BEST MANAGEMENT PRACTICES

4

EROSION AND SEDIMENT CONTROL

IN THIS CHAPTER:

4.1 SOIL PREPARATION AND ROUGHENING

DESCRIPTION

Soil preparation and roughening involves the assessment and preparation of surface soils for BMP installation. This preparation should include soil testing and recommendations for correcting compacted soils. Roughening surface soils by mechanical methods maybe required to prepare soil for additional BMPs or break up overland flow. Soil preparation can also involve tilling topsoil to prepare a seed bed and incorporating soil amendments to enhance vegetative establishment.

APPLICABILITY

Soil preparation: Soil preparation is essential for proper vegetative establishment, and may be combined with any soil stabilization method, including rolled erosion control products or sod.

Compaction: Compaction is a result of construction activity and repairing compacted soils is essential to effective erosion control. Further correcting compacted soil supports successful final stabilization, and vegetative restoration.

Roughening: Soil roughening is generally referred to as track walking a slope, where treads from heavy equipment run parallel to the contours of the slope, creating small terraces. Roughening may be performed:

- Along any disturbed slopes;
- In combination with hydraulically applied stabilization methods, compost blankets or mulch;
- As a complementary process for controlling erosion on a site; and
- In combination with perimeter controls, additional erosion control measures, grade breaks, and vegetative establishment for maximum effectiveness.

Soil roughening was used on this construction area to prepare for vegetative establishment.

4.1 SOIL PREPARATION AND ROUGHENING

GUIDELINES

Soil Preparation: Where appropriate or feasible, soil should be scarified to eliminate crust, improve air and water infiltration, and support vegetative establishment

Compaction: Correct compacted soils according to the recommendations of the project's landscape architect, soil engineer, or landscape contractor.

Cut Slope Roughening: Stair-step grade or groove the cut slopes that are steeper than 3:1.

- Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer.

Fill Slope Roughening:

- Place on fill slopes with a gradient steeper than 3:1 in lifts not to exceed 8 inches and make sure each lift is properly compacted.
- Place and compact main body of fill in accordance with the geotechnical or soils engineer's recommendations.
- Use grooving or tracking to roughen the face of the slopes.
- Do not blade or scrape the final slope face, unless a rolled erosion control product (RECP) BMP is specified. These products should only be installed on smooth slope faces.

Roughening for Slopes to be Mowed:

- Slopes which require mowing activities should not be steeper than 3:1.
- Roughen these areas with shallow grooves by track walking, scarifying, sheepsfoot rolling, or imprinting.
- Make grooves close together (between land 10 inches), and not less than 1 inch deep, and perpendicular to the direction of runoff.

Heavy machinery was used to track walk these soils.

4.1 SOIL PREPARATION AND ROUGHENING

Roughening with Tracked Machinery:

- Limit roughening with tracked machinery to soils with a sandy textural component to avoid undue compaction of the soil surface.
- Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.

MAINTENANCE AND INSPECTION

Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.

Soil roughening can be used as a complementary process for controlling erosion.

4.2 ROLLED EROSION CONTROL PRODUCTS

DESCRIPTION

Rolled erosion control products (RECPs) are used in combination with topsoiling, soil amendments and vegetative growth to form surfaces that help to protect disturbed soil areas from the erosive forces of water, wind or the scouring forces of channelized flow. RECPs involve the placement of geotextiles, plastic covers, and erosion control blankets and mats to stabilize disturbed soil areas, and protect soil from erosion by wind or water. RECPs can be used as stand-alone soil stabilization BMPs or in conjunction with re-vegetation. They can also be used to reinforce mulch.

GUIDELINES

When choosing a product appropriate for the specific site condition consider:

- Effectiveness of reducing erosion, flow velocity and runoff;
- Compatibility with native plants, wildlife, moisture retention;
- Durability, longevity and projected maintenance; and
- Plastic products are not allowed in areas that protect wildlife such as the San Francisco Garter Snake and the California Red-legged Frog.

Jute netting was placed along these slopes to prevent erosion prior to the establishment of vegetation.

TYPE	COST/YARD2 (INSTALLED)*
Geotextiles	$9.30
Netting (Biodegradeable)	$7.23
Erosion Control Blankets	$5.16
Mats	$7.70

*These are estimates of construction cost per acre. Costs vary greatly due to size of area treated, accessibility, slope steepness, location and inflation.

Source: California Department of Transportation. 2013. Caltrans Erosion Control Tool Box. www.dot.ca.gov/hq/LandArch/ec/index.html.

4.2 ROLLED EROSION CONTROL PRODUCTS

Types of RECPs

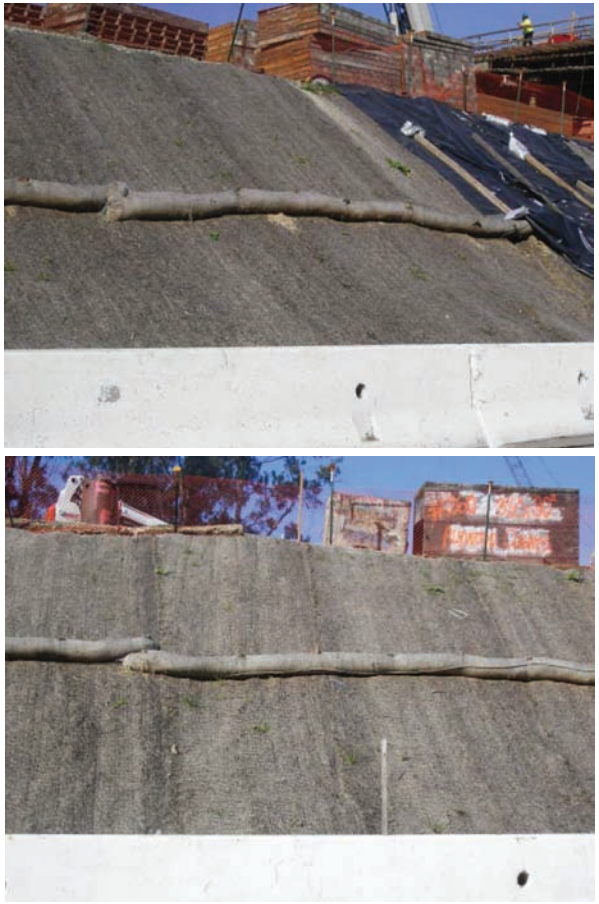
Geotextiles: Geotextiles can be used for drainage control and slope stabilization. Geotextiles are a woven non-biodegradable polypropylene fabric. Woven geotextiles are used on disturbed soil areas where durable materials are needed to endure abrasive forces through the life of a project.

Plastic Covers: Plastic covers can be used for drainage control and slope stabilization. Plastic covers are used on stockpiles of soil and/or mulch, and on very small disturbed soil areas that require immediate attention for a short period of time.

Netting: Netting can be used to secure loose mulches.

Erosion Control Blankets: Erosion control blankets can be biodegradable and/or photodegradable. Biodegradable and photodegradable blankets are composed of biodegradable fibers such as curled wood fiber, wood, jute, straw, coconut, or a combination of straw and coconut fibers.

Mats: Mats or Turf Reinforcement Mats (TRMs) act as a three-dimensional matrix that is thick and porous enough to incorporate soil. TRMs are designed to be a more of a permanent form of soil stabilization, but are also suitable for temporary stabilization and high-velocity concentrated flow situations.



Jute netting with fiber rolls are installed to stabilize this steep slope along the roadway.

4.2 ROLLED EROSION CONTROL PRODUCTS

INSTALLATION

- Remove all rocks, clods, vegetation or other obstructions and grade to allow the blanket or mat to come into consistent contact with the soil surface. Improper installation allows rain runoff to flow under the blanket.
- Ensure RECPs are adequately overlapped and securely anchored to resist the effects of wind and water.
- If the area is to be mowed at a later date, the anchoring staples or stake pins should be driven flush to the soil surface to avoid a potential hazard during the mowing.
- Install in accordance with manufacturer's instructions.

MAINTENANCE AND INSPECTION

RECPs should be inspected periodically and after rainstorms for signs of erosion or undermining. Failures should be corrected immediately. Material should be reinstalled following any tears or separations, and the slope or channel should be backfilled and stabilized.

Erosion control blankets are being used to stabilize disturbed soil area.

4.3 HYDRAULIC MULCH

DESCRIPTION

Hydraulic mulch is a mixture of wood mulch, and water (with or without combinations of stabilizing emulsion, recycled paper, and/or other organic fibers). This slurry is applied to disturbed soil areas using hydro-mulching equipment to temporarily stabilize the soil, and reduce erosion caused by wind and water. Common types of hydraulic mulches include organic fiber mulch and hydraulic matrix (this includes mulches with binders added and products that are all inclusive and cover several application specification). These products should be specified by the qualified SWPPP developer and/or landscape architect.

GUIDELINES

- Roughen the soil prior to application. Refer to Soil Roughening on pg. 36.
- To be effective, hydraulic matrices require 24 hours to dry before rainfall occurs.
- Avoid mulch over spray onto roads, sidewalks, drainage channels, existing vegetation.
- Follow project specifications for application. Rates vary depending on slope, material type soils.

All mulch products should be applied during a dry period, with a minimum of 24-hour set time from application to first rain event for all hydraulic products.

These disturbed soils were stabilized using a bonded fiber matrix.

4.3 HYDRAULIC MULCH

MAINTENANCE

Inspect BMPs prior to forecasted rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season. Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked.

A construction worker is applying a bonded fiber matrix to disturbed soil area.

4.4 STRAW MULCH

DESCRIPTION

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or anchoring it with a tackifier. Straw mulch is used as a temporary surface cover for soil stabilization on sites until soils can be prepared for re-vegetation.

GUIDELINES

- Straw should be derived from certified weed free wheat, rice or barley.
- Straw mulch should be evenly distributed on the soil surface. Manufacturer suggested application rates should be followed so that mulch covers the soil in a uniform layer without any visible bare spots.
- Straw mulch may be spread with a straw blower or by hand. Be sure that air born dust is kept to a minimum. Manual application is time and labor intensive, and tends to result in consistent thickness. California regulations require that all straw blowing equipment meet air quality standards that diminish dust issues during application.
- Typical application is 4,000 lbs per acre. If applied with seed, the seed should be applied hydraulically with a 500 lb per acre trace material (paper or combination mulch), straw applied, then a binding material at a minimum of 250 lbs per acre or as specified.

MAINTENANCE AND INSPECTION

Inspect straw mulch prior to and after rain events. Repair any damaged areas and re-mulch exposed areas of soil.

Straw mulch is applied to help vegetation establishment.

TYPE	COST/YARD2 (INSTALLED)***	SEDIMENT REDUCTION (%)
Bonded Fiber Matrix	$1.158*	90%
Straw (Hydraulically applied)	$0.52**	90%
Wood	$0.19**	45%

*Hydromulching cost varies with the type of mulch selected, the application method, water availability and area size.

**Mulch application methods (by hand or by commercial blowers) can effect costs.

***These are very rough estimates of construction cost per acre. Costs vary greatly due to size of area treated, accessibility, slope steepness, location and inflation.

Source: North Carolina State University 2008. SoilFacts: Mulch Options for Erosion Control on Construction Sites. www.soil.ncsu.edu/publications/Soilfacts/AG439-67W.pdf

California Department of Transportation. 2013. Caltrans Erosion Control Tool Box. www.dot.ca.gov/hq/LandArch/ec/index.html

4.5 WOOD MULCHING

DESCRIPTION

This BMP consists of applying a mixture of shredded wood mulch, bark, or compost to bare soil to reduce runoff, increase infiltration, and reduce erosion due to rainfall impact. Wood mulch may provide temporary or permanent ground cover for landscaping projects.

GUIDELINES

- Select wood mulch products appropriate for the application and site conditions.
- Application preparation involves removal of existing vegetation, filling and compaction of holes or voids, and scarifying the embankment. Depending upon the product, wood mulch should be placed at a depth of two to three inches.
- Inspection and maintenance involves monitoring to assure the mulch lasts an adequate time to achieve erosion control objectives. Inspect areas before and after rains events. Repair any damaged areas by adding more wood mulch.

Wood mulch is applied to landscaping to reduce erosion and to help with vegetation establishment.

4.6 HYDROSEEDING

DESCRIPTION

Hydroseeding consists of applying a mixture of fiber, seed, fertilizer, and stabilizing liquid mixture with hydro mulch equipment to protect exposed soils from erosion by water and wind.

APPLICABILITY

Hydroseeding may be performed on:

- Disturbed areas requiring temporary protection until permanent stabilization is established.
- Disturbed areas that will be re-disturbed following an extended period (6 to 12 months) of inactivity
- Cleared and graded areas exposed to seasonal rains or temporary irrigation.
- Areas not subject to heavy wear by construction equipment or high traffic.

INSTALLATION

Where appropriate, soil should be prepared (See Soil Preparation BMP on pg. 36).

- Hydraulic seed can be applied using a multiple step or one step process.
- In a multiple step process, hydraulic seed is applied first, followed by mulch or a RECP.
- In the one step process, hydraulic seed is applied with hydraulic mulch in a hydraulic matrix. When the one step process is used to apply the mixture of fiber, seed, etc., the seed rate should be increased to compensate for all seeds not having direct contact with the soil, or as specified by the landscape architect.
- All hydraulically seeded areas should have mulch, or alternate erosion control cover to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.

MAINTENANCE AND INSPECTION

Regularly inspect the area to ensure seed germination and vegetation establishment. Where seeds fail to germinate, the area must be re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates. Physical inspection should be performed following rain events to observe gully and displaced mulch.

Hydroseed was applied to the hillside to provide stabilization.

Do not apply hydroseed to areas receiving heavy vehicle traffic.

4.7 SOIL BINDERS

DESCRIPTION

Soil binders are stabilizing emulsions applied directly to the surface of disturbed soil areas or used as the stabilizer in hydraulic mulch, hydroseeding, and/or on straw mulch. Soil binders applied directly to the surface temporarily reduce erosion caused by water and wind by penetrating the top soil and binding the soil particles together.

GUIDELINES

Soil binders can be effective for periods of 3 months or longer, depending on the requirement of the specifications. Soil binders are categorized as: short-lived plant based materials, long-lived plant based materials, polymeric emulsion blends (acrylic polymers), and cementitious-based binders.

The less durable stabilizing emulsions are called tackifiers. Short lived plant based materials, highly diluted polymeric emulsions and cementitious binders are tackifiers. They are applied directly to the soil surface or are used as the stabilizing emulsion in hydraulic and straw mulches for disturbed soil areas that require short term stabilization.

The more durable stabilizing emulsions are heavy duty soil binders. Heavy duty soil binders are applied directly to the soil surface or used as the stabilizing emulsion in hydraulic and straw mulches for disturbed soil areas that require long term stabilization. Long lived plant based materials, less diluted polymeric emulsions and cementitious binders are considered heavy duty soil binders. Soil binders are also used to stabilize temporary roads during construction. Use only those binders specified in the plans, for each application.

A hydraulic mulch with binder is applied to distrubed soil areas.

4.7 SOIL BINDERS

INSTALLATION

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps should be followed:

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.
- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.

MAINTENANCE AND INSPECTION

Inspect BMPs prior to forecasted and rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season. Repair eroded areas and reapply BMP as soon as possible. Minimize damage to stabilized areas while making repairs. The binder will be reapplied as needed to maintain effectiveness.

A hydraulic mulch with binder is applied to a disturbed soil area.

4.7 SOIL BINDERS

CATEGORY	TYPE	DESCRIPTION
Plant-Based Material (Short Lived)	Guar	Biodegradable, natural galactomannan-based hydrocolloid, treated with dispersing agents for easy field mixing.
	Starch	Non-iconic, cold-water soluble (pre-gelatinized) granular corn-starch.
	Psyllium	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 Emuision	A non-iconic 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-in-soluble binding and cementing agent upon application.
Polymeric Emulsion Blends	Liquid Polymers of Methacrylates & Acrylates	A tackifier/sealer that is 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 surfactant, and/or silicates.
	Copolymers of Sodium Acrylates & Acrylamides	Non-toxic, dry powders that are comprised of copolymers of sodium acrylate and acrylamide.
	Poly-Acrylamide & Copolymers of Acrylamides	Linear copolymer polyacrylamide is packages as a dry-flowable solid.
	Hydro-Colloid Polymers	Various combinations of dry-flowable poly-acrylamides, copoly-mers, and hydrocolloid polymers
	Acrylic Copolymers & Polymers	Liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55 percent solids. The polymeric compund 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 not re-emulsify when cured.
Cementitious- Based Binders	Gypsum	A formulated gypsum-based product that readily mixes with water 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 89 percent.

4.8 SODDING

DESCRIPTION

Sodding is a permanent erosion control practice and involves laying a continuous cover of grass sod on exposed soils. Sodding can stabilize disturbed areas and reduce the velocity of stormwater runoff. This BMP can provide immediate vegetative cover for critical areas and stabilize areas that cannot be readily vegetated by seed. It also can stabilize channels or swales that convey concentrated flows, and reduce flow velocities.

Sod is installed to provide permanent vegetation and erosion control.

INSTALLATION

- In the area to be sodded, clear all trash, debris, roots, branches, stones and clods larger than 2 inches in diameter.
- If a soil test determines the need, prepare the soil, and add lime and fertilizer.
- Lay strips of sod:
  - Beginning at the lowest area to be sodded.
  - Perpendicular to the direction of water flow, and stagger it in a brick-like pattern.
- On slopes steeper than 30%, staple the corners and middle of each strip firmly. Place jute or plastic netting over the sod to protect against washout during establishment.
- Roll the sodded area and irrigate.
- Ensure that sod is harvested, delivered, and installed within a period of 36 hours. If it is not transplanted within this period, inspect and approve the sod before its installation.

MAINTENANCE AND INSPECTION

When mowing, do not remove more than one-third of the shoot. Maintain a grass height between 2 and 3 inches. After the first growing season, determine if additional fertilization or liming is needed. Permanent, fine turf areas require yearly maintenance fertilization. If the grass is unhealthy, the cause shall be determined and appropriate action taken to re-establish a healthy ground cover.

4.9 DIVERSION STRUCTURES

DESCRIPTION

Diversion structures are structures that intercept, divert, and convey surface runoff around or through the project site in a non-erosive manner.

GUIDELINES

Dikes and drainage swales are suitable for use, individually or together. When properly placed and maintained, dikes used as temporary diversions can control the velocity and direction of stormwater runoff. Used by themselves, they do not have any sediment removal capability. They must be used with an appropriate sediment-trapping device at the outfall of the diversion channel. It may be necessary to use other erosion and sediment control measures such as check dams, plastic sheeting or blankets to prevent scour and erosion in these swales, dikes and ditches. In some cases, the swale may need to be constructed of concrete or rock. Diversion structures may be used:

- To convey surface runoff down sloping land;
- Along paved surfaces to intercept runoff;
- Along the top of slopes to divert surface flow from slopes;
- To divert and direct runoff towards stabilized drainage systems; and
- Below steep grades where runoff begins to concentrate.

INSTALLATION

- A combination dike and swale is easily constructed by a single pass of a bulldozer or grader, and compacted by a second pass of the tracks or wheels over the ridge.
- Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.
- Temporary diversion dikes should not adversely impact adjacent properties, and should not be used in areas with slopes steeper than 10%.
- Provide stabilized outlets.
- Divert sediment laden runoff into sediment traps.

MAINTENANCE AND INSPECTION

Check channels, embankments and ditch beds for erosion, washout and accumulation of sediment and debris. Remove sediment accumulation and debris, and repair or replace lost riprap, linings or soil stabilization, as needed.

A temporary diversion structure was built upstream from a steep slope. It prevents runoff from flowing down the slope and causing hillside erosion.

4.10 SLOPE DRAINS

DESCRIPTION

Slope drains convey water down a slope into a stabilized water trapping device or area. Slope drains are used with lined ditches atop a fill bank to convey surface flow away from incline areas and to protect exposed slopes.

GUIDELINES

- Install slope drains perpendicular to the slope contour.
- Drain pipes must be securely anchored to the slope, and must be adequately sized to carry the capacity of the design storm and associated forces.
- Compact the soil around and under the slope drain inlet, outlet, and along the length of the pipe. Protect the pipe inlet with filter fabric. Use flared end sections for inlets and discharges for pipes 12 inches in diameter and larger.
- Protect the discharge outlet with riprap or other velocity dissipation devices. For high velocity discharge, integrate concrete into the riprap.

MAINTENANCE AND INSPECTION

Inspect prior to and after each rain event and twice monthly until the upstream drainage area is stabilized. Inspect outlets for erosion and downstream scour. In the event of scour, reduce the flows into the channel unless other preventative measures can be implemented.

Clean runoff is directed to the storm system through a slope drain. This prevents the runoff from flowing down the steep slope.

4.11 CHECK DAMS

DESCRIPTION

Check dams are small structures placed across a natural or man-made drainage channel to reduce scour and erosion by reducing flow velocity and encouraging sediment deposition. They are typically constructed of gravel rock bags, rip rap or fencing depending on site conditions and material availability.

GUIDELINES

Check dams are generally used in:

- Small open channels;
- Steep channels where runoff velocities exceed five feet per second;
- Ditches or channels where grass linings are being established; or
- Temporary ditches where short term service does not warrant establishment of erosion resistant linings.

INSTALLATION

- Install check dams approximately 20 feet from the intake structure and at regular intervals along the channel. Space dams closer together where there is a high potential of erosion (steep grades and/or high flows).
- Embed structure sufficiently in sides and bottom of channel to prevent undercutting.
- The dams should be placed at a height and distance allowing small pools to form behind them but also allowing high velocity runoff (typically a two year storm or larger) to safely flow over them without an increase in upstream flooding or damage to the dam.
- Stabilize channel immediately downstream of check dams to prevent erosion at the toe of the structure.
- If using a prefabricated check dam, follow manufacturer's recommendations and installation instructions.

MAINTENANCE AND INSPECTION

Perform maintenance as required. Inspect following rainfall events and at least daily during prolonged rainfall. Maintain to provide an adequate sediment holding capacity. Remove debris daily and remove sediment when it accumulates to 1/3 of the dam height.

Plastic check dams are used to reduce runoff velocity and to control erosion and sediment displacement.

Gravel bags are used to form a check dam along the roadway.

4.12 INLET AND CATCH BASIN PROTECTION

DESCRIPTION

Drain inlet and catch basin protection reduces sediment entering the storm drain system carried by runoff from a construction site. Effective storm drain protection allows sediment to settle out of water or filters sediment from the water before it enters the drain inlet. All inlets and basins that are connected to the storm drain system must be protected. Inlet protection is the last line of defense for water quality prior to water entering the drainage system.

There are several types of inlet and catch basin protection measures:

Excavation around the perimeter of the inlet/basin

Excavating an area around an inlet creates a settling pool that removes sediments as water is released slowly into the inlet through small holes protected by gravel and filter fabric.

Reusable barriers around drain entrances

Erecting a barrier made of plastic filtration fencing around an inlet creates a shield against sediment while allowing water to flow into the drain. This barrier slows runoff while catching soil and other debris at the drain inlet.

GUIDELINES

Excavation around the perimeter of the drop inlet

Install these controls before any soil disturbance in the drainage area. Excavate around drop inlets at least 1 foot deep (2 feet maximum). Side slopes at the edge of the excavation should be no steeper than 2:1. Design the shape of the excavated area such that the dimensions fit the area from which stormwater is expected to drain. Drill or cast one 1 inch diameter hole for each 12 inch of wall length in each side of the inlet at approximately 3 inch above bottom of the excavation. Cover each hole with filter fabric and protect with a minimum of 1 cubic foot of 1/2 – 3/4 inch of clean gravel.

Reusable barriers around inlet entrances

Stake the plastic filtration fencing close to the inlet to prevent overflow onto unprotected soils. Stakes should be at least 1.5 feet long for fences that are at least 10 inches tall. Follow manufacturers' guidelines for specific installation instructions.

MAINTENANCE AND INSPECTION

Check all temporary control measures before and after each storm event. During extended storm events, inspect at least once every 24 hours.

- Remove accumulated sediment from the area around the drop inlet and catch basin when the capacity is reduced by half.
- Remove additional debris from the shallow pools periodically. The weep holes in excavated areas around inlets can become clogged, preventing water from draining out of the pools.
- Clear sediment build around barrier.


Unprotected inlets


Unprotected inlets


Unprotected inlets


Properly protected inlets


Properly protected inlets


Properly protected inlets

4.13 FIBER ROLLS

DESCRIPTION

A fiber roll consists of straw, flax or synthetic fiber that is rolled and bound into a tubular cylinder, and staked or otherwise attached to the ground to prevent movement. These rolls intercept runoff and reduce the flow allowing sediment to settle out. Fiber rolls can also reduce erosion by interrupting the length of a slope. They are not appropriate for use on paved surfaces.

APPLICABILITY

Fiber rolls can be used**:**

- Around temporary stockpiles;
- As perimeter control;
- At the top of slopes to intercept sheet flow from flatter areas;
- At the bottom of the slopes;
- Parallel to the contours of the slope;
- To shorten slope length of exposed and erodible slopes along face or at-grade breaks; and
- Perpendicular to the flow lines in ditches and swales.

GUIDELINES

If more than one fiber roll is placed in a row, the rolls should be overlapped by at least one foot. The diameter of the stake should be approximately 1" for ease of driving through the roll. Refer to manufacturers' installation instructions for proper installation.

Sloped Ground: On slopes, install fiber rolls along the contour with a slight downward angle at the end of each row to prevent ponding at the midsection.

Turn the ends of each fiber roll upslope to prevent runoff from flowing around the roll.

Install the rolls in shallow trenches (width equal to diameter of roll) 3 to 5 inches deep for soft, loamy soils and 2 to 3 inches deep for hard, rocky soils.

Rolls must be staked down at an interval of every four feet to be effective. Biodegradable wood stakes or willow cuttings are recommended. Drive the stakes through the middle of the roll and deep enough into the ground to anchor it in place. About 3 to 5 inches of the stake should stick out above the roll. A 24-inch stake is recommended for use on soft, loamy soils. An 18-inch stake is recommended for use on hard, rocky soils.

The table contains recommended spacing between fiber rolls:

PERCENT SLOPE	MAX SPACING BETWEEN ROLLS (CLOSER IS MORE EFFECTIVE)
0-25%	20 feet
25 - 50%	15 feet

Fiber rolls are installed along a hillside to reduce erosion.

Plastic mesh fencing is installed parallel to the contours along the slope.

4.13 FIBER ROLLS

Level Ground: Typically, the rolls are installed along sidewalks, on the bare lot side, to keep sediment from washing onto sidewalks and streets and into gutters and storm drains. For installations along sidewalks and behind street curbs, it might not be necessary to stake the fiber rolls, but trenches must still be dug. Fiber rolls placed around storm drains and inlets must be staked into the ground.

MAINTENANCE AND INSPECTION

The maintenance requirements of fiber rolls are minimal, but regular inspection is recommended to ensure that the rolls remain firmly anchored in place and are not excessively crushed or damaged by equipment traffic.

- Inspect fiber rolls before and after rain events, and at least daily during prolonged rainfall.
- Repair or replace split, torn, unraveled, or slumping fiber rolls. Fiber rolls are typically left in place on slopes after construction is complete as part of site stabilization. If they are removed, collect and dispose of the accumulated sediment.
- After removal, fill and compact holes, trenches, depressions or any other ground disturbance to blend with the surrounding landscape.

LIMITATIONS

- Difficult to move once saturated. Some saturated fiber rolls may require a crane or other machinery to remove from site.
- If not properly staked and trenched in, fiber rolls could be displaced by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide. Use RECP with stronger soil stabilizing properties.

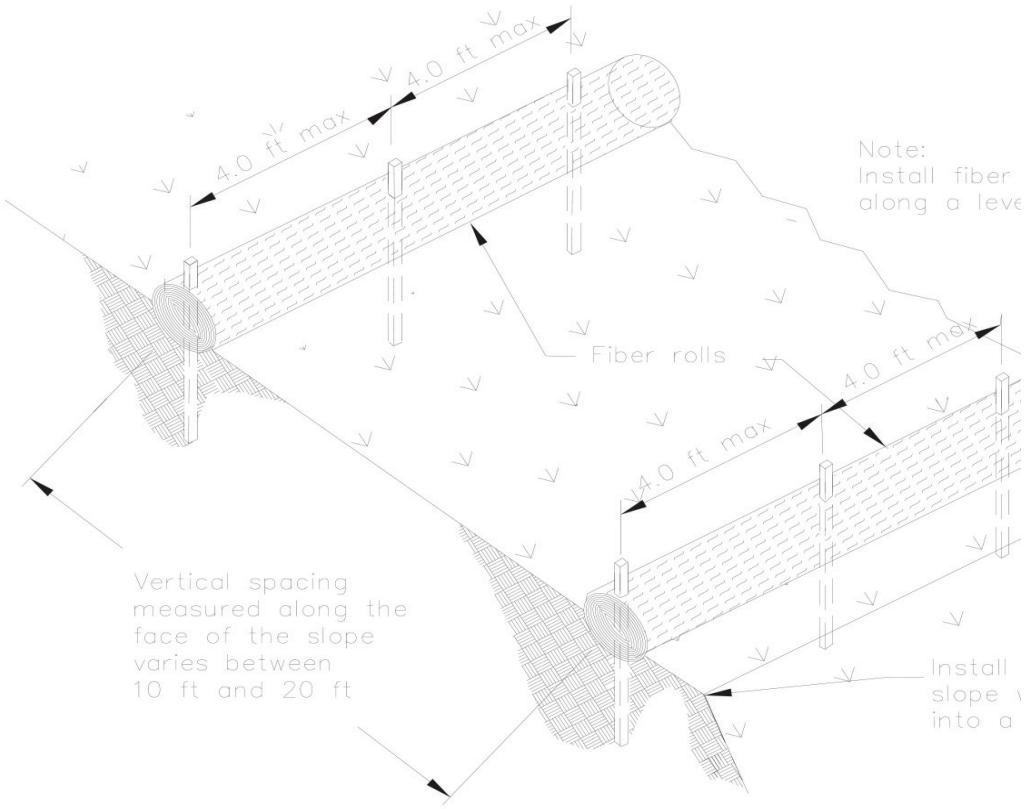
ALTERNATIVES

Polyethylene sediment-filtration fencing can be used as a substitute for the traditional fiber roll. This reusable and recyclable product is used for slope protection and stabilization. It slows the velocity and spreads the flow of runoff. The filter removes pollutants and sediment from the runoff. These products are easy to install, highly resistant to vehicle and foot traffic, and are lightweight.

Fiber rolls are properly installed around a stockpile.

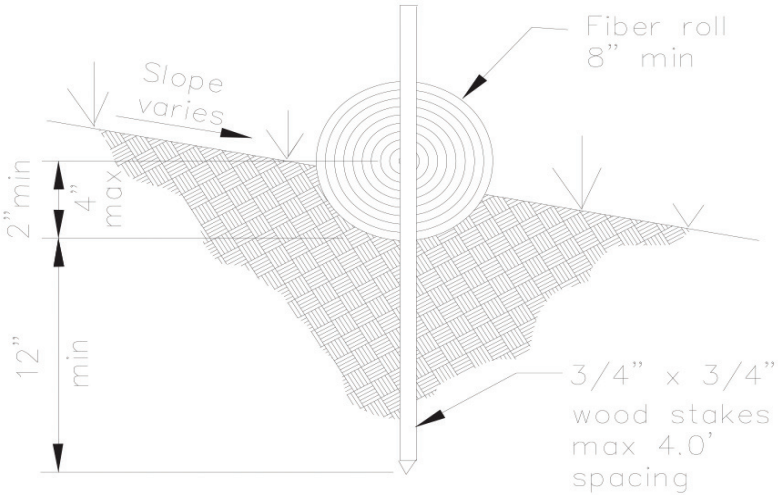
Remove or by pass all obstructions prior to placing fiber roll. Do not install the roll over the obstruction.

4.13 FIBER ROLLS



TYPICAL FIBER ROLL INSTALLATION

N.T.S.



ENTRENCHMENT DETAIL

N.T.S.

4.14 SILT FENCE

DESCRIPTION

A silt fence is a temporary linear barrier that captures sediment by retaining runoff, allowing the sediment to settle out. The fences are typically made of a non-woven geotextile, and come in standard or heavy-duty strength.

APPLICABILITY

Silt fences can be used:

- Along the contour of a slope;
- Below the toe or down slope of exposed or erodible slopes;
- Below other cleared areas; and
- In areas where sheet flow occurs.

GUIDELINES

The fence should be installed on a level contour. The ends of the fence should be angled up stream to prevent sedimentary laden water from running around the ends.

- Excavate a 6 inch wide by 6 inch deep trench along the line of the fence. Backfill the trench with native material.
- The bottom 12 inches of fence should be securely placed into the ground.
- Stake posts a maximum of 6 feet apart, and securely place posts into the ground a minimum of 18 inches.
- Where additional structural support is needed, fasten a plastic or wire mesh support fence to standard strength silt fence.

This silt fence is not properly installed and sized causing failure.

Silt fence is attached to construction fencing to prevent sediment from leaving the site.

4.14 SILT FENCE

MAINTENANCE AND INSPECTION

Silt fences can be maintenance intensive. Perform inspections before and after every rain event, and every 24 hours during extended rain events. Also, weekly inspections throughout the rainy season are recommended. Remove sediment deposits when they reach 1/3 of the fabric height. All torn or decomposed fencing should be replaced. Do not allow water or sediment depth to exceed 1.5 feet at any point. The fence should remain in place until the disturbed area is permanently stabilized.

ALTERNATIVES

Temporary high density polyethylene sediment-filtration fencing can be used as a substitute for the traditional silt fence. This reusable product which is made from recycled materials, is used for slope and perimeter protection. It slows the velocity and spreads the flow of runoff while handling larger floods and pressures. The filter removes pollutants and sediment from the runoff. These products are easy to install, durable, and are lightweight.

Extend the silt fence to the top of the perimeter fencing. This provides wind control and site security.

Silt fence is properly installed along the slope to intercept sheet flow.

4.15 GRAVEL BERM

DESCRIPTION

A gravel berm consists of a row of gravel bags installed end to end to form a barrier across a slope to intercept runoff, reduce runoff velocity and release runoff as sheet flow after providing some sediment removal.

APPLICABILITY

Berms are used as linear sediment control measures. Suitable locations include:

- At the top, toe, face and grade break of slopes;
- Along a roadway to keep sediment off paved areas;
- At the perimeter of sites; and
- As sediment traps at drainage outlets.

INSTALLATION

A gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. This provides a stagnant area for sediment to settle. The gravel is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flow.

- Locate gravel bag berms on level contours
- Locate bags at the following intervals when placed along slopes:
  - 4:1 or flatter slope: place bags at 20 ft intervals
  - 4:1 to 2:1 slope: place bags at 15 ft intervals
  - 2:1 or greater: place bags at maximum of 10 ft intervals

Inspect and maintain all BMP's to ensure that they perform well, and do not fail like this gravel bag berm.

A gravel berm acts a sediment trap near a catch basin.

4.15 GRAVEL BERM

MAINTENANCE AND INSPECTION

This BMP is labor and maintenance intensive. Inspect gravel bags before and after rain events, and weekly during the rainy season. Repair and replace broken or ripped bags, and remove accumulated sediment when it reaches 1/3 the height of the bag.

A gravel berm is being used to slow the runoff and filter out sediment.

4.16 SEDIMENT TRAP

DESCRIPTION

This is a temporary settling area formed by shallow excavation, perimeter construction of an earthen embankment or an embankment constructed across a waterway or low drainage area. It includes a controlled release structure like a sump pump or overflow structure.

The sediment trap is used as a pretreatment measure for entry of the runoff into the storm drain system or natural waterway. This BMP allows sediment to settle out of runoff prior to the discharge of the water into the local storm drainage system or natural waterway.

GUIDELINES

The trap should be excavated where breech of the perimeter would not pose a risk to life or property. Access should be provided for maintenance including sediment removal.

The length of the trap should be more than three times the width. Traps with levees greater than five feet in height should be designed by a professional civil engineer. The trap inlet should be located as far as possible from the outlet structure in order to allow maximum sediment settlement. Traps may require protective fencing to ensure safety.

MAINTENANCE AND INSPECTION

Traps should be inspected before and after every rain event, weekly during the rainy season, and at 24-hour intervals during extended storms. Check inlet and outlet structures and spillways for signs of erosion, damage or obstructions. Examine trap banks for seepage and structural soundness. Remove accumulated sediment when the storage trap is 1/3 full.

To assist with vector control, vegetation should be removed from the basin frequently.

Sediment is allowed to settle out of the runoff. The overflow structure discharges the clean water to the storm system.

4.17 ACTIVE TREATMENT SYSTEMS (ATS)

DESCRIPTION

An active treatment system is required when traditional erosion and sediment applications are not effective and when zero discharge is a condition of construction for a project. One key distinction between this BMP and others, is that it is “Active” (requires power source).

These systems require detailed analysis of site conditions and the hydrology associated with the site’s stormwater management. The system is designed by the project engineer, and managed and maintained by certified ATS personnel.

The primary treatment process with an ATS is the employment of chemical coagulation, chemical flocculation, or electrocoagulation in order to reduce turbidity caused by suspended sediments. Any chemical materials specified in the ATS must be approved by the California State Water Resources Control Board (SWRCB). These systems usually require review and approval by the Regional Water Quality Control Board (Region 2).

APPLICABILITY

Use this BMP, per the design criteria and requirements described in the SWRCB Construction General Permit (CGP) when:

- Discharging to turbidity sensitive waters, and turbidity reduction by other BMPs are insufficient
- Where site constraints limit the ability to construct a properly sized sediment trap; or
- Where use is required by the CGP.

GUIDELINES

Chemically treated stormwater discharged from construction sites should:

- Be designed and approved by a Certified Professional In Erosion and Sediment Control (CPESC), a Certified Professional in Stormwater Quality (CPSWQ), or a California registered civil engineer.
- Meet residual chemical and toxicity requirements as defined in the CGP.
- Include a filtration step between the coagulant treatment train and the effluent discharge.
- Be done in accordance with all local, state, and federal laws and regulations.
- Should be equipped with instrumentation that automatically measures and records effluent water quality data and flow rate.
- Comply with all provisions and prohibitions in the CGP.

Active treatment system being used at a sewer replacement project in downtown San Francisco

Active treatment system being used at a sewer replacement project in downtown San Francisco

4.17 ACTIVE TREATMENT SYSTEMS (ATS)

- The project shall have a site-specific Operation and Maintenance (O&M) manual covering the procedures required to install, operate and maintain the ATS.
- Operators shall have training specific to using an ATS and liquid coagulants for storm water discharges.
- Any discharger who deploys an ATS on their site shall conduct the daily visual monitoring and record findings in the project data log.

MAINTENANCE AND INSPECTION

Daily on-site visual monitoring of the ATS operation and performance shall be done by a qualified person as required. The name and phone number of the qualified person assigned the responsibility of operation and monitoring of the system, and documentation of the qualified person's training as required by the statewide General Construction Stormwater Permit will need to be provided on site.

ATS require continuous monitoring when operating. Special attention needs to be given to ATS whenever they are being started up for the first time, restarted after an extended down time, and after maintenance or repair work has been done on the system.