

# APPENDIX A – BMP TOOLBOX

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## **ROAD DRAINAGE BMPS**

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## **BMP- OUTSLOPING**

### DESCRIPTION

Roads constructed with an outsloped pitch allow runoff to disperse along the entire road's edge instead of concentrating flow within an inboard ditch. The purpose is to minimize the interruption of surface and subsurface water patterns, minimize water concentration along roads, and maximize water dispersal.

### APPLICATIONS

Used on low speed roads on side slopes where fillslopes are stable.

### LIMITATIONS

- Rolling dips are required at intervals to disperse water off the road surface.
- A rocked or paved road surface is necessary to maintain an outsloped road.
- Outsloping may not be appropriate on curves or other areas where vehicles may slip off the outside edge. A crowned road or insloped road may be required in such cases.

### CONSTRUCTION GUIDELINES

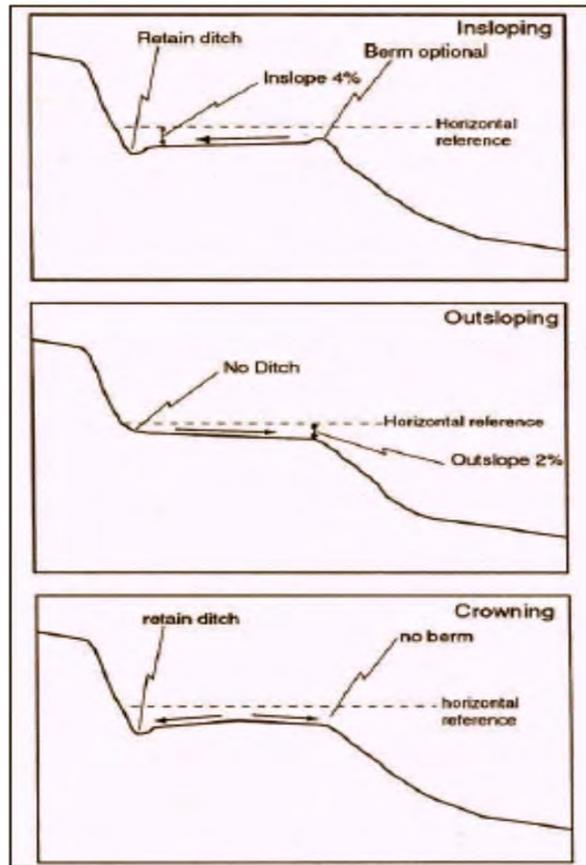
- 1) Frequency of rolling dips and the amount of outboard pitch required to maintain a good road varies with grade (see details).
- 2) When fill slopes are stable, the road should be designed with a minimum width and a gentle (3-4%) outslope.
- 3) Rolling dips are preferred to waterbars, which should be used only where winter use of the road is limited. Waterbars will break down or breach with extended traffic and create the need for higher maintenance.

### BMP MAINTENANCE

- Roads should be inspected frequently to repair signs of erosion or wear on the surface and in the rolling dips or waterbars.

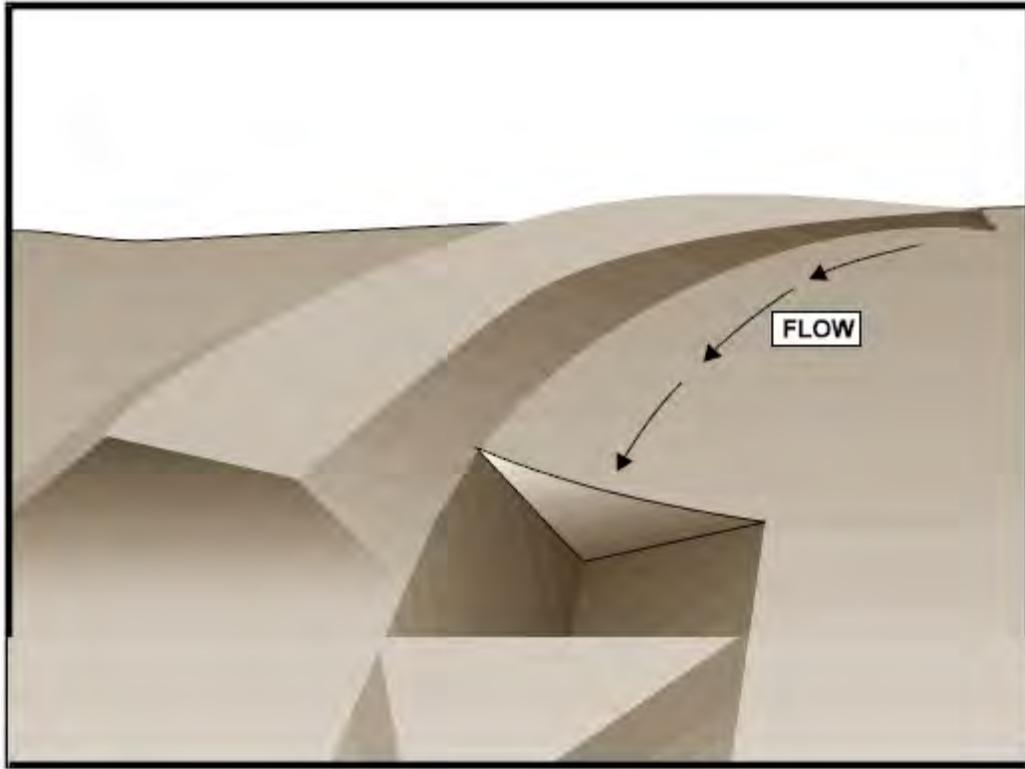
### BMP REMOVAL

N/A



Utilizing road shape to reduce surface run-off rates. (DFG CA Salmonid Stream Habitat Restoration Manual Ch. X)

Maximum suggested road surface drainage spacing based on road gradient and soil composition			
Soil composition	Road gradient (%)		
	2% - 4%	5% - 8%	9% - 12%
Granitic or sandy	400	300	200
Clay or loam	500	400	250
Shale or gravel	600	500	300



## **BMP- DITCH RELIEF CULVERTS**

### DESCRIPTION

Ditch relief culverts (DRCs) divert water from an inside road ditch to an outside area beyond the outer edge of the road fill. Ditch relief culverts take the flow through or beneath the road surface. Ditch relief culverts may also be used to filter water in a buffer zone prior to entering a waterway, provided the historical path of the flow of water is not changed.

### LIMITATIONS

- Culverts should be designed and installed at intervals along the road that are close enough to prevent erosion of the ditch and at the culvert outfall, and at locations where collected water and sediment is not discharged directly into watercourses.
- Ditches should neither be discharged directly into the inlet of a watercourse crossing culvert, nor should ditch relief culverts discharge into a watercourse without first directing flow through an adequate filter strip.

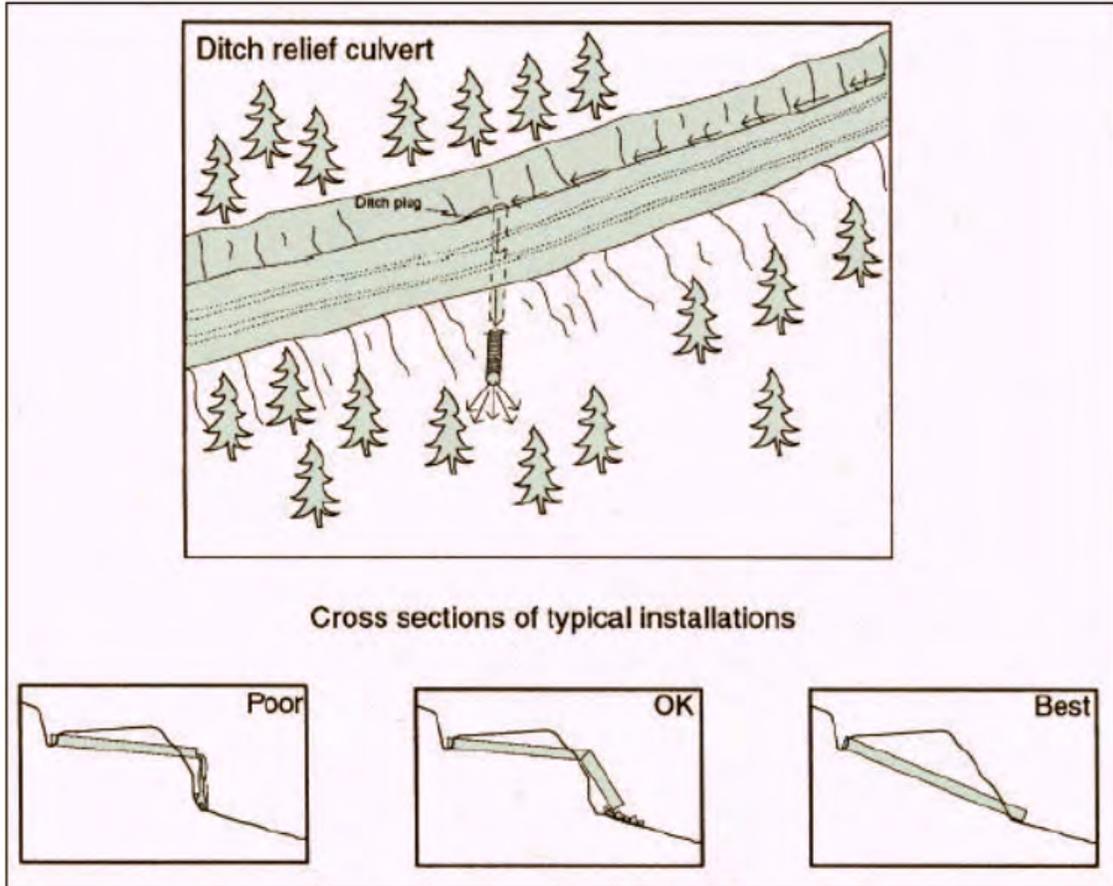
- In addition to installing ditch relief culverts on either approach to watercourse crossings, it is also advisable to consider installing ditch drains before curves, above and below through-cut road sections, and before and after steep sections of the road.
- DRCs should not be used on erosive slopes without a downspout.

### CONSTRUCTION GUIDELINES

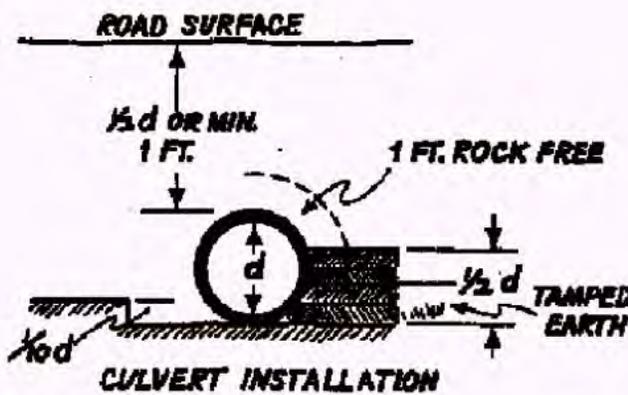
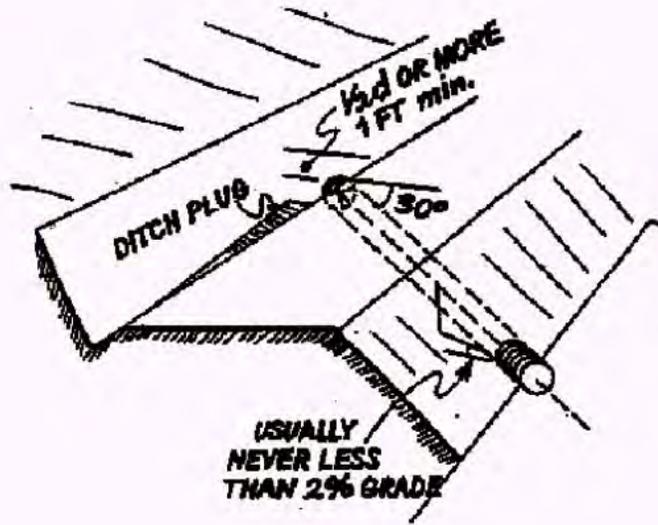
- 1) In areas of high erosion and/or storm runoff, minimum ditch relief culvert sizes should be 18 inches in diameter, and never less than 12 inches in other areas.
- 2) A 10% grade to the culvert will usually be self cleaning. The culvert grade should also be at least 2% greater than the ditch which feeds it. The culvert should be placed at a 30 degree skew to the ditch to improve inlet efficiency and prevent plugging and erosion at the inlet.
- 3) Culverts should be installed at the gradient of the original ground slope, so it will emerge on the ground surface beyond the base of the fill. If not, either the fill below the culvert outlet should be armored with rock, or the culvert should be fitted with an anchored downspout to carry erosive flow past the base of the fill.
- 4) The pipe should be covered by a minimum of 1 foot of compacted soil, or a depth of 30% of its diameter, whichever is greater.
- 5) Inlet protection, such as rock armoring or drop structures, can be used to help minimize erosion.
- 6) On new roads, ditch flow should be culverted and discharged into buffer areas and filter strips before it reaches a watercourse crossing.
- 7) DRCs must be spaced frequently enough to carry ditch and road surface waters without creating erosive concentrated flows. See attached table for spacing guidelines.

### BMP MAINTENANCE

- Regular inspection and maintenance to remove debris.
- To ensure proper working condition, culverts need to be inspected and maintained for any signs of erosion after storms.



Typical ditch relief culvert installation. (DFG CA Salmonid Stream Habitat Restoration Manual. CH X, 2002).



Source:  
 Weaver, William E. PhD and Danny Hagans,  
 Pacific Watershed Associates. Handbook for  
 Forest and Ranch Roads. Prepared for the  
 Mendocino County Resource Conservation  
 District, June 1994.

## DITCH RELIEF CULVERTS

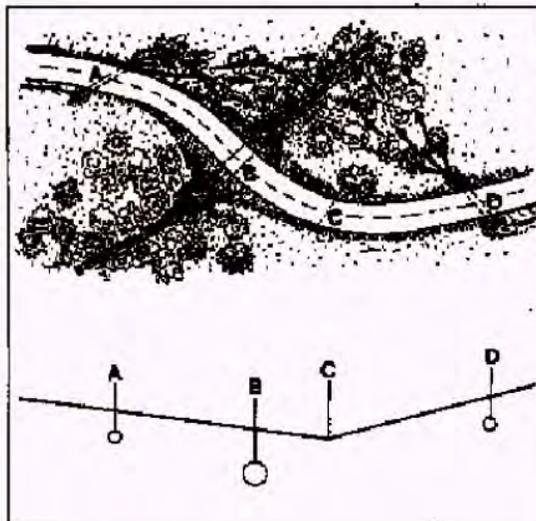
Sheet 1 of 2

Maximum suggested spacing for ditch relief culverts <sup>1</sup> (ft)					
Road grade (%)	Soil erodibility				
	very high	high	moderate	slight	very low
2	600-800 <sup>2</sup>				
4	530	600-800 <sup>2</sup>			
6	355	385	600-800 <sup>2</sup>		
8	265	425	525	600-800 <sup>2</sup>	
10	160	340	420	555	
12	180	285	350	460	600-800 <sup>1</sup>
14	155	245	300	365	560
16	135	215	270	345	490
18	118	190	240	310	435

1. Adapted from Transportation Handbook U.S.D.A. Forest Service, R-6, 1966.

2. Spacing greater than 600 feet generally not recommended.

Where a road approaches a stream crossing (B), ditch flow should be culverted across the road (A, D) and discharged into a vegetated buffer that can filter the runoff before it reaches the watercourse. If the stream culvert plugs with debris or is topped by flood flows, flow will spill over the road at the change-in-grade at location "C" and back into the stream channel. (modified from M.D.S.L., 1991)



Source:

Weaver, William E. PhD and Danny Hagans, Pacific Watershed Associates. Handbook for Forest and Ranch Roads. Prepared for the Mendocino County Resource Conservation District, June 1994.

## DITCH RELIEF CULVERTS

Sheet 2 of 2

# **BMP- CRITICAL DIP**

## DESCRIPTION

A relief outlet or drainage feature in the roadbed which captures overflow from culverted crossings and redirects the overflow back into the original channel. Construction may be similar to BMP – Rolling Dip (Road Surface BMPs).

## APPLICATIONS

For stream crossings with high diversion potential wherever the road climbs through the crossing and one approach slopes away from the stream crossing. The Critical Dip will prevent stream diversion down the road if the culvert plugs.

## LIMITATIONS

- Must be deep enough that it is not obliterated by normal grading, but not so deep that it is difficult to negotiate or a hazard to normal traffic.

## CONSTRUCTION GUIDELINES

1) Stream crossings should be constructed to prevent diversion of flood overflow if the culvert were to become plugged. This can be done by designing the road to dip into and out of the stream at the crossing site or by installing a broad rolling dip on the down-road side of the crossing. This will allow the overflow to be directed back into the natural stream channel.

2) Road surface and fill slopes at the critical dip should be rocked or otherwise stabilized.

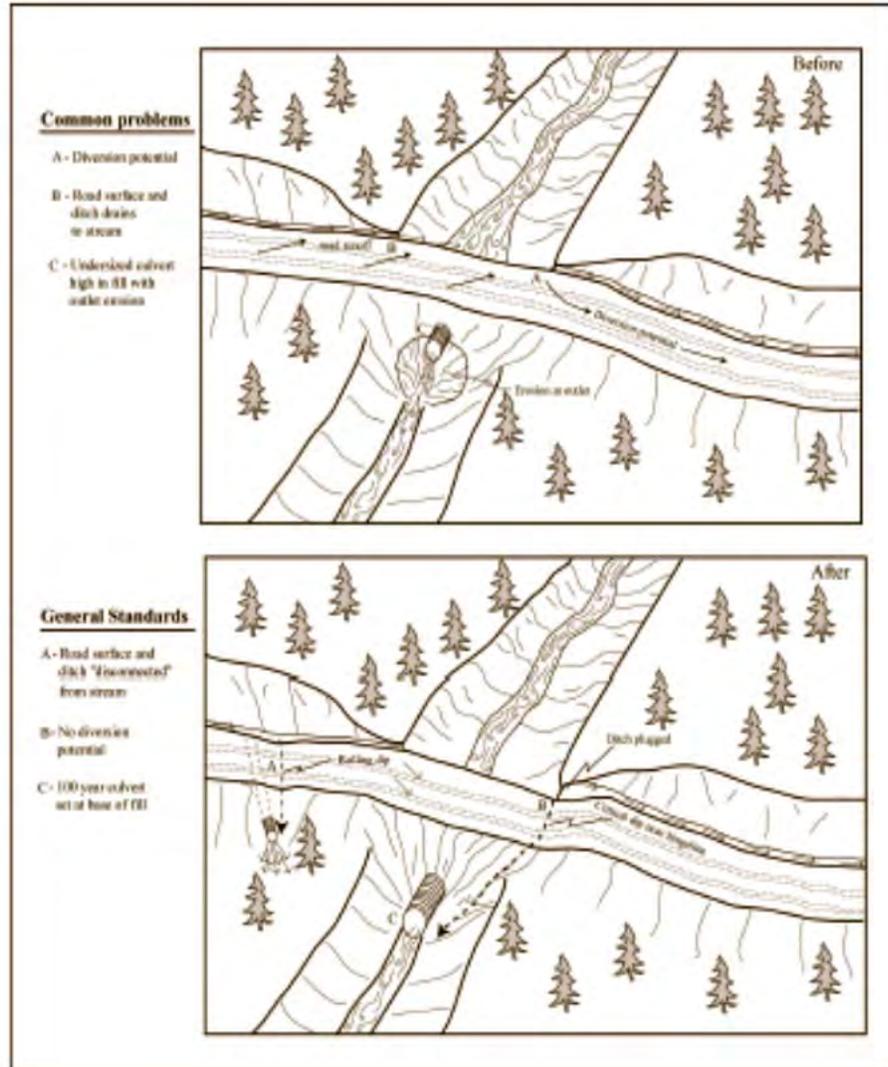
## BMP MAINTENANCE

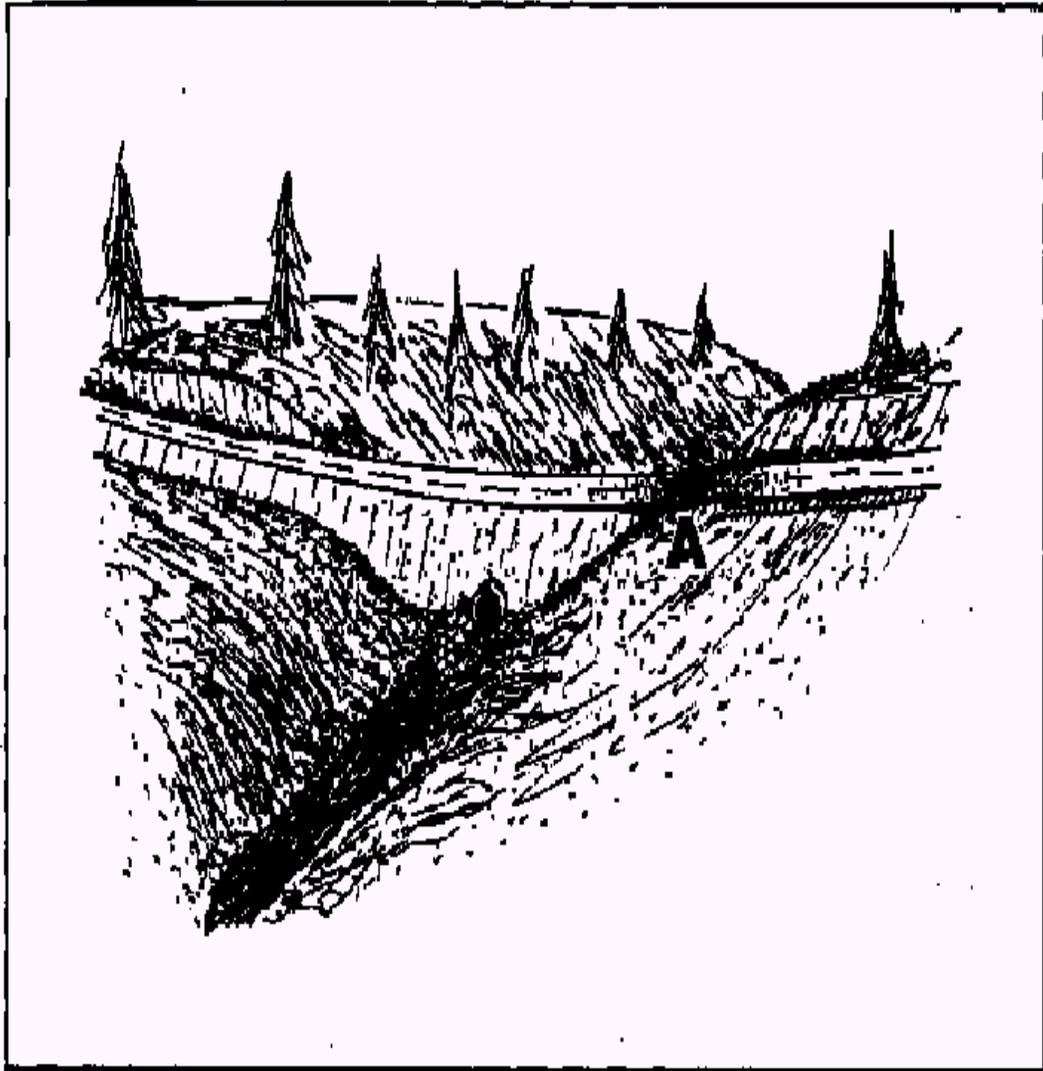
- Check outlet for erosion and repair as needed.
- Periodically inspect before and during rainy season. Remove sediment buildup, repair ruts.

## BMP REMOVAL

- N/A

Upgraded stream crossing with Critical Dips installed to direct drainage.(DFG CA Salmonid Stream Habitat Restoration Manual Ch. X, 2002).





If culvert plugs, flow would reach the road surface and flow back into the channel at location "A" where the road changes grade.

### ***Critical Dip***

SLO COUNTY ROAD MAINTENANCE AA-10

# **BERM REMOVAL**

## DESCRIPTION

This BMP refers to removal of specific berms (see below) along roadsides that have been created either as side-cast from road grading operations, constructed as roadside safety bumpers, or as water diversion barriers. These types of berms are typically made of soil or road base to a height of one-half to one and a half feet in height. Berms on the downslope side or outside of an outsloped road can allow water to concentrate on road surfaces for long distances.

## APPLICATIONS

Removal or frequent breaching of berms in many cases is recommended to prevent water from concentrating and forming rills and gullies. **Frequent dispersal** of water off road surfaces is the key to road-related erosion control.

## LIMITATIONS

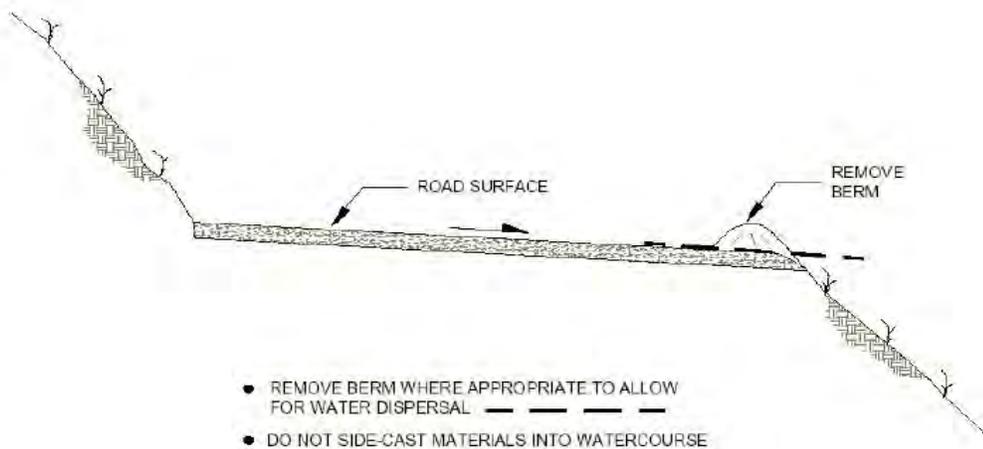
- 1) Care must be taken so that spoils from berm removal are not deposited into a watercourse.
- 2) Some berms must be left in place where it is necessary to keep water from flowing onto sensitive areas.
- 3) Some berms may keep vehicles from sliding off the road – there are alternatives, however such as coarse road base with good traction, less road outslope, insloped or crowned road surfaces, or guard rails.

## CONSTRUCTION GUIDELINES

- 1) Mark the specific areas for berm removal before grading begins.
- 2) Consider whether the berm or an alternative device is needed where slippery road surfaces are present, especially where roads outslope on steep embankments.
- 3) Wherever possible, pull the berm material back into the road and incorporate into the road surface. Care must be taken not to interrupt other drainage facilities such as **rolling dips** or **critical dips**. Moistening and compacting the material may be required.
- 4) If there is too much material to incorporate into the road surface, the material must be end-hauled to a stable area where it will not erode into a watercourse.
- 5) In some cases, specifically gentle slopes away from watercourses, pushing the material off the side of the road may be warranted. All areas of bare soil greater than 100 square feet should be seeded and mulched before the end of October.
- 6) The final surface grade where berms have been removed must be outsloped to allow water to run off the road surface to the downhill side.

## **BMP MAINTENANCE**

- Where berm breaches plug, they must be unplugged. Winter monitoring before and/or after major storm events may be required.
- Where berms re-form, they must be removed.
- Tire tracks and ruts in dirt road surfaces may short-circuit the benefits of berm removal. Re-grading or digging ditch outlets by hand may be required.

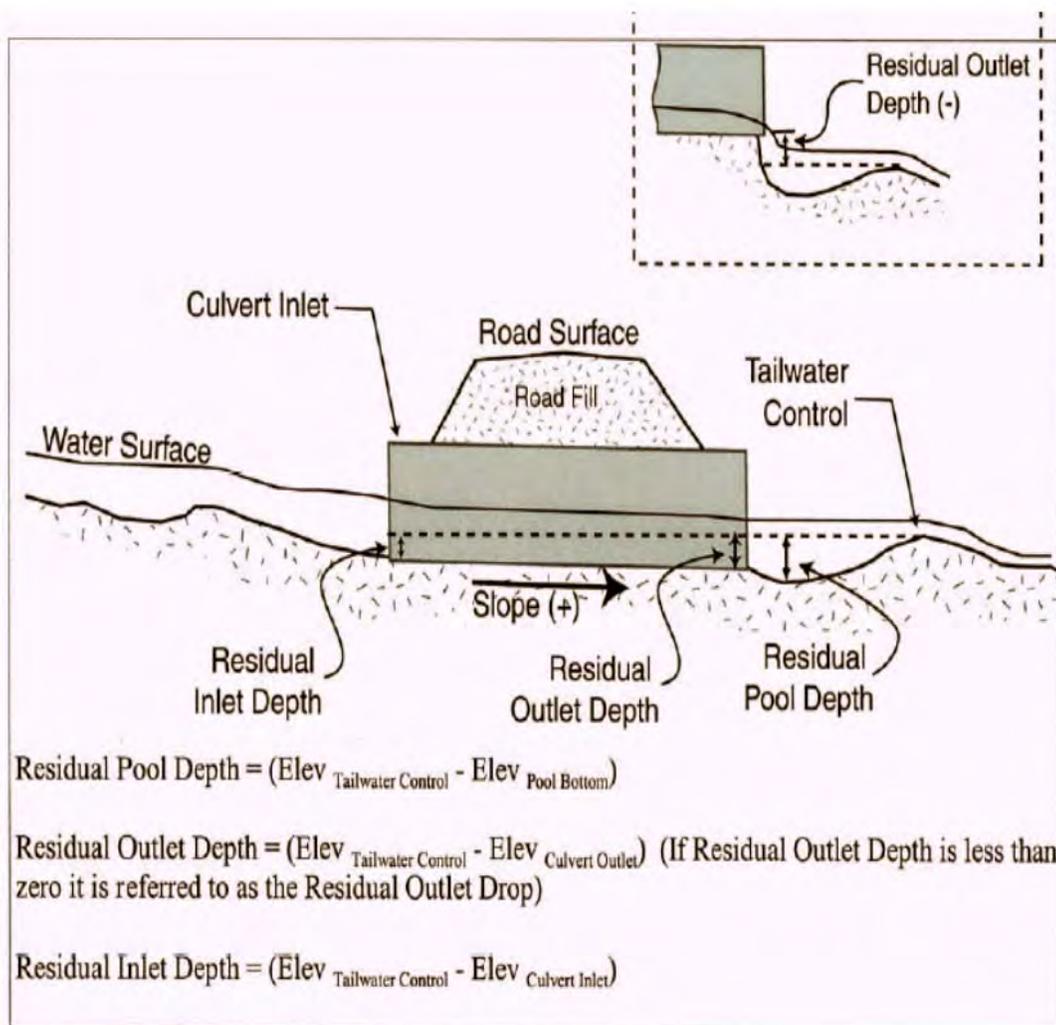


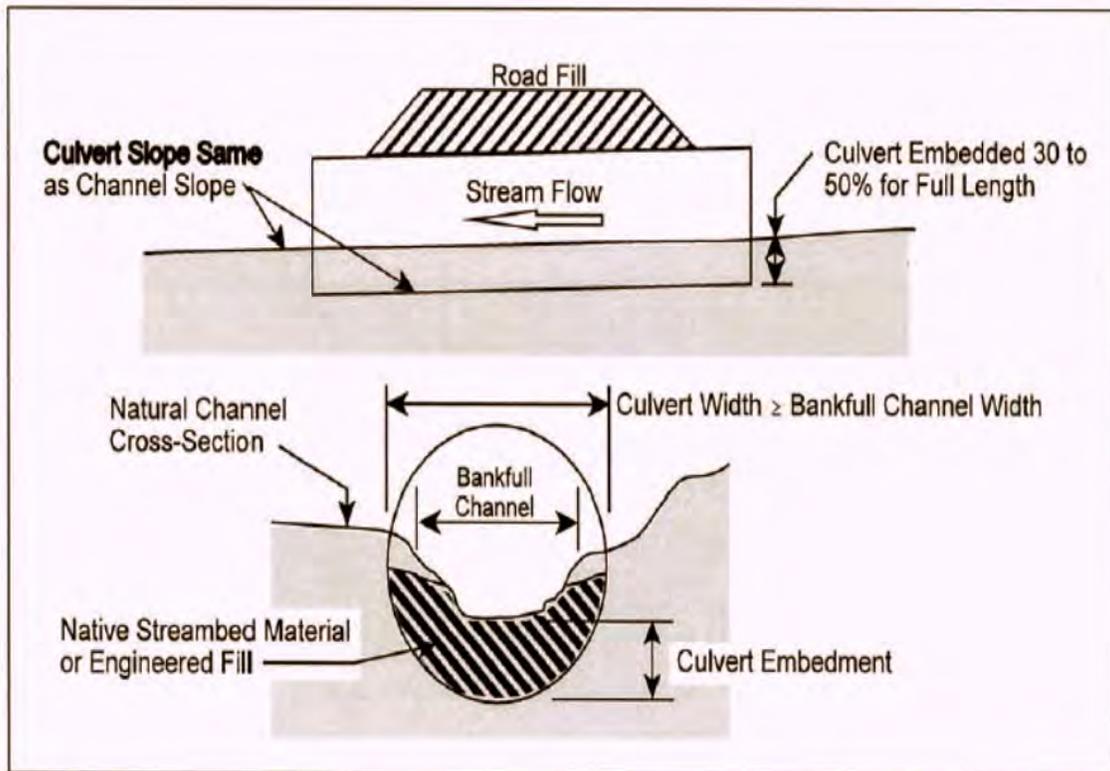
## **Culvert BMPs**

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**Note:** For detailed specifications on fish passage through county structures, see NOAA Fisheries Guidelines for Salmonid Passage at Stream Crossings, and Passage Criteria for All Aquatic Life Forms, in Chapter IX of the California Salmonid Stream Habitat Restoration Manual CDFG, 2002 and also found at: <http://www.dfg.ca.gov/nafwb/pubs>.

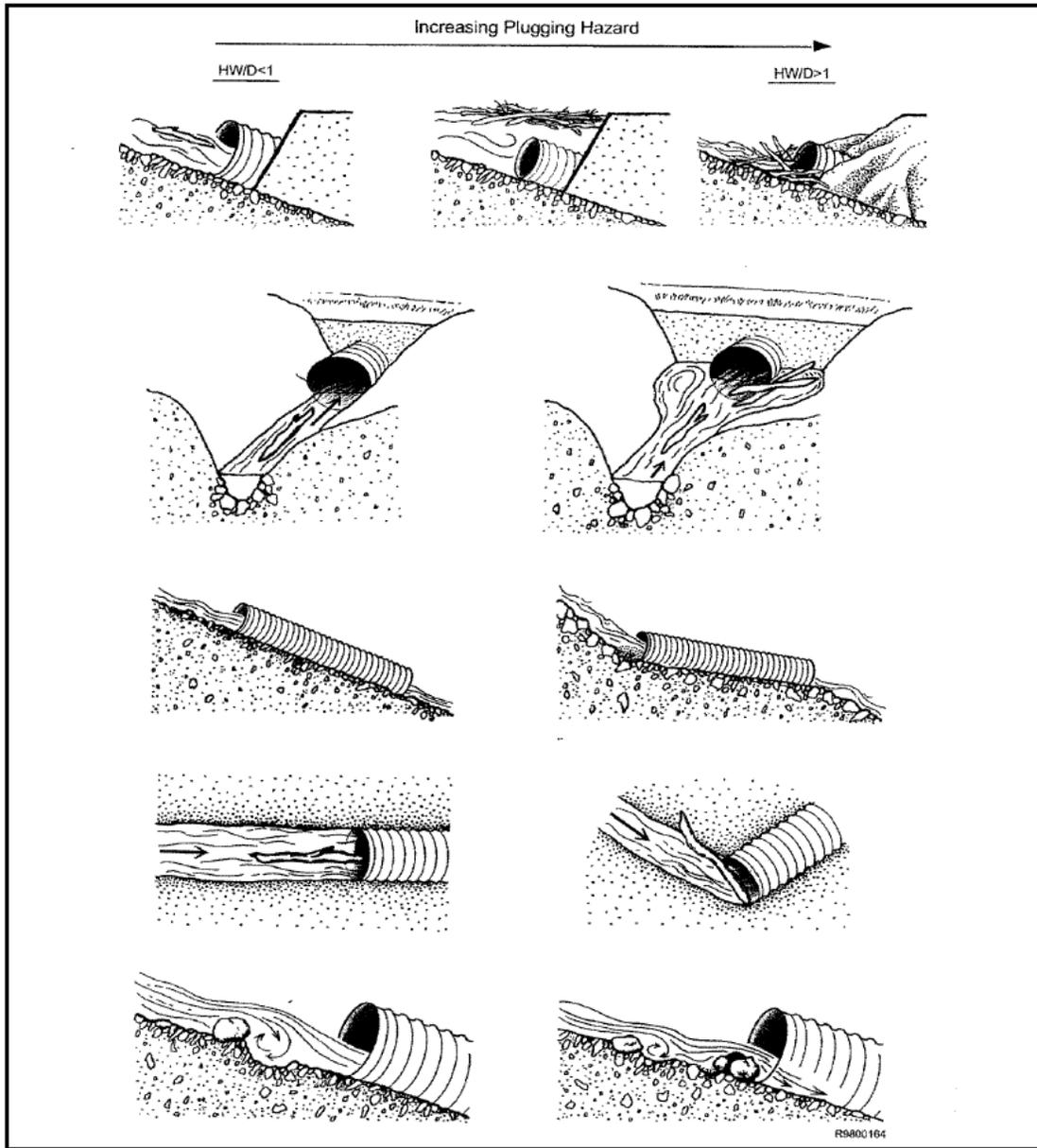
## DIAGRAM - CULVERT HYDRAULICS





**Stream simulation strategy option for installing culverts for fish passage. (DFG CA Salmonid Stream Habitat Restoration Manual. CH IX, 2002)**

# DIAGRAM - CULVERT PLUGGING



## **BMP - CULVERT SIZING**

### DESCRIPTION

Current state and federal guidelines for new crossing installation aim to provide unimpeded passage for both adult and juvenile salmonids. Guidelines have also been developed for sizing culverts on non-fish bearing streams. For detailed specifications see Appendix C: NOAA Fisheries Guidelines for Salmonid Passage at Stream Crossings and Fish and Game Passage Criteria for All Aquatic Life Forms Chapter IX of the California Salmonid Stream Habitat Restoration Manual CDFG, 2002.

### APPLICATIONS

Three design guidelines have been created by state and federal agencies for designing new and replacement culverts. The three methods are:

1. The Active Channel Design Method is a simplified design that is intended to size a culvert sufficiently large and embedded enough into the channel to allow for natural movement of bedload and formation of a stable bed inside the culvert. Used for streams under 3% natural slope and for culverts less than 100 feet in length.
2. The Stream Simulation Design Method is a design process that is intended to mimic the natural stream processes within a culvert. Fish passage, sediment transport, flood and debris conveyance with the culvert are intended to function as they would in a natural channel. Stream simulation culverts require a greater level of information on hydrology and geomorphology (topography of the stream channel) and a higher level of engineering expertise than Active Channel Design Method.
3. The Hydraulic Design Method is a design process that matches the hydraulic performance of a culvert with swimming abilities of a target species and age class of fish. Determination of high and low flow fish passage design flows, water velocity, and water depth are required for this method.
4. All culverts will be designed and approved by a Registered Civil Engineer.

## LIMITATIONS

- It is the responsibility of the project sponsor to obtain the most current version of the culvert criteria for fish passage. Copies of the current criteria are available from the California Department of Fish and Game through the appropriate regional office.
- Obtain all applicable permits for modification of the bed or bank of a stream.
- Culvert installation can generate sediment so erosion and sediment control measures need to be implemented.
- All culverts are prone to failure. Examine alternatives to culverts such as bridges and wet crossings.

## CONSTRUCTION GUIDELINES

- 1) Choose the appropriate method from the four sketches presented.
- 2) All culverts should be designed to pass the 100-year storm at less than 100% of the culverts height. This allows for passage of woody debris during extreme high flows. The size of the culvert as determined by methods 1, 2, or 3 should be checked to pass the 100-year storm. The 100-year storm flow can be determined by using the rational method, local stream gage data, or regional flood estimation equations. The culvert size should then be checked using a simple hydraulic program such as Culvert Master or Fish-Xing now available on-line.
- 3) Culvert width should be at least as wide as the active channel. This reduces constriction of flows at the inlet.
- 4) The culvert bottom should be buried below the streambed allowing for a natural bottom, creating a smooth entrance at the upstream and downstream end without excessive drops.
- 5) Minimize stream diversion potential by providing an outslope (see BMP - Outsloping) or dip (see BMP - Critical Dip) in the road grade at the crossing so that when the culvert plugs, water passes over the road and returns to its original course without being diverted down the road or road ditch.
- 6) Place the culvert parallel to the natural channel so that the inlet will not plug, and flow from the outlet will not erode either of the channel banks.
- 7) Whenever possible, the road should cross at right angles to the stream channel.

8) Prevent discharge of soil and other pollutants into the watercourse. Prevention methods include: construction when there is no water in the stream (see BMP – Seasonal Planning), diverting the water around the construction site or installing a temporary dam (see BMP - Aqua Barrier), and installing other silt barrier and control BMPs.

9) Debris-free fill soil, preferably with some clay content, must be properly compacted in layers along the length of the pipe to prevent water piping on the outside of the culvert. See also BMP - Ditch Relief Culvert for installation details.

10) Fill slopes at the inlet and outlet should be armored with the appropriate size rock or well- vegetated with perennial vegetation. Fill slopes should be no steeper than 2:1 (H:V).

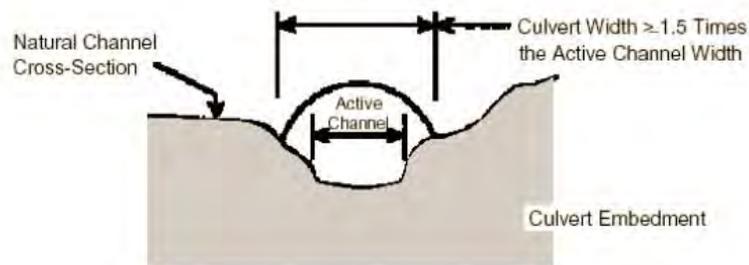
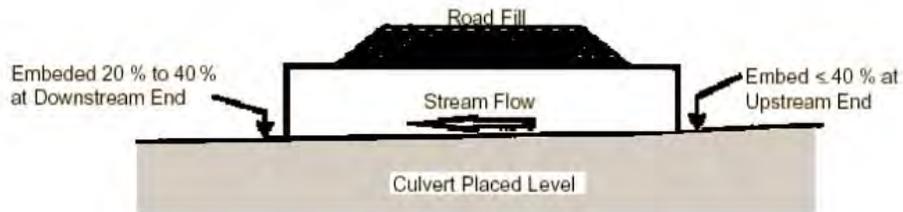
11) Maintain copies of permits on-site during construction.

### BMP MAINTENANCE

- Culverts require a high degree of maintenance to prevent plugging. Trash racks for small culverts such as the Single-Post Trash Rack BMP may help to reduce plugging but still must be checked and cleaned before and during the rainy season.
- Check around the culvert for piping or by-passing. Plug any gaps.
- Maintain the integrity of fill-slope protection of both the inlet and outlet sides.
- Check culverts for rusted bottoms or joint separation.

### BMP REMOVAL

- If the crossing is to be abandoned or cannot receive annual maintenance, remove the culvert and slope back the banks to the original grade. Seed and mulch all bare soil areas with the appropriate weed free seed and mulch. Dispose of fill in an upland stable location, and stabilize with seed and mulch.

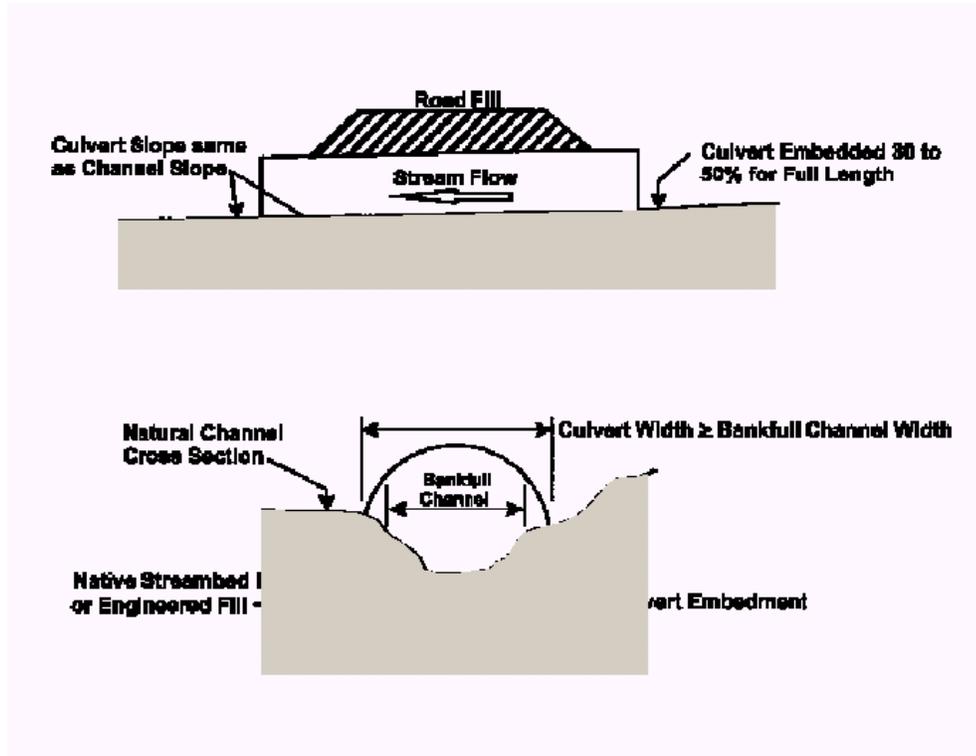


Active Channel Design Option :

- New and replacement culvert installations
- Simple installations on very small streams with channel slopes less than 3 %
- Short culvert length (less than 100 feet)
- Passage required for all fish

Choose a culvert size 1.5 times the width of the active channel. The active channel is that width indicated by the end of perennial vegetation and bed materials scoured a several storm events per year. Install the culvert at 0% or less slope. Embed the culvert so that the downstream end is 20 % to 40% embedded, and the upstream end is equal to or less than 40 % embedded.

**OPTION #1**



Stream Simulation Design Option:

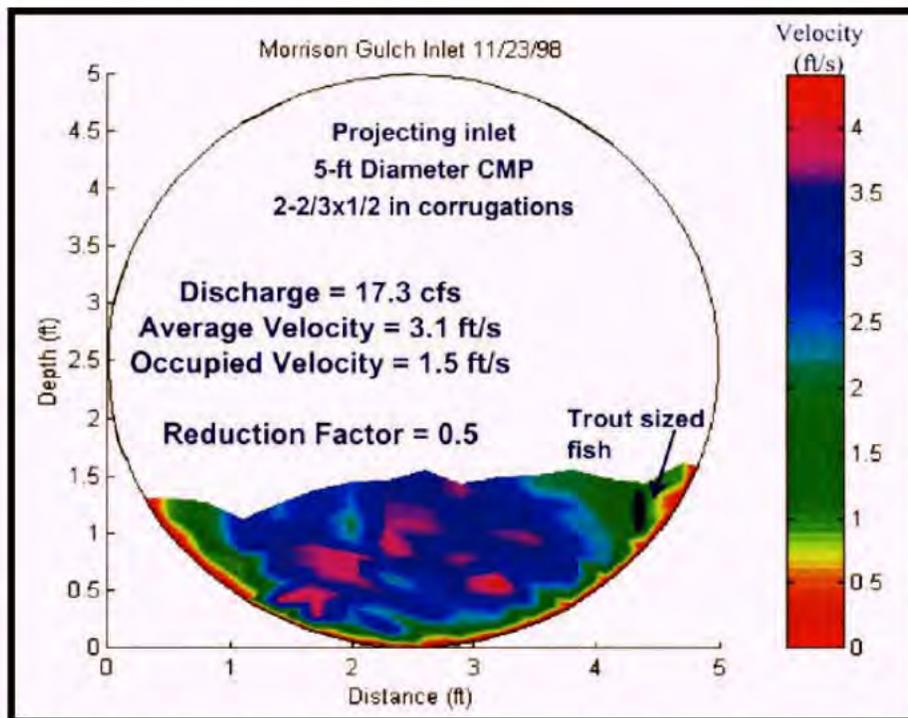
- New and replacement culvert installations
- Minimum Culvert width = 6 feet
- Simple installations with channel slopes less than 6 %
- Moderate to long culvert length (greater than 100 feet)
- Passage required for all fish
- Ecological connectivity required

Need topographic survey, hydrology, channel forming discharge geometry. See Sept. 2000 Army Corps waterways experiment station report "Channel Forming Discharge"

See California Department of Fish & Game, 2002. California Salmonid Stream Habitat Restoration Manual, chapter IX.

**OPTION #2**

**Fish passage can be computed by Roads Engineers by using Fish Xing Software for culvert design and assessment, found at <http://www.fs.fed.us.fishxing/>**



On Quarry Road at Morrison Gulch, tributary to Jacoby Creek, Humboldt Bay watershed.

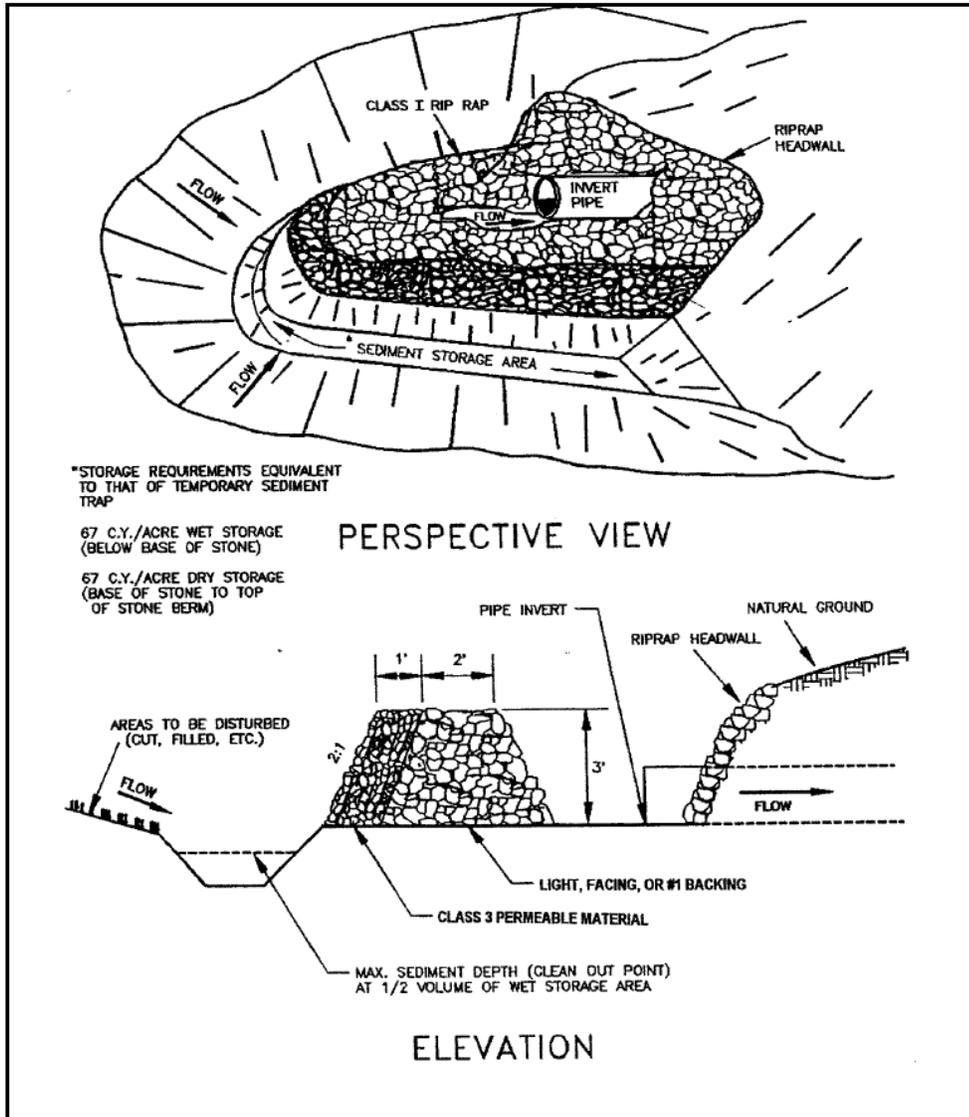
Hydraulic Design Option :

- New, replacement, and retrofit culvert installations
- Minimum Culvert width = 3 feet
- Low to moderate channel slopes less than 3 %
- Active Channel Design or Stream Simulation Option is not physically feasible
- Swimming ability and behavior of target species of fish is known
- Ecological connectivity not required
- Evaluation of proposed improvements to existing culverts

Detailed design matching hydraulic performance of culvert with swimming ability of target species and age class of fish. High level of engineering expertise, hydrologic data analysis needed. Fish passage software for culvert design and assessment is available on the net at [www.stream.fs.fed.us/fishxing/](http://www.stream.fs.fed.us/fishxing/)

SLO COUNTY ROAD MAINTENANCE AA-22

## BMP - CULVERT INLET SEDIMENT TRAP



Source: Association of Bay Area Governments (ABAG). 1995. Manual of Standards for Erosion & Sediment Control Measures. 2<sup>nd</sup> edition. Oakland CA.

SLO COUNTY ROAD MAINTENANCE AA-23

## **BMP - ENERGY DISSIPATER**

### DESCRIPTION

An energy dissipater is a structure designed to control erosion at the outlet of a culvert 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. 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. Evaluate existing culverts and schedule upgrades of energy dissipater installations as appropriate.

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

### LIMITATIONS

- Do not use this BMP below the mean high water line of any water body before obtaining appropriate permits. Due to issues relative to Corps 404 jurisdiction sometimes energy dissipaters are not placed below the ordinary high water mark which results in increased erosion.
- Consider other energy dissipaters such as concrete impact basins, paved outlet structures, or a half culvert where site conditions warrant.
- Rock/riprap dissipaters may require containment in mattresses to maintain their effectiveness.

### CONSTRUCTION GUIDELINES

- 1) Adequately compact berm material to prevent failure.
- 2) Apply temporary seeding and mulch to all surfaces of a soil diversion berm according to the BMP-Seasonal Planning.

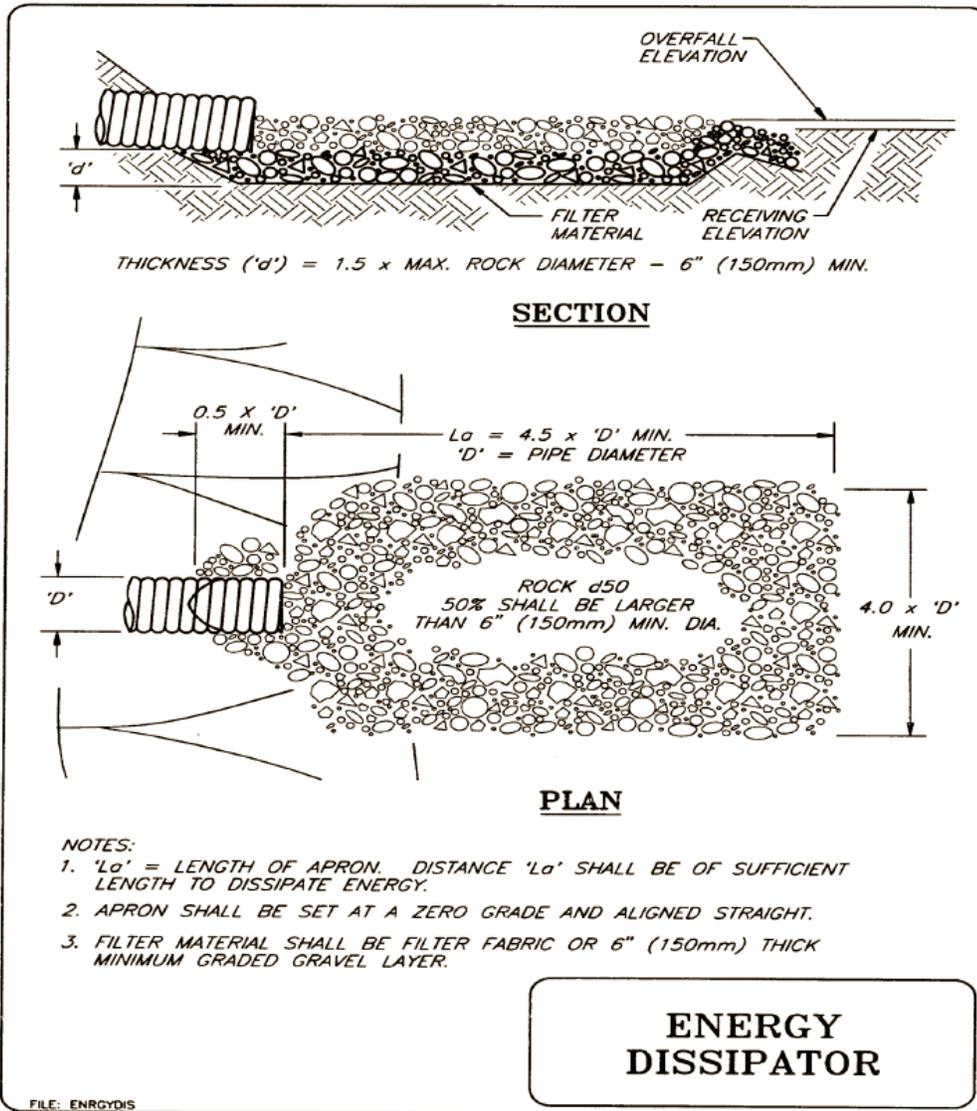
## BMP MAINTENANCE

- After heavy rains, inspect outlet structures for erosion or dislodged stones. Immediately make all needed repairs to prevent further damage.



## BMP REMOVAL

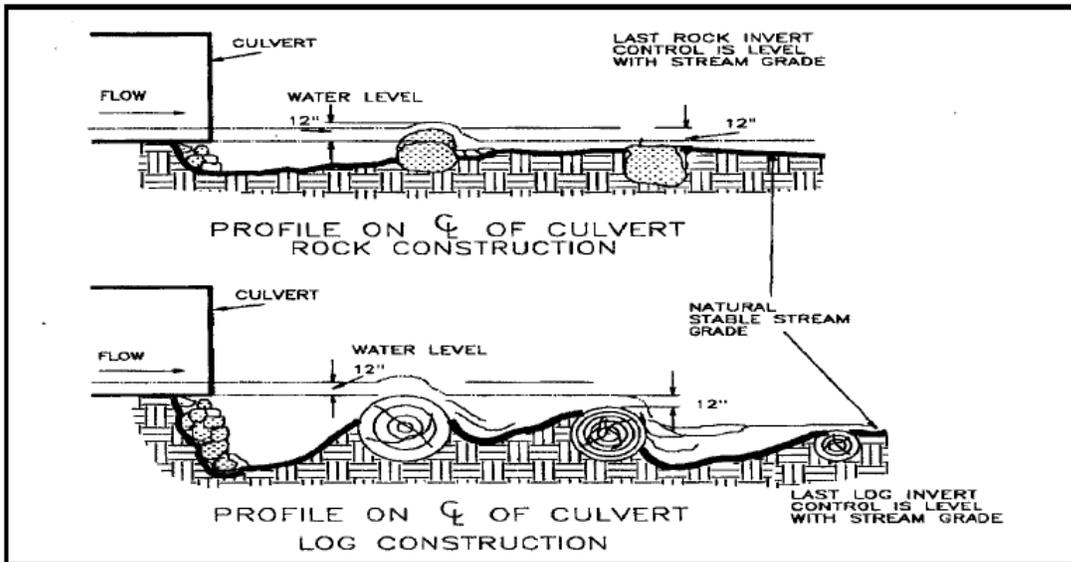
- ✓ BMP removal should not be necessary.



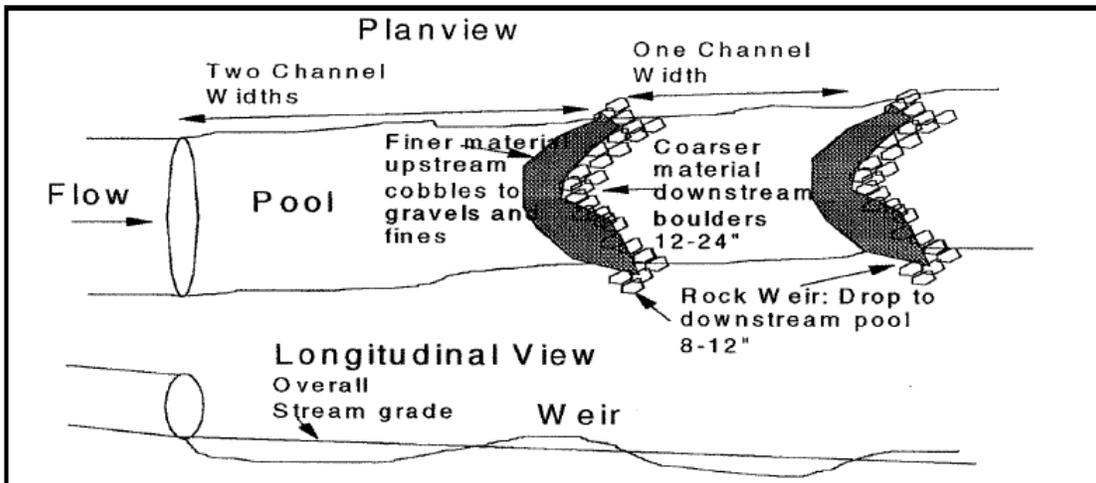
# BMP - BACK-FLOODING WEIRS

## APPLICATIONS

This BMP should be used when a culvert is *not* installed with at least 1/4 of its diameter at or below stream grade. The purpose is to help pass adult and juvenile fish where a jump barrier was created by scour at the downstream end of culverts.



Source: California Dept. of Fish and Game (CDFG). 1998. California Salmonid Stream Habitat Restoration Manual. By Gary Flosi, et al. Inland Fisheries Div., 3<sup>rd</sup> edition.



Source: Robison, E., A. Mirati, and M. Allen. 1999. Oregon Road/Stream Crossing Restoration Guide. Advanced Fish Passage Training Version. Salem OR.

# **EROSION CONTROL BMPs**

<b>BLANKETS/GEOTEXTILE FABRICS .....</b>	<b>AA - 29</b>
<b>COIR FABRIC-NETTING.....</b>	<b>AA - 37</b>
<b>COIR LOGS/STRAW ROLLS.....</b>	<b>AA - 38</b>
<b>BROADCAST SEEDING.....</b>	<b>AA - 41</b>
<b>HYDROSEEDING.....</b>	<b>AA - 42</b>
<b>MULCHING.....</b>	<b>AA - 44</b>
<b>PLANTING .....</b>	<b>AA - 45</b>
<b>SURFACE ROUGHENING &amp; SOIL TRACKING .....</b>	<b>AA - 49</b>
<b>STEPPED OR TERRACED SLOPE .....</b>	<b>AA - 54</b>
<b>PLASTIC COVERING .....</b>	<b>AA - 55</b>
<b>ROCK BREAST WALL.....</b>	<b>AA - 57</b>

# **BMP – BLANKETS/GEOTEXTILE FABRICS**

## **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**

- 1) Proper site preparation is essential to ensure complete contact of the protection matting with the soil.
- 2) Grade and shape area of installation.
- 3) Remove all rocks, clods, and vegetative or other obstructions so that the installed blankets, or mats will have direct contact with the soil.
- 4) Prepare seedbed by loosening 2-3 inches (50-75 mm) of topsoil above final grade.
- 5) Seed area before blanket installation for erosion control and re-vegetation. (Seeding after mat installation is often specified for turf reinforcement application.)
- 6) 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:

- 1) 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.
- 2) Unroll blanket downslope in the direction of the water flow.
- 3) The edges of adjacent parallel rolls must be overlapped 2-3 inches and be stapled every 3 feet.
- 4) When blankets must be spliced, place blankets end over end (shingle style) with 6-inch overlap. Staple through overlapped area, approximately 12 inches apart.
- 5) Lay blankets loosely and maintain direct contact with the soil - do not stretch.
- 6) 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.

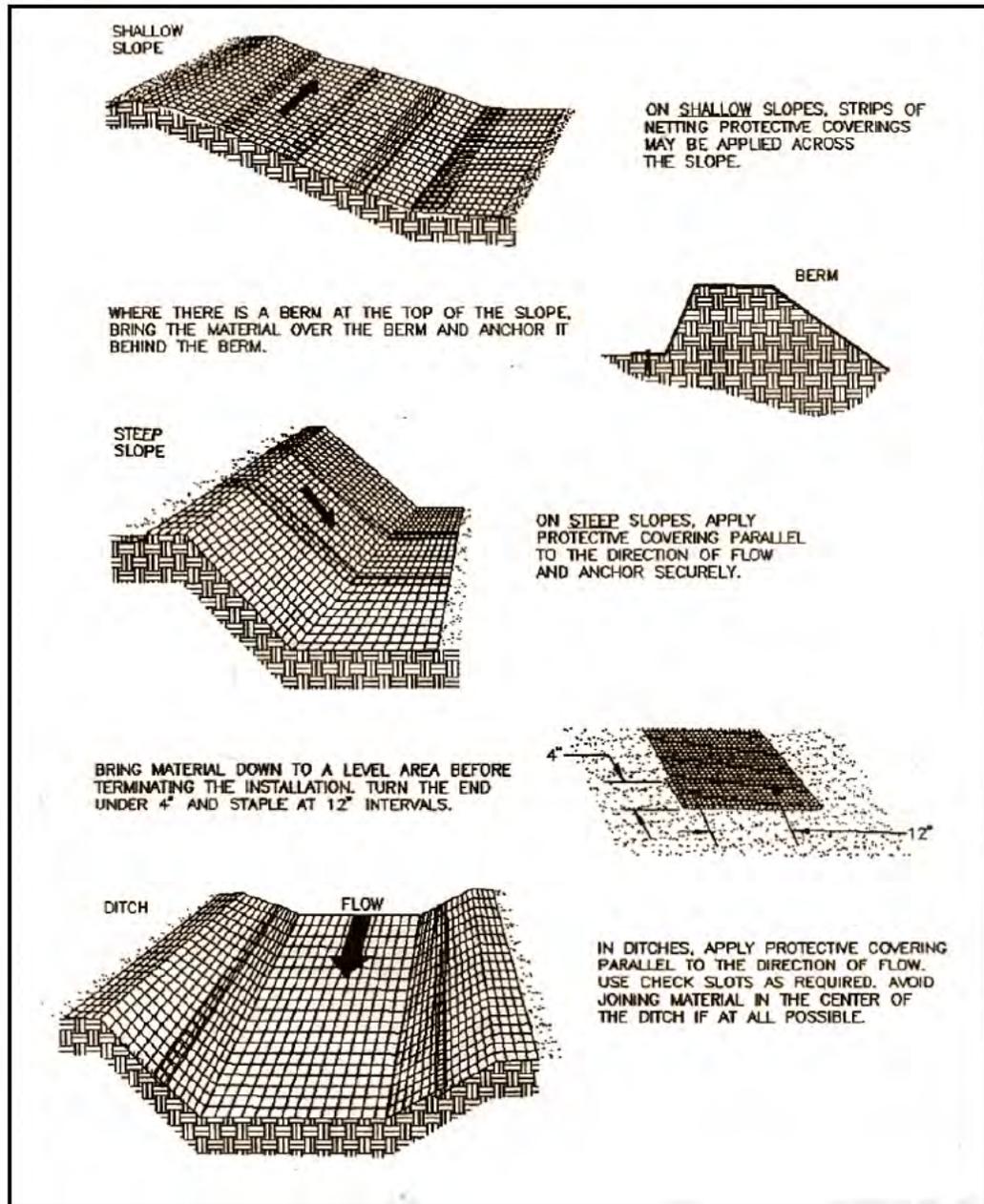
### BMP MAINTENANCE

- 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 drainage way.

### BMP REMOVAL

- BMP removal should not be necessary.

## Placement of Biodegradable Blankets

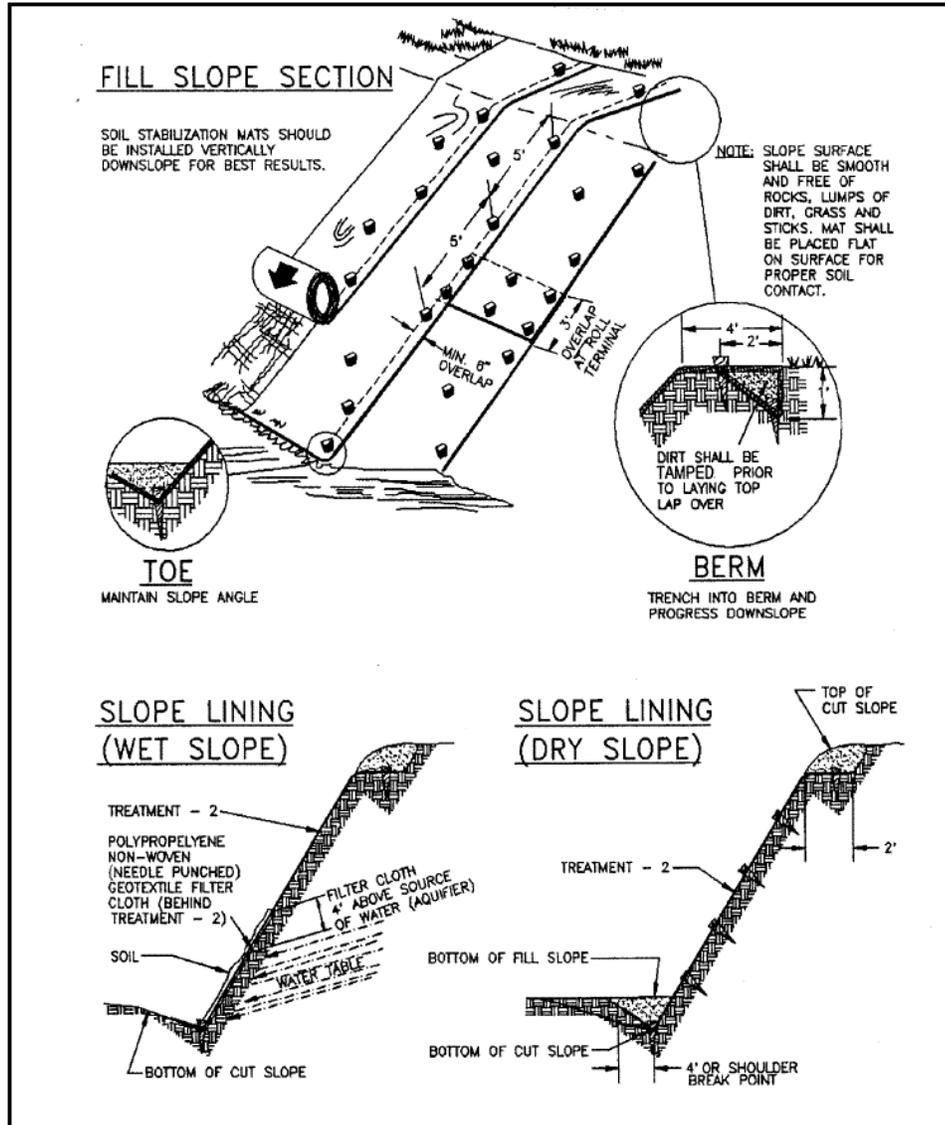


(Source: ABAG. 1995. Manual of Standards for Erosion & Sediment Control Measures. Oakland CA.)



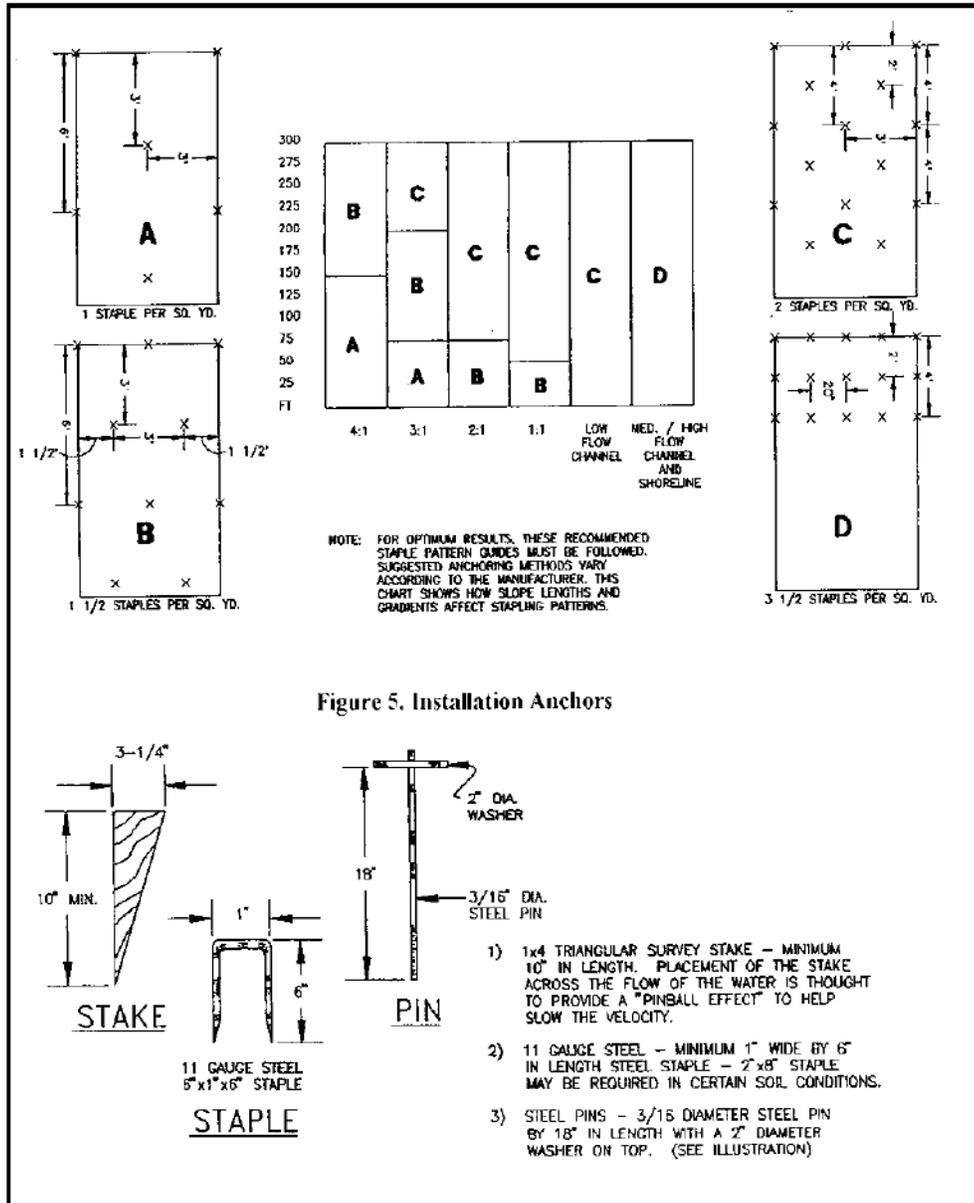
## Placement of Non-biodegradable Blankets

\* **Important Note:** Non-biodegradable blankets should not be used in fish bearing streams and US Fish and Wildlife Service prohibits their use on stream crossings in the bankful channel.



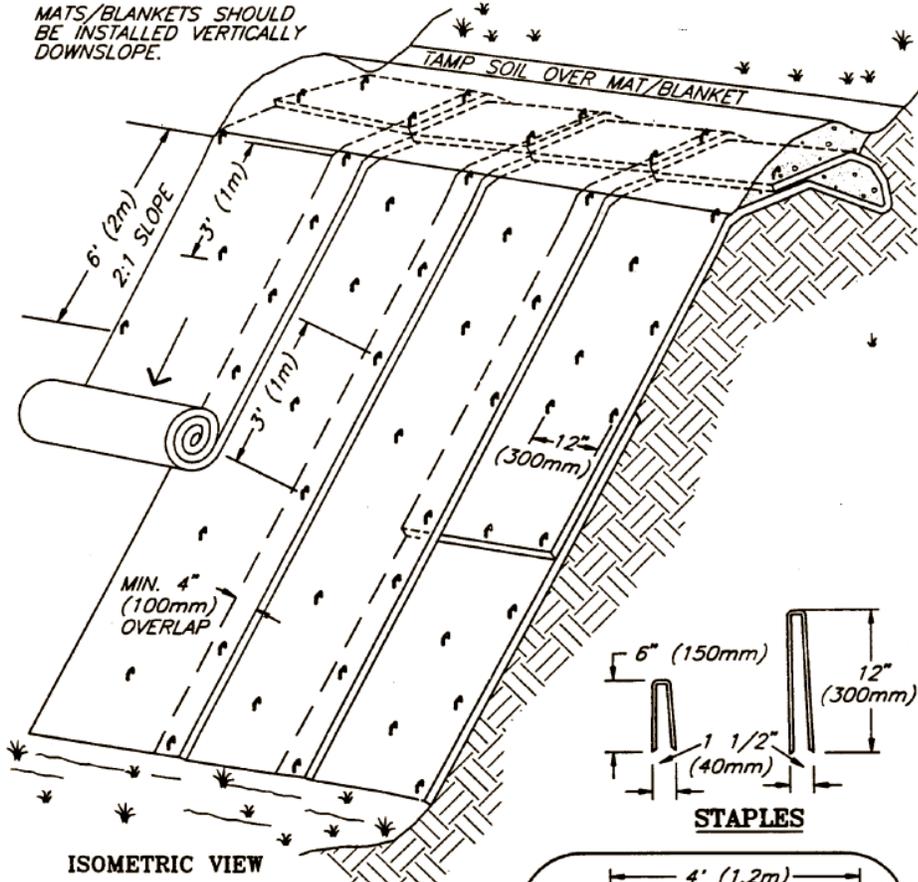
(Source: ABAG, 1995. Manual of Standards for Erosion & Sediment Control Measures. Oakland CA.)

# Anchoring of Blankets

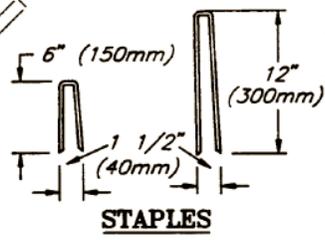


(Source: ABAG, 1995. Manual of Standards for Erosion & Sediment Control Measures. Oakland CA.)

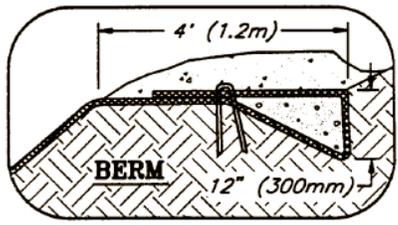
MATS/BLANKETS SHOULD BE INSTALLED VERTICALLY DOWNSLOPE.



**TYPICAL SLOPE  
SOIL STABILIZATION**



**STAPLES**



**NOT TO SCALE**

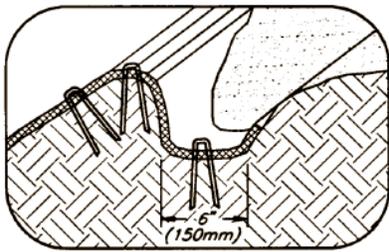
**NOTES:**

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.

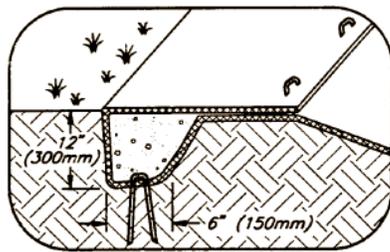
**EROSION BLANKETS &  
TURF REINFORCEMENT MATS  
SLOPE INSTALLATION**

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©

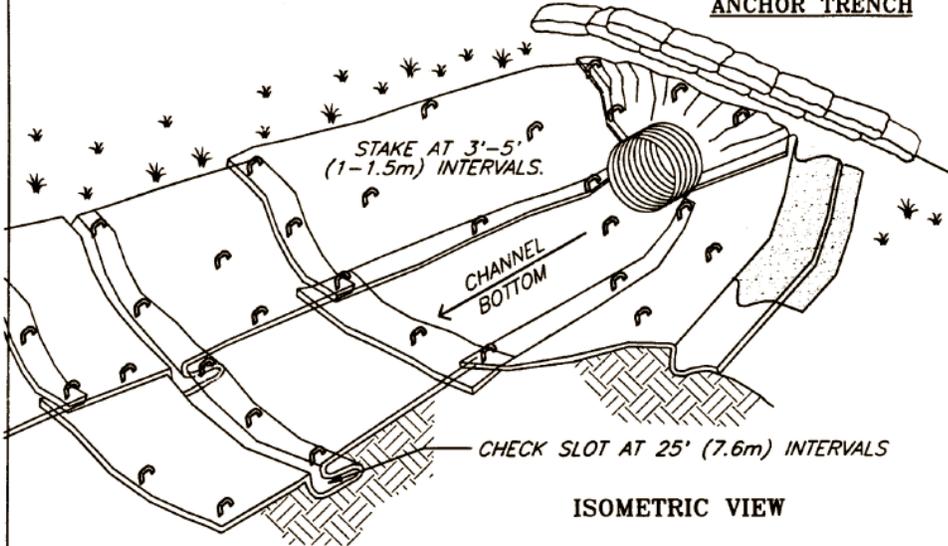
FILE: BLNKTSLP



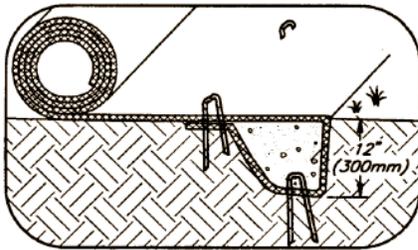
**LONGITUDINAL ANCHOR TRENCH**



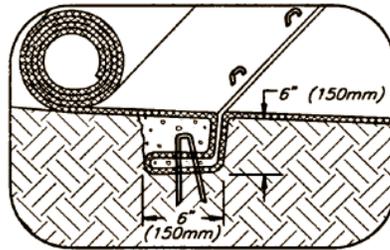
**TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH**



**ISOMETRIC VIEW**



**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.

FILE: BLNKTCHA

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

© 1994 JOHN McCULLAN

# **BMP - COIR FABRIC/NETTING**

## 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

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

## BMP MAINTENANCE

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

## **BMP - COIR LOGS AND STRAW ROLLS**

### DESCRIPTION

Straw rolls 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 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 inhibits its usefulness.

### CONSTRUCTION GUIDELINES

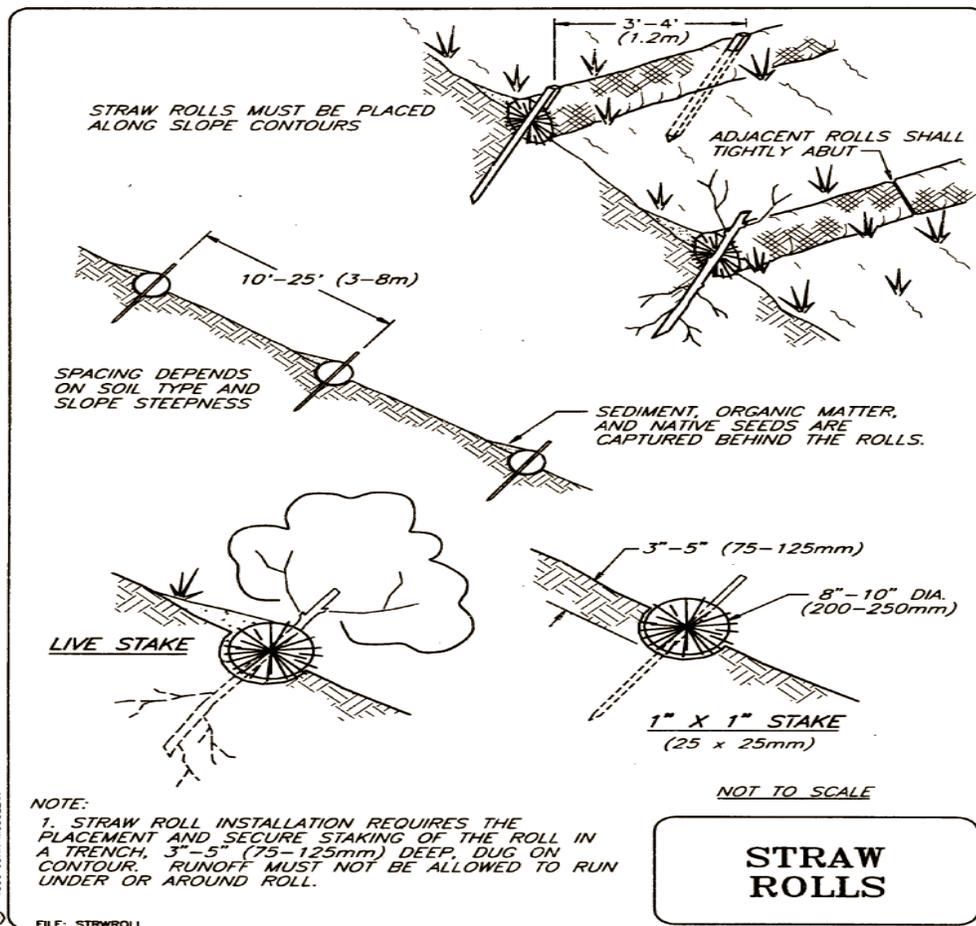
- 1) Logs are placed in 2 to 3 inch deep trenches and staked along the contours of newly constructed or disturbed slopes.
- 2) Log spacing depends on soil type and slope steepness.
- 3) Adjacent logs shall be tightly abutted to prevent water flow and gully formation between logs.
- 4) Ensure that logs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

## BMP MAINTENANCE

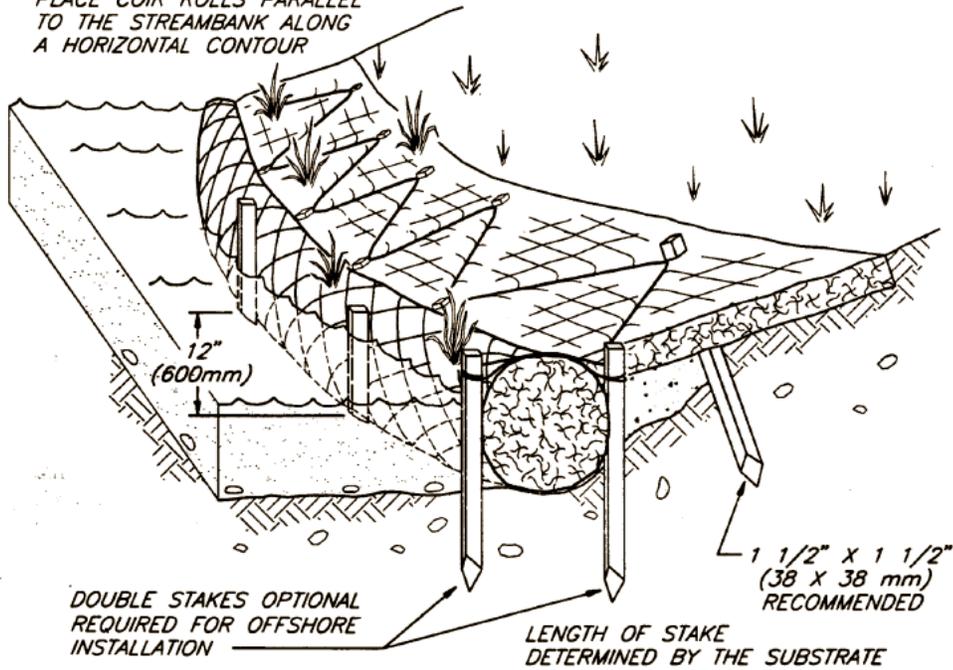
- During construction, inspect daily during the workweek.
- Schedule additional inspections during storm events.
- Make any required repairs immediately.
- For perimeter control installations (securing spoils, etc.), remove sediment deposits when they reach  $\frac{1}{2}$  the height of the log/roll.

## BMP REMOVAL

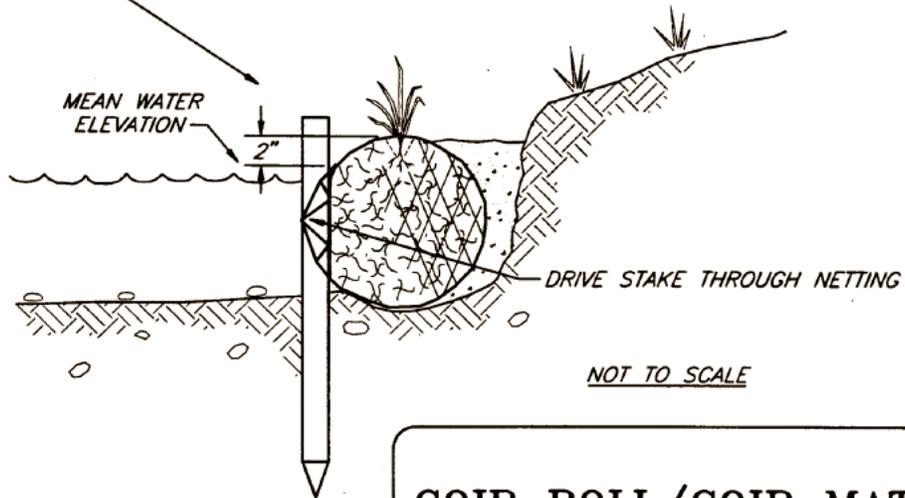
- Remove sediment buildup in front of BMP.
- Revegetation of the site may be necessary.
- Dispose of netting properly. Straw or coir filling may be used as mulch.
- BMP removal may not be necessary.



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



NOT TO SCALE

**COIR ROLL/COIR MATS**

© 1996 JOHN McCULLAH

FILE: COIRRM

SLO COUNTY ROAD MAINTENANCE AA-40

# **BMP – BROADCAST SEEDING**

## DESCRIPTION

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

## APPLICATIONS

We encourage hand seeding whenever possible to aid in controlling erosion on construction sites. Seed only areas intended to be left dormant for a year or more, such as soil berms.

## LIMITATIONS

- After broadcast seeding, mulch the area and/or install erosion control blankets or mats.
- Schedule seeding to fit the germination timing for the specific grasses to be used. Typically this is October and November for cool season California grasses. If seed is applied earlier, increase the seed and mulch quantities.

## CONSTRUCTION GUIDELINES

- 1) Select seed mixes appropriate to the season and site conditions. Permit conditions and/or sensitive locations may require special seed mixes. Avoid the use of tall growing flashy fuel types or types with known allelopathy such as annual rye grass. Consider native perennials whenever possible.
- 2) Grade as needed and feasible to permit the use of equipment for seedbed preparation.
- 3) Grade and scarify the site as needed and feasible to permit good seed to soil contact. See BMP Surface Roughening and Soil Tracking. Commercial fertilizers are seldom recommended as they can leach into the stream and the high nitrogen promotes broadleaf weed growth over native perennial growth. In areas where there is no longer topsoil, consider amending the soil with mycorrhizal inoculants and/or mature screened compost.
- 4) Install needed erosion control practices, such as sediment basins, diversion dikes and channels, prior to seeding. Divert concentrated flows away from seeded areas.

- 5) 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 disking, raking or harrowing.
- 6) Spread seed uniformly and according to manufacturer's recommendations.
- 7) Straw mulch, erosion control blankets or mulch and tackifiers/soil binders should be applied over the seeded areas.

#### BMP MAINTENANCE

- Inspect during seed establishment period. Re-seed, due to mortality, as necessary. Areas that 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.

## **BMP – HYDROSEEDING**

#### DESCRIPTION

Hydro-seeding is broadcasting grass seed, tackifier, wood fiber mulch and water on disturbed areas using a hydro-seeding 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

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

#### LIMITATIONS

- Hydro-seeding should not be used on stream banks or in areas subject to scour.
- Schedule seeding to fit the germination timing for the specific grasses to be used. Typically this is October and November for cool season California grasses. If seed is applied earlier, increase the seed and mulch quantities

## CONSTRUCTION GUIDELINES

- 1) Select seed mixes appropriate to the season and site conditions. Permit conditions and/or sensitive locations may require special seed mixes. Avoid the use of tall growing flashy fuel types or types with known allelopathy such as annual rye grass. Consider native perennials whenever possible. Commercial fertilizers are seldom recommended as they can leach into the stream and the high nitrogen promotes broadleaf weed growth over native perennial growth. In areas where there is no longer topsoil, consider amending the soil with mycorrhizal inoculants and / or mature screened compost
- 2) Install needed erosion control practices, such as sediment basins, diversion dikes and channels, prior to hydro-seeding. Divert concentrated flows away from Hydro-seeded areas.

<sup>1</sup> If a plant type is allelopathic, it exudes chemicals into the surrounding soil that discourage or inhibit other plant types from growing. *Eucalyptus* is a commonly known allelopathic species.

- 3) 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.
- 4) Spread hydroseed mix uniformly and according to manufacturer's recommendations.
- 5) Cover hydroseeded areas with other methods as needed.

## BMP MAINTENANCE

Inspect during seed establishment period. Re-seed, due to mortality, as necessary. Areas that 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.

# **BMP – MULCHING**

## DESCRIPTION

Mulching is the application of sterile *weed-free* straw, wood fiber (*as in hydromulch*), local leaf litter, mature screened compost or other suitable materials to the soil surface. This BMP is used to reduce the potential for soil becoming water or air borne, and to encourage vegetation establishment. Typically, apply an erosion control seed mix to scarified bare ground and cover bare areas where surface erosion and sediment delivery could occur.

Rates of about 4,000 pounds/acre, or approximately 50 bales/acre of straw, meet this standard. Use mulch to cover seed to improve microclimatic conditions for germination and seedling survival. Seeding and mulching rates are highly variable, depending on the seed mix used. Consult your local extension office or seed supplier for recommended rates of application and local site conditions.

## 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

- 1) Mulch should be applied so that the soil is covered enough to allow seeds to protect against erosion, but still allow seeds to germinate.
- 2) Select the appropriate mulch for the site. Local leaf litter or on-site grass mowings may be preferred if available. Rice straw is relatively weed free in upland areas but not necessarily the best choice for wetlands. Irrigated cereal grains and sterile wheat straw may be appropriate, but residual germination may compete with target re-vegetation species. Wood fiber mulch provided by hydro-mulchers is the most sterile medium. Mature screened compost is effective both for erosion control and as a soil builder.”
- 3) In areas subject to runoff or wind erosion, mulch shall be secured to the soil by mechanical or manual crimping, anchoring with branches, plant-derived tackifiers, or other appropriate methods.

## BMP MAINTENANCE

- Conduct periodic inspections and reapply mulch where missing.

## BMP REMOVAL

- BMP removal is not necessary.

# **BMP – PLANTING**

## DESCRIPTION

Planting, as outlined in this BMP, involves the establishment of native woody perennial species for the purpose of erosion control and/or habitat enhancement. See also Hand Seeding, Hydro-seeding, and Mulching BMPs.

## APPLICATIONS

Wherever riparian or upland woody vegetation is required and it is determined that natural recruitment will not be sufficient.

## LIMITATIONS

- Sources of good quality locally native plant materials may be limited.
- An extended establishment period may require years of maintenance.
- Sources of water for irrigation may be limited.
- Permit requirements may guide design and maintenance planning.

## CONSTRUCTION GUIDELINES

- 1) Choose the appropriate species for the site as determined by what is growing in the surrounding areas, soil type, water requirements, exposure, wildlife species requirements and permit requirements. Spacing and structure must also be considered.
- 2) Schedule the planting time as appropriate for the species and project maintenance capabilities. Riparian and upland species should be planted in November and December. The planting window for willow sprigs may be extended into the late summer (but not spring) if irrigation is provided. Emergent species may be planted after high flows if sufficient water will be available.
- 3) Order plant materials from a reputable native plant nursery well in advance to allow the nursery time to collect and propagate local species. Nine months to two years lead time may be required.

4) Inspect nursery-grown plant materials prior to accepting. Avoid tree species grown in one gallon flat bottom pots which promote root girdling. Revegetation plans typically specify tree size – for example:

- Tree Species: Trees, with the exception of cottonwood, willows, and dogwood, shall be grown from locally collected seed. Tree species shall be grown in 14-inch deep Treepots™ for at least 9 months and shall have root systems that fill the containers but are not root bound; roots shall show active growing tips. The minimum stem caliper of the main trunk shall be 0.2 inches at 1 inch above the root crown. Tops shall be at least 6 inches tall and have healthy, live buds and/or leaves, with no broken leaders.

- Shrub and Vine Species: Shrubs and vines shall be grown from seeds or cuttings, except elderberry, which shall be grown from seed. Shrubs and **vines** shall be grown in 10-inch deep Deepots™ or one gallon pots for at least 9 months and shall have root systems that fill the containers but are not root bound; roots shall show active growing tips. The minimum stem caliper of the main trunk of elderberries shall be 0.2 inches at 1 inch above the root crown. All other species shall either have a similar caliper or have sufficient number of stems of a sufficient size to be equivalent to a 0.2-caliper single stem. Tops shall have healthy, live buds and/or leaves.

- Plants shall show no signs of deleterious infection from bacteria, fungus, or insects. Reject plants with open wounds or unusual swelling of stems or branches.

- Willow sprigs shall be 0.75 inch to 1.5 inches in diameter at the base and 3 feet long. Sprigs shall be cut clean with sharp hand saws. Branches shall be pruned off with sharp shears close to the main stem but just outside the branch collar. Sprigs with swelling, scar tissue, boring insects, or disease shall be rejected. Sprigs shall be cut from live healthy materials. Donor trees or areas of trees from which sprigs are cut shall be pre-approved by the owner. No more than 50% of an existing cottonwood or willow clump shall be removed for sprigs, unless the clump is scheduled to be destroyed by grading. No sprigs shall be taken from within 20 feet of a willow or cottonwood with an active bird nest in it.

- Site preparation includes the removal of all vegetation in the planting area. Scalp a 3 foot by 3 foot area free of vegetation and debris down to bare mineral soil.

5) Install plants according to attached drawings. If significant rain is not forecast, water-in the plants.

6) Where deer or rabbit browse is anticipated, it may be necessary to install browse protectors. If the riparian zone has high velocity floods, wait until early spring to install protectors. Welded wire cages around cottonwoods may be required if beavers are in the area.

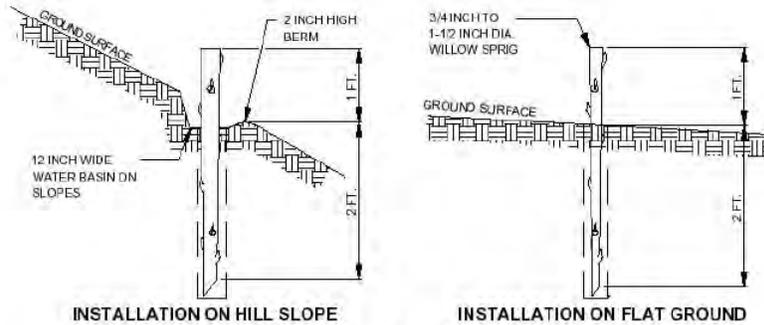
7) Schedule irrigation and maintenance requirements according to the needs of the plants and conditions. Maintenance may be required for one to three years. If watering is required, supplemental watering must begin in early spring (March) or as soon as the surface soil begins to dry.

## BMP MAINTENANCE

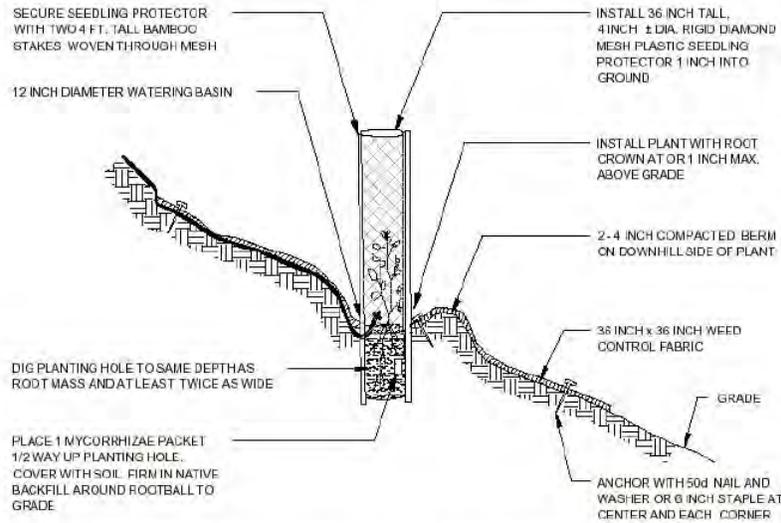
- Regular inspection of plantings should be anticipated. As often as once per week, but no less than once per month for the first year.
- Maintenance includes weeding, watering, repair to browse protectors at a minimum.
- Where irrigation is required, it is essential to begin irrigation in the spring (March or April) before the soil begins to dry. This is the time when the plant and nearby weedy species put on the most growth and have the highest water demand. Transplants are most susceptible to drought in the spring and early summer. At the same time, it is important not to waterlog native species. Allow the soil surface (top ½ inch) to dry between waterings.
- Monitor plant survival in October to anticipate plant replacement that may be required by permit.
- Trimming lower branches of willows to allow for unrestricted stream flow may be desirable.

## BMP REMOVAL

- It may be necessary to remove irrigation lines, browse protectors, and other materials at the end of the establishment period.



**INSTALLATION ON HILL SLOPE**      **INSTALLATION ON FLAT GROUND**  
**WILLOW OR COTTONWOOD SPRIG PLANTING DETAIL**



NOTE: SEEDLING PROTECTORS TO BE PLACED ON TREES ONLY. SHRUBS AND VINES TO BE PLANTED AS ABOVE WITHOUT SEEDLING PROTECTOR. REMOVE PROTECTOR AFTER 3 YEARS.

**CONTAINER - GROWN PLANTS PLANTING DETAIL**

# **BMP – SURFACE ROUGHENING and SOIL TRACKING FOR PLANTING PREPARATION**

## 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.

Do ***not*** use this BMP:

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

## CONSTRUCTION GUIDELINES

### **Cut Slope Roughening:**

- 1) Stair-step grade or groove the cut slopes that are steeper than 3:1.
- 2) 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.
- 3) Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- 4) Groove the slope using machinery to create a series of ridges and depressions that run across the slope, on the contour.

### **Fill Slope Roughening:**

- 1) 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.
- 2) Ensure that the face of the slope consists of loose, uncompacted fill 4-6 inches deep.
- 3) Use grooving or tracking to roughen the face of the slopes, if necessary.
- 4) Apply seed, fertilizer and straw mulch then track or punch in the mulch with the bulldozer.
- 5) Do not blade or scrape the final slope face.

### **Roughening With Tracked Machinery:**

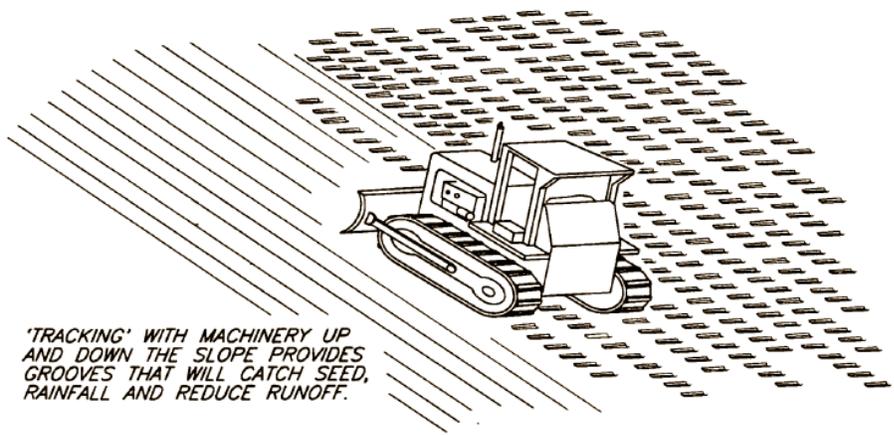
- 1) Limit roughening with tracked machinery to soils with a sandy textural component to avoid undue compaction of the soil surface.
- 2) Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.
- 3) Immediately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

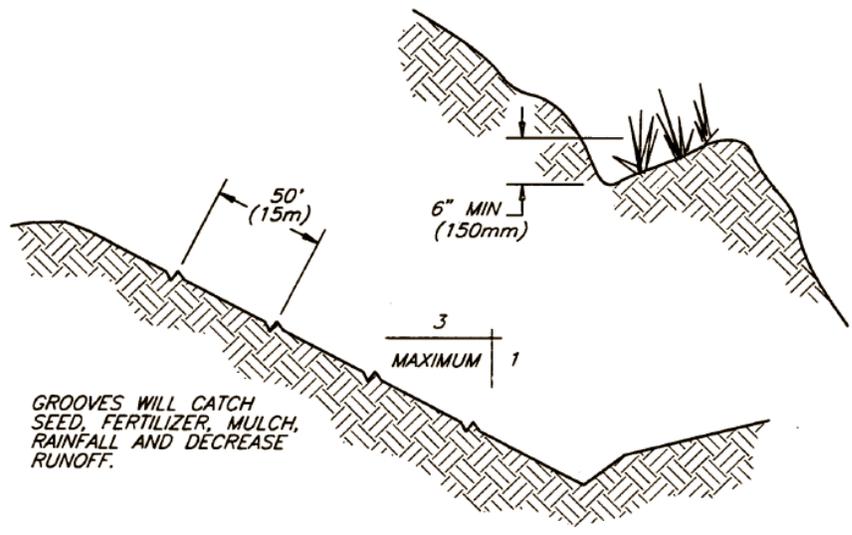
### **BMP REMOVAL**

- BMP removal is not necessary.



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

**TRACKING**



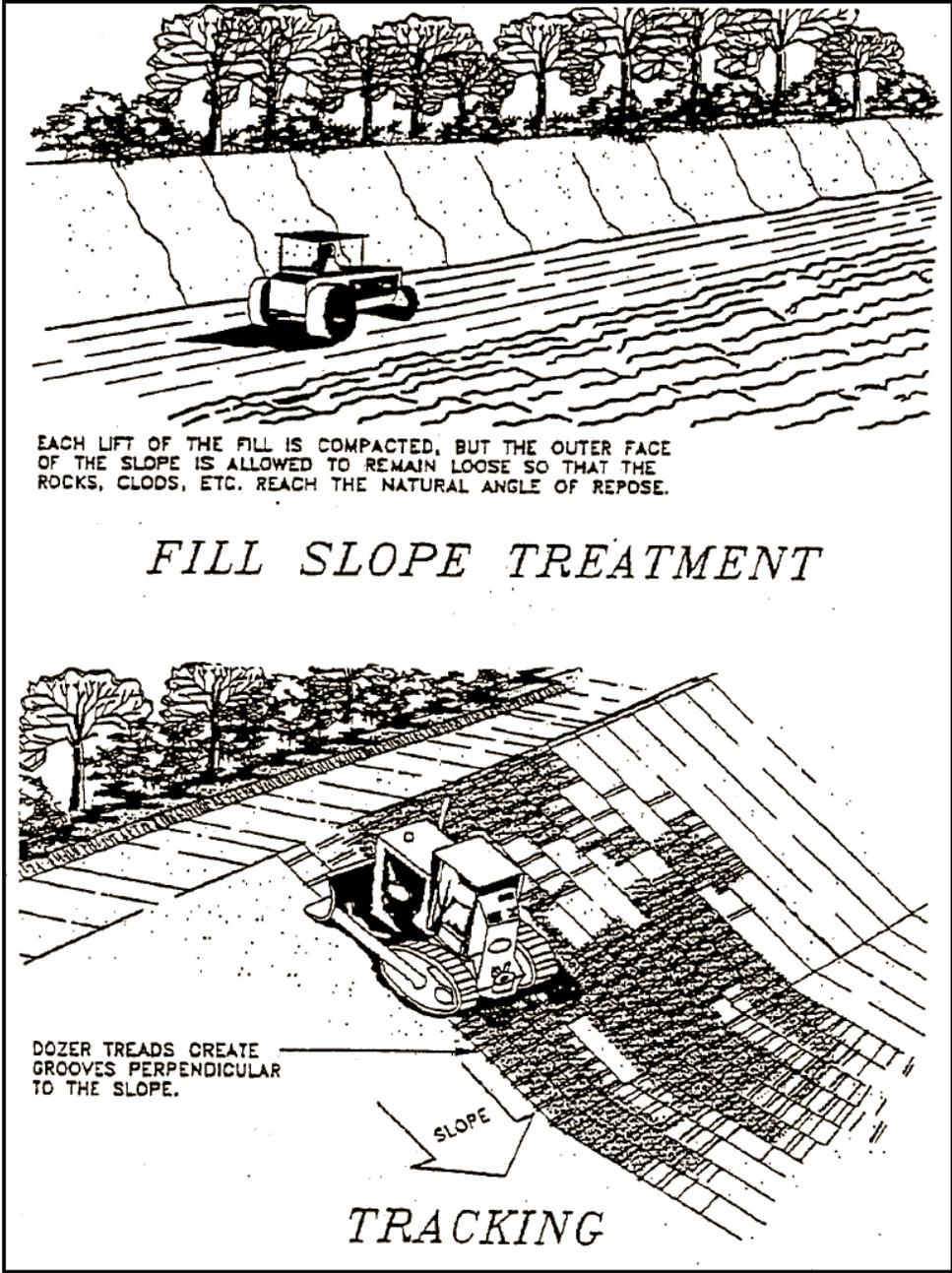
GROOVES WILL CATCH SEED, FERTILIZER, MULCH, RAINFALL AND DECREASE RUNOFF.

**CONTOUR FURROWS**

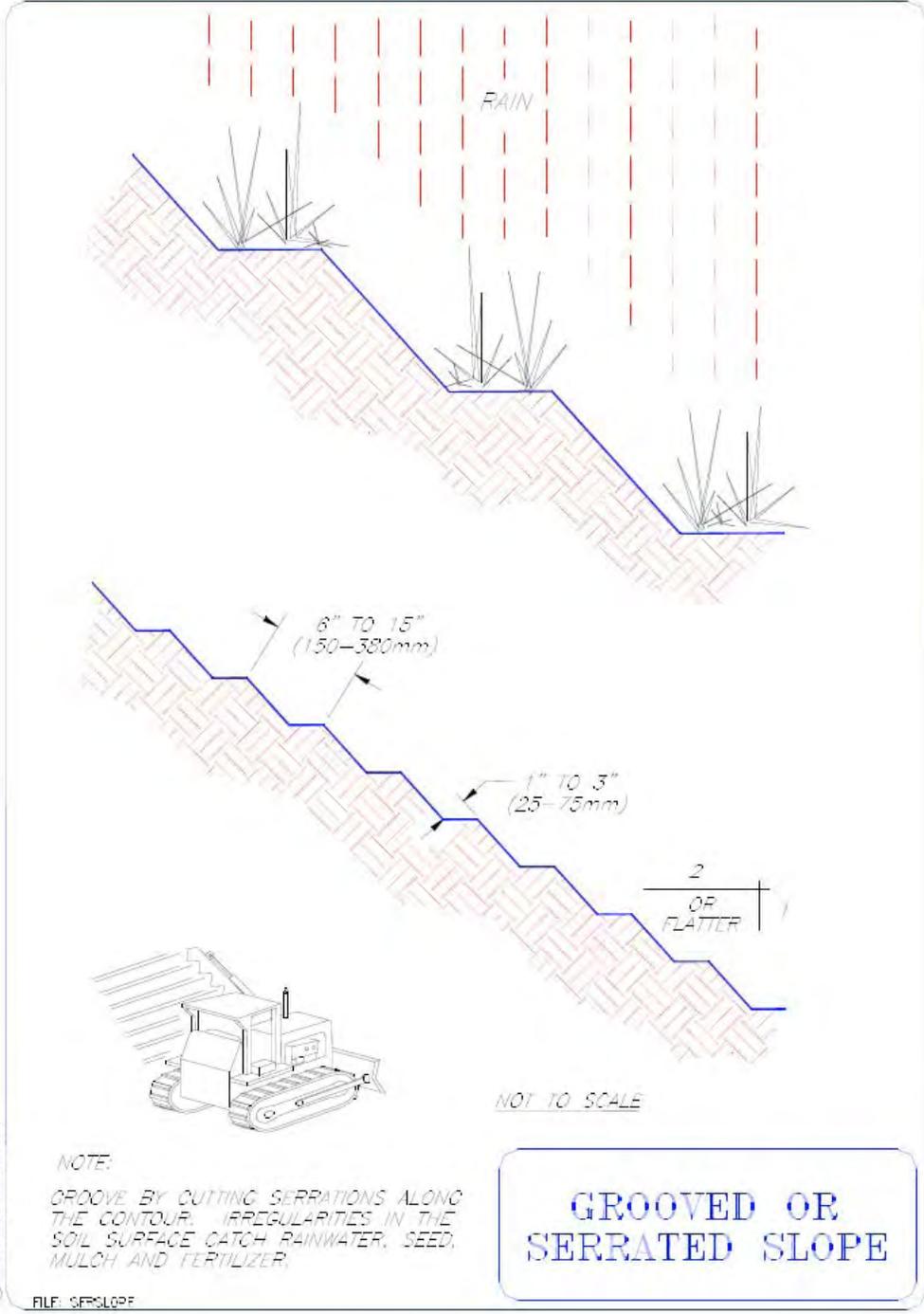
**SURFACE ROUGHENING**

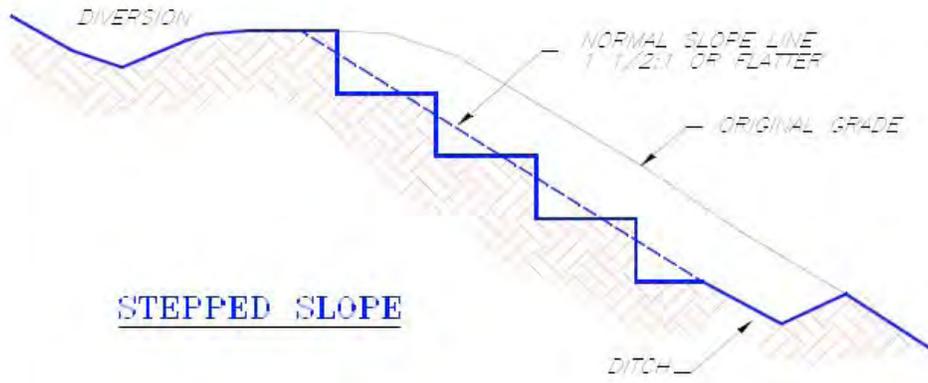
© 1994 JOHN McCULLAH

FILE: SRFROUGH

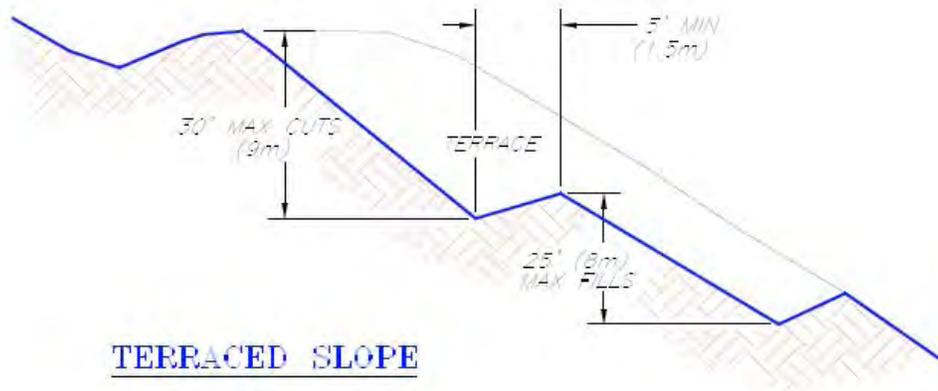


Source: Tri-County Regional Road Maintenance ESA Program Guidelines, Washington State, July 2000





**STEPPED SLOPE**



**TERRACED SLOPE**

NOT TO SCALE

- NOTES:
1. VERTICAL CUT DISTANCE SHALL BE LESS THAN HORIZONTAL DISTANCE.
  2. VERTICAL CUT SHALL NOT EXCEED 2 FT (0.6m) IN SOFT MATERIAL AND 3 FT (0.9m) IN ROCKY MATERIAL.

**STEPPED OR TERRACED SLOPE**

© 1994 JOHN McCOUL-H

FILE STPSLOPE

# **BMP – PLASTIC COVERING**

## DESCRIPTION

Plastic covering is a temporary soil stabilization method. Material should be polyethylene sheeting at least 6 mils thick.

## APPLICATIONS

Plastic covering can be used to stabilize stockpiled materials and unfinished slopes to protect from erosion caused by wind and water. Also used to cover spills during rainfall to reduce pollutant dispersion as clean-up proceeds.

## LIMITATIONS

- Plastic is easily vandalized, torn, and photodegradable and must be disposed of in a landfill.
- Plastic results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.

## CONSTRUCTION GUIDELINES

- 1) Plastic covering should be anchored by sandbags placed no more than 10 feet apart and by keying into the tops of slopes to prevent infiltration of surface waters under the plastic. On steep slopes, attach rope between bags to keep them from sliding.
- 2) Seams should be taped or weighted down along their entire length and there should be at least a 12 to 24-inch overlap of all seams.
- 3) Stockpiles should be located a minimum of 50 feet away from concentrated flows of stormwater, drainage courses, and inlets.
- 4) Perimeter sediment barriers such as silt fences, berms, or straw wattles may be required.

## BMP MAINTENANCE

- Plastic covering should be checked regularly during construction.
- Installation should be checked during and after any significant storms to check for erosion and undermining.
- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.

## BMP REMOVAL

- Plastic covering and related materials may be reused if in good condition, otherwise materials should be removed from the site and disposed of properly.



- Plastic sheeting shall be polyethylene and have a minimum thickness of 6 mil.
- No runoff shall be allowed to run under the plastic covering.
- Covering shall be installed and maintained tightly in place by using sandbags on ropes with a maximum 10 foot grid spacing in all directions. All seams shall be taped or weighted down full length and there shall be at least a 12-inch overlap of all seams. For seams parallel to the slope contour, the uphill sheet shall overlap the downhill sheet.
- Drainage from areas covered by plastic sheeting shall be controlled such that no discharge occurs directly onto uncontrolled, disturbed areas of the site.

## **TEMPORARY PLASTIC COVERING**

# **BMP – ROCK BREAST WALL**

## DESCRIPTION

A low retaining wall (usually 10 feet or less in height) constructed against the base of a slope. The wall is usually built by stacking rocks atop one another in a single ,one-rock width course. Synonyms include gravity wall, loose rock retaining wall, rock armoring.

## APPLICATIONS

Constructed to protect the toe of the slope and to prevent slope damage by erosion, especially piping and spring seepage from the face of the slope.

## LIMITATIONS

- Careful rock placement is required to prevent injuries to construction workers and others.
- Existing slope must be geologically stable.

## CONSTRUCTION GUIDELINES

- 1) Toe or footing trench into native material is required as shown.
- 2) Method of placement must meet Caltrans Method A standards for ½ ton class rock: “Larger rocks shall be placed in the footing trench. Rocks shall be placed with their longitudinal axis normal to the embankment face and arranged so that each rock above the foundation course has a 3-point bearing on the underlying rocks. Foundation course is the course place on the slope in contact with the ground surface. Bearing on smaller rocks which may be used for chinking voids will not be acceptable. Placing of rocks by dumping will not be permitted. Local surface irregularities of the slope protection shall not vary from the planned slope by more than 0.3-m measured at right angles to the slope.”
- 3) Slope face of wall shall not be steeper than 0.5 horizontal to 1 vertical.
- 4) Walls need to be engineered. Rock size, rock thickness, and toe width will vary.

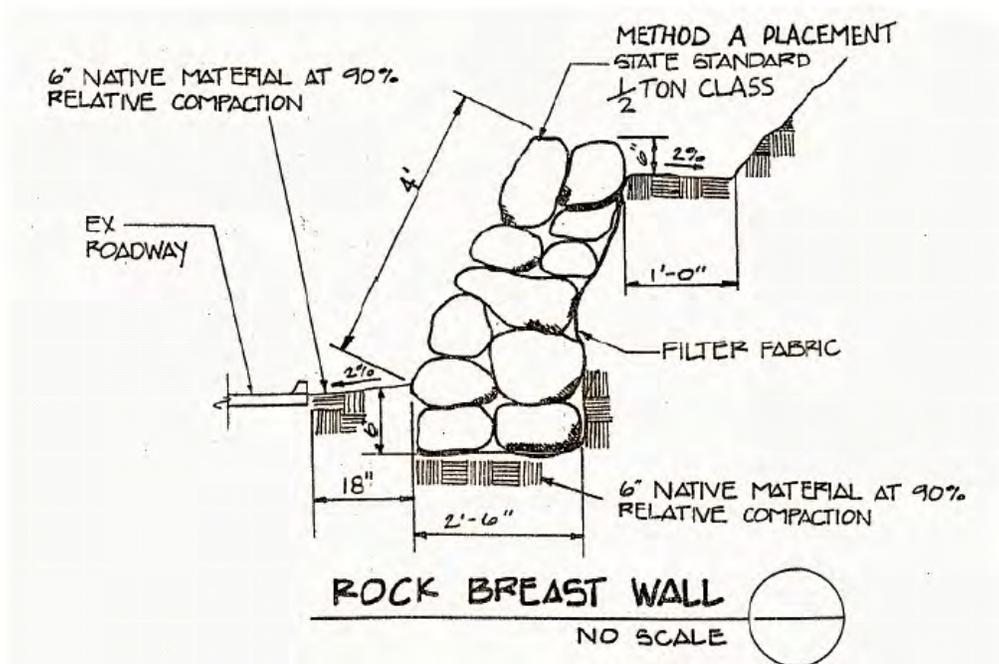
## BMP MAINTENANCE

- Inspect wall for movement and settling. Repair as needed.

## ROCK BREAST WALL

**Description:** A rock breast wall is a low retaining wall (usually 10 feet or less in height) constructed against the base of a slope. The wall is usually built by stacking rocks atop one another in a single, one-rock width course.

**Purpose:** To defend the toe of the slope and to prevent slope damage by erosion, especially piping and spring sapping as a result of seepage exiting from the face of the slope.



SLO COUNTY ROAD MAINTENANCE AA-58

## **SEDIMENT MANAGEMENT BMPS**

<b>CHECK DAM – ROCK .....</b>	<b>AA - 60</b>
<b>CHECK DAM – STRAW BALE .....</b>	<b>AA - 62</b>
<b>CONCRETE WASHOUT.....</b>	<b>AA - 64</b>
<b>CONTAINMENT OF CONCRETE POURS.....</b>	<b>AA - 67</b>
<b>SILT MAT INLET.....</b>	<b>AA - 69</b>
<b>SILT MAT/VEGETATED GRASSY SWALE.....</b>	<b>AA - 71</b>
<b>SILT FENCE .....</b>	<b>AA - 72</b>
<b>SEDIMENTATION SUMP.....</b>	<b>AA - 79</b>
<b>SILTATION POND/SETTLING POND .....</b>	<b>AA - 81</b>
<b>STORM DRAIN INLET PROTECTION .....</b>	<b>AA - 88</b>
<b>SWEEPING .....</b>	<b>AA - 90</b>

# **BMP – CHECK DAM: ROCK**

## DESCRIPTION

A semi-porous rock grade control structure.

## APPLICATIONS

Use only in small upland drainages and gullies. Used to provide channel grade stability. May be designed to trap sediment for removal. See BMP Sediment Sump - Trap.

## LIMITATIONS

- Maximum weir height is 5 feet.
- Check dams tend to flatten the channel grade and can cause upstream meandering which may erode stream banks and cut around the structure.
- An adequate cutoff trench into competent native ground is essential.
- The rock on the weir must be correctly placed and sized or the structure will fail.
- Cannot be used in fish bearing streams.

## CONSTRUCTION GUIDELINES

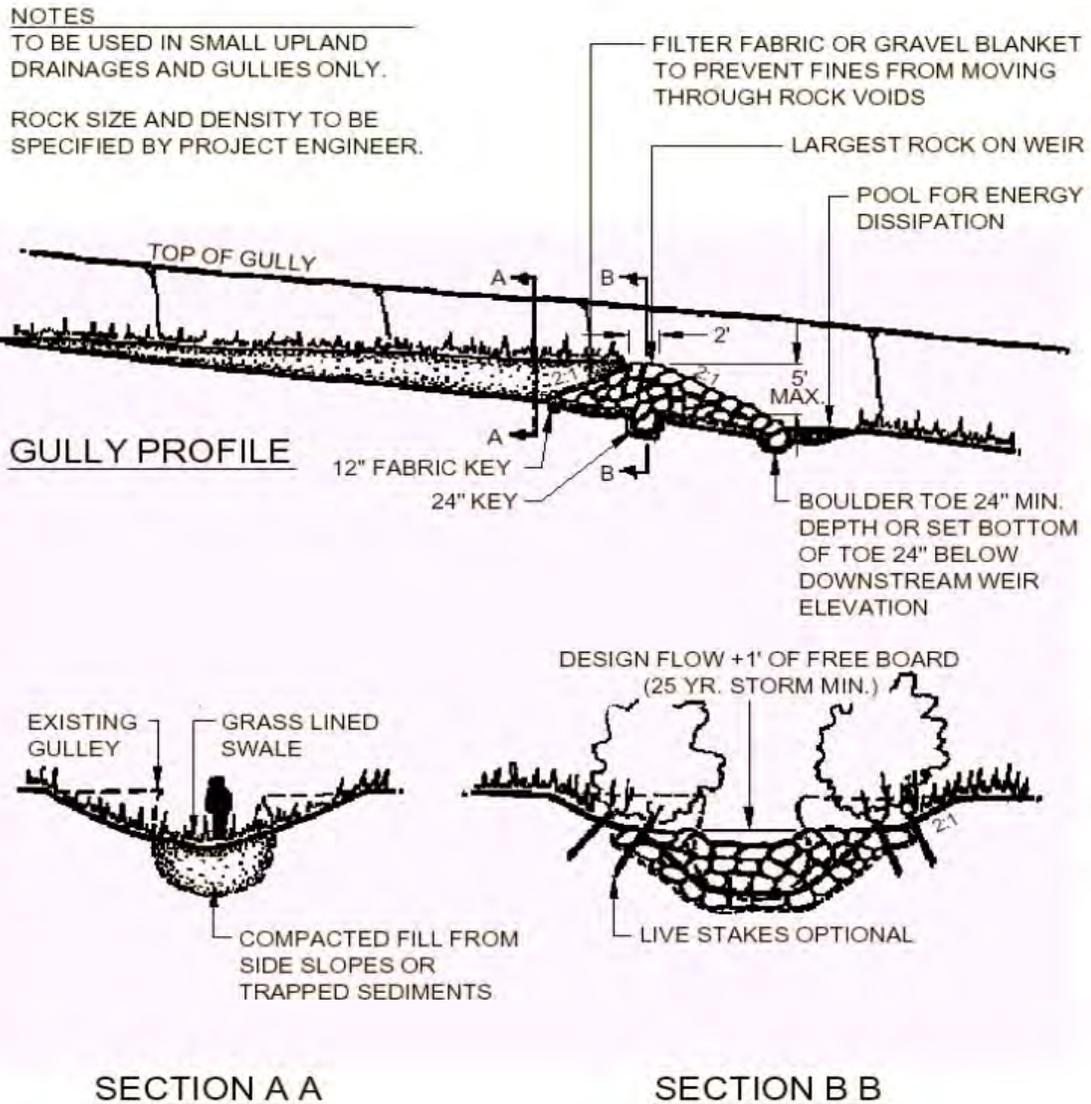
- 1) Weir opening must be large enough for the design flow (25 year or greater) plus one foot of freeboard.
- 2) Center cutoff trench must be keyed into native ground to a depth of 2 feet both underneath and on the sides of the structure.
- 3) Toe trench at downstream end is critical to prevent undercutting. See drawing.
- 4) Rock is placed in an interlocking matrix with each rock supported at a minimum of three points. Fill voids between large rocks with small rock. Typically rock shall have a minimum specific gravity of 2.7 and a minimum diameter of 18 inches (rock size and density may be specified by project engineer). Use smaller rocks to chink into voids.
- 5) Coir mat, filter fabric, or a gravel blanket is used as shown to prevent fines from moving through rock voids.
- 6) Rock check dams may be constructed in a series with the toe of the upstream dam approximately level with the weir opening of the downstream dam.
- 7) Engineered fill placed to a designed gradient upstream of the check dam is preferable to random sediment accumulation.

## BMP MAINTENANCE

- Adjust rock if displaced.
- If upstream channel begins to cut around structure, remove rock in middle of weir to widen and lower opening.

## BMP REMOVAL

- N/A



# **BMP – CHECK DAM: STRAW BALE**

## DESCRIPTION

Temporary sediment catchments constructed of straw bales. Also used as grade control structures to facilitate vegetation establishment.

## APPLICATIONS

Use in small upland drainages and gullies only. Used to trap sediment from dewatering operations. (See BMP: Dewatering – Pumping or Draining). May also be used to allow for revegetation in eroded swales.

## LIMITATIONS

- When used as sediment catchments, must be inspected and cleaned out regularly.
- Temporary structures. Rely on vegetation to stabilize over the long run.
- Check dams tend to flatten channel grade causing upstream bank-full meandering which may erode stream banks.
- Adequate cutoff trench into competent native ground is essential. Incorrect installation may cause increased erosion

## CONSTRUCTION GUIDELINES

- 8) Never use metal stakes or rebar to anchor bales unless a provision is included to remove these materials. Metal stakes pose a serious safety hazard.
- 9) Key bales 4 inches into the ground and side banks. Compact moist soil around side banks.
- 10) Center must be lower than sides to act as a spillway. Add rock downstream of center weir bale.
- 11) Secure with a minimum of two wooden stakes per bale.

## BMP MAINTENANCE

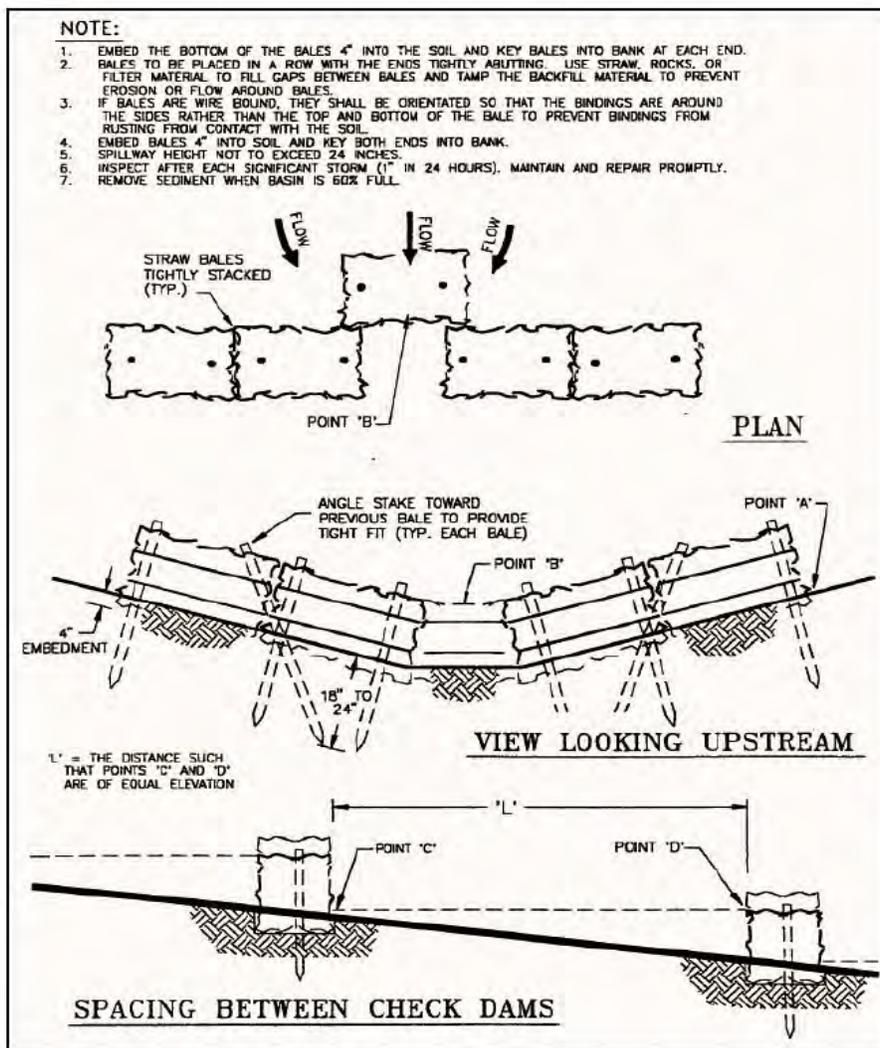
- When used as sediment catchments, must be inspected and cleaned out when basin is 60% full.
- Inspect sediment catchments after each significant storm (1 inch in 24 hours).

## **BMP REMOVAL**

● Straw bales and stakes used as a catchment basin are removed after the project has stabilized. The area is then smoothed, reseeded and mulched (see Seeding BMP and Mulching BMP).

- ✓ When used as grade control to facilitate vegetation establishment, removal is not required.

## **CHECK DAM – STRAW BALE**



Source: McCullah, J. 1992. *Erosion and Sediment Control Standards Design Manual*  
—County of Shasta. Prepared for the Western Shasta RCD. Redding CA. 187 p.

# **BMP - CONCRETE WASHOUT**

## **DESCRIPTION**

Concrete washout areas prevent concrete waste discharges to waterways and storm drains. Concrete and cement-related mortars are toxic to fish and the aquatic environment.

## **APPLICATIONS**

Concrete washouts are applicable for projects that require;

- on-site preparation and use of Portland cement concrete, asphalt concrete, or cement mortar
- equipment washouts

## **LIMITATIONS**

- An appropriate area for the washout must be identified at least 50 feet away from watercourses and storm drains in case of accidental breaching.
- The storage capacity of the basin must be sized correctly for the job.

## **CONSTRUCTION GUIDELINES**

- 1) The location of the concrete washout should be clearly labeled and all employees should be educated about proper concrete disposal.
- 2) Avoid mixing excess amounts of fresh concrete or cement mortar on-site.
- 3) Wash out concrete mixers only in designated washout areas where the water will flow into temporary sealed basins or onto stockpiles of aggregate base or sand. Use as little water as possible to reduce hardening and evaporation time of waste products.
- 4) Construct a basin large enough to contain all liquid and waste concrete materials generated during washout procedures. A minimum basin size is 9 feet x 9 feet and 2 feet deep. Plastic liner materials shall be a minimum of 60-mil polyethylene sheeting free of holes and defects.
- 5) Recycle washout by pumping back into mixers for reuse when possible.

## BMP MAINTENANCE

- The concrete washout should be checked frequently to ensure proper use and effectiveness.
- At 75% capacity, the washout must be cleaned or new facilities must be constructed and ready for use.
- The hardened concrete and materials related to the washout must be broken up, removed, and disposed of in accordance to local regulations.
- Area disturbed by the concrete washout must be repaired.

## REFERENCES AND ADDITIONAL INFORMATION

California Regional Water Quality Control Board. *Erosion and Sediment Control Field Manual*, page 108, Third Edition, July 1999. Caltrans. *Storm Water Quality Handbooks: Construction Site Best Management Practices Manual*, November 2000.



Source:  
California Regional Water Quality Control  
Board. Erosion and Sediment Control Field  
Manual, Third Edition, July 1999.

**CONCRETE  
WASHOUT**

SLO COUNTY ROAD MAINTENANCE AA-66

# **BMP- CONTAINMENT OF CONCRETE POURS**

## DESCRIPTION

Proper management and techniques of pavement construction materials will greatly reduce or eliminate discharge into waterways resulting from paving, surfacing and the materials related to the removal of paving waste. Concrete and cement-related materials are toxic to fish and the aquatic environment.

## APPLICATIONS

Containment of concrete will be necessary when forming, cutting, surfacing, paving, cleaning, or removal activities occur.

## LIMITATIONS

- Fine particulate matter may not be removed by the filtering methods.
- Some containment controls become ineffective during wet weather.

## CONSTRUCTION GUIDELINES

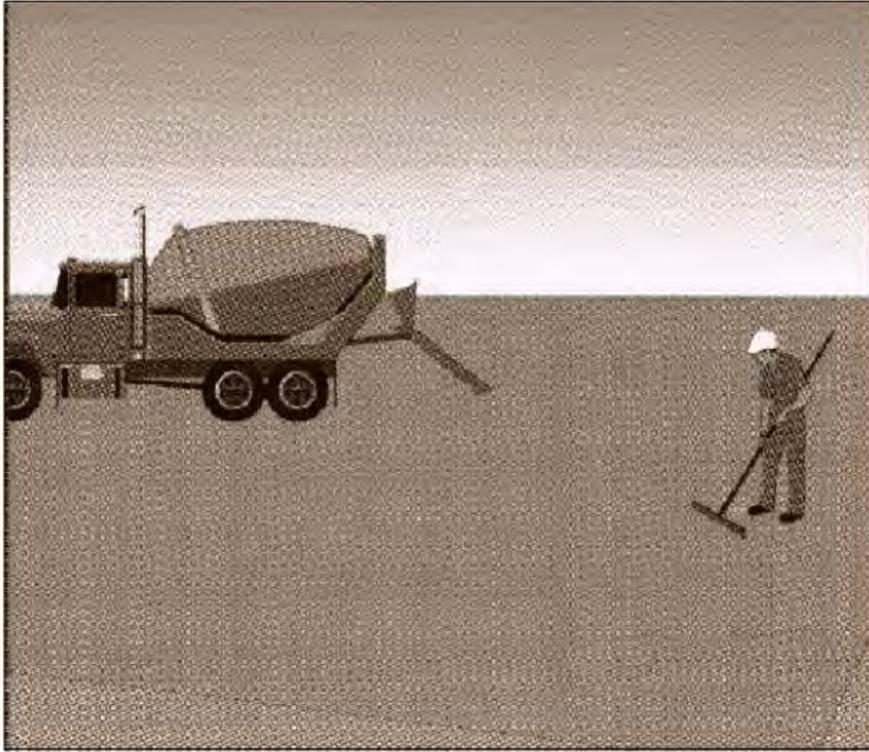
- 1) Apply concrete in dry weather to prevent runoff.
- 2) Drip pans or absorbent materials should be placed under paving machines when parked or stored on site.
- 3) Straw bales, sand bags, silt mats, or other controls should be used in drainage areas to filter runoff.
- 4) Use as little water as possible to reduce runoff.
- 5) Sweepings should be returned to the stockpile or disposed of in the trash, not washed into the street or a waterway.
- 6) Recycle broken concrete and asphalt.

## BMP MAINTENANCE

- Check filter areas to ensure effective control of concrete waste. Remove waste build-up before filters are filled to capacity.
- Inspect and maintain machinery to minimize leaks and drips.
- Check with employees and subcontractors to ensure that measures are being followed.

## BMP REMOVAL

- Drip pans, absorbent materials, wash water, and solids must be disposed of at approved facilities.



Source:  
California Regional Water Quality Control  
Board. Erosion and Sediment Control Field  
Manual, Third Edition, July 1999.

**CONTAINMENT,  
CONCRETE POUR**

SLO COUNTY ROAD MAINTENANCE AA-68

## **BMP – SILT MAT INLET**

### DESCRIPTION

A silt mat inlet protector is a filter fabric with an erosion control blanket and riser placed over a storm drain drop inlet to help reduce the introduction of sediment into the watercourse during construction.

### APPLICATIONS

During construction, silt mats are the last line of defense to trap sediment before runoff enters the storm drain.

### LIMITATIONS

- The silt mat inlet protection is only effective at low flows.
- Only effective for drop inlets which have been designed in a concave area – not for use on street side curb gutters.
- Inlet filters may cause stormwater to by-pass the inlet only to re-enter the watercourse at an unprotected location.
- Silt mat inlet protection must be monitored and maintained frequently.

### CONSTRUCTION GUIDELINES

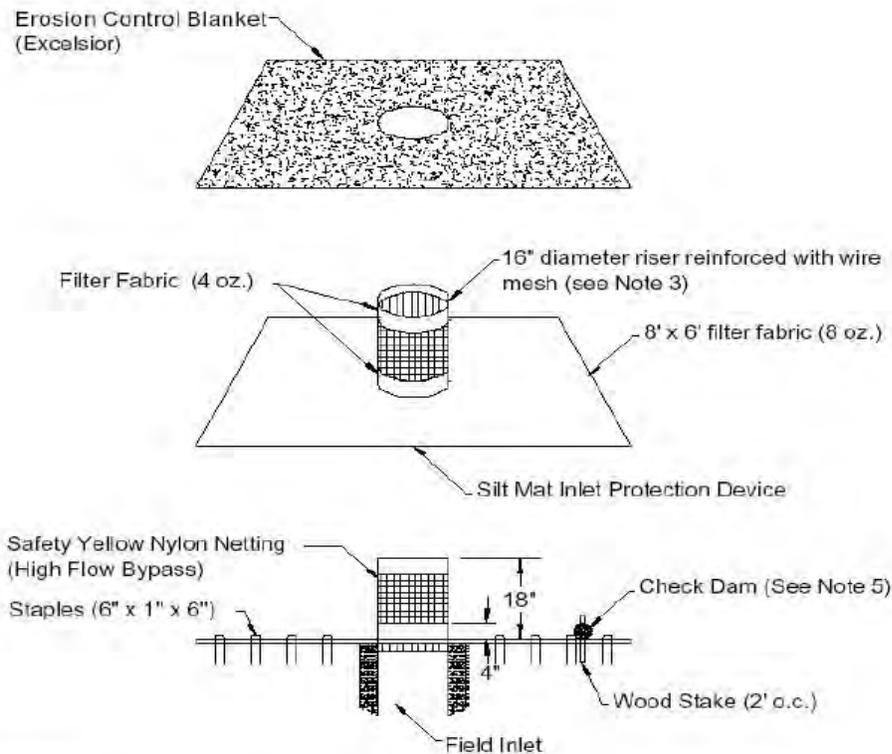
- 1) All upstream erosion control measures must be in place prior to installation of silt mat.
- 2) Clear and smooth the area to be covered by the erosion control blanket.
- 3) Roll out the blanket over the cleared area. Secure the edges of the blanket with staples or washed angular gravel.
- 4) Install the inlet protection device to the blanket as shown in the attached manufacturer's details.

### BMP MAINTENANCE

- Filter maintenance requirements vary with the application. Silt mats should be inspected before and after every rain event.
- During extended periods of rainfall, inspection should be at least every 24 hours.
- Silt and debris should be removed when the depth exceeds three inches (3") and disposed of in accordance with local agency requirements.
- The silt mat should be replaced when ripped or damaged.

## **BMP REMOVAL**

- Silt mat can be removed when no longer necessary for inlet protection. All materials should be disposed of properly.



### **NOTES:**

1. Clear and level area (6'-0" x 8'-0" min.) surrounding field inlet.
2. Roll out mat and center riser over inlet grate.
3. Install wire mesh frame into riser.
4. Secure mat in place using staples (6" x 1" x 6" min.) at approximately 1'-0" o.c.e.w. On hard surfaces, anchor with washed angular gravel or rock.
5. Side(s) of erosion control blanket may be rolled to form check (silt) dam to further slow or direct flows. Stake in place as shown.
6. Inspect inlet protection device before and after rain events, and weekly throughout the rainy season. During extended rain events, inspect at least once every 24 hours.
7. Remove and properly dispose of accumulated silt and debris to allow for proper function of device.

Source:

[www.kristar.com/media/pdf/siltmat.pdf](http://www.kristar.com/media/pdf/siltmat.pdf)

KriStar Enterprises, Inc., Santa Rosa, CA  
(800) 579-8819

## **BMP – SILT MAT/VEGETATED GRASSY SWALE**

### DESCRIPTION

An erosion control blanket installed in a swale or drainage ditches and outlets at construction sites, functioning to both prevent erosion and collect water-borne sediments. The mat may be seeded to establish vegetation which aids in sediment entrapment.

### APPLICATIONS

A last line of defense to trap sediments before construction site waters enter the natural watercourse.

### LIMITATIONS

- Not for large volumes or high flows – swale slope must be low gradient.
- Plastic netted erosion control blankets may entrap wildlife. Use plastic-netted erosion control blankets only when the design shear stress exceeds the manufacturer's recommendations for non-plastic products and wildlife entrapment will not be an issue.

### CONSTRUCTION GUIDELINES

- 5) All upstream erosion control measures must be in place prior to installation of silt mat.
- 6) Where installation is downstream of a discharge point such as a culvert or discharge hose, a rock energy dissipater will be required over a portion of the silt mat.
- 7) There are many types and grades of erosion control blanket. The blanket chosen should be non-plastic, consisting of natural fibers such as coir or excelsior. The blanket must meet the manufacturer's design specifications for the flow rates, velocities, and shear stresses anticipated.
- 8) Install as per manufacturer's instructions. See accompanying details. It is essential that pre-installation soil surfaces are smooth to provide good soil to silt mat contact without tenting.
- 9) If used with an appropriate perennial seed mix, the effectiveness of the silt mat may increase as the grass grows. (see Broadcast Seeding BMP)
- 10) Do not use fertilizers in conjunction with the silt mat and seeding, as the fertilizer may mobilize and contaminate downstream waters.

## **BMP MAINTENANCE**

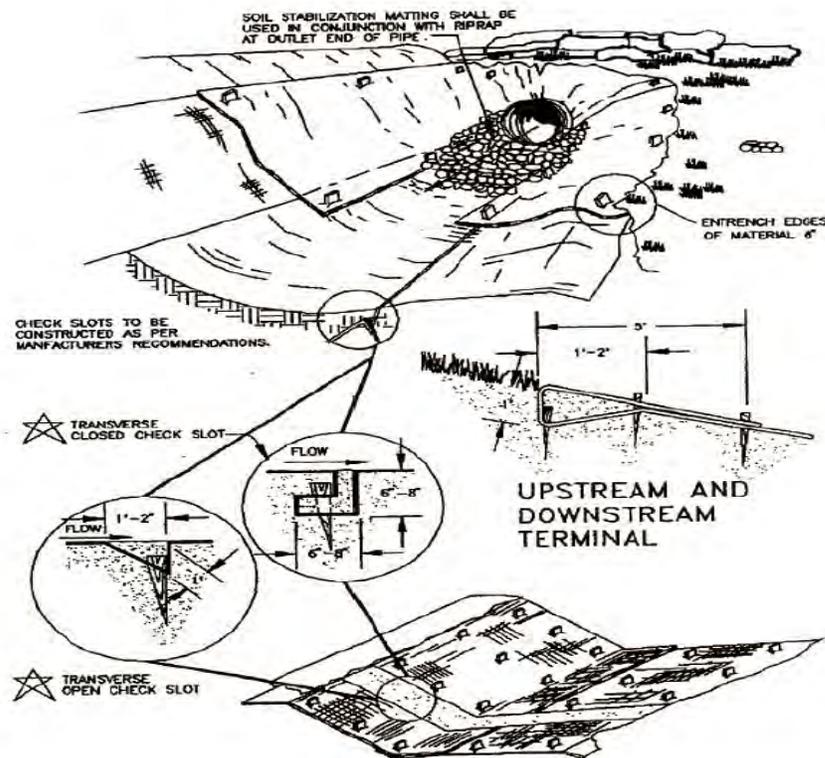
- Inspect silt mat during and after flow events. Re-fasten any loose areas, or replace damaged sections.

## **BMP REMOVAL**

- Removal may not be required as the natural materials decompose on site.

### SILT MAT- SWALE

**Purpose:** To capture sediment and prevent erosion at culvert discharge points where there are no high flow rates.



Source: King County 2000 Regional Road Maintenance Endangered Species Act Program Guidelines

## **BMP- SILT FENCE**

### DESCRIPTION

A silt fence is a temporary sediment barrier consisting of filter fabric entrenched into the soil and attached to supporting posts. Silt fence installed with a trencher or by slicing is the most effective installation method to ensure against common silt fence failures. The slicing method for silt fence installation utilizes an implement towed behind a tractor to “plow” or slice the silt fence material into the soil. The slicing method requires the “Tommy” silt fence machine or equivalent. Silt fence machines install the silt fence by slicing through the soil, rather than excavating it. Slicing minimally disrupts the soil upward and slightly displaces the soil, maintaining the soil’s profile and creating an optimal condition for future mechanical compaction. Compacted soil resists water infiltration and moisture saturation, thus nearly eliminating washouts.

### APPLICATIONS

Silt fence is a sediment control practice. Silt fence is intended to be installed where sediment-laden water can pond, thus allowing the sediment to fall out of suspension and separate from the runoff. It is not intended to be an erosion control practice. Improperly applied or installed silt fence will increase erosion. Only install silt fence where water can pond. Silt fence placed off contour will effectively divert runoff if that is desired.

Silt fence can be used where:

- sheet and rill erosion would occur;
- protection of adjacent property or areas beyond the limits of grading is needed (perimeter control);
- the size of the drainage area is no more than 1/4 acre per 100 linear feet of silt fence;
- the maximum flow path length above the barrier is 100 feet (30.5 m);
- the maximum slope gradient above the barrier is 2:1;
- small swales are carrying silt, the slope is less than 2%, and the drainage area is less than 2 acres (0.8 ha);
- silt fence is the only feasible option.

## **LIMITATION**

The high failure rate of silt fences is often due to:

- Improper placement on the site
  - Inadequate quantities relative to the area contained
- Shallow trenches with little or no soil compaction.
- Inadequate attachment to posts
- Failure to maintain the silt fence after installation.

When installing, remember these important facts:

- No formal design is required. Silt fences have a useful life of one season. Their principal mode of action is to slow and pond the water and allow soil particles to settle. Silt fences are not designed to withstand high heads of water, and therefore should be located where only shallow pools can form. Their use is limited to situations in which sheet or overland flows are expected.
- Silt fences should be placed on contour to be most effective. Site perimeters and property boundaries rarely follow slope contour. If silt fences are placed along property boundaries, water may be diverted to the low point and failure may occur.
- The slicing method has the capability to turn in a short distance, thus properly installing silt fence where needed. Turning enables upturns on the ends of silt fence runs, maneuvering around obstacles on construction sites, protection along property lines, and following contours as prescribed in Best Management Practices.
- Silt fences normally cannot filter the volumes generated by channel flows. When installed across a concentrated flow path, undercutting of the fence often occurs. Silt fences should not be designed to impound sediment or water more than 18 inches (0.5 m) high. Sediment shall be cleaned from behind the fence when it reaches 50% of the designed impoundment height (9 inch (0.2 m)).

## **CONSTRUCTION GUIDELINES**

Some design considerations include:

- 1) Determine what kind of runoff, and how much, is coming onto the site; too much volume of water per silt fence area means failure will happen;
- 2) Determine where and how the total volume is going to exit; total drainage area is the prime consideration of silt fence quantity, not necessarily slope;
- 3) Soil type can play a role in the placement and quantity requirements; sandy soils might require more silt fence per area to contain the volume of potential sediment; clay soils might need fewer fences because the volume of potential sediment loss is less, although the volume of water might be greater because clay soils allow less rainfall infiltration;
- 4) Type, size and spacing of fence posts; wood posts are inadequate and should not be used; steel t-posts weighing at least 1.25 lbs per ft. are required, as they can be driven 24 inches into compacted soil, which is necessary to hold a horizontal load 18 inches high, and they can also be recycled and used repetitively; improper spacing of posts causes failures;

- 5) Type of filter cloth; if all the elements of the silt fence installation are properly adhered to, the fabric does not make much difference; even lightweight nonwoven fabric will hold 18 inches of sediment; wire supported fence is costly and ineffective.
- 6) Typical silt fence specifications were written 25 years ago and have changed little since. Some states have recognized some of the inherent problems, such as inadequate trench depth, and implemented minor changes to improve efficacy. The 25 year-old specifications, referred to as the trenching method, have never been tested for efficacy and proven worthwhile. A trencher was simply the only piece of equipment available at the time capable of securing the fabric into the soil, regardless of efficacy. Today, many contractors just open a furrow with a blade and backfill onto the fabric with the crumbs. Loose soil, both from the trencher or the blade, absorbs water quickly and becomes saturated easily, washing out under the fabric.
- 7) The soil should be sliced and the fabric mechanically installed into the soil
- 8) The height of a silt fence shall not exceed 36 inches (0.9 m). Storage height and ponding height shall never exceed 18 inches (0.5 m).
- 9) To minimize erosion, install silt fence at the head of a slope to slow velocity and to create a large storage area.
- 10) The fence line shall follow the contour as closely as possible.
- 11) The ends of the fence should be turned uphill.
- 12) Steel support posts should be utilized, properly spaced and driven into compacted soil
- 13) Post spacing shall not exceed 6 feet (1.8 m).
- 14) The filter fabric is stapled or wired directly to the posts. Filter fabric shall not be stapled to existing trees.
- 15) Fabric should be attached to the posts with three diagonal ties
- 16) Set any silt fence placed at the toe of a slope at least 6 feet (1.8 m) from the toe in order to increase ponding volume.

#### BMP MAINTENANCE

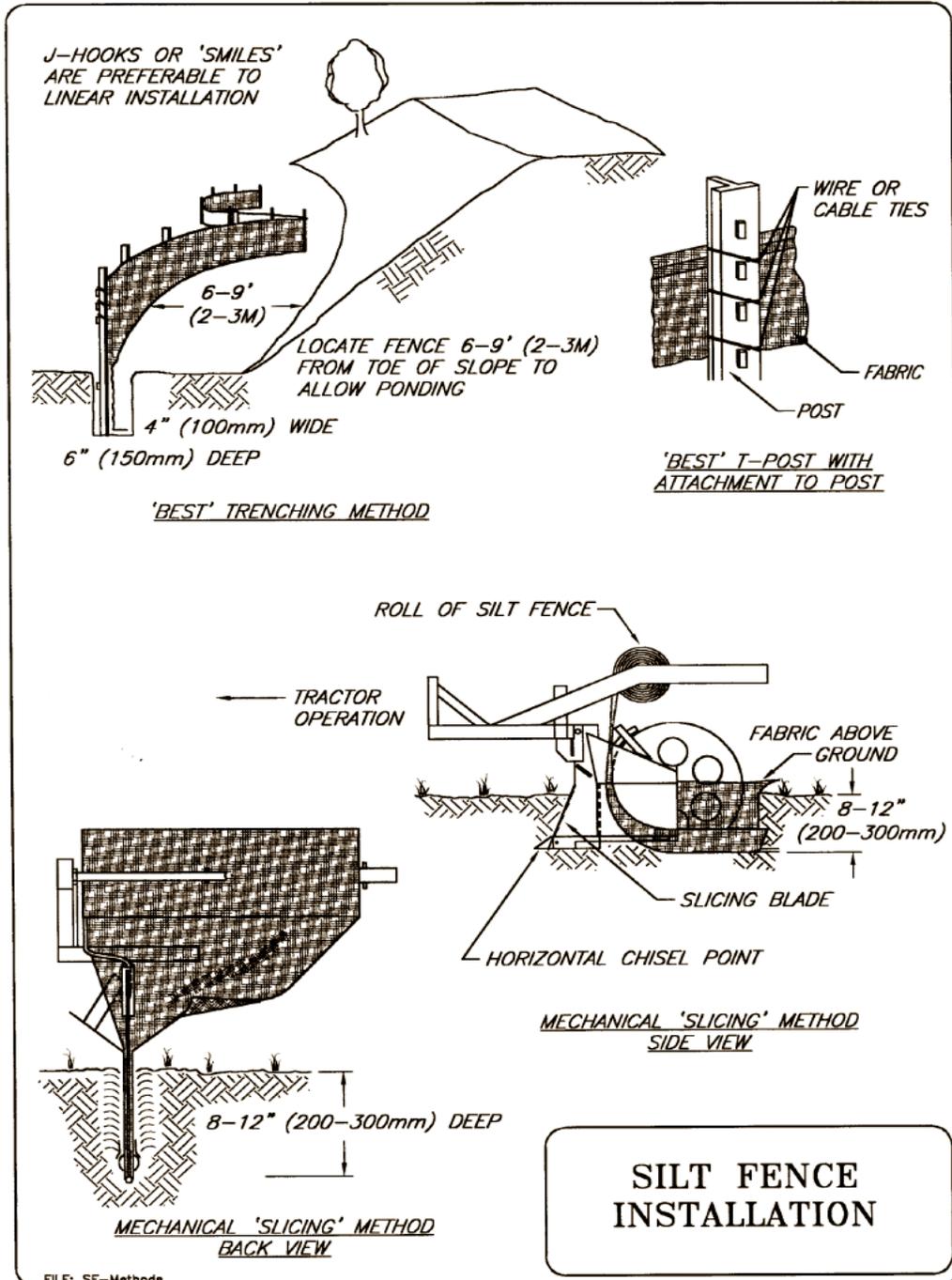
- Inspect silt fences and filter barriers weekly after each significant storm, i.e. 1 inch (25.4 mm) in 24 hours. Make any required repairs immediately.
- Remove sediment when it reaches 1/3 height of the fence or 9 inches (0.3 m) maximum.
- The removed sediment shall conform to the existing grade and be vegetated or otherwise stabilized.

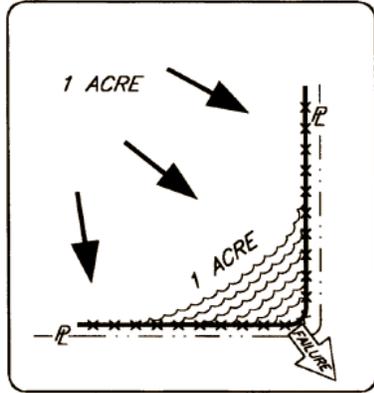
#### BMP REMOVAL

- Once a silt fence has served its purpose, make sure you permanently stabilize the upslope area and remove any sediment stored behind the silt fence **before** removing it.

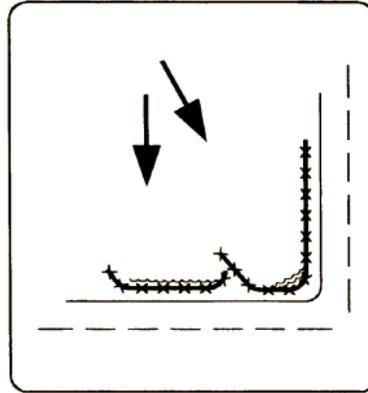
**ADDITIONAL RESOURCES**

*Silt Fence That Works*, Thomas Carpenter, CPESC, 2000. Tommy Silt Fence Machine, 3718 S.W. Court Ave., Ankeny, Iowa, 50021 (800) 965-4665 www.tommy-sfm.com  
*Installation of Silt Fence Using the Tommy Static Slicing Method*, Environmental Technology Verification Report, Washington, DC, 2000

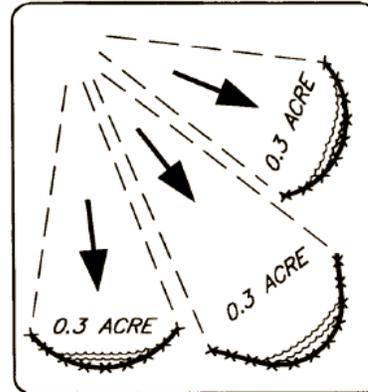
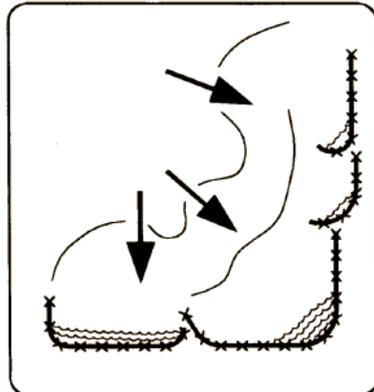




*Incorrect* – Do Not layout "perimeter control" silt fences along property lines. All sediment laden runoff will concentrate and overwhelm the system.



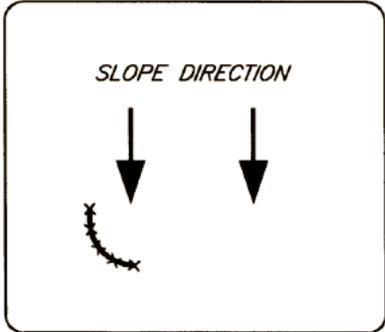
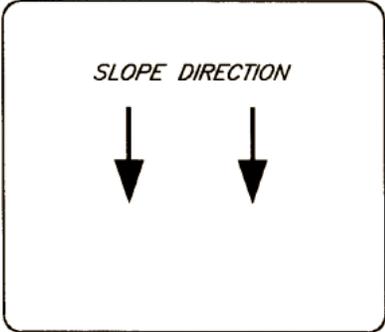
*Correct* – Install J-hooks



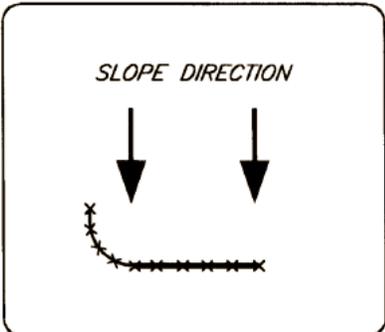
*Discreet segments of silt fence, installed with J-hooks or 'smiles' will be much more effective.*

## SILT FENCE PLACEMENT FOR PERIMETER CONTROL

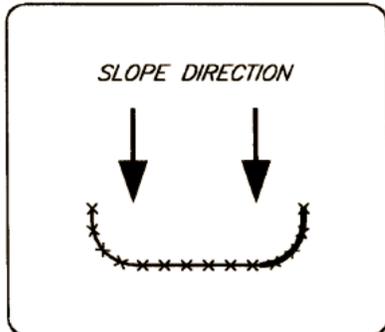
FILE: SF-Perimeter Control



*STEP 1 – CONSTRUCT LEG*



*STEP 2 – CONSTRUCT DAM*

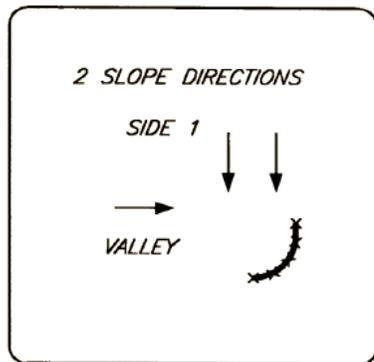
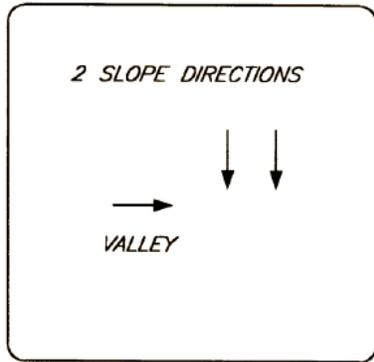


*STEP 3 – CONSTRUCT LEG 2*

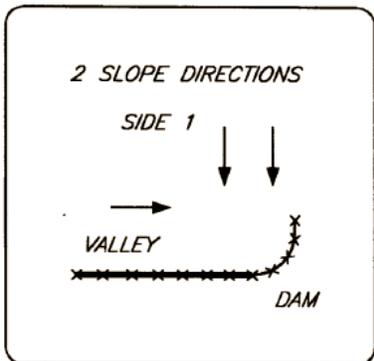
*INSTALLATION WITH J-HOOKS OR 'SMILES' INCREASE SILT FENCE EFFICIENCY.*

**SILT FENCE  
TYPICAL PLACEMENT—ONE SLOPE**

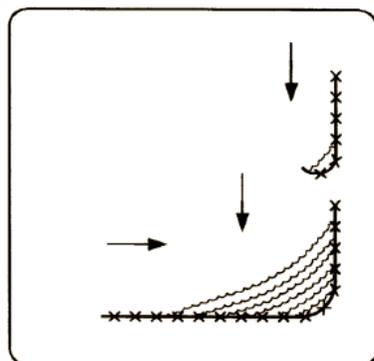
FILE: SF-One Slope



STEP 1 - CONSTRUCT A DAM



STEP 2 - CONSTRUCT SIDE 2



STEP 3 - CONSTRUCT J-HOOKS AS NEEDED

INSTALLATION WITH J-HOOKS WILL INCREASE SILT FENCE EFFICIENCY AND REDUCE EROSION-CAUSING FAILURES.

**SILT FENCE  
TYPICAL PLACEMENT-TWO SLOPES**

FILE: SF-Two Slopes

# **BMP – SEDIMENT TRAP OR SUMP**

## DESCRIPTION

A sediment sump (also known as a sediment trap) is a small basin with a controlled release structure. The basin is formed by excavating or by constructing an earthen embankment, straw bale check dam, or gravel bag barrier across the drainage path. The trap is used only to retain larger size sediment and should only be used in conjunction with upstream erosion control measures and downstream sediment controls.

## APPLICATIONS

Sediment traps may be used during wet construction periods for small drainages of less than 5 acres where sediment-laden storm water may enter the storm drain system or watercourse. See also BMP – Siltation Pond.

## LIMITATIONS

- Requires an area large enough to settle water.
- Not appropriate for drainage areas greater than 5 acres or within fish bearing streams.
- Removes only larger materials (not excessive fines) and must be used in conjunction with other erosion control methods.
- May require safety fencing to keep people out.
- Not to be used in a live stream.
- Location must be approved by appropriate agencies to avoid unintended impacts to wetlands or other key habitats.

## CONSTRUCTION GUIDELINES

- 1) Sediment traps should be constructed prior to rainy season and construction activities.
- 2) Trap shall be located: 1) by excavating a suitable area or where a low embankment can be constructed across a swale, 2) where failure would not cause loss of life or property damage, and 3) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.
- 3) Trap shall be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 67 cubic yards/acre and 33 cubic yards/acre of contributing drainage area, respectively, based on 0.5 inches of runoff volume over a 24 hour period. Multiple traps and/or additional volume may be required to accommodate site specific rainfall and soil conditions.

- 4) Traps with an impounding levee greater than 4.5 feet tall, measured from the lowest point to the impounding area to the highest point of the levee, and traps capable of impounding more than 1300 cubic yards, shall be designed by a professional Civil Engineer registered with the state of California.
- 5) Areas under embankments, structural work, and sediment traps shall be cleared and stripped of vegetation.
- 6) Trap length to width ratio shall be greater than 3:1 (L:W) or baffles are required to prevent short circuiting of the inlet flow.
- 7) Trap inlets shall be located to maximize the travel distance to the trap outlet. Use rock or vegetation to protect the trap outlets against erosion.
- 8) To dewater the trap, the outlet shall be constructed in one of the following two ways: a) Use corrugated metal, high density polyethylene (HDPE), or reinforced concrete riser pipe with dewatering holes encased in gravel to prevent floating debris from flowing out of the trap or obstructing the system; or b) Construct a crushed stone outlet section of the embankment at the low point of the trap. The stone section serves as a non-erosive spillway outlet for flood flows and the bottom section provides a means of dewatering the trap between rainfall events.

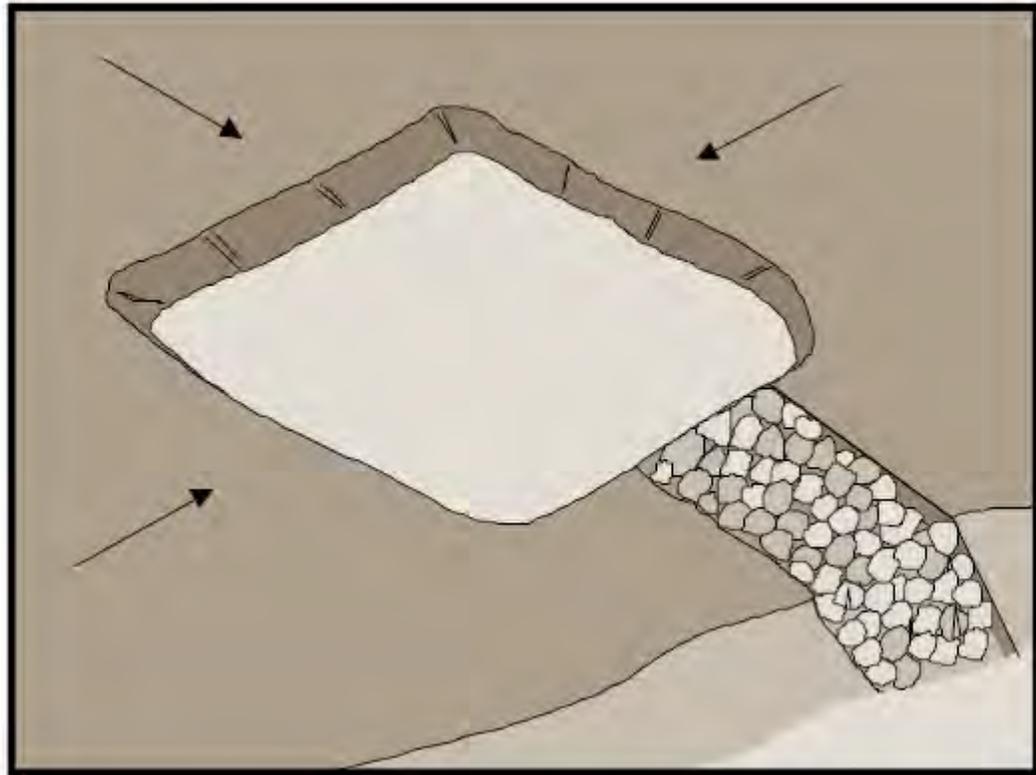
#### BMP MAINTENANCE

- Inspect sediment traps before and after rainfall events and weekly during the rest of the rainy season. During extended rainfall events, inspect sediment traps at least every 24 hours.
- Check trap banks for seepage and structural soundness.
- Check outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Check outlet area for erosion and stabilize if required.
- Remove accumulated sediment when the volume has reached one-third the original trap volume.
- Properly dispose of sediment and debris removed from trap.
- Check fencing for damage and repair as needed.

#### BMP REMOVAL

- Once site has stabilized, remove dam structure, re-grade to original contours, mildly compact if fill is placed, seed and mulch, or otherwise stabilize areas of bare soil.
- Dispose of imported fill material in approved stable areas away from watercourses.

## SEDIMENT TRAP



## **BMP – SILTATION POND/SETTLING POND**

### DESCRIPTION

A siltation pond or desilting basin is a temporary basin formed by excavating and/or constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is discharged. It is a last line of defense to prevent sediment from entering a watercourse after all other pertinent upslope erosion control measures have been installed.

## APPLICATIONS

Desilting basins can be used on large construction projects with disturbed areas during the rainy season, and where sediment laden water may enter the drainage system or watercourses, or at outlets of disturbed soil with areas between 5-10 acres.

## LIMITATIONS

- All erosion control BMPs must be in place to minimize amount of sediment entering the basin.
- Requires large surface area to permit settling of sediment.
- Not appropriate for areas greater than 30 ha (75 acres).
- Not to be located in live fish bearing streams.
- If safety is a concern, basins may require protective fencing.

## CONSTRUCTION GUIDELINES

- 1) Limit the contributing area to the desilting basin to only runoff from the disturbed soil areas. Use temporary concentrated flow conveyance controls to divert runoff from undisturbed areas away from the desilting basin.
- 2) Desilting basins shall be designed to have a capacity equivalent to 100 cubic meters of storage (as measured from the top of the basin to the principal outlet) per hectare of contributory area. This design is less than the required size to capture the 0.01 mm particle size but larger than that required to capture particles 0.02 mm or larger.
- 3) The length of the basin shall be more than twice the width of the basin; the length shall be determined by measuring the distance between the inlet and the outlet.
- 4) The depth must be no less than one (1) meter nor greater than 1.5 m.
- 5) Basins with an impounding levee greater than 1.5 m tall, measured from the lowest point to the impounding area to the highest point of the levee, and basins capable of impounding more than 1000 cubic meters shall be designed by a professional Civil Engineer registered with the state of California.
- 6) Design and locate desilting basins so that they can be maintained (cleaned out). Construct desilting basins prior to the rainy season and construction activities.
- 7) Desilting basins, regardless of size and storage volume, shall include features to accommodate overflow or bypass flows that exceed the design storm event.
- 8) Basins shall be designed to drain within 72 hours following storm events.
- 9) The outflow from the desilting basin shall be provided with outlet protection to prevent erosion and scouring of the embankment and channel.

- 10) Basin shall be located: 1) by excavating a suitable area or where a low embankment can be constructed across a swale, 2) where post-construction (permanent) detention basins will be constructed, 3) where failure would not cause the loss of life or property damage, and 4) where the basins can be maintained on a year-round basis to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area, and to maintain the basin to provide the required capacity.
- 11) Areas under embankments, structural work, and sediment traps shall be cleared and stripped of vegetation.
- 12) Basin inlets shall be located to maximize water travel distance to the basin outlet.
- 13) Rock or vegetation shall be used to protect the basin inlet and slopes against erosion.
- 14) A forebay, constructed upstream of the basin, may be provided to remove debris and larger particles.
- 15) Principal outlet shall consist of a corrugated metal, high density polyethylene (HDPE), or reinforced concrete riser pipe with dewatering holes and an antivortex device and trash rack attached to the top of the riser to prevent floating debris from flowing out of the basin or obstructing the system. This principal structure shall be designed to accommodate the inflow design storm.
- 16) Structure shall be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation.
- 17) Attach riser pipe (watertight connection) to a horizontal pipe (barrel) which extends through the embankment to toe of fill. Provide anti-seep collars on the barrel.
- 18) Cleanout level shall be clearly marked on the riser pipe.
- 19) Avoid dewatering of groundwater to the desilting basin during the rainy season. Insignificant quantities of accumulated precipitation may be dewatered to the desilting basin unless precipitation is forecasted within 24 hours.
- 20) Area may require fencing if safety is a concern.
- 21) One of the dewatering configurations shown below for the principal outlet may be used. The Contractor shall verify that the outlet is properly designed to handle the design and peak flows.
- 22) Outlet #1 (see drawing): Perforate the top one-third of the riser with 13 mm (0.5in) diameter holes spaced 200 mm (8 in) vertically and 250 mm (10 in) -300 mm (12 in) horizontally. Place 19 mm (0.75 in) gravel over perforated holes to approximately 50 mm (2 in) minimum thickness to assist in prevention of clogging of dewatering holes. Gravel will naturally settle into a cone surrounding the riser pipe.
- 23) Outlet #2 (see drawing): Perforate the lower one-half of the riser pipe with 13 mm (0.5 in) diameter holes spaced approximately 75 mm (3 in) apart, in each outside valley (corrugated metal pipe). Place 19 mm (0.75 in) gravel over perforated holes to approximately 50 mm (2 in) minimum thickness to assist in prevention of clogging of dewatering holes. Gravel will naturally settle into a cone surrounding the riser pipe.

24) Outlet #3 (see drawing): Provide two 25 mm (1 in) diameter holes above the sediment storage volume on opposite sides of the non-perforated riser pipe. This will typically provide sufficient detention time for basins to drain approximately 4 ha (10 ac). Construct an emergency spillway to accommodate flows not carried by the principal spillway. Spillway shall consist of an open channel (earthen or vegetated) over undisturbed material (not fill) or constructed of a non-erodible riprap. Spillway control section, which is a level portion of the spillway channel at the highest elevation in the channel, shall be a minimum of 6 m (20 ft) in length. Use outlet protection at the pipe outlet.

### BMP MAINTENANCE

- Inspect temporary desilting basins before and after rainfall events and weekly during the rest of the rainy season. During extended rainfall events, inspect sediment traps at least every 24 hours.
- Examine basin banks for seepage and structural soundness.
- Check inlet and outlet structures and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Check inlet and outlet areas for erosion and stabilize if required.
- Remove sediments when storage zone is one-third full.
- Properly dispose of sediment and debris removed from trap.
- Check fencing for damage and repair as needed.

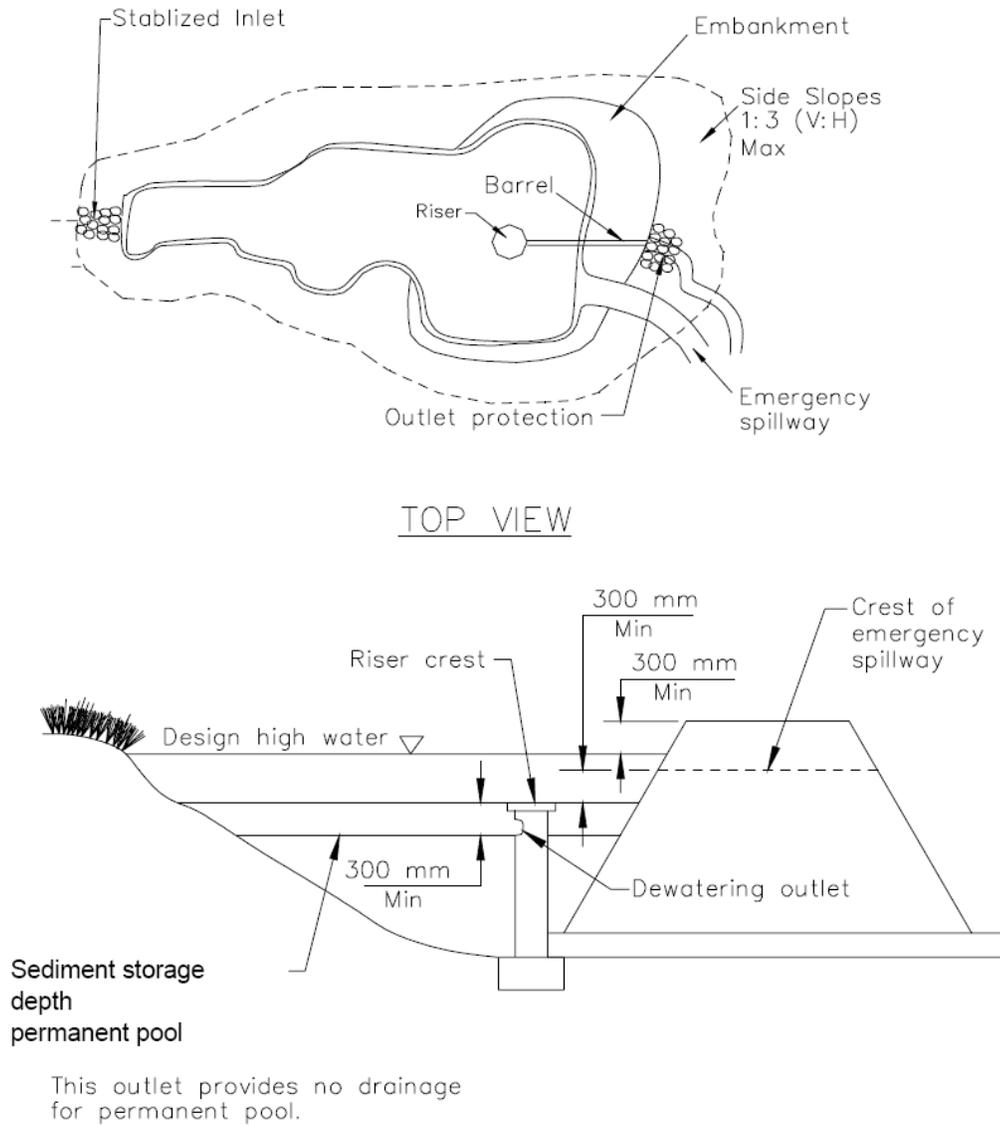
### BMP REMOVAL

- Re-grade dam and basin area to original slope unless another configuration is specified.
- Stabilize areas of bare soil with seed and mulch prior to the rainy season.

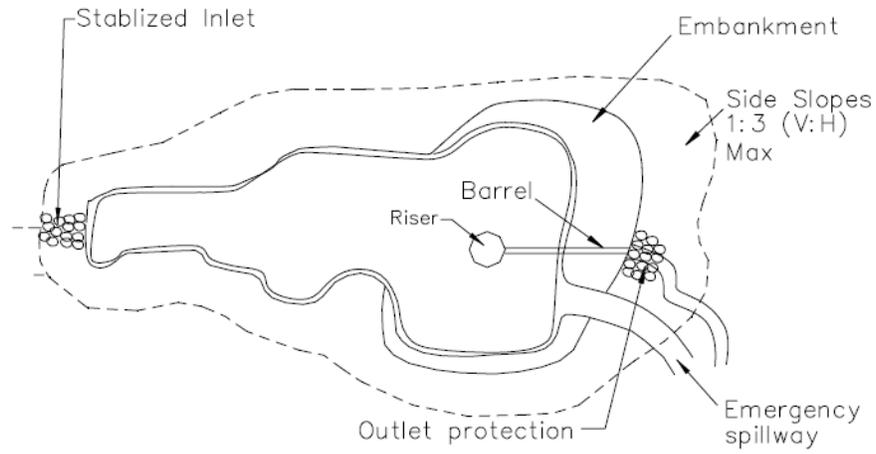
**SOURCE**

Caltrans. *Storm Water Quality Handbooks: Construction Site Best Management Practices Manual*, pages SC-2, March 1, 2003

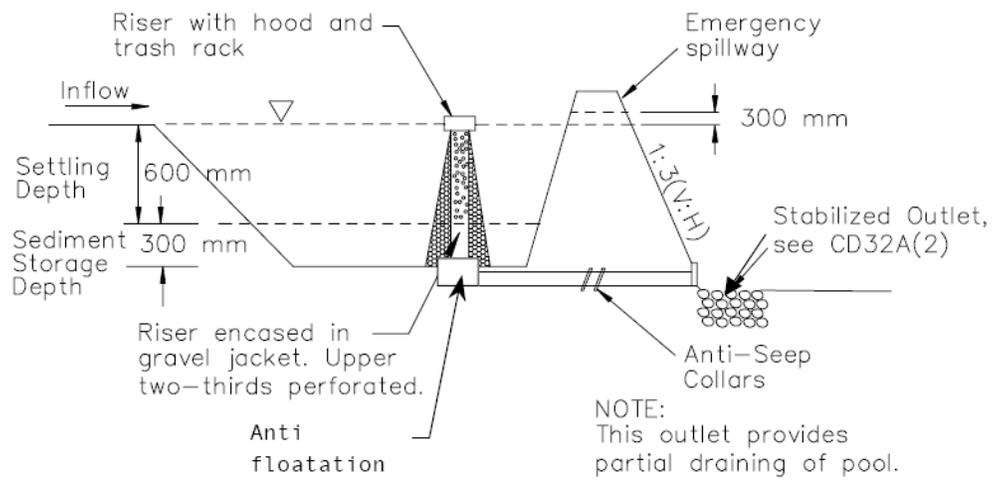
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**FIGURE 1: SINGLE ORIFICE DESIGN**  
NOT TO SCALE



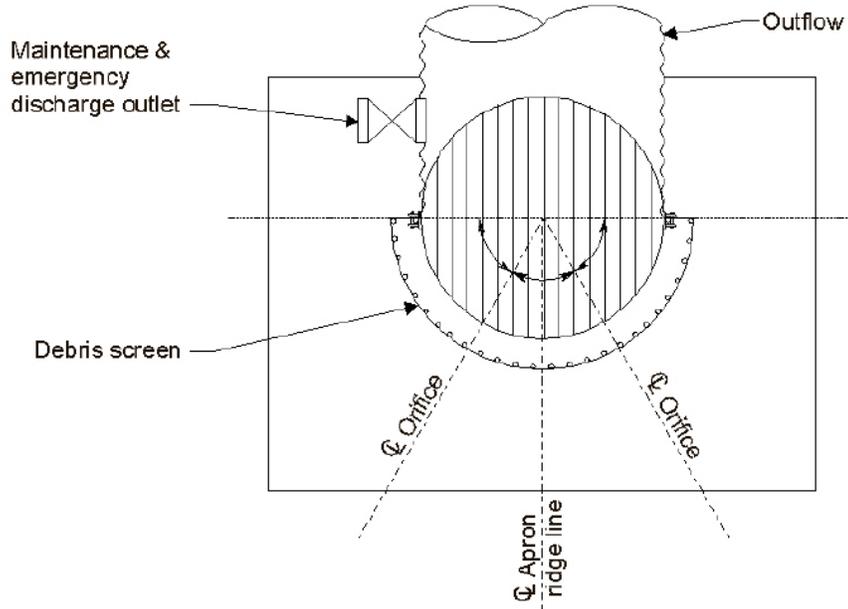
TOP VIEW



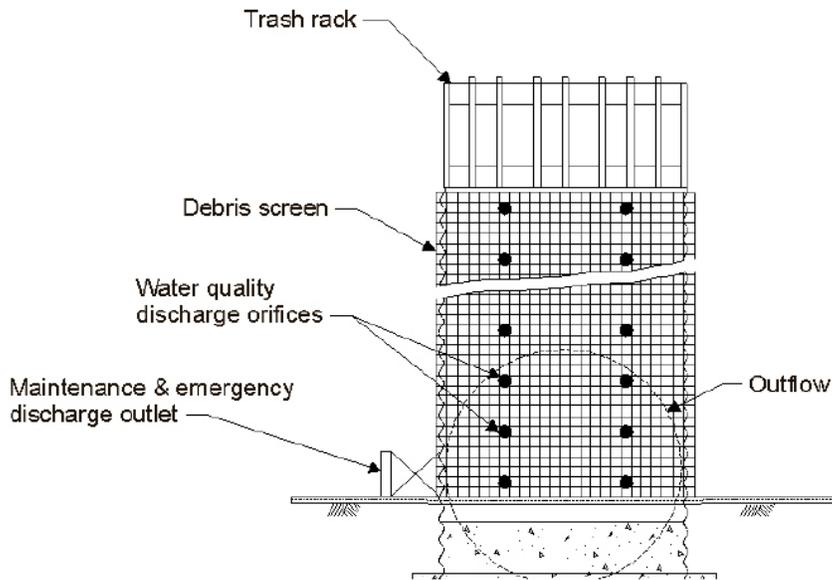
1

**FIGURE 2: MULTIPLE ORIFICE DESIGN**  
**NOT TO SCALE**

**Plan**



**Profile**



**FIGURE 3: MULTIPLE ORIFICE OUTLET RISER  
NOT TO SCALE**

# **BMP – STORM DRAIN INLET PROTECTION**

## DESCRIPTION

Curb inlet sediment barriers on storm drains are temporary barriers constructed from concrete block and gravel or gravel filled sandbags.

## APPLICATIONS

Curb inlet sediment barriers 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. Use this BMP where new construction, reconstruction and/or private development is generating sediment or polluted runoff.

## LIMITATIONS

- Do *not* use this BMP on steep sloping streets.
- Consider this BMP a “backup,” used *in addition to* controlling potential erosion at the source.

## CONSTRUCTION GUIDELINES

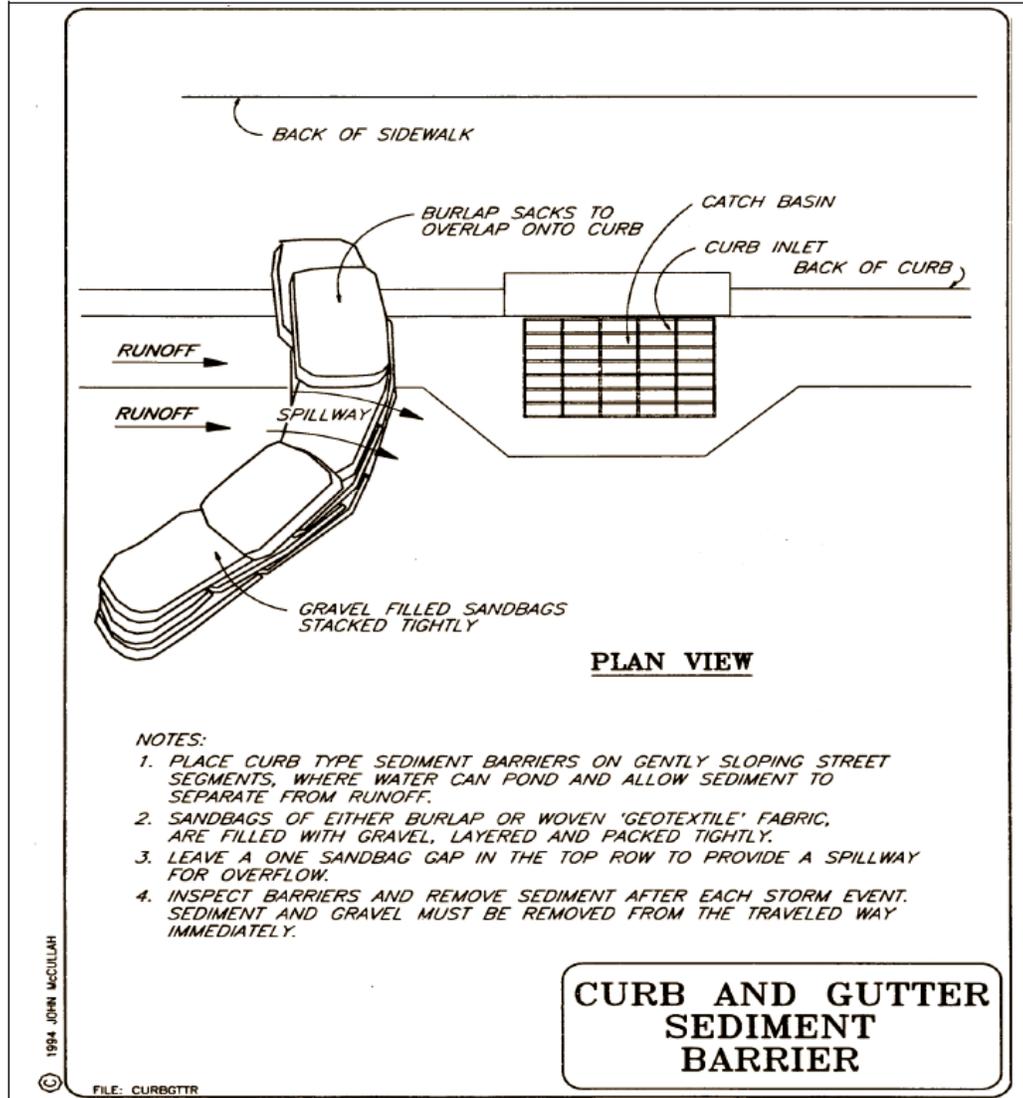
- 1) Place the barriers on gently sloping streets where water can pond.
- 2) The barriers must allow for overflow from a severe storm event. A spillway shall be constructed with the sandbag structures to allow overflow.
- 3) Sandbags shall be filled with 3/4-inch drain rock or 1/4-inch pea gravel.
- 4) 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.
- 5) Several layers of bags should be overlapped and packed tightly.
- 6) 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

- Remove when upstream source of sediment has been eliminated



SLO COUNTY ROAD MAINTENANCE AA-89



## **BMP – SWEEPING**

### DESCRIPTION

Sweeping performed by hand or mechanical means is an effective way to clean debris and reduce the possibility for runoff into storm drains, watercourses, and streams.

## APPLICATIONS

Sweeping is preferred to the use of water to clean up soil particles and debris. Use sweeping to help suppress dust on roadways and at construction sites. Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress.

## LIMITATIONS

- Some dust particles may become air-born.
- May not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

## CONSTRUCTION GUIDELINES

- 1) To prevent inhalation of dust and fine sediment, use respiratory protection.
- 2) Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be more focused and effective.
- 3) Collect waste and dispose of at permitted facilities. If material is not mixed with debris or trash, consider incorporating the removed sediment back into the project.
- 4) Use a minimum amount of water with mechanical brooms.
- 5) Do not pick up suspicious debris but instead call the appropriate agency or HazMat contractor.

## BMP MAINTENANCE

- Keep brooms and sweeping machinery in good condition. Repair any leaks.
- Inspect potential sediment tracking locations daily.

## BMP REMOVAL

- Collect waste frequently and dispose properly.

## **WATER MANAGEMENT BMPs**

<b>ASPHALT BERM</b> .....	<b>AA - 93</b>
<b>AQUA BARRIER</b> .....	<b>AA - 94</b>
<b>COFFERDAM</b> .....	<b>AA - 96</b>
<b>DEWATERING</b> .....	<b>AA - 101</b>
<b>DIVERSION BERM</b> .....	<b>AA - 103</b>
<b>FISH EXCLUSION</b> .....	<b>AA - 104</b>
<b>LEVEL SPREADER</b> .....	<b>AA - 105</b>
<b>SANDBAG</b> .....	<b>AA - 108</b>
<b>SLOPE DRAIN – TEMPORARY</b> .....	<b>AA - 110</b>
<b>SLOPE DRAIN – OVERSIDE</b> .....	<b>AA - 112</b>
<b>SLOPE DRAIN- SWALE</b> .....	<b>AA - 115</b>
<b>STREAM BYPASS (WATER DIVERSION)</b> .....	<b>AA - 118</b>

# **BMP - ASPHALT BERM**

## 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 to 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

Do *not* use this BMP:

- to concentrate runoff onto unstable, eroded areas.
- near edges of slides or streambanks where cutback berms could slip into a stream.

## CONSTRUCTION GUIDELINES

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

## BMP MAINTENANCE

- Conduct periodic inspections, and repair berms 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.

# **BMP – AQUA BARRIER**

## DESCRIPTION

Aqua barriers are temporary, re-usable water-filled plastic tubes installed as dams. An aqua barrier can be used as a type of coffer dam.

## APPLICATIONS

Aqua barriers can be used in any situation where water damming, water diversion, or silt containment is necessary. The dams are portable, re-usable, and come in a variety of sizes to fit any project.

## LIMITATIONS

- Use of aqua barriers in a waterway are subject to federal, state, and local permits.
- A portable pump and abundant local water supply must be available.
- Sharp objects will puncture the plastic.
- Not suitable for steep channel gradients.
- Presents a temporary barrier to migrating aquatic species.

## CONSTRUCTION GUIDELINES

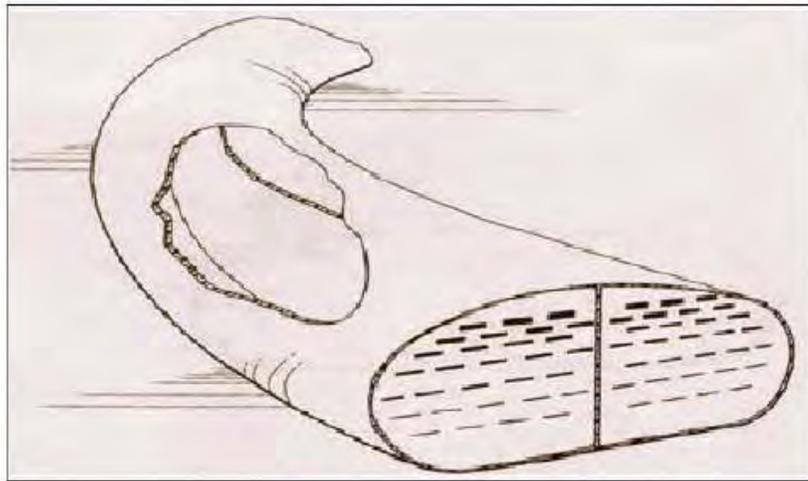
- 1) Instructions for aqua barriers vary by manufacturer; however they are generally put in place in the waterway then filled with water.
- 2) Although the barriers are flexible and conform to varied terrain, some smoothing and leveling of the ground surface may be needed.
- 3) Substrate beneath the barriers must be of sufficient strength and uniformity to support the load.
- 4) Safety issues regarding potential breach of dam must be addressed in the planning stages.
- 5) 25% minimum freeboard is required. More freeboard may be needed for slick or weak soils, or higher velocities over 3 feet per second.

## BMP MAINTENANCE

- Aqua barriers should be checked routinely for tears and stability.

## BMP REMOVAL

- Water released from the aqua barrier on-site may require additional measures to ensure environmental compliance.
- An energy dissipating device is required to prevent erosion from draining water.



PORTABLE, WATER-FILLED DAM

- Water diversion for dewatering
- Cofferdam
- Silt containment

Source:  
AquaDams/Water Structures Unlimited  
[www.waterstructures.com/  
Applications/page1.html](http://www.waterstructures.com/Applications/page1.html)

## **BMP- COFFERDAM**

### 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

A cofferdam is a potentially serious “taking” issue (could cause harm to listed species) and is not a routine road maintenance BMP. For information on incidental take permits for fish habitats, see Chapter 2-Permits. Consultation with a fisheries biologist and agency biologists is imperative if there are salmonids present in the stream system. A Streambed Alteration Agreement (1600permit) is needed from DFG which will outline the terms and conditions to protect aquatic habitat and species.

Do *not* use this BMP:

- if there is insufficient stream flow to support aquatic species.
- in deep water unless designed or reviewed by an engineer.
- to completely dam stream flows.

### CONSTRUCTION GUIDELINES

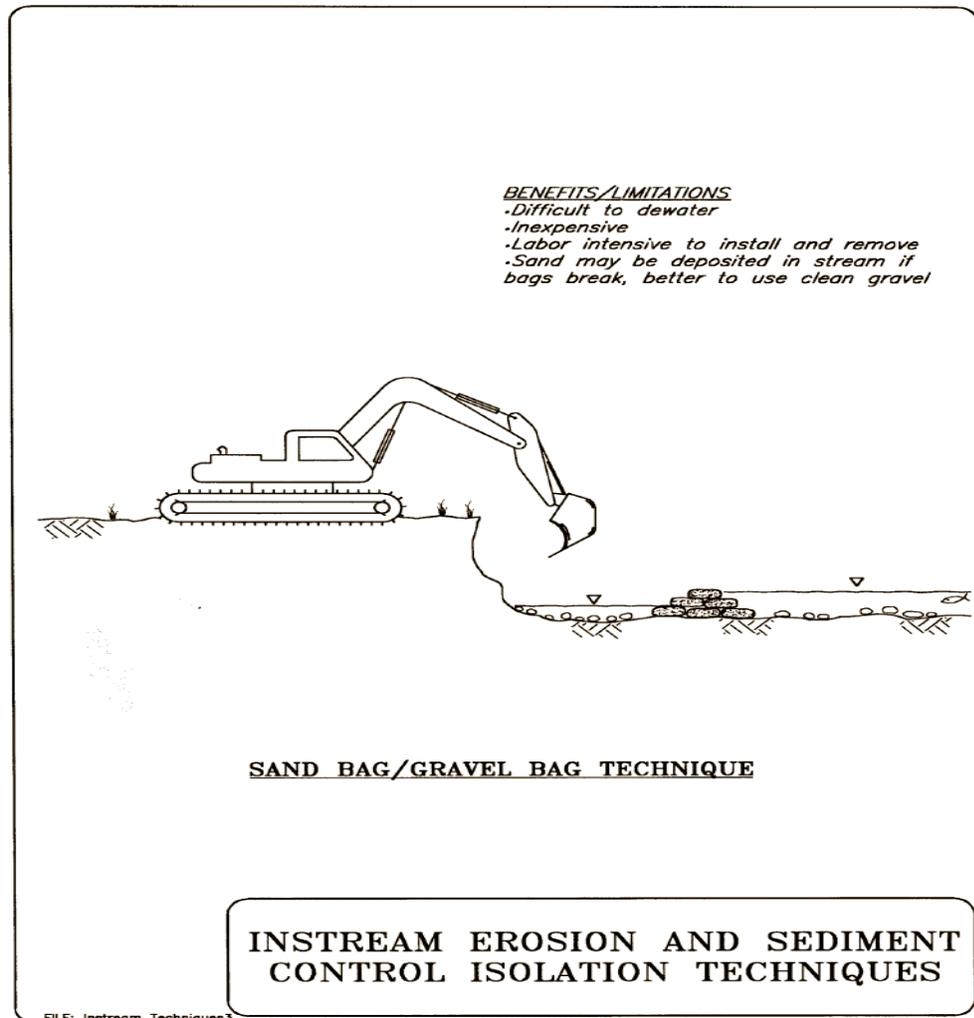
- 1) When used in watercourses or streams, cofferdams must be used in accordance with permit requirements. Materials for cofferdams should be selected based on ease of maintenance and complete removal following construction activities.
- 2) Construct cofferdams of sandbags, placed by hand. Sandbags should be filled with clean river run gravels.
- 3) Cover dam covered in visqueen to minimize water infiltration

## BMP MAINTENANCE

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

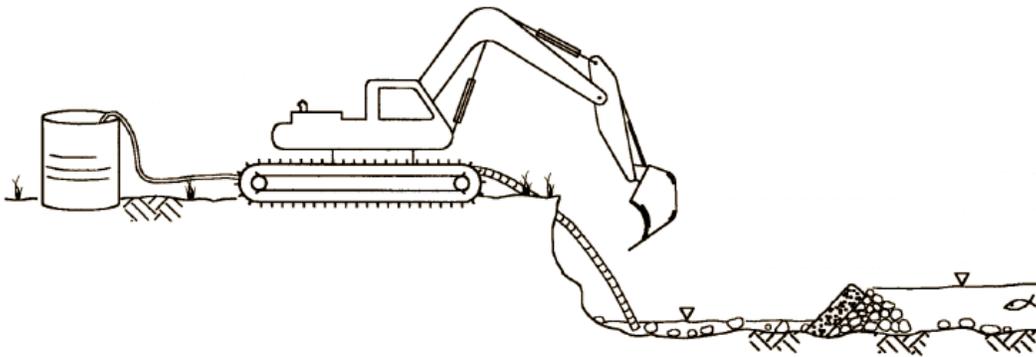
## BMP REMOVAL

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



*BENEFITS/LIMITATIONS*

- Allows partial dewatering*
- Relatively inexpensive*
- Useful for small streams*
- Minimal TSS when removed*



*NOTES:*

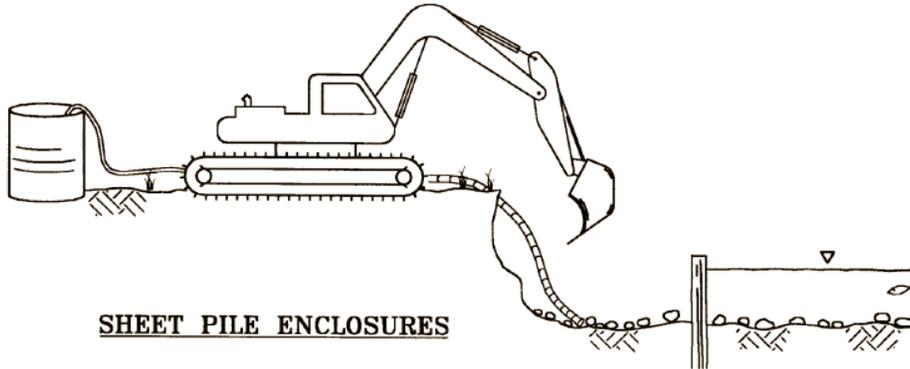
- Step 1. Install clean gravel*
- Step 2. Place impermeable soil*
- Step 3. Do work*
- Step 4. Decommission berm by removing soil layer first*
- Step 5. Pump work area. Head differential will cause turbo water to flow into work area*
- Step 6. Remove or spread gravel*

**GRAVEL/SOIL BERM INSTREAM  
ISOLATION TECHNIQUE**

FILE: Berm Instream Techniques

BENEFITS/LIMITATIONS

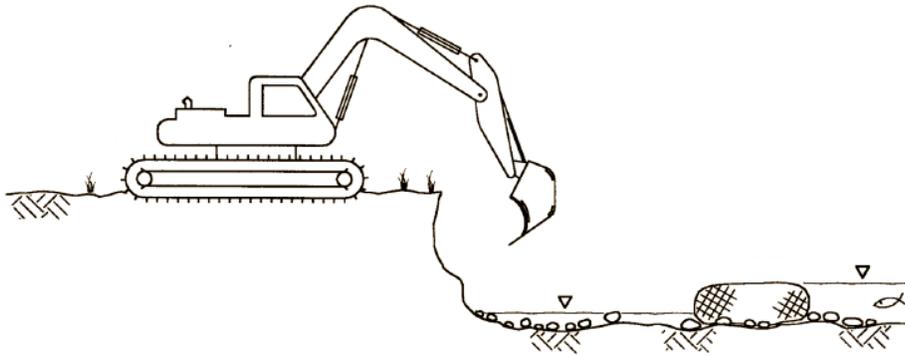
- .Allows full dewatering*
- .Relatively expensive*
- .Useful in large rivers, lakes, high velocity*
- .Not really appropriate for small streams*
- .Requires staging and heavy equipment access areas*



SHEET PILE ENCLOSURES

BENEFITS/LIMITATIONS

- .Allows partial dewatering*
- .Moderately expensive*
- .Ease of installation and removal unknown*
- .Can be designed for small streams to large rivers*



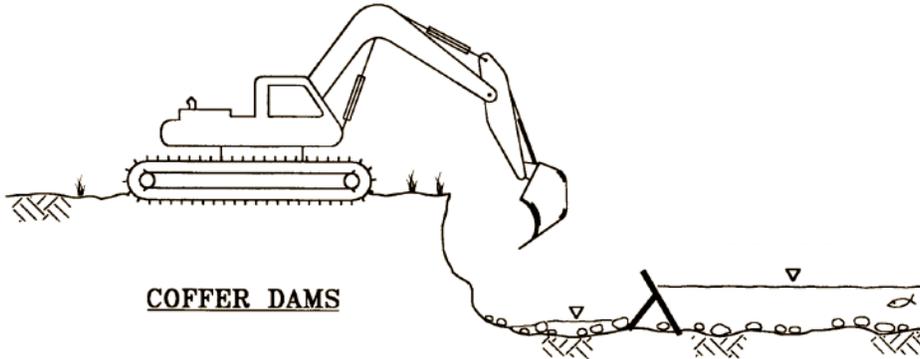
WATER-FILLED GEOTEXTILE (AQUA DAM)

**INSTREAM EROSION AND SEDIMENT  
CONTROL ISOLATION TECHNIQUES**

FILE: Instream Techniques2

***BENEFITS/LIMITATIONS***

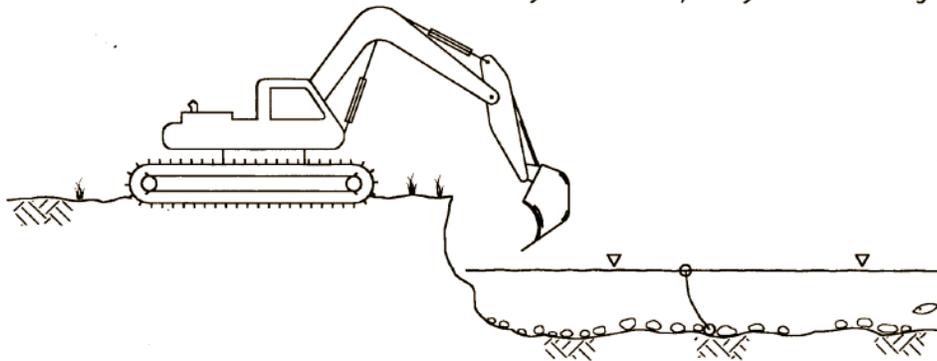
- Allows partial dewatering*
- Many different types available*
- Relatively expensive*
- Can be designed for large and small streams*
- Ease of installation and removal unknown*



**COFFER DAMS**

***BENEFITS/LIMITATIONS***

- Does not allow dewatering*
- Inexpensive*
- Used in slow water lakes only*
- Not very effective especially when removing*



**GEOTEXTILES, SILT BARRIERS, CURTAINS**

**INSTREAM EROSION AND SEDIMENT  
CONTROL ISOLATION TECHNIQUES**

FILE: instream Techniques1

# **BMP – DEWATERING**

## DESCRIPTION

A temporary method to remove and filter water from excavated areas on construction sites prior to discharge to the storm drain or surface waters. See also Aqua Barrier, Cofferdam, and Stream Bypass BMPs.

## APPLICATIONS

Used for draining creeks, lakes, ponds, sediment traps, basins, or excavations on construction sites. Also used wherever sediment-laden water must be removed from the construction site using a dewatering pump.

## LIMITATIONS

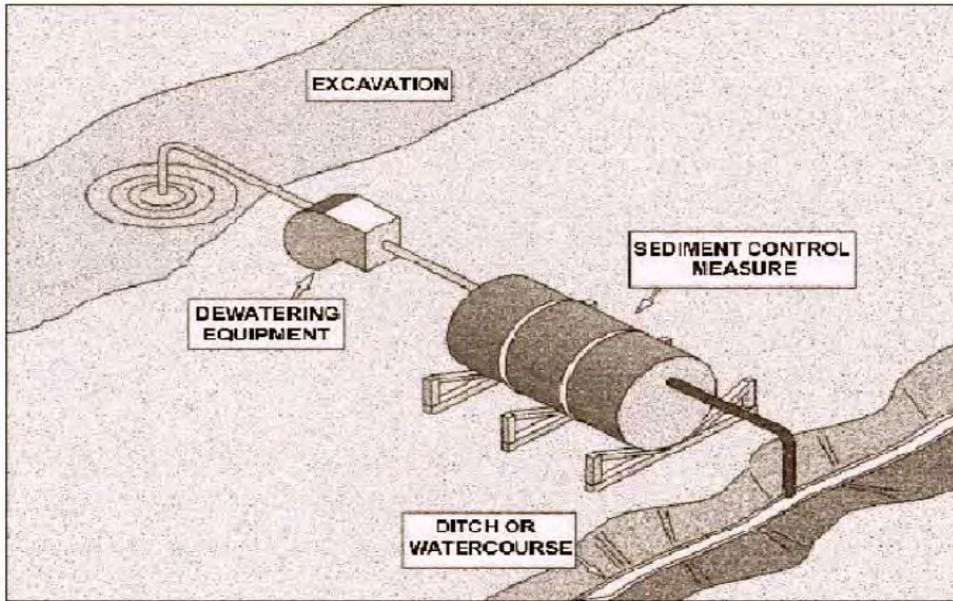
- Conditions at individual sites will determine the scope and applicability of dewatering.
- Dewatering is subject to federal, state, and local permits.
- The discharge of sediment-laden water from a dewatering site into any water of the State without filtration is prohibited.
- A fish or aquatic wildlife rescue plan may be required. Check with San Luis Obispo County Public Works Dept. environmental Staff.

## CONSTRUCTION GUIDELINES

- 1) A dewatering structure should be sized to allow water to flow through any filtering media without overflowing the structure.
- 2) Adequate erosion and sediment control measures are to be considered first. Dewatering practices should be considered as a last-resort control measure.
- 3) Check water for odors, discoloration, or an oily sheen. If present, have the water tested by a certified lab. Discuss test results with San Luis Obispo County Public Works Dept. Environmental Staff and Regional Water Quality Control Board Staff to determine how and where to discharge.
- 4) An energy dissipater may be needed to prevent erosion at the outlet.

## BMP MAINTENANCE

- Inspect and clean sediment control devices frequently to prevent build-up or blockage of the sediment filters.
- Monitor effluent to ensure that no sediment is discharged into a storm drain or water of the State.



SEE ALSO;  
AQUA BARRIER  
STREAM BYPASS (WATER DIVERSION)  
COFFER DAM

Source:  
Caltrans. Storm Water Quality Handbooks:  
Construction Site Best Management Practices  
Manual, November 2000.

**DEWATERING  
& FILTERING  
(PUMPING OR DRAINING)**

# **BMP - DIVERSION BERM**

## **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 to direct stormwater runoff away from an unstable slope.

## **APPLICATIONS**

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

## **LIMITATIONS**

A diversion berm is a potentially serious “taking” issue for endangered salmon and is not a routine road maintenance BMP. For information on incidental take permits for fish habitats, see *Chapter 2-Permits*.

Do *not* use this BMP:

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

## **CONSTRUCTION GUIDELINES**

- 1) Adequately compact berm material to prevent failure.
- 2) Apply temporary seeding and mulch to all surfaces of a soil diversion berm according to the BMP-Seasonal Planning.

## **BMP MAINTENANCE**

- Conduct periodic inspections, and repair berms as necessary.

## **BMP REMOVAL**

- Evaluate site to determine BMP is no longer needed :verify that the area has stabilized and is no longer a potential source of sediment-laden water.
- Remove sediment buildup.
- Remove BMP – recycle and/or re-use if applicable.
- Re-vegetate area disturbed by BMP removal.

# **BMP – FISH EXCLUSION**

## DESCRIPTION

Road maintenance activities may require work within streams that contain fish and other aquatic resources. Some of these activities require water to be diverted around the work site (see BMP – Stream Bypass) with the fish removed, relocated upstream of the work area, and excluded from the work site until work is completed.

## APPLICATIONS

Fish exclusion may be necessary when work is done in watercourses and streams (slope stabilization, sediment removal, vegetation or habitat management, debris removal) and for repair, replacement, maintenance, or installation of stream crossings (pipes, culverts, fish ladders) and bridges.

## LIMITATIONS

- Fish exclusion from the work site prior to dewatering must be with authorization from the National Marine Fisheries Service and the California Department of Fish and Game. Fish exclusion is done only under the supervision of a qualified fisheries biologist with the appropriate State and Federal permits. Consult with San Luis Obispo County environmental staff prior to planning work in any watercourse that may have Fish Exclusion potential.

## CONSTRUCTION GUIDELINES

- 1) Isolate the work area (block nets).
- 2) Remove as many fish as possible using seines and relocate upstream or downstream in pools of adequate size.
- 3) Gradually dewater work area.
- 4) Remove as many remaining fish as possible using seines and dip nets, and relocate.
- 5) Electroshock, if required by permit, to avoid any strandings in pools where other methods are ineffective.

## BMP MAINTENANCE

- Keep records of fish exclusion activities.
- Obtain any needed training from the qualified fishery biologist.
- Only assist the supervising fisheries biologist in accordance with State and Federal procedures when requested.
- Help clean fish screens of leaves and debris as necessary, and report any mortality to the supervising biologist

## BMP REMOVAL

- Once work is completed, gradually return the stream to its original condition so as not to cause a surge downstream or strand fish upstream.

## **SOURCES**

*Five Counties Salmonid Conservation Program. 2002. A Water Quality and Stream Habitat Protection Manual for County Road Maintenance in Northwestern California Watersheds. [<http://www.5counties.org/>]*

## **BMP - LEVEL SPREADERS**

### DESCRIPTION

A non-erosive outlet for concentrated runoff constructed to disperse flow uniformly across a slope.

### APPLICATIONS

Use to convert concentrated flow to sheet flow and release it uniformly over a stabilized area. The level spreader is most often used as an outlet for temporary or permanent diversions and diversion dikes. Runoff water containing high sediment loads must be treated in a sediment-trapping device before release in a level spreader.

## LIMITATIONS

Use this BMP if:

- sediment-free storm runoff can be released in sheet flow down a stabilized slope without causing erosion.
- a level lip can be constructed without filling.
- the area below the spreader lip is uniform with the slope of 10% or less and is stable for anticipated flow conditions, preferably well vegetated.
- the runoff water will not re-concentrate after release.
- there will be no traffic over the spreader.

## CONSTRUCTION GUIDELINES

- 1) The level spreader is a relatively low-cost structure to release small volumes of concentrated flow where site conditions are suitable. The outlet area must be uniform and well vegetated with slopes of 10% or less. Take particular care to construct the outlet lip completely level in a stable, undisturbed soil. Any depressions in the lip will concentrate the flow, resulting in erosion.
- 2) Determine the capacity of the spreader by estimating peak flow from the 10-year storm. Restrict the drainage area so that maximum flows into the spreader will not exceed 30 cfs.
- 3) When water enters the spreader from one end, as from a diversion, select the appropriate length, width, and depth of the spreader from the table below:

<b>Design Flow (cfs)</b>	<b>Entrance Width (ft)</b>	<b>Depth (ft)</b>	<b>End Width (ft)</b>	<b>Length (ft)</b>
0-10	10	0.5	3	10
10-20	16	0.6	3	20
20-30	24	0.7	3	30

- 4) Construct the level lip on undisturbed soil to uniform height and zero grade over the length of the spreader. (However, aprons frequently cannot be set at zero grade due to slope.) Protect it with an erosion-resistant material, such as erosion control blankets or mats, to prevent erosion and allow vegetation to become established.

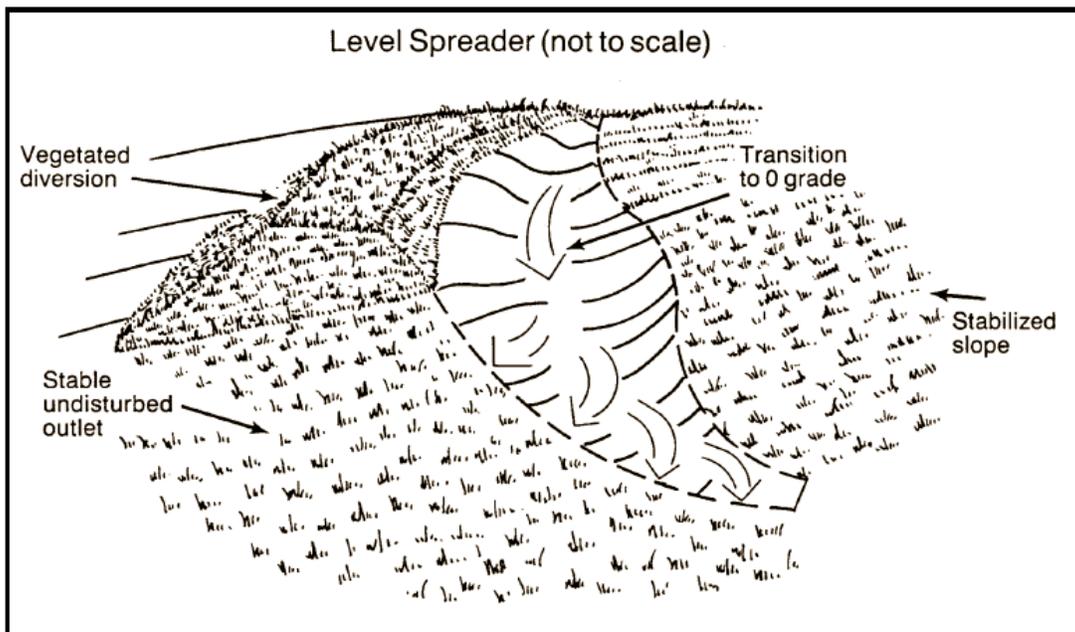
- 5) The blankets or matting should be a minimum of 4 ft wide extending 6 inches over the lip and buried 6 inches deep in a vertical trench on the lower edge. The upper edge should butt against smoothly cut sod and be securely held in place with closely spaced heavy-duty wire staples at least 12 inches long.
- 6) Ensure that the spreader lip is level for uniform spreading of storm runoff.
- 7) Construct the level spreader on undisturbed soil (not on fill).
- 8) Construct a 20-ft transition section from the diversion channel to blend smoothly to the width and depth of the spreader.
- 9) Disperse runoff from the spreader across a properly stabilized slope not to exceed 10%. Make sure the slope is sufficiently smooth to keep flow from concentrating.
- 10) Immediately after its construction, appropriately seed the disturbed area with native grasses and mulch.

### BMP MAINTENANCE

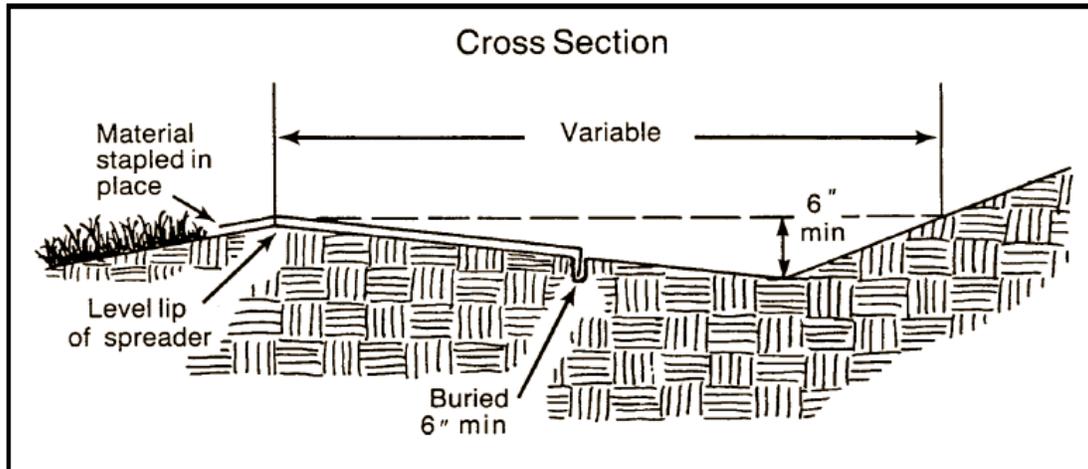
- Inspect level spreaders after every rainfall until vegetation is established, and promptly make needed repairs. After the area has been stabilized, make periodic inspections and keep vegetation in a healthy, vigorous condition.

### BMP REMOVAL

- Removal is not necessary.



## LEVEL SPREADER (NOT TO SCALE)



## BMP SANDBAG

### DESCRIPTION

A sandbag is a pre-manufactured cloth or plastic bag filled with sand or gravel. Sandbags can be used to keep water away from work areas and unstable slopes, and 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.



SLO COUNTY ROAD MAINTENANCE AA-108

## APPLICATIONS

This BMP may be used during emergencies to control the flow and level of water. It may be used during construction to form dewatered areas such as cofferdams and clean water bypasses.

## LIMITATIONS

Do *not* use this BMP where prohibited by permit conditions or as a permanent structure.

## CONSTRUCTION GUIDELINES

- 1) When using this BMP in water bodies, fulfill appropriate permit conditions.
- 2) Secure ends of sandbags to ensure material does not scatter.
- 3) When used as a barrier, stack bags tightly together and in alternative (bricklayer) fashion.
- 4) Fill bags with clean sand or gravel.

## BMP MAINTENANCE

- During construction, inspect daily with additional inspections during storms.
- Replace damaged sandbags.
- Remove sediment when deposits reach the height of the sandbag barrier.

## 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 and spread material in sandbags on slopes and stable areas where allowed by permit conditions.

# **BMP – SLOPE DRAIN –TEMPORARY**

## DESCRIPTION

A slope drain is a pipe used to temporarily intercept and divert runoff into stabilized areas. May be used with lined ditches to intercept and direct surface flowaway from slope areas.

## APPLICATIONS

Slope drains may be used at construction sites where slopes may be eroded by surface runoff.

## LIMITATIONS

- Severe gully erosion may occur if the drain fails.

## CONSTRUCTION GUIDELINES

- 1) The slope drain should be heavy duty flexible PVC, ABS or comparable pipe.
- 2) A dike should be used to direct runoff to the drain. The inlet should be lined with filter cloth.
- 3) The drainage area should be no larger than 10 acres per pipe.
- 4) Slope should be no greater than 2:1 (H:V).
- 5) Riprap or other energy dissipation device should be used at the outlet.
- 6) Drains should be perpendicular to the contour of the slope.
- 7) Compact soil around and under entrance, outlet, and along the length of the pipe.
- 8) The drain should be anchored and stabilized into the soil with water tight connections.
- 9) For drains 12 inches and larger a standard flared end section should be used.

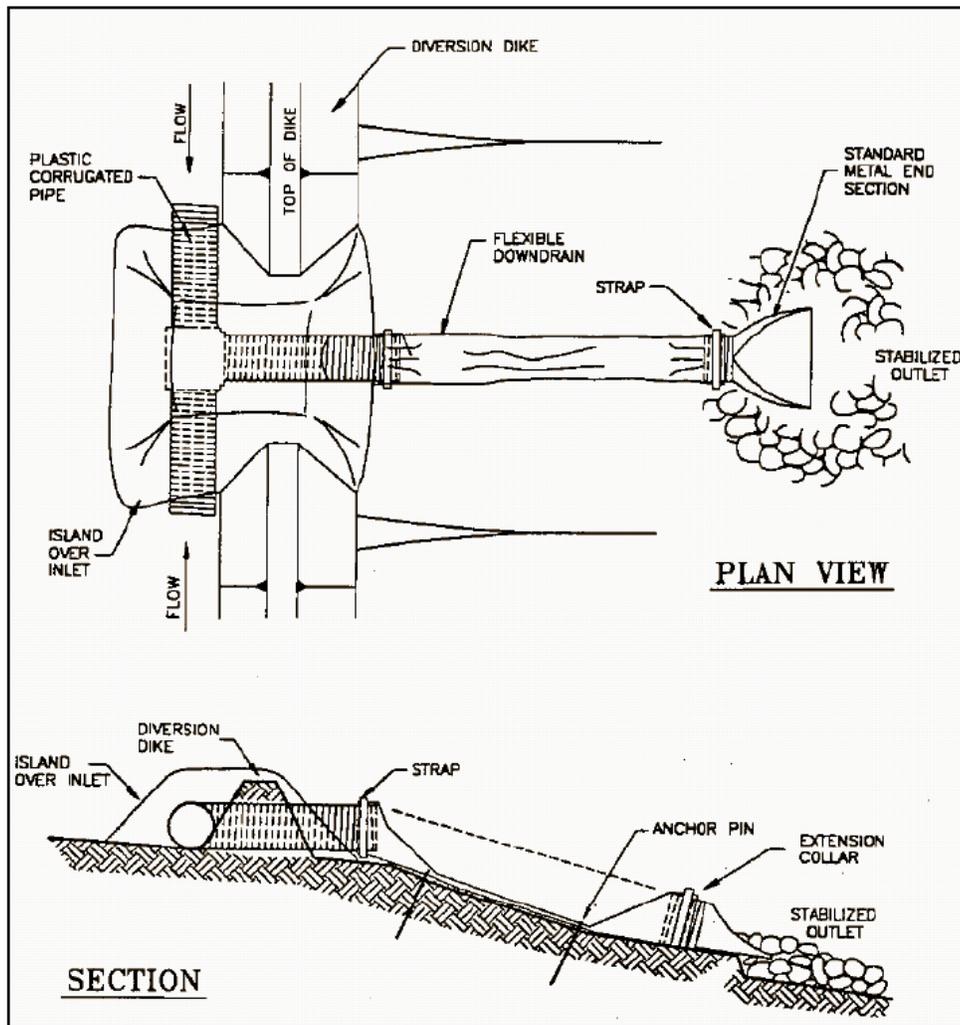
## BMP MAINTENANCE

- Check connections, inlet and outfall areas frequently for signs of distress to prevent slope drain failure.
- Inspect drains before and after rainfall or heavy use for signs of erosion or scour. Additional energy dissipaters or reduced flow may be necessary to accommodate flow.
- Remove sediment accumulation. If necessary, flush out debris from pipe and trap sediment before it enters a waterway.

## BMP REMOVAL

- When site is stabilized, remove structure, grade out slope, seed and mulch bare areas.

### SLOPE DRAIN - TEMPORARY



Source: McCullah, J. 1992. Erosion and Sediment Control Standards Design Manual  
- County of Shasta. Prepared for the Western Shasta RCD. Redding CA. 187 p.

# **BMP – SLOPE DRAIN –OVERSIDE**

## DESCRIPTION

A slope drain is a pipe or open chute used to intercept and divert runoff into stabilized areas.

## APPLICATIONS

Slope drains may be used to drain certain bench or road way configurations where it is necessary to minimize flow onto cut or fill slopes.

## LIMITATIONS

- Severe gully erosion may occur if the drain fails.

## CONSTRUCTION GUIDELINES

- 1) The slope drain should be heavy duty flexible PVC, ABS, corrugated metal, or comparable pipe. It may be open trough shape (half culvert, lengthwise).
- 2) A dike should be used to direct runoff to the drain. The inlet should be lined with filter cloth.
- 3) The drainage area should be no larger than 10 acres per pipe.
- 4) Slope should be no greater than 2:1 (H:V).
- 5) Riprap or other energy dissipation device should be used at the outlet.
- 6) Drains should be perpendicular to the contour of the slope.
- 7) Compact soil around and under entrance, outlet, and along the length of the pipe.
- 8) The drain should be anchored and stabilized into the soil with water tight connections.
- 9) For drains 12 inches and larger a standard flared end section should be used.

**See also: CalTrans Standard Plans, "Overside Drains," Plan #D87D.**

[www.dot.ca.gov/hq/esc/oe/project\\_plans/index.htm](http://www.dot.ca.gov/hq/esc/oe/project_plans/index.htm)

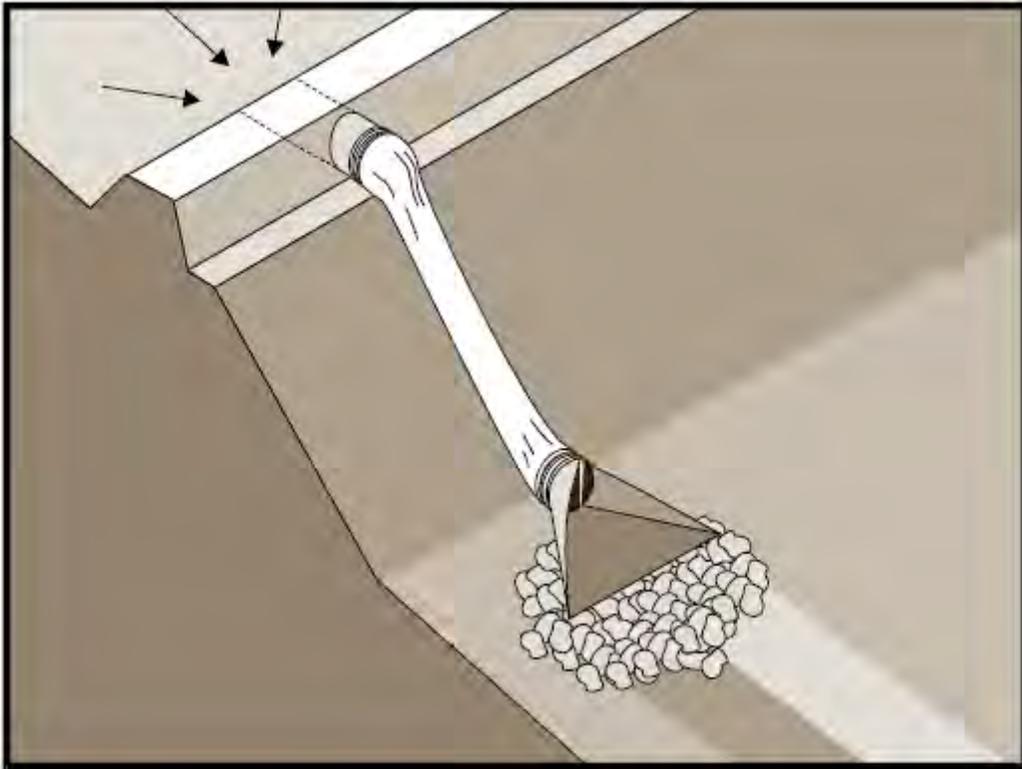
## BMP MAINTENANCE

- Check connections, inlet and outfall areas frequently for signs of distress to prevent slope drain failure.
- Inspect drains before and after rainfall or heavy use for signs of erosion or scour. Additional energy dissipaters or reduced flow may be necessary to accommodate flow.
- Remove sediment accumulation. If necessary, flush out debris from pipe and trap sediment before it enters a waterway.

BMP REMOVAL

- N/A

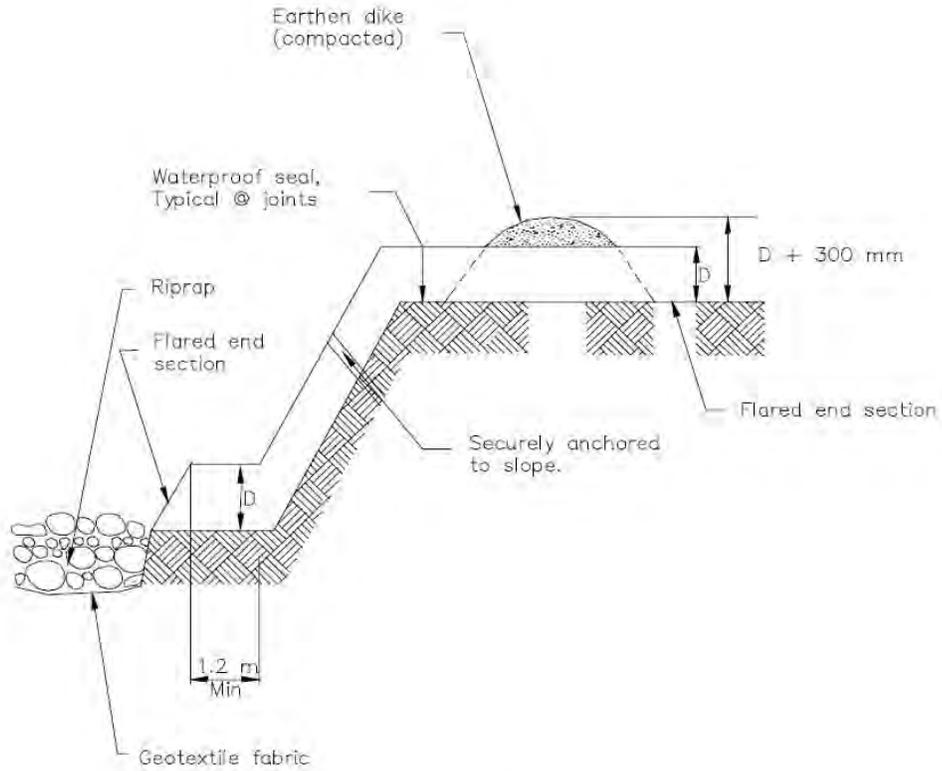
**SLOPE DRAIN - TEMPORARY**



# SLOPE DRAIN - OVERSIDE

## Slope Drains

**SS-11**



TYPICAL SLOPE DRAIN  
NOT TO SCALE



## **BMP – SLOPE DRAIN –SWALE**

### DESCRIPTION

A constructed water channel excavated into a side hill or built with an earthen dike. Typically built nearly parallel to the hillslope contour with a 2% or greater flowline grade.

### APPLICATIONS

Swales or ditches are used to divert and convey surface run-on away from the work site or unstable area, into a stable area in order to prevent erosion. Also used below steep grades where runoff begins to concentrate, at the top of slopes, and as slope breaks.

### LIMITATIONS

- Not suitable as sediment trapping devices
- May be necessary to use other soil stabilization and sediment controls such as check dams, erosion control blankets, turf reinforcement mat, or rock to prevent scour and erosion in newly graded swales.

### CONSTRUCTION GUIDELINES

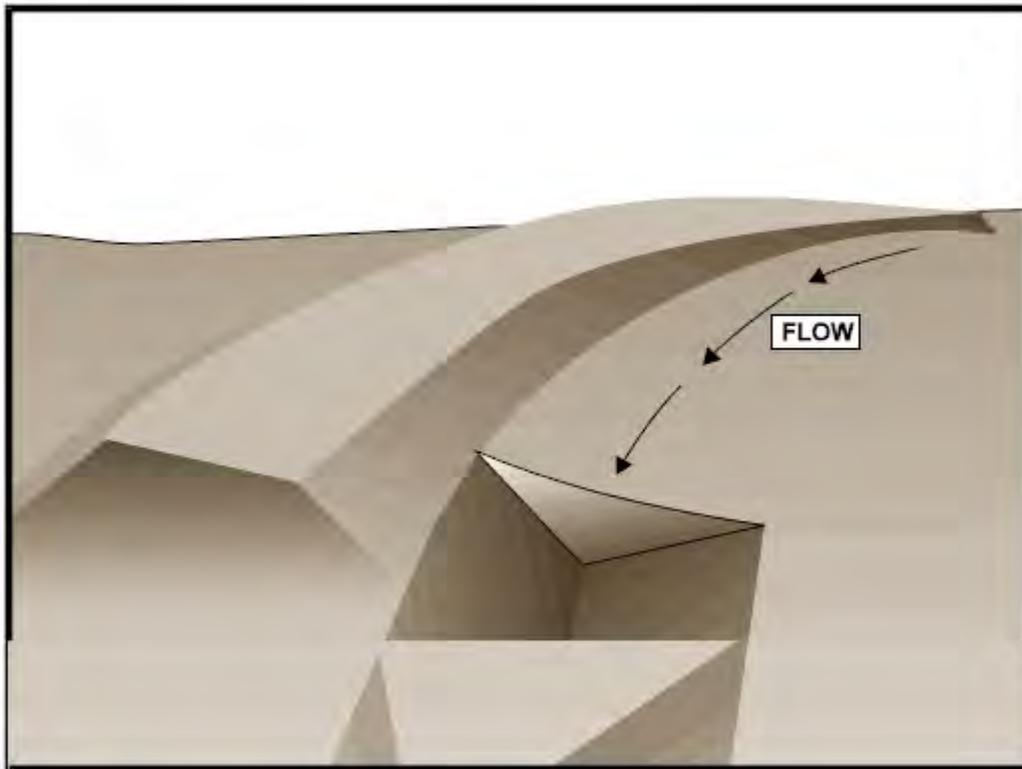
- 1) Slope drain swales must be correctly sized to accommodate the flows of the contributing watershed.
- 2) Conveyances must be stabilized by compaction, vegetation, matting and/or hard armor depending on the calculated flow velocity.
- 3) Water should be outlet back to the natural watercourse as soon as possible and not diverted into another watershed if possible.
- 4) Provide stabilized outlets.

### BMP MAINTENANCE

- Inspect newly constructed swales prior to the rainy season, after significant rainfall events, and regularly during the rainy season.
- Replace lost riprap, lining, or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment, and repair linings and embankments as needed.

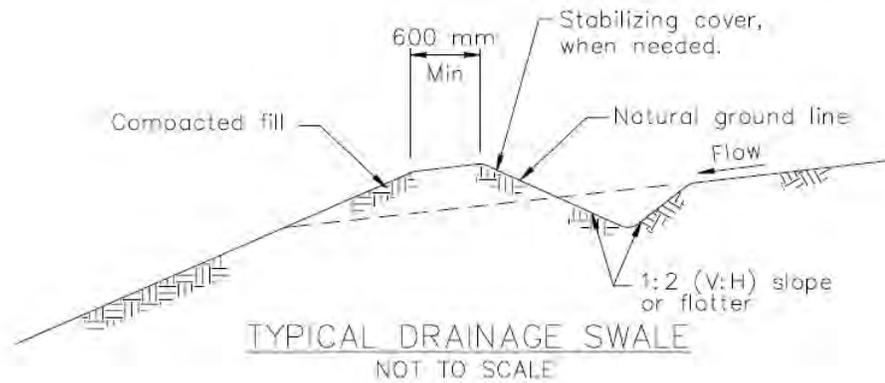
## BMP REMOVAL

- If temporary, remove as soon as the surrounding drainage area has been stabilized, recontour the slope, seed and mulch bare areas.



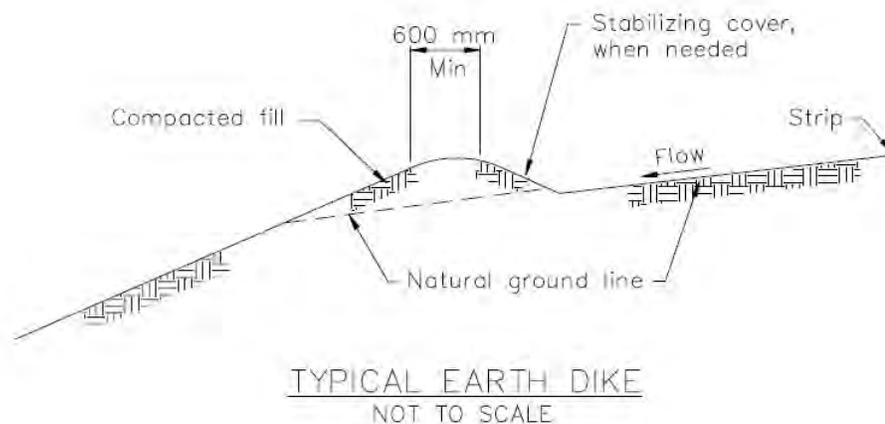
# Earth Dikes/Drainage Swales and Lined Ditches

**SS-9**



#### NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade, in conformance with Section 19-5 of the Caltrans Standard Specifications.



# **BMP - STREAM BYPASS (WATER DIVERSION)**

## DESCRIPTION

A stream diversion is a temporary bypass through a pipe, flume, or excavated channel that carries water flow around work areas.

## APPLICATIONS

Commonly used for culvert installation or replacement. Where possible, a stream diversion should be the first choice to control erosion and sediment during the construction of culverts or other instream structures. Maintaining a live channel is always the utmost priority. Therefore, we recommend a partial bypass.

## LIMITATIONS

The stream diversion technique you use depends upon the type of work involved, physical characteristics of the site, and the volume of water flowing through the project.

### ***Advantages of a pumped diversion include:***

- Downstream sediment transport can almost be eliminated.
- De-watering of the work area is possible.
- Pipes can be moved about to allow construction operations.
- The dams can serve as temporary access.
- Increased flows can be managed by adding more pumping capacity.

### ***Some disadvantages of a pumped diversion are:***

- Flow volume is limited by pump capacity.
- Requires 24-hour monitoring of pumps.
- Sudden rain could overtop dams
- Creates in-stream disturbance to install and remove dams.

### ***Advantages of excavated channels and flumes are:***

- Isolates work from water flow and allows dewatering
- Can handle larger flows than pumps.

***Disadvantages of excavated channels and flumes are:***

- Bypass channel or flume must be sized to handle flows, including possible floods.
- Channels must be protected from erosion.
- Flow diversion and then re-direction with small dams causes in-stream disturbance and sediment.

***Do not use stream diversions;***

- without identifying potential impacts to the stream channel.
- until all necessary permits have been obtained. A stream bypass is a potentially serious “taking” issue and is not a routine road maintenance BMP (for information on incidental take permits for fish habitats, see Chapter 2-Permits).

**CONSTRUCTION GUIDELINES**

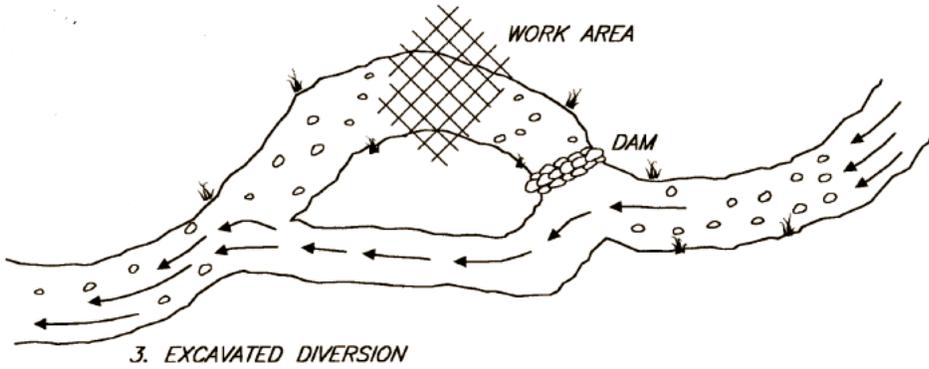
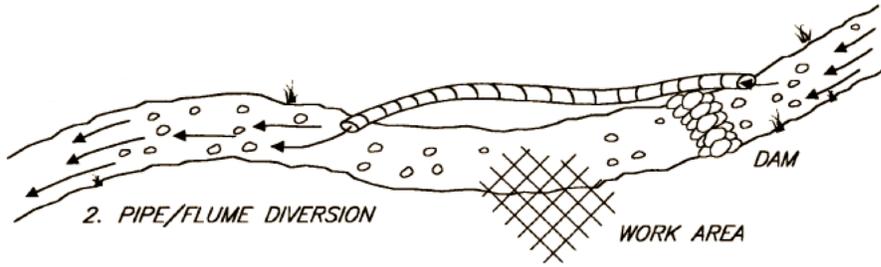
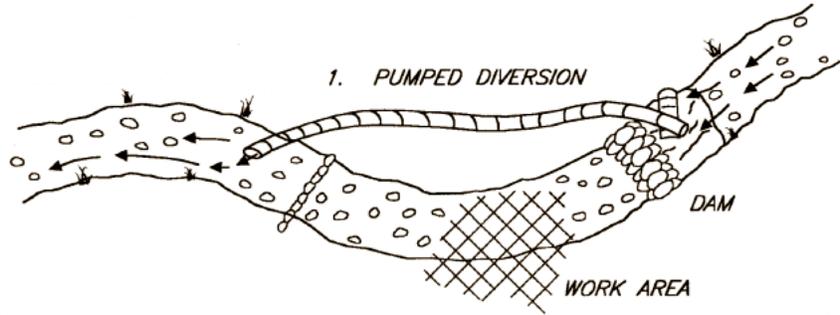
- 1) Guidelines vary based on existing site conditions.
- 2) The preferred option is a partial bypass, which maintains a live stream channel.
- 3) Size pipes adequately to allow fish passage.

**BMP MAINTENANCE**

- Closely monitor and maintain all stream diversions
- Pumped diversions require 24-hour monitoring of pumps

**BMP REMOVAL**

- Once the work is completed, remove the stream diversion and redirect the flow through the new culvert or back into the original stream channel.



**TYPICAL STREAM  
DIVERSION TECHNIQUES**

FILE: Stream Diversion

# STREAMBANK PROTECTION HARDSCAPE BMPs

**BOULDER/RIPRAP..... AA - 122**

**STREAMBED GRAVEL ..... AA - 125**

**Concrete Cribwall..... AA – 126**



# **BMP - BOULDER/RIPRAP**

## 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 should only be used as a last resort in locations where planting or other stabilizing methods are impracticable. Riprap may also be used in combination with biotechnical BMPs. Riprapped areas should be evaluated for finishing with topsoil and re-vegetation to improve the drainage capacity of the fill and the stability of the riprap matrix.

## LIMITATIONS

- Avoid using riprap as a stand-alone method of streambank stabilization when practicable. Consult with San Luis Obispo County Public Works environmental and engineering staff to seek alternative complimentary BMP's utilizing approved combination with biotechnical methods.
- Obtain permits from appropriate agencies before placing any riprap below the mean high water line of any water body, or in other sensitive areas. For example, placing rock riprap in pools at the bottom of culverts is a regulated activity. Road crews frequently fill pools this way, and it is mistakenly believed to have little or no impact. Filling these pools can have a substantial impact!

## CONSTRUCTION GUIDELINES

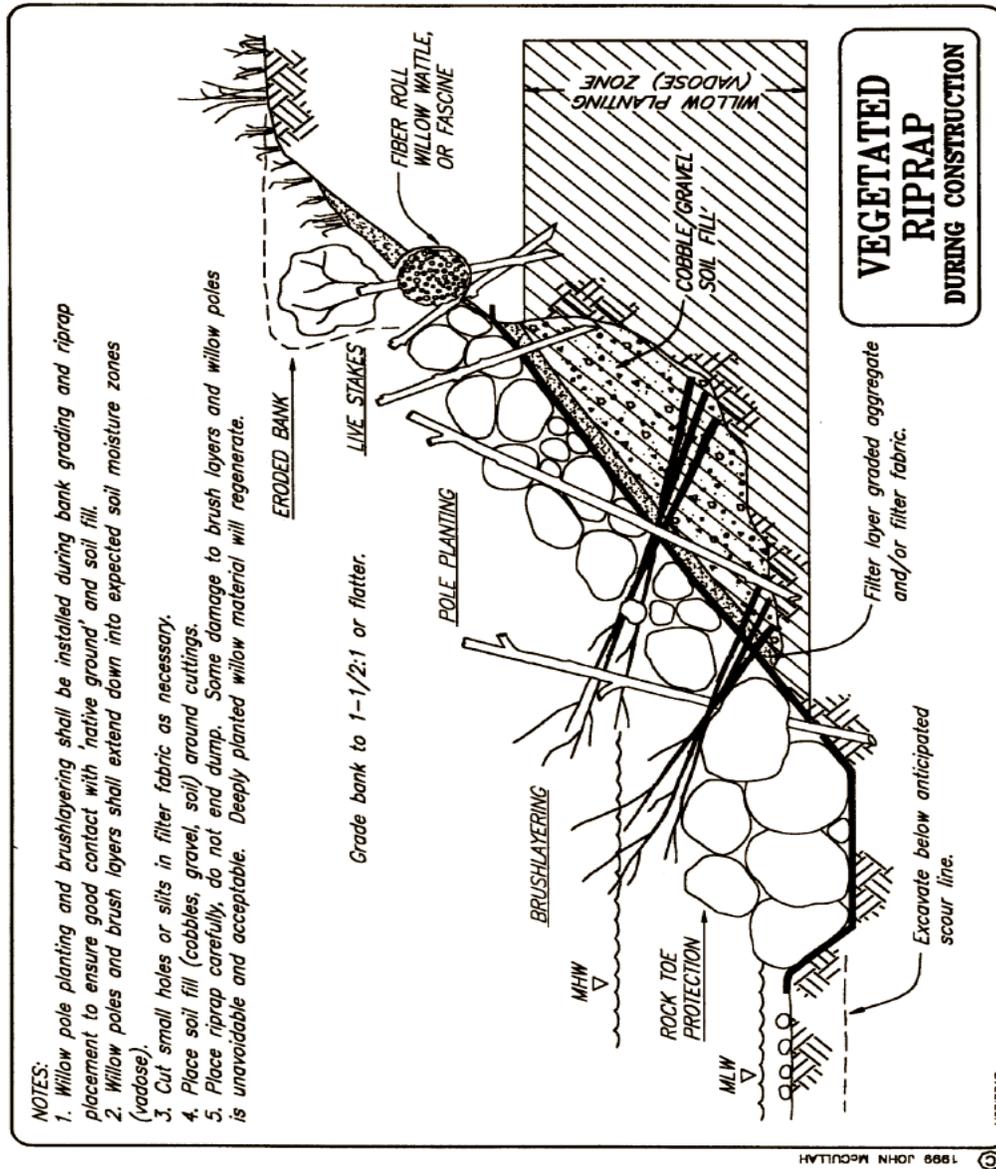
- 1) Perform live staking or pole planting during riprap placement as much as possible.
- 2) Plant native trees during construction (not after) while there is no soil in the riprap interstitial spaces.
- 3) Schedule topsoil and revegetation finish work at an appropriate time of year. Ideally install riprap when soil is moist enough to support the vegetation you plan to incorporate. Often vegetated riprap projects fail due to low soil moisture. Maintain soil moisture during prolonged dry periods to support plant growth and ensure success.
- 4) Key the toe of the riprap slope to a stable foundation at its base, and below scour
- 5) Size for 100-year event.

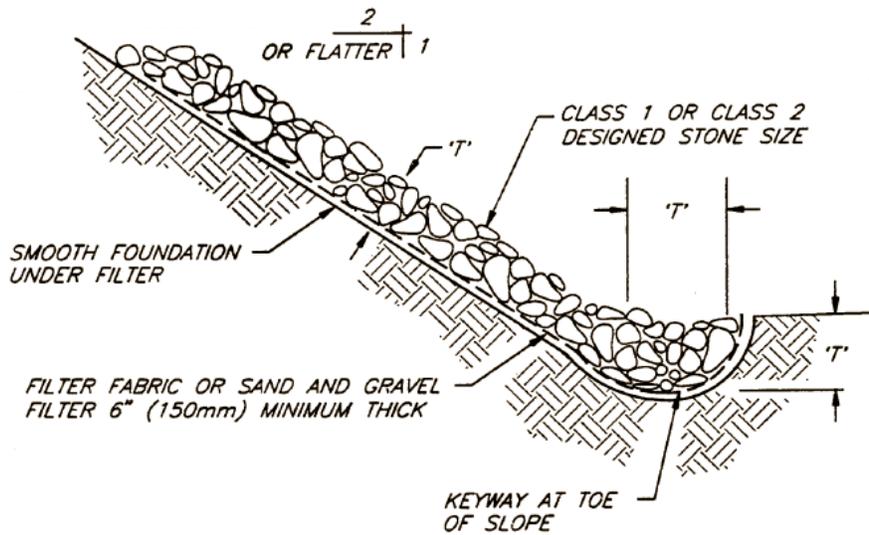
## BMP MAINTENANCE

- Inspect riprap inspected periodically for scour or dislodged stones and repair immediately.

## BMP REMOVAL

- BMP removal should not be necessary.





### TYPICAL SECTION

**NOTE:**

'T' = THICKNESS: THICKNESS SHALL BE DETERMINED BY THE ENGINEER.

MINIMUM THICKNESS SHALL BE 1.5x THE MAXIMUM STONE DIAMETER,  
NEVER LESS THAN 6" (150mm).

**RIPRAP  
PROTECTION**

© 1994 JOHN McCULLAH

FILE: RIPRAP

# **BMP – STREAMBED GRAVEL**

## DESCRIPTION

Streambed gravel is clean, alluvial river-run, non-angular (smooth) gravel of variable sizes used for in-stream habitat protection and maintenance, or sometimes in a culvert.

## APPLICATIONS

Streambed gravel can be used to provide a natural substrate for fish and for minimizing siltation in ditches and/or stormwater facilities.

## LIMITATIONS

- Placing gravel in streams constitutes fill and must be permitted by the appropriate agencies.
- Gravel tends to move from the site, downstream, during winter storm run-off.
- When used as a bedding underneath a culvert, gravel may allow piping of water under the culvert.
- In some regions, river-run alluvial gravel can be difficult to acquire.

## CONSTRUCTION GUIDELINES

- 1) Place gravel in accordance with applicable design and permit conditions.
- 2) Check gravel gradation to ensure it meets design specifications.
- 3) If gravel has excessive fines, wash gravel off-site (at a location where washed water cannot enter watercourses, streams or wetlands) until it runs clear.
- 4) Haul material in clean truck bed.
- 5) Dump cleaned rock onto tarped area on-site.
- 6) Place a cover and berm around clean rock stockpiles. Re-wash rock before using if it becomes dirty.

## BMP MAINTENANCE

- Replace as needed

## BMP REMOVAL N/A

# VEGETATED AND NON-VEGETATED CONCRETE CRIBWALLS

## DESCRIPTION



A vegetated concrete cribwall consists of a hollow, box-like interlocking arrangement of concrete beams filled with suitable backfill material and layers of live branch cuttings that root inside the crib. The roots of the cuttings will eventually behave as a coherent gravity structure itself.

## DESCRIPTION

A non-vegetated concrete cribwall consists of a block-like interlocking arrangement of concrete beams.



## APPLICATIONS

Vegetated and non vegetated concrete cribwalls are used for the stabilization of embankments and road cuts. They are helpful at the base of slopes where a low toe-wall can be used to reduce the steepness of a slope and stabilize the toe. Vegetation incorporated within the cribwalls has a more natural appearance and is less visually intrusive than a structural treatment alone. Vegetated cribwalls also minimize problems with graffiti and defacement of retaining walls. Non-vegetated cribwalls may be necessary where restricted right -of -way limits safe periodic trimming associated with maintaining overhanging vegetation.

## LIMITATIONS

- Design and construction of very high cribwalls should be approved by a qualified geotechnical engineer.
- Place crib walls below scour.
- Engineer for at least a 100-year event.

## CONSTRUCTION GUIDELINES

1) Concrete crib walls must be designed to withstand expected lateral earth forces and must satisfy external stability requirements, as well as meet internal stability from shear stress, bending, and compression. Commercial crib wall systems and standard designs should satisfy these requirements.

## BMP MAINTENANCE

- Check cribwalls periodically to ensure slope stability.
- Vegetation may need to be periodically trimmed.

## BMP REMOVAL

- Removal is not necessary.

## ADDITIONAL RESOURCES

*Evergreen Wall, TEC-TON Enterprises, PO BOX 218, E. Pembroke, NY 14056-0218, (716) 762-8314, [www.evergreenwall.com](http://www.evergreenwall.com)*

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# **PLANNING AND PREVENTION BMPs**

<b>SEASONAL PLANNING .....</b>	<b>AA - 130</b>
<b>SMALL SPILL KIT .....</b>	<b>AA - 132</b>
<b>LARGE SPILL KIT .....</b>	<b>AA - 133</b>

# **BMP - SEASONAL PLANNING**

## DESCRIPTION

The purpose is to protect aquatic resources and fisheries to the greatest extent possible through scheduling and sequencing of construction activities with the implementation of erosion and sediment control measures. Minimize the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

## APPLICATIONS

All projects involving land-disturbing activities. Sequencing to minimize land disturbance during the rainy season.

## CONSTRUCTION GUIDELINES

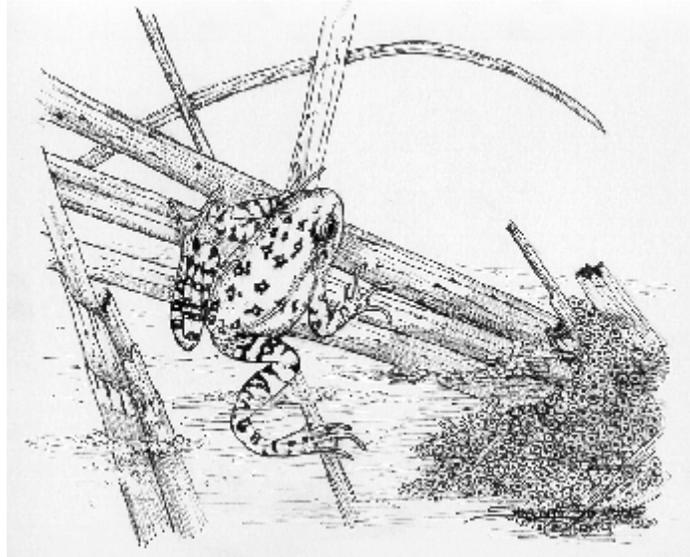
- 1) Obtain all required permits well before beginning of construction as unforeseen permitting delays and requirements may require drastic delays in scheduling.
- 2) Create a timetable incorporating water quality and erosion control measures into construction plans.
- 3) Avoid working between October 15 and April 1<sup>st</sup> to limit impacts during critical periods for aquatic species during the wet season.
- 4) Schedule work to minimize the extent of site disturbance at any one time. Where appropriate, incorporate staged revegetation of graded slopes as work progresses.
- 5) Schedule establishment of permanent vegetation including appropriate planting time and maintenance.
- 6) Maintain year-round sediment control practices even during dry months when unexpected changes in weather could cause a discharge into waterways.
- 7) Plan enough time before rainfall to allow for effective use of vegetation or other soil stabilization methods.

## BMP MAINTENANCE

- During construction, check the schedule frequently and change the schedule to accommodate changes to the work plan.
- Monitor the weather forecast for rainfall and adjust the construction schedule to allow the implementation of soil stabilization and sediment controls prior to the onset of rain.
- Be prepared year-round to deploy soil stabilization and sediment control practices. Keep the site stabilized year-round, retain and maintain rainy season sediment trapping devices in operational condition.

## SEASONAL ACTIVITY RESTRICTIONS BY SPECIES

Consult with San Luis Obispo County Department of Public Works Environmental Staff about routine Road Maintenance activities and planned seasonal periods of activity. It is our intention to reduce impacts on specific species through this seasonal approach by limiting activities in and around streams to avoid the rainy season, thereby lessening impacts. Also of concern are several species of native plants and animals that could potentially benefit from seasonal planning. Plan activities around periods of nesting, breeding or blooming when possible in order to lessen potential conflicts.



Red Legged Frog



Western Burrowing Owl

## SMALL SPILL KIT



### DESCRIPTION

Commercial emergency response spill kits contain absorbent material to contain and clean up small chemical spills.

### APPLICATIONS

Spill kits typically have the capacity to help clean up 6 to 14 gallon size spills. Use wherever petroleum products, concrete and chemical pollutants may spill. Around heavy machinery with hydraulic fluids and at any on-site designated refueling/servicing areas. Also used to clean up chemical fertilizers and pesticides.

### LIMITATIONS

- Assess the needs of project to match the type and size of kits to ensure proper materials in case of emergency.
- For larger spills, see "Spill - Large" BMP. Large spills must be reported immediately.

## CONSTRUCTION GUIDELINES

- 1) Kits may contain absorbent pads, socks, wattles, pillows, disposal bags, warning labels, and emergency response guidebook.
- 2) Use appropriate personal protective equipment.
- 3) Deploy materials to stop the flow into the ground or off-site. This may require constructing an emergency earthen berm.
- 4) Repair source of leak (containers or machinery) or remove from site.
- 5) Dispose of contaminated materials and soil in an approved location.
- 6) Report all significant spills.

## BMP MAINTENANCE

- Replace spill kits or parts of spill kits when used.

## BMP REMOVAL

- Dispose of contaminated materials in an approved location.

## LARGE SPILL KIT



SLO COUNTY ROAD MAINTENANCE AA-133

## DESCRIPTION

A palletized boxed spill kit capable of absorbing 140 gallons or more.

## APPLICATIONS

Used as first line of defense on larger spills. Immediately notify local emergency response agency by dialing 911. Use wherever petroleum products and/or concrete and chemical pollutants may spill. Around heavy machinery with hydraulic fluids and at any on-site designated refueling/servicing areas. Also used to clean up chemical fertilizers and pesticides.

## LIMITATIONS

- Assess the needs of project to match the type and size of kits to ensure proper materials in case of emergency.
- Determine whether or not materials are too hazardous to be contained by on site personnel. May require a certified HazMat team.

## CONSTRUCTION GUIDELINES

- 1) Follow guidelines in the Stormwater Pollution Prevention Plan for the project.
- 2) Notify the local emergency response agency by dialing 911. Also notify other appropriate local officials, including The San Luis Obispo County Office of Emergency Service at 781-5011, and the San Luis Obispo County Public Works environmental staff. All necessary emergency telephone numbers should be available at the construction site.
- 3) Notify the Governor's Office of Emergency Services Warning Center at (800) 852-7550.
- 4) For spills of federal reportable quantities, notify the National Response Center at (800) 424-8802.
- 5) Notification should first be made by telephone and followed up with a written report as soon as possible.
- 6) If safe, stop the source of the spill and contain the spill's spread. Use appropriate personal protective equipment found in the spill kit (rubber gloves, safety glasses).
- 7) A spill cleanup contractor or HazMat team should be contacted immediately.
- 8) Construction personnel should not attempt to initiate cleanup until appropriate and qualified staff have arrived at the site.
- 9) Other agencies which may need to be consulted include local fire, police, and public works departments, the U.S. Coast Guard, the California Highway Patrol, the California Department of Toxic Substance Control, California Division of Oil and Gas, Cal/OSHA, etc.

- Replace spill kits or parts of spill kits when used.

SLO COUNTY ROAD MAINTENANCE AA-134

BMP REMOVAL

- Dispose of contaminated materials in an approved location.

