



Caltrans Construction Stormwater Pollution Prevention Training

Construction Site BMPs and Field Applications

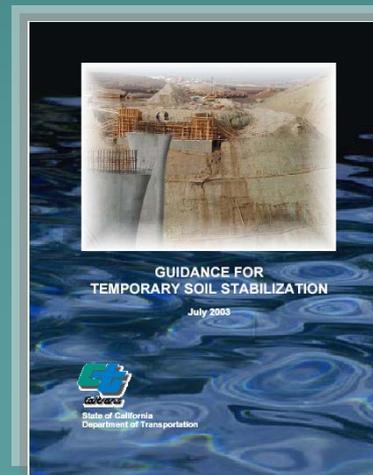
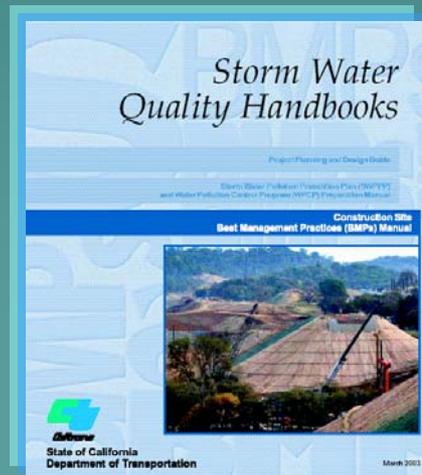
Module 2

Introduction

- ◆ Class Handouts
- ◆ Sign-in Sheet
- ◆ Breaks / Lunch

Course Handbooks

- ◆ Caltrans Storm Water Quality Handbooks and Manuals
 - Construction Site BMPs Manual (Reference Only)
 - Guidance for Temporary Soil Stabilization
 - ◆ Get Manuals online at <http://www.dot.ca.gov/hq/construc/stormwater/manuals.htm> or hard copies are available from Caltrans Publications



Introduction: Your Facilitators

- ◆ Who are we ?
- ◆ What is our background?

Introduction: About You

- ◆ Who are you?
- ◆ What is your storm water background?
- ◆ What do you want to learn from this class?

Course Highlights

- ◆ ***Introduction***
- ◆ Planning for Erosion and Sediment Control
- ◆ Erosion Control (Soil Stabilization) BMPs
- ◆ Sediment Control BMPs
- ◆ Wind Erosion Control BMPs
- ◆ Tracking Control BMPs
- ◆ Non-Stormwater Management BMPs
- ◆ Waste Management and Materials Pollution Control BMPs
- ◆ Class Exercise
- ◆ Field Demonstration of BMPs



Introduction: Class Objectives

After successful completion of the course, you should be able to:

- ◆ Understand which temporary BMPs are used to
 - Control erosion
 - Control sediment
 - Control wind erosion
 - Manage non-stormwater
 - Manage materials and waste
- ◆ Understand erosion and sediment control planning strategies

Introduction

- ◆ **Temporary soil stabilization BMP defined –**
 - Interim control measures which are installed or constructed to control soil erosion and which are not maintained after project completion
 - Permanent soil stabilization BMP defined – Measures which are installed or constructed to control soil erosion and which are maintained after project completion



Introduction

- ◆ Temporary **soil stabilization** can be the single-most important factor in reducing erosion at construction sites.

[NPDES General Construction Permit](#)



SWRCB / NPDES - General Construction Permit

◆ Rainy Season

- At a minimum, the discharger/operator must implement an effective combination of erosion and sediment control on all disturbed areas during the rainy season
- The discharger shall consider surface stabilization measures such as: covering with mulch, temporary seeding, soil stabilizers, binders, fiber rolls or blankets, temporary vegetation, permanent seeding, and a variety of other measures.



Course Highlights

- ◆ Introduction
- ◆ ***Planning for Erosion and Sediment Control***
- ◆ Erosion Control (Soil Stabilization) BMPs
- ◆ Sediment Control BMPs
- ◆ Wind Erosion Control BMPs
- ◆ Tracking Control BMPs
- ◆ Non-Stormwater Management BMPs
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- ◆ Class Exercise
- ◆ Field Demonstration of BMPs



Planning for Erosion Control

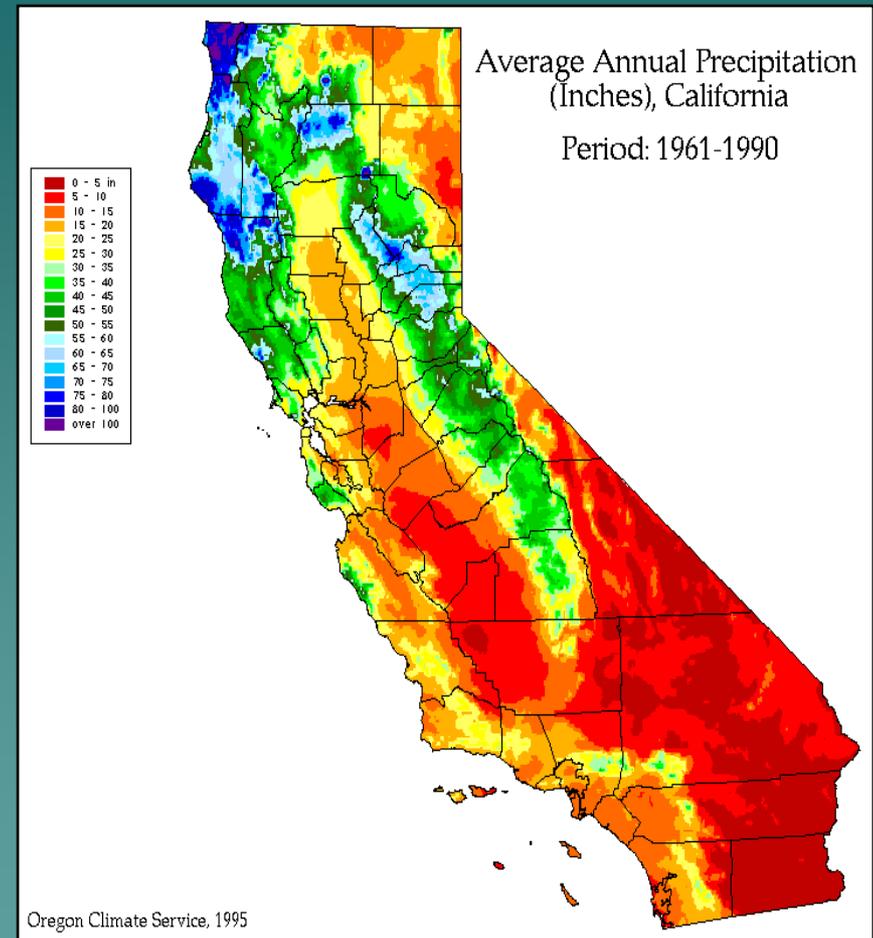
- ◆ *Disturbed Soil Area (DSA)*: Areas of exposed, erodible soil, including stockpiles, that are within the construction limits and that result from construction activities (actual surface area and not horizontal projection)
- ◆ *Active Areas* are construction areas where soil-disturbing activities have already occurred and continue to occur or will occur during the ensuing 21 days
- ◆ *Non-Active Areas* are construction areas (formerly active areas) that will be idle for at least 21 days
- ◆ To effectively stabilize DSAs **proper planning**, selection and implementation of soil stabilization BMPs is necessary

Planning Considerations

- ◆ Rainy Season
- ◆ Site Evaluation
- ◆ Water Pollution Control Strategies
- ◆ Soil Preparation

Rainy Season

- ◆ Review and evaluate soil disturbing activities during the rainy season
- ◆ Be aware of when and how much precipitation could potentially fall during storm events



Site Evaluation

- ◆ Flow Conditions
- ◆ Slope Inclination and Length
- ◆ Soil Properties
- ◆ Surface area
- ◆ Atmospheric Condition
- ◆ Accessibility of Equipment
- ◆ Duration of Needs

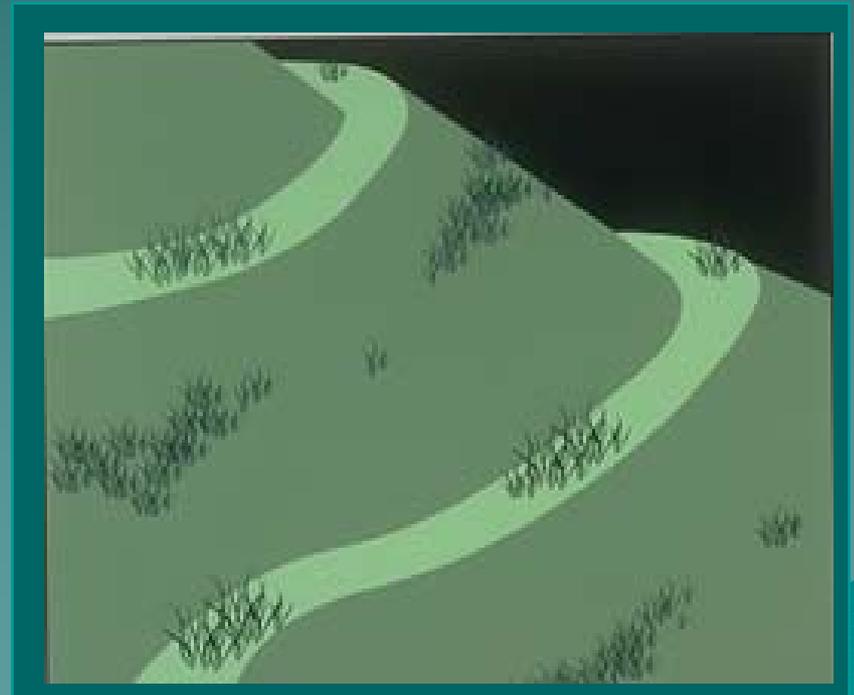
Site Evaluation - Flow Conditions

- ◆ Determine the types of flows which will impact the DSA of the construction site
 - Sheet Flow
 - Channelized Flow
 - Run-on
 - Run-off

Site Evaluation - Slope Inclination and Length

- ◆ Slope Inclination
 - Is the gradient of the face of the slope

- ◆ Slope Length
 - Is measured or calculated along the continuous incline surface



Site Evaluation - Soil Properties

- ◆ Soil Composition
 - Classification of soil grain size, shape and mineralogy
- ◆ Shear Strength and Density
 - Shear strength is the resistance to sliding from one mass of soil to another
 - Density is the percent of void space in the soil
- ◆ Permeability
 - Measure of how fast water can move through the soil
- ◆ Soil Chemistry
 - The makeup of the soil
- ◆ Geological Features
 - Subsurface geology

Site Evaluation - Surface Area

- ◆ **Small:**
 - Equal to or less than 1 acre
- ◆ **Medium:**
 - Between 1 and 5 acres
- ◆ **Large:**
 - Greater than 5 acres

Site Evaluation – Atmospheric Conditions

- ◆ Atmospheric conditions may limit the type of soil stabilization applied to disturbed soil areas
 - Temperature
 - Moisture and Humidity
 - Wind

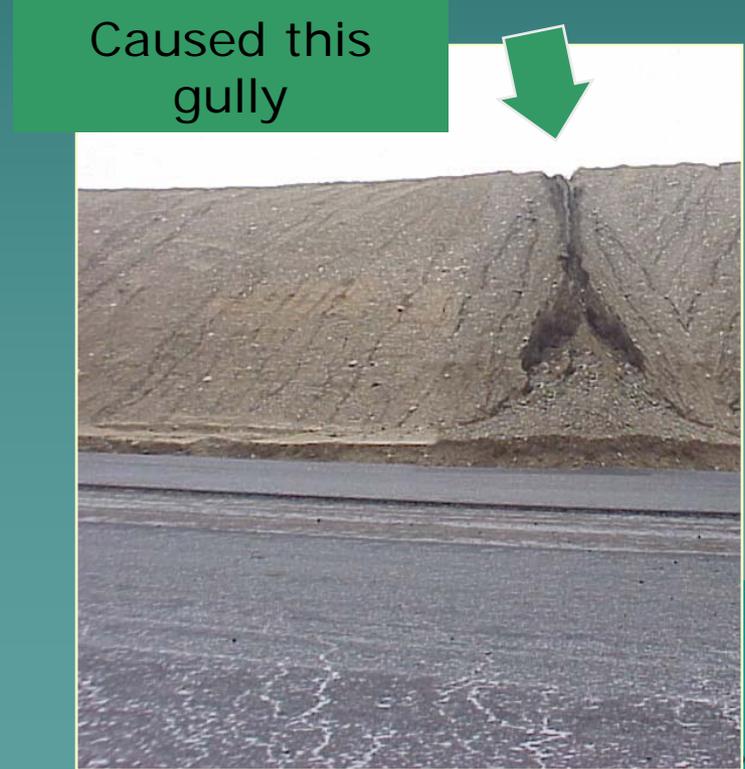
Site Evaluation - Accessibility of Equipment

- ◆ **Access** to DSA may limit soil stabilization equipment from reaching areas



Site Evaluation - Drainage

- ◆ It is essential to understand site **run-off**, **run-on** dynamics and control the drainage.



Site Evaluation - Duration of Need

- ◆ The length of time that a DSA will need to be protected should be considered
 - Less than or equal to 3 months
 - Between 3 and 12 months
 - Greater than or equal to 12 months

What can this site teach us?

- ◆ Incorrectly applied erosion control can actually increase erosion
- ◆ For example: Silt fence should not be installed up and down slope
- ◆ Silt fence stakes are not spaced close enough to provide adequate bracing
- ◆ Fiber rolls may have been used to break-up slope length



Weather Tracking

- ◆ Contractor to designate a person to monitor the forecast for probability, duration and expected intensity

Weather information is provided on the National Weather Service website at:

<http://www.nws.noaa.gov/>



Erosion Control Strategies

- ◆ Erosion Control vs. Sediment Control
- ◆ Prevent storm water contact with the construction site
- ◆ Limit amount of disturbed soil areas (DSAs)
- ◆ Protect (DSAs) from erosion
- ◆ Minimize sediment in storm water before leaving the site
- ◆ Prevent storm water contact with other pollutants



Erosion Control

- ◆ Any practice that protects the soil surface and prevents the soil particles from being detached by rainfall or wind.
- ◆ Erosion control, therefore, is a **source control** that treats the soil as a resource that has value and should be kept in place.

Sediment Control

- ◆ Any practice that traps the soil particles after they have been detached and moved by wind or water.
- ◆ Sediment control measures are usually **passive systems** that rely on filtering or settling the particles out of the water or wind that is transporting them.

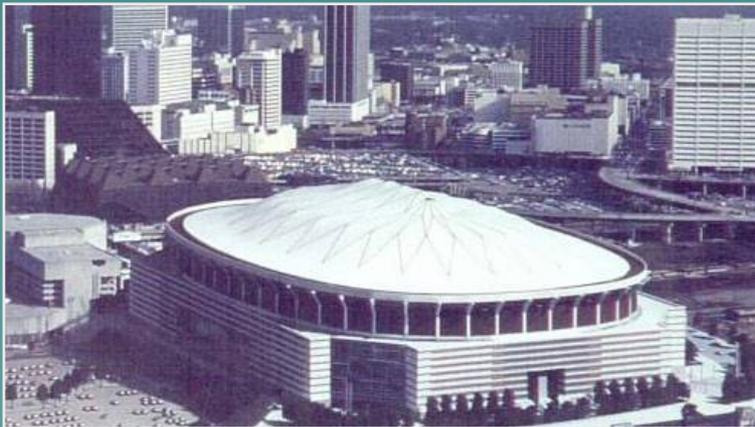
Which are More Effective?

- ◆ Erosion controls are preferred
 - keep the soil in place
 - enhance the protection of the site resources

- ◆ As required, use ***erosion controls as the primary protection***, with ***sediment controls as a secondary system***.

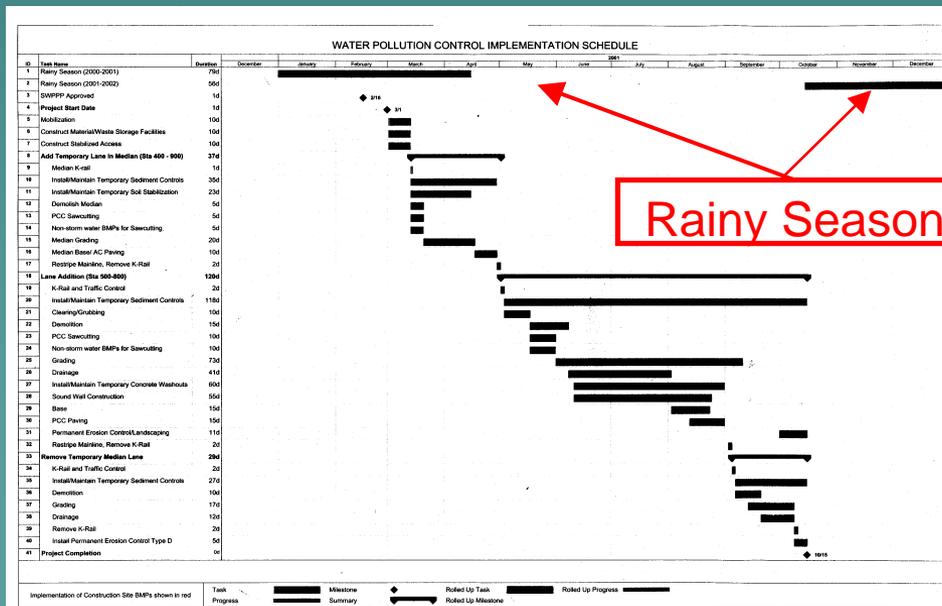
Prevent Storm Water Contact With The Construction Site

- ◆ Storm water from the sky - Rainfall
- ◆ Storm Water from adjacent areas - Run-on



Prevent Storm Water Contact With The Construction Site

- ◆ A BMP that is practicable to protect DSAs from rainfall is:
 - Scheduling



Limit the Amount of DSA

- ◆ Limit the amount and duration that DSAs are exposed to rainfall impact, run-on and run-off and wind
- ◆ Implement temporary control practices on non-active DSAs within 14 days from the cessation of soil-disturbing activities or one day prior to the onset of precipitation, whichever occurs first
- ◆ Implement temporary control practices for active DSAs prior to the onset of precipitation and throughout each day for which precipitation is forecasted.



Protect Disturbed Soil Areas From Erosion

- ◆ BMPs practicable to protect DSAs from run-on are:
 - Earth dikes/drainage swales and lined ditches
 - Sandbag Barriers



Protect Disturbed Soil Areas From Erosion

- ◆ BMPs to protect DSAs from erosion are:
 - Temporary soil stabilization
 - Top of slope dikes
 - Slope drains
 - Gravel bag berms or fiber rolls



Minimize Sediment In Storm Water Before Leaving Site

- ◆ Sediment Barriers
 - Silt Fence
 - Sandbag barrier
 - Straw bale barrier
 - Fiber Rolls
 - Gravel Bag Berm
- ◆ Sediment/Desilting Basins and Sediment Traps
- ◆ "Site Containment"



Site Containment

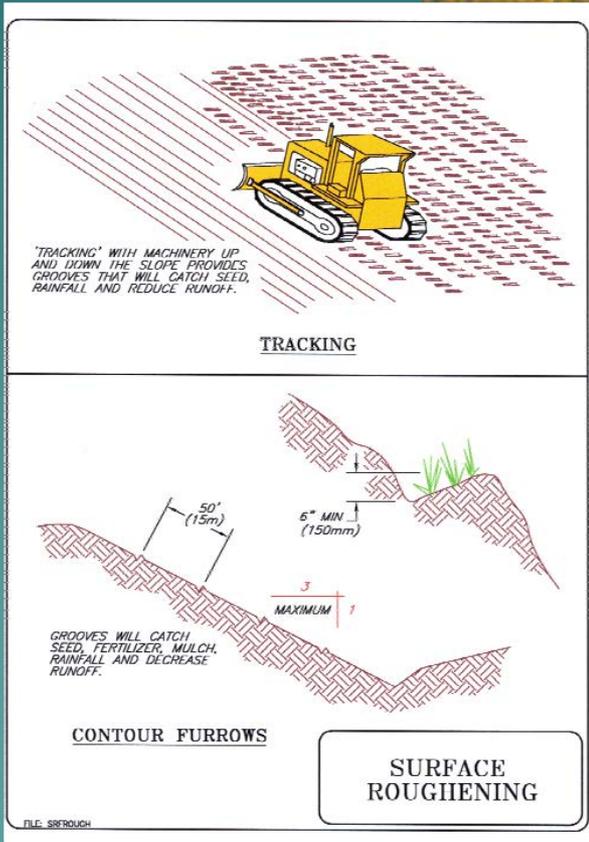
- ◆ Site features that form temporary receptacles to capture and prevent discharge of runoff from DSAs
 - Excavations
 - Topographical features
- ◆ Receptacle or depression large enough to contain runoff from a 100-year, 24-hour storm (where possible)
- ◆ If adequate volume is not available
 - Reduce contributing drainage area
 - Design a settling pond with an outlet structure
 - Use a different BMP strategy

Soil Preparation

- ◆ Proper preparation of the soil is necessary prior to the application of soil stabilization materials

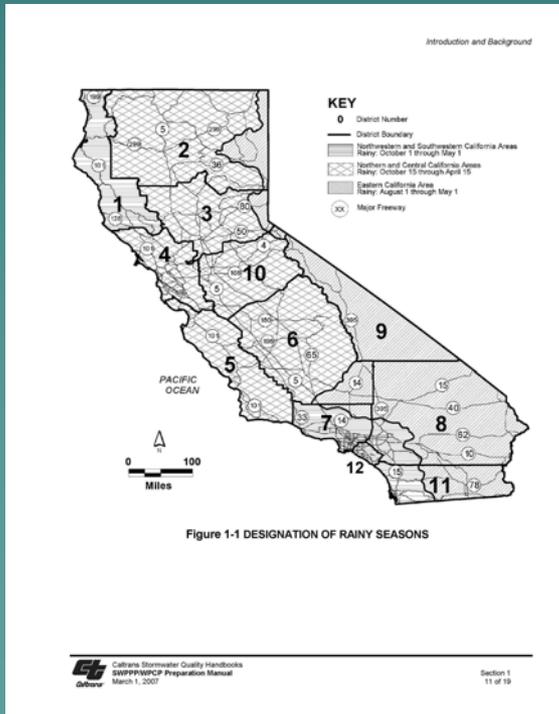


Soil Preparation



Implementation Requirements

- ◆ SWPPP/WPCP Preparation Manual
- ◆ Figure 1-1
- ◆ Tables 1-2, 1-3, and 1-4



Introduction and Background

Table 1-2

| Rainfall Area | Applicability | Elevation |
|---------------|--|---------------------|
| 1 | District 1 in the following areas: all of Del Norte and Humboldt Counties within 20 miles of the coast in Mendocino County | <3,000 ft |
| 2 | District 2 (except within Area 1) District 2 within the North Coast, Lahontan, and Central Valley RWQCB jurisdictions Districts 3, 4 and 5 District 10 | <800 ft |
| 3 | District 3 (except within Area 1) District 2 within the North Coast, Lahontan, and Central Valley RWQCB jurisdictions Districts 3, 4 and 5 | 800 ft - 3,000 ft |
| 4 | District 4 within the Central Valley RWQCB jurisdiction District 7 within the Santa Ana and San Diego RWQCB jurisdictions District 11 within the San Diego RWQCB jurisdiction District 12 | <1,000 ft |
| 5 | District 5 within the Central Valley RWQCB jurisdiction District 2 within the Central Coast, Los Angeles, and Central Valley RWQCB jurisdictions District 6 within the Santa Ana and San Diego RWQCB jurisdictions District 11 within the San Diego RWQCB jurisdiction District 12 | 1,000 ft - 3,000 ft |
| 6 | Schriener | <3,000 ft |
| 7 | District 7 within the Lahontan RWQCB jurisdiction District 7 within the Lahontan RWQCB jurisdiction District 8 within the Lahontan and Colorado River Basin RWQCB jurisdictions District 9 District 11 within the Colorado River Basin RWQCB jurisdiction | <3,000 ft |

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Introduction and Background

Table 1-3

REQUIRED COMBINATION OF TEMPORARY SOIL STABILIZATION AND TEMPORARY SEDIMENT CONTROLS AND BARRIERS⁽¹⁾

NON-ACTIVE DISTURBED SOIL AREAS⁽²⁾

| SEASON | RAINFALL AREAS ⁽³⁾ | TEMPORARY BMP | SLOPE (V/H) ⁽⁴⁾ | | | |
|----------------------|---|-----------------------------------|----------------------------|-------|-------|-------|
| | | | ≤ 1:30 | ≤ 1:4 | ≤ 1:2 | > 1:2 |
| RAINY ⁽⁵⁾ | 1 & 6 | SOIL STABILIZATION ⁽⁶⁾ | X | X | X | X |
| | | SEDIMENT BARRIER ⁽⁷⁾ | X | X | X | X |
| | | DESIGN TRIG BASIN ⁽⁸⁾ | X | X | X | X |
| | | SOIL STABILIZATION ⁽⁶⁾ | X | X | X | X |
| | 2, 4 & 5 | SEDIMENT BARRIER ⁽⁷⁾ | X | X | X | X |
| | | DESIGN TRIG BASIN ⁽⁸⁾ | X | X | X | X |
| | | SOIL STABILIZATION ⁽⁶⁾ | X | X | X | X |
| 3 | SEDIMENT BARRIER ⁽⁷⁾ | X | X | X | X | |
| | DESIGN TRIG BASIN ⁽⁸⁾ | X | X | X | X | |
| 7 | SOIL STABILIZATION AND SEDIMENT CONTROL PRACTICES TO BE DETERMINED BY APPLICABLE RWQCB ⁽⁹⁾ | | | | | |

(1) Unless otherwise noted, the BMP is required for the slope inclinations indicated on slope lengths greater than 10 ft.
(2) Required in addition to the temporary sediment barrier, where feasible. Feasibility will depend on site-specific factors such as available right-of-way within the project limits, topography, soil type, disturbed soil area, other sediment, and climate conditions.
(3) Implementation of soil stabilization controls are not required except prior to predicted rain.
(4) The indicated temporary BMP required on all slope lengths.
(5) The indicated temporary BMP required on slope lengths greater than 50 ft.
(6) Sediment control and barriers include all temporary sediment control construction (BMPs) identified in the Statewide Storm Water Management Plan (2008). Lower basin systems are required to what are identified in the Central Coast and Colorado River Basin partner contracts. The intent is to provide the transport of sediment at the downstream edge of disturbed soil areas.
(7) Refer to Section 1.4.3 for practices.

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Introduction and Background

Table 1-4

REQUIRED COMBINATION OF TEMPORARY SOIL STABILIZATION AND TEMPORARY SEDIMENT CONTROLS AND BARRIERS⁽¹⁾

ACTIVE DISTURBED SOIL AREAS⁽²⁾

| SEASON | RAINFALL AREAS ⁽³⁾ | TEMPORARY BMP | SLOPE (V/H) ⁽⁴⁾ | | | |
|----------------------|---|-----------------------------------|----------------------------|-------|-------|-------|
| | | | ≤ 1:30 | ≤ 1:4 | ≤ 1:2 | > 1:2 |
| RAINY ⁽⁵⁾ | 1 & 6 | SOIL STABILIZATION ⁽⁶⁾ | X | X | X | X |
| | | SEDIMENT BARRIER ⁽⁷⁾ | X | X | X | X |
| | | DESIGN TRIG BASIN ⁽⁸⁾ | X | X | X | X |
| | | SOIL STABILIZATION ⁽⁶⁾ | X | X | X | X |
| | 2, 4 & 5 | SEDIMENT BARRIER ⁽⁷⁾ | X | X | X | X |
| | | DESIGN TRIG BASIN ⁽⁸⁾ | X | X | X | X |
| | | SOIL STABILIZATION ⁽⁶⁾ | X | X | X | X |
| 3 | SEDIMENT BARRIER ⁽⁷⁾ | X | X | X | X | |
| | DESIGN TRIG BASIN ⁽⁸⁾ | X | X | X | X | |
| 7 | SOIL STABILIZATION AND SEDIMENT CONTROL PRACTICES TO BE DETERMINED BY APPLICABLE RWQCB ⁽⁹⁾ | | | | | |

(1) Unless otherwise noted, the BMP is required for the slope inclinations indicated on slope lengths greater than 10 ft.
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Course Highlights

- ◆ Introduction
- ◆ Planning for Erosion and Sediment Control
- ◆ ***Erosion Control (Soil Stabilization) BMPs***
- ◆ Sediment Control BMPs
- ◆ Wind Erosion Control BMPs
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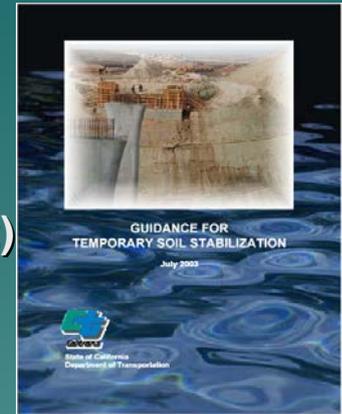
Soil Stabilization BMPs

- ◆ **Temporary Soil Stabilization BMPs are designed to eliminate or reduce the erosion of disturbed soil areas, and provide dust control during the process of construction and reduce the transport of sediment and pollutants by storm water**



Soil Stabilization BMPs

- ◆ In this section we will discuss the following temporary soil stabilization BMPs:
 - SS-1 Scheduling
 - SS-2 Preservation of Existing Vegetation
 - SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)
 - SS-4 Temporary Erosion Control (With Temporary Seeding)
 - SS-5 Temporary Soil Stabilizer
 - SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion) (SSP 07-350)
 - SS-7 Temporary Erosion Control Blanket (SSPs 07-390, 07-395)
 - SS-8 Temporary Mulch (Wood)
 - SS-9 Earth Dikes/Drainage Swales & Lined Ditches
 - SS-10 Outlet Protection/Velocity Dissipation Devices
 - SS-11 Slope Drains
 - SS-12 Streambank Stabilization



SS-1 Scheduling

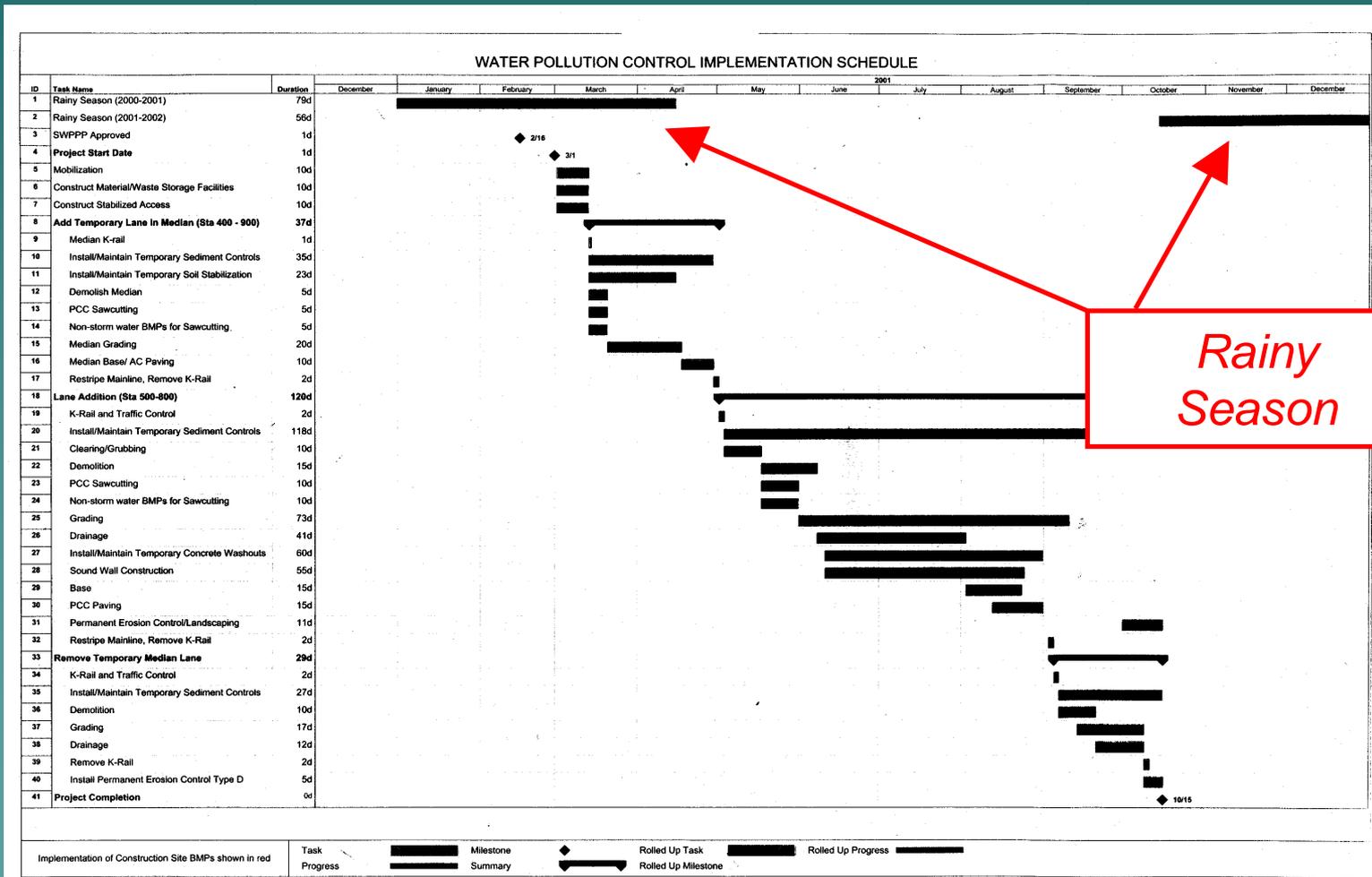
- ◆ Involves developing a schedule for every project
- ◆ Includes sequencing of construction activities with implementation of temporary construction BMPs
- ◆ Purpose is to reduce the amount and duration of soil exposure to erosion, and to perform construction and control practices in accordance with planned schedule

SS-1 Scheduling

- ◆ Consider Order of Work provisions to require phasing so certain areas or controls are in place before rainy season.
- ◆ Consider coordinating project bidding and award schedule with the time for work completion so grading and erosion control measures can be completed prior to rainy season.

SS-1 Scheduling

Example of Graphical Schedule



What is the Optimum Grading Period?



| MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY |
|--------|---------|-----------|----------|--------|
| | | 1 | 2 | 3 |
| | | 8 | 9 | 10 |
| 6 | 7 | 13 | 14 | 15 |
| 12 | | | | 16 |
| | | | | 23 |

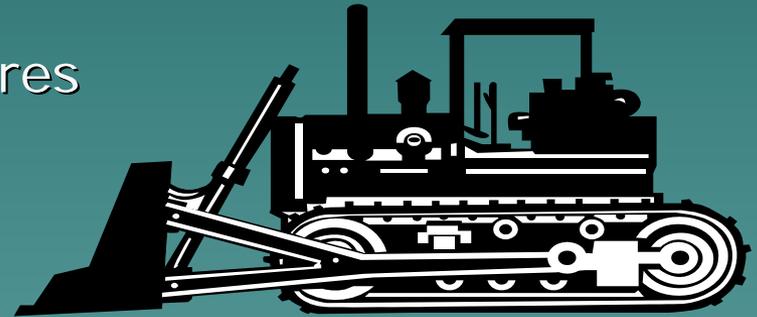
- ◆ Optimum grading period is the non-rainy season, particularly for the critical areas.
- ◆ If grading extends into rainy season, minimize the length of time that soils are exposed, and the total area of exposure.
- ◆ Materials used for erosion and sediment control should be on site at all times during the rainy season.

Timing is Critical During Rainy Season

- ◆ **Minimize** the length of time that soils are left exposed.
- ◆ **Reduce** the total area of exposed soil during the winter season.
- ◆ **Protect** critical areas such as drainage channels, streams, and natural watercourses.
- ◆ **Stabilize** exposed areas quickly.

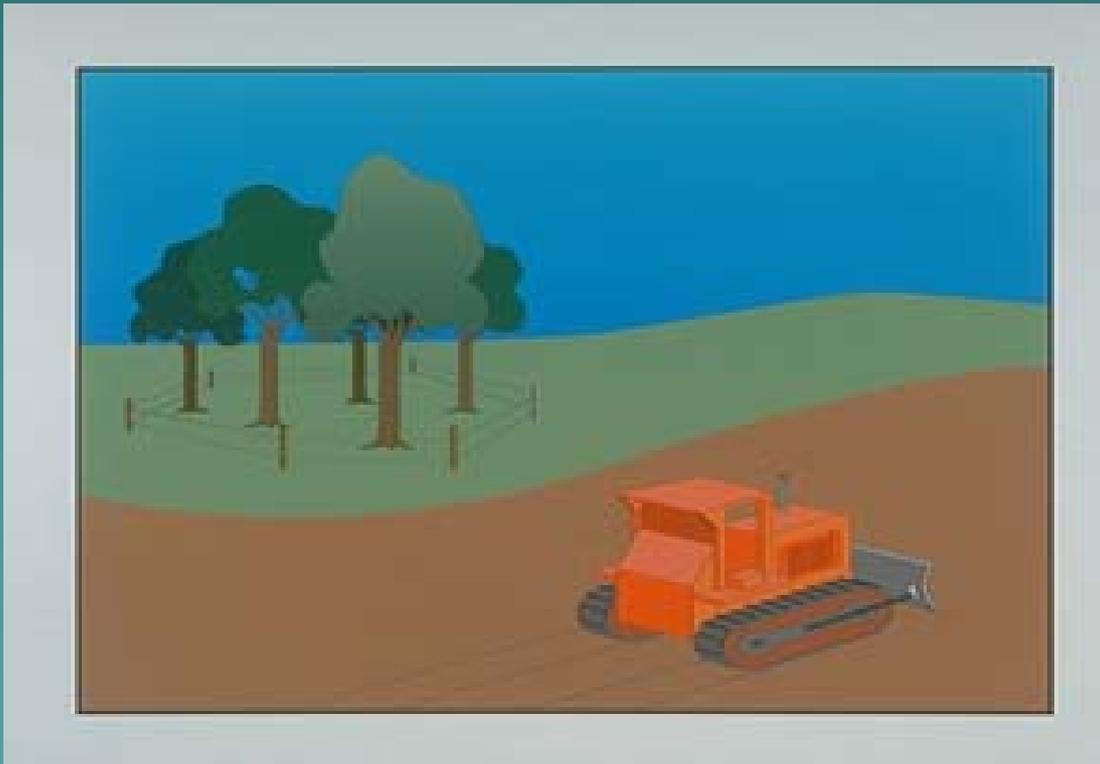
Schedule for Grading and Construction

- ◆ Recommended Sequence of Events that assure Effective Erosion and Sediment Control:
 - Stabilize Construction Access
 - Install Sediment Control Measures
 - Install Runoff Control
 - Land Clearing and Grading
 - Soils Stabilization
 - Roadway/Structure Construction
 - Highway Planting and and Final Stabilization



SS-2 Preservation of Existing Vegetation

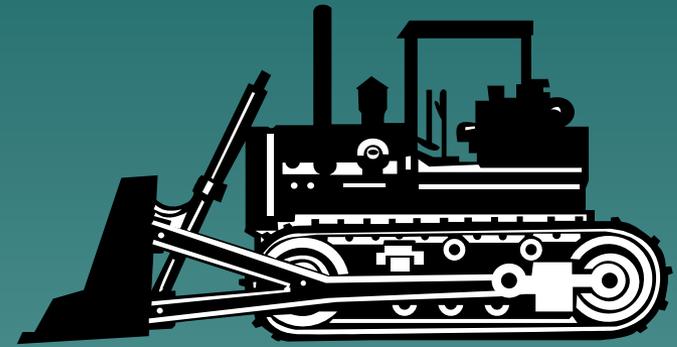
- ◆ Wherever possible, existing vegetation should be preserved.



- ◆ Leaving existing vegetation is particularly important along the site perimeter or adjacent to water bodies.

SS-2 Preservation of Existing Vegetation

- ◆ Pre-Construction
- ◆ Protect trees and roots
- ◆ Delineate vegetation areas to be protected
- ◆ Identify vegetative buffers



Soil Stabilization BMPs

- ◆ **BMPs used to protect or bind disturbed soil area from **raindrop impact erosion, sheet erosion and wind erosion****

SS-3 Temporary Hydraulic Mulch

SS-4 Temporary Erosion Control (With Temporary Seeding)

SS-5 Temporary Soil Stabilizer

SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion)

SS-7 Temporary Erosion Control Blanket/Temporary Cover(Plastic Covers)

SS-8 Temporary Mulch (Wood)ing



Soil Stabilization Selection Criteria Matrix

Temporary Soil Stabilization Criteria Matrix

| CLASS | TYPE | Antecedent Moisture | Availability | Ease of Clean-Up | EC Effectiveness (%) | Degradability | Length of Drying Time (hrs.) | Time to Effectiveness | Longevity | Mode of Application | Residual Impact | Native | Runoff Effect |
|---|--|---------------------|--------------|------------------|----------------------|---------------|------------------------------|-----------------------|-----------|---------------------|-----------------|--------|---------------|
| Straw Mulch | Wheat Straw | D | S | H | 90-95 | B | 0 | 1 | M | L/M | M | | + |
| | Rice Straw | D | S | H | 90-95 | B | 0 | 1 | M | L/M | M | | + |
| Wood Fiber Mulch | Wood Fiber | D | S | H | 50-60 | B | 0-4 | 1 | M | H | L | | + |
| | Cellulose Fiber | D | S | H | 50-60 | B | 0-4 | 1 | S | H | L | | + |
| Recycled Paper Mulch | | D | S | H | 50-60 | B | 0-4 | 1 | S | H | L | | + |
| Bonded Fiber Matrix | Biodegradable | D | S | H | 90-95 | B | 12-18 | 1 | M | H | M | | + |
| Biodegradable | Jute Mesh | D | S | H | 65-70 | B | | 1 | M | L | M | | + |
| | Curled Wood Fiber | D | S | H | 85-90 | P/B | | 1 | M | L | M | | + |
| | Straw | D | S | H | 85-90 | P/B | | 1 | M | L | M | | + |
| | Wood Fiber | D | S | H | 85-90 | P/B | | 1 | M | L | M | | + |
| | Coconut Fiber | D | S | H | 90-95 | P/B | | 1 | L | L | M | | + |
| | Coconut Fiber Mesh | D | S | H | 85-90 | B | | 1 | L | L | M | | + |
| | Straw Coconut Fiber | D | S | H | 90-95 | P/B | | 1 | L | L | M | | + |
| | Plastic Netting | D | M | H | <50 | P | | 1 | L | L | H | | + |
| Non-Biodegradable | Plastic Mesh | D | M | H | 75-80 | P | | 1 | L | L | H | | + |
| | Synthetic Fiber with Netting | D | M | H | 90-95 | P | | 1 | L | L | H | | + |
| | Bonded Synthetic Fibers | D | M | H | 90-95 | P | | 1 | L | L | H | | + |
| | Combination with Biodegradable | D | M | H | 85-90 | P | | 1 | L | L | H | | + |
| High-Density | Ornamentals | | S-M | H | 50-60 | | | 28 | M-L | H | L-M | N/E | + |
| | Turf species | | S | H | 50-60 | | | 28 | L | H | M-H | N/E | + |
| | Bunch grasses | | S-M | H | 50-60 | | | 28 | L | H | L-M | N | + |
| Fast-Growing | Annual | | S | H | 50-60 | | | 28 | L | H | L-H | N/E | + |
| | Perennial | | S | H | 50-60 | | | 28 | L | H | M | N/E | + |
| Non-Competing | Native | | S-M | H | 50-60 | | | 28 | L | H | L-M | N | + |
| | Non-Native | | S-M | H | 50-60 | | | 28 | L | H | L-H | E | + |
| Sterile | Cereal Grain | | S | H | 50-60 | | | 28 | L | H | L | E | + |
| Plastic | Rolled Plastic Sheeting | | S | | 100 | P | | 1 | M | L | H | | - |
| | Geotextile (Woven) | | S | | 90-95 | P | | 1 | M | L | H | | - |
| (PBS) Plant Material Based- Short Lived | Guar | D | S | H | 80-85 | B | 12-18 | | S | B | L | | 0/+ |
| | Psyllium | P | S | H | 25-35 | B | 12-18 | | M | B | L | | 0 |
| | Starches | D | S | H | 25-30 | B | 9-12 | | S | H | L | | 0 |
| (PBL) Plant Material Based- Long Lived | Pitch/ Rosin Emulsion | D | S | M | 60-75 | B | 19-24 | | M | B | M | | - |
| | | | | | | | | | | | | | |
| (PEB) Polymeric Emulsion Blends | Acrylic polymers and copolymers | D | S | M | 35-70 | P/C | 19-24 | | L | B | M | | +/- |
| | Methacrylates and acrylates | D | M | M | 35-40 | P/C | 12-18 | | S | W | L | | 0/+ |
| | Sodium acrylates and acrylamides | D | M | M | 20-70 | P/C | 12-18 | | S | H | L | | +/- |
| | Polyacrylamide | D | M | M | 55-65 | P/C | 4-8 | | M | H | L | | 0/+ |
| | Hydro-colloid polymers | D | M | H | 25-40 | P/C | 0-4 | | M | H | L | | 0/+ |
| (PRB) Petroleum/ Resin-Based Emulsions | Emulsified Petroleum Resin | D | M | L | 10-50 | P/C | 0-4 | | M | B | M | | 0/- |
| (CBB) Cementitious Based Binders | Gypsum | D | S | M | 75-85 | P/C | 4-8 | | M | H | L | | - |
| | = not applicable for category, class or type | | | | | | | | | | | | |
| UNK | = unknown | | | | | | | | | | | | |

Source: Guidance Document – Soil Stabilization for Temporary Slopes, URS Greiner Woodward Clyde, November 1999.

| | | |
|-------------------------------|---|--|
| Antecedent Moisture | D | Soil should be relatively dry before application |
| | P | Soil should be pre-wetted before application |
| Availability | S | A short turn-around time between order and delivery, usually 3-5 days |
| | M | A moderate turnaround time, between 1-2 weeks |
| Ease of Clean-Up | L | Require pressure washing, a strong alkali solution, or solvent to clean up |
| | M | Requires cleanup with water while wet; more difficult to clean up once dry |
| | H | May be easily removed from equipment and overspray areas by a strong stream of water |
| Installed Cost | | Dollars per hectare |
| Degradability | C | Chemically degradable |
| | P | Photodegradable |
| | B | Biodegradable |
| Length of Drying Time | | Estimated hours |
| Time to Effectiveness | | Estimated days |
| Erosion Control Effectiveness | | Percent reduction in soil loss over bare soil condition. |
| Longevity | S | 1-3 months |
| | M | 3-12 months |
| | L | > than 12 months |
| Application Mode | L | Applied by hand labor |
| | W | Applied by water truck |
| | H | Applied by hydraulic mulcher |
| | B | Applied by either water truck or hydraulic mulcher |
| | M | Applied by a mechanical method other than those listed above (e.g., straw/blower) |
| Residual Impact | L | Projected to have a low impact on future construction activities |
| | M | Projected to have a moderate impact on future construction activities |
| | H | Projected to have a significant impact on future construction activities |
| Native | N | Plant or plant material native to the State of California |
| | E | Exotic plant not native to the State of California |
| Runoff Effect | + | Runoff is decreased over baseline (bare soil) |
| | 0 | No change in runoff from baseline |
| | - | Runoff is increased over baseline |
| Water Quality Impact | L | Low potential to impact water quality |
| | M | Moderate potential to impact water quality |
| | H | Higher potential to impact water quality |

Criteria

| TEMPORARY SOIL STABILIZATION CONTROL CRITERIA | | | | | | | | | | | | | |
|---|--------------|------------------|-----------------------|----------------------|---------------|-----------------------------|------------------------------|-----------|---------------------|-----------------|--------|---------------|----------------------|
| Antecedent Moisture | Availability | Ease of Clean-Up | Installed Cost Per Ha | EC Effectiveness (%) | Degradability | Length of Drying Time (hrs) | Time to Effectiveness (days) | Longevity | Mode of Application | Residual Impact | Native | Runoff Effect | Water Quality Impact |

Antecedent Moisture

| | |
|---|--|
| D | Soil should be relatively dry prior to application |
| P | Soil should be pre-wetted prior to application |

Availability

| | |
|---|---|
| S | A short turn-around time between order and delivery, usually 3-5 days |
| M | A moderate turnaround time, between 1-2 weeks |

Ease of Clean Up

| | |
|---|--|
| H | Easily removed from equipment and overspray areas by a strong stream of water; disposal of excess product or packaging materials not significant |
| M | Readily removed by water while still wet, but may require more aggressive measures once dry; added time required to dispose of waste materials |
| L | May require pressure washing, a strong alkali solution, or solvent; additional operation and maintenance costs increases cost of practice |

EROSION AND SEDIMENT CONTROL BMPs INSTALLED COSTS AND EFFECTIVENESS

- ◆ Installed cost (refer to updated cost at end of training material)
- ◆ Erosion control effectiveness - level of control (%) over bare soil (no treatment) condition

| BMP | Unit Cost Installed | Estimated Relative Erosion/ Sediment Control Effectiveness |
|--|---------------------|---|
| Sediment Control | | |
| Silt Fence | | UNK |
| Fiber Rolls | | 58% |
| Erosion Control | | |
| Fertilizer | | N/A |
| Seeding | | 50% |
| Stolonizing | | 90% |
| Hydraulic Mulching | | 50 – 60% |
| Compost Application | | 40 – 50% |
| Straw Mulching | | 90 – 95% |
| Soil Binders | | |
| Plant Material-Based (Short-Term) | | 80 – 85% |
| Plant Material-Based (Long-Term) | | 60 – 65% |
| Polymeric Emulsion Blends | | 30 – 70% |
| Petroleum Resin-Based | | 25 – 20% |
| Cementitious Binder-Based | | 80 – 85% |
| Bonded Fiber Matrices | | |
| Rolled Erosion Control Products | | |
| Biodegradable | | |
| Jute | | 65 – 70% |
| Curled Wood Fiber | | 85 – 90% |
| Straw | | 85 – 90% |
| Wood Fiber | | 85 – 90% |
| Coconut Fiber | | 90 – 95% |
| Coconut Fiber Net | | 85 – 90% |
| Straw Coconut | | 90 – 95% |
| Non-Biodegradable | | |
| Plastic Netting | | < 50% |
| Plastic Mesh | | 75 – 80% |
| Synthetic Fiber w/Netting | | 90 – 95% |
| Bonded Synthetic Fibers | | 90 – 95% |
| Combination Synthetic and Biodegradable Fibers | | 85 – 90% |

Source: Erosion Control Pilot Study Report,
URS Greiner Woodward Clyde, June 2000, Table 4-1

Degradability

| | |
|---|-----------------------|
| C | Chemically degradable |
| P | Photo-degradable |
| B | Biodegradable |

Length of Drying Time

- ◆ Hours from time of application

Time to Effectiveness

- ◆ Provided as number of days
- ◆ Same as length of drying time for hydraulic soil stabilizers (HSS)

SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

- ◆ What is it?
 - A mixture of wood mulch, and water – with or without combinations of stabilizing emulsions, and /or, synthetic fibers



SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

◆ How is it applied?

- It's mixed into a slurry and applied using hydro-mulching equipment



SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

- ◆ There are four types of hydraulic mulches that we are going to focus on?
 - Hydraulic Mulch (SSPs 07-380 and 07-382)
 - Hydraulic Matrix (SSPs 07-380 and 07-382)
 - Bonded Fiber Matrix (SSPs 07-380 and 07-381)
 - Mechanically Bonded Fiber Matrix (SSPs 07-380 and 07-381)

SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

- ◆ **Hydraulic Mulch**
 - Shredded wood fibers, water and/or a stabilizing emulsion (tackifier)
 - Mixed together and applied with hydro-mulching / hydro seeding equipment
 - Sprayed onto disturbed soil at a prescribed rate as a liquid slurry
 - 100% biodegradable



SS-3 Temporary Hydraulic Mulch

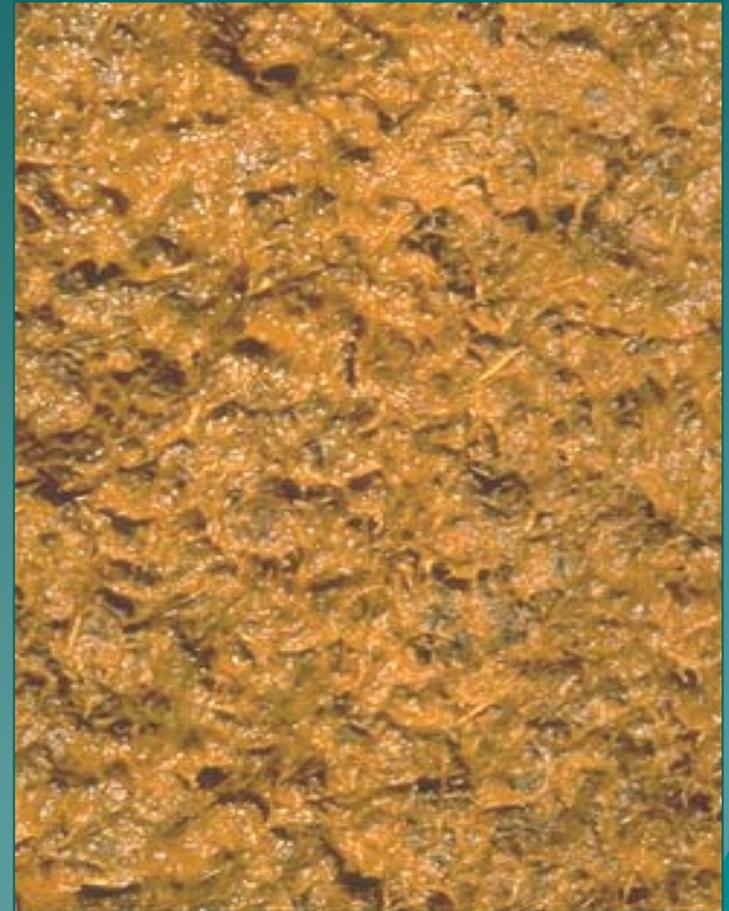
(SSPs 07-380, 07-381, 07-382)

◆ Hydraulic Matrix

- Shredded wood fiber, water and a stabilizing emulsion
- Mixed together and applied with hydro-mulching / hydroseeding equipment
- Sprayed onto disturbed soil at a prescribed rate as a liquid slurry
- 100% biodegradable

SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

- ◆ **Bonded Fiber Matrix (BFM)**
 - A bonded fiber matrix consisting of strands of continuous elongated wood fibers combined with a stabilizing emulsion and water
 - Mixed together and applied with hydro-mulching / hydroseeding equipment
 - Sprayed onto disturbed soil at a prescribed rate as a liquid slurry
 - 100% biodegradable



SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

- ◆ **Mechanically Bonded Fiber Matrix (M-BFM)**
 - A bonded fiber matrix consisting of strands of continuous elongated wood fibers and/or mechanically (interlocking) bonded synthetic fibers combined with a stabilizing emulsion and water
 - Mixed together and applied with hydro-mulching / hydroseeding equipment
 - Sprayed onto disturbed soil at a prescribed rate as a liquid slurry
 - 100% biodegradable and photodegradable



SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

- ◆ Standards and Specifications
- ◆ Surface preparation
 - Roughen soil surface with small furrows along the contours
 - ◆ Ripping, Sheepsfoot, Track Walk, Slope Serrations
 - Refer to Standard Specification 6-1.07, 9-1.03, 20-2, 20-2.07, 20-2.11, 20-4, 20-4.09, and 20-4.10
 - Sprayed onto disturbed soil at a prescribed rate as a liquid slurry
 - 100% biodegradable





SS-3 Temporary Hydraulic Mulch

(SSPs 07-380, 07-381, 07-382)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.1-b

Applicability of Hydraulic Mulch (SS-3) to Site Characteristics

| Type | Class | Flow Conditions | Maximum Slope Inclination (V:H) ⁽¹⁾ | Soil Classification ⁽²⁾ | Surface Area | Atmospheric Conditions | Accessibility | Drains to 303(d) Listed Water Body | Duration of Need ^(Y) |
|----------------------------------|-----------------------------------|-----------------|--|---|-----------------|------------------------|---------------|---|---------------------------------|
| Hydraulic Mulch | Biodegradable | sheet | 1:2 | GM, GC, SW, SP, SM, SC, ML, CL, OL, MH CH, OH, Pt | medium to large | A | B | C,D | 3 to 12 months |
| Hydraulic Matrix | Biodegradable | sheet | 1:2 | GM, GC, SW, SP, SM, SC, ML, CL, OL, MH CH, OH, Pt | medium to large | A | B | C,D | Lees than 3 months |
| Bonded Fiber Matrix | Biodegradable | sheet | 1:2 | GM, GC, SW, SP, SM, SC, ML, CL, OL, MH CH, OH, Pt | medium to large | A | B | C,D | 3 to 12 months |
| Mechanically Bonded Fiber Matrix | Biodegradable and Photodegradable | sheet | 1:2 | GM, GC, SW, SP, SM, SC, ML, CL, OL, MH CH, OH, Pt | medium to large | A | B | C,D | Greater than 12 months |

(1): Conservative Maximum Slope Inclination (V:H) recommended by Caltrans for product applicability, manufacturer may recommend greater slope inclinations

(2): Refer to Table 2.1-b: Unified Soil Classification System for soil classification descriptions.

A: The BMP cannot be applied during a storm event or freezing conditions. Avoid applying in strong winds and over spraying.

B: The disturbed soil area must be accessible to equipment.

C: If disturbed soil area drains to 303(d) listed water body, potential non-visible pollutant.

D: If disturbed soil area drains to 303(d) listed water body, potential pollutants if breach or malfunction occurs.

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.1-c

Application Rates of Hydraulic Mulch (SS-3)

| Type | | Application Rate _(W) | Guidelines |
|----------------------------------|---------------|---------------------------------|--|
| Hydraulic Mulch | kg/ha | 2,250 – 4,500 | <p>Some general guidelines to be followed regarding the of application rate and percent soil binder include:</p> <ul style="list-style-type: none"> • Increase the application rate and percent soil binder (if applicable) as the slope increases. • Increase the application rate and percent soil binder (if applicable) to soils with a high infiltration rate and expansive properties. • Increase the application rate and percent soil binder (if applicable) to roughened soils for complete coverage. • Increase application rate in areas of heavy rainfall. |
| | lb/ac | 2,000 – 4,000 | |
| | % soil binder | 0 - 5 | |
| Hydraulic Matrix | kg/ha | 2,250 – 4,500 | |
| | lb/ac | 2,000 – 4,000 | |
| | % soil binder | 5 - 10 | |
| Bonded Fiber Matrix | kg/ha | 3,400 – 4,500 | |
| | lb/ac | 3,000 – 4,000 | |
| Mechanically Bonded Fiber Matrix | kg/ha | 3,400 – 4,500 | |
| | lb/ac | 3,000 – 4,000 | |

(W): Data obtained from Caltrans, Storm Water Quality Handbooks; Construction Site BMP Manual, 2003

SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.1-d

Time and Cost of Hydraulic Mulch (SS-3)

| <i>Type</i> | <i>Delivery Time^(Y)</i> | <i>Installation Time</i> | <i>Time Until Effective</i> |
|---|------------------------------------|------------------------------|-----------------------------|
| | <i>days</i> | <i>hours/hectare</i> | <i>days</i> |
| <i>Hydraulic Mulch</i> | 3-7 | 10 ⁽¹⁾ (4 hrs/ac) | 1 to 2 |
| <i>Hydraulic Matrix</i> | 3-7 | 10 ⁽¹⁾ (4 hrs/ac) | 1 to 2 |
| <i>Bonded Fiber Matrix</i> | 3-7 | 10 ⁽¹⁾ (4 hrs/ac) | 1 to 2 |
| <i>Mechanically Bonded Fiber Matrix</i> | 3-7 | 10 ⁽¹⁾ (4 hrs/ac) | 1 to 2 |

(1): Assumes a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Actual installation time may vary depending on location and field conditions.

(X): Data obtained from the Caltrans, Erosion Control Manual (Draft), Training Materials, 2003

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-3 Temporary Hydraulic Mulch (SSPs 07-380, 07-381, 07-382)

Table 2.2.1-a: Limitations of Hydraulic Mulch

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

| <i>Category</i> | <i>Limitation</i> |
|-----------------------------|--|
| <i>Selection</i> | <ul style="list-style-type: none"> Hydraulic mulch consisting of only paper or recycled paper fibers is not permitted. Paper is acceptable if incorporated with a biodegradable fiber (such as wood). |
| | <ul style="list-style-type: none"> Do not be used in areas in which the mulch would be considered unsuitable with immediate future earthwork and would, therefore, need to be removed or reapplied. The site must be accessible to mulching equipment for hydraulic mulch to be applied. |
| | <ul style="list-style-type: none"> Avoid overspray hydraulic mulch onto existing vegetation, sidewalks, travel ways, sound walls, and channels. Walking, moving equipment, and/or vehicular traffic across areas where hydraulic mulch is applied will damage the BMP by breaking the crusted surface of the porous mat. |
| <i>Flow Conditions</i> | <ul style="list-style-type: none"> Hydraulic mulch should not be used in areas containing swift-moving concentrated flow or high-volume sheet flow because it has a tendency to be washed away. |
| | <ul style="list-style-type: none"> When necessary, use with other soil stabilization and sediment control BMPs (see Section 2.3) to reduce the slope lengths and limit run-on flows to the areas where the hydraulic mulch is applied. |
| <i>Time Until Effective</i> | <ul style="list-style-type: none"> Hydraulic mulch requires minimum drying times, therefore, it cannot be applied immediately before rainfall, during rainfall, and/or where standing water is present. |
| <i>Duration of Need</i> | <ul style="list-style-type: none"> Hydraulic mulch is a short-term soil stabilization practice in that it generally lasts through only a portion of the growing/rainy season. |
| <i>Maintenance</i> | <ul style="list-style-type: none"> Reapplication of hydraulic mulch may be necessary to effectively stabilize the soil throughout the season. |

SS-4 Temporary Erosion Control (With Temporary Seeding)

◆ What is it?

- The process of vegetating disturbed soil areas by applying a mixture of stabilizing emulsion, seed, fertilizer, and wood fiber to disturbed soil



SS-4 Temporary Erosion Control (With Temporary Seeding)

◆ How is it applied?

- It's mixed into a slurry and applied using hydro-mulching equipment



SS-4 Temporary Erosion Control (With Temporary Seeding)

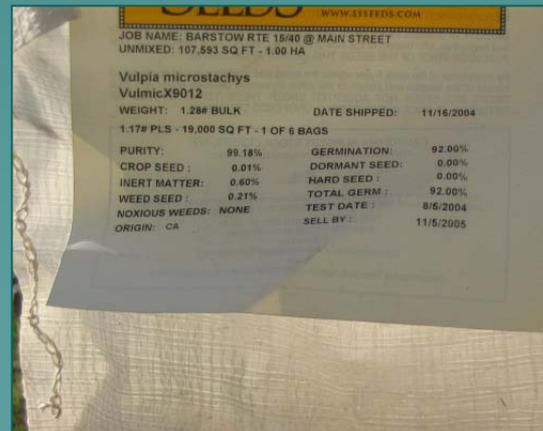
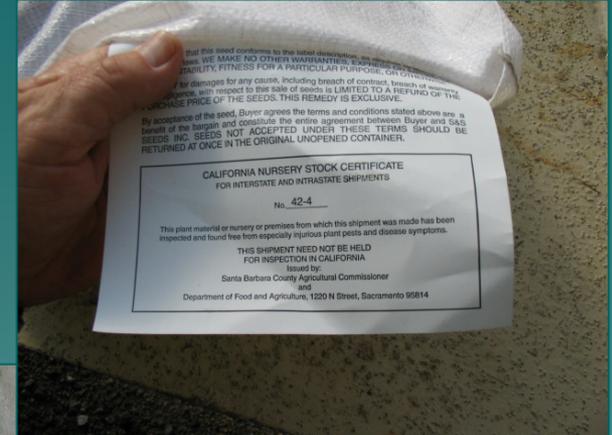
- ◆ It can also be applied as:
 - A stand alone process – seed and emulsion
 - Mixed with Hydraulic Mulch
 - Mixed with Soil Binders
 - Applied prior to application of Straw Mulch
 - Applied prior to application of Rolled Erosion Control Products
 - Applied prior to application of Wood Mulch

SS-4 Temporary Erosion Control (With Temporary Seeding)

- ◆ Standards and Specifications
- ◆ Surface preparation
 - Roughen soil surface with small furrows along the contours
 - ◆ Ripping, Sheepsfoot, Track Walk
 - Refer to Standard Specification 20-2.01 and 20-3.0

SS-4 Temporary Erosion Control (With Temporary Seeding)

- ◆ Standards and Specifications
- ◆ Material and seed mixture
 - Must be approved by DSWC and Landscape Architect
 - ◆ Refer to Standard Specification 20-2.10 and project Special Provisions



SS-4 Temporary Erosion Control (With Temporary Seeding)

- ◆ How will hydroseeding work on your site?
- ◆ Let's look at some specifics



SS-4 Temporary Erosion Control (With Temporary Seeding)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.2-b

Applicability of Temporary Erosion Control (With Temporary Seeding) (SS-4) to Site Characteristics

| Type | Applied with SS BMPs | Flow Conditions | Slope Inclination (V:H) ⁽¹⁾ | Soil Classification ⁽²⁾ | Surface Area | Atmospheric Conditions | Accessibility | Drains to 303(d) Listed Water Body | Duration of Need ^(Y) |
|--|---------------------------------|-----------------------|--|--|-----------------|------------------------|---------------|------------------------------------|---------------------------------|
| Seed must be approved for site conditions by the Landscape Architect | Stand alone | sheet | 1:3 | SW, SP, SM, SC, ML ^Φ , CL ^Φ , OL, MH ^Φ , CH ^Φ , OH, Pt | small to large | A | B | D | Greater than 12 months |
| | Hydraulic Mulch | sheet | 1:2 | SW, SP, SM, SC, ML ^Φ , CL ^Φ , OL, MH ^Φ , CH ^Φ , OH, Pt | small to large | A | B | C | Greater than 12 months |
| | Soil Binder | sheet | 1:2 | SW, SP, SM, SC, ML ^Φ , CL ^Φ , OL, MH ^{ΦΣ} , CH ^{ΦΣ} , OH ^Σ , Pt | small to large | A | B | C | Greater than 12 months |
| | Straw Mulch Integrated | sheet | 1:2 | SW, SP, SM, SC, ML ^Φ , CL ^Φ , OL, MH ^Φ , CH ^Φ , OH, Pt | small to large | A | B | D | Greater than 12 months |
| | Straw Mulch and Soil Binder | sheet | 1:2 | SW, SP, SM, SC, ML ^Φ , CL ^Φ , OL, MH ^Φ , CH ^Φ , OH, Pt | small to large | A | B | C,D | Greater than 12 months |
| | Rolled Erosion Control Products | channelized and sheet | 1:1 | GM, GC, SW, SP, SM, SC, ML ^Φ , CL ^Φ , OL, MH ^Φ , CH ^Φ , OH, Pt | small to medium | A | E | D | Greater than 12 months |

(1): Conservative Maximum Slope Inclination (V:H) recommended by Caltrans for product applicability, manufacturer may recommend greater slope inclinations

(2): Refer to Table 2.1-b: Unified Soil Classification System for soil classification descriptions.

(1): Conservative Maximum Slope Inclination (V:H) recommended by Caltrans for product applicability, manufacturer may recommend greater slope inclinations

(2): Refer to Table 2.1-b: Unified Soil Classification System for soil classification descriptions.

~~A: The BMP cannot be applied during a storm event or freezing conditions. Avoid applying in strong winds and over spraying.~~

~~B: The disturbed soil area must be accessible to equipment.~~

C: If disturbed soil area drains to 303(d) listed water body, potential non-visible pollutant.

D: If disturbed soil area drains to 303(d) listed water body, potential pollutants if breach or malfunction occurs.

Φ: Success of seed germination is limited in soils that have high silt and/or clay due to poor soil permeability.

Σ: Soil with high moisture content may compromise the soil binder's effectiveness and curing time. Hydroseeding with soil binder generally not recommended for these soils.

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-4 Temporary Erosion Control (With Temporary Seeding)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.2-c

Time and Cost of Temporary Erosion Control (With Temporary Seeding) (SS-4)

| <i>Applied with SS BMPs</i> | <i>Delivery Time^(Y)</i> | <i>Installation Time</i> | <i>Time Until Effective^(Y)</i> |
|--|------------------------------------|-------------------------------------|---|
| | <i>days</i> | <i>hours/hectare</i> | <i>days</i> |
| <i>Stand Alone</i> | 3-14 | ↓ 10 ⁽¹⁾ (4 hrs/ac) | 28 |
| <i>Hydraulic Mulch</i> | 3-14 | ↓ 10 ⁽¹⁾ (4 hrs/ac) | 28 |
| <i>Soil Binder</i> | 3-14 | ↓ 10 ⁽¹⁾ (4 hrs/ac) | 28 |
| <i>Straw Mulch</i> | 3-14 | ↓ 15 ⁽²⁾ (6 hrs/ac) | 28 |
| <i>Straw Mulch and Soil Binder</i> | 3-14 | ↓ 25 ⁽³⁾ (10 hrs/ac) | 28 |
| <i>Rolled Erosion Control Products</i> | 3-14 | ↓ 106 ⁽⁴⁾ (42 hrs/ac) | 28 |

(1): Assumes a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Actual installation time may vary depending on location and field conditions.

(2): Assumes installation of hydroseed is done by a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Followed by the application of straw mulch that is bound to the soil by integration (crimped or punched). Also assumes that the straw mulch is applied by a 6 man crew with 2 straw blowers that can cover 4 acres per day. Actual installation time may vary depending on location and field conditions.

(3): Assumes the application (first pass) of the hydroseed is done by a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Followed by the application of straw mulch (second pass) that will be bound together by a soil binder. Assumes the straw mulch is applied by a 6 man crew with 2 straw blowers that can cover 4 acres per day. Followed by the application of the soil binder (third pass). Assumes the application of the soil binder is done by a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Actual installation time may vary depending on location and field conditions.

(4): Assumes the application of the hydroseed is done by a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Assumes the application of the rolled erosion control product is done by a 2 man crew. Actual installation time may vary depending on location and field conditions.

(X): Data obtained from the Caltrans, Erosion Control Manual (Draft), Training Materials, 2003

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

Table 2.2.2-a: Limitations of Hydroseeding

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

| Category | Limitation |
|-----------------------------|---|
| Selection | <ul style="list-style-type: none"> The effectiveness of hydroseeding can be limited by the increased potential of erosion during the period of vegetation establishment. |
| | <ul style="list-style-type: none"> Hydroseeding should not be used in areas in which the mulch would be considered unsuitable with immediate future earthwork and would, therefore, need to be removed or reapplied. |
| Installation | <ul style="list-style-type: none"> Some regions may have a limited growing season due to the cold climate. Proper establishment of vegetation must be coordinated with the climatic conditions or seasonal variations of the region. |
| | <ul style="list-style-type: none"> Some methods of application may require multiple applications (passes). Procedures that require multiple applications can add to the cost. |
| | <ul style="list-style-type: none"> It can be difficult to establish vegetation on steep slopes and arid climates. Some soil types (e.g. coarse sandy infertile soils on cut slopes) are also difficult to vegetate. |
| | <ul style="list-style-type: none"> Stable soil temperature and moisture content during the period of germination is essential for the establishment of vegetation. |
| | <ul style="list-style-type: none"> Vegetation may not be established properly without including supplemental irrigation, which can add significantly to the cost. |
| | <ul style="list-style-type: none"> Care must be taken not to overspray onto existing vegetation, sidewalks, travel ways, sound walls, and channels. |
| | <ul style="list-style-type: none"> Walking, moving equipment, and/or vehicular traffic across areas where a hydroseed is applied will damage the BMP by trampling/destroying the seed or the new growth. |
| Flow Conditions | <ul style="list-style-type: none"> Hydroseeding should not be used in areas containing swift-moving concentrated flow or high-volume sheet flow because it has a tendency to be washed away unless used in conjunction with a BMP that can withstand concentrated flows (e.g. TRMs). |
| | <ul style="list-style-type: none"> When necessary, use with other soil stabilization and sediment control BMPs (see Section 2.3), to reduce the slope lengths and limit run-on flow to the areas where the hydroseed is applied. |
| Time Until Effective | <ul style="list-style-type: none"> Hydroseeding is not an immediate method of soil stabilization. If there is insufficient time to establish the vegetation, hydroseeding must be used in conjunction with SS-3, SS-5, SS-6, SS-7 and/or SS-8 |
| Duration of Need | <ul style="list-style-type: none"> Temporary vegetation is not recommended for short durations. |
| Maintenance | <ul style="list-style-type: none"> Reapplication of hydroseed may be necessary to effectively stabilize the soil throughout the season. |
| | <ul style="list-style-type: none"> If not properly maintained (e.g., mowed or watered), established grasses can become a fire hazard. |
| | <ul style="list-style-type: none"> Temporary vegetation may have to be removed before permanent vegetation can be established. |

SS-5 Temporary Soil Stabilizer

◆ What is it?

- An emulsion categorized as plant based (long and short lived), polymeric emulsion blend (acrylic polymers), or cementitious-based binders that penetrates the top soil and binding the soil particles together
- Tackifiers are a soil binder made up of short lived plant based materials and highly diluted polymeric emulsions, and cementitious-based binders – limited durability
- Long-lasting binders are generally made from pitch or rosin materials



SS-5 Temporary Soil Stabilizer

- ◆ How is it used?
 - As a stand alone stabilizer or as a stabilizing emulsion in hydraulic and straw mulches where it acts as a binding agent for the mulch
- ◆ How is it applied?
 - It's mixed into a slurry and applied using hydro-mulching equipment or



SS-5 Temporary Soil Stabilizer

- ◆ Standards and Specifications
 - Refer to Standard Specification 20-2.11
 - Must be environmentally benign



SS-5 Temporary Soil Stabilizer

- ◆ How will soil binders work on your site?
- ◆ Let's take a closer look

SS-5 Temporary Soil Stabilizer

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.3- b: Descriptions of Soil Binders

| Category | Type | Description |
|---|---|---|
| Plant-Based Material (Short Lived) | Guar | <ul style="list-style-type: none"> Biodegradable, natural galactomannan-based hydrocolloid, treated with dispersing agents for easy field mixing. |
| | Starch | <ul style="list-style-type: none"> Non-ionic, cold-water soluble (pre-gelatinized) granular cornstarch. |
| | Psyllium | <ul style="list-style-type: none"> Finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. |
| Plant-Based Material (Long Lived) | Pitch & Rosin Emulsion | <ul style="list-style-type: none"> A non-ionic pitch and rosin emulsion that has a minimum solids content of 48 percent. The rosin shall be a minimum of 26 percent of the total solids content. The soil stabilizer shall be a non-corrosive, water-dilutable emulsion that cures to water-insoluble binding and cementing agent upon application. |
| Polymeric Emulsion Blends | Liquid Polymers of Methacrylates & Acrylates | <ul style="list-style-type: none"> A tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100 percent acrylic emulsion blend of 40 percent solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants, and/or silicates. |
| | Copolymers of Sodium Acrylates & Acrylamides | <ul style="list-style-type: none"> Non-toxic, dry powders that are comprised of copolymers of sodium acrylate and acrylamide. |
| | Poly-Acrylamides & Copolymer of Acrylamides | <ul style="list-style-type: none"> Linear copolymer polyacrylamide is packaged as a dry-flowable solid. |
| | Hydro-Colloid Polymers | <ul style="list-style-type: none"> Various combinations of dry-flowable poly-acrylamides, copolymers, and hydrocolloid polymers. |
| | Acrylic Copolymers & Polymers | <ul style="list-style-type: none"> Liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55 percent solids. The polymeric compound shall be handled and mixed in a manner that will not cause foaming or shall contain an antifoaming agent. Polymeric soil stabilizer shall be readily miscible in water, non-injurious to seed or animal life, and non-flammable. It shall provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and shall not re-emulsify when cured. |
| Cementitious-Based Binders | Gypsum | <ul style="list-style-type: none"> A formulated gypsum-based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of highly pure gypsum that is ground, calcined, and processed into calcium sulfate hemihydrate with a minimum purity of 86 percent. |

SS-5 Temporary Soil Stabilizer

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.3-c: Applicability of Soil Binders (SS-5) to Site Characteristics

| Type | Class | Flow Conditions | Maximum Slope Inclination (V:H) ⁽¹⁾ | Soil Classification ⁽²⁾ | Surface Area | Atmospheric Conditions | Accessibility | Drains to 303(d) Listed Water Body | Duration of Need ^(Y) |
|--|------------------------------------|-----------------|--|--|-----------------|------------------------|---------------|------------------------------------|---------------------------------|
| Guar | Plant-Based Material (Short Lived) | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Less than 3 months |
| Starch | | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Less than 3 months |
| Psyllium | | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Between 3 and 12 months |
| Pitch & Rosin Emulsion | Plant-Based Material (Long Lived) | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Between 3 and 12 months |
| Liquid Polymers of Methacrylates & Acrylates | Polymeric Emulsion Blends | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Less than 3 months |
| Copolymers of Sodium Acrylates & Acrylamides | | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Less than 3 months |
| Poly-Acrylamides & Copolymer of Acrylamides | | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Between 3 and 12 months |
| Hydro-Colloid Polymers | | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Between 3 and 12 months |
| Acrylic Copolymers & Polymers | | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Greater than 12 months |
| Gypsum | Cementitious-Based Binders | sheet | 1:2 | GM ^π , GC ^π , SW, SP, SM, SC, ML, CL, OL, MH ^Σ , CH ^Σ , OH ^Σ , Pt | medium to large | A | B | C,D | Between 3 and 12 months |

(1): Conservative Maximum Slope Inclination (V:H) recommended by Caltrans for product applicability, manufacturer may recommend greater slope inclinations

(2): Refer to Table 2.1-b: Unified Soil Classification System for soil classification descriptions.

A: The BMP cannot be applied during a storm event or freezing conditions. Avoid applying in strong winds and over spraying.

B: The disturbed soil area must be accessible to equipment.

C: ~~If disturbed soil area drains to 303(d) listed water body, potential non-visible pollutant.~~

D: ~~If disturbed soil area drains to 303(d) listed water body, potential pollutants if breach or malfunction occurs.~~

π: Use of a soil binder in soils with gravel content is less effective as gravel content increases.

Σ: Soil with high moisture content may compromise the soil binder's effectiveness and curing time. Soil Binders are not recommended for these soils.

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-5 Temporary Soil Stabilizer

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.3-d
Mixing/Dilution Rates and Application Rates of Soil Binders

| Class | Type | Dilution/Mixing Rate _(W) | | Application Rate _(W) | |
|------------------------------------|--|---|---------------|--|------------------|
| | | Metric | SI | Metric | SI |
| Plant-Based Material (Short Lived) | Guar | 1.2-1.8kg/L | 1-5 lb/gal | Dependant upon slope inclination See Table 2.2.3-e | |
| | Starch | A | | 170 kg/ha | 150 lb/ac |
| | Psyllium | A | | 90-225 kg/ha | 80-200 lb/ac |
| Plant-Based Material (Long Lived) | Pitch & Rosin Emulsion | Clayey soils 1:5 (emulsion: water) Sandy soils 1:10 | | A | |
| Polymeric Emulsion Blends | Liquid Polymers of Methacrylates & Acrylates | 190L/ha | 20 gal/ac | A | |
| | Copolymers of Sodium Acrylates & Acrylamides | A | A | Dependant upon slope inclination See Table 2.2.3-f | |
| | Poly-Acrylamides & Copolymer of Acrylamides | 1.5 kg/1000L | 1 lb/ 100 gal | 5.6 kg/ha | 5 lb/ac |
| | Hydro-Colloid Polymers | A | | 60-70 kg/ha | 53-62 lb/ac |
| | Acrylic Copolymers & Polymers | 1:10 (emulsion: water) | | 11000 L/ha | 1175 gal/ac |
| Cementitious-Based Binders | Gypsum | A | | 4500-13500 kg/ha | 4000-12000 lb/ac |

A: Refer to the manufactures specifications or the Projects Special Provisions for dilution/mixing rates or application rates.

(W): Data obtained from Caltrans, Storm Water Quality Handbooks; Construction Site BMP Manual, 2003

SS-5 Temporary Soil Stabilizer

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.3-e
Application Rates of the Guar Soil Binder Based on Slope Inclination (W)

| Unit | Slope Inclination (V:H) | | | | |
|-------|-------------------------|-----|-----|-----|-----|
| | Flat | 1:4 | 1:3 | 1:2 | 1:1 |
| kg/ha | 45 | 50 | 56 | 67 | 78 |
| lb/ac | 40 | 45 | 50 | 60 | 70 |

(W): Data obtained from Caltrans, Storm Water Quality Handbooks; Construction Site BMP Manual, 2003

Table 2.2.3-f
Application Rates of Copolymers of Sodium Acrylates and Acrylamides Based on Slope Inclination (W)

| Unit | Slope Inclination (V:H) | | |
|-------|-------------------------|------------|-------------|
| | Flat to 1:5 | 1:5 to 1:3 | 1:2 to 1:1 |
| kg/ha | 3.4 - 5.6 | 5.6 - 11.2 | 11.2 - 22.4 |
| lb/ac | 3.0 - 5.0 | 5.0 - 10.0 | 10.0 - 20.0 |

(W): Data obtained from Caltrans, Storm Water Quality Handbooks; Construction Site BMP Manual, 2003

SS-5 Temporary Soil Stabilizer

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

**Table 2.2.3-g
Time and Cost of Soil Binders (SS-5)**

| Type | Delivery Time ^(Y) | Installation Time | Time Until Effective (Drying Time) ^(X) |
|--|------------------------------|--------------------------------|---|
| | days | hours/hectare | hours |
| Guar | 3-7 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 12 - 18 |
| Starch | 3-7 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 9 - 12 |
| Psyllium | 3-7 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 12 - 18 |
| Pitch & Rosin Emulsion | 3-7 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 19 - 24 |
| Liquid Polymers of Methacrylates & Acrylates | 7-14 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 12 - 18 |
| Copolymers of Sodium Acrylates & Acrylamides | 7-14 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 12 - 18 |
| Poly-Acrylamides & Copolymer of Acrylamides | 7-14 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 4 - 8 |
| Hydro-Colloid Polymers | 7-14 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 0 - 4 |
| Acrylic Copolymers & Polymers | 3-7 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 36 - 48 |
| Gypsum | 3-7 | ↘ 10 ⁽¹⁾ (4 hrs/ac) | 4 - 8 |

(1): Assumes a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Actual installation time may vary depending on location and field conditions.

(X): Data obtained from the Caltrans, Erosion Control Manual (Draft), Training Materials, 2003

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-5 Temporary Soil Stabilizer

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.3-a: Limitations of Soil Binders

| <i>Category</i> | <i>Limitation</i> |
|-----------------------------|---|
| Selection | <ul style="list-style-type: none"> The constituents of some soil binders have the potential to leach out of the soil and/or become slippery during rainy conditions. |
| | <ul style="list-style-type: none"> Some soil binders require that storm water sampling be performed to determine if the water flowing over or leaching out of the soil binder is contaminated. The Caltrans SWPPP/WPCP Preparation Manual, Pollutant Table, Attachment S, identifies the soil binders that do not require sampling. |
| | <ul style="list-style-type: none"> Soil binders may not be compatible with certain soils. (e.g., soils primarily consisting of silt or clay or highly compacted soils may not allow the soil binder to penetrate the top soil). |
| | <ul style="list-style-type: none"> Soil chemistry can limit how effective a soil binder may perform. Do not apply to areas where the binder would be considered unsuitable with immediate future earthwork and would need to be removed or reapplied. |
| | <ul style="list-style-type: none"> The site must be accessible to equipment needed to apply soil binders. |
| Installation | <ul style="list-style-type: none"> Low relative humidity can adversely affect the soil binders. Soil binders cannot be applied when the temperature is below 4°C (40°F), in areas where soil is frozen, or when the site experiences freeze and thaw conditions. |
| | <ul style="list-style-type: none"> The number and frequency of applications may be affected by the surface and subgrade type and conditions, atmospheric conditions, and scheduled maintenance. |
| | <ul style="list-style-type: none"> Walking, moving equipment, and/or vehicular traffic across areas where a soil binder is applied will damage the BMP by breaking the bonds of the treated top soil. |
| | <ul style="list-style-type: none"> Care must be taken not to overspray soil binders onto existing vegetation, sidewalks, travel ways, sound walls, and channels. |
| Flow Conditions | <ul style="list-style-type: none"> Soil binders should not be used in areas containing swift-moving concentrated flow or high-volume sheet flow because it has a tendency to be washed away. When necessary, use with other soil stabilization and sediment control BMPs (see Section 2.3) in order to reduce the slope lengths and limit run-on flows to areas where the soil binder is applied. |
| Time Until Effective | <ul style="list-style-type: none"> Soil binders have minimum drying times, therefore, soil binders cannot be applied immediately before rainfall, during rainfall, and/or where standing water is present. |
| Duration of Need | <ul style="list-style-type: none"> Some soil binders are a short term soil stabilization practice in that they generally last through only a portion of the growing/rainy season. |
| Maintenance | <ul style="list-style-type: none"> Reapplication of soil binders may be necessary to effectively stabilize the soil throughout the season. Runoff can penetrate a soil binder treated area at the top of the slope, undercut the treated soil and cause spot failures by discharging at a point further down the slope. |

SS-5 Temporary Soil Stabilizer Polyacrylamide (PAM)

- ◆ PAM is a chemical that can be applied to disturbed soils to reduce erosion and improve settling of suspended sediment.
- ◆ PAM is suitable for use on distributed soil areas that discharge to a sediment trap or sediment basin.
- ◆ PAM will work when applied to saturated soil but is not as effective as applications to dry or damp soil.

SS-5 Temporary Soil Stabilizer Polyacrylamide (PAM)

- ◆ **PAM can be applied to the following areas:**
 - Rough graded soils that will be inactive for a period of time.
 - Final graded soils before application of final stabilization
(e.g., paving, planting, mulching)
 - Temporary haul roads prior to placement of crushed rock surfacing.
 - Compacted soil road base
 - Construction staging, materials storage, and layout areas
 - Soil stockpiles
 - Areas that will be mulched

SS-5 Temporary Soil Stabilizer Polyacrylamide (PAM)

Limitations

- ◆ There is limited experience in California with use of PAM for erosion and sediment control
- ◆ PAM should not be directly applied to water or allowed to enter a water body.
- ◆ Do not use PAM on a slope that flows into a water body without passing through a sediment trap or sediment basin.
- ◆ PAM will work when applied to saturated soil but is not as effective as applications to dry or damp soil.
- ◆ Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used.

SS-5 Temporary Soil Stabilizer Polyacrylamide (PAM)

Limitations

- ◆ The specific PAM copolymer formulation must be anionic. *Cationic PAM shall not be used in any application because of known aquatic toxicity problems.*
- ◆ PAM designated for erosion and sediment control should be “water soluble” or “linear” or “non-cross linked”
- ◆ A sampling and analysis plan must be incorporated into the SWPPP as PAM may be considered to be a source of non-visible pollutants.



SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion)

(SSP 07-350)

- ◆ What is it?
 - The process of applying a uniform layer of straw over a disturbed soil area to temporarily stabilize the soil



SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion)

(SSP 07-350)

◆ How is it applied?

- By hand (labor intensive) or by mechanical blower





SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion)

(SSP 07-350)

- ◆ How is it secured to the ground?
 - Crimped or punched (Integrated)
 - Glued with a stabilizing emulsion





SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion)

(SSP 07-350)

◆ Standards and Specifications

– Straw mulch must be derived from barley, rice, or wheat

– Refer to Standard Specification 20-2, 20-2.02, 20-3, and 20-2.11

Glenn County Department of Agriculture
 P.O. Box 351
 720 N. Colusa Street
 Willows, CA 95988
 Phone : (530) 934-6501 Fax : (530) 934-6503

**CERTIFICATE OF WEED FREE FORAGE
 (HAY, STRAW, MULCH)**

GROWER'S NAME K+R Farming
 GROWER'S ADDRESS 6439 Co. Rd. 3A
 CITY Willows STATE CA ZIP 95988
 PERMIT # 11-02-11-00473
 COMMODITY Rice straw FIELD SITE# 6
(one site # per certificate)
 CONSIGNEE'S NAME (if applicable) Hayco Farm - 4456
 ESTIMATE NUMBER OF BALES: 480 (or) WEIGHT: _____ (TONS)

This certifies that all the conditions under the guidelines adopted pursuant to California Food and Agriculture Code sections 5101 and 5205 have been met.

[Signature] Date 10-7-02
 Grower's Signature Date
[Signature] Date 10/2/02
 Inspector's Signature Date

Additional Conditions:
 1. Unless marked* seed free, outside pass of field or check shall not be certified. All rwin (straw) shall be the same color.
 2. Certified straw must be baled with two different colors of rwin, one of which must be silver. If using 3 rwin bales, the middle color shall be silver. If more than three rwin bales, the middle 2 shall be silver.

COMMENTS: _____

*CDFA example of noxious weeds: Yellow Star Thistle, Blackweed (Morning Glory), Johnson Grass (see 4360).
 Certificate of weed free forage 8/11/2003

SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion)

(SSP 07-350)

- ◆ How will Straw mulch work on your site?
- ◆ Let's look at some specifics





SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion)

(SSP 07-350)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.4-b

Applicability of Straw Mulch (SS-6) to Site Characteristics

| Type | Method of Binding | Flow Conditions | Maximum Slope Inclination (V:H) ⁽¹⁾ | Soil Classification ⁽²⁾ | Surface Area | Atmospheric Conditions | Accessibility | Drains to 303(d) Listed Water Body | Duration of Need ^(Y) |
|------------------------|---------------------------------|-----------------|--|---|-----------------|------------------------|---------------|------------------------------------|---------------------------------|
| Wheat, Rice, or Barley | Integrated | sheet | 1:2 | SW, SP SM, SC, ML, CL, OL, MH, CH, OH, Pt | small to large | A | B | D | Between 3 and 12 months |
| | Soil Binder | sheet | 1:2 | SW, SP SM, SC, ML, CL, OL, MH, CH, OH, Pt | small to large | A | B | C,D | Between 3 and 12 months |
| | Rolled Erosion Control Products | sheet | 1:2 | SW, SP SM, SC, ML, CL, OL, MH, CH, OH, Pt | small to medium | A | E | D | Between 3 and 12 months |

(1): Conservative Maximum Slope Inclination (V:H) recommended by Caltrans for product applicability, manufacturer may recommend greater slope inclinations

(2): Refer to Table 2.1-b: Unified Soil Classification System for soil classification descriptions.

A: The BMP cannot be applied during a storm event or freezing conditions. Avoid applying in strong winds and over spraying.

B: The disturbed soil area must be accessible to equipment.

~~C: If disturbed soil area drains to 303(d) listed water body, potential non-visible pollutant.~~

~~D: If disturbed soil area drains to 303(d) listed water body, potential pollutants if breach or malfunction occurs.~~

E: The product is applied manually; therefore, road or pad proximity limitations do not affect their applicability.

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999



SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion) (SSP 07-350)

Table 2.2.4-c
Time and Cost of Straw Mulch (SS-6)

| Type | Method of Binding | Delivery Time ^(Y) | Installation Time | Time Until Effective |
|------------------------|--------------------------------|------------------------------|----------------------------------|----------------------|
| | | days | hours/hectare | days |
| Wheat, Rice, or Barley | integrated | 3-5 | 5 ⁽¹⁾ ? (2 hrs/ac) | ASAA |
| | soil binder | 3-5 | 15 ⁽²⁾ (6 hrs/ac) | 1 to 2 |
| | Rolled Erosion Control Product | 3-5 | 43 ⁽³⁾ (17 hrs/ac) | ASAA |

ASAA: The BMP is effective as soon as it is applied.

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

- (1): Assumes a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Actual installation time may vary depending on location and field conditions.
- (2): Assumes the straw mulch (first pass) is applied by a 6 man crew with 2 straw blowers that can cover 4 acres per day. Followed by the application of the soil binder (second pass). Assumes the application of the soil binder is done by a 2 man crew with one 3000 gallon water truck (or access to water) that can cover 2 acres per day. Actual installation time may vary depending on location and field conditions.
- (3): Assumes the straw mulch (first pass) is applied by a 6 man crew with 2 straw blowers that can cover 4 acres per day. Assumes the application of the rolled erosion control product is done by a 2 man crew. Actual installation time may vary depending on location and field conditions.

(X): Data obtained from the Caltrans, Erosion Control Manual (Draft), Training Materials, 2003

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-6 Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion) (SSP 07-350)

Table 2.2.4-a: Limitations of Straw Mulch

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

| Category | Limitation |
|----------------------|--|
| Selection | <ul style="list-style-type: none"> Due to high demand prior to the rainy season, supplies of straw and/or available erosion control contractors may be limited. This can in turn increase the cost of installation and/or restrict the ability to install straw mulch in a timely manner. Straw mulch should not be used in areas in which the mulch would be considered unsuitable with immediate future earthwork and would therefore need to be removed or reapplied. |
| Installation | <ul style="list-style-type: none"> Installing straw mulch manually can be physically challenging and time intensive. These factors decrease the ability to easily disperse straw mulch over large areas and limit the amount of surface area that can be covered in a timely, cost effective manner. Due to the equipment limitations, installing straw mulch with a straw blower requires that the disturbed soil area be within 45 meters (150 feet) [with a hose attachment 90 meters (300 feet)] of a surface or road having the ability to support heavy equipment. If not anchored correctly to the soil, straw mulch can be blown off by wind or washed away from the disturbed soil areas onto, streets, environmentally sensitive areas, and/or into storm drains. Care must be taken not to overspray straw mulch onto existing vegetation, sidewalks, travel ways, and channels. Walking, moving equipment, and/or vehicular traffic across areas where straw mulch is applied can damage the BMP by breaking the bond between soil, straw and if used the stabilizing emulsion, in turn exposing the underlying soil to wind and water. |
| Flow Conditions | <ul style="list-style-type: none"> Straw mulch should not be used in areas containing swift-moving concentrated flows or high-volume sheet flow because it has a tendency to be washed away. When necessary, use with other soil stabilization and sediment control BMPs (see Section 2.3) to reduce the slope lengths and limit run-on flows to areas where the straw mulch is applied. |
| Time Until Effective | <ul style="list-style-type: none"> If used in conjunction with a soil binders it will have minimum drying times. In this situation, it would not be applied immediately before rainfall, during rainfall, and/or where standing water is present. |
| Duration of Need | <ul style="list-style-type: none"> Straw mulch biodegrades over time and will therefore last for a moderate length of time. |
| Maintenance | <ul style="list-style-type: none"> Reapplication of straw mulch may be necessary to effectively stabilize the soil throughout the season. |

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

◆ What is it?

- Rolled erosion control BMPs used to protect disturbed soil areas from erosion by water and wind
- A high strength BMP that can be used as a stand alone BMP or used in conjunction with re-vegetation
- Turf Reinforcement Mats (TRMs) are most commonly used for channels

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

- ◆ What types are there and how are they used?
 - Geotextiles: Woven non-biodegradable polypropylene fabric. Can be used for soil stabilization and drainage control
 - Plastic Covers (plastic sheeting): Impervious, non-biodegradable. Uses include stockpiles and small areas requiring immediate attention
 - Netting: Plastic, or geotextiles. Plastic is photodegradable geosynthetic such as polypropylene, polyethylene, nylon, and/or PVC. Used to secure loose mulches like straw to allow vegetation growth



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

- ◆ **What types are there and how are they used?**
 - Erosion Control Blankets: Can be biodegradable or biodegradable and photodegradable. Biodegradable blankets typically composed of fibers such as jute, straw, coconut or a combo of straw and coconut fibers. Biodegradable and photodegradable are made up of biodegradable fibers such as excelsior (curled wood fiber), straw, coconut or a combo of straw and coconut fibers, and photodegradable polypropylene or polyethylene. Used as a temporary soil stabilizer.



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Temporary Degradable Erosion Control Blanket (ECB) – FHWA FP-03 Spec., Section 629

- ◆ “A temporary degradable RECP composed of processed natural or polymer fibers mechanically, structurally, or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment.”

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

ECB Degradation

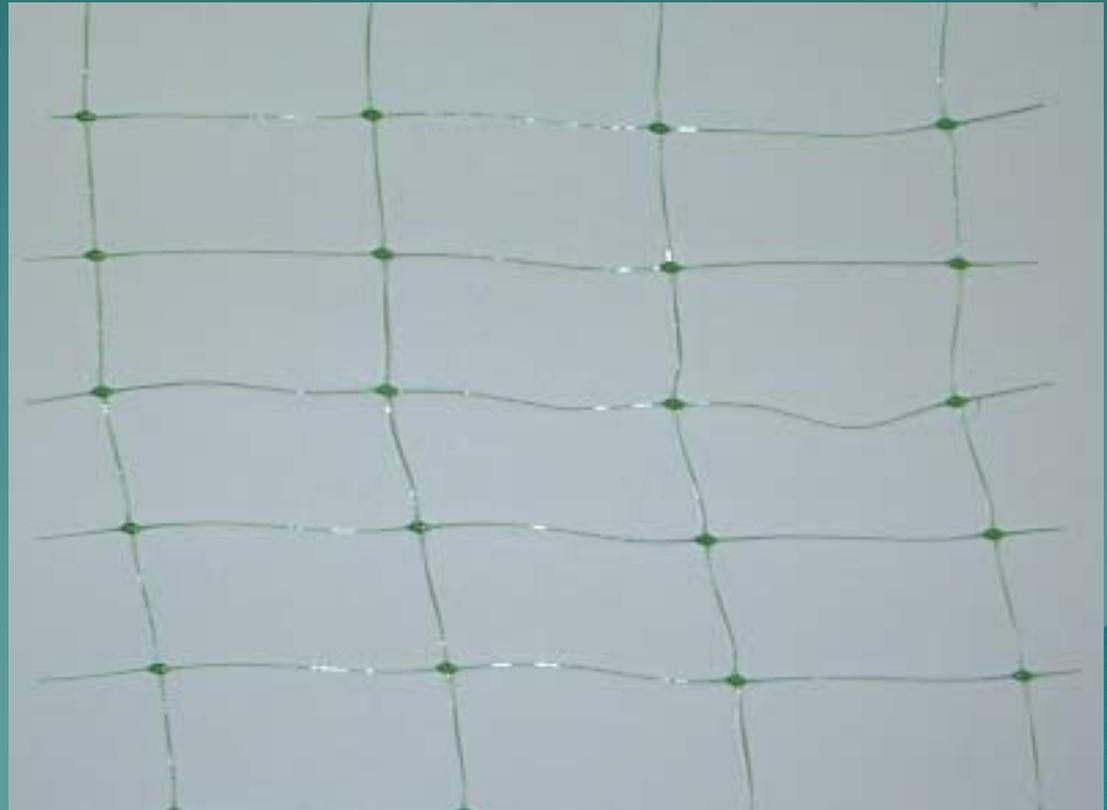
- ◆ Because ECBs are temporary degradable materials, they are often manufactured from netting(s) that are either photodegradable or biodegradable. While the matrix, if any, is usually biodegradable.

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Photodegradation

- ◆ The process where a material is chemically degradable by the action of light.

Example of a
photodegradable
netting

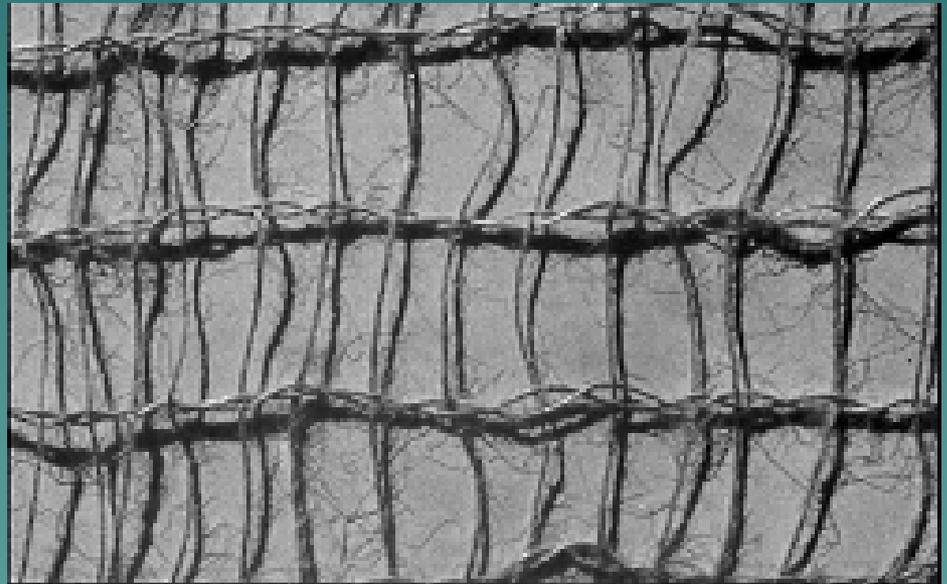


SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Biodegradation

- ◆ Capable of being broken down into innocuous products by the action of living things such as microorganisms.

Example of a
biodegradable
netting





SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Where and Why Use Temporary Degradable RECPs

- ◆ Anywhere land disturbing activities will take place and design erosive forces acting on the site exceed the limits of conventional vegetation establishment methods
- ◆ Use where mulches and blown straw fail
- ◆ Use where shear forces do not exceed the limits of unreinforced vegetation

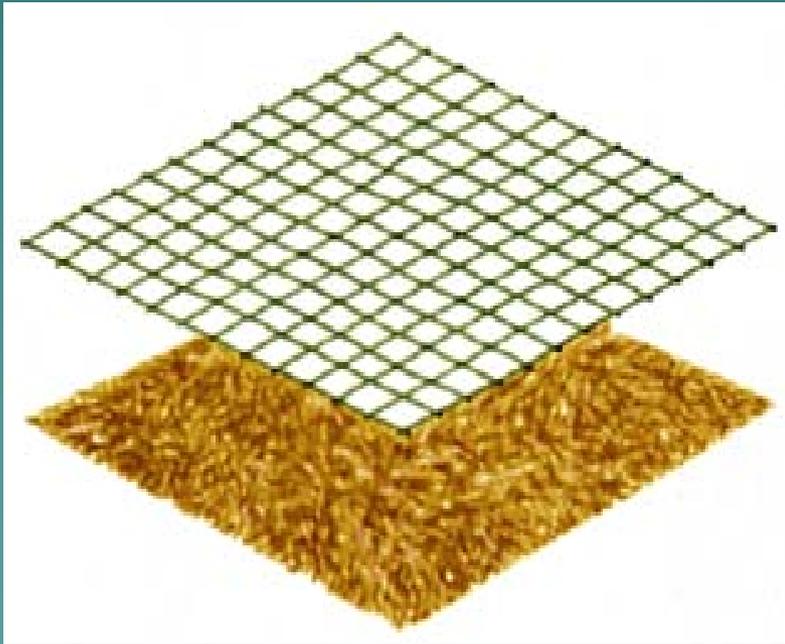
SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Where and Why Use Temporary Degradable RECPs Cont.

- ◆ RECPs provide erosion protection prior to vegetation establishment
 - Reduce runoff velocity and volume (improve infiltration of water)
 - Reduce soil detachment and transportation
 - Absorb raindrop energy
 - Trap soil particles
- ◆ Organic matrix materials provide mulching action to assist in vegetation establishment

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

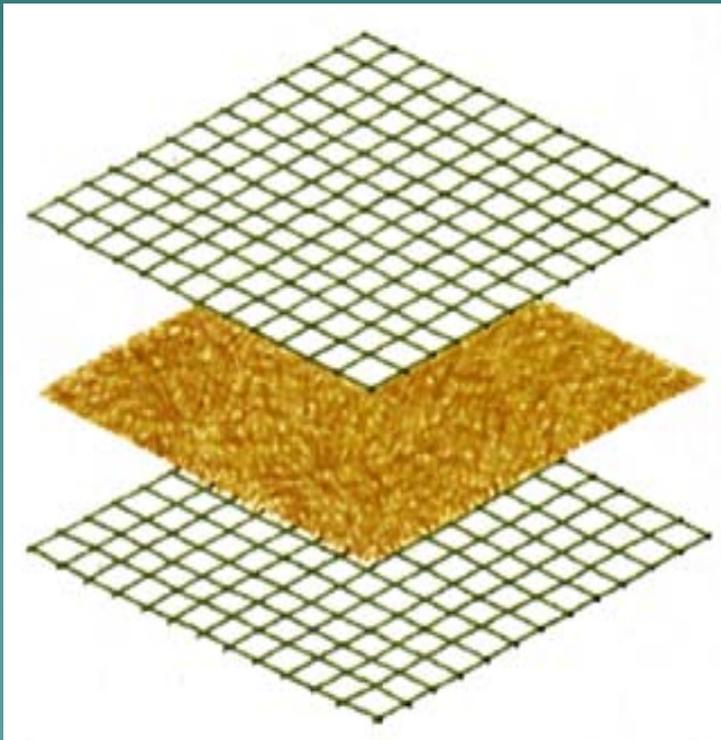
Temporary Degradable ECBs Single Net Short-Term ECTC definition



- ◆ An erosion control blanket composed of processed degradable natural or polymer fibers mechanically bound together by a single degradable synthetic or natural fiber netting to form a continuous matrix or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

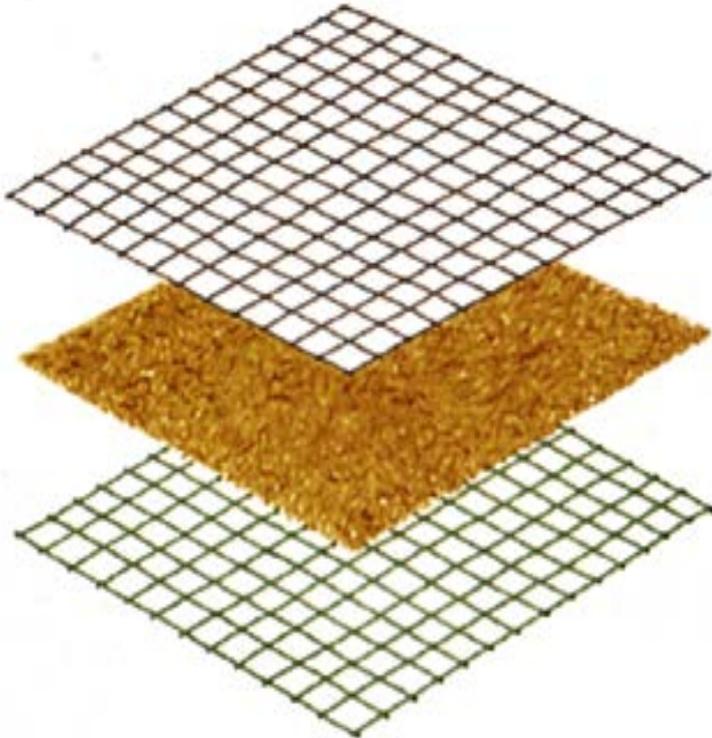
Temporary Degradable ECBs Double Net Short-Term ECTC definition



- ◆ Processed degradable natural and/or polymer fibers mechanically bound together between two degradable, synthetic or natural fiber nettings.

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Temporary Degradable ECBs Double Net Extended – Term ECTC definition



- ◆ An erosion control blanket composed of processed slow degrading natural or polymer fibers mechanically bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Double Net Extended-Term RECP Installation

◆ Before Vegetation Establishment

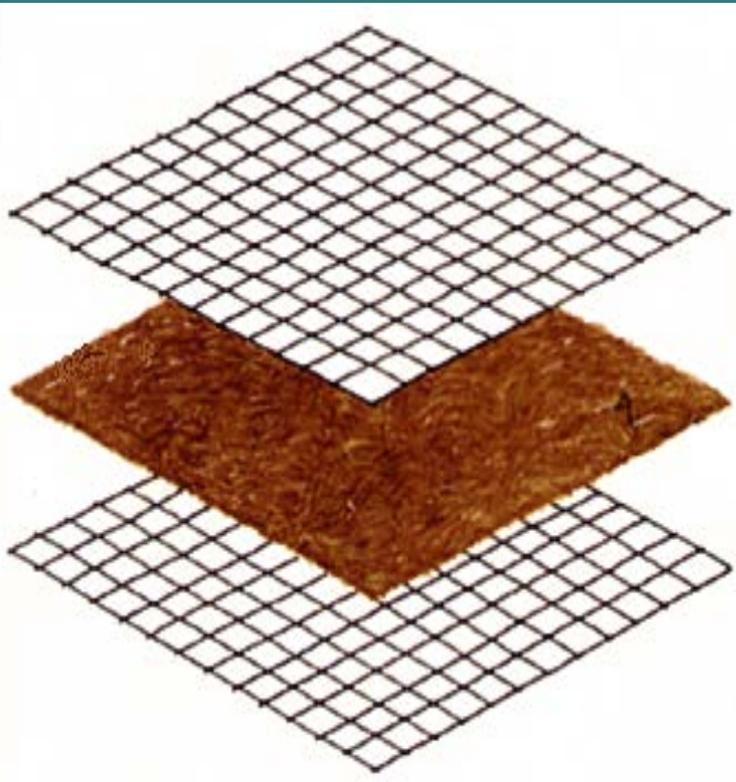


◆ During Vegetation Establishment



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Temporary Degradable ECBs Double Net Long – Term ECTC definition



- ◆ An erosion control blanket composed of processed slow degrading natural or polymer fibers mechanically bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.

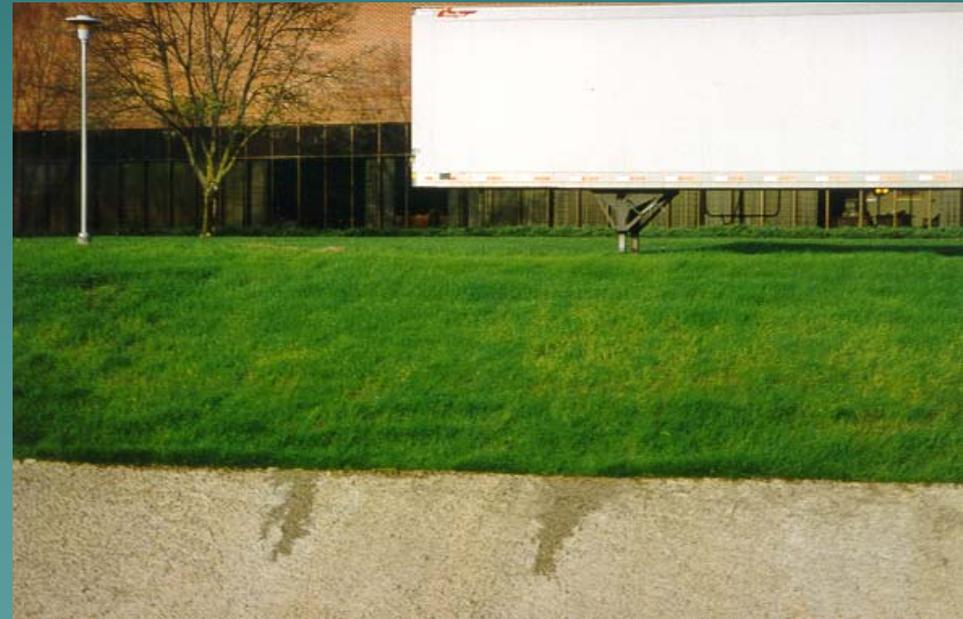
SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Double Net Long-Term RECP Installation

Partially Vegetated



Fully Vegetated



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

100% Biodegradable Temporary Rolled Erosion Control Products



- ◆ Ideal for use in environmentally /ecologically sensitive areas where synthetics are unwelcome.
- ◆ Reduces the likelihood of wildlife entanglement.
- ◆ Excellent for wetland/bioengineering sites.
- ◆ Increased erosion control capabilities.

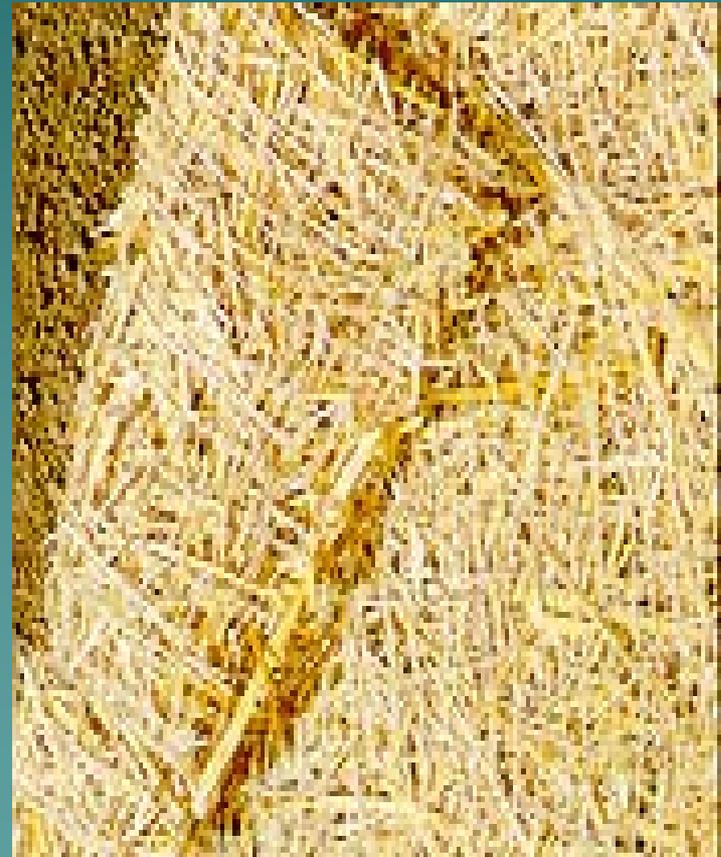
SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Short-Term 100% Biodegradable RECPs

Single Net Short-Term



Double Net Short-Term



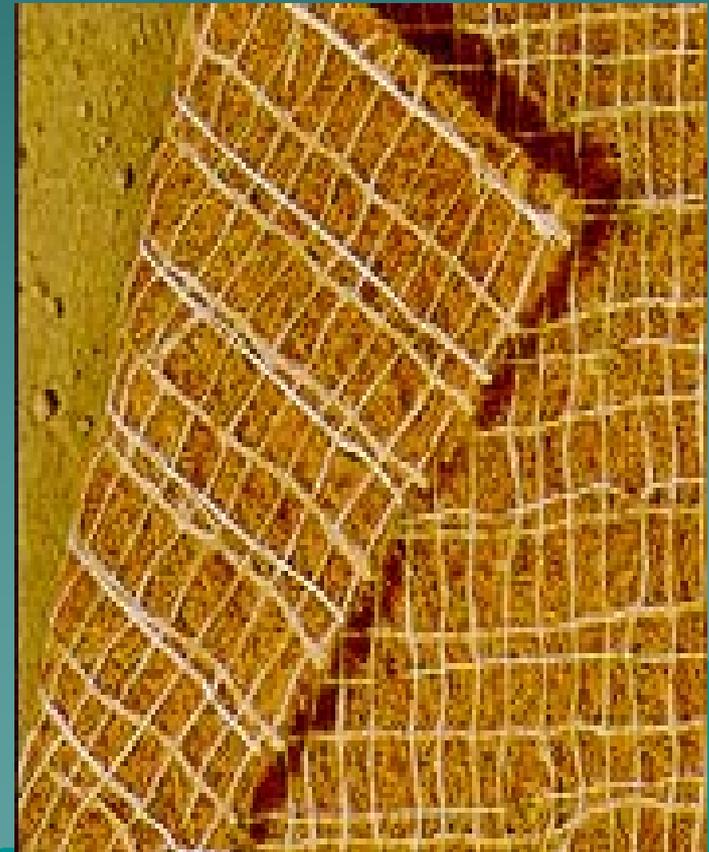
SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Extended and Long-Term 100% Biodegradable RECPs

Double Net Extended-Term



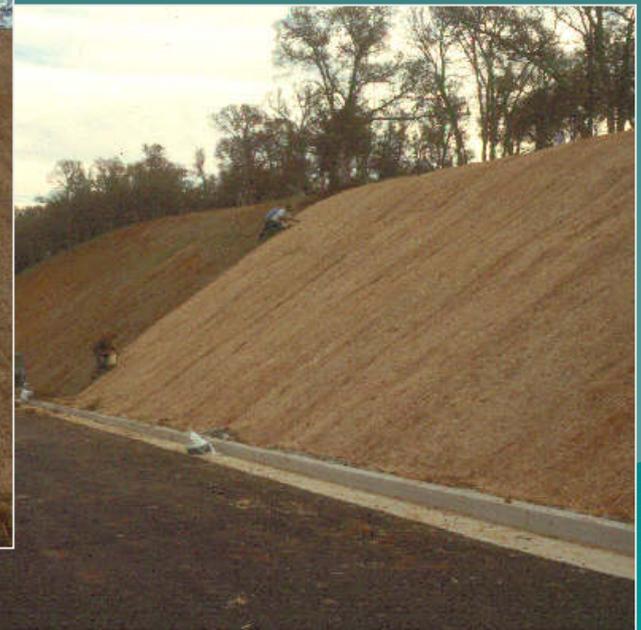
Double Net Long-Term



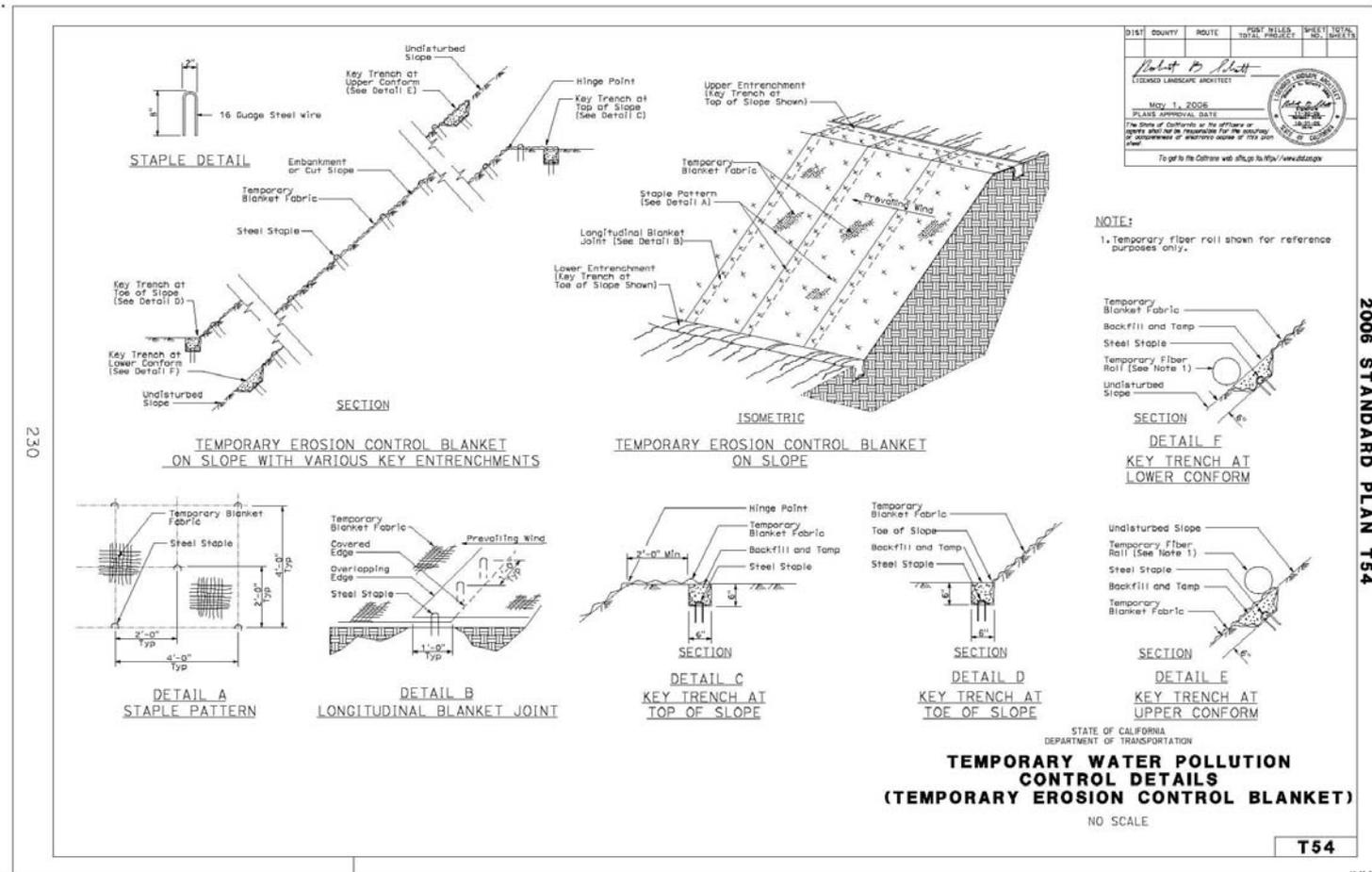
SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

◆ How are they applied?

- Generally speaking they are rolled out on the disturbed soil and anchored down



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)



(Source: Caltrans Standard Plans, May 2006)

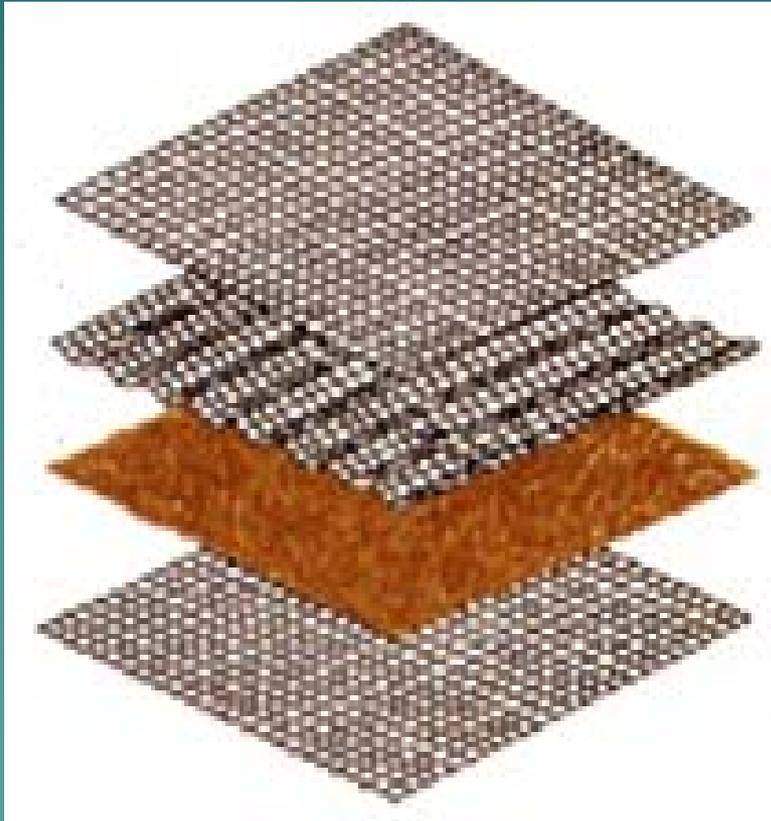
SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

- ◆ **What types are there and how are they used?**
 - **Mats or Turf Reinforcement Mats (TRMs):** Can be biodegradable fiber and photodegradable synthetic netting or interwoven non-biodegradable geosynthetic material . Constructed to form a three-dimensional matrix. Used as a permanent soil stabilizer, and for difficult temporary situations.



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Turf Reinforcement Mats (TRMs) FHWA FP-03 Spec., Section 629



- ◆ “A long term non-degradable RECP composed of UV stabilized, non-degradable synthetic fibers, filaments, nettings, or wire mesh processed into three dimensional reinforcement matrices designed for permanent and critical hydraulic applications where design discharges exert velocities and shear stresses that exceed the limits of mature, natural vegetation.”

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Why Use TRMs?

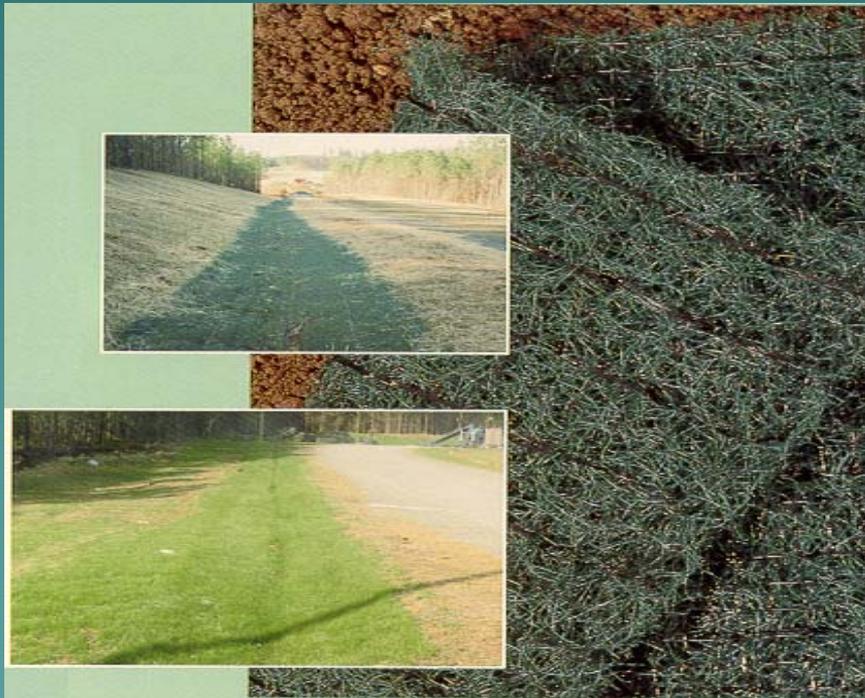


- ◆ Used where mature vegetation will not survive or provide sufficient erosion control against design flow conditions.

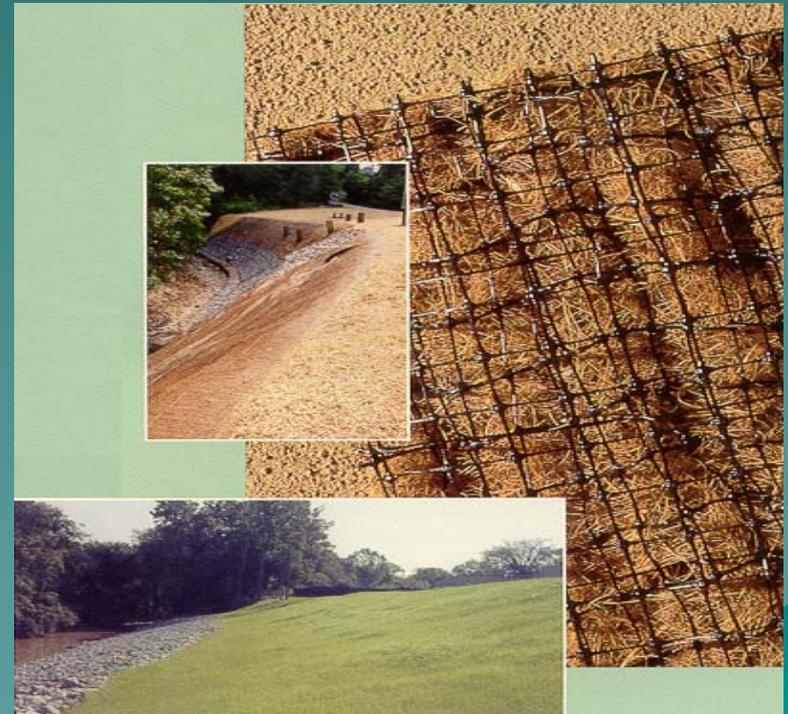
SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Permanent Erosion Control / Turf Reinforcement Mats

100% Synthetic TRM



Composite - TRM



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Slope Protection



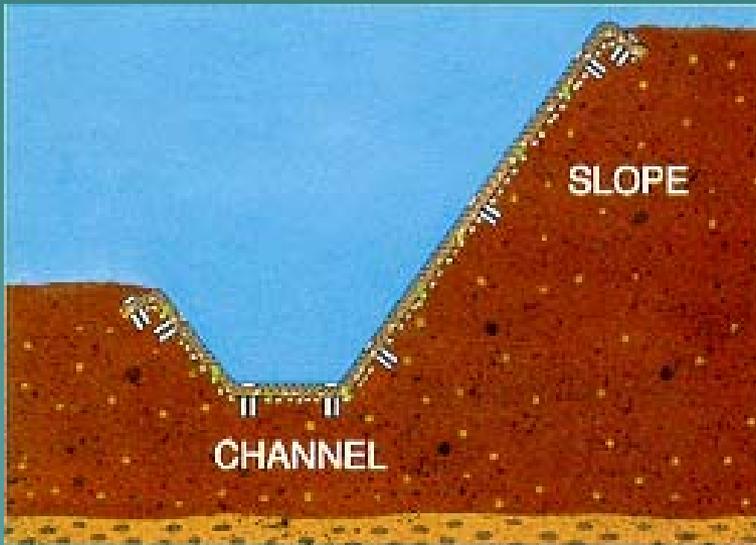
Channel Protection



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Phase I Pre-emergence

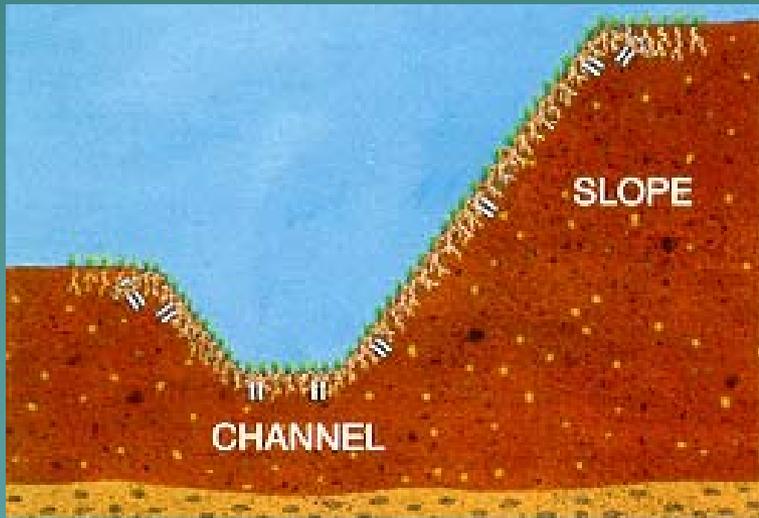
- ◆ Unvegetated; TRM provides primary protection for seed and bare soil.



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Phase II Establishment

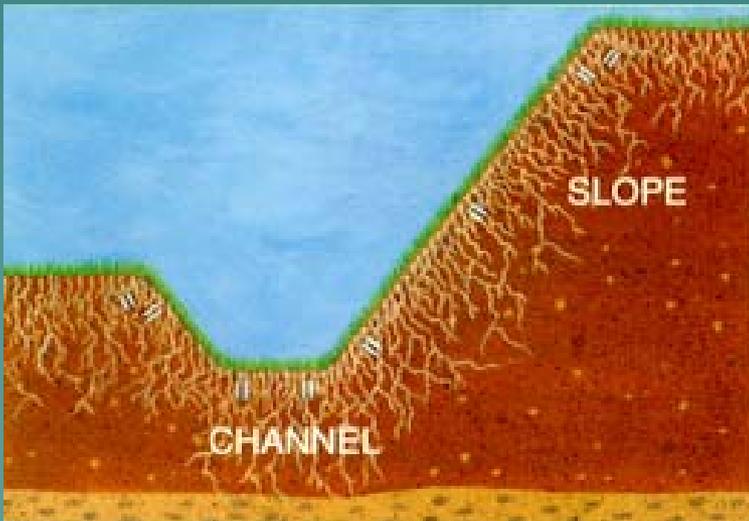
- ◆ Partially Vegetated; TRM provides primary protection and seedling reinforcement; Moderate vegetative stand (Occurs 2-24 months after installation).



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Phase III Mature Vegetation

- ◆ Fully Vegetated; Vegetation provides primary erosion protection while TRM provides supplemental erosion control and vegetation reinforcement (Occurs 6-36 months after installation).



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Permanent, Non-degradable Composite - TRM

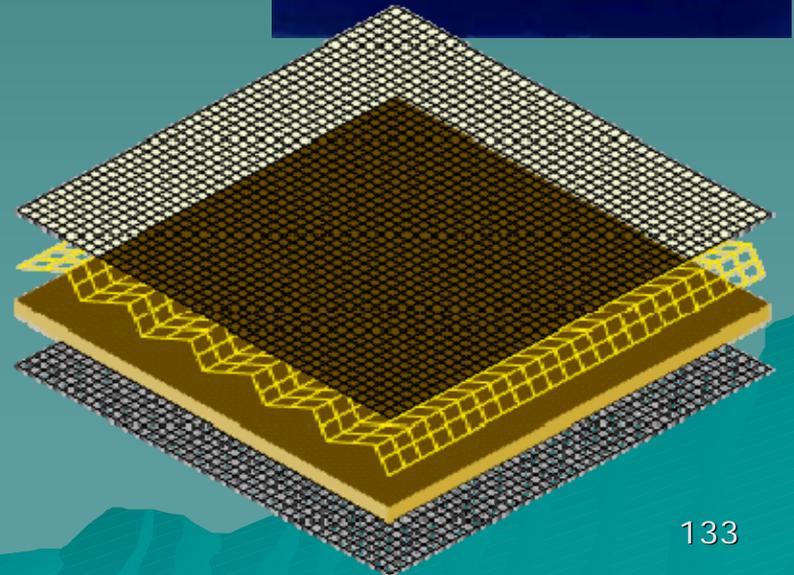
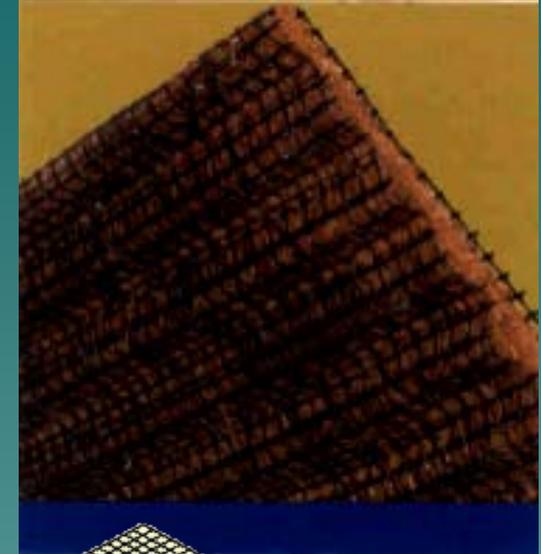


- ◆ A long term non-degradable RECP composed of UV stabilized...synthetic fibers, filaments, nettings and/or wire mesh, processed into a permanent, three dimensional matrix which may be supplemented with degradable natural fiber components.

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Composite TRM Example

- ◆ **Fiber Matrix**
 - 100 % Coconut
- ◆ **Top Netting**
 - super high strength black poly
- ◆ **Center Netting**
 - ultra high strength
 - corrugated black poly
- ◆ **Bottom Netting**
 - super high strength black poly



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

August 2001



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

May 2002



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

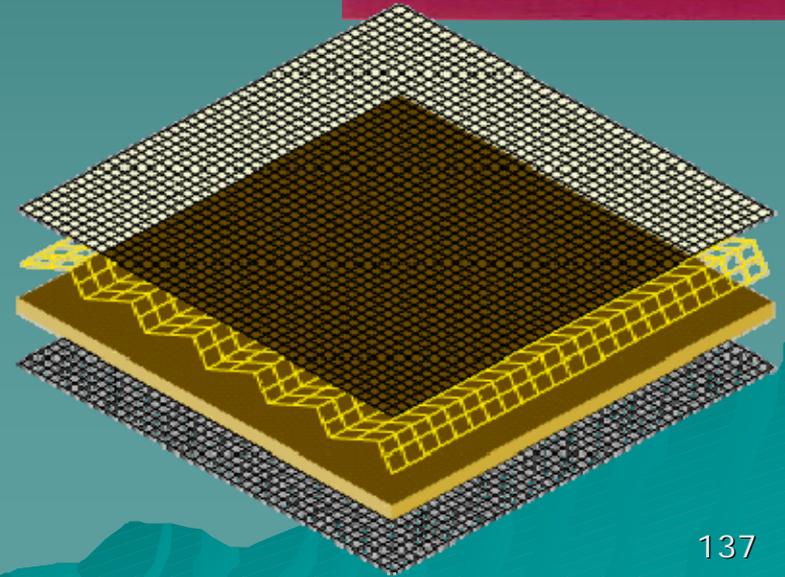
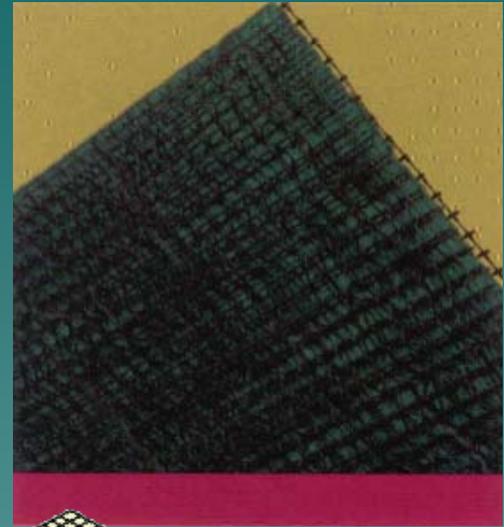
July 2003



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

100% Synthetic TRM Example

- ◆ **Fiber Matrix**
 - 100 % Polypropylene
- ◆ **Top Netting**
 - ultra high strength black poly
- ◆ **Center Netting**
 - ultra high strength
 - corrugated black poly
- ◆ **Bottom Netting**
 - ultra high strength black poly



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Fall 2001



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

June 2002

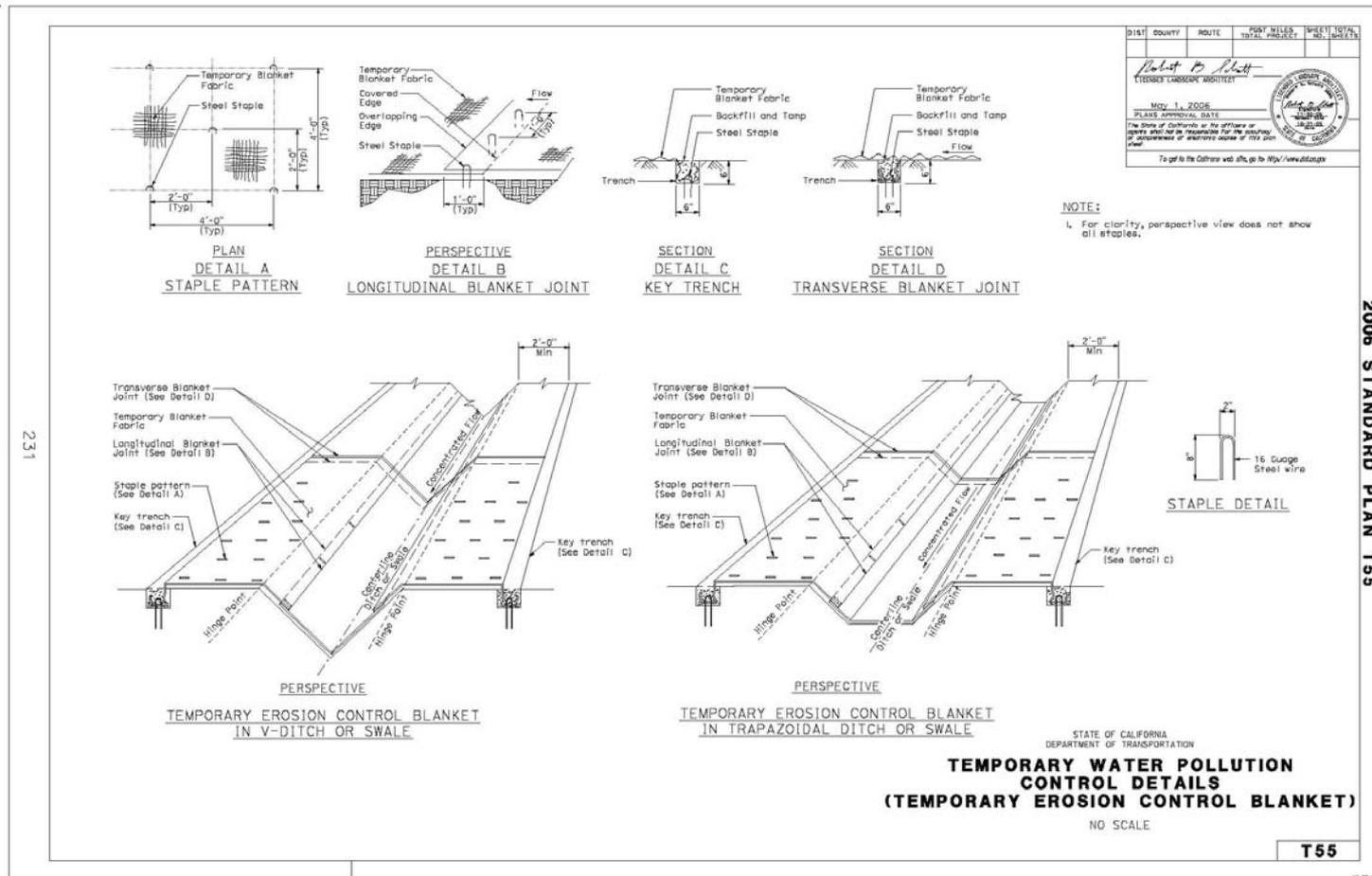


SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

June 2003



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)



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(Source: Caltrans Standard Plans, May 2006)

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

◆ Fasteners



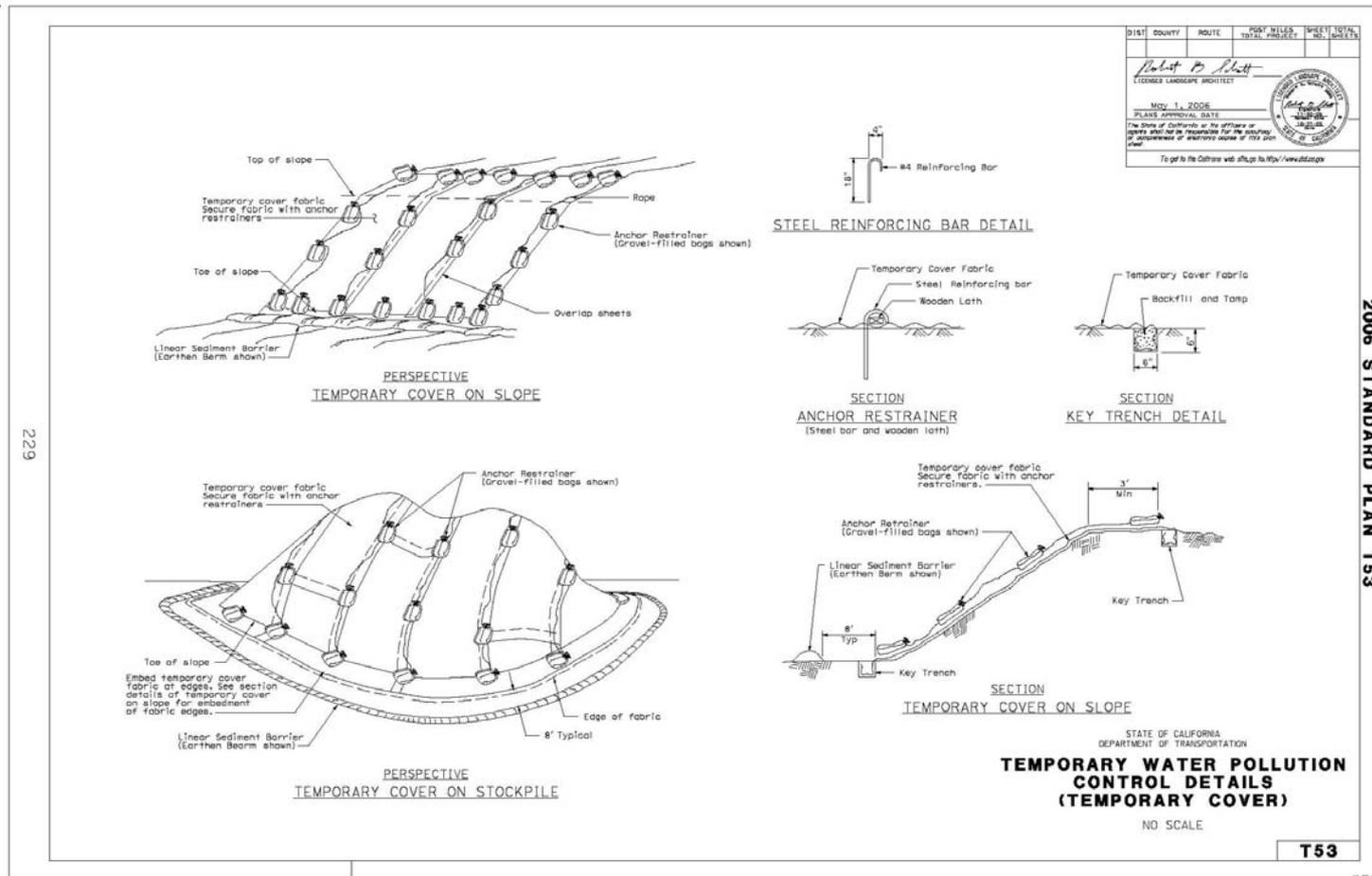


SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Temporary Covers

- ◆ Woven geotextile
- ◆ Geomembrane 10 mil
- ◆ Restrained in place
 - Gravel bags – 8 foot max spacing
 - Steel anchors and wooden lath
- ◆ 24 inch overlap
- ◆ 6 inch soil embedment (non-butting edges)
- ◆ Restrainers placed on the toe and overlap

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)



(Source: Caltrans Standard Plans, May 2006)



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

◆ Standards and Specifications

- Refer to Standard Specification, 7-1.13, 15-1.02, 88-1.04, 20-2, 20-3.02
- Selection must be based on site-specific conditions
- To be effective BMP must maintain contact with the soil
- Refer to Section 2.2.5 starting with Page 5 of the temporary soil stabilization guide

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.5-b:

Descriptions and Specifications of Rolled Erosion Control Products

| <i>Geotextiles (Non-Biodegradable)</i> | |
|---|--|
| <i>Woven</i> | <ul style="list-style-type: none"> Made of woven polypropylene fabric. <ul style="list-style-type: none"> Minimum thickness of 1.5 millimeters (0.06 inches) Minimum width of 3.7 meters (12 feet) Minimum tensile strength of 0.67 kilo-Newtons (warp) 0.36 kilo-Newtons (fill) Conformance with ASTM: D4632 Permittivity <ul style="list-style-type: none"> approximately 0.07 seconds⁻¹ in Conformance with ASTM: D4491 Ultraviolet (UV) stability <ul style="list-style-type: none"> 70 percent in Conformance with ASTM: D4355 Geotextiles shall be secured in place with wire staples ⁽¹⁾ or sandbags and by keying into the tops of slope and edges to prevent infiltration of surface waters under the geotextile. Geotextiles can be re-used if, in the opinion of the Resident Engineer, they are suitable for the use intended. Staples ⁽¹⁾ or metal geotextile stake pins ⁽²⁾ shall be used to secure the blanket to the disturbed soil area. |
| <i>Plastic Covers (Non-Biodegradable)</i> | |
| <i>Rolled Plastic Sheeting</i> | <ul style="list-style-type: none"> Minimum thickness of 6 mil Keyed in at the top of slope and firmly held in place with sandbags or other weights placed no more than 3 meters (10 feet) apart. Seams are typically taped or weighted down along their entire length, and there shall be at least a 300 to 600 millimeters (12 to 24 inches) overlap of all seams. Edges shall be embedded a minimum of 150 millimeters (6 inches) into the soil. |
| <i>Netting (Non-Biodegradable)</i> | |
| <i>Plastic Netting</i> | <ul style="list-style-type: none"> Lightweight bi-axially-oriented polypropylene polyethylene, nylon, or polyvinyl chloride (PVC) netting. Designed for securing loose mulches like straw to soil surfaces to establish vegetation. The netting is photodegradable and is supplied in rolled strips, which shall be secured with U-shaped staples ⁽³⁾ or stakes ⁽²⁾ in accordance with manufacturers' recommendations. |
| <i>Plastic Mesh</i> | <ul style="list-style-type: none"> Open-weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than 0.5 centimeters (0.2 inches). It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which shall be secured to the soil with U-shaped staples ⁽¹⁾ or stakes ⁽²⁾ in accordance with manufacturers' recommendations. |

(1) (2) (3): See Standards and Specifications of rolled erosion control products for dimensions of the staples, geotextile pins, and blankets.

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

**Table 2.2.5-b (continued):
Descriptions and Specifications of Rolled Erosion Control Products**

| <i>Erosion Control Blankets(Biodegradable)</i> | |
|--|--|
| <i>Jute</i> | <ul style="list-style-type: none"> • A natural fiber that is made into a yarn, which is loosely woven into a biodegradable mesh. • Designed to be used in conjunction with vegetation and has lifespan of approximately 1 year. • The material is supplied in rolled strips, which shall be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations. • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| <i>Straw Blanket</i> | <ul style="list-style-type: none"> • Machine-produced blankets of straw with a lightweight biodegradable netting top layer. • The straw shall be attached to the netting with biodegradable thread or glue strips. • Straw blanket shall be furnished in rolled strips • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| <i>Coconut Fiber Blanket (Coir)</i> | <ul style="list-style-type: none"> • Machine-produced blankets of 100 percent coconut fiber with biodegradable netting on the top and bottom. • The coconut fiber shall be attached to the netting with biodegradable thread or glue strips. • The blanket ⁽³⁾ shall be furnished in rolled strips • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| <i>Coconut Fiber Mesh (Coir)</i> | <ul style="list-style-type: none"> • Thin permeable membranes made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable blanket. • Designed to be used in conjunction with vegetation and typically has lifespan of several years. • The material is supplied in rolled strips, which shall be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations. • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| <i>Straw/Coconut (Coir) Fiber Blanket</i> | <ul style="list-style-type: none"> • Machine-produced mats. <ul style="list-style-type: none"> – 70 percent straw and 30 percents coconut fiber – biodegradable netting on the top and bottom net • The straw and coconut fiber shall be attached to the netting with biodegradable thread or glue strips. • Straw coconut fiber blanket ⁽³⁾ shall be furnished in rolled strips. • ⁽¹⁾ Staples shall be used to secure the blanket to the disturbed soil area. |

(1) (2) (3): See Standards and Specifications of rolled erosion control products for dimensions of the staples, geotextile pins, and blankets.

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

**Table 2.2.5-b (continued):
Descriptions and Specifications of Rolled Erosion Control Products**

| Erosion Control Blankets(Non-Biodegradable) | |
|--|--|
| Wood Fiber Blanket | <ul style="list-style-type: none"> • Biodegradable fiber mulch with extruded plastic netting held together with adhesives. • The material is furnished in rolled strips, which shall be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations. • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| Excelsior (Curled Wood Fiber) | <ul style="list-style-type: none"> • Machine-produced blankets of curled wood excelsior <ul style="list-style-type: none"> - 80 percent of the fiber 150 millimeters (6 inches) or longer. - Top surface covered with a photodegradable extruded plastic mesh. - Smolder resistant without the use of chemical additives - Non-toxic and non-injurious to plant and animal life • Excelsior blanket shall be furnished in rolled strips. <ul style="list-style-type: none"> - A minimum width of 1220 millimeters (48 inches) - Average weight of 0.5 kilograms per meter squared (12 pounds per foot squared); ±10 percent, at the time of manufacture. • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| Biodegradable Fibers with Synthetic Netting | <ul style="list-style-type: none"> • Biodegradable fibers, such as wood, straw, and/or coconut fiber, with a light weight polypropylene net stitched to the top and/or stitched to the bottom. It is furnished in rolled strips, which shall be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations. • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| Mats (Non-Biodegradable) | |
| Biodegradable Fibers with Synthetic Netting | <ul style="list-style-type: none"> • Biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high-strength continuous- filament geo-matrix or net stitched to the bottom. • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| Synthetic Fiber with Synthetic Netting | <ul style="list-style-type: none"> • Turf reinforcement mats composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. • The mat is a dense, 3-dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. • The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geo-matrix. • The material is furnished in rolled strips, which shall be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations. • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |
| Bonded Synthetic Fibers | <ul style="list-style-type: none"> • Turf reinforcements mats that consist of a 3-dimensional geo-matrix nylon (or other synthetic) material. • Typically the material has more than 80 percent open area that facilitates root growth. Its tough root-reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. • It can be installed over prepared soil, followed by seeding into the mat. • Once vegetated, it becomes an invisible composite system of soil, roots, and geo-matrix. • The material is furnished in rolled strips that shall be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations. • Staples ⁽¹⁾ shall be used to secure the blanket to the disturbed soil area. |

(1) (2) (3): See Standards and Specifications of rolled erosion control products for dimensions of the staples, geotextile pins, and blankets.



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.5-c: Installation on Slopes

Installation of geotextiles, plastic covers, erosion control blankets and mats, on slopes shall be done in accordance with the manufacturers' specifications. General guidelines are as follows:

1. Begin at the top of the slope and anchor the blanket into a trench 150 millimeters deep by 150 millimeters wide (6 inches by 6 inches) by backfilling the trench and compacting the back filled soil by tamping.
2. Unroll the blanket in the down-slope direction. Lay the blanket loosely maintaining direct contact with the soil. Do not stretch the blanket.
3. Overlap the edges of adjacent parallel blankets 50 millimeters (2 inches) to 75 millimeters (3 inches). Staple the blanket's overlapped edges in the down slope direction every 1 meter (3 feet).
4. If the blankets must be spliced (overlapped) wherever one blanket ends and another begins, place the uphill blanket over the top of the downhill blanket with a 150 millimeter (6 inch) overlap. Staple the blanket through the overlapped area approximately every 300 millimeters (12 inches).

Staples must be adequately placed along the edges, down the center, and staggered throughout the blanket to maintain contact with the soil surface.

| Slope (V:H) | #staples/m ² | #staples/yard ² |
|---------------------|-------------------------|----------------------------|
| Less than 1:4 | 2 | 2 |
| Between 1:4 and 1:2 | 1.5* | 1.5* |
| Greater than 1:2 | 1 | 1 |

* Also requires 1 staple per meter (1 staple per yard) in the center.

Table 2.2.5-d: Installation in Channels

Installation of geotextiles, erosion control blankets and mats in channels shall be done in accordance with the manufacturers' specifications. General guidelines are as follows:

1. Dig initial anchor trench 300 millimeters (12 inches) deep and 150 millimeters (6 inches) wide across the channel at the lower end of the project area.
2. Excavate intermittent check slots, 150 millimeters (6 inches) deep and 150 millimeters (6 inches) wide across the channel at 8 to 10 meter (25 to 30 foot) intervals along the channels-
3. Cut longitudinal channel anchor slots 100 millimeters (4 inches) deep and 100 millimeters (4 inches) wide along each side of the installation to bury edges of matting, whenever possible extend matting 50 to 75 millimeters (2 to 3 inches) above the crest of the channel side slopes.
4. Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 300 millimeter (12 inch) intervals. Note: matting will initially be upside down in anchor trench.
5. In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 75 millimeters (3 inches).
6. Secure these initial ends of mats with anchors at 300 millimeter (12 inch) intervals, backfill and compact soil.
7. Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 75 millimeter (3 inch) overlap.
8. Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold it back against itself. Anchor through both layers of mat at 300 millimeter (12 inch) intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
9. Alternate method for non-critical installations: Place two rows of anchors on 150 millimeter (6 inch) centers at 8 to 10 meter (25 to 30 foot) intervals in lieu of excavated check slots.
10. Shingle-lap spliced ends a minimum of 300 millimeters (12 inches) apart on 300 millimeter (12 inch) intervals.
11. Place edges of outside mats in previously excavated longitudinal slots, anchor using prescribed staple pattern, then backfill and compact the soil.
12. Anchor, fill and compact upstream end of mat in a 300 millimeter (12 inch) by 150 millimeter (6 inch) terminal trench.
13. Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

- ◆ How will SS-7 work on your site?
- ◆ Let's take a closer look





SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.5-e: Applicability of Rolled Erosion Control Products (SS-7) to Site Characteristics

| BMP Name | Class | Type | Flow Conditions | Maximum Slope Inclination (V:H) ⁽¹⁾ | Soil Classification ⁽²⁾ | Surface Area | Atmospheric Conditions | Accessibility | Drains to 303(d) Listed Water Body | Duration of Need ^(Y) |
|-------------------------------|-----------------------------------|---|--------------------------|--|------------------------------------|-----------------|------------------------|---------------|------------------------------------|---------------------------------|
| Geotextiles ⁽³⁾ | Non-Biodegradable | Woven | channelized and/or sheet | 1:1 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Between 3 and 12 months |
| Plastic Covers ⁽³⁾ | Non-Biodegradable | Rolled Plastic Sheeting | channelized and/or sheet | 1:1 | all | small | all ^σ | E | D | Between 3 and 12 months |
| Netting | Photodegradable | Plastic Netting | sheet | 1:2 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Between 3 and 12 months |
| | | Plastic Mesh | sheet | 1:2 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Greater than 12 months |
| Erosion Control Blankets | Biodegradable | Jute | sheet | 1:2 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Between 3 and 12 months |
| | | Straw Blanket | sheet | 1:2 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Between 3 and 12 months |
| | | Coconut Fiber Blanket | sheet | 1:1.5 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Greater than 12 months |
| | | Coconut Fiber Mesh | sheet | 1:1.5 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Greater than 12 months |
| | Biodegradable and Photodegradable | Straw Coconut Fiber Blanket | sheet | 1:1.5 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Greater than 12 months |
| | | Wood Fiber Blanket | sheet | 1:2 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Between 3 and 12 months |
| | | Excelsior (Curled Wood Fiber) | sheet | 1:2 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Between 3 and 12 months |
| | | Biodegradable Fibers with Synthetic Netting | sheet | 1:1.5 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Greater than 12 months |
| Mats ⁽⁴⁾ | Non-Biodegradable | Biodegradable Fibers with Synthetic Netting | channelized and/or sheet | 1:1.5 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Greater than 12 months |
| | | Synthetic Fiber with Synthetic Netting | channelized and/or sheet | 1:1 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Greater than 12 months |
| | | Bonded Synthetic Fibers | channelized and/or sheet | 1:1 | SW, SP, SM, SC, ML, CL, OL, MH, CH | small to medium | all ^σ | E | D | Greater than 12 months |

(1): Conservative Maximum Slope Inclination (V:H) recommended by Caltrans for product applicability, manufacturer may recommend greater slope inclinations

(2): Refer to Table 2.1-b: Unified Soil Classification System for soil classification descriptions.

(3): Are not applicable with hydroseeding

(4): Using hydroseed with turf reinforcement mats in channelized flow situations may have limited success due to potentially turbulent flows.

A: The BMP cannot be applied during a storm event or freezing conditions. Avoid applying in strong winds and over spraying.

B: The disturbed soil area must be accessible to equipment.

C: ~~If disturbed soil area drains to 303(d) listed water body, potential non-visible pollutant.~~

D: ~~If disturbed soil area drains to 303(d) listed water body, potential pollutants if breach or malfunction occurs.~~

E: The product is applied manually; therefore, road or pad proximity limitations do not affect their applicability.

σ: May be difficult to insert pins into frozen ground.

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

Table 2.2.5-f: Time and Cost of Rolled Erosion Control Products (SS-7)

| BMP Type | Type | Delivery Time ^(Y) | Installation Time ^(Z) | Time Until Effective |
|--------------------------|---|------------------------------|------------------------------------|----------------------|
| | | days | hours/hectare | days |
| Geotextiles | Woven | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| Plastic Covers | Rolled Plastic Sheeting | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| Netting | Plastic Netting | 7-14 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| | Plastic Mesh | 7-14 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| Erosion Control Blankets | Jute | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| | Straw Blanket | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| | Coconut Fiber Blanket | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| | Coconut Fiber Mesh | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| | Straw Coconut Fiber Blanket | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| | Wood Fiber Blanket | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| | Excelsior (Curled Wood Fiber) | 3-5 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| | Biodegradable Fibers with Synthetic Netting | 7-14 | 38 ⁽¹⁾ ↓ (15 hrs/ac) | ASAA |
| Mats | Biodegradable Fibers with Synthetic Netting | 7-14 | 96 ⁽¹⁾ ↓ (38 hrs/ac) | ASAA |
| | Synthetic Fiber with Synthetic Netting | 7-14 | 96 ⁽¹⁾ ↓ (38 hrs/ac) | ASAA |
| | Bonded Synthetic Fibers | 7-14 | 96 ⁽¹⁾ ↓ (38 hrs/ac) | ASAA |

ASAA: The BMP is effective as soon as it is applied.

(1): Assumes that the rolled erosion control product is installed by a 2 man crew.

(X): Data obtained from the Caltrans, Erosion Control Manual (Draft), Training Materials, 2003

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

(Z): Data obtained from the RS Means, Site work and Landscape Cost Data, 22nd ed. 2003

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)



SS-7 Temporary Erosion Control Blanket/Temporary Cover (Plastic Covers) (SSPs 07-390 and 07-395)

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Table 2.2.5-a

Limitations of Rolled Erosion Control Products

| Category | Limitation |
|-----------------------------|---|
| Selection | <ul style="list-style-type: none">• Rolled erosion control products should not be applied in areas in which it would be considered unsuitable with immediate future earthwork and would need to be removed or reapplied.• Geotextiles and erosion control blankets generally are not suitable for sites that are excessively rocky. Unless combined with topsoiling and/or soil amendments, these products may be unable to maintain complete contact with the soil surface.• Plastic covers are impervious and can cause erosion problems in receiving areas due to the excessive flow with increased velocities.• Plastic covers must only be used as a soil stabilization practice on stockpiles of soil and/or mulch, and on very small disturbed soil areas that require immediate attention for a short period of time.• Geotextiles can be reused if approved by the Resident Engineer.• Wildlife can become entangled in some rolled erosion control products. |
| Installation | <ul style="list-style-type: none">• Installation of rolled erosion control products requires manual labor that can be physically challenging and time intensive. The inability to easily disperse rolled erosion control products over large areas and limit the amount of surface area that can be covered in a timely, cost effective manner.• To be effective, the product must maintain contact with the surface of the disturbed soil area. To ensure this, prior to the application of the BMP, rocks, clogs, sticks, and vegetation must be removed and rills and/or gullies must be filled and compacted. If necessary, topsoiling may be required to properly prepare the soil surface.• Some rolled erosion control products are easily torn and photodegradable. Walking, moving equipment and/or vehicular traffic across areas where these products are applied could damage the BMP.• If not installed correctly: Undercutting could occur at the top of the slope if the BMP is not trenched and anchored correctly. Undermining of the blanket could occur if complete contact with the soil is not maintained. Separation along the vertical and/or horizontal seams could occur due to improper overlap and/or stapling.• If vegetation establishment is used in conjunction with rolled erosion control products and the area is to be mowed at a later date, the anchoring staples, or stake pins must be driven flush to the soil surface to avoid a potential hazard during the mowing. |
| Flow Conditions | <ul style="list-style-type: none">• Because some rolled erosion control products have flow rate limitations not all are suitable for channelized flow. Flow rate limitations and tensile strength must be considered.• When necessary, rolled erosion control products should be used with other soil stabilization and sediment control BMPs (see Section 2.3) to reduce the slope lengths and limit run-on flows to areas where the rolled erosion control products are applied. |
| Time Until Effective | <ul style="list-style-type: none">• Rolled erosion control products are effective as soon as they are applied. |
| Maintenance | <ul style="list-style-type: none">• When damage occurs, reapplication or repair to the damaged areas is necessary to maintain the effectiveness of the BMP. |

SS-8 Temporary Mulch (Wood)

◆ What is it?

- The process of applying bark, shredded wood, and/or compost (recycled green material) to bare soil to reduce the potential for erosion from wind and water
- Used primarily for landscaping



SS-8 Temporary Mulch (Wood)

- ◆ Standards and Specifications
 - Landscape Architect should approve use of wood mulch
 - Refer to Standard Specifications 20-2.01, and 20-3.02 for soil surface preparation
 - Roughen soil surface with small furrows along the contours via ripping, sheepsfoot, track walk
 - If used as a temporary BMP the mulch must be removed prior to re-starting work

SS-8 Temporary Mulch (Wood)

- ◆ How will wood mulch work on your site?
- ◆ Let's look at some specifics



SS-8 Temporary Mulch (Wood)

Table 2.2.6-b
Applicability of Wood Mulch (SS-8) to Site Characteristics

| Type | Flow Conditions | Maximum Slope Inclination (V:H) ⁽¹⁾ | Soil Classification ⁽²⁾ | Surface Area | Atmospheric Conditions | Accessibility | Drains to 303(d) Listed Water Body | Duration of Need ^(Y) |
|---------------------------------|-----------------|--|--|--------------|------------------------|---------------|---|---------------------------------|
| Compost/Recycled Green Material | sheet | 1:3 | SW, SP, SM, SC, ML, CL, OL, MH, CH, OH, Pt | small | A | B, E | C, D | Between 3 and 12 months |
| Shredded Wood/Bark | sheet | 1:3 | SW, SP, SM, SC, ML, CL, OL, MH, CH, OH, Pt | small | A | B, E | C, D | Between 3 and 12 months |

(1): Maximum Slope Inclination (V:H) recommended by Caltrans.

(2): Refer to Table 2.1-b: Unified Soil Classification System for soil classification descriptions.

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

A: The BMP cannot be applied during a storm event or freezing conditions. Avoid applying in strong winds and over spraying.

B: If applied mechanically, the disturbed soil area must be accessible to equipment.

~~C: If disturbed soil area drains to 303(d) listed water body, potential non-visible pollutant.~~

~~D: If disturbed soil area drains to 303(d) listed water body, potential pollutants if breach or malfunction occurs.~~

E: If applied manually, the road or pad proximity limitations do not affect their applicability.

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-8 Temporary Mulch (Wood)

Table 2.2.6-c
Application Depths of Wood Mulch (SS-8) (W)

| Type | Uniform Depth | Slope Inclination | | |
|---------------------------------|---------------|-------------------|---------------------|------------------|
| | | Less than 1:4 | Between 1:4 and 1:3 | Greater than 1:3 |
| Compost/Recycled Green Material | millimeters | 50.0 | 50.0 | NA |
| | inches | 2.0 | 2.0 | NA |
| Shredded Wood/Bark | millimeters | 50.0 | 75.0 | NA |
| | inches | 2.0 | 3.0 | NA |

NA: Not Applicable

(W): Data obtained from Caltrans, Storm Water Quality Handbooks; Construction Site BMP Manual, 2003

Table 2.2.6-d
Time and Cost Wood Mulch (SS-8)

| Type | Delivery Time ^(Y) | Installation Time | Time Until Effective |
|---------------------------------|------------------------------|------------------------------------|----------------------|
| | days | hours/hectare | days |
| Compost/Recycled Green Material | 3-5 | 320 ⁽¹⁾ (128 hrs/ac) | ASAA |
| Shredded Wood/Bark | 3-5 | 320 ⁽¹⁾ (128 hrs/ac) | ASAA |

ASAA: The BMP is effective as soon as it is applied.

(1): Assumes the use of a skid steel loader to apply the mulch, 1 equipment operator, and a 4 man crew to spread the wood mulch. Actual installation time may vary depending on location and field conditions.

(X): Data obtained from the Caltrans, Erosion Control Manual (Draft), Training Materials, 2003

(Y): Data obtained from the URS Greiner Woodward Clyde, Soil Stabilization for Temporary Slopes, 1999

SS-8 Temporary Mulch (Wood)

Table 2.2.6-a: Limitations of Wood Mulch

| <i>Category</i> | <i>Limitation</i> |
|------------------------|---|
| Selection | <ul style="list-style-type: none"> Wood mulches are not suitable for slopes steeper than 1:3 (V:H) because it has a tendency to be moved down steep slopes. Wood mulches are best suited for slopes which are 1:5 (V:H) or flatter. Wood mulch should not be used in areas where the mulch would be considered unsuitable with immediate future earthwork and would, therefore, need to be removed or reapplied. |
| Installation | <ul style="list-style-type: none"> If not properly prepared, wood mulch (particularly compost) can introduce undesirable vegetation into the underlying soil. Installing wood mulch using manual labor can be physically challenging and time intensive. These factors decrease the ability to easily disperse wood mulch over large areas and limit the amount of surface area that can be covered in a timely, cost effective manner. Walking, moving equipment, and/or vehicular traffic across areas where wood mulch is applied can damage the BMP by exposing the underlying soil to wind and water. |
| Flow Conditions | <ul style="list-style-type: none"> Wood mulch should not be used in areas containing swift-moving concentrated flows or high-volume sheet flow because it has a tendency to be washed away (wood is buoyant and may float). When necessary, it should be used with other soil stabilization and sediment control BMPs (see Section 2.3) to reduce the slope lengths and limit run-on flows to the areas where wood mulch is applied. |
| Maintenance | <ul style="list-style-type: none"> If washed down a slope by sheet flow or concentrated flow, wood mulch can clog storm drain inlets and/or storm drains. Reapplication of wood mulch may be necessary to effectively stabilize the soil throughout the season. Wood mulch may need to be removed from or integrated into the disturbed soil before the area can be permanently stabilized. |

(Source: Caltrans Guidance for Temporary Soil Stabilization, July 2003)

Concentrated Flow Conveyance Controls

- ◆ **SS-9 Earth Dikes/Drainage Swales & Lined Swales**
- ◆ **SS-10 Outlet Protection/Velocity Dissipation Devices**
- ◆ **SS-11 Slope Drains**
- ◆ **SS-12 Streambank Stabilization**
- ◆ **Some Sediment Control BMPs**

SS-9 Earth Dikes/Drainage Swales and Lined Swales

- ◆ Rip-rap lined swale is permeable
- ◆ Roughness slows flow velocities



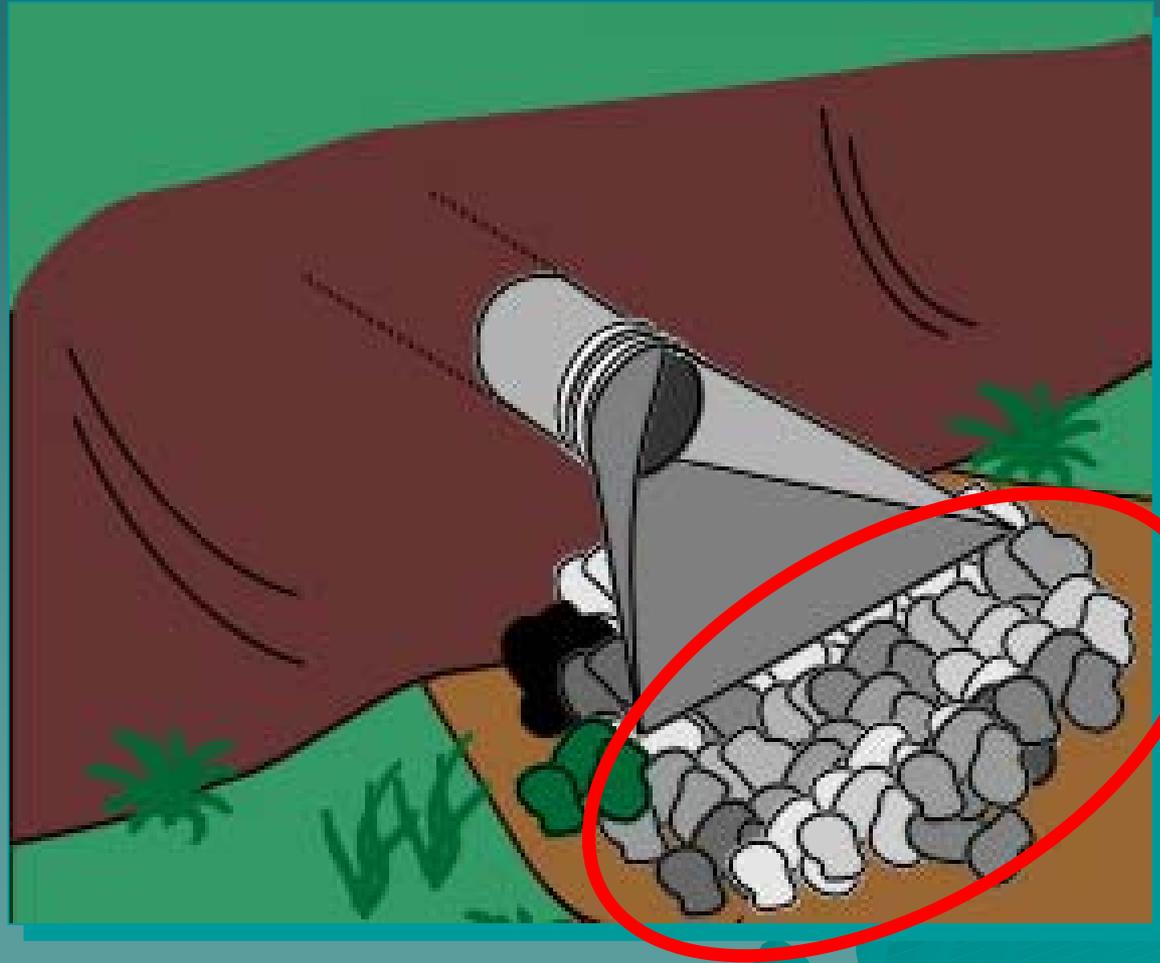
SS-9 Earth Dikes/Drainage Swales and Lined Swales

- ◆ Asphalt concrete lined ditch prevents scour.



SS-10 Outlet Protection/Velocity Dissipation Devices

- ◆ Outlet protection prevents scour and reduces velocities.



SS-10 Outlet Protection/Velocity Dissipation Devices

- ◆ Rock must be sized appropriately to withstand exit velocities.



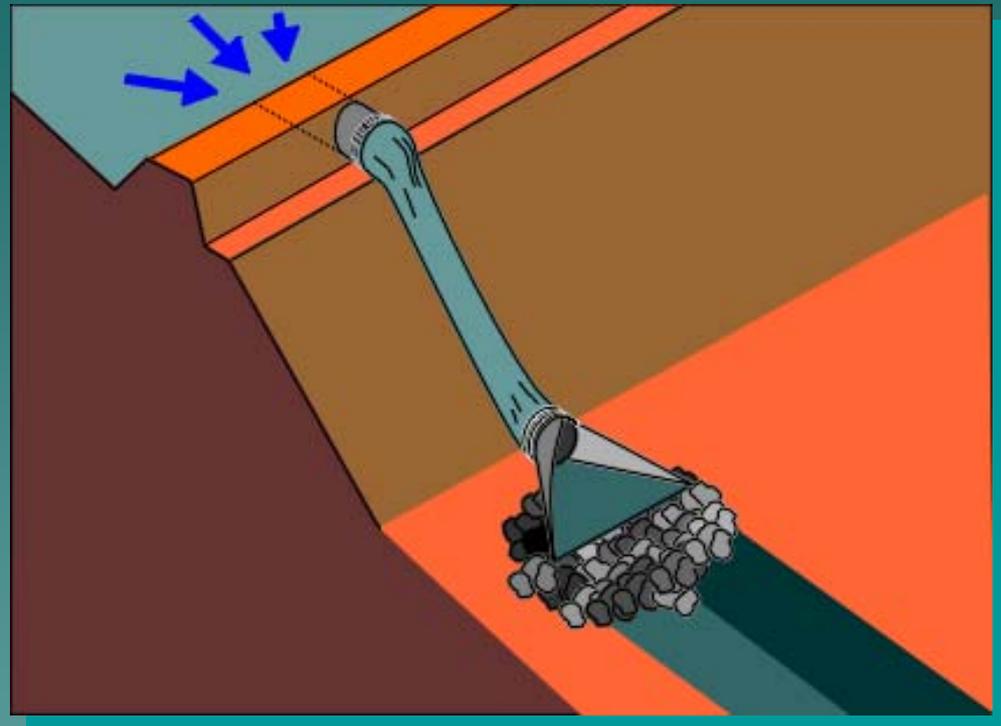
SS-10 Outlet Protection/Velocity Dissipation Devices

- ◆ Flared culvert end section combined with a rock blanket is an effective combination.



SS-11 Slope Drains

- ◆ A slope drain conveys runoff down slopes to avoid gullyng.
- ◆ Provide for outlet protection, velocity dissipation at outlet of drain.



SS-11 Slope Drains

- ◆ Slope drains should be sized to convey large, infrequent storms down or around the slope.



SS-11 Slope Drains

- ◆ Even short slopes require protection.



SS-11 Slope Drains



- ◆ Slope drains can be temporarily constructed



SS-12 Soil Stabilization Streambank Stabilization



- ◆ Specific permit requirements or mitigation measures such as Regional Water Quality Control Board (RWQCB) 401 Certification may apply
- ◆ Construction work near perennial streams should optimally be performed during the dry season
- ◆ Do not place soil stabilizers like tackifiers or hydro mulch below the mean high water level

Other Soil Stabilization Controls

- ◆ Terracing
- ◆ Stair-stepping
- ◆ Track Walking

Terracing



***Terracing
reduces the slope
length***

Terracing



Terracing



The steeper the slope, the more important the terraces

Terracing

Concrete lined ditch serves as a terrace drain.



Terracing



Here a grass-lined ditch serves as a terrace drain.

Stair-stepping



Adding stair steps to a slope can reduce erosion and enhance revegetation

Stair-stepping



***This site is in
District 11.***

Stair-stepping

Can be done on steep slopes



Stair-stepping



Track Walking



***Can be done in
different soil
types***

Track Walking

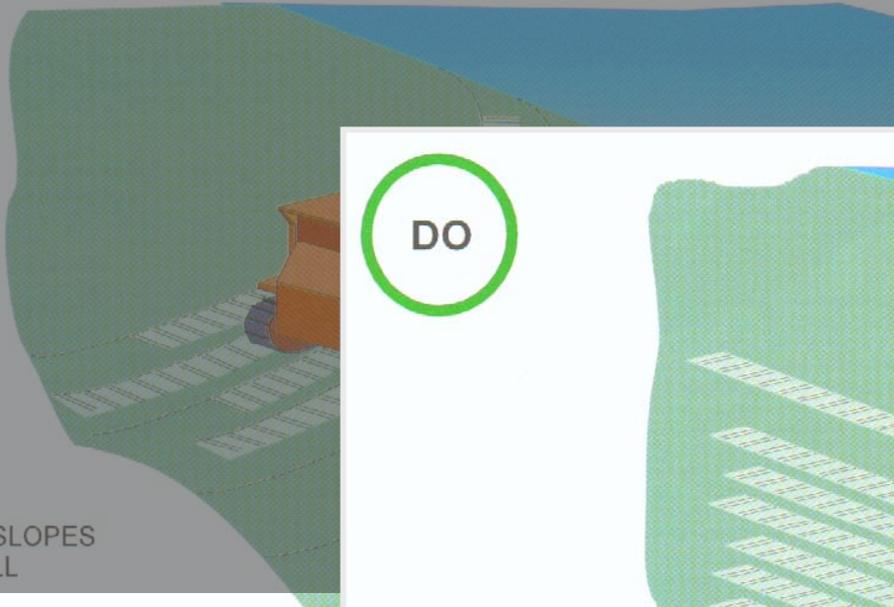
***Ranging from
clayey to sandy
soils.***



Track Walking



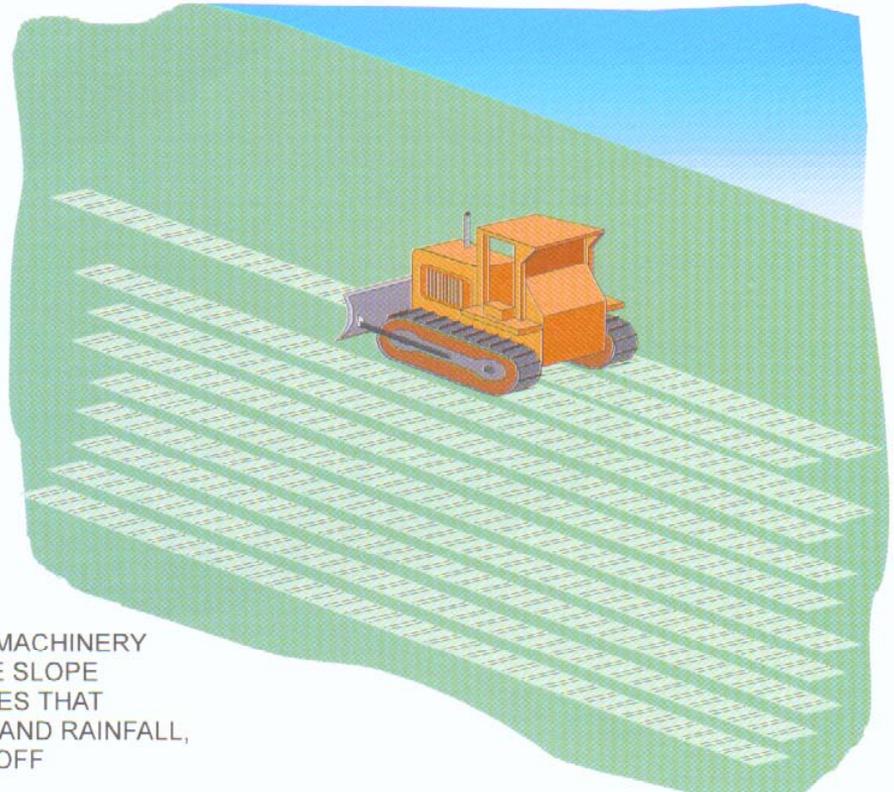
DON'T



DO NOT TRACK SLOPES
ACROSS THE HILL



DO



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