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| <b>SECTION 10.0</b><br><b>BEST MANAGEMENT PRACTICES</b> |
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| <b>BMP 10.1</b><br><b>ASPHALT BERM</b> |
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**DESCRIPTION**

An asphalt berm is a ridge of asphalt concrete or “cutback” constructed at the top of a disturbed slope. The purpose of the BMP is direct stormwater runoff away from an unstable slope.

**APPLICATIONS**

This BMP may be used wherever stormwater runoff must be diverted away from a disturbed slope and toward a sediment containment facility or stable runoff.

**LIMITATIONS**

This BMP should not be used:

- ✓ to concentrate runoff onto unstable, eroded areas.

**CONSTRUCTION GUIDELINES**

- ✓ Construct asphalt berm to the minimum height and width needed to divert runoff without adding unnecessary weight.
- ✓ Asphalt berms may be striped or marked for traffic safety.
- ✓ Asphalt berms may be used to anchor temporary plastic sheeting.

**BMP MAINTENANCE**

- ✓ Periodic inspection should be conducted, and berms repaired as necessary.

**BMP REMOVAL**

- ✓ Asphalt berm removal may not be necessary, or may be conducted during permanent slope or streambank repair activities.
- ✓ Recycle or reuse asphalt berm material if applicable.
- ✓ Dispose of plastic sheeting if applicable.

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| <b>BMP 10.2</b><br><b>BRUSHLAYERING</b> |
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## **DESCRIPTION**

Brushlayering is a technique used in stabilizing shallow slope failures or rebuilding slopes which incorporates willows and other types of branches with soil backfill. Live brush layers act as horizontal drains, improve slope stability by providing tensile strength and natural revegetation. Brushlayering may include the use of geogrids or fabric soil wraps and rip rap or other structural toe support.

## **APPLICATIONS**

Brushlayering involves relatively simple construction. Among the ground stabilizing techniques, the brushlayer has an immediate impact, its protective and stabilizing effect extending into lower soil horizons. At extreme sites where erosion, deposition, and rockfall are particular hazards, brush layers and the pioneer vegetation that develops with them are gradually eliminating these problems. Fast establishment of a stable soil-root complex is possible. Relatively short and spreading branches of the scrub willows growing in mountainous regions can be used. Simultaneous brushlayering construction during fill operations is possible. It is one of the best techniques for revegetating and stabilizing streambanks and slopes. Living and non-living brush layers along streambanks also provide valuable fish habitat.

## **LIMITATIONS**

- ✓ Not suitable for the stabilization of deep, organic topsoil layers.
- ✓ Live materials should be harvested and constructed during the dormancy stage of plant growth.
- ✓ Permits may be required for installation along streambanks.

## **CONSTRUCTION GUIDELINES**

Choose a technique such as key trenching, rock toe, retaining wall, root wads, live siltation, coir logs, or buried toe rock to secure the toe of the slope. Begin layering at the bottom of the slope. Along a stream, the first brush layer typically occurs at the mean high water (MHW) level, often identified by the line of growing vegetation. A brush layer may be installed below MHW to create fish habitat and temporary plant cover.

Excavate a bench 2 to 3 feet deep so that it angles slightly down and into the slope. Twenty to 25 branches are placed on the bench, slightly criss-crossed. The basal ends are placed into the slope with the tips extending beyond the edge of the bench no more than  $\frac{1}{4}$  the total branch length. Place 2 to 4 inches of soil on top of the branches and tamp into place.

## BMP: BRUSHLAYERING (continued)

Repeat the branch, topsoil, layering sequence until the desired bank height is achieved. Fill slopes can be created at the same time a brush layer is installed.

On a cut slope and existing streambanks, each layer is excavated at the time the brush layer is installed.

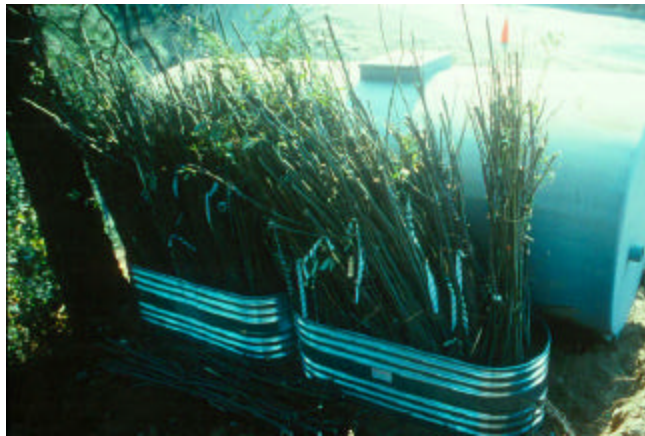
### BMP MAINTENANCE

- ✓ No maintenance of brushlayers should be required if materials are placed at appropriate depths.
- ✓ Fill slopes should be periodically inspected and any failures corrected immediately.

### MATERIALS

Materials include branches and cuttings of deciduous woody plants capable of producing adventitious roots, most appropriately willow. Live brushlayer materials can be stored in containers under shade until installation. For best results, soak willow for at least 24 hours, or up to 30 days. Willows may be bundled and soaked in a stream near the project site.

Soaking willow cuttings.



### BMP REMOVAL

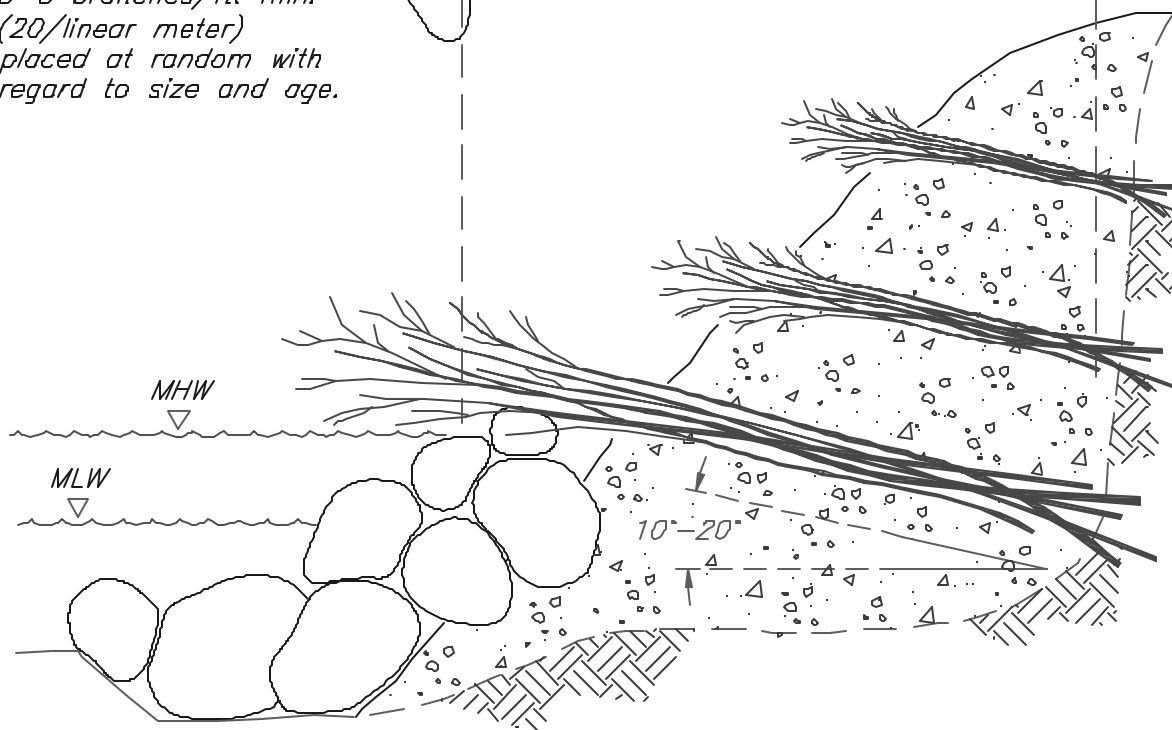
- ✓ Not required.

FRONT OF SLOPE

BACK OF  
TERRACE

*Crisscross branches  
5–8 branches/ft. min.  
(20/linear meter)  
placed at random with  
regard to size and age.*

### PLAN VIEW



#### NOTES:

1. Tilt branches down into the slope 10°–20° min.
2. Brushlayering may be constructed with non-compacted or compacted backfill without damage to the brush layer.
3. Branches irrespective of length, should protrude 8–18in. (0.20–0.50 meters) beyond the face of the slope.

## BRUSHLAYERING WITH ROCK TOE PROTECTION

## **BMP 10.3**

### **BRUSH PACKING**

#### **DESCRIPTION**

Brush packing is a biotechnical gully and slump repair technique. Cuttings or branches of rootable plant species are layered between successive lifts of soil fill to repair large rills, gullies, and small slumps on slopes.

#### **APPLICATIONS**

Since brush packing involves refilling the gully with soil between successive layers of branches, this practice is not recommended for gully repair in drainages or ephemeral stream channels. The slope and gully must have soil material available with which to fill the slumps and gullies. Brush packing should be used in conjunction with slope scaling or slope grading activities where rills, gullies, and other channelizations are removed by re-grading.

Brush packing utilizes alternating layers of live branch cuttings and soil to repair large rills, gullies, and slumps. Similar to brush layering, the brush packing technique is more appropriate for the repair of gullies on slopes, and it can be implemented with hand labor.

#### **LIMITATIONS**

- ✓ Not suitable for the stabilization of deep, organic topsoil layers.
- ✓ Live materials should be harvested and constructed during the dormancy stage of plant growth.
- ✓ Permits may be required for installation along streambanks.
- ✓ Usually requires manual labor to fill and regrade slope.

#### **CONSTRUCTION GUIDELINES**

It is imperative to treat any source of concentrated flows or other causes of gulling before performing brush packing treatments. Cut branches to a length which corresponds to the depth of the gully. Branches should extend the entire depth of the rill or gully, with tips protruding from the slope face when grading is complete. Branch cuttings shall be a mixture of younger wood and older wood, from 6-50 mm (¼-2 inches) diameter.

Fill the bottom of the rill, gully, or slump with soil, approximately 12 inches, and shape and compact the soil terrace such that it dips into the slope. Place branch cuttings, 3-8 inches thick, in a crisscross or overlapping configuration. The growing tips shall protrude 6-12 inches from the slope face, with the basal ends dipping back into the slope. It is important that the basal ends of the branches are lower than the branch tips. Live stakes may be driven through the soil-branch layers for extra stabilization.

## BMP: BRUSH PACKING (continued)

Continue re-grading the slope and cover the brush layer with a 150-300 mm (6-12 inch) layer of soil. Compact to ensure good soil contact with the branch cuttings. Then continue brush packing and soil layering until the gully is filled and the slope is re-graded. The final installation should match the existing slope with the in-field section slightly higher to ensure that runoff collection and channelization does not occur.

Seed and mulch the slope. Shallow slopes, generally 3:1 or flatter, may be seeded and mulched by hand. Steeper slopes should have seed applied hydraulically and the mulch shall be anchored with tackifier or other approved methods.

## BMP MAINTENANCE

- ✓ Regular inspection and maintenance should be conducted, particularly during the first year.
- ✓ Failures of fill or drainage structures should be corrected immediately.

## MATERIALS

Live materials needed include branches and cuttings of deciduous woody plants capable of producing adventitious roots, most appropriately willow. Straw or other mulch can be mixed with soil to help fill in the gully.

Coir netting or erosion control blanket material can be wrapped around the soil layers to protect the slope face (see Brush Layering with Soil Wrap).

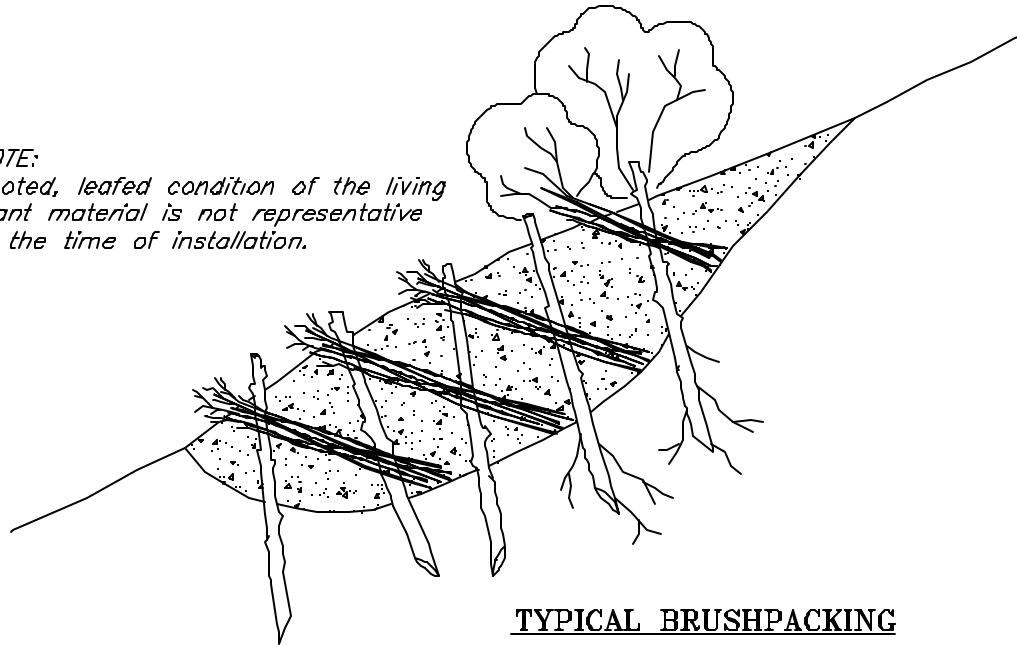
Polypropylene geogrids can be incorporated into the soil layers if additional strength and durability are desired.

## BMP REMOVAL

- ✓ Not required

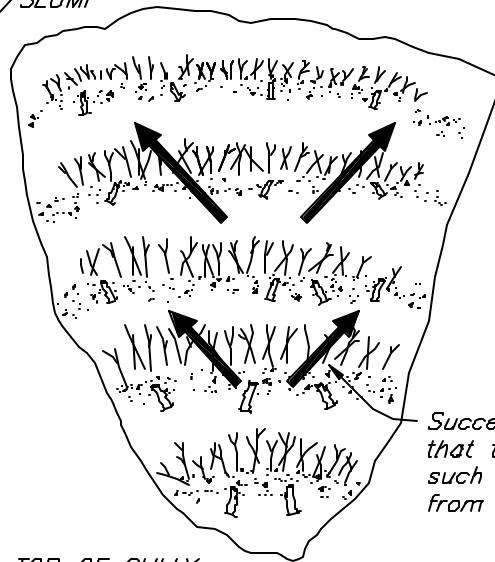
**NOTE:**

*Rooted, leafed condition of the living plant material is not representative of the time of installation.*



**TYPICAL BRUSHPACKING**

*BOTTOM OF GULLY/SLUMP*



*Successful brushpacking requires that the gully be filled convex such that runoff drains away from the center.*

*TOP OF GULLY*

**PLAN VIEW**



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| <b>BMP 10.4</b><br><b>CLEAN WATER BYPASS</b> |
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**DESCRIPTION**

A clean water bypass enables operators or maintenance workers to transport surface or subsurface flows around a construction area without adding significant amounts of turbidity or sediment. Clean water bypasses are typically used for short term diversion of small amounts of water over short distances to enable dewatering of minor construction or repair sites.

**APPLICATIONS**

Clean water bypasses may be used to divert low flow volumes away from culvert replacements, headwall repairs, bank stabilization projects, or other works that are not expected to last more than 48 hours. Clean water bypasses may not be used in active streams or tributaries inhabited by anadromous fishes (i.e. Gazos, Pescadero, Butano, Alpine, etc.).

**LIMITATIONS**

This BMP should not be used:

- ✓ Should not be used if there is insufficient streamflow to support aquatic species.
- ✓ Should not be used in deep water unless designed or reviewed by an engineer.
- ✓ Should not be used to completely dam streamflows.

**BMP MAINTENANCE**

- ✓ During construction, inspect daily during the work week.
- ✓ Schedule additional inspections during storm events.
- ✓ Immediately repair any gaps, holes or scour.

**BMP REMOVAL**

- ✓ Remove sediment buildup.
- ✓ Remove BMP. Recycle or re-use if applicable.
- ✓ Revegetate areas disturbed by BMP removal if applicable.

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| <b>BMP 10.5</b><br><b>COFFERDAM</b> |
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## **DESCRIPTION**

A cofferdam is a temporary structure built into a waterway to enclose a construction area and reduce sediment pollution from construction work in or adjacent to water. Cofferdams may be made of rock, sand bags, wood or aqua barriers.

## **APPLICATIONS**

This BMP may be used in construction activities such as streambank stabilization, culvert installation, bridges, piers or abutments. It may be used in combination with other methods such as clean water bypasses and/or pumps.

## **LIMITATIONS**

This BMP should not be used:

- ✓ Should not be used if there is insufficient streamflow to support aquatic species.
- ✓ Should not be used in deep water unless designed or reviewed by an engineer.
- ✓ Should not be used to completely dam streamflows.

## **CONSTRUCTION GUIDELINES**

When used in watercourses or streams, cofferdams must be used in accordance with Army Corps of Engineers guidelines. Materials for cofferdams should be selected based on ease of maintenance and complete removal following construction activities.

## **BMP MAINTENANCE**

- ✓ During construction, inspect daily during the work week.
- ✓ Schedule additional inspections during storm events.
- ✓ Immediately repair any gaps, holes or scour.

## **BMP REMOVAL**

- ✓ Remove sediment buildup.
- ✓ Remove BMP. Recycle or re-use if applicable.
- ✓ Revegetate areas disturbed by BMP removal if applicable.

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| <b>BMP 10.6</b><br><b>COIR FABRIC/NETTING</b> |
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## **DESCRIPTION**

Coir fabric/netting is a geo-textile product made from coconut fibers loosely woven into a fabric usually packaged in roll form. This fabric can be used to provide a reduction in water velocity/erosive forces and/or habitat protection and topsoil stabilization.

## **APPLICATIONS**

This BMP may be used in areas to provide stabilization/protection to the soil surface of steep slopes or stream banks. It can be used in combination with vegetation and/or seeding to reinforce soil in high flow/high velocity waters and on slopes as steep as 1:1. It may be used as bank stabilization before vegetation efforts have occurred.

Coir fabric or netting is preferred to jute. Jute fabrics are often treated with preservatives that will discourage the growth of vegetation. Jute will also degrade much more quickly than coir.

## **LIMITATIONS**

This BMP should not be used:

- ✓ In the streambed.
- ✓ When short-term biodegradability is desired.

## **CONSTRUCTION GUIDELINES**

- ✓ When used near watercourses or streams, coir fabrics/nettings must be used in accordance with permit requirements.
- ✓ Fabric may be laid out horizontally or vertically on slope.
- ✓ Stakes or staples must be used to anchor fabric to ground.
- ✓ Lay loosely on the surface so fabric makes contact with the ground (do not stretch for extra coverage).
- ✓ Overlap fabric edges at least 12 inches.
- ✓ The fabric should be trenched in at least 12 inches deep at the top and bottom ends of the installation to prevent undercutting.
- ✓ If used in conjunction with hand seeding or hydroseeding, place seeding first and cover with fabric.
- ✓ Live staking may be done after the fabric is placed by piercing the fabric.

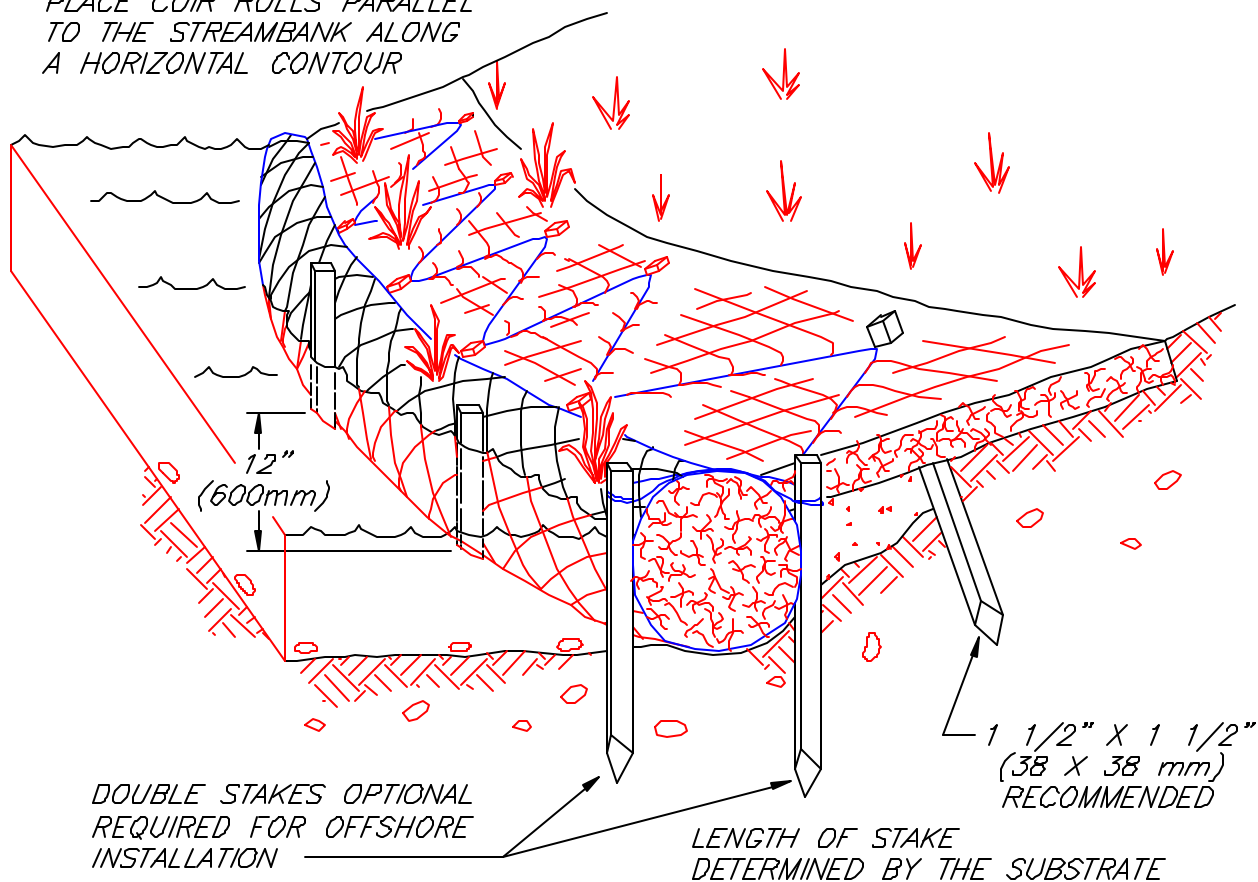
## **BMP MAINTENANCE**

- ✓ During construction, inspect daily during the work week.
- ✓ Schedule additional inspections during storm events.
- ✓ Make any required repairs immediately.

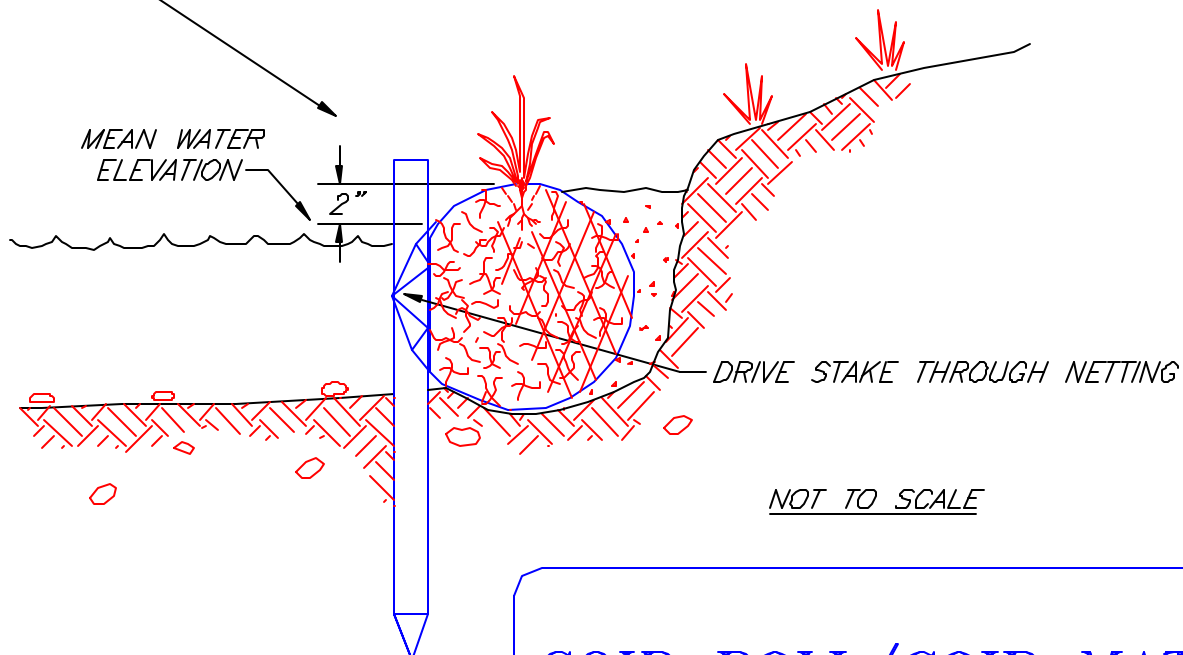
## **BMP REMOVAL**

- ✓ BMP removal is not necessary.

PLACE COIR ROLLS PARALLEL  
TO THE STREAMBANK ALONG  
A HORIZONTAL CONTOUR



PLACE COIR ROLL SUCH THAT THE ROLL EXTENDS  
2" (50 mm) ABOVE MEAN WATER ELEVATION



COIR ROLL/COIR MATS

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| <b>BMP 10.7</b><br><b>CONCRETE WASHOUT</b> |
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**DESCRIPTION**

Concrete washouts are facilities at construction sites that capture wash water, concrete and aggregate flushed from concrete mixers, chutes, etc. Concrete washouts may be contained settling basins dug into the ground, raised and contained structures, trailers, etc.

**APPLICATIONS**

Concrete washout facilities are required whenever flushing of concrete mixing equipment in the field will result in more than 10 gallons of wash water, when flushing onto slopes or near active stream channels, and other situations that may result in the discharge of wash water, suspended particles or other wastes into any watercourse.

**CONSTRUCTION GUIDELINES**

Concrete washouts should be designed to contain all anticipated wash water and concrete wastes for the period of time required to settle out particles, evaporate wash water or siphon it for transport and disposal. Washouts should be lined with waterproof fabric, or fully contained in metal structures or tanks to prevent leaking. Washout facilities should be maintained at least weekly, with all concrete and aggregate removed when  $\frac{1}{2}$  the storage volume is filled.

**BMP MAINTENANCE**

- ✓ During construction, inspect daily during the work week.
- ✓ Clean out when  $\frac{1}{2}$  storage volume is filled
- ✓ Immediately repair any leaks

**BMP REMOVAL**

- ✓ Remove wash water, concrete particles and aggregate to stable storage facility
- ✓ Remove BMP. Recycle or re-use if applicable.
- ✓ Revegetate areas disturbed by BMP removal if applicable.

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| <b>BMP 10.8</b><br><b>CONTAINMENT</b> |
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**DESCRIPTION**

Containment measures are intended to be deployed in the event of a spill of hazardous chemicals, fuels, oils, cement, and other liquids or powders to prevent pollution of water, air, or soil resources. Containment measures may include absorbent materials to soak up spills, tools such as shovels or hoes to dig small emergency containments, tarps to cover dry spills, etc.

**APPLICATIONS**

Containment measures should be available at all construction sites and at any time that chemicals are to be used near a watercourse.

**BMP REMOVAL**

- ✓ Handle chemicals and absorbents in accordance with instructions from fire protection staff, Environmental Health officials and/or manufacturer

**SPILL PREVENTION AND RESPONSE**

Fluid spills shall not be hosed down. The Contractor shall use dry cleanup methods (absorbent materials, cat litter, and/or rags) whenever possible. If water must be used, the Contractor will be required to collect the water and spilled fluids and dispose of it as hazardous waste. Spilled fluids shall not be allowed to soak into the ground or enter into any watercourse.

Spilled dry materials shall be swept up immediately. Dry spills shall not be washed down or buried. Spills on dirt areas should be removed by digging up and properly disposing of contaminated soil. Significant spills shall be reported immediately and documented using the Maintenance Notification Form (Form RM-E01).

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| <p style="text-align: center;"><b>BMP 10.9</b></p> <p style="text-align: center;"><b>CURB INLET SEDIMENT BARRIER</b></p> |
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## **DESCRIPTION**

Curb inlet sediment barriers are temporary barriers constructed from concrete block and gravel or gravel filled sandbags or rock socks (refer to BMP 10.23, "Sandbags/Rock Socks").

## **APPLICATIONS**

Curb inlet sediment barriers are intended to reduce the sediment discharged into storm drains by ponding the runoff and allowing the sediment to settle out. The structures allow for overflow from high runoff events and the gravel allows the ponds to dewater rapidly. Curb inlet sediment barriers should be used where new construction, reconstruction and/or where private development is generating sediment or polluted runoff.

## **LIMITATIONS**

- ✓ This BMP should not be used on steep sloping streets.
- ✓ This BMP should be considered a "backup" used in addition to controlling potential erosion at the source.

## **CONSTRUCTION GUIDELINES**

- ✓ Place the barriers on gently sloping streets where water can pond.
- ✓ The barriers must allow for overflow from a severe storm event. A spillway shall be constructed with the sandbag structures to allow overflow.
- ✓ Sandbags shall be filled with 3/4 inch drain rock or 1/4 inch pea gravel.
- ✓ The sandbags shall be placed in a curved row from the top of curb at least 3 feet into the street. The row should be curved at the ends, pointing uphill.
- ✓ Several layers of bags should be overlapped and packed tightly.
- ✓ Leave a one-sandbag gap in the top row to act as a spillway.

## **BMP MAINTENANCE**

- ✓ Inspect and clean barrier during and after each significant storm and remove sediment from behind sandbag structure after every storm.
- ✓ Any sediment and gravel shall be immediately removed from the traveled way of roads.
- ✓ The removed sediment shall be placed where it cannot enter a storm drain, stream, or be transported off site.
- ✓ If the gravel becomes clogged with sediment, it must be carefully removed from the inlet and either cleared or replaced.



## **BMP REMOVAL**

- ✓ BMP removal should not be necessary until completion of construction
- ✓ When no longer needed, remove and dispose of BMP and all sediment in secure location

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| <b>BMP 10.10</b><br><b>DIVERSION BERM</b> |
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## **DESCRIPTION**

A diversion berm is a temporary ridge of compacted soil or aggregate base material, sandbags or continuous bag berm constructed at the top or base of a disturbed slope. The purpose of the BMP is direct stormwater runoff away from an unstable slope.

## **APPLICATIONS**

This BMP may be used wherever stormwater runoff must be temporarily diverted away from a disturbed slope and toward a sediment containment facility or stable runoff.

## **LIMITATIONS**

This BMP should not be used:

- ✓ in fast flowing water.
- ✓ as a replacement for failing roadway shoulders.
- ✓ as slide debris storage within 150' of any water body.

## **CONSTRUCTION GUIDELINES**

- ✓ Berm material should be adequately compacted to prevent failure.
- ✓ Temporary seeding and mulch shall be applied to all surfaces of a soil diversion berm according to the "Timing of Work" BMP.

## **BMP MAINTENANCE**

- ✓ Periodic inspection should be conducted, and berms repaired as necessary.

## **BMP REMOVAL**

- ✓ Evaluate site to determine BMP is no longer needed (the area has stabilized – potential of sediment laden water exiting the area has passed).
- ✓ Remove sediment buildup.
- ✓ Remove BMP – recycle and/or re-use if applicable.
- ✓ Revegetate area disturbed by BMP removal if applicable.

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| <p style="text-align: center;"><b>BMP 10.11</b><br/><b>ENERGY DISSIPATER/FLUME</b></p> |
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## **DESCRIPTION**

An energy dissipater is a structure designed to control erosion at the outlet of a channel or conduit by reducing the velocity of flow and dissipating the energy.

## **APPLICATIONS**

This BMP is required at the outlet of any new or replacement drainage culvert. Existing culverts shall be evaluated and upgrades (energy dissipater installations) scheduled as appropriate.

The outlets of channels, conduits, and other structures are points of high erosion potential. To prevent scour and undermining, an outlet stabilization structure is needed to absorb the impact of the flow and reduce the velocity to non-erosive levels.

A riprap-lined apron is a commonly used practice for this purpose because of its relatively low cost and ease of installation. The riprap apron should be extended downstream until stable conditions are reached, even though this may exceed the length calculated for design velocity control. Down drains and flumes may also be used as energy dissipaters. Rock aprons may also be required below down drains and flumes depending on slope steepness and soil conditions.

## **LIMITATIONS**

- ✓ This BMP shall not be used below the mean high water line of any water body unless permits have been obtained.
- ✓ Consider other energy dissipaters such as concrete impact basins or paved outlet structures where site conditions warrant.
- ✓ Rock/rip rap dissipaters may require containment in gabion baskets or mattresses to maintain their effectiveness.

## **CONSTRUCTION GUIDELINES**

- ✓ Berm material should be adequately compacted to prevent failure.
- ✓ Temporary seeding and mulch shall be applied to all surfaces of a soil diversion berm according to the "Timing of Work" BMP.

## **BMP MAINTENANCE**

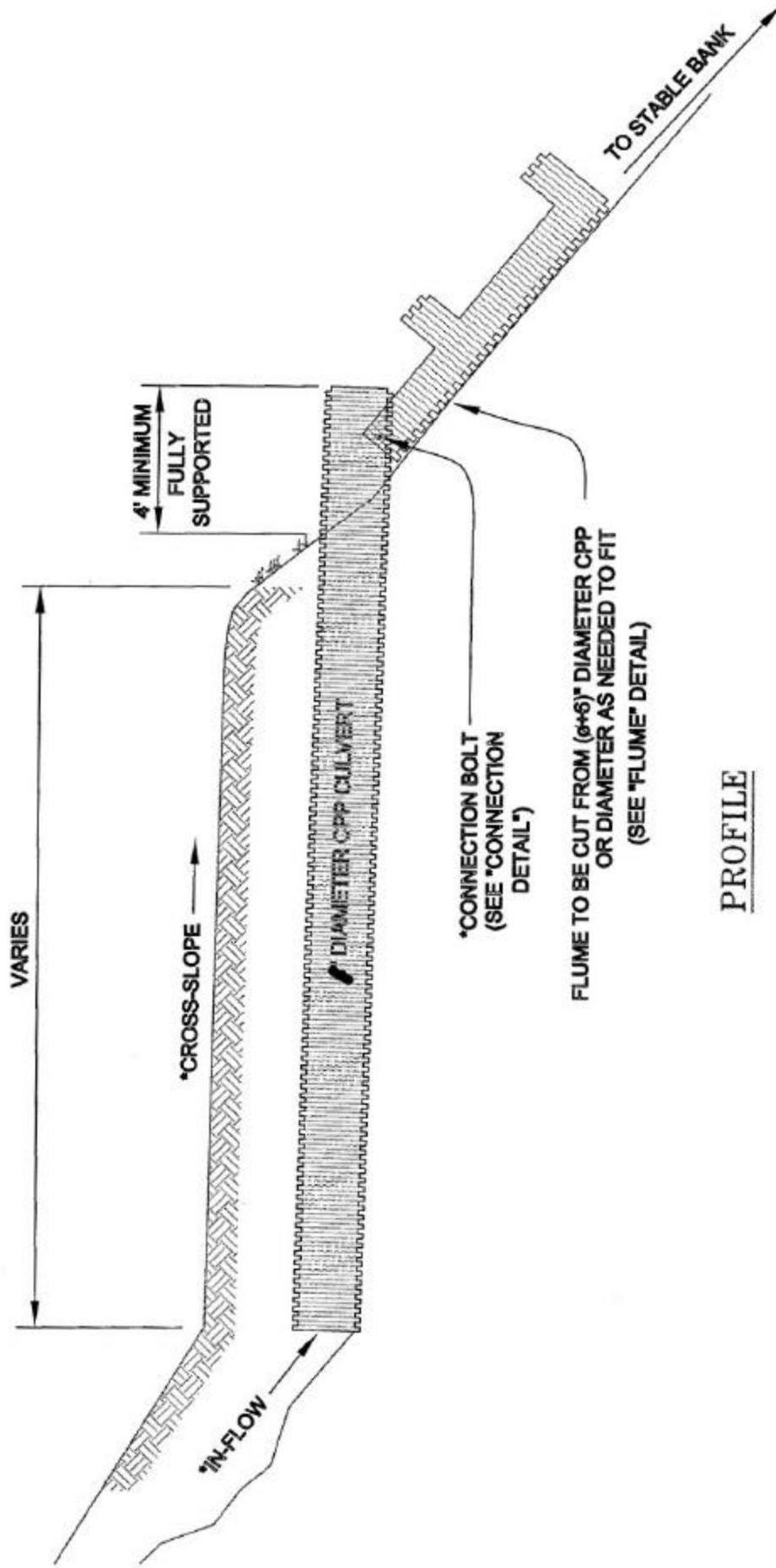
- ✓ Inspect outlet structures after heavy rains to see if any erosion around the structures has taken place or if stones have been dislodged. Immediately make all needed repairs to prevent further damage.

BMP: ENERGY DISSIPATER (continued)

- ✓ Clean flumes as necessary.

## **BMP REMOVAL**

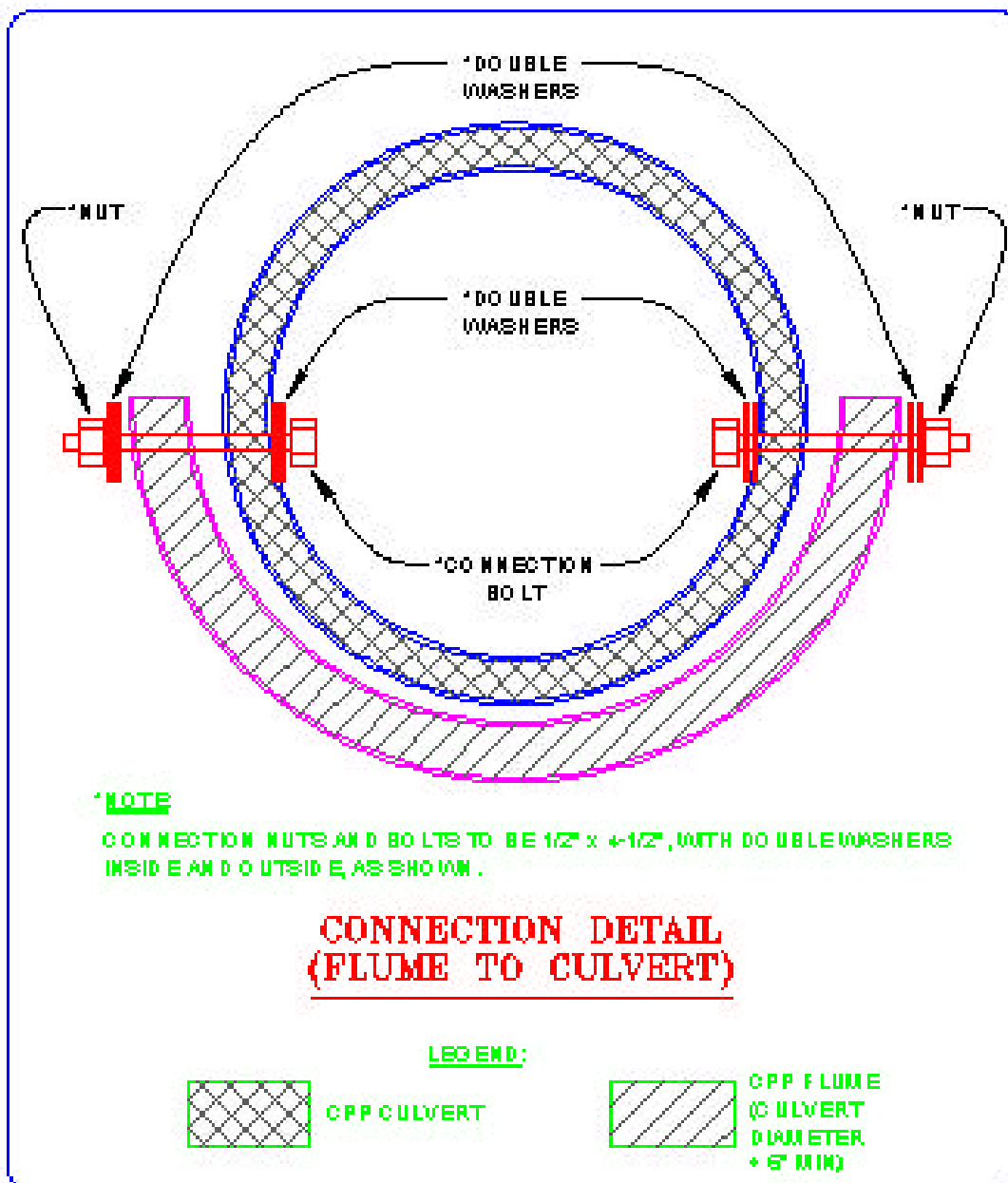
- ✓ BMP removal should not be necessary.



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- (1) CROSS-SLOPE TO BE 1-2% UNLESS OTHERWISE APPROVED BY ENGINEER
- (2) SOURCES OF INFLOW ARE EXISTING (I.e. NATURAL DRAINAGE GULLIES, ETC.).
- (3) LOCATION OF CONNECTION BOLT TO BE DETERMINED IN THE FIELD BY THE ENGINEER.



## **BMP 10.12**

# **EQUIPMENT MAINTENANCE & FUELING**

### **DESCRIPTION**

Equipment maintenance and fueling is frequently required at construction sites. Proper equipment maintenance and fueling procedures will ensure that no fluids are discharged into watercourses, and that any spills are promptly cleaned up, reported (if necessary) and properly disposed of.

### **GENERAL REQUIREMENTS**

A separate area should be designated for equipment maintenance and fueling, away from any slopes, watercourses or drainage facilities. Where equipment is expected to be stored for more than a few days, cleanup materials and tools should be kept nearby and available for immediate use (refer to BMP 10.8, "Containment"). Equipment should not be stored in areas that will potentially drain to watercourses or drainage facilities. If equipment must be stored in areas with the potential to generate runoff, drip pans, berms, sandbags or absorbent booms should be employed to contain any leaks or spills.

Equipment should be inspected daily for leaks or damage and promptly repaired.

### **SPILL PREVENTION AND RESPONSE**

Fluid spills shall not be hosed down. The Contractor shall use dry cleanup methods (absorbent materials, cat litter, and/or rags) whenever possible. If water must be used, the Contractor will be required to collect the water and spilled fluids and dispose of it as hazardous waste. Spilled fluids shall not be allowed to soak into the ground or enter into any watercourse.

Spilled dry materials shall be swept up immediately. Dry spills shall not be washed down or buried. Spills on dirt areas should be removed by digging up and properly disposing of contaminated soil. Significant spills shall be reported immediately and documented using the Maintenance Notification Form (Form RM-E01).

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| <p style="text-align: center;"><b>BMP 10.13</b></p> <p style="text-align: center;"><b>EROSION CONTROL BLANKETS &amp; MATS</b></p> |
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## **DESCRIPTION**

Erosion control blankets and mats are installed to protect the prepared soil surface of a steep slope.

## **APPLICATIONS**

Erosion control blankets are used on steep slopes to temporarily stabilize and protect disturbed soil from raindrop impact and surface erosion, to increase infiltration, decrease compaction and soil crusting, and to conserve soil moisture. Erosion control blankets also protect seeds from predators, reduce desiccation and evaporation by insulating the soil and seed environment.

Some types of erosion control blankets and turf reinforcement mats are specifically designed to stabilize channelized flow areas.

## **LIMITATIONS**

- ✓ This BMP should not be used in areas subject to scour from high flows (e.g. streambanks) unless designed by an engineer. Permits shall be obtained prior to any streambank or shoreline installation.
- ✓ Blankets and mats manufactured with plastic netting shall be avoided.

## **CONSTRUCTION GUIDELINES**

- ✓ Proper site preparation is essential to ensure complete contact of the protection matting with the soil.
- ✓ Grade and shape area of installation.
- ✓ Remove all rocks, clods, vegetative or other obstructions so that the installed blankets, or mats will have direct contact with the soil.
- ✓ Prepare seedbed by loosening 2-3 inches (50-75 mm) of topsoil above final grade.
- ✓ Seed area before blanket installation for erosion control and re-vegetation. (Seeding after mat installation is often specified for turf reinforcement application.)
- ✓ U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats to the ground surface. Wire staples should be a minimum of 11 gauge. Metal stake pins should be 3/16 inch diameter steel with a 1 1/2 inch steel washer at the head of the pin. Wire staples and metal stakes should be driven flush to the soil surface. All anchors should be 6-8 inches long and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils.



### **Installation on Slopes:**

- ✓ Begin at the top of the slope and anchor its blanket in a 6 inch deep x 6 inch wide trench. Backfill trench and tamp earth firmly.
- ✓ Unroll blanket downslope in the direction of the water flow.
- ✓ The edges of adjacent parallel rolls must be overlapped 2-3 inches and be stapled every 3 feet.
- ✓ When blankets must be spliced, place blankets end over end (shingle style) with 6 inch overlap. Staple through overlapped area, approximately 12 inches apart.
- ✓ Lay blankets loosely and maintain direct contact with the soil - do not stretch.
- ✓ Blankets shall be stapled sufficiently to anchor blanket and maintain contact with the soil. Staples shall be placed down the center and staggered with the staples placed along the edges Steep slopes, 1:1 to 2:1, require 2 staples per square yard. Moderate slopes, 2:1 to 3:1, require 1-2 staples per square yard (1 staple 3' on center). Gentle slopes require 1 staple per square yard.

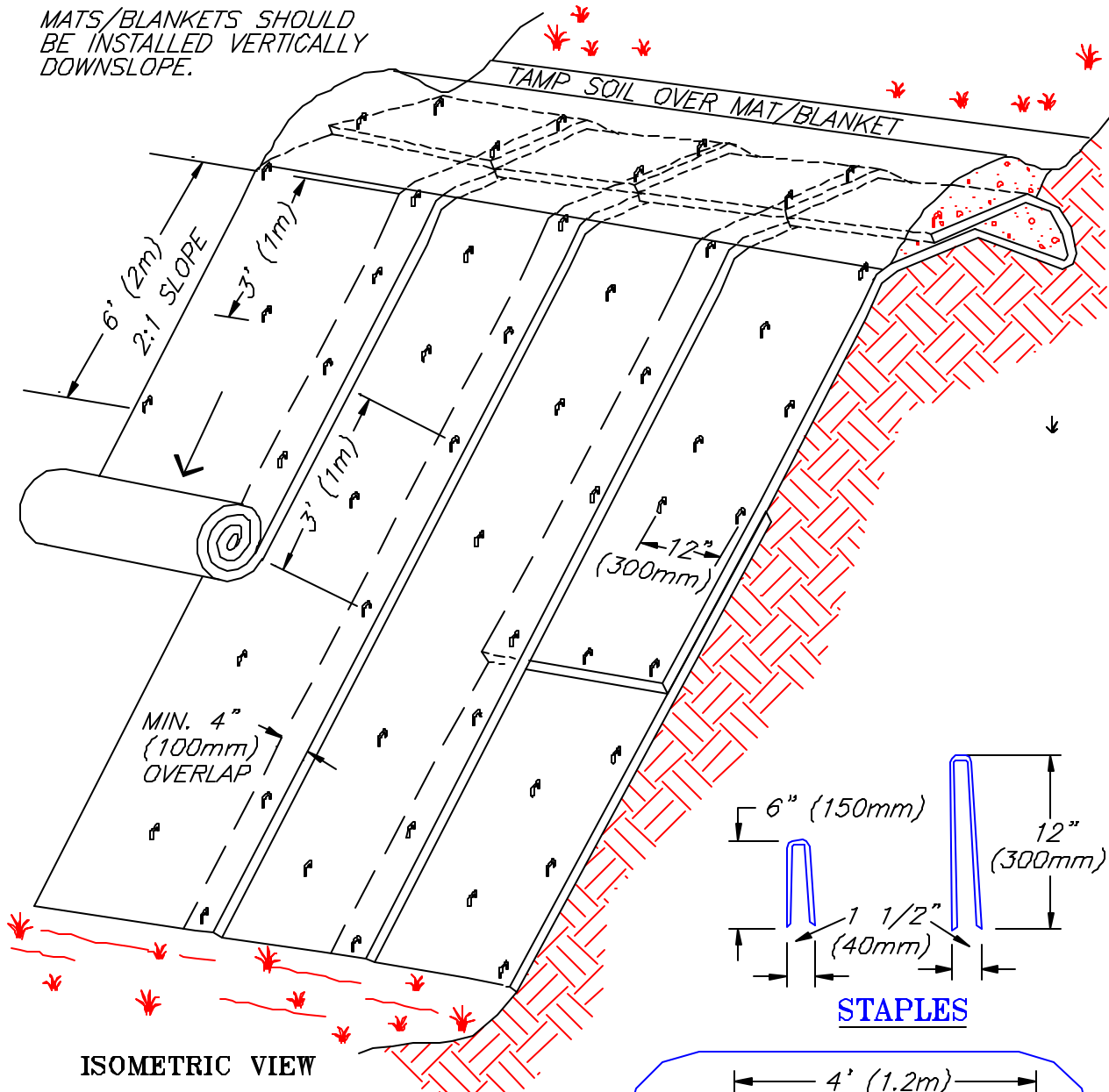
### **BMP MAINTENANCE**

- ✓ All blankets and mats should be inspected periodically following installation.
- ✓ Inspect installation after significant rainstorms to check for erosion and undermining. Any failure should be repaired immediately.
- ✓ If washout or breakage occurs, re-install the material after repairing the damage to the slope or drainageway.

### **BMP REMOVAL**

- ✓ BMP removal should not be necessary.

MATS/BLANKETS SHOULD BE INSTALLED VERTICALLY DOWNSLOPE.

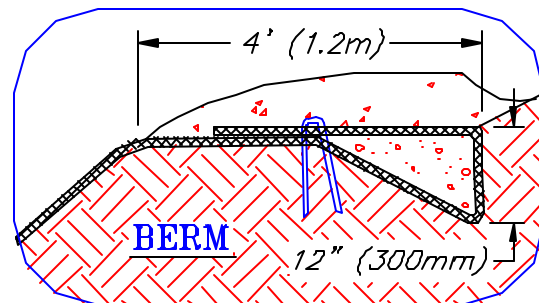


ISOMETRIC VIEW

## TYPICAL SLOPE SOIL STABILIZATION

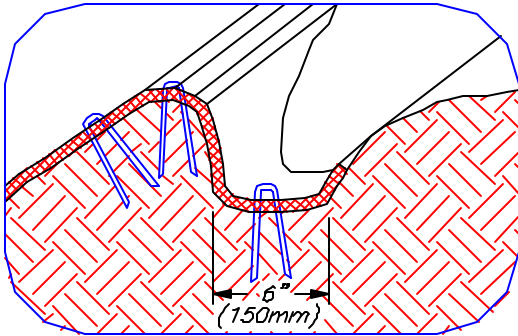
### NOTES:

1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.

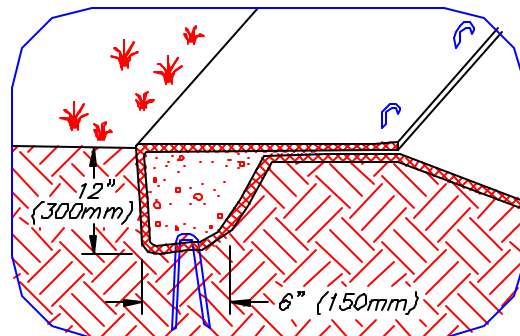


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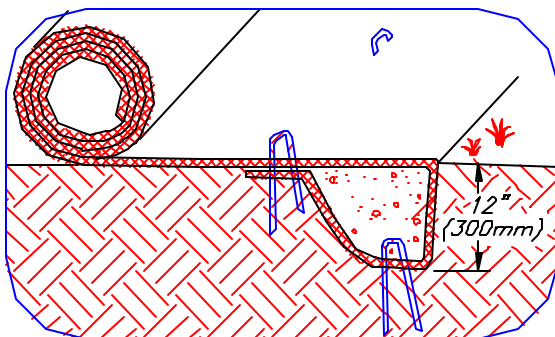
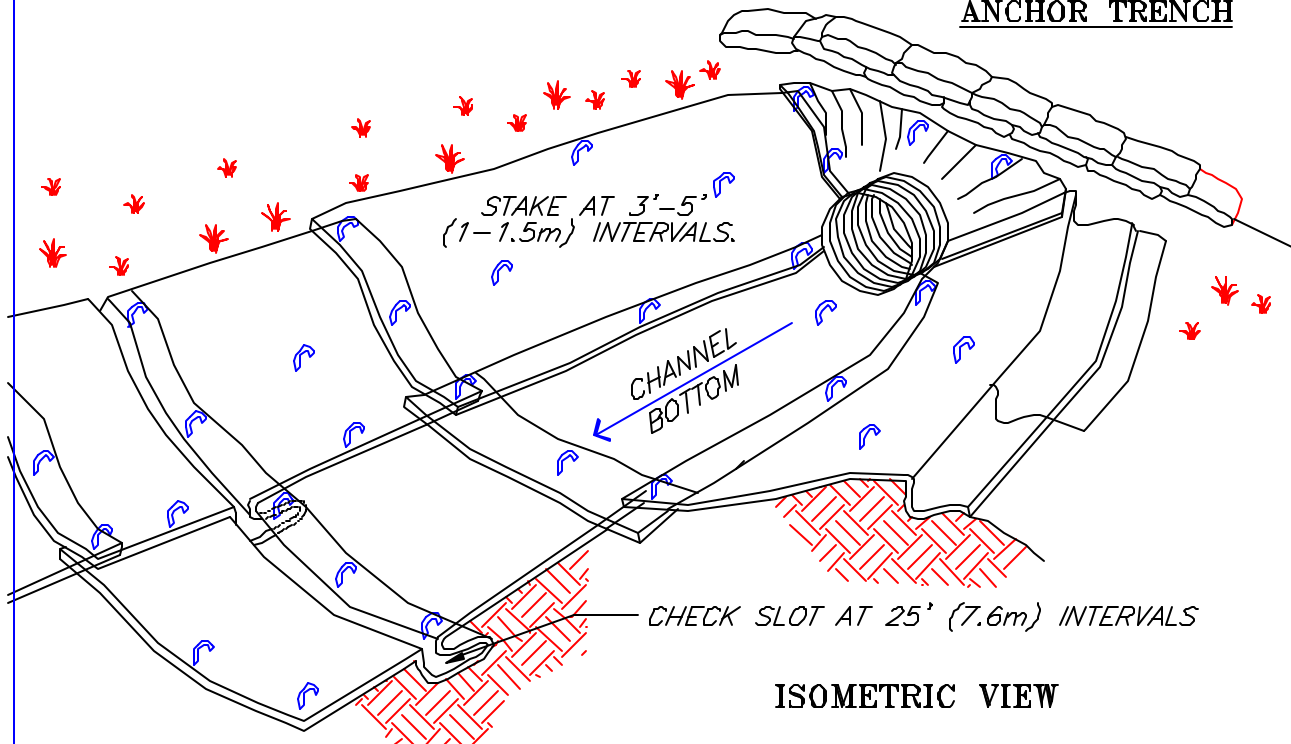
## EROSION BLANKETS & TURF REINFORCEMENT MATS SLOPE INSTALLATION



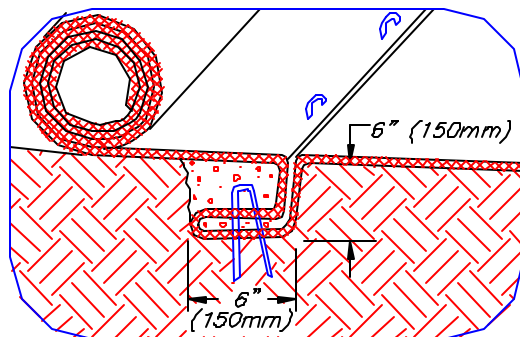
**LONGITUDINAL ANCHOR TRENCH**



**TERMINAL SLOPE AND CHANNEL  
ANCHOR TRENCH**



**INITIAL CHANNEL ANCHOR TRENCH**



**INTERMITTENT CHECK SLOT**

**NOTES:**

1. CHECK SLOTS TO BE CONSTRUCTED PER MANUFACTURERS SPECIFICATIONS.
2. STAKING OR STAPLING LAYOUT PER MANUFACTURERS SPECIFICATIONS.

**EROSION BLANKETS &  
TURF REINFORCEMENT MATS  
CHANNEL INSTALLATION**

|   |
|---|
| <b>BMP 10.14</b><br><b>HAND SEEDING</b> |
|---|

## **DESCRIPTION**

Hand Seeding is broadcasting grass seed on disturbed or bare soil areas by hand or a hand seeding device. This BMP is used to reduce the potential for soil to become water or air borne, reduce erosion after vegetation establishment, provide for vegetative buffers and aid in habitat protection. Seeding with appropriate seed mixes will also help discourage colonization by non-native and invasive plant species.

## **APPLICATIONS**

Hand seeding is encouraged whenever possible to aid in controlling erosion on construction sites. Seeding shall be applied to areas intended to be left dormant for a year or more, such as soil berms.

## **LIMITATIONS**

- ✓ Hand seeding should be followed by mulching and/or installation of coir netting, erosion control blankets or mats.
- ✓ This BMP should not be used during months when seed germination will not occur.

## **CONSTRUCTION GUIDELINES**

- ✓ Select seed mixes appropriate to the season and site conditions. Permit conditions and/or sensitive locations may require special seed mixes.
- ✓ Grade as needed and feasible to permit the use of equipment for seedbed preparation.
- ✓ Install needed erosion control practices, such as sediment basins, diversion dikes and channels, prior to seeding. Divert concentrated flows away from seeded areas.
- ✓ Surface roughening: If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted or hardened the soil shall be loosened with discing, raking or harrowing.
- ✓ Spread seed uniformly and according to manufacturer's recommendations.
- ✓ Straw mulch, erosion control blankets or mulch and tackifiers/soil binders should be applied over the seeded areas.

Where the typical installation of cereal barley seed and rice straw mulch are applied, seed shall be applied at the rate of \_\_\_\_ pounds per acre and rice straw mulch shall be applied at the rate of \_\_\_\_ pounds (\_\_\_\_ bales) per acre for a thickness of approximately 2 inches.

## **BMP MAINTENANCE**

- ✓ Inspect during seed establishment period. Re-see, due to mortality, as necessary. Areas which fail to establish cover adequate to prevent sheet and rill erosion will be reseeded as soon as such areas are identified. Spot seeding can be done on small areas to fill in bare spots where grass did not grow properly.

## **BMP REMOVAL**

- ✓ BMP removal should not be necessary.

|   |
|---|
| <b>BMP 10.15</b><br><b>HYDROSEEDING</b> |
|---|

**DESCRIPTION**

Hydroseeding is broadcasting grass seed, tackifier, wood fiber mulch and water on disturbed areas using a hydroseeding machine. This BMP is used to reduce the potential for soil becoming water or air borne, to reduce erosion after vegetation is established, provide vegetative buffers and to aid in habitat protection. Seeding with appropriate seed mixes will also help discourage colonization by non-native and invasive plant species.

**APPLICATIONS**

Hydroseeding may be used after soil disturbance is completed at construction sites and/or on bare slopes.

**LIMITATIONS**

- ✓ Hydroseeding should not be used on streambanks or in areas subject to scour.
- ✓ This BMP should not be used during months when seed germination will not occur.

**CONSTRUCTION GUIDELINES**

- ✓ Select seed mixes appropriate to the season and site conditions. Permit conditions and/or sensitive locations may require special seed mixes.
- ✓ Install needed erosion control practices, such as sediment basins, diversion dikes and channels, prior to hydroseeding. Divert concentrated flows away from hydroseeded areas.
- ✓ Surface roughening: If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted or hardened the soil shall be loosened with discing, raking or harrowing.
- ✓ Spread hydroseed mix uniformly and according to manufacturer's recommendations.
- ✓ Cover hydroseeded areas with other methods as needed.

**BMP MAINTENANCE**

- ✓ Inspect during seed establishment period. Re-see, due to mortality, as necessary. Areas which fail to establish cover adequate to prevent sheet and rill erosion will be reseeded as soon as such areas are identified. Spot seeding can be done on small areas to fill in bare spots where grass did not grow properly.

BMP: HYDROSEEDING (continued)

## **BMP REMOVAL**

✓ BMP removal should not be necessary.

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|---|
| <p style="text-align: center;"><b>BMP 10.16</b><br/><b>LARGE WOODY DEBRIS</b></p> |
|---|

## **DESCRIPTION**

Large woody debris is any large piece of woody material generally defined as 6 inches and larger in diameter and at least 10 feet long, including the trunk and root mass, including stumps or rootwads.

## **APPLICATIONS**

When incorporating woody material into projects, it is necessary to identify the desired performance and habitat benefits. Each project must be specifically tailored to meet the objectives identified for the habitat and any structures to be protected. It can be used in combination with other BMPs.

## **LIMITATIONS**

This BMP should not be used:

- ✓ when specific design requirements and desired habitat benefits have not been identified.
- ✓ in water bodies until all necessary permits have been obtained.
- ✓ Refer to “Streambank Stabilization” BMP for installation methods.

## **CONSTRUCTION GUIDELINES**

- ✓ Guidelines will vary based on existing site conditions, size and shape of the wood, forces exerted by moving water, etc.
- ✓ Construct in accordance with design and permit conditions.

## **BMP MAINTENANCE**

- ✓ Monitor large woody debris installed to ensure it remains as built. Consult as necessary for adjustments and/or modifications to large woody debris installations.

## **BMP REMOVAL**

- ✓ BMP removal should not be necessary.



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| <b>BMP 10.17</b><br><b>LIVE POLE DRAIN</b> |
|--|

## **DESCRIPTION**

A live pole drain is a biotechnical and reclamation technique intended to drain excess moisture away from an unstable site. The plants used to construct the bundles (willow) will sprout and grow, with the moisture continuing to drain from the lower end. The bundles of cuttings are usually placed in shallow trenches in a manner that they intersect and collect excessive slope moisture. That excess water is then allowed to drain onto a stabilized area.

## **APPLICATIONS**

This BMP may be used on unstable slopes, landslide repairs, and small slumping gullies.

## **LIMITATIONS**

- ✓ Live pole drains are not effective in larger, well defined channels with concentrated flows, as the pole drains will simply plug the channel and cause more erosion as the channel adjusts to maintain capacity.
- ✓ Installation should be conducted at times of the year when weather conditions are cool and moist and the plant material is dormant.

## **CONSTRUCTION GUIDELINES**

Install the drains in the areas of seepage, either by excavating a shallow trench or utilizing an existing drainage gully, so the drains intercept and control the excess moisture. Use wattle/fascine techniques to construct the bundles. The bundles should be tied tightly with twine or rope. Place the bundle of cuttings in the trench. Construct side drains as needed. Key the bundles into each other by jamming the ends firmly together.

Use construction stakes and/or live stakes to hold the fascines in place. Insert the stakes adjacent to the rope ties for additional support. Stake the pole drains at 3-6 foot intervals. Lightly backfill the bundles with native soil. Some twigs and branches should be left above the ground as the willow material requires some sunlight exposure to grow.

## **BMP MAINTENANCE**

- ✓ Regular inspection and maintenance should be conducted, particularly during the first year.
- ✓ Failures of fill or drainage structures should be corrected immediately.

BMP: LIVE POLE DRAIN (continued)

## **BMP REMOVAL**

- ✓ BMP removal is not necessary.

|   |
|---|
| <b>BMP 10.18</b><br><b>LIVE STAKING</b> |
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## **DESCRIPTION**

Live staking involves the insertion of live, vegetative cuttings into the ground in a manner that allows the cutting (stake) to take root and grow. This BMP is used to reduce the potential for soil to become water borne, to reduce water velocity/erosive forces, and to aid in habitat protection.

## **APPLICATIONS**

This BMP may be used to repair small slips and slumps, to reinforce or enhance stream banks, and to anchor and enhance the effectiveness of wattles, fascines, straw logs and other erosion control materials. It may also be used in conjunction with approved rip rap installations (vegetated rip rap).

## **LIMITATIONS**

This BMP should not be used:

- ✓ where vegetation growth will interfere with maintenance or facility access.
- ✓ where vegetation growth will create safety issues.
- ✓ for immediate soil stabilization results.

## **CONSTRUCTION GUIDELINES**

Live staking must be implemented during the dormancy period of chosen plant species, late fall to early spring. If native willows or cottonwood are not found in the vicinity, live staking may not be a good option. Cuttings should generally be  $\frac{3}{4}$  inch in diameter or larger depending on the species. Cuttings of small diameter (up to 1 -  $\frac{1}{2}$  inches) shall be 18 inches long minimum. Poles should be 1.5-3.5 inches diameter and 6-8 feet long. The actual length of cuttings depends on the application but the cutting should be long enough to reach into moist soils in mid-summer or the capillary fringe.

Stakes must not be allowed to dry out. All cuttings should be soaked in water for a minimum of 24 hours. Soaking significantly increases the survival rate of the cuttings, however they must be planted the same day they are removed from water.

Use an iron stake or bar to make a pilot hole in firm soil. Plant the stakes butt-ends into the ground, with the leaf bud scars or emerging buds always pointing up. Be careful not to damage the buds, strip the bark or split the stake during installation. The stakes should not be planted in rows or at regular intervals, but at random in the most suitable places at a rate of 2-5 cuttings/square yard.

Set the stake as deep as possible into the soil, preferably with 80 percent of its length into the soil and in contact with mid-summer moist soils. The stake should protrude only to a maximum of one-quarter its length above the ground level to prevent it from drying. Stakes should be cut so that cutting extends above competing herbaceous vegetation. At least 2 buds and/or bud scars shall be above the ground after planting. It is essential to have good contact between the stake and soil for roots to sprout. Tamp the soil around the cutting. Do not fertilize.

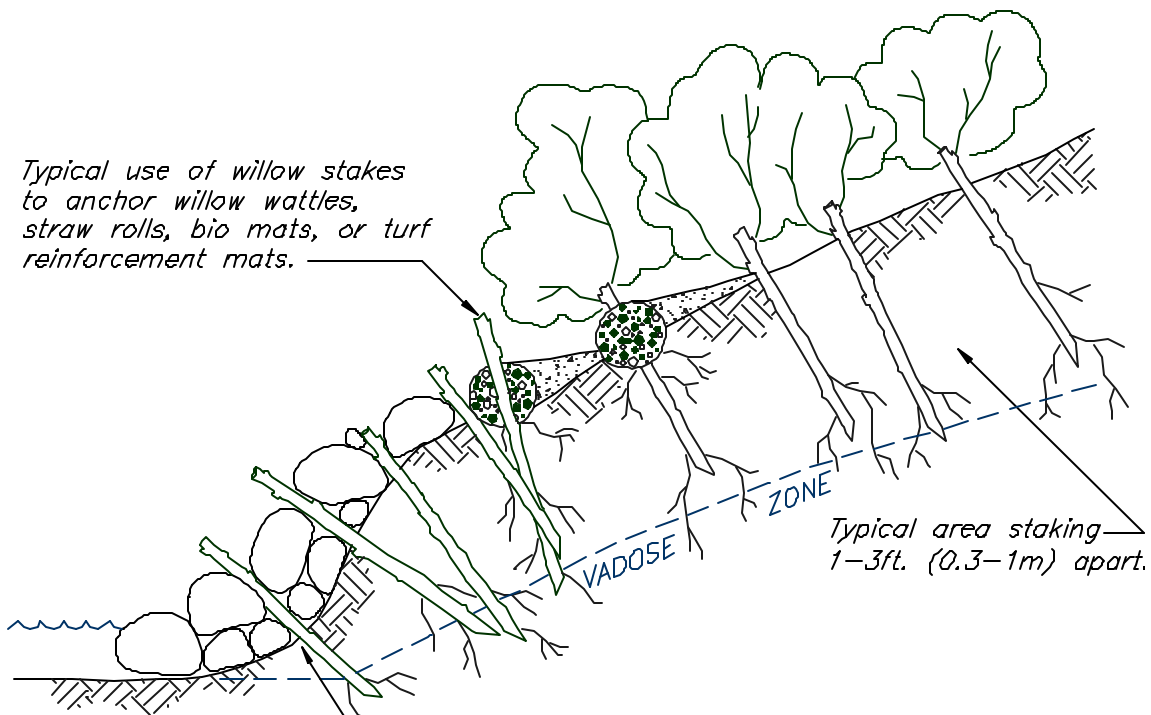
## **BMP MAINTENANCE**

- ✓ Periodic inspection, repair and maintenance will be done in accordance with permit requirements. If no permits are required, vegetation will be monitored for the first two years or until the vegetation is established.
- ✓ Staked area may need to be watered during summer months.

## **BMP REMOVAL**

- ✓ BMP removal is not necessary.

Typical use of willow stakes to anchor willow wattles, straw rolls, bio mats, or turf reinforcement mats.



Typical — drive or plant willow stakes through openings in riprap or gabions.

Plant 80% of stake length into the ground.

18in. (0.5m) min.

Cut top of stake square.

2 to 5 buds scars shall be above the ground.

Trim branches close.

3/4-3in. (20-75mm) diameter.

Make angled cut at butt-end, plant butt-end down.

#### NOTES:

1. Harvest and plant stakes during the dormant season.
2. Use healthy, straight and live wood at least 1 year old.
3. Make clean cuts and do not damage stakes or split ends during installation, use a pilot bar in firm soils.
4. Soak cuttings for 24 hours (min.) prior to installation.
5. Tamp the soil around the stake.

## LIVE STAKING AND JOINT PLANTING

|                                     |
|-------------------------------------|
| <b>BMP 10.19</b><br><b>MULCHING</b> |
|-------------------------------------|

**DESCRIPTION**

Mulching is the application of rice or sterile straw, wood chips, leaf litter, redwood duff, or other suitable materials on the soil surface applied manually or by machine. This BMP is used to reduce the potential for soil becoming water or air borne, and to encourage vegetation establishment.

**APPLICATIONS**

This BMP may be used to provide protection to the soil surface and to protect newly seeded areas. This BMP may be used in combination with plantings.

**LIMITATIONS**

- ✓ Mulch may not adhere well to slopes steeper than 2:1.
- ✓ Mulch should not be placed in water bodies or in ditches where water flow is continuous.

**CONSTRUCTION GUIDELINES**

- ✓ Mulch should be applied so that the soil is covered enough to allow seeds to protect against erosion, but still allow seeds to germinate.
- ✓ Native mulches (redwood duff, leaf litter, etc.) are preferred in sensitive areas.
- ✓ In areas subject to runoff or wind erosion, mulch shall be secured into the soil by mechanical or manual crimping, anchoring with branches, or other appropriate methods.

**BMP MAINTENANCE**

- ✓ Periodic inspection should be conducted, and mulch reapplied in areas where missing.

**BMP REMOVAL**

- ✓ BMP removal is not necessary.

|                                   |
|-----------------------------------|
| <b>BMP 10.20</b><br><b>RIPRAP</b> |
|-----------------------------------|

## **DESCRIPTION**

Riprap is a structural method appropriate for supporting slopes and/or reducing erosion in areas where biotechnical methods are unsuitable and where engineered retaining structures are unnecessary.

## **APPLICATIONS**

Riprap may be used to stabilize steep slopes with seepage problems and/or unstable soils that need armoring to prevent sloughing. This BMP shall only be used as a last resort in locations where planting or other stabilizing methods are impracticable. Rip rap may also be used in combination with biotechnical BMPs.

Rip rapped areas should be evaluated for finishing with topsoil and revegetation to improve the drainage capacity of the fill and the stability of the riprap matrix.

## **LIMITATIONS**

- ✓ Rip rap shall not be used as a stand-alone method of streambank stabilization.
- ✓ Permits must be obtained prior to placing any rip rap below the mean high water line of any water body, or in other sensitive areas.

## **CONSTRUCTION GUIDELINES**

- ✓ Perform live staking or pole planting during rip rap placement as appropriate.
- ✓ Place rip rap to its full thickness in one operation.
- ✓ The toe of the riprap slope should be keyed to a stable foundation at its base.
- ✓ Schedule topsoil and revegetation finish work at an appropriate time or year.

## **BMP MAINTENANCE**

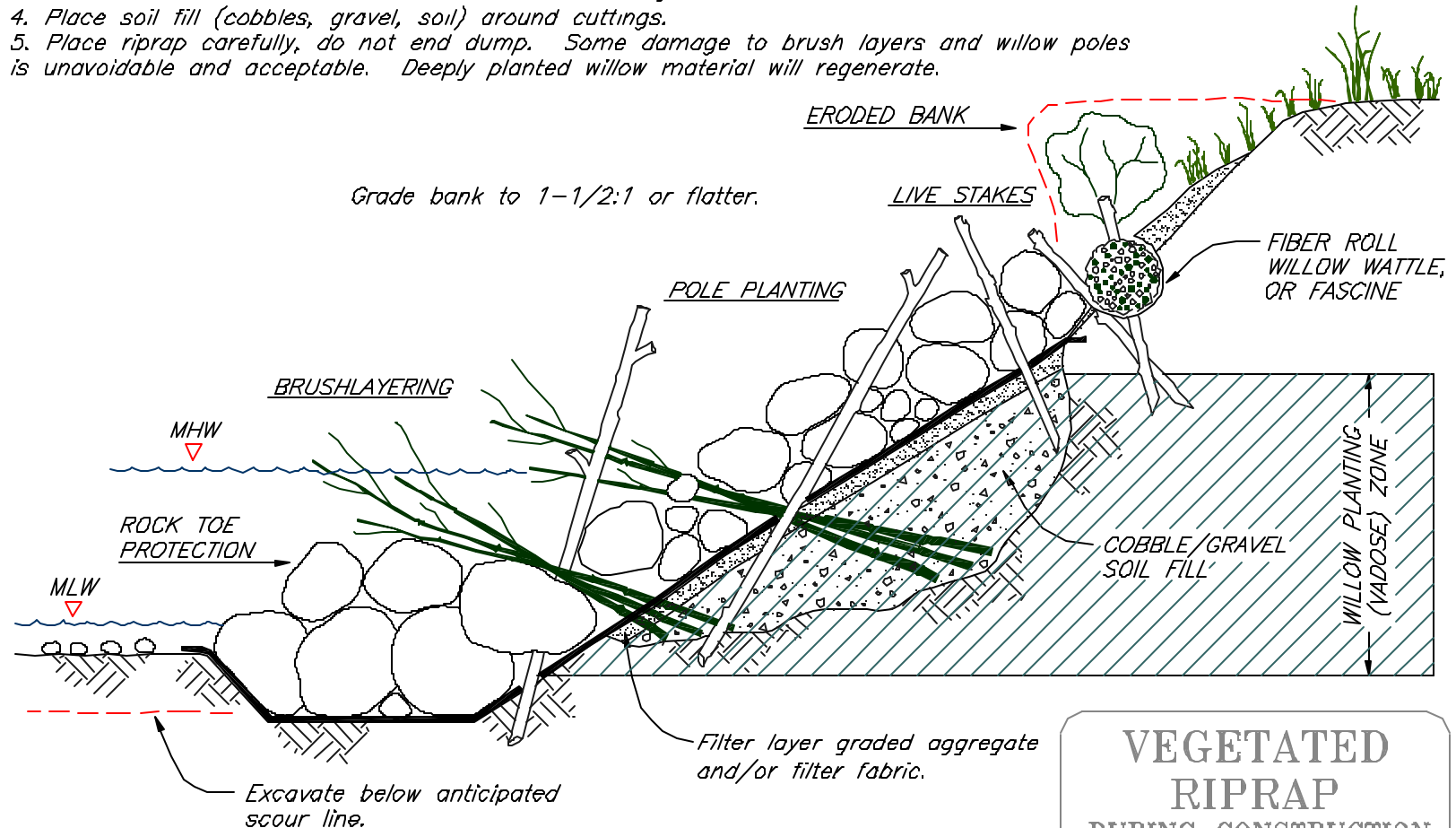
- ✓ Riprap should be inspected periodically for scour or dislodged stones and repairs made immediately.

## **BMP REMOVAL**

- ✓ BMP removal should not be necessary.

**NOTES:**

1. Willow pole planting and brushlayering shall be installed during bank grading and riprap placement to ensure good contact with 'native ground' and soil fill.
2. Willow poles and brush layers shall extend down into expected soil moisture zones (vadose)
3. Cut small holes or slits in filter fabric as necessary.
4. Place soil fill (cobbles, gravel, soil) around cuttings.
5. Place riprap carefully, do not end dump. Some damage to brush layers and willow poles is unavoidable and acceptable. Deeply planted willow material will regenerate.



**VEGETATED  
RIPRAP  
DURING CONSTRUCTION**



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| <p style="text-align: center;"><b>BMP 10.21</b><br/><b>ROCK SLOPE PROTECTION</b></p> |
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## **DESCRIPTION**

Rock slope protection is a rock or rip rap matrix placed against a failed portion of slope to provide a buttress against additional failure. The weight and interlocking characteristics of large rip rap provide a stabilizing force. Rock slope protection is not used for streambank stabilization.

## **APPLICATIONS**

Rock slope protection may be employed to stabilize small slides, or to protect grade transitions adjacent to small structures against erosion. Rock slope protection does not provide protection against erosion due to overland flow, and should not be relied upon for energy dissipation from culvert outfalls or adjacent to bridge abutments.

## **LIMITATIONS**

This BMP should not be used:

- ✓ On any streambank (refer to Section 8.1, “Bank Stabilization,” and BMP 10.29)

## **CONSTRUCTION GUIDELINES**

Angular rock rip rap should be used, and should be sized to ensure a thickness of at least 2 courses over the slope failure. Filter fabric may be placed on the slope prior to the rock. If filter fabric is used, the edges should be buried to a depth of six inches (6”). Rock should be placed

## **BMP MAINTENANCE**

- ✓ During construction, inspect daily during the work week.
- ✓ Schedule additional inspections during storm events.
- ✓ Immediately repair any gaps, holes or scour.

## **BMP REMOVAL**

- ✓ Remove sediment buildup.
- ✓ Remove BMP. Recycle or re-use if applicable.
- ✓ Revegetate areas disturbed by BMP removal if applicable.

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| <b>BMP 10.22</b><br><b>ROLLING DIP</b> |
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## **DESCRIPTION**

Rolling dips are ridges or ridge-and-channels constructed diagonally across a sloping road or utility right-of-way that is subject to erosion to limit the accumulation of erosive volumes of water on roads by diverting surface runoff at designated intervals.

## **APPLICATIONS**

Rolling dips are gently sloping excavations running diagonally across the road surface, and are appropriate for winter use on unpaved roads and in areas prone to inundation due to culvert plugging. Rolling dips are much easier to traverse and require less maintenance than waterbars.

## **LIMITATIONS**

- ✓ Never outlet rolling dips onto unprotected fill slopes. Install energy dissipaters or overside drains at outlet ends.
- ✓ Use gravel to stabilize the diversion where significant vehicular traffic is anticipated.
- ✓ Rolling dips should not be constructed in areas of high speed vehicle travel.

## **CONSTRUCTION GUIDELINES**

- ✓ Rolling dips should be built at an angle of 45 to 60 degrees from the centerline.
- ✓ The diversion should have a positive grade of 2% minimum.
- ✓ For rolling dips the height from channel bottom to the top of the settled ridge shall be 18 inches and the side slopes of the ridge shall be 2:1 or flatter where practicable.
- ✓ The distance it takes for unrocked, unprotected running surface of a nearby road to develop a 1 inch rill is a rough measure of the appropriate spacing distance.
- ✓ Signs alerting motorists to the dip or waterbar shall be installed in both directions.

## **BMP MAINTENANCE**

- ✓ Periodically inspect waterbars and rolling dips. Inspect after every heavy rainfall for erosion damage. Immediately remove sediment from the flow area.
- ✓ Check outlet areas and make timely repairs as needed.

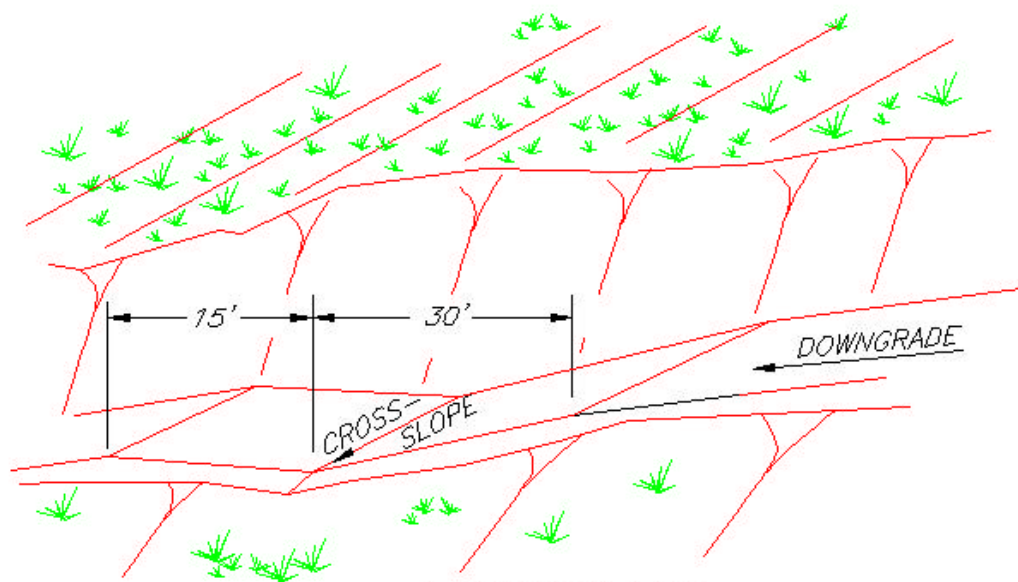
BMP: ROLLING DIP (continued)

## **BMP REMOVAL**

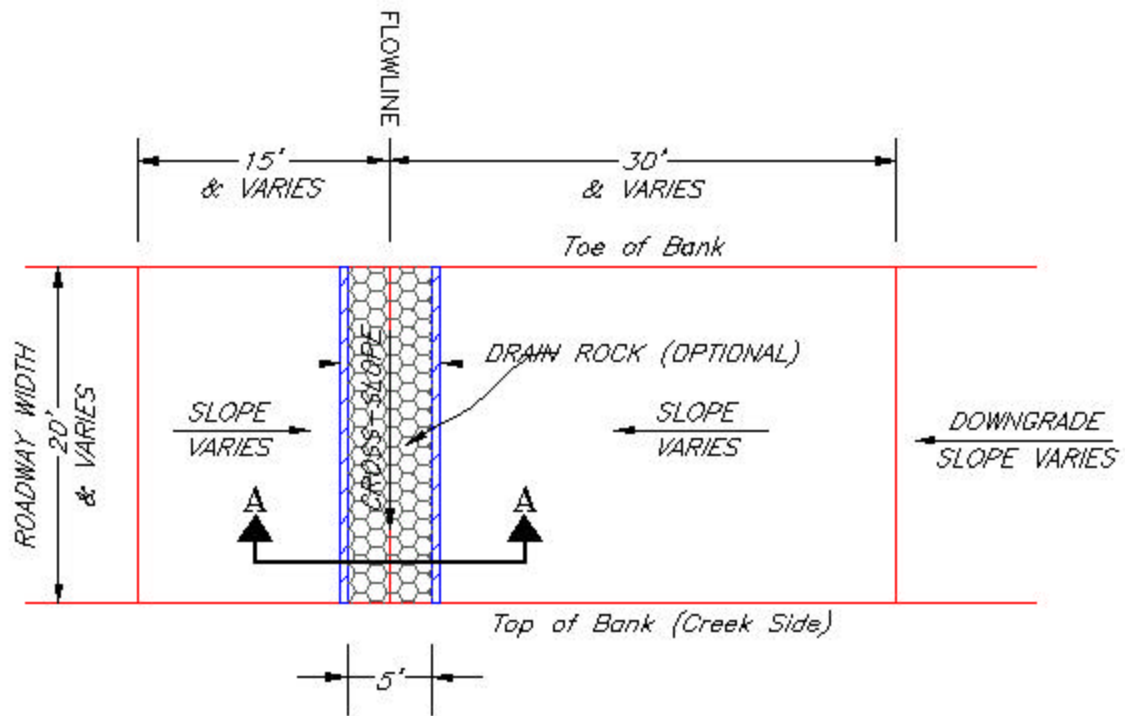
- ✓ BMP removal should not be necessary.

## **ADDITIONAL RESOURCES**

Handbook for Forest and Ranch Roads, Mendocino County Resource Conservation District, June 1994.



**ROLLING DIP**



**PLAN**

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|---|
| <b>BMP 10.23</b><br><b>SAND BAGS/ROCK SOCKS</b> |
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## **DESCRIPTION**

Sandbags and rock socks are pre-manufactured cloth or plastic bags filled with sand or gravel. Sandbags are generally impermeable, and can be used to keep water away from work areas and unstable slopes. Rock socks are permeable and are typically used to construct curb inlet sediment barriers. Sandbags are also used as protection against flooding, as ballast, and in the construction of cofferdams and clean water bypasses.

## **APPLICATIONS**

Sandbags may be used during emergencies to control the flow and level of water, or during construction to form dewatered areas such as cofferdams clean water bypasses. Sandbags placed around drainage inlets divert flow away from the inlet. Rock socks may be used to protect inlets by providing filtration of runoff while allowing flow to enter the storm drain system.

## **LIMITATIONS**

This BMP should not be used:

- ✓ as a permanent structure.

## **CONSTRUCTION GUIDELINES**

- ✓ When used in water bodies, this BMP must be used in accordance with permit conditions.
- ✓ Secure ends of sandbags to ensure material does not scatter.
- ✓ When used as a barrier, stack bags tightly together and in alternative (brick-layer) fashion.

## **BMP MAINTENANCE**

- ✓ During construction, inspect daily during the workweek. Schedule additional inspections during storm events. Make any required repairs.
- ✓ Replace damaged sandbags/rock socks.
- ✓ Remove sediment when deposits reach  $\frac{1}{2}$  the height of the sandbag barrier.
- ✓ Replace rock socks when  $\frac{1}{2}$  full of sediment, or when water no longer flows through rock sock or when water is not clean after flowing through rock sock.

## **BMP REMOVAL**

- ✓ Evaluate site to determine when BMP is no longer needed.
- ✓ Remove sediment buildup in front of BMP.
- ✓ Remove BMP, recycle and/or re-use if applicable.
- ✓ Revegetate area disturbed by BMP removal.
- ✓ Material in sandbags may be spread on slopes and stable areas where allowed by permit conditions.

|                                       |
|---------------------------------------|
| <b>BMP 10.24</b><br><b>SILT FENCE</b> |
|---------------------------------------|

## **DESCRIPTION**

A silt fence is a temporary sediment barrier consisting of fabric stretched across and attached to supporting posts and entrenched into the soil. It is generally installed perpendicular to the flow direction to slow or stop water and to allow perimeter filtration, settling of soil particles, and to reduce water velocity.

## **APPLICATIONS**

This BMP may be used for perimeter protection (around construction work sites, slide debris stockpiles, etc.). It may be used in combination with other BMPs.

## **LIMITATIONS**

This BMP should not be used:

- ✓ where rock or hard surfaces prevent full and uniform anchoring of the barrier.
- ✓ directly in streams or water courses.
- ✓ around drop inlets or in front of storm drain inlets.
- ✓ as a diversion dam.

## **CONSTRUCTION GUIDELINES**

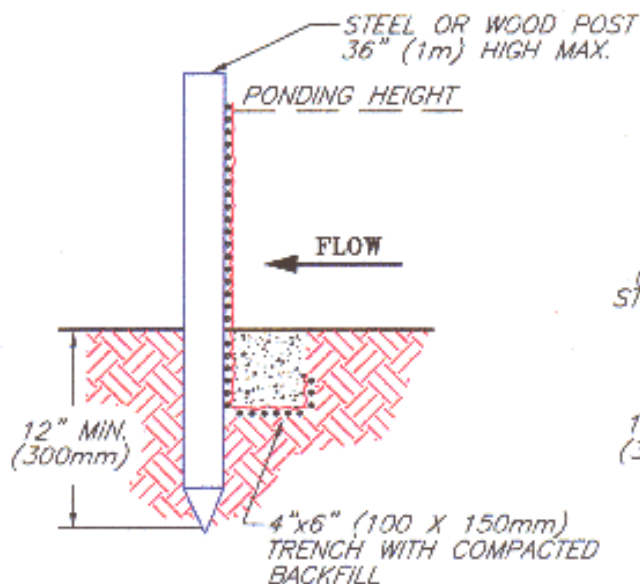
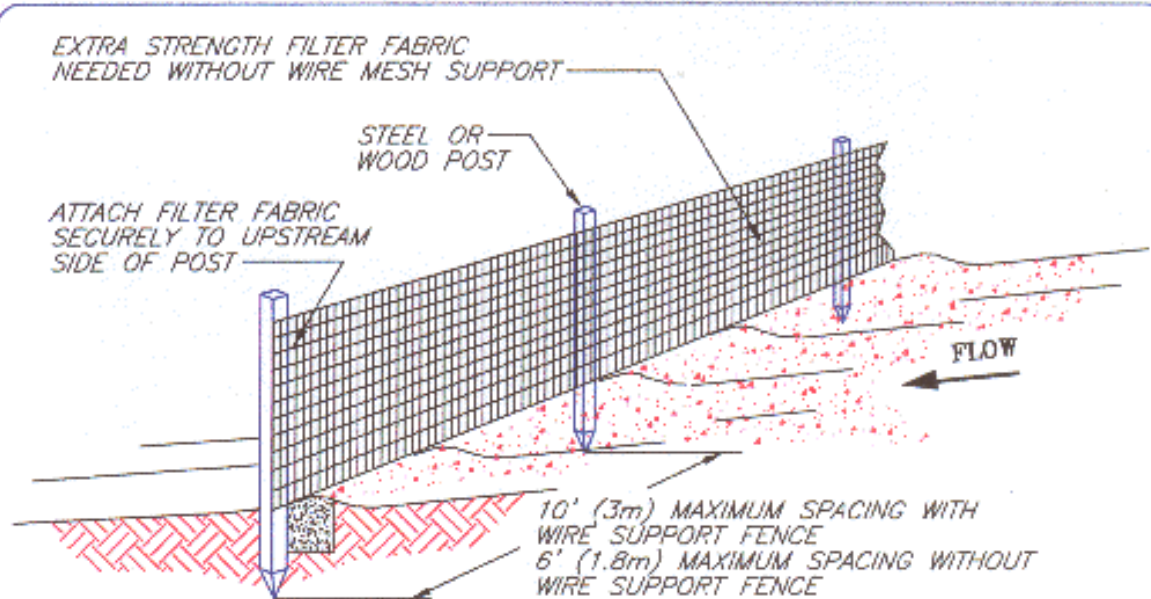
- ✓ Place silt fence along contours.
- ✓ Stakes or posts should be to the downhill side of the fence.
- ✓ The bottom of the fabric must be continuously and securely anchored for its entire length to prevent undermining.
- ✓ Increase the elevation at the ends of the BMP installation to prevent “end runs.”

## **BMP MAINTENANCE**

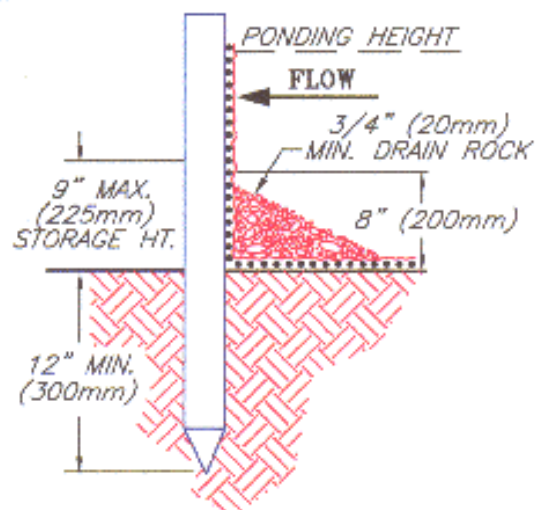
- ✓ During construction, inspect daily during the workweek. Schedule additional inspections during storm events. Make any required repairs.
- ✓ Replace damaged sections.
- ✓ Remove sediment when deposits reach ½ the height of the silt fence.

## **BMP REMOVAL**

- ✓ Evaluate site to determine when BMP is no longer needed.
- ✓ Remove sediment buildup in front of BMP.
- ✓ Remove BMP, recycle and/or re-use if applicable.
- ✓ Revegetate area disturbed by BMP removal.



**TRENCH DETAIL**



**INSTALLATION WITHOUT TRENCHING**

**NOTES:**

1. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.

2. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN NECESSARY. 9" (225mm) MAXIMUM RECOMMENDED STORAGE HEIGHT.

3. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT WILL NOT CONTRIBUTE SEDIMENT OFF-SITE AND CAN BE PERMANENTLY STABILIZED.

FILE: SILTFENC

NOT TO SCALE

**SILT FENCE**



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| <p style="text-align: center;"><b>BMP 10.25</b><br/><b>STORMWATER SEPARATION SYSTEMS</b></p> |
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### **DESCRIPTION**

Stormwater separation systems are engineered devices installed in storm drain facilities to remove solids, grease and other pollutants.

### **APPLICATIONS**

Stormwater separation systems may be installed where deep structures allow for their placement and maintenance, or where sufficient quantities of pollutant materials require regular removal in order for the storm drains to operate correctly.

### **LIMITATIONS**

This BMP should not be used:

- ✓ Where it will not be regularly maintained.
- ✓ In lieu of regularly scheduled inspection and cleaning.

### **BMP MAINTENANCE**

- ✓ Inspect and clean separation system at least twice annually, or as indicated by manufacturer.
- ✓ Schedule additional inspections during storm events.
- ✓ Remove debris, sediment, grease and pollutants and dispose of properly.
- ✓ Report debris removed for Countywide Stormwater Pollution Prevention Program.

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| <p style="text-align: center;"><b>BMP 10.26</b><br/><b>STRAW ROLL, STRAW LOG, COIR LOG</b></p> |
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## **DESCRIPTION**

Straw rolls/logs are manufactured from straw wrapped in netting. Coir logs are similar, but are filled with coconut fiber rather than straw. The logs are placed and staked in shallow trenches along the contour of newly constructed or disturbed slopes. They can be used to provide perimeter protection, settling, reduction in water velocity/erosive forces and habitat protection.

## **APPLICATIONS**

The BMP may be used for temporary soil stockpile protection, drop inlet protection, temporary check dams, bank or slope stabilization, and streambank toe protection. This BMP may be used for perimeter sediment control, and is preferred over silt fencing and straw bales. It may also be used to replace missing sections of earthen berms (example: above new ditch relief culverts).

Straw rolls/logs should be manufactured of rice straw or a sterile (non-seed bearing) straw to prevent the introduction of non-native grasses. Polypropylene or coir netting is preferred over plastic netting.

## **LIMITATIONS**

This BMP should not be used:

- ✓ where flow volume or water velocity inhibit its usefulness.

## **CONSTRUCTION GUIDELINES**

- ✓ Logs are placed in 2 to 3 inch deep trenches and staked along the contours of newly constructed or disturbed slopes.
- ✓ Log spacing depends on soil type and slope steepness.
- ✓ Adjacent logs shall be tightly abutted to prevent water flow and gully formation between logs.
- ✓ Ensure that logs are in contact with the ground in the trenches to prevent water flow under logs.
- ✓ Live staking may be used in conjunction with logs.

## **BMP MAINTENANCE**

- ✓ During construction, inspect daily during the work week.
- ✓ Schedule additional inspections during storm events.
- ✓ Make any required repairs immediately.
- ✓ For perimeter control installations (securing spoils, etc.), remove sediment deposits when they reach  $\frac{1}{2}$  the height of the log/roll.

## **BMP REMOVAL**

- ✓ Remove sediment buildup in front of BMP.
- ✓ Revegetation of the site may be necessary.
- ✓ Dispose of netting properly. Straw or coir filling may be used as mulch.
- ✓ BMP removal may not be necessary.

STRAW ROLLS MUST BE PLACED  
ALONG SLOPE CONTOURS

ADJACENT ROLLS SHALL  
TIGHTLY ABUT

10'-25' (3-8m)

SPACING DEPENDS  
ON SOIL TYPE AND  
SLOPE STEEPNESS

SEDIMENT, ORGANIC MATTER,  
AND NATIVE SEEDS ARE  
CAPTURED BEHIND THE ROLLS.

LIVE STAKE

3"-5" (75-125mm)  
8"-10" DIA.  
(200-250mm)  
1" X 1" STAKE  
(25 x 25mm)

NOT TO SCALE

NOTE:

1. STRAW ROLL INSTALLATION REQUIRES THE  
PLACEMENT AND SECURE STAKING OF THE ROLL IN  
A TRENCH, 3"-5" (75-125mm) DEEP, DUG ON  
CONTOUR. RUNOFF MUST NOT BE ALLOWED TO RUN  
UNDER OR AROUND ROLL.

**STRAW  
ROLLS**

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| <p style="text-align: center;"><b>BMP 10.27</b><br/><b>STREAMBANK STABILIZATION</b></p> |
|---|

## **DESCRIPTION**

This BMP utilizes native materials (large woody debris, vegetation, etc.) to stabilize streambanks. Streambank stabilization activities require permits.

## **APPLICATIONS**

Streambank stabilization techniques are appropriate adjacent to water bodies, on shallow slope failures, and in any location where native revegetation and/or natural construction materials and finishes are desired.

## **LIMITATIONS**

This BMP should not be used:

- ✓ without identifying potential impacts to upstream and downstream banks, structures and facilities.
- ✓ in or adjacent to water bodies until all necessary permits have been obtained.

## **CONSTRUCTION GUIDELINES**

- ✓ Guidelines will vary based on existing site conditions, size and shape of woody materials, forces exerted by moving water, etc.
- ✓ Construct in accordance with design and permit conditions.

## **BMP MAINTENANCE**

- ✓ Monitor finished streambanks to ensure stability and vegetative growth. Consult as necessary for adjustments and/or modifications to streambank stabilization installations.

## **BMP REMOVAL**

- ✓ BMP removal should not be necessary.

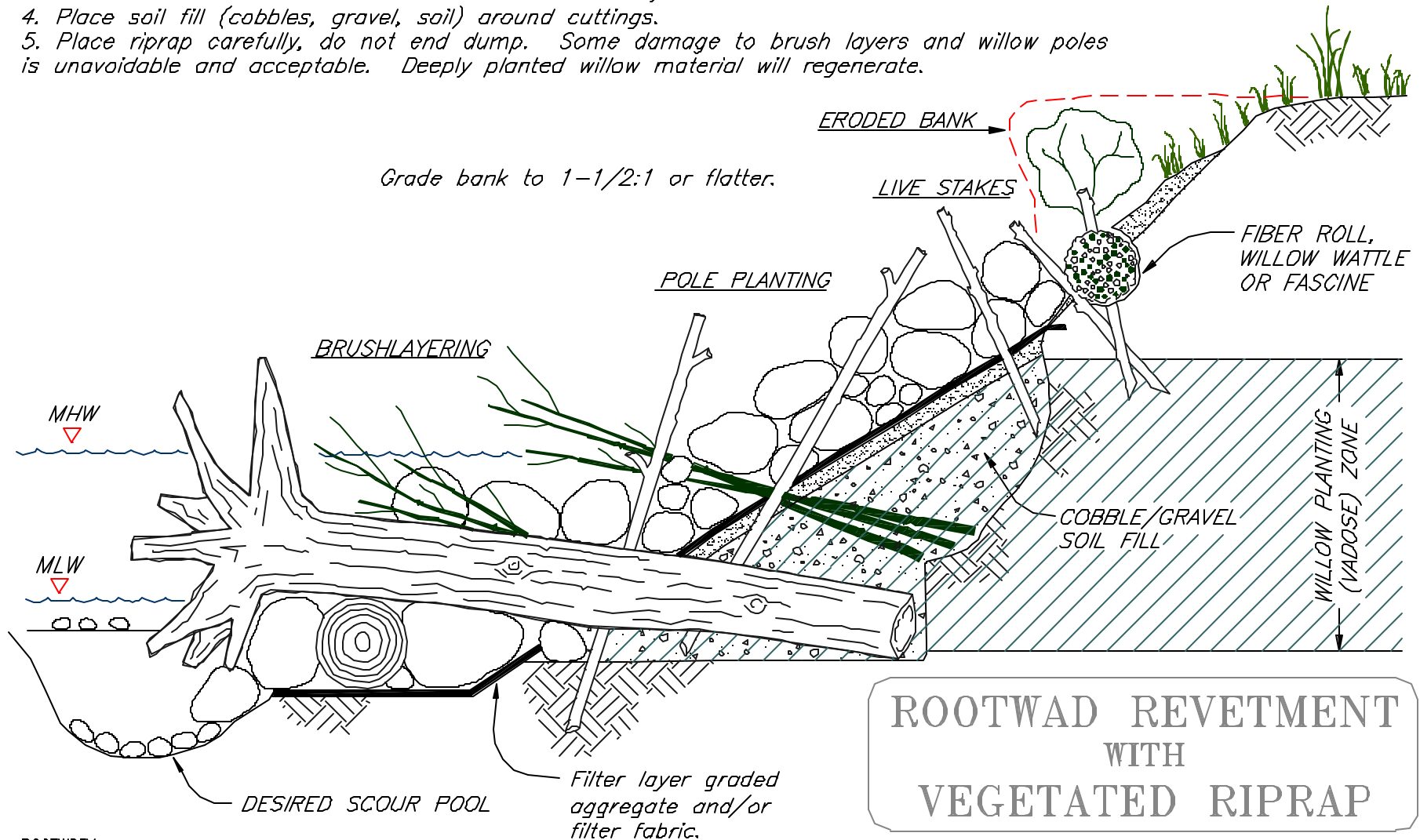
## **ADDITIONAL RESOURCES**

Bio Draw 1.0, Compendium of Biotechnical Soil Stabilization Solutions, Salix Applied Earthcare, 2000.

Guidelines for Bank Stabilization Projects in the Riverine Environments of King County, King County, Washington, Department of Public Works, June 1993.

**NOTES:**

1. Willow pole planting and brushlayering shall be installed during bank grading and riprap placement to ensure good contact with 'native ground' and soil fill.
2. Willow poles and brush layers shall extend down into expected soil moisture zones (vadose).
3. Cut small holes or slits in filter fabric as necessary.
4. Place soil fill (cobbles, gravel, soil) around cuttings.
5. Place riprap carefully, do not end dump. Some damage to brush layers and willow poles is unavoidable and acceptable. Deeply planted willow material will regenerate.



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| <p style="text-align: center;"><b>BMP 10.28</b></p> <p style="text-align: center;"><b>SURFACE ROUGHENING</b></p> |
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### **DESCRIPTION**

Surface roughening is a technique for roughening a bare soil surface with furrows running across the slope, stair stepping, or tracking with construction equipment. Surface roughening is intended to aid the establishment of vegetative cover from seed, to reduce runoff velocity and increase infiltration, and to reduce erosion and provide for sediment trapping.

### **APPLICATIONS**

All construction slopes require surface roughening to facilitate long-term stabilization with vegetation, particularly slopes steeper than 3:1.

### **LIMITATIONS**

Slopes may be impossible to get machinery on due to steepness of slope or difficult access. Hand raking across the slope may be the only way to roughen the surface.

This BMP should not be used:

- ✓ on slopes with a rock surface.
- ✓ unless simultaneous revegetation/seeding is planned.

### **CONSTRUCTION GUIDELINES**

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. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.
- ✓ Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- ✓ Groove the slope using machinery to create a series of ridges and depressions that run across the slope, on the contour.

Fill Slope Roughening:

- ✓ Place fill slopes with a gradient steeper than 3:1 in lifts not to exceed 8 inches, and make sure each lift is properly compacted.
- ✓ Ensure that the face of the slope consists of loose, uncompacted fill 4-6 inches deep.

#### BMP: SURFACE ROUGHENING (continued)

- ✓ Use grooving or tracking to roughen the face of the slopes, if necessary.
- ✓ Apply seed, fertilizer and straw mulch then track or punch in the mulch with the bulldozer.
- ✓ Do not blade or scrape the final slope face.

#### 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.
- ✓ Immediately seed and mulch roughened areas to obtain optimum seed germination and growth.

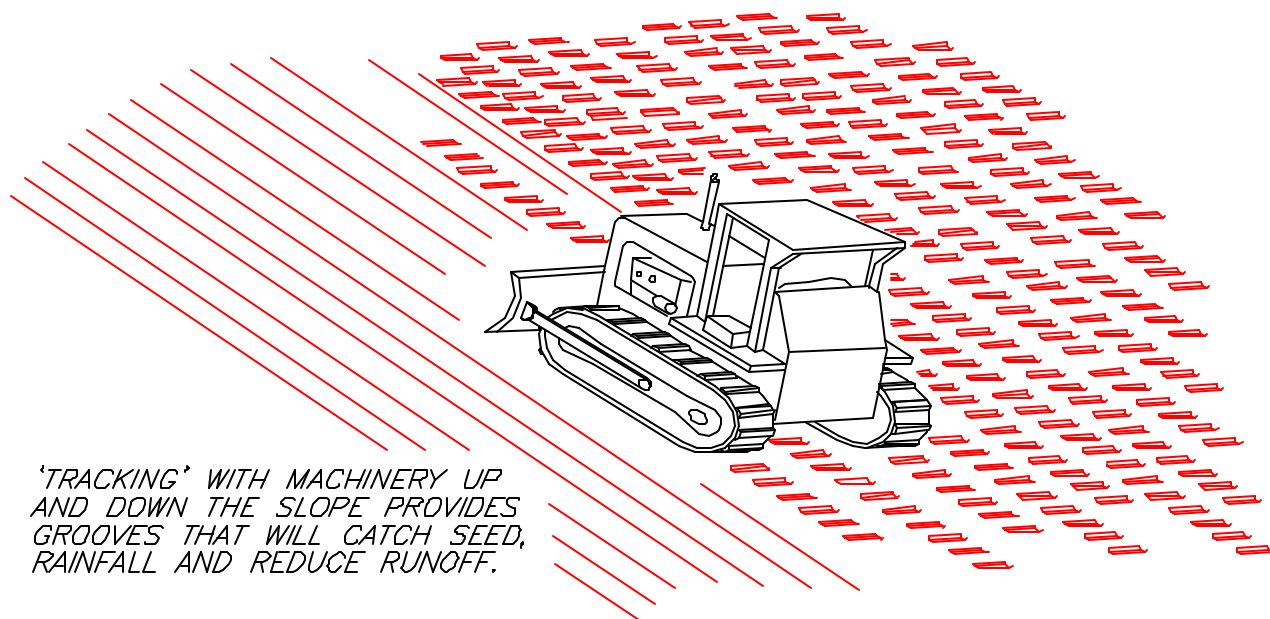
#### **BMP MAINTENANCE**

- ✓ During construction, inspect BMPs daily during the workweek.
- ✓ Schedule additional inspections during storm events. Check for erosion and sloughing, and make any required repairs.

#### **BMP REMOVAL**

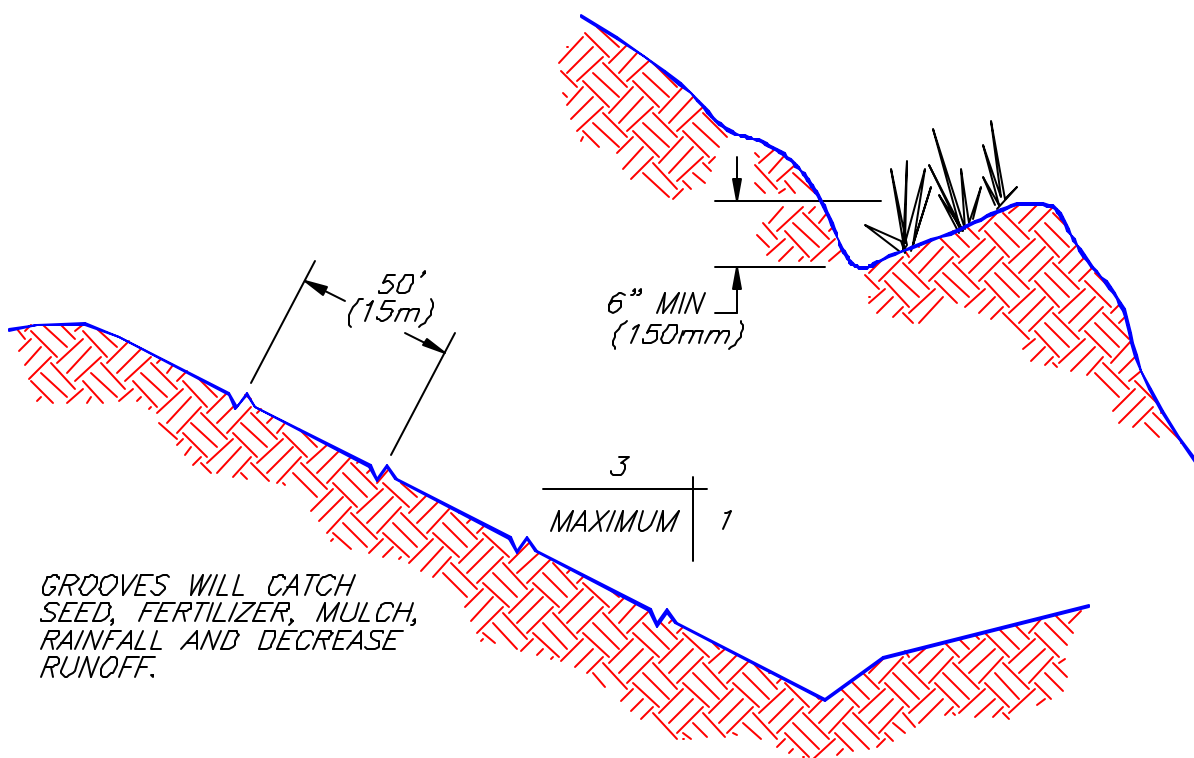
- ✓ BMP removal is not necessary.





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

## TRACKING



*GROOVES WILL CATCH SEED, FERTILIZER, MULCH, RAINFALL AND DECREASE RUNOFF.*

## CONTOUR FURROWS

## SURFACE ROUGHENING

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| <b>BMP 10.29</b><br><b>TIMING OF WORK</b> |
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**DESCRIPTION**

In general, routine maintenance and construction activities that remove vegetative soil cover and/or will potentially release sediment into stormwater will be conducted during the dry season (approximately April through October).

Activities that are subject to permit requirements will be conducted during the period authorized by the permits.

Bare soil surfaces resulting from maintenance and/or construction activities shall be covered with suitable erosion controls (fabrics, hydroseeding, mulch, etc.):

- ✓ No later than 3 days following the disturbance during the rainy season (approximately November through March).
- ✓ No later than 7 days following the disturbance during the dry season (approximately April through October).

Every effort shall be made to immediately cover bare soil surfaces resulting from maintenance and/or construction activities prior to storms.

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| <p><b>BMP 10.30</b></p> <p><b>TRAFFIC CONTROL</b></p> |
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**NOTE: THIS SECTION UNDER DEVELOPMENT IN ROAD SERVICES SECTION.**

**DESCRIPTION**

Traffic control protects workers and the motoring public, and aids in the prevention of vehicle accidents at construction sites.

**APPLICATIONS**

**LIMITATIONS**

**CONSTRUCTION GUIDELINES**

**BMP REMOVAL**

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| <b>BMP 10.31</b><br><b>VEGETATIVE BUFFER</b> |
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**DESCRIPTION**

A vegetative buffer is a strip of vegetation adjacent to sensitive areas, ditches, pavement and water bodies. This BMP prevents soil from becoming water borne, and may help restore shallow slope failures by trapping soil and debris.

**APPLICATIONS**

This BMP may be used adjacent to ditches and/or sensitive areas and water bodies, parallel to roadways, parking lots, etc. It may be used in combination with other BMPs.

**LIMITATIONS**

This BMP should not be used:

- ✓ if it creates a potential public safety hazard.

**CONSTRUCTION GUIDELINES**

- ✓ Existing vegetation shall be preserved as a buffer to the greatest extent possible.
- ✓ Use live staking, brush layering, wattles/fascines and/or seeding methods to restore vegetative buffers after disturbances.

**BMP MAINTENANCE**

- ✓ Mow, trim or selectively harvest the vegetative buffer in accordance with applicable permits and/or approved vegetation management plans.
- ✓ Revegetate as necessary.

**BMP REMOVAL**

- ✓ BMP removal is not necessary.

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| <p style="text-align: center;"><b>BMP 10.32</b></p> <p style="text-align: center;"><b>VEGETABLE-BASED EQUIPMENT OIL</b></p> |
|---|

**NOTE: PROPOSED USE OF VEGETABLE OIL IN SAN MATEO COUNTY EQUIPMENT IS CURRENTLY UNDER REVIEW IN ROAD SERVICES. DETAILS FOR THIS SECTION PENDING.**

**DESCRIPTION**

Vegetable-based equipment oil may replace petroleum products for use in some types of equipment. Vegetable oils may be preferred in sensitive aquatic habitats.

**APPLICATIONS**

**LIMITATIONS**

**SPECIFICATIONS**

**BMP MAINTENANCE**

✓

**BMP DISPOSAL**

✓

|   |
|---|
| <b>BMP 10.33</b><br><b>WATTLES/FASCINES</b> |
|---|

**DESCRIPTION**

Wattles and fascines are live branch cuttings, usually willows, bound together into long, tubular bundles used to stabilize slopes and stream banks. Both wattles and live fascines are true biotechnical practices. The live branches and live stakes provide the biological element while the stems, rope ties and wedge shaped wooden stakes all combine to provide the structural elements. Fascines differ from wattles in that the branch cuttings all point in the same direction in fascines, where they may point in either direction in wattles. Wattles are typically aligned on contour, where fascines are angled slightly upslope (and thus tend to produce more vigorous growth).

**APPLICATIONS**

Wattles/fascines may be used for long slopes, road fills, road cuts, gullies or slumped areas, eroded slopes or eroding stream banks. May be used to repair small earth slips and slumps or to protect slopes from shallow slides 1-2 feet deep. Wattles/fascines may be used to stabilize entire cut or fill slopes or localized gully areas of slopes, or may be installed on newly built slopes or as a remedial action on existing slopes. This technique is useful on slopes requiring other planting materials such as woody vegetation, transplants and grasses. Wattles/fascines enhance conditions for natural invasion and the establishment of other plants from the surrounding plant community.

**LIMITATIONS**

- ✓ Plant material harvest and installation must be performed during the dormant season, late fall through early spring.
- ✓ Where increased infiltration may cause slope failures, fascines should be used instead of wattles to ensure positive drainage.

**CONSTRUCTION GUIDELINES**

Wattles/fascines should be pre-soaked for 24 hours or installed on the same day they are harvested and prepared. Wattles/fascines must be stored in the shade and under cover, preferably in water. Use site reconnaissance to identify species and site conditions on adjacent sites and compare their conditions to the construction site. Planting will be more successful as the soil, site conditions, and species selected match stable and vegetated nearby sites.

Cuttings shall be tied together to form bundles, tapered at each end, 6-30 feet in length, depending on site conditions or limitations in handling. The completed bundles should be 6-12 inches in diameter. Stagger the cuttings in the bundles so that the tips are evenly distributed throughout the length of the bundle.

Wattle/fascine bundles shall be compressed and tightly tied with rope or twine of sufficient strength and durability. Polypropylene 'tree rope' approximately 3/16 inch in diameter provides the necessary strength and durability. Bundles shall be tied 12-15 inches apart.

**Table 1: General Installation Guidelines**

| Slope<br>(H:V) | Slope Length Between<br>Wattles/Fascines<br>(feet) |
|----------------|--|
| 1:1 to 1.5:1   | 3-4  |
| 1.5:1 to 2:1   | 4-5  |
| 2:1 to 2.5:1   | 5-6  |
| 2.5:1 to 4:1   | 6-8  |
| 3.5:1 to 4:1   | 8-12   |
| 4.5:1 to 5:1   | 10-20  |

Perform any slope repairs prior to wattle/fascine installation.

Beginning at the base of the slope, dig a trench on contour. The trench shall be shallow, about ½ the diameter of the wattle. The trench width will vary from 12-18 inches depending on the slope angle. Place the wattles immediately after trenching to reduce desiccation of the exposed soil. Wattles shall be staked firmly in place with one row of construction stakes on the downhill side of the wattling, not more than 3 feet apart. second row of stakes shall be placed through the wattles, near the ties, at not more than 5 feet apart. Overlap the tapered ends of adjacent wattles so the overall wattle thickness of the wattle is uniform. Two stakes shall be used at each bundle overlap such that a stake may be driven between the last two ties of each wattle.

Live stakes, if specified, are generally installed on the downslope side of the bundle. Drive the live stakes below and against the bundle between the previously installed construction stakes. Proper backfilling is essential to the successful rooting of the wattles. Backfill wattles with soil from the slope or trench above. The backfill shall be worked into the wattle interstices and compacted behind and below the bundle by walking on and working from its wattling terrace.

Repeat the proceeding steps to the top of the slope. Place moist soil along the sides of the live bundle. The top of the bundle should be slightly visible when the installation is completed. Plant the slope as specified.

Seed and mulch slope, if specified. Shallow slopes, generally 3:1 or flatter may be seeded and mulched by hand. Steeper slopes can have seed applied hydraulically and the mulch should be anchored with tackifier or other approved methods.

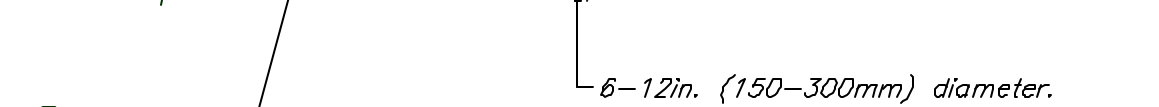
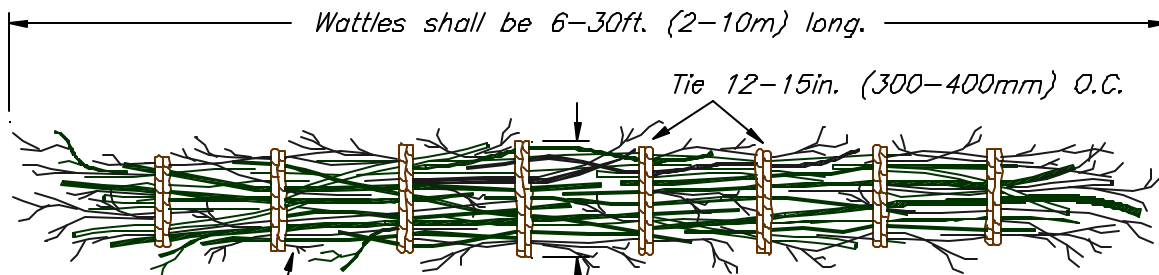
### **BMP MAINTENANCE**

- ✓ Regular inspection and maintenance of wattle installations should be conducted, particularly during the first year.
- ✓ Staked area may need to be watered during summer months.
- ✓ Rills and gullies around or under wattles shall be repaired immediately.

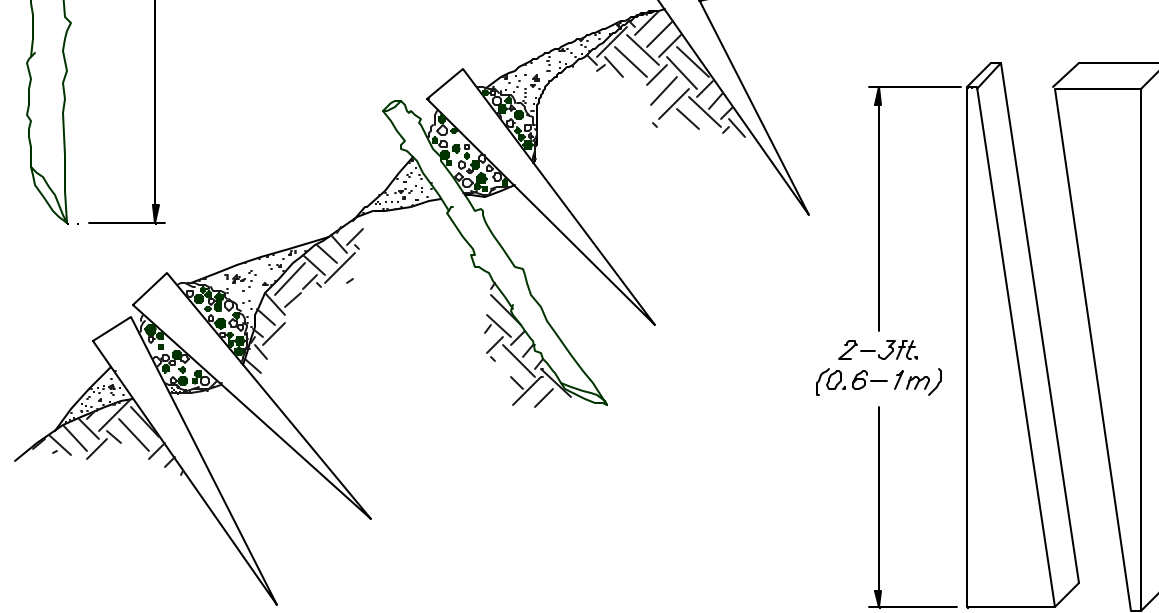
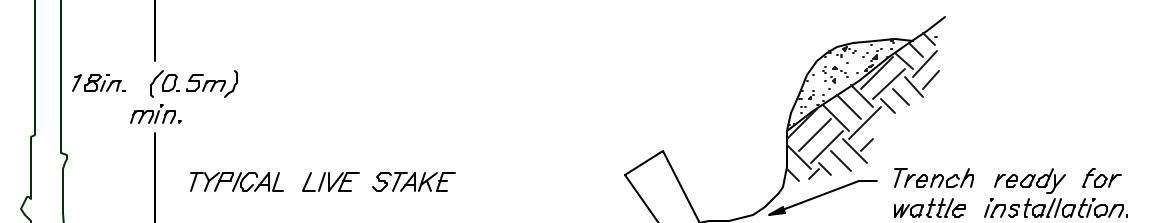
### **BMP REMOVAL**

- ✓ BMP removal is not necessary.





Prepare wattles with 1/4-1/2in. (6-40mm) cuttings with alternating butt-ends and tied securely with twine or rope.



Typical construction stake, saw 2X4 (50X100mm) lumber on diagonal.

#### NOTES:

1. Harvest and install wattles during dormant season or favorable conditions
2. Install wattles on slope contours.
3. All work proceeds from the bottom of the slope to the top.
4. Fill or partially cover wattle with soil from slope or trench above.
5. Compact and work soil into completed wattles.

WATTLE