Hydromodification

Best Management Practices (BMPs) for Coastal Louisiana Nonpoint Source Pollution

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FORWARD

Copies of this manual in handbook or electronic format are available from the Louisiana Department of Natural Resources, Coastal Management Division online at http://dnr.louisiana.gov/crm/

Comments or suggestions on the practices provided in this manual should be submitted in writing to the Coastal Management Division at the following address:

Louisiana Department of Natural Resources
Coastal Management Division
P.O. Box 44487
Baton Rouge, Louisiana 70804-4487

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All programs and services of the federal, state, and local agencies and organizations that were involved in this project are available on a nondiscriminatory basis regardless of race, color, nationality, religious affiliation, sex, age, marital status, or disability.

Prepared by

For the Louisiana Department of Natural Resources
Baton Rouge, Louisiana
2008

Purpose and Use of this Manual

This manual was prepared as a field guide for urban, suburban, and rural public and private landowners and land users, including contractors, field workers, homeowners, and public officials, to minimize coastal impact from recreational and developmental activities.

This manual provides a comprehensive overview of the nonpoint source pollution Best Management Practices (BMPs) specific to the Louisiana Coastal Zone. This manual is only one part of the Coastal Nonpoint Pollution Control Program (CNPCP) efforts. The overall goal of the program is to protect, maintain, and sustain Louisiana coastal waters and wetlands. This manual provides thorough, concise, and efficient communication of Louisiana coastal BMPs to anyone involved in the use of Louisiana coastal resources. The recommendations provided in this manual were determined based on cost efficiency, effectiveness, relevant usage in other coastal states, and ease of design and construction. These recommendations are based on local site judgments and are not intended to supersede local ordinances or good engineering judgment.

CNPCP would like to thank the private and public participants who have helped in the development of this manual including members of the Calcasieu and Vermillion Parish Police Juries, representatives from the Louisiana Corps of Engineers, the Louisiana Department of Natural Resources, and Providence Engineering and Environmental Group LLC.

For more public education/outreach and other program efforts beyond this manual, please visit the CNPCP website at:
http://dnr.louisiana.gov/crm/coastmgt/interagencyaff/nonpoint/nonpoint.asp

Denotations

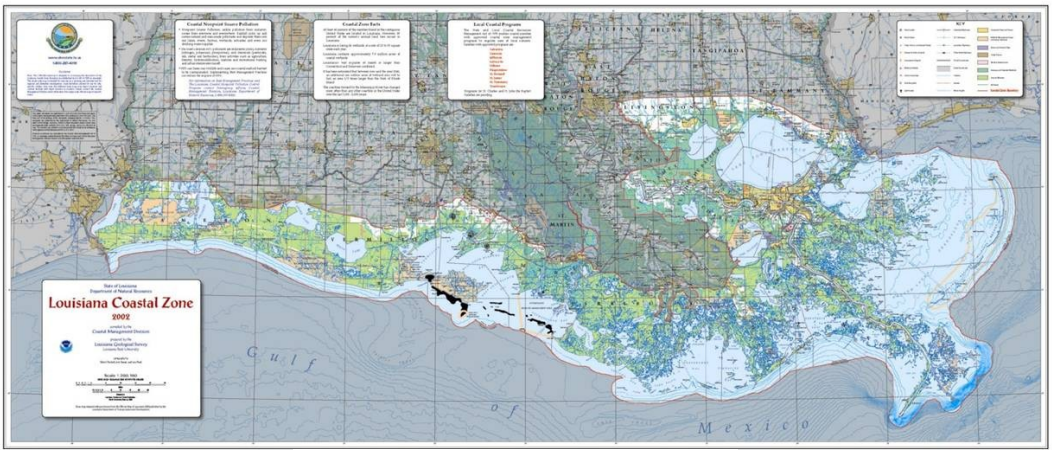
Pages with a green box in the upper corners are construction-specific BMPs

T Pages labeled with a boxed “T” describe temporary BMP measures

P Pages labeled with a boxed “P” describe permanent BMP measures

Additional note: Slope ratios are presented as horizontal (run) : vertical (rise)

Background and Introduction



The Louisiana Coastal Zone

In 1990, the Coastal Zone Act Reauthorization Amendments (CZARA) were passed. These amendments required the development and implementation of CNPCPs in states with federally approved coastal zone management programs. The Louisiana CNPCP must implement management measures that address the control and prevention of nonpoint source (NPS) pollution from five designated sources: agriculture, forestry, hydromodification, marinas and recreational boating, and urban runoff. The developed management measures must be approved by both the National Oceanic and Atmospheric Administration (NOAA) and the United States Environmental Protection Agency (USEPA).

In response to CZARA requirements, management measures were thoroughly researched, evaluated, and approved by USEPA as appropriate and effective coastal zone management practices. These recommendations do not represent mandated government regulations. Rather, this manual is the result of CNPCP efforts to prevent the necessity of increased state and federal regulation of coastal zone activities. These BMPs are intended as voluntary guidelines. We are dependent upon the cooperation of government agencies and private citizens to help implement these BMPs.

Three manuals have been developed which address NPS pollution from three major sources: urban storm water runoff; urban storm water from roads, highways, and bridges; and hydromodification.

List of Contacts

USEPA

Regional
Region 6 Office (Dallas, TX)
Telephone: 214-665-6450

Wetlands Information
Wetlands.helpline@epa.gov
Telephone: (800) 832-7828

LDEQ

Single Point of Contact (SPOC)
SPOC (Toll-Free) 225-219-3640
888-763-5424

LA State Police (For Spill Emergencies)

24-Hour Hotline
24-Hour Hotline (Toll Free) 225-925-6595
877-925-6595

LDNR

Louisiana Dept. of Natural Resources
Coastal Management Division
P.O. Box 44487
Baton Rouge, LA 70804
Telephone: (225) 342-7591
Toll Free: (800) 267-4019
http://dnr.louisiana.gov/crm/

LSU AgCenter

Soil Fertility/Nutrient Management
Telephone: (225) 578-6083
www.lsuagcenter.com/stpal

Permit Information

In 1987, the Clean Water Act established guidelines to control nonpoint source pollution. The Coastal Zone Act Reauthorization Amendments of 1990 entrusted coastal states with the responsibility of managing coastal resources. In 1996, Louisiana was delegated administrative authority to regulate storm water discharges through the Louisiana Pollutant Discharge Elimination System.

Activity	Permit #	Notice of Intent (NOI)
Construction		
Small (1-5 acres)	LAR200000	N/A
Large (> 5 acres)	LAR100000	CSW-G
Industrial (Multi-Sector General Stormwater Permit)	LAR050000	MSGP-G
Sand and Gravel Extraction	LAG490000	SCC3-G
Municipal Separate Storm Water Sewers[1]		
Small	LAR040000	MS4-G
Medium (≥ 100,000 people)		MS4-G
Large (≥ 250,000 people)		MS4-G
Cement, Concrete, and Asphalt Facilities	LAG110000	CCAF-G
Dewatering of Petroleum Storage Tanks, Tanks Beds, New Tanks, and Excavations	LAG300000	DPST-G
Oil and Gas Exploration, Development and Production Facilities Within Coastal Waters	LAG330000	CWOGF-G
Potable Water Treatment Plants	LAG380000	H20-G
Automotive, Motorcycle, and Recreational Vehicle Dealerships, Paint and Body Shops, Automotive Repair and Maintenance Shops	LAG470000	ARB-G
Light Commercial Facilities	LAG480000	LCF-G
Sanitary		
< 5,000 gpd	LAG530000	WPS-G
< 25,000 gpd	LAG540000	WPS-G
< 50,000 gpd	LAG560000	WPS-G
< 100,000 gpd	LAG570000	WPS-G
Hydrostatic Testing Wastewater	LAG670000	HST-G
Exterior Vehicle Washwater	LAG750000	CW-G
Construction, Demolition Debris and Woodwaste Landfills	LAG780000	C&D-G
Implementing Corrective Action Plans for Cleanup of Petroleum UST Systems	LAG830000	PST-G
Treated Groundwater, Potentially Contaminated Stormwater, and/or Associated Waters	LAG940000	CGW-G

Best Management Practices for Coastal Louisiana Nonpoint Source Pollution

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Hydromodification Overview

Hydromodification refers to activities that are done in or around bodies of water that change natural hydrologic flow, sediment load, or runoff characteristics. Hydromodifications affect our bayous, canals, channels, estuaries, lakes and rivers. Hydromodification nonpoint source impacts to these water bodies results in water quality degradation, accelerated erosion, increased sedimentation, and habitat reduction or elimination.

Some of the most common hydromodification activities in the Louisiana Coastal Zone are:

Bank Stabilization (ex. Riprap)	*Flow Regulation Activities (ex. Locks/dams)*
Channel or Shoreline Clearing	*Gradient Increases*
Channelization	*In-Stream Construction (ex. Bridges)*
Culvert Installation	*Levee Construction*
Decreasing Channel Length	*Stream or Wetland Fills*
Draining or Filling Activities	*Waterway Relocation*

BMPs for Hydromodification have been divided into three categories:

- Sediment Control
- Waterway Protection
- Runoff Conveyance

Sediment Control

Sediment control practices are based on the presumption that storm water will transfer and deposit a certain amount of the particulate matter to receiving waters during runoff. The USEPA has recognized suspended solids as the number one impairment of the Nation's surface waters. There are a variety of temporary measures that can be used alone or in combination to control sediment unloading, reduce suspended solids, and maximize pollution prevention.

Waterway Protection

Waterway protection practices are meant to protect the integrity of channel, ditch, lake, river, and other waterway banks and beds. These practices work to prevent erosion by decreasing the impact energy of the water on the bank. There are a number of different measures that can be used to prevent erosion including channel shaping and channel reinforcement.

Runoff Conveyance

Storm water runoff that is not evaporated or infiltrated can lead to surface erosion or may transport contaminated runoff and sediment to coastal receiving waters. Therefore, excess storm water runoff needs to be concentrated and directed into channels to prevent erosion and the potential contamination of surface water. Runoff conveyance practices can employ a number of different BMPs which serve to safely transport storm water.

BMPs
Sediment Control

RIPARIAN BUFFER

Photo courtesy of USDA NRCS

Definition

A riparian buffer is an area of restricted development along a shoreline, wetland, or stream. These buffer zones are usually composed of both grass and deeply rooted vegetation such as trees and shrubs.

Purpose

To provide physical protection of a water body or wetland from disturbance by slowing runoff velocity and aiding in bank erosion prevention through the use of a combination of various plant systems

Applicability

- Areas where waterway ecosystems and habitats need to be conserved
- In areas where restricted use will provide storm water and flood control management benefits

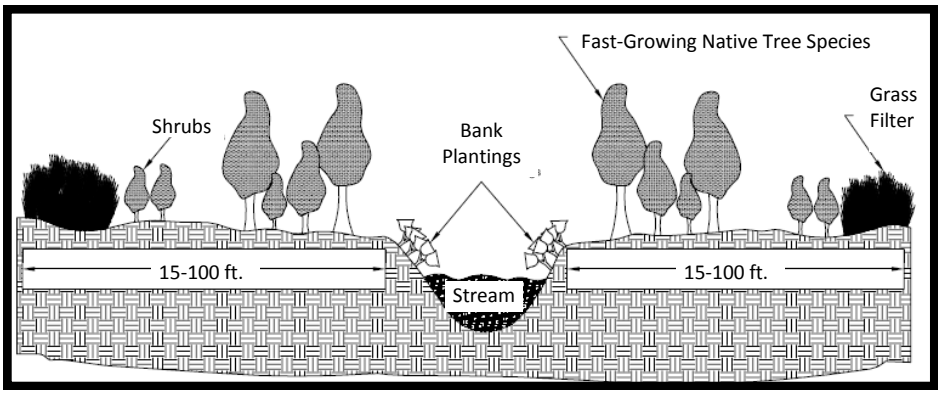
- In the prevention of waterway pollution from sediments and other contaminants

Planning Considerations

To avoid ineffective channel flow through the buffer, these areas should be designed to have storm water capture areas such as depressions, grass filters, or filter strips.

Recommended Specifications

- When able, protect native trees, shrubs, and other vegetative ground cover by planning construction activities around riparian zones.
- If establishing new vegetation, be sure to chose a variety of native plant species.
- Buffer zones should have a width of at least 15-20 feet on both sides of the waterway; ideal widths are 25-100 feet on each side.
- Buffer zone widths should be increased to treat sheet flow that is coming off of slopes.



Maintenance

Occasional inspection is necessary to ensure that environmental conditions or neighboring land use is not overloading the buffer area.

BMPs
Sediment Control

VEGETATED FILTER STRIPS

Photo courtesy of Alabama SWCC

Definition/Purpose

Vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. This practice is successful in decreasing runoff velocities, filtering particulate pollutant, promoting soil infiltration, and in some cases, groundwater recharge.

Applicability

Large areas of low-velocity, sheet flow surface runoff

Planning Considerations

In order to be effective, strips must be properly designed. If sheet flow cannot be maintained and high-velocity channels are allowed to form, the effectiveness of this practice can be compromised.

Recommended Specifications

- Filter strips should be used on slopes with 2% (minimum) to 6% (maximum) grade.
- Minimum effective filter strip widths (feet):

Table adapted from LDEQ, BMPs for Hydromodification Activities

Soil Type	Slope (%)	Surface Distance Draining Across Filter (ft)				
		0-50	51-75	76-100	101-150	151+
1	**≤ 8**	10	12	15	18	20
1	**8.1-12**	12	15	18	20	20
2	**≤ 3**	10	12	15	18	20
2	**3.1-8**	12	12	18	20	20
2	**8.1-12**	12	15	20	20	20

Min. effective filter strip widths

1 Fine-Medium Soils: sand-sandy loam
2 Medium-Heavy Soils: sandy loam-clay

- See Appendix C,I (ref. Seeding) for appropriate filter strip species.

Maintenance

Comparable to regular landscape maintenance:

- Height generally maintained between 3-12 inches, depending on species
- Regular inspection to check for soil build-up that may impound water
- Re-grading or re-seeding, as necessary

BMPs
Sediment Control

FLOATING TURBIDITY BARRIER

Photo courtesy of Alabama SWCC

Definition

Turbidity barriers are temporary silt barriers made from weighted filter fabric extending down from buoyant tubes.

Purpose

To reduce sediment transportation to or within bodies of water

Applicability

- In waterways that are adjacent to construction sites
- Around waterways that are subject to sediment loading from adjacent up-slope lands
- In low flow conditions (≤ 5 ft/sec)

☞ TIP

Floating turbidity barriers are good practices if sediment release to or sediment generation within a water body is unavoidable. However, this should be considered a cleanup practice. Every effort should first be made to avoid releasing sediment into a water body.

Planning Considerations

> **☞ TIP**
>
> Should NOT be installed perpendicular to current flow

- Turbidity barriers should not be used in high energy areas without permits.
- Tubes should be adequately visible and marked for distinction.
- Barrier fabric permeability should be based on sediment particle size, but should be able to handle the anticipated water volume and not restrict flow.

Recommended Specifications

- Care should be taken when weighting the curtain. Tidal movement of changes in flow velocities may affect the volume of water the barrier is handling. The curtain should be weighted to maintain buoyancy in the channel without collapsing into the channel (low tide/low flow conditions) or being captured in a flow stream (high tide/high flow conditions).
- Particles should be allowed to settle for 6-12 hours (minimum) before barrier removal.
- Barrier use is limited to depths of 10-12 feet (maximum).

Maintenance

- Periodic inspection of mesh and anchors to check for tearing or damage and removal of any marine growth
- Frequent inspection to check for snagging or slack due to changes in hydrology
- Inspection of buoys for damage and degradation of visibility

BMPs
Waterway Protection

BANK PROTECTION

Photo courtesy of USDA NRCS

Definition/Purpose

Bank protection is the use of vegetative or structural constructions to stabilize the sides of a channel, ditch, canal or any other waterway to protect the banks from water-induced erosion.

Applicability

- Live, flowing waterways
- Banks downstream of construction development sites
- Banks that border private or public property

Planning Considerations

- Vegetative and other structural liners may decrease channel capacity resulting in flooding during large storm events.
- Compared to structural measures, vegetative practices are less expensive to install and maintain, are less damaging to the environment, and slow storm water runoff into the waterway.

☞ TIP

- Vegetation should always be considered before other structural options.
- Installing native self-maintaining vegetation will reduce maintenance requirements.

Recommended Specifications

- Overlapping riprap can be used on very steep slopes.
- Minimum stone size is 30 pounds (see Appendix C,III for riprap specifications); however larger stone sizes are necessary for larger flow velocity channels - professional engineering design may be required to determine appropriate stone sizing.
- Vegetative protection can be used to protect banks when in-stream flow does not exceed 6 feet/second.
- Brushlayering involves binding together long bundles of live branch cuttings and placing these bundles on the slopes of a bank. This method can be used on slopes with ratios ≤ 2:1; live branch cuttings should be overlapped and placed at right angles to the slope contour.
- Cribwalls are interlocking arrangements of untreated wood material; may be constructed of branch cuttings from ½ -2 inches in diameter and logs 4-6 inches in diameter; cribwalls should be properly mulched after seeding to help establish vegetative growth.

Maintenance

- Control of vegetative growth
- Structural inspection and maintenance

BMPs
Waterway Protection

BANK VEGETATIVE BUFFERS

Photo courtesy of USDA NRCS

Definition

This practice involves the use of native or established vegetation to form a buffer area adjacent to a ditch, channel, or canal.

Purpose

- To intercept sheet flow runoff from surrounding areas and allow for soil infiltration, sediment trapping, and contribute to ground water recharge
- To slow runoff velocity, prevent bank erosion, and promote bank stabilization

Applicability

In areas where surrounding land use does not restrict adequate buffer sizing

Planning Considerations

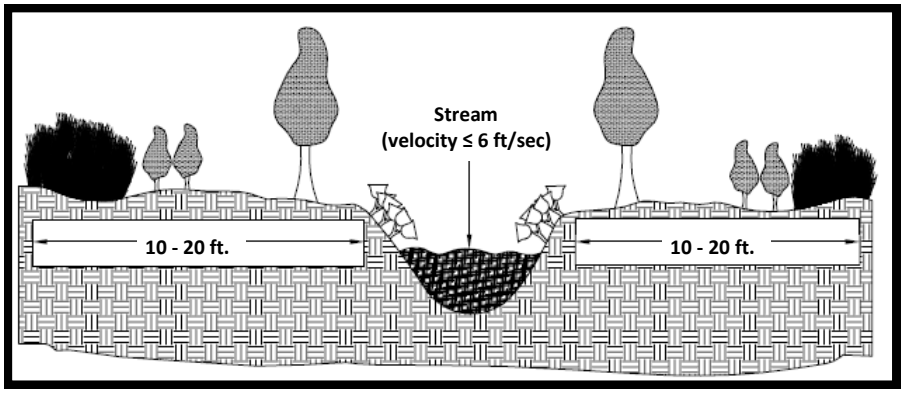
Bank buffer zone sizing depends upon the total runoff drainage area.

TIP

Useful in the treatment of sheet flow. Not applicable for treatment of concentrated storm water flow!

Recommended Specifications

- Vegetated buffer regions offer good protection when in-stream velocities are ≤ 6 feet/second.
- Vegetative buffers should have a minimum width of 10 feet with a recommended width of 20 feet.



Maintenance

Adequate vegetative cover of the entire buffer zone must be maintained for this practice to remain effective.

BMPs
Waterway Protection

CHANNEL CLEARING

Photo courtesy of USDA NRCS

Definition

Channel clearing involves the removal of sediment deposits, snags, drifts, and other obstructions to prevent them from being mobilized in channel debris flows.

Purpose

To protect against erosion and flooding by preventing:

- The creation of channel debris dams
- Debris build-up leading to increases in peak flow rates
- Blockages of culvert inlets
- Reductions in channel flow capacity

Applicability

In any bayou, channel, ditch, lake, river or other water body where trees, brush, logs, sediment or other debris is restricting water body capacity

Planning Considerations

Before channel clearing efforts are initiated a preliminary assessment should be conducted to evaluate potential effects on channel slope, alignment, and soil loading characteristics as well as any anticipated effects on wildlife habitat.

☞ TIP

Erosion control blankets (see page 21) are a good BMP to use in conjunction with channel clearing efforts.

Recommended Specifications

- Trees and other vegetation which are rooted in the soil should be cut as close to the surface level as possible.
- Materials removed from in, or around the channel should be removed from the area and properly disposed of to prevent it from reentering the channel.
- Herbicides should be used only if absolutely necessary and with strict adherence to state and federal guidelines on chemical usage in aquatic environments. Herbicide product label should also be read and followed.

Maintenance

- Periodic inspection will reduce the need to implement this BMP
- Vegetative maintenance such as mowing or fertilization, as necessary
- Debris removal
- Vegetation of bare/exposed areas

BMPs
Waterway Protection

CHANNEL STABILIZATION

Photos courtesy of USDA NRCS

Definition/Purpose

Channel stabilization involves the implementation of rock, riprap, gravel, grade controls or concrete to maintain the integrity of natural and artificial channels and to prevent erosion and deterioration.

Applicability

- Open channels, ditches, or bayous with small drainage areas (< 1 square mile) that are subject to erosion and gully formation
- Channels that lack riparian buffers or other natural vegetative protection
- Channels that are subject to frequent high velocity runoff due to proximity to roadways, bridges, or buildings

Planning Considerations

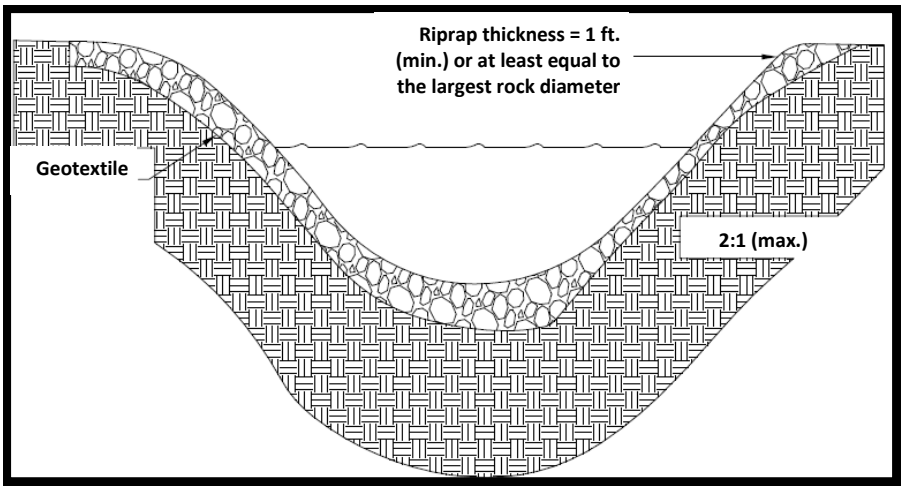
Consideration should be given to potential effects on wildlife as well as the potential effects of wildlife on stabilization measures.

TIP

- Concrete should only be used if absolutely necessary
- All stabilization types (riprap, gravel, etc) are best when used jointly with vegetative controls

Recommended Specifications

- Riprap should only be used to stabilize channels in which flow rates do not exceed 10 feet/second.
- Riprap should not be used on channel slopes greater than 2:1.
- Stones should be carefully placed on well-graded slopes with minimal voids between rocks and with a constant thickness.
- Additional riprap specifications are provided in Appendix C,III.
- Concrete may be used in channels with velocities greater than 10 feet/ second or when wildlife (such as burrowing rodents) may interfere with structural integrity of riprap.
- Concrete should be designed to handle the load and velocity conditions specific to the channel; however additional outlet protection practices may need to be employed at channel inlets/outlets.



Maintenance

- Annual inspection to monitor riprap displacement or concrete lining erosion
- Repair (sealing) of cracks in concrete and replacement of damaged or misplaced stones
- Removal of debris, weeds and vegetation from channel lining

BMPs
Waterway Protection

DIVERSIONS AND DIVERSION DIKES

Definition/Purpose

Diversions are structures such as gutters, drains, sewers, channels, and swales that are used to collect storm water runoff and divert flow so that runoff does not contaminate or become contaminated by other water sources. Diversions are often accompanied by supporting earthen ridges (diversion dikes).

Diversion dikes are earthen levees that usually accompany a diversion, channel, ditch, or swale that is built along the perimeter of a site.

Applicability

- To redirect storm water runoff from potentially contaminated industrial sites
- To redirect runoff from low-lying areas to prevent flooding or to allow for vegetative growth to establish in these areas
- In areas where runoff from elevated areas may cause erosion
- On sloping terrains to reduce slope length and minimize soil losses

Planning Considerations

- Diversions should be designed so that runoff from areas of potential contamination are directed to appropriate treatment facilities.
- Infiltration capabilities of utilized structure materials should be evaluated to determine the potential for groundwater contamination.
- Diversions may create concentrated flows that can lead to increased erosion, so this BMP should be considered for cooperative use with other BMPs; for example, outlet protection and channel stabilization measures.
- Coordination with a sediment trapping device can significantly reduce the erosion potential of concentrated runoff that collects in the diversion channel and prevents particulates from being transferred to surface waters.
- The practice should not be used in areas where a vehicle pathway is crossed.

Recommended Specifications

- Once constructed, diversions should be immediately stabilized with vegetation, mulch, or other stabilization methods along disturbed areas that drain into the diversion area.
- Diversion dike slopes should not exceed a 2:1 ratio.
- Dikes should have a 4 feet (minimum) width at the expected water level for the diversion.
- Dikes should be designed to extend a minimum distance of 0.3 feet above the expected water level.
- An outlet protection system should be incorporated.

Photos courtesy of USDA NRCS

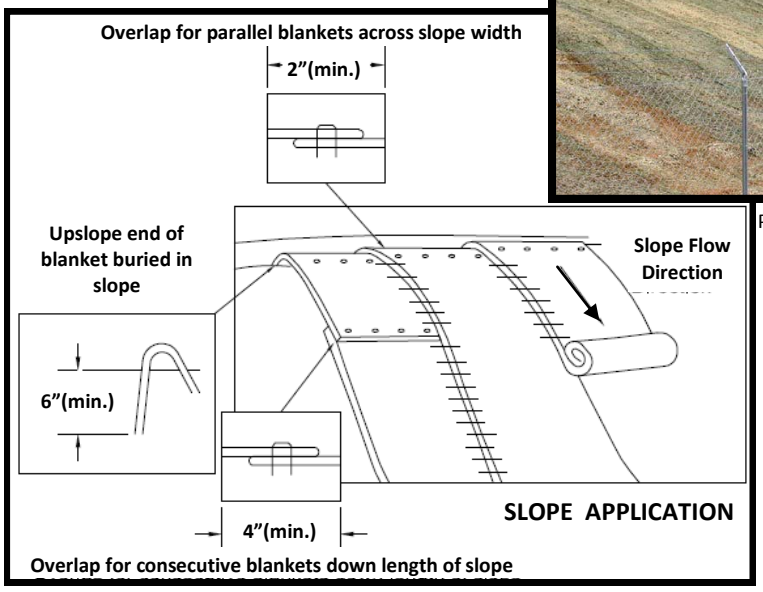
Maintenance

- Inspection after every storm event and every two weeks until final stabilization and the establishment of vegetative cover
- Periodic monitoring to ensure that diversion or diversion dike structure is not eroding due to concentrated flow
- Diversion clearing to remove any obstructions from flow path

BMPs
Waterway Protection

EROSION CONTROL BLANKET

Photo courtesy of Alabama SWCC



Definition/Purpose

Erosion Control Blankets are protective coverings made of environmentally-friendly, biodegradable materials that provide temporary, maintenance-free stabilization of soil, typically until vegetation can be established.

Applicability

- Areas of slow vegetative growth
- Slopes or other high-runoff erosion areas where vegetative seed displacement potential is high

Planning Considerations

- Material selection depends on intended use, surface and environmental conditions, and desired protection time.

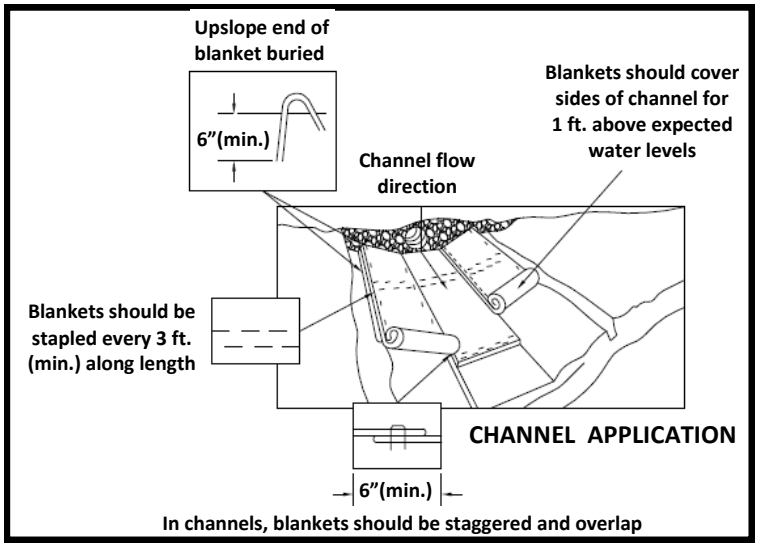
- Blankets are typically used on areas with a limited length and steepness (generally no greater than 2:1).

TIP

Preparation (compaction) of subsoil is necessary before installing an erosion control blanket.

Recommended Specifications

- Follow manufacturer directions for installation and maintenance.
- Blankets should always be installed parallel to the direction of flow.
- Blankets should be buried at least 6 inches deep at upslope end.
- After placement, blankets should be stapled every 3 feet (minimum) along the length of the blanket.



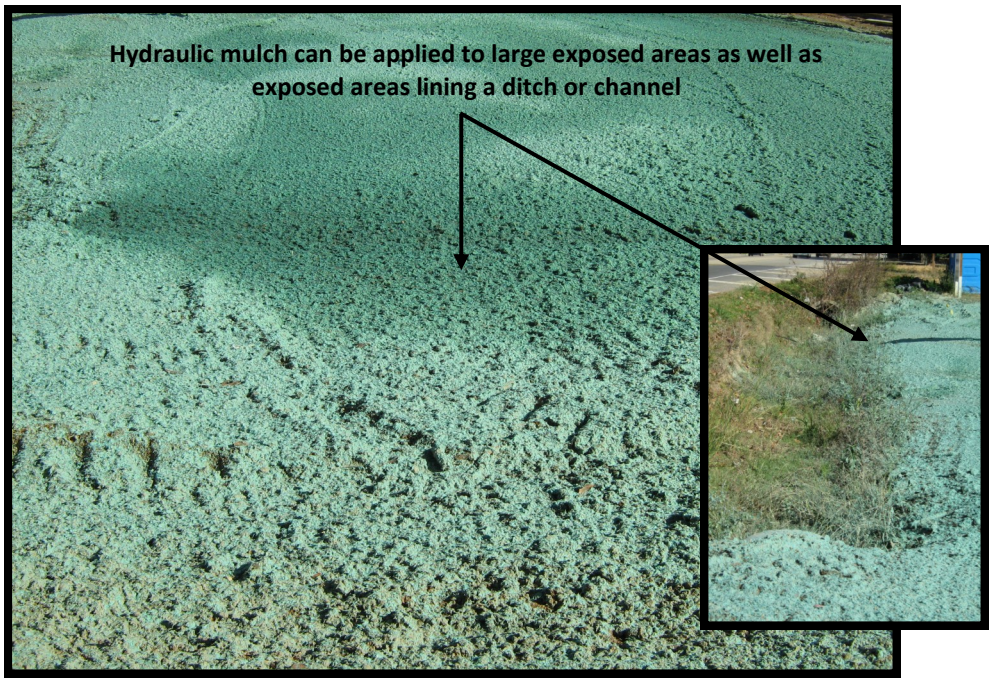
Maintenance

Low, because they degrade as vegetation establishes. Minimal maintenance includes:

- Periodic inspection and removal of sediment build-up of ≥ 2 inches over the blanket surface
- Immediate repair or replacement if blanket is damaged, there is visible erosion of the blanket, or if washout occurs

BMPs
Waterway Protection

HYDRAULIC MULCH



Photos courtesy of Providence

Definition

Hydraulic mulch is a mixture of shredded grass, hay, straw or wood fibers (mulch) and a soil binding agent that is applied to surfaces with specialized hydro-mulching equipment.

Purpose

To stabilize soils, prevent bank erosion and to provide protection, moisture control and temperature control to seeds allowing vegetation to establish

Applicability

As a temporary stabilization technique until permanent vegetation can be established

Planning Considerations

- To be effective, hydro-mulch needs at least 24-hours to dry before a storm event.
- Avoid "overkill"; only use the minimum amount necessary to stabilize the surface.

TIP

Prior to application, subsoil should be prepared (compacted)

Recommended Specifications

- Hydro-mulch materials should be continuously agitated so that a homogenous mixture results.
- Hydro-mulch should be uniformly applied by specialized hydro-mulching equipment so that a continuous layer is formed.
- Mixtures containing polyacrylamide (PAM) may not be applied during extremely cold temperatures (≤41°F) or extremely windy (≥20 miles/hr) conditions.

TIP

A database of hydromulch manufacturers and suppliers as well as more detailed information on hydromulching is available at the USEPA website: www.epa.gov/cpg/products/mulch.htm

Maintenance

Hydraulic mulching provides temporary soil stabilization; reapplication may be necessary.

RIPRAP LINING IN CHANNELS

Photo courtesy of USDA NRCS

Definition/Purpose

This practice involves the use of heavy unsupported or grouted rocks to line the sides or bottoms of channels for structural support, to stabilize storm drains, to protect erodible soils, and to stabilize culvert outlets.

Applicability

- In areas that need additional resistance to channel degradation
- Areas where channel flow leads to erosion of channel (banks, bottom, slope) soil

Planning Considerations

- Grading should always be done prior to riprap installation.
- Riprap must be used with a geotextile underlayer.

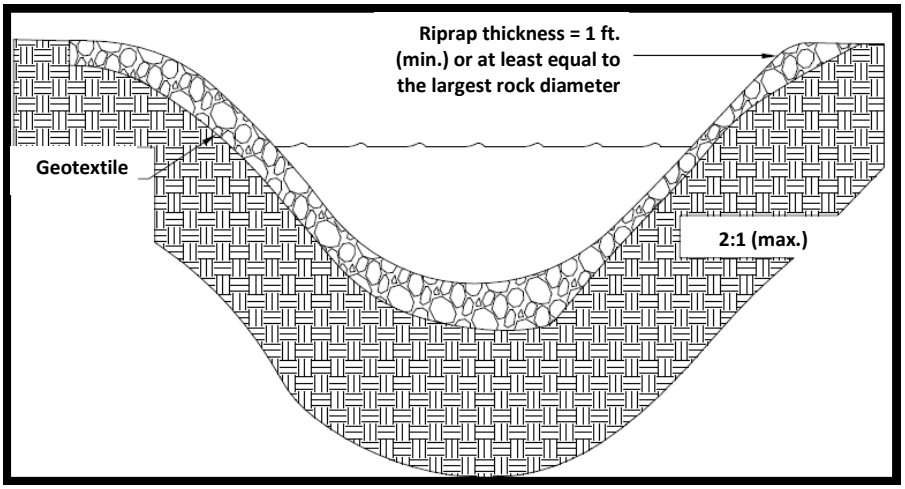
☞ TIP

Concrete channel lining is never encouraged. However, concrete lining may be considered in instances where riprap structure is consistently compromised due to region-specific challenges or wildlife interference (*i.e.* burrowing rodents)

- Rock riprap use is limited by channel flow velocity. Extreme flows may cause dislodging of placed stones. In these cases, riprap may be grouted.
- Riprap stones should be appropriately sized for flow conditions (see Appendix C,III).

Recommended Specifications

- When grouting riprap, grout mixture should consist of 1 part Portland Cement to 3 parts sand, mixed thoroughly in water.
- When grouting riprap, stones should be placed first followed by grout pouring. Grout should be poured to a minimum depth of 6 inches.
- Riprap should not be used on steep (≥ 2:1) slopes.
- Riprap layer thickness should be equal to at least the largest rock diameter.
- Stones should be carefully placed on well-graded slopes with minimal voids between rocks and with a constant thickness.



Maintenance

- Annual inspection to monitor potential rock or soil displacement or concrete lining erosion
- Annual drift checks, when riprap is used in high flow channels, to monitor riprap depth and distribution

SEDIMENT BASINS AND ROCK DAMS

Definition

Sediment basins are excavated or natural depressions that are associated with earthen embankments or rock/gravel damming structures that retain and slowly drain runoff water.

Purpose

To capture and detain storm water runoff to promote sediment settling and runoff velocity reduction

Applicability

- In the drainage of (5-10 acres) when used alone
- In the drainage of up to 100 acres when sediment basins are used in combination with an earthen dam
- In the drainage of up to 50 acres when sediment basins are used in combination with a rock dam (rock dams are used when earthen embankments are difficult to construct or when riprap is readily available)
- As either a temporary (≤3 years) or permanent (>3 years) practice

Planning Considerations

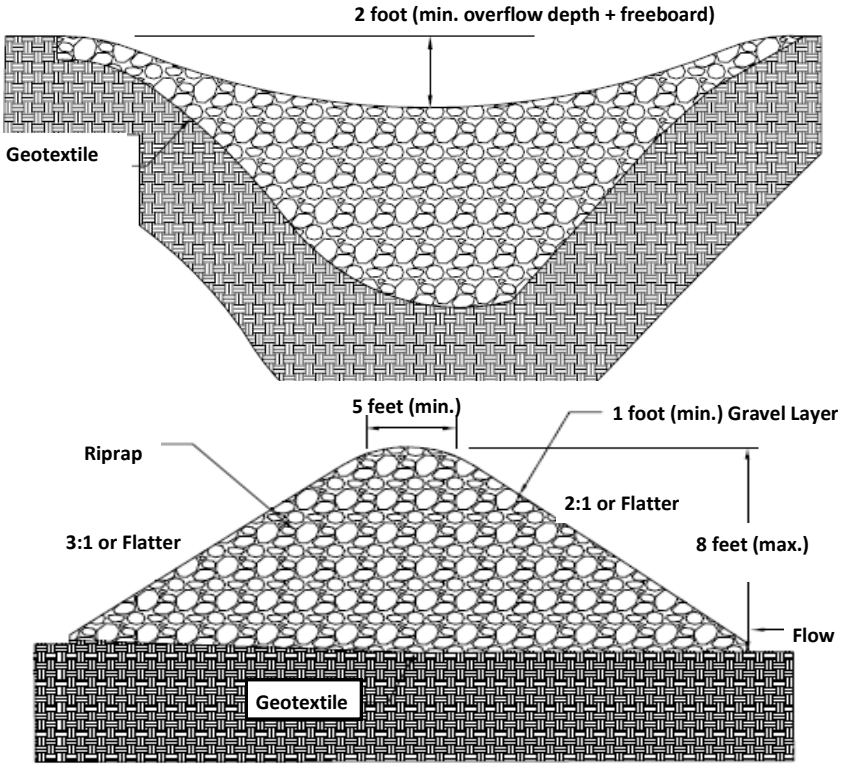
- Sediment basins-dam combinations should NOT be used in areas where basin overflow or dam failure would devastate life or property.
- The effectiveness of this practice is dependent upon particulate size and the capacity of the basin to handle the influx flow rate.

☞ TIP

Professional engineering design is recommended for sediment basin/rock dam construction. If this practice is meant to be permanent, then professional engineering design is required.

Recommended Specifications

- Basin/dam construction should be done prior to grading.
- Rock dams should be no greater than 8 feet high and have a minimum top width of 5 feet.
- Rock dams should have slopes no greater than 2:1 on the basin side and no greater than 3:1 on the outlet side of the dam.
- On the basin side of the dam, a minimum of 1 foot of gravel should be used to cover the dam from top to bottom to slow drainage.

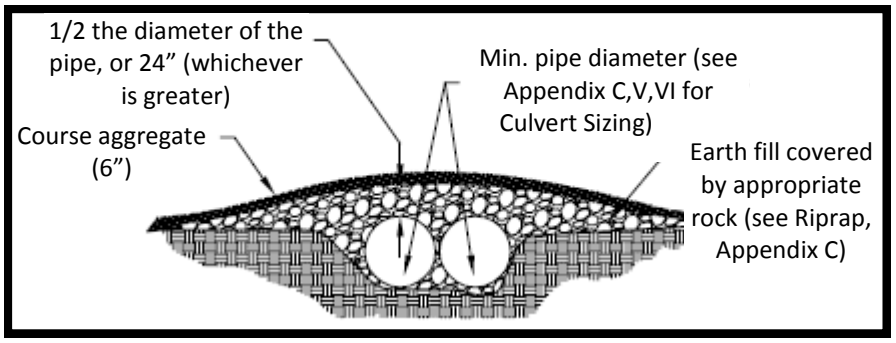


Maintenance

- Routine inspection
- Removal of debris
- Sediment removal if sediment basin reaches 50% capacity

BMPs
Waterway Protection

TEMPORARY WATER CROSSING



Definition/Purpose

A temporary crossing is a non-permanent structure, typically a bridge, culvert, or ford, that provides a safe and stable way for construction vehicle traffic to cross a watercourse.

Applicability

Temporary (construction) sites where equipment or materials need to be transported across streams or channels

Planning Considerations

- When implementing temporary water crossings, it is important to provide bank stabilization, minimize the risk of damage to the streambed or channel, and minimize sediment loading from construction traffic.
- Impacts on surrounding areas during construction, placement, and removal need to be evaluated and monitored.

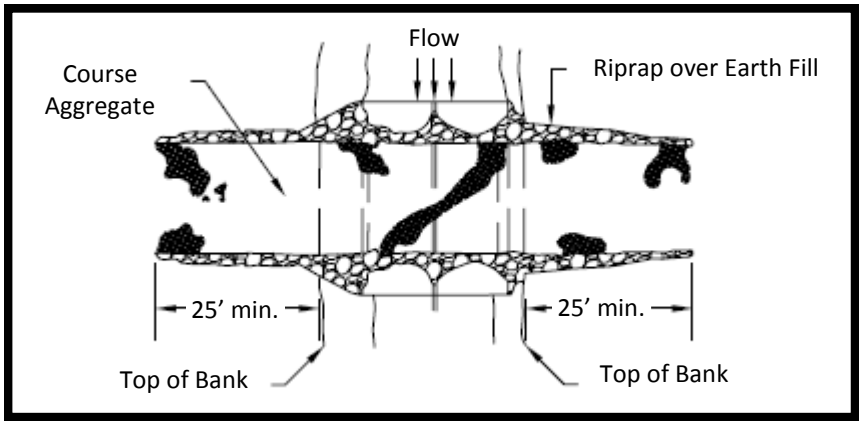
☞ TIP

Whenever possible, the need to construct temporary waterway crossings should be avoided. However, when necessary, bridges are the best option because they result in the least bank erosion and sediment loading damage.

- Culverts should be appropriately sized to support flow and soil conditions.
- Culvert size should be adequately designed to support, and not interfere with, migrating fish in the channel.
- Bridges require engineering design and more careful construction and maintenance to guarantee safe usage.
- Fords should only be used if no practical alternative is available and only during low flow periods to minimize stream pollution.

Recommended Specifications

- Bridges require support beams at 8 foot intervals along the width of a channel.
- Additional information on culvert design is given in Appendix C,V,VI.
- Filter cloth should be used to cover streambeds when culverts are used.
- Filter cloth coverage should extend a minimum of 6 inches and maximum of 1 foot beyond the culvert.
- 18 inches (minimum) of compacted fill is recommended over culverts.



Maintenance

Maintenance requirements vary depending upon the type of crossing used; however, all crossings should be inspected at least once a week. Repairs to temporary structures or banks should be done immediately.

CHEMICAL STABILIZATION

Photos courtesy of Alabama SWCC

Definition/Purpose

Chemical Stabilization is the use of chemical adhesive materials, such as vinyl, asphalt, or rubber emulsions, that can be quickly and easily applied to soil surfaces to provide immediate and temporary soil stabilization.

Applicability

- Areas where vegetation is hard to establish due to environmental constraints or where timely stabilization is key
- As a complementary practice (in combination with another BMP) to enhance soil and erosion control

Planning Considerations

- Use proper application to allow water infiltration and decrease runoff.
- Choosing a chemical stabilizer requires considerations for soil type, application methods, and chemical characteristics.
- Manufacturers instructions for application rates and procedures should be closely followed.
- If improperly applied, chemical stabilizers can have the opposite effect by creating impervious soil surfaces which may increase surface runoff.

Recommended Specifications

Mixtures containing polyacrylamide (PAM) may not be applied during extremely cold temperatures (≤41°F) or extremely windy (≥20 miles/hr) conditions.

Maintenance

Chemical stabilizers are compatible with and gradually penetrate the soil. Therefore, chemical stabilizers provide only temporary stabilization. Application areas should be inspected weekly. Reapplication may be necessary if relied on for extended periods.

SPUR DIKES (EMBEDDED FLOW OBSTRUCTIONS)

Photo courtesy of USDA NRCS

Definition/Purpose

Spur dikes are projecting structures that are used in waterways either adjacent to an abutment to gradually contract the stream and promote smooth flow of water around and beneath a bridge or independent of abutments to redirect water flow.

Applicability

- In the maintenance of the stability of any in-stream structure
- In erosion prevention of:
  - Bridge piers and abutments;
  - Embankments
  - Channel banks and bottoms

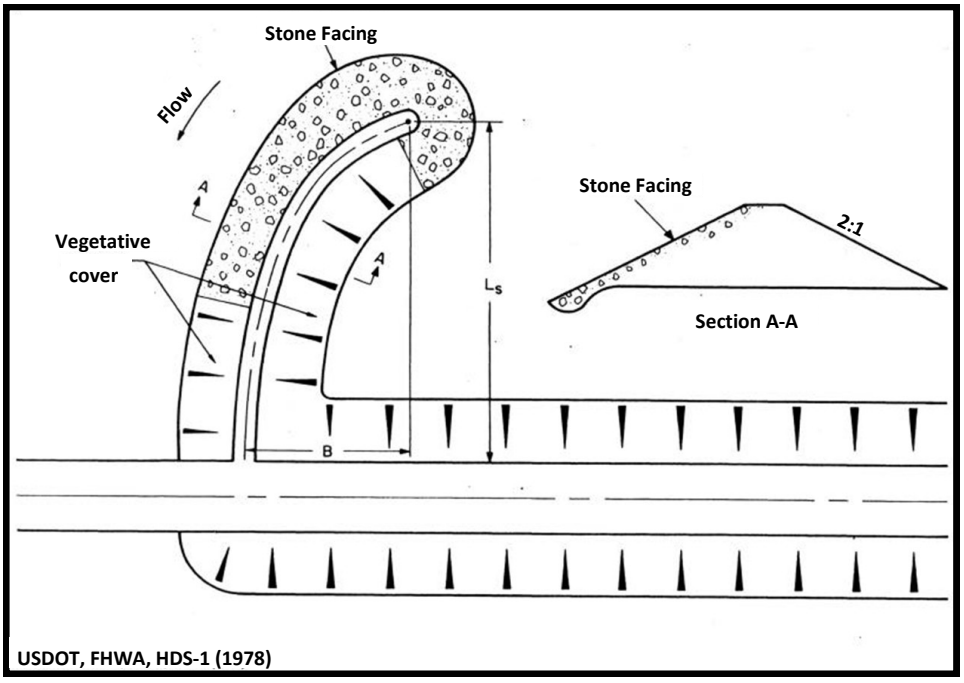
Planning Considerations

- Spur dikes should be elliptical or straight in shape to prevent eddy formation at upstream ends.

- Dikes should be installed at angles to water flow to prevent eddy formation around the edges and along the sides of the dike.

Recommended Specifications

- Spur dikes are more effective at reducing water-induced bank erosion when installed upstream of the area to be protected.
- For elliptical-shaped dikes, a ratio of 2.5:1 (length : width) is recommended.
- Should be of sufficient height above water level to prevent overtopping .
- Recommended minimum length (L_s) of 100 ft, when possible, to establish curvilinear flow.



USDOT, FHWA, HDS-1 (1978)

Maintenance

Dikes should be periodically inspected for erosion and for effectiveness. Installation of additional dikes or elongation of existing dikes may be necessary as channel hydrology changes.

BMPs
Runoff Conveyance

TEMPORARY SLOPE DRAINS

Definition/Purpose

Slope drain systems are made of flexible conduit that can be used to divert slope runoff to temporary alternate outlets.

Applicability

- Typically, in areas which drain no more than five acres
- In areas where stabilization needs are temporary (≤ 2 years)
- In recently graded areas until permanent drainage is installed

Planning Considerations

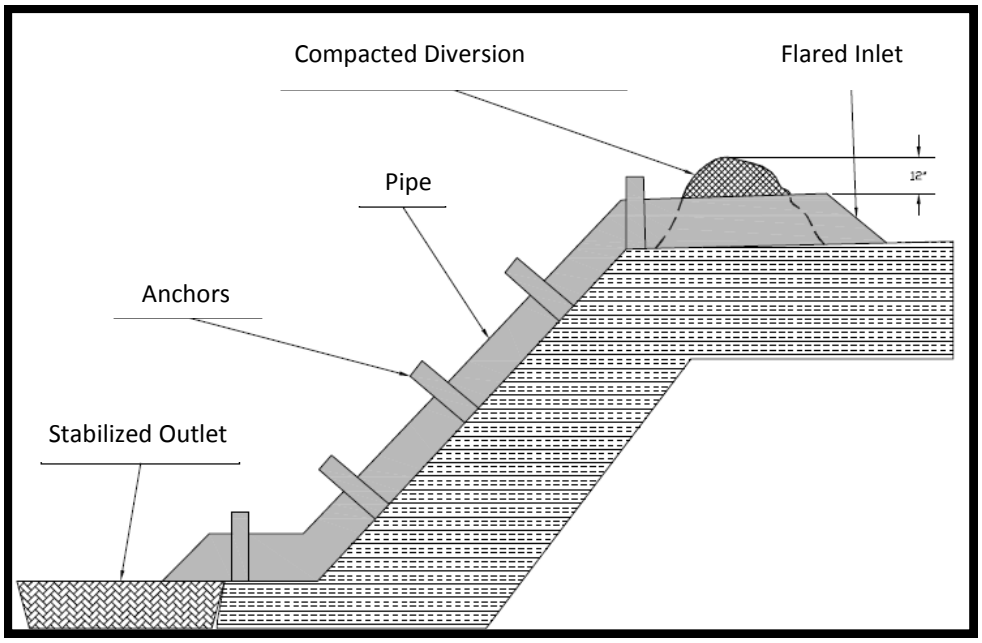
- Design of the drain, specifically pipe inlet capacity, channel capacity, and ridge height, should be adequate for drainage of the effective area.
- Drain should be constructed of heavy-duty materials suitable for specific use with this purpose.
- Permanent slope drains are often buried.

Recommended Specifications

- Anchors should be spaced a maximum of 10 feet apart.
- The pipe entrance should be flared and watertight.
- The height of the diversion should be at equal to the pipe diameter plus 0.5 feet (minimum).
- The outlet should be reinforced, and appropriate erosion control BMPs, such as outlet protection practices, should be employed.
- Some general guidelines for conduit sizing are provided on the facing page; more specific information on conduit selection is provided in Appendix C,V,VI (see Culverts Quick Reference Guide and/or Specific Selection Instructions).

Conduit Sizing Considerations	
Drainage Areas (Acres)	**Conduit Diameter (Inches)**
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

Table adapted from Alabama SWCC



Maintenance

Slope drains require routine monitoring to avoid drain inlet/outlet blocking and to ensure the effectiveness of erosion control measures at the drain outlet. Failure can lead to gully formation, erosion, and sedimentation at the outlet.

Appendix A:
BMP Quick Reference Listings

BMP Category Color Coding	
Sediment Control	
Waterway Protection	
Runoff Conveyance	

Management Area Addressing	
PHYSICAL AND CHEMICAL CHARACTERISTICS OF SURFACE WATERS	
Waterway Protection	
Runoff Conveyance	
INSTREAM AND RIPARIAN HABITAT RESTORATION	
Sediment Control	
Waterway Protection	
Runoff Conveyance	
STREAMBANK AND SHORELINE EROSION	
Sediment Control	
Waterway Protection	
Runoff Conveyance	

Appendix A:
BMP Quick Reference Listings

Suggested BMP	Suggested Meeting Management Area
Bank Protection	Erosion control/prevention
Bank Vegetative Buffers	Erosion control, bank stabilization
Channel Clearing	Sediment transport control
Channel Stabilization	Erosion control
Chemical Stabilization	Soil stabilization, erosion control
Diversion	Ground/surface water contamination control
Diversion Dike	Contamination control, sediment transport control
Erosion Control Blanket	Soil stabilization, erosion control
Floating Turbidity Barrier	Sediment transport control
Hydraulic Mulch	Soil stabilization, erosion control
Riparian Buffer	Bank/shoreline protection, contamination control
Riprap Channel Lining	Erosion control, soil stabilization
Sediment basin/rock dam	Sediment transport control, sediment filtration
Spur Dikes	Erosion control
Temporary Slope Drains	Erosion control
Temp. Water Crossing	Bank stabilization, sediment transport control
Vegetated Filter Strips	Sediment control, sediment filtration

Appendix B:
Recommended Improvement Examples

BANK STABILIZATION

BAD

Inadequate bank protection leads to channel erosion.

Incorporating riprap and other stabilizing structures onto channel banks can help prevent erosion and stabilize the channel.

GOOD

Appendix B:
Recommended Improvement Examples

BANK PROTECTION

BAD

Lack of buffer allows dirt and debris to pollute the channel and compromise its integrity.

Incorporating channel stabilization practices and sediment fences helps keep dirt and debris out of the channel.

GOOD

Appendix C:
Material Specifications

I. SEEDING

A. Preparative Requirements:

- Soil testing
- Tillage
- Debris/weed removal

B. Specific Requirements (Table adapted from LDOTD Standard Specifications, 2006)

Type[7]	Seed Mixture[1]	Pounds/ Acre	Kilograms/ Hectare	Soil Area[2]	Planting Dates	Establishment Period[6]
A	Hulled Bermuda	30	34	1,2,3,4,5	Mar.-Sep.	Mar.-Dec.
B	Hulled Bermuda Crimson Clover[3]	20 25	22 23	1,2,3,5	Feb.-Mar.	Feb.-Jan.
C	Kentucky 31 Fescue Unhulled Bermuda	25 20	28 22	1,2,3,4,5	Sep.-Feb.	Sep.-May
D[7b]	Unhulled Bermuda Crimson Clover[3]	20 40	22 45	1,2,3,4,5	Sep.-Feb.	Sep.-May
E[7c]	Pensacola Bahia[4]	25	28	1,2,3,5	Mar.-Sep.	Mar.-Dec.
F	Ball Clover Unhulled Bermuda	25 20	28 22	1,2,3,4,5	Feb.-Mar.	Feb.-Jun.
G	Vetch (Common) Unhulled Bermuda	40 20	45 22	1,2,3,4,5	Sep.-Oct.	Sep.-Jan.
H	N/A in Coastal Zone	N/A	N/A	N/A	N/A	N/A
I	Annual Rye	30	34	1,2,3,4,5	Sep.-Jan.[5]	Sep.-Apr.

[1]Only Hulled Bermuda or Unhulled Bermuda are permitted in rest areas.

[2]Corresponding soil areas: 1- Alluvial soils of Mississippi/Red River bottoms
2– Mississippi terraces and loessial hill soils
3– Coastal plain soils
4– Coastal prairie soils
5– Ouchita River bottom

[3]Inoculated prior to planting with proper bacteria culture

[4]Type E requires Roadside Development Specialist approval

[5]Annual Rye should not be planted before September 20 and may be planted as late as January 15

[6]Vegetation is considered established when at least 85% of the seeded area is covered with grass stems and there are not voids over 4 sq ft.

[7]For all seed varieties, the min. percentage of pure live seed is at least 80%/max. percentage weed seed at most 1%

[7b]78% (min. percentage pure live seed) for Crimson Clover

[7c]2% (max. percentage weed seed) for Pensacola Bahia

Appendix C:
Material Specifications

II. GEOTEXTILE FABRICS

A. General Requirements:

- Min. composition of 85% (weight/weight) polyolefin, polyester, or polyamide
- Min. roll overlap of 18 inches
- Roll sewing: polyester or Kevlar thread, "J" or "Butterfly" seam, two-thread chain stitch
- Must be covered within 7 days of placement (see relevant overlay BMP structures, below)

B. Specific Requirements

Property	Test Method	Class A	B	C	D	S	F	G
AOS, Metric Sieve, µm, Max.	ASTM D 4751	300	300	300	212	600	850	850
Grab Tensile, N, Min.	ASTM D 4632	330	400	580	800	800	400	400
% Elongation @ Failure, Min.	ASTM D 4632	—	—	50	50	—	—	—
% Elongation @ 200 N, Max.	ASTM D 4632	—	—	—	—	—	—	50
Burst Strength, N, Min.	ASTM D 3787	440	620	930	1290	1390	—	—
Puncture, N, Min.	ASTM D 4833	110	130	180	330	330	—	—
Trapezoid Tear Strength, N, Min.	ASTM D 4533	110	130	180	220	220	—	—
Permittivity, Sec.$^{-1}$, Min.	ASTM D 4491	1.0	1.0	1.0	1.0	0.2	0.01	0.01
Grab Tensile Strength Retained after Weathering 150 h, UVA lamps, % Min.	ASTM D 4632 ASTM G 154	70	70	70	70	70	—	—
Grab Tensile Strength Retained after Weathering 50 h, UVA lamps, % Min.	ASTM D 4632 ASTM G 154	—	—	—	—	—	70	70

Table copied from LDOTD Standard Specifications, 2006

C. Relevant BMPs	Fabric Class Required
Riprap	D
Silt Fencing	F or G
Soil Stabilization (Construction Entrances)	C, D, or S
Underdrains	A, B, C, or D

Appendix C:
Material Specifications

III. RIPRAP

A. General Requirements
- Sturdy, holds up to exposure to Louisiana environmental elements
- Reasonably pure, free from foreign materials
- Min. solid weight = 155 lb/cu^3
- No dimension should be less than 1/3 the largest dimension for individual stones
- Requires geotextile fabric base

B. Specific Requirements

Riprap Class [Avg. Stone, lb (kg)]	Spherical Diameter [Avg. Stone, ft (mm)]	Percent of Stone Smaller Than Average
30 (15)	0.74 (255)	15-50
55 (25)	0.88 (270)	15-50
130 (60)	1.17 (360)	15-50
250 (115)	1.46 (455)	15-50
440 (200)	1.76 (535)	14-50
1000 (455)	2.31 (705)	10-50

Table adapted from LDOTD Standard Specifications, 2006

IV. FERTILIZER

Approved Fertilizer Compositions and Application Rates:
(Nitrogen-Phosphoric Acid-Soluble Potash, N-P-K)

Approved Type	Pounds per Acre	Kilograms per Hectare
8-8-8	1000	1120
12-12-12	667	748
13-13-13	615	689
16-16-16	500	560

Table adapted from LDOTD Standard Specifications, 2006

Appendix C:
Material Specifications

V. CULVERTS - QUICK REFERENCE GUIDE/GENERAL INSTRUCTIONS

A. Preparation
- Area around where the culvert is to be placed should be excavated to a width of 18 in (min.) on all sides.
- The compacted earth below the culvert should have a thickness of at least ½ of the culvert diameter (8 in, min.) of compacted earth above the culvert.
- Unstable soil or rock bases should be removed and replaced prior to culvert installation.
- Culvert installation should begin at the downstream end.

B. Culvert selection—see chart on next page (page 43).

C. Installation
- Each end of the culvert should extend 1 ft (min.) beyond the slope/fill material.
- Culvert should be placed with a 1%-2% downgrade slope.
- Culvert should be angled 30°-45° in the direction of water flow.
- Riprap or other outlet protection measures should be used at outflow end of culvert.
- Soil replaced and compacted above the culvert should be equal to half of the culvert diameter (min.).

Appendix C:
Material Specifications

Acres Drained	Light Soils (example sands)			Moderate Soils (example loams)			Heavy Soils (example clays)		
	Flat	Moderate	Steep	Flat	Moderate	Steep	Flat	Moderate	Steep
Slope	(0-5 %)	(5-15%)	(15+%)	(0-5 %)	(5-15%)	(15+%)	(0-5 %)	(5-15%)	(15+%)
5	18	18	18	18	18	21	21	21	24
10	18	18	18	21	24	27	27	27	36
20	18	18	18	24	27	36	36	36	42
30	18	18	18	27	30	36	36	42	48
40	18	18	18	27	36	42	42	48	
50	18	18	18	30	36	48	48	48	
75	18	21	21	36	42				
100	21	21	24	36	48				
150	21	24	24	42					
200	24	30	30	48					
250	27	30	30						
300	30	36	36						
350	30	36	42						
400	36	36	42						

Culvert Diameter (in.)

Table adapted from LDEQ Forestry BMP Guide, 2001

Appendix C:
Material Specifications

VI. CULVERTS - SPECIFIC SELECTION GUIDELINES

A. Determine the drainage area (in acres):
The Louisiana Department of Natural Resources (LDNR) maintains a Strategic Online Natural Resources Information System (SONRIS) that can be used to retrieve acreage information and perform drainage calculations. The site provides interactive, geographically oriented, versatile map capabilities with relevant tutorials on map use. The site can be accessed at: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm.

B. Determine the drainage runoff in cubic feet per second (cfs):
See Table **A** on page 45.

C. Determine the size of pipe/culvert required:
See Tables **B** and **C** on page 46. To use these tables, look under the length of pipe that is needed to span a slope or roadway (also allowing for a 1-5 ft extension on either side) for the drainage runoff value from **A**. Go down the chart until you find a number that is equal to or greater than the value from **A**. Go Across the chart to find the correct pipe diameter and recommended gauge.

(Tables **A**, **B**, and **C** adapted from "Best Management Practices for Hydromodification Activities," Louisiana Department of Environmental Quality)

Appendix C:
Material Specifications

A. Drainage Runoff in Cubic Feet per Second

Acres	Marsh, Range & Woodland Areas	Rice Areas	Improved Pasture Areas	Coastal Cultivated Areas	Industrial and Municipal Flat Areas	Maximum for Hill Areas	Industrial and Municipal Hill Areas
2	0.12	0.28	0.37	0.55	0.69	1.61	1.91
4	0.22	0.49	0.66	0.98	1.22	2.86	3.41
6	0.31	0.69	0.92	1.38	1.71	4.01	4.78
8	0.39	0.88	1.17	1.75	2.18	5.10	6.07
10	0.47	1.05	1.41	2.11	2.63	6.14	7.31
15	0.66	1.48	1.97	2.96	3.68	8.61	10.25
20	0.84	1.90	2.51	3.75	4.70	10.94	13.20
30	1.20	2.63	3.50	5.30	6.55	15.33	18.30
40	1.50	3.34	4.50	6.70	8.33	19.50	23.21
50	1.80	4.03	5.40	8.06	10.03	23.50	27.96
60	2.10	4.70	6.30	9.40	11.70	27.33	32.54
70	2.40	5.33	7.11	10.70	13.30	31.10	37.00
80	2.70	5.96	7.95	11.93	14.84	34.73	41.40
90	2.92	6.60	8.80	13.20	16.40	38.31	45.63
100	3.20	7.20	9.60	14.40	17.90	41.83	49.81
120	3.70	8.40	11.20	16.72	20.81	48.70	57.99
140	4.22	9.51	12.70	19.02	23.80	55.40	65.94
160	4.72	10.63	14.20	21.26	26.50	61.90	73.70
180	5.21	11.73	15.63	23.50	29.20	68.30	81.30
200	5.70	12.80	17.10	25.60	31.90	74.54	88.80
220	6.20	13.90	18.50	27.72	34.50	80.70	96.10
240	6.62	14.90	19.90	29.80	37.09	86.77	103.33
260	7.08	15.93	21.24	31.86	39.65	92.75	110.46
280	7.53	16.94	22.59	33.89	42.17	98.66	117.49
300	7.97	17.94	23.93	35.89	44.67	104.50	124.45
350	9.07	20.41	27.21	40.82	50.80	118.83	141.51
400	10.13	22.81	30.42	45.62	56.80	132.81	158.17
450	11.18	25.16	33.55	50.33	62.63	146.51	174.47
500	12.21	27.47	36.63	54.94	68.38	159.96	190.49
550	13.22	29.74	39.66	59.79	74.03	173.18	206.23
600	14.21	31.98	42.64	63.96	79.60	186.21	221.74

Appendix C:
Material Specifications

B. Size requirements for corrugated metal pipes flowing full under 0.2 of a foot head

Length of Pipe/Culvert Needed (ft)						Pipe Diameter (in)	Equivalent Pipe Arch (in)	Minimum Recommended Gauge
10	20	30	40	50	60			
1.6	1.4	1.3	1.2	1.1	1.0	12	--	16
2.7	2.4	2.2	2.0	1.9	1.7	15	17x18	16
4.0	3.6	3.3	3.1	2.9	2.7	18	21x15	16
5.5	5	4.7	4.4	4.2	3.9	21	24x18	16
7.3	6.8	6.3	6.0	5.7	5.4	24	28x20	14
11.6	11.0	10.4	9.9	9.5	9.1	30	35x24	14
17.0	16.2	15.5	14.9	14.3	13.8	36	42x29	12
23.4	22.4	21.6	20.9	20.2	19.6	42	29x33	12
30.7	29.7	28.7	27.9	27.1	26.4	48	57x38	12
39.1	37.9	36.9	35.9	35.0	34.2	54	64x43	12
48.5	47.2	46.0	44.9	43.9	43.0	60	71x47	10

C. Size requirements for concrete, PVC, or smooth steel pipes flowing under 0.2 of a foot head

Length of Pipe/Culvert Needed (ft)						Pipe Diameter (in)
10	20	30	40	50	60	
1.8	1.7	1.6	1.5	1.4	1.3	12
2.9	2.7	2.6	2.4	2.3	2.2	15
4.2	4.0	3.8	3.7	3.5	3.4	18
5.8	5.6	5.4	5.2	5.0	4.3	21
7.7	7.4	7.1	6.9	6.7	6.5	24
12.1	11.8	11.4	11.2	10.9	10.6	30
17.5	17.1	16.8	16.4	16.1	15.8	36
24.0	23.5	23.1	22.7	22.3	22.0	42
31.4	30.9	30.4	30.0	29.6	29.1	48
39.8	39.3	38.8	38.3	37.8	37.3	54
49.2	48.7	48.1	47.6	47.0	46.5	60

GLOSSARY

Abutment - A support structures for bridges, piers, walls, or dams

Apron - An area of non-erosive material designed to prevent erosion at the outlet ends of culverts, pipes, and other drainage devices

Berm - A sloped wall or embankment that separates a ditch from a bank

Best Management Practice - Educational and procedural activities that can resolve or reduce specific water quality resource problems if followed and implemented according to their established guidelines

Channelization - The straightening or deepening of a channel to increase flow capacity

Compaction - The compression of soil to decrease the overall void volume

Contaminant - Any substance that is introduced into a water body in which it does not belong and has the potential to adversely affect the quality of the water

Culvert - An enclosed concrete, metal, or plastic conduit that is used to transport water

Dam - A barrier designed to contain the flow of water for storage or for diversion purposes, to prevent erosion, or to retain soil, sediment and other particulate debris

Dike - An embankment to confine or control water, often built along the banks of waterways to prevent flooding, a levee

Discharge - The volume of water transported per unit time; rate of water flow

Diversion - A channel with a supporting ridge on the lower side constructed at the top, across, or at the bottom of a slope for the purpose of controlling surface runoff

Diversion Dike - An embankment used to divert surface runoff

Embankment - A man-made angled deposit of soil, rock, or other structural material used to control Or exclude water from an area, a dam

Erosion - The wearing away of land by water, wind, ice, gravity, or other environmental forces

Fertilizer - Any organic or inorganic material that is added to soils to supply elements that enhance vegetative growth

Filter fabric - A woven or non-woven, water-permeable material that is used in erosion and sediment control practices to trap sediment or prevent the movement of fine soil particles

Geotextile - A permeable textile of synthetic fibers

GLOSSARY

Gradient - A change in elevation per unit length (slope)

Gully - A deep ditch or hollow formed from the erosive forces of running water

Hydraulic - Activated or powered by fluids

Hydrology - The science of the behavior of water in the atmosphere, on the surface of the earth, and underground

Infiltration - The gradual downward flow of water from the surface through soil to ground water and water table reserves

Laminar flow - Steady, continuous, parallel and straight fluid movement

Mulch - A natural (plant residue) or synthetic layer of materials used to cover soil surfaces to conserve moisture, stabilize soils, and minimize temperature fluctuations

Nonpoint source pollution - Pollution that initiates from indirect, diffuse origins and does not result from singular, discernible conveyances

Outlet - The point of water disposal from a bayou, canal, channel, ditch, lake, river, or drain

Pesticides - Chemicals that are used to control or eliminate animals, insects, or undesirable vegetative growth

pH - A numerical representation of the concentration of hydrogen (H+) ions in a solution. pH ranges are from 0 (acidic) to 14 (alkaline) with 7 being neutral

Pollutant - Any substance that is introduced into water that adversely affects the quality of the water body. Any substance in overabundance can be considered a pollutant. Common water pollutants are sediment, solids, agricultural and industrial waste, metals, sewage, and biological and chemical materials

Receiving water - Any body of water into which runoff or effluent flow is discharged

Riparian - Of, on, or pertaining to the banks of a water body

Runoff - Storm water that does not evaporate or infiltrate and flows from the land surface into surface waters

Scour - The clearing and digging action of flowing water, especially the downward erosion of the banks and beds of waterways

Sediment - Particulate material, both mineral and organic, that is in suspension, being transported, or has been moved from its site of origin by air, water, gravity, or ice

Glossary

Sedimentation - The deposition, by settling, of a suspended material

Slope - The degrees of deviation of a surface from the horizontal; measured as a numerical ratio or as a percent. In ratio form, the first number represents horizontal distance, and the second number represents the vertical distance (ex. 2:1)

Stabilization - Treatments to minimize deterioration of surfaces due to erosive or other environmental forces