605 PERMISSION OF OTHER AGENCIES OR OWNERS

No application for grading approval shall relieve the applicant of responsibility for securing other permits or approvals required for work which is regulated by any other department or other public agency, or for obtaining any easements or authorization for grading on property not owned by the applicant. Proof of applicable public agency permits may be required prior to issuance of grading approval.

CHAPTER 9.33 PLANS AND SPECIFICATIONS

9.33.1701 APPLICATION - PLANS

Five (5) complete sets of plans, as determined by the Director, including but not limited to, profiles, cross sections, topographic maps, erosion and sediment control plans, and accompanying specifications shall be submitted to the Director with each application for grading approval or when otherwise required by the Director for enforcement of any provision of this Ordinance. At the time of application, the applicant may provide preliminary grading plans. Prior to the issuance of grading approval, the applicant must furnish Final Grading Plans and all Erosion and Sediment Control Plans. Preliminary grading plans with appropriate changes and additions thereto may be accepted as final grading plans. When the final grading plans and other required documents have been approved, grading approval will be issued by the Director. The work shall be done in strict compliance with the approved plans and specifications which shall not be changed or altered except in accordance with the provisions of this Chapter.

9.33.1702 PRELIMINARY GRADING PLANS

Preliminary grading plans provide for review and determination of grading requirements prior to approval of final plans and issuance of grading approval. Precise design at this stage is not required. The plans shall be clearly and legibly drawn and entitled "Preliminary Grading Plan," and shall contain a statement of the purpose of the proposed grading, and shall include all of the information required in the Manual of Standards, Chapter 2, Section 2.

9.33.1703 FINAL GRADING PLANS

Final grading plans and specifications shall be prepared and signed by a registered Civil Engineer, except as otherwise provided herein. In addition to all requirements for preliminary grading plans, the final plans shall include the information required in the Manual of Standards, Chapter 2, Section 2. The Director may waive the requirement that all plans and specifications be prepared and signed by a registered Civil Engineer if the grading would not endanger the public health, safety, or welfare as determined by the Director and would not involve or require any of the following:

(a) Cuts and fills with a combined total of 350 cubic yards or more.

(b) An access road serving five or more existing or proposed residences.

(c) A cut or fill that is located so as to cause unduly increased pressure or reduce support upon adjacent structure of property.

(d) The construction of any drainage or sediment control structures, culverts, or facilities or alteration of any existing drainage course.

(e) The creation or aggravation of an unstable slope condition.

9.33.1704 EROSION AND SEDIMENT CONTROL PLAN (ESC PLAN)

The ESC Plan shall be prepared for all projects to control surface runoff and erosion and to retain sediment on a particular site and prevent pollution of site runoff during the period when pre-construction and construction related grading activities occur, but before final improvements or permanent structures are complete. The ESC Plan shall be prepared and submitted concurrently with the Final Grading Plan. The ESC Plan may be incorporated on the same plan sheet as the Final Grading Plan unless it makes the sheet cluttered, or it may be submitted on a clean separate sheet. The separate sheet shall be drawn clearly and legibly and entitled "Erosion and Sediment Control Plan", shall contain a statement of the purpose of the proposed Best Management Practices to be used, and shall include all of the information required and contained in the Manual of Standards, Chapter 2, Section 3.

9.33.1705 POST CONSTRUCTION EROSION AND SEDIMENT CONTROL PLAN (PC PLAN)

The PC Plan shall be prepared for all projects to control surface runoff and erosion and retain sediment on a particular site after all planned final improvements and/or structures have been installed or erected. The PC Plan shall be prepared and submitted concurrently with the Final Grading Plan. The PC Plan shall be drawn clearly and legibly, and entitled "Post Construction Erosion and Sediment Control Plan." The PC Plan shall contain a statement of the purpose of the proposed Best Management Practices to be used to secure the project after completion, and shall include all of the information required and contained in the Manual of Standards, Chapter 2, Section 4.

9.33.1706 WINTERIZATION CERTIFICATION

A winterization certification shall be submitted no later than September 15 for all projects where any construction will occur between October 1 and April 30. Construction that will occur solely in the summer months, between May 1 and September 30 will not be required to submit a winterization certification. The winterization certification shall consist of a written statement or descriptive plan sheet from the owner certifying that the project under construction is prepared for an event which will stop construction, such as rain or snow, that all ESC Plan Best Management Practices are in place and operating correctly, that housekeeping practices are maintained and that the site can be left or abandoned safely for an extended period of time during the rainy season without causing any erosion and sediment control problems. If a winterization certification is required and has not been submitted and approved prior to September 16, the grading approval will be suspended until a winterization certification is submitted and approval obtained. Refer to the Manual of Standards, Chapter 4, Section 5, for additional information regarding winterization certification.

9.33.1707 MODIFICATION OF APPROVED PLANS

Any modifications of an approved final plan shall be submitted in writing to the Director, who shall approve or deny such modification in his/her sole discretion. All necessary soils and geological information and design details shall accompany any proposed modification. Any modification shall be compatible with all subdivision map or land use requirements.

9.33.1708 GENERAL DESIGN STANDARDS

Any activities performed under the authority of the Grading Ordinance, including but not limited to grading, excavation, soil storage, soil transportation, erosion and sediment control measures, shall conform to the General Design Standards set forth in the Manual of Standards, Chapter 3.

CHAPTER 9.34 PERMIT REQUIREMENTS

9.34.1801 GENERAL

The Director shall issue grading approval if final grading plans satisfy the provisions of the Grading Ordinance and the Manual of Standards. The Director shall identify the provision, requirement, or condition which has not yet been met or performed by the applicant in the event the issuance of grading approval is denied.

9.34.1802 FEES

(a) Before grading approval is issued, the applicant shall deposit with the Director cash or a check, in a sufficient sum to cover the fee for issuance of the approval, charges for review of plans, specifications and reports, other engineering services, field investigations, necessary inspection or other work and routine laboratory tests of materials and compaction, all in accordance with the schedule of fees and costs established and adopted by the City Council. If the initial deposit does not cover the cost of review and inspection, the Director may charge additional fees.

(b) If grading work is done in violation of the Grading Ordinance or does not comply with the terms and conditions of a grading approval issued for such grading, a fee covering investigation of any violation and inspection and plan checking of work required to correct such violation shall be charged to the violator to cover all costs actually incurred by the City.

9.34.1803 PROGRESS REPORT

Applicant shall submit periodic progress reports on specified calendar dates and at commencement and completion of specified grading and erosion and sediment control operations. The dates upon which such reports are required and their content shall be as required by the Director in the grading approval.

9.34.1804 SUBMIT "RECORD CONSTRUCTION DRAWINGS"

The applicant shall submit to the Director record construction drawings of the final grading plan and Erosion and Sediment Control Plans following completion of grading operations.

9.34.1805 PERFORMANCE OF WORK - INSPECTION

The Director may inspect any work done pursuant to the Grading Ordinance at any time during the course of construction. No person shall be deemed to have complied with the Grading Ordinance until a final inspection of the work has been made by the Director. As a condition of any grading approval, the applicant shall provide the City a right-of-entry and reasonable access, in accordance with Chapter 9.35.1907, to the site during the performance of all work and for a minimum period of one year after acceptance by the Director of all improvements pursuant to the Grading Ordinance.

9.34.1806 LOCATION OF PROPERTY LINES

Prior to any grading work or related activities, the owner must flag all property corners of the parcel of land to be graded. If the property corners are unknown, or whenever the location of a property line or easement or the title thereto is disputed during the application process or during a grading operation, a survey by a licensed Land Surveyor or Civil Engineer or other resolution of the title dispute, all at the expense of the applicant, may be required by the Director.

9.34.1807 OTHER RESPONSIBILITIES OF APPLICANT

(a) Protection of Utilities: The applicant shall be responsible for the prevention of damage to any public utilities or services.

(b) Protection of Adjacent Property: The applicant shall be responsible for the prevention of damage to adjacent property. No person(s) shall excavate on land sufficiently close to the property line to endanger any adjoining public street, sidewalk, alley, structure, or other public or private property, or easement, without supporting and protecting such property from any damage which might otherwise result.

(c) Advance Notice: The applicant shall notify the Director at least 24 hours prior to the start of work.

(d) Erosion and Sediment Control: It shall be the sole responsibility of the applicant to prevent discharge of sediment from the site, in quantities greater than before the grading occurred, to any watercourse, drainage system, or adjacent property.

9.34.1808 TIME LIMITS

All the work required by the permit or grading approval shall be completed within the time limits specified in the permit or approval. If the work cannot be completed within the specified time, a request for an extension of time setting forth the reasons for the requested extension shall be presented in writing to the Director no later than 30 days prior to the expiration of the permit or approval. The Director shall in his/her sole discretion approve or deny such request. The Director may require a new application and fees depending on the time between the expiration date and the extension request, revisions in City regulations, and/or changed circumstances in the immediate area.

9.34.1809 TRANSFER OF GRADING APPROVAL

No approval or permit issued under the Grading Ordinance may be transferred or assigned in any manner whatsoever, without the express written consent of the Director.

9.34.1810 IMPROVEMENT SECURITY REQUIRED

(a) As a condition for the issuance of grading approval, the Director may require the deposit of an improvement security in an amount deemed sufficient by him/her to assure faithful performance of the grading work in the event of default on the part of the applicant. Said security shall be in a form acceptable to the City of Sacramento.

(b) In the case of subdivisions, the improvement security shall remain in effect until final inspections have been made and all grading work and subdivision improvements have been accepted by the City of Sacramento.

(c) For projects other than subdivisions, the improvement security shall remain in effect until final inspections have been made and all grading work has been accepted by the Director.

(d) In addition to the improvement security, the Director may also require the deposit of maintenance security in an amount deemed sufficient by him/her to guarantee and maintain the grading work performed, to assure the proper functioning of drainage systems and adequate erosion and sedimentation control. Said maintenance security shall be in a form acceptable to the City of Sacramento and shall remain in effect for a period of one year after the date of acceptance of the improvements or grading work, as designated in subsections (b) and (c) above, or such other periods of time as required by the Director.

(e) Any deposit required by the Director pursuant to this ordinance shall be payable to the City of Sacramento.

(f) Upon failure to complete the work, failure to comply with all of the terms of the Grading Ordinance, or failure of the completed site to function properly to provide proper drainage or erosion and sedimentation control, the City may do the required work, or cause it to be done and collect from the applicant or surety all costs incurred thereto, including administrative and inspection costs. Any unused portion of a deposit shall be refunded to the applicant after deduction by the City of the cost of the work.

9.34.1811 APPEALS

Appeals of any decision made pursuant to the Grading Ordinance shall be made to the Construction Codes Advisory and Appeals Board in writing, setting forth the specific grounds therefor. Such appeals shall be heard and determined in accordance with the procedures set forth in Chapter 9.19 of this Title.

CHAPTER 9.35 ENFORCEMENT

9.35.1901 ENFORCEMENT OFFICIAL

The Director shall enforce the provisions of the Grading Ordinance.

9.35.1902 SUSPENSION AND REVOCATION OF GRADING APPROVAL

The Director may suspend or revoke grading approval for good cause. In the event that a suspension or revocation is appealed to the Construction Codes Advisory and Appeals Board, no work shall be performed pending appeal except as expressly authorized, in writing, by the Director.

9.35.1903 STOP WORK ORDER

(a) Whenever any work is being done in violation of the provisions of the Grading Ordinance or any other applicable law, ordinance, rule or regulation, the Director may order the work stopped by serving written notice of such violation on any persons engaged in, doing, or causing such work to be done. Any such person shall forthwith stop such work until authorized by the Director to proceed with the work. If there are no persons present on the premises, the notice shall be posted in a conspicuous place. The notice shall state the nature of the violation. Any person violating a stop work order shall be guilty of an infraction.

(b) Upon receipt of or knowledge of the existence of such stop work notice, the person performing the work shall:

1. Stop work immediately; and

2. Within twenty-four (24) hours, provide the Director with a list of remedies which can be immediately undertaken to bring the work into compliance with this Title; and

3. Within twenty-four (24) hours after acceptance of such remedies by the Director, undertake at the violator's expense, such action as is necessary to bring the work into compliance with this Title.

4. If engineering work is required to identify and define the proper course of action, as determined by the Director, such work shall be provided by the violator at no cost to the City.

9.35.1904 ABATEMENT OF UNLAWFULLY CREATED CONDITIONS

(a) Any condition in violation of the Grading Ordinance is hereby declared to be a public nuisance, subject to abatement in accordance with Title 61 of this Code. In the event that the Director determines that a violation has created a condition which is of such a nature to be imminently dangerous to the public health, safety or welfare, such condition may be abated in accordance with the summary abatement procedures set forth at Chapter 61.09, et. seq. of this Code.

The following conditions are hereby declared to constitute an imminently dangerous condition:

1. When a violation has altered natural drainage patterns and has caused flooding to any downstream or upstream property; or

2. When a violation results in a condition which creates a drainage alteration such that upstream or downstream property may be flooded when weather conditions change and the owner, lessee, or licensee of the property on which the violation exists cannot be found; or

3. When a violation results in a hazard, requiring immediate correction for the preservation of the public health, safety, or welfare; or

4. When a violation results in a discharge or release of significant amounts of sediment which causes or threatens to cause flooding, property damage, or unsafe conditions.

(b) The costs incurred by City to abate any nuisance caused by a violation of the Grading Ordinance shall be assessed against the subject property as a lien or made a personal obligation to the owner of the property as provided in Chapter 61.10, et. seq. of this Code. Such costs may include, but shall not be limited to, the following:

1. Engineering and design costs.

2. Contractor service bills or public employee wages at cost.

3. Administrative overhead and supervision based on ten percent (10%) of all other costs incurred.

4. Interest which shall accrue and be billed at the rate of ten percent (10%) of all unpaid amounts from the date of billing.

5. Attorney fees and costs.

(c) The abatement procedures set forth in this section are cumulative and in addition to any other rights or remedies which are or may be available to City to correct or cause to be corrected any violation of the Grading Ordinance, or to abate a condition which is otherwise a public nuisance.

9.35.1905 INFRACTION

Any person violating any provision of the Grading Ordinance shall be guilty of an infraction.

9.35.1906 NON-EXCLUSIVE REMEDIES

The remedies provided herein are not exclusive, and are in addition to any other remedy or penalty provided by law for violation of the Grading Ordinance.

9.35.1907 RIGHT-OF-ENTRY

Whenever necessary to enforce the provisions of the Grading Ordinance, the Director may enter the premises at all reasonable times to the extent authorized by law to perform any duty imposed by the Grading Ordinance. If such entry is refused, the Director shall have recourse to every remedy provided by law to secure entry.

PASSED FOR PUBLICATION: November 23, 1993

DATE ENACTED: December 07, 1993

DATE EFFECTIVE: January 06, 1994

MAYOR

ATTEST:

CITY CLERK

FOR CITY CLERK USE ONLY

ORDINANCE NO.: 93-068

DATE ADOPTED: DEC 07 1993