

URBAN STORM WATER RUNOFF: ROADS, HIGHWAYS, BRIDGES



**BEST MANAGEMENT
PRACTICES (BMPs)
FOR COASTAL LOUISIANA
NONPOINT SOURCE
POLLUTION**

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Department of Agriculture (USDA) Natural Resource Conservation Service
(NRCS)

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

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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

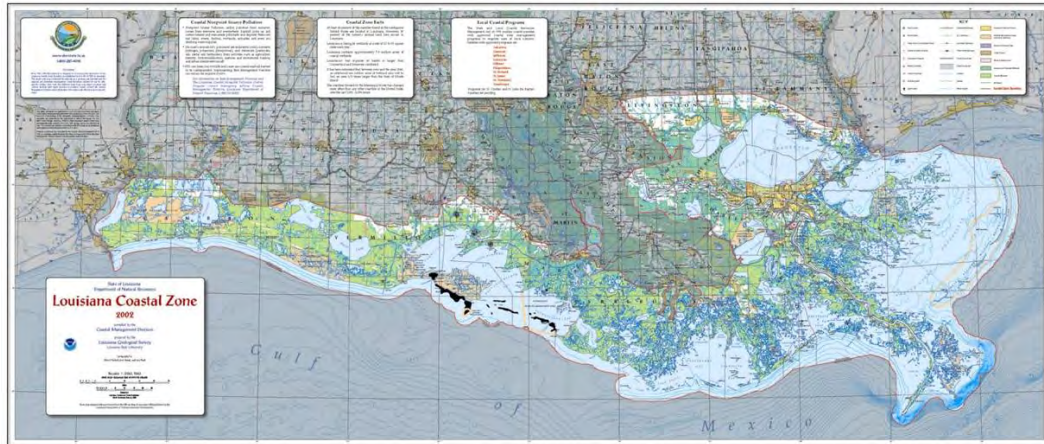
 Pages with a green box in the upper corners are construction-specific BMPs

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

 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)	225-219-3640
SPOC (Toll-Free)	888-763-5424

LA State Police (For Spill Emergencies)

24-Hour Hotline	225-925-6595
24-Hour Hotline (Toll Free)	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. As a result, engaging in any activity that has the potential to discharge into state waters requires proper permits. These Louisiana permits are intended to ensure that discharges comply with Clean Water Act regulations.

Activity	Permit #	Notice of Intent (NOI)
Construction Small (1-5 acres) Large (> 5 acres)	LAR200000 LAR100000	N/A CSW-G
Industrial (Multi-Sector General Stormwater Permit)	LAR050000	MSGP-G
Sand and Gravel Extraction	LAG490000	SCC3-G
Municipal Separate Storm Water Sewers¹ Small Medium (≥ 100,000 people) Large (≥ 250,000 people)	LAR040000	MS4-G MS4-G 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	H2O-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 < 25,000 gpd < 50,000 gpd < 100,000 gpd	LAG530000 LAG540000 LAG560000 LAG570000	WPS-G WPS-G WPS-G 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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Urban Storm Water Runoff: Roads, Highways, Bridges Overview

Urban storm water runoff is storm water runoff flow, from urban or suburban areas, that does not infiltrate into the soil or evaporate into the air. Runoff flow that originates from roadways, highways, bridges and other impermeable surfaces can carry contaminants into our bayous, canals, channels, estuaries, lakes, and rivers.

Contaminants such as dirt, dust, glass, grease, oils, rubber, trash, and other street debris are deposited onto these surfaces from vehicles, highway littering, and roadway construction and maintenance. The most common source categories of water pollution in urban runoff from roads, highways, and bridges are:

Sediments—Soils and other particulate matter are often overlooked as a serious contributor to NPS pollution. However, the USEPA (1998) recognizes suspended solids (sediment) as the number one impairment of the Nation's surface waters.

Fertilizers and Nutrients—Inorganic salts and eroded soils

Hydrocarbons—Carbon and hydrogen-based compounds (including oil and grease by-products)

Pathogens—Disease-causing organisms and materials

Pesticides—Chemicals used to control organisms or vegetative growth

Metals and Non-Metal Components of Metals Products

BMPs for urban storm water runoff have been divided into four categories:

- Site Preparation and Maintenance
- Surface Stabilization
- Sediment Control
- Runoff Conveyance

Urban Storm Water Runoff: Roads, Highways, Bridges Overview

Site Preparation and Maintenance

Urban storm water runoff from roads, highways, and bridges is a major contributor to nonpoint source pollution of Louisiana coastal waters. Increases in land use and development in urban areas of the Louisiana Coastal Zone lead to increases in the susceptibility of coastal waters to storm water runoff. There are several pertinent BMPs related to road, highway, and bridge construction planning and management in addition to BMPs for the responsible maintenance of these structures that can reduce the impact of nonpoint source pollutants on coastal resources.

Surface Stabilization

Erosion and sediment control are critical to the reduction of nonpoint source pollutants and the preservation of the Louisiana Coastal Zone. There are a variety of vegetative, structural, permanent, and temporary measures that can be used alone or in combination to provide surface stability, minimize the production of sediment, and maximize pollution prevention.

Runoff Conveyance

Storm water runoff that is not evaporated or infiltrated can lead to surface erosion or may transport runoff from contaminated sites. Therefore, excess storm water runoff should 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.

Sediment Control

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.

BMPs

Site Preparation and Maintenance

CONSTRUCTION SEQUENCING

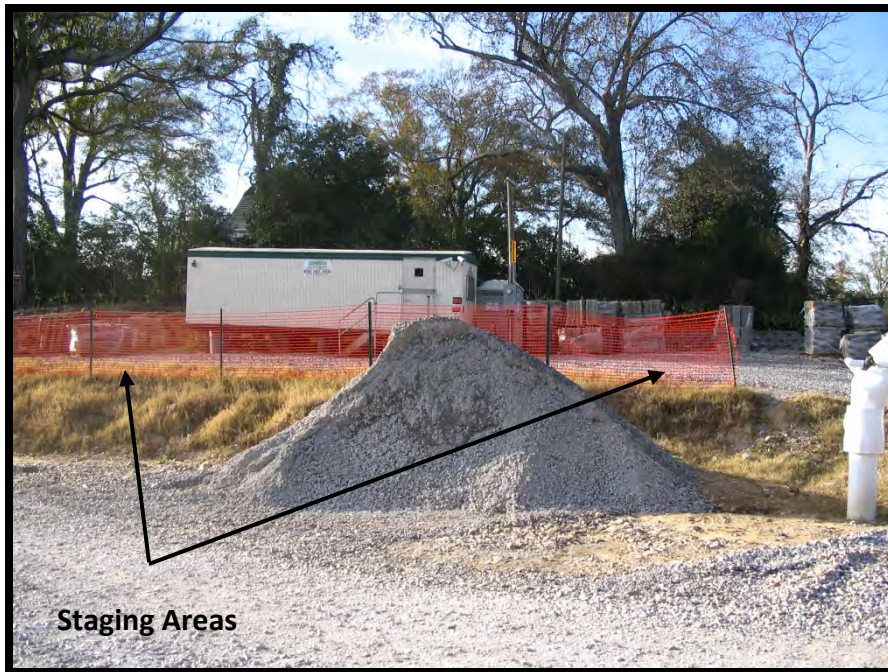


Photo courtesy of Providence

Definition

Construction sequencing involves the development and implementation of a planned construction schedule that coordinates site activities.

Purpose

To reduce on-site erosion and off-site sedimentation

Applicability

Should always be implemented

TIP

As a general rule of thumb, only disturb land that is going to be used within the next 3 months. If construction will not be done in an area within a 3 month period, do not disturb the area.



BMPs

Site Preparation and Maintenance

Planning Considerations

- Scheduling and planning at a construction site should be performed to ensure that erosion and sediment control practices are installed and set in place before any land disturbances occur.
- Runoff will need to be managed throughout each phase of construction.
- Sequence design should account for phases of construction that may significantly impact other downhill phases.
- Sequence design may need to plan accordingly for both construction and residential/commercial access as work progresses.
- Schedule should be flexible or have contingencies for weather and other variables that will affect sequencing schedules.

Recommended Specifications

- Establishing construction access/entrances with attention to sediment control and surface stabilization should be done first as land disturbance begins.
- Preservation of vegetation, temporary vegetative, and other sediment controlling BMP measures should be considered before construction begins.
- Along with the schedule of activities, the construction plan should also list the necessary BMPs that will be installed with each step of the construction plan and have allotted time for installation and set-up of the practices.
- The schedule should take into account all stages of the construction project following through until the final stabilization stage. This should be considered the final phase of a construction project and should involve the complete removal of all temporary measures used throughout the project.

Maintenance

Adherence, within reason, to the sequencing schedule

BMPs

Site Preparation and Maintenance

FERTILIZER AND PESTICIDE CONTROL

Definition/Purpose

Fertilizers and pesticides are chemicals that are used in commercial and residential applications to sustain erosion-controlling vegetation.

Applicability

- In areas where soil conditions are not ideal
- In areas where weeds or other undesired vegetation offer competition
- In cases where insects or other pests are detrimental to vegetation

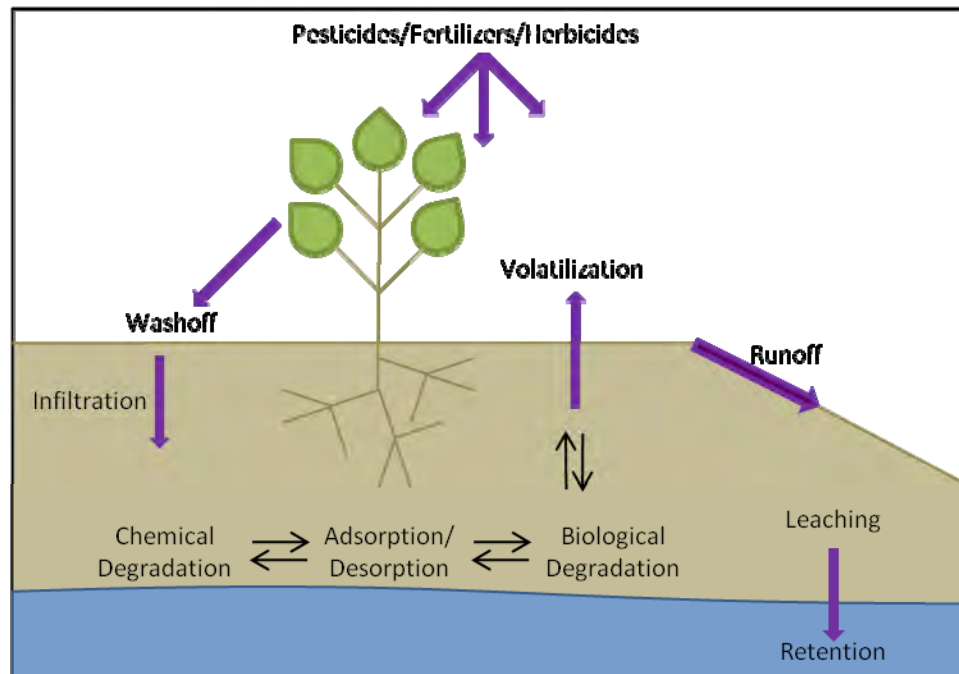
Planning Considerations

- Chemical use depends on strict following of label instructions as well as Louisiana Department of Agriculture and Forestry guidelines regarding the use of all fertilization and pesticide chemicals.
- Handling and distribution of the chemicals should be monitored and controlled with regard to environmental conditions at the time of application.
- Chemicals should not be used within 48 hours of an anticipated rain event.

Recommended Specifications

- See product and State specifications on pesticide/fertilizer use.
- Only commercial fertilizers should be used.
- Chemical composition should be specified by a 3-number sequence representing the percentages (by weight) of nitrogen (N), phosphoric acid (P), and soluble potash (K).
- For controlled-release fertilizer tablet use, the N-P-K composition should be 20-10-5 and contain calcium, sulfur, and iron.
- Acceptable fertilizers should be 8-8-8, 12-12-12, 13-13-13, or 16-16-16.
- Additional information about application rates is given in Appendix C.I.

Site Preparation and Maintenance



Maintenance

Usually only offers temporary control. Reapplication is therefore necessary to sustain the effectiveness of this practice.

TIP

Soil testing is a quick, inexpensive ($\approx$ \$7), and efficient way to determine whether or not lime or fertilizers are needed. LSU AgCenter Soil Testing and Plant Analysis Laboratory (STPAL) has several lab facilities throughout the state that offer pH and nutrient content soil analysis. Contact information for this lab can be found on page iii.

BMPs

Site Preparation and Maintenance

ROADWAY AND BRIDGE MAINTENANCE



Photo courtesy of Providence

Definition

Road and bridge maintenance involves the utilization of pollution prevention techniques, as part of an operation or maintenance program, that serve to reduce or eliminate sediment and pollutant contributions to storm water runoff.

Applicability

In any setting - daily roadway and bridge use, along with scheduled repairs and maintenance, generates substantial amounts of sediment and pollutants

Planning Considerations

- Roadway and bridge maintenance is an integral part of most urban areas. Pollution prevention practices should not be difficult to incorporate and implement.
- Additional training and equipment may be necessary to apply pollution prevention practices to roadway and bridge maintenance schedules.
- More specified pollution prevention practices may be required for roadways or bridges that are near sensitive water bodies.

Recommended Specifications

- Paving should be done only in dry weather conditions.
- Practicing good housekeeping procedures will reduce the need to implement additional BMPs.
- Clear spill prevention and clean-up procedures should be outlined.
- Drain inlets should be protected using fabric or gravel barriers or straw bales during maintenance procedures (information on straw bales is provide on page 41).
- Additional devices, such as tarps or vacuums, may be needed to prevent runoff contamination for bridge maintenance work where day-to-day BMPs are not in place.

Maintenance

- Maintain roadside vegetation
- Street sweeping
- Litter control and removal
- Stripping, patching, and shoulder maintenance
- General maintenance
- Minimizing deicer application

BMPs

Site Preparation and Maintenance

TOP SOILING

Definition

Top soiling is the removal, stockpiling, and preservation of the existing soil surface (topsoil) from construction areas for immediate or future use in vegetated areas.

Purpose

To enhance site stabilization and the subsequent establishment of vegetation, especially in poor soil conditions

Applicability

- Any area where the soil surface to be disturbed has desirable properties (high organic matter content, good consistency, high water-retaining capacity, and high nutrient content)
- In areas where vegetative establishment is impeded by poor native soil properties (low-water retaining capacity, low pH)

Planning Considerations

- Topsoil is more erosion resistant than other soils, so strategic replacement of topsoil can help stabilize a site.
- Topsoil may contain weeds and weed seeds that may contribute to undesired vegetation.
- Scrapers are the most effective equipment for stripping topsoil.

Recommended Specifications

- Particle size, pH, organic content, textural class, chemical composition, and soluble salt content should be tested prior to replacement.
- Topsoil should have a pH range of 5.5-8.0 and an organic content of 2% (minimum).



BMPs

Site Preparation and Maintenance

- When being replaced, topsoil should be distributed over the surface to a depth of 6 inches (minimum).
- Stripping should begin in areas of increased elevation and continue towards lower areas for efficient topsoil removal.
- Normal depths for stripping are the uppermost 2-4 inches of soil.



Photo courtesy of Alabama SWCC

Maintenance

Top soiling requires stripping and stockpiling the soil for further use. Removal and reapplication is necessary when the site has been prepared for topsoil use.

TIP

Using temporary practices to vegetate topsoil will help to stabilize topsoil piles while in reserve.

BMPs

Surface Stabilization

CONSTRUCTION ROAD STABILIZATION

Surface Stabilization



Photo courtesy of Providence

Definition

Construction road stabilization is the use of construction specifications, techniques, and materials to stabilize soils on which a road or travel way is constructed.

Purpose

To reduce vehicle-induced erosion, especially during wet weather conditions

Applicability

As part of roadway, parking lot, or vehicle transportation route construction plans in both temporary and permanent circumstances

BMPs

Surface Stabilization

Planning Considerations

Road stabilization should be done immediately following initial grading.

Recommended Specifications

- Temporary roadways should fall in line with natural topographic features.
- Permanent roadways should consider natural or planned storm water runoff paths.
- Drainage structures should be incorporated which have been appropriately designed for roadway runoff conditions.
- Re-grading, compaction, and material removal should be done as necessary.

Maintenance

- Periodic evaluation of roadway stability
- Trash and material removal from roadways and drainage areas
- Reapplication or evening out of stabilization materials as necessary

BMPs

Surface Stabilization



DUST CONTROL

Surface Stabilization



Photo courtesy of Providence

Definition/Purpose

Dust control measures aim to reduce soil surface activity and air movement that cause dust generation.

Applicability

- Construction sites
- Large open areas

TIP

The number one way to reduce dust generation is to plan construction activities to limit the total amount of exposed soil at any one time!

Planning Considerations

- Environmental conditions may limit dust control options; for example, in dry conditions, evaporation may limit the effectiveness of irrigation practices.
- Additional oversight may be necessary for chemical stabilization controls (see pgs. 11-12 for details on chemical stabilization methods).

Recommended Specifications

- Sprinkling/Irrigation—keeping the soil moist will reduce sediment dispersion.
- Mulching—can reduce wind erosion by up to 80%.
- Wind barriers—effective in retaining windborne sediment. This effectiveness varies based on permeability of the material chosen and the height of the barrier. Generally, for each foot raised, an 8 foot to 10 foot deposition zone will develop.
- Tillage—can reduce soil losses by up to 80%.
- Stone placement—reduces soil erosion. Larger stones (≥ 20 cm) are more effective than smaller stones. Stone offers a permanent solution to dust control unlike mulching, barriers, tillage, and chemical treatments.
- Spray-on chemical soil treatments—can reduce soil erosion by 70-90%. However, these treatments must be used responsibly to avoid contamination of muck soils, surface water, and groundwater.

Maintenance

With the exception of stone installments, these treatments offer only temporary solutions to dust control. Therefore, areas should be routinely inspected to determine if there are any areas of exposed soil where retreatment is necessary.

BMPs

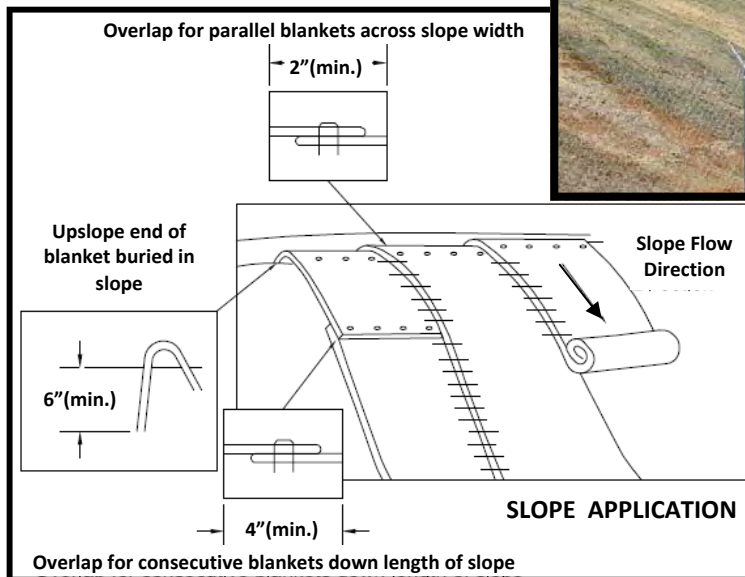
Surface Stabilization



EROSION CONTROL BLANKET



Photo courtesy of Alabama SWCC



Surface Stabilization

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 timecourse.

BMPs

Surface Stabilization

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

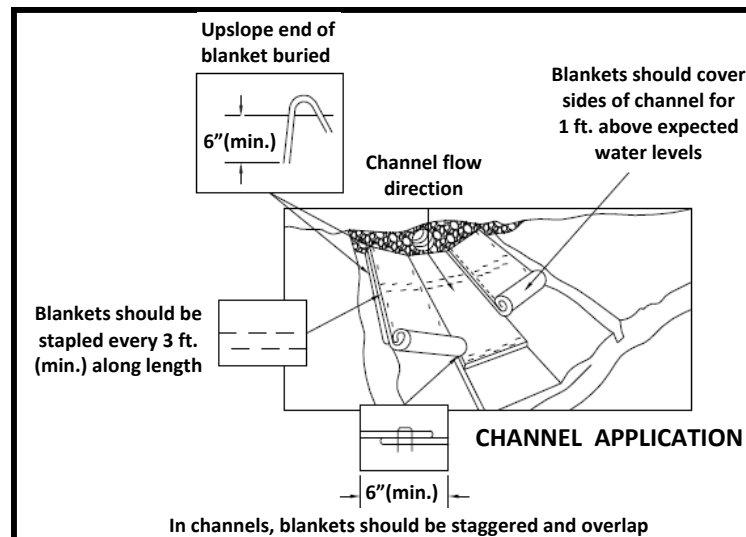


TIP

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.



Surface Stabilization

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

Surface Stabilization



OUTLET PROTECTION



Photo courtesy of USDA NRCS

Surface Stabilization

Definition/Purpose

Structurally lined aprons or other energy dissipating devices located at the outlets of pipes or paved channel sections that prevent erosion through the reduction of concentrated storm water flow velocity.

Applicability

At pipe and channel outlets where high velocity discharge exceeds the erosion-resistance of the outlet reservoir

Planning Considerations

- Riprap, grouted riprap, or concrete can be used for outlet protection.
- The end of the apron or structure should merge smoothly with the receiving channel so that discharge velocities do not increase at the end of the apron.

Recommended Specifications

- Apron structure should not slope, outlet elevation should equal the elevation of the downstream end of the receiving channel.

- When riprap is used, riprap size requirements should be well-defined (information on these requirements can be found in Appendix C,V).
- When riprap is used, apron thickness should be 1.5 times the maximum stone diameter, but thickness should be at least 6 inches; for concrete use, apron thickness should be a minimum of 4 inches.
- Apron width should be at least 3 times the diameter of the pipe or paved channel section discharging onto the apron.
- Required apron lengths are greater for larger discharge velocities and outlet pipe diameters (see table below). Apron structures should have a minimum length of 8 feet.

	<u>Minimum Length of Apron (feet)</u>											
	Pipe Diameter (inches)											
	12	15	18	21	24	27	30	36	42	48	54	60
3	8											
5	8											
8	11	10										
10	14	12	10									
15	18	16	14	12								
20		18	18	16	12							
30			22	20	18	16						
40			26	24	24	20	18					
50				26	26	24	22	18				
70					30	30	28	25				
100						36	36	33	27			
150							42	42	42	38	33	28
200								48	45	42	37	32

Table adapted from USDA Soil Conservation Service

Maintenance

Outlet protection practices are typically low maintenance. Outlets should be inspected periodically for cracks in the concrete or misplaced riprap stones, and repairs or replacement should be done immediately.

BMPs

Surface Stabilization

SUBSURFACE DRAIN

Definition

A subsurface drain is a perforated pipe or continuous layer of porous material installed below the ground surface that intercepts, collects and carries excessive groundwater to a stable outlet.

Purpose

To remove excess water from soil surfaces, improve slope stability and reduce slope erosion

Applicability

- Areas where vegetative growth would be benefitted by water table stability
- In areas where runoff pooling is prevalent and undesirable, such as around homes, commercial buildings, roadways, and bridge structures

Planning Considerations

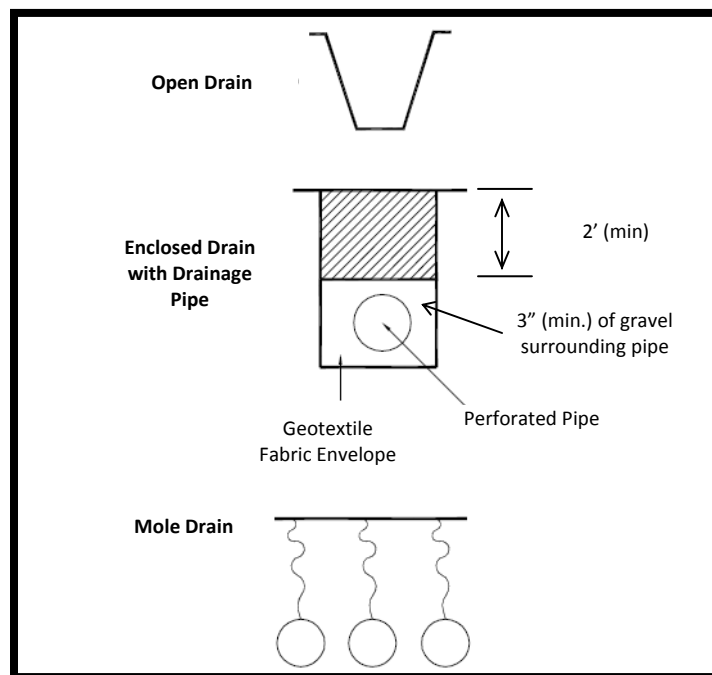
- Subsurface drains require professional engineering design.
- Drain installation should be planned around tree and other vegetative root systems.
- The most effective drain material may be influenced by surrounding soil characteristics.
- 3 different subsurface drain types are available:
 - Relief drains—drain with slope
 - Underdrains
 - Interceptor drains—run perpendicular to slope

BMPs

Surface Stabilization

Recommended Specifications

- The drain should be surrounded by gravel to prevent soil infiltration into the drain.
- Sand or geotextile may be used as a filter; however when geotextile is used, guidelines provided in Appendix C,IV should be followed.
- Specifications for perforated piping can be found on page 44 ('Underdrains').
- Access points should be installed along length of drain to allow removal of sediment build-up.
- Additional BMPs should be used in conjunction with this practice to provide outlet protection.



Maintenance

Subsurface drains are typically low maintenance; however, devastating soil damage or incomplete initial bonding with surrounding soil may cause drain wash out and collapse.

BMPs

Runoff Conveyance



CHECK DAM



Photo courtesy of Alabama SWCC

Definition

Check dams are small, temporary structures that are constructed across areas of concentrated flow, such as a swale or a channel.

Purpose

Used to temporarily slow velocity of concentrated water flows and reduce erosion

Applicability

- In channels that have temporary periods of concentrated runoff flows (as opposed to live flow streams)
- As a temporary erosion control measure in channels that cannot be permanently stabilized



TIP

Implementation Guidelines

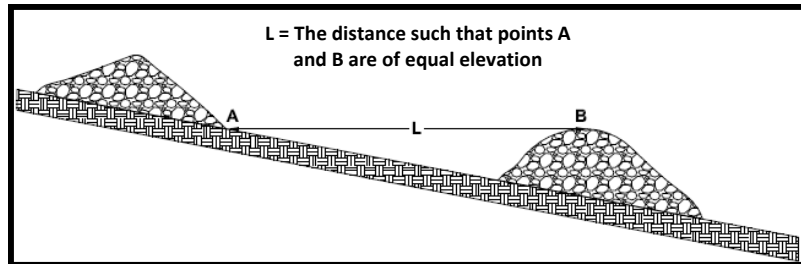
Material	Diameter (inches)
Logs	6 - 8
Rocks	2 - 4

Planning Considerations

- Construction materials (gravel, logs, rock, sandbags, and straw bales) vary in terms of effectiveness and maintenance needs.
- Check dams are ineffective as a stand alone practice for sediment trapping; they work best when used in conjunction with sediment control BMPs.
- For long channels, a series of check dams may be more effective.

Recommended Specifications

- Construction of check dams in flowing streams requires regulatory agency approval.
- When installing check dam series, the base of the upstream dam should be at the same elevation as the top of the downstream dam.



- Check dams should not be used in channels whose drainage area exceeds 10 acres.
- Check dams should have a minimum height of 3 feet.
- Center dam should be at least 6 inches lower than the channel edge.
- Check dam materials should be embedded into the sides and bottom of the channel for increased stability.

Maintenance

- Routine inspection and removal of fallen leaves and other debris that can clog the dam
- Routine inspection and repair of dam damage or erosion

BMPs

Runoff Conveyance



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.

BMPs

Runoff Conveyance

Recommended Specifications

- Once constructed, diversions should be immediately stabilized with vegetation, mulch, or other stabilization methods (see Surface Stabilization BMPs) 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.



Photo courtesy of USDA NRCS

Runoff Conveyance

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

Runoff Conveyance



POROUS PAVEMENT

Definition

Porous pavement is a permeable pavement surface resembling traditional pavement in appearance, but structurally different in consistency. Porous pavement is made primarily of coarse bulk materials with little to no filler material so that voids are created in the surface.

Purpose

To allow for storm water runoff from the pavement to gradually infiltrate into the subsoil, promoting groundwater recharge and reducing flooding

Applicability

As surfaces for low traffic loads, such as parking lots or bike/walking trails on the tops of levees

Planning Considerations

Though initial costs are higher than traditional pavement surfaces, budget planning may indicate overall decreases in total costs due to the elimination of any need for additional land-intensive BMPs. These savings should be apparent in decreases in overall land consumption.

Recommended Specifications

- Underlying soils should have a permeability of 0.5-3 inches/hour.
- Stone reservoir layer should be level and at an appropriate depth to allow the porous pavement surface to be 2-5 feet above groundwater table.
- Incorporation of an overflow trench around the pavement perimeter can help collect excess storm water runoff during large storm events.
- Stabilization of up-slope areas (see Surface Stabilization section for full BMP lists; vegetation is most appropriate) will prevent pore clogging.

BMPs

Runoff Conveyance



Photo courtesy of Alabama SWCC

Maintenance

- Needs to be inspected and vacuum swept regularly to avoid clogging which will decrease the effectiveness of this practice
- Maintenance of adjacent vegetation will help prevent clogging and reduce vacuum sweeping frequency



TIP

One potential cause for failure is that new owners may be unaware that there is a porous pavement surface on site. Disclosing this information to future property owners will help insure the success of this BMP.

BMPs

Sediment Control



CONSTRUCTION ENTRANCES



Photo courtesy of Providence

Definition/Purpose

The implementation of gravel and filter layers to trap sediment from exiting construction vehicle and equipment before it can be transported to public roads. Typical stabilization practice is a filter cloth underneath gravel padding.

Applicability

At any construction site exit routes where mud, dust, and other debris from construction areas can be transported onto off-site paved surfaces

Planning Considerations

- Filter cloths should always be used as the bottom-most layer to help keep gravel from being ground into the subsoil and to prevent ground rutting.
- Additional practices, such as wash rack installation, may also be necessary if construction entrance pads are insufficient at removing debris from the vehicles tires.



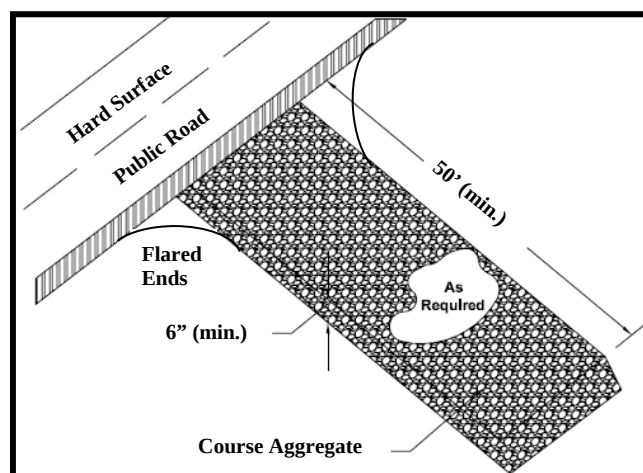
BMPs

Sediment Control

- Stabilization areas should be wide enough to support any construction vehicles entering/exiting the site.
- This practice is effective only if ALL construction exit points implement this practice.

Recommended Specifications

- When exits connect directly to a paved roadway, the end of the stabilization area should be flared so that as exiting vehicles turn onto the roadway, they do not leave the stabilized area.
- Minimum recommended dimensions are 50 feet in length and 20 feet in width, but vary based on vehicle size; entranceway lengths and widths should be appropriately sized so that two vehicles may simultaneously enter/exit a site and stay in contact with the prepared entrance pad.
- Gravel layer thickness should be at least 6 inches.
- Coordination with additional BMPs may be necessary to provide bank stabilization when a construction exit crosses a ditch or channel.



Maintenance

- Regular sweeping of gravel or soil that is tracked off site
- Periodic resituating or replacement of gravel to maintain stabilization and effectiveness

BMPs

Sediment Control



FIBER ROLLS



Photo courtesy of USDA NRCS

Definition/Purpose

Fiber rolls are erosion control devices made from natural materials such as straw, flax, rice, coconut fibers, or compost that are rolled into tubes and wrapped with bio- or UV-degradable netting.

Applicability

Sediment Control

- As a complement to permanent erosion control devices to further reduce the erosion effects associated with slopes
- To reduce the velocity, filter, and distribute overland flows allowing for increased soil infiltration and reduced sediment loading of receiving water
- In areas where the goal is not to redirect flow around a barricade, but to filter out sediment and allow runoff flow-through
- In contoured installations and along site perimeter areas due to their moldability
- In areas where landscape, mulching, seeding, and vegetative obstructions are not desired
- As check dams in channels, ditches, or swales

BMPs

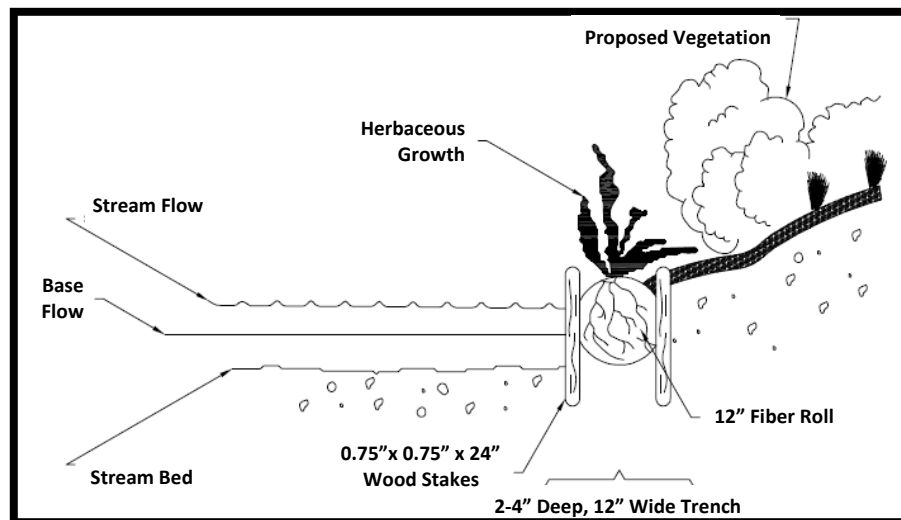
Sediment Control

Planning Considerations

- Trenching is strictly required prior to fiber roll placement.
- Fiber roll placement requires careful consideration because once rolls are saturated, they cannot be moved or relocated.
- Rolls should be designed so that the diameter is appropriately sized for slow flow. Steeper slopes require larger or multiple smaller rolls.

Recommended Specifications

- Trenches for fiber rolls should be 2-4 inches (minimum) deep with a width equal to roll diameter.
- Rolls should be staked at each end and every 4 feet (minimum) along the length of the roll. Stakes should be of nominal size 0.75x0.75 inch with a minimum length of 24 inches.



Maintenance

Fiber rolls have an anticipated life expectancy of three to five years before degradation and thus have very low maintenance requirements. However, replacement or repair may be necessary if the roll had become split or has begun to unravel or slump.

BMPs

Sediment Control



GRAVEL BAG AND SANDBAG BERM

Definition

Gravel and sand bag berms are constructed of gravel or sand filled bags that are placed on flat stream beds to intercept sheet flow and divert runoff.

Purpose

To prevent erosion and filter runoff

Applicability

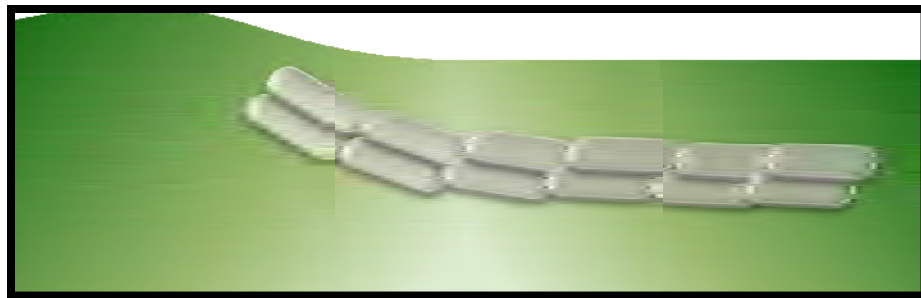
- Lining the bottoms of level contour streambeds of moderately concentrated flow channels (such as ditches or swales)
- Along the sides of ditches and channels
- Along site perimeters
- Parallel to roadways to reduce sediment transport to road surfaces
- As temporary channel crossings

Planning Considerations

- Bag installation and removal are time and labor intensive.
- Gravel bags are less of a containment issue in failure than sandbags, but both are susceptible to rupture and spillage.
- Gravel bags have a limited drainage area of five acres.
- Bag materials selection is important. Burlap should not be used for sandbags.

Recommended Specifications

- This is not intended as a stand-alone BMP. This practice should be used in conjunction with other sediment control practices.
- Plastic (polyethylene) bags are reusable. Burlap may not be reused.
- Sand bags should be filled $\frac{1}{2}$ to $\frac{3}{4}$ full.
- Gravel bags should contain gravel that is 4 to 8 inches in diameter.
- Bags should be staggered at the seams with the top of each bag tucked under itself.



Maintenance

Gravel and sandbags have limited durability and may need to be monitored and replaced. Maintenance requirements are greater for both in concentrated flow areas.

BMPs

Sediment Control



MULCH FILTER BERMS AND SOCKS



Photo courtesy of John Jacob and Baytown.org

Definition

Mulch filters socks are mulch-filled mesh fabric sacks. The mesh intercepts and detains storm water runoff allowing penetration into the mulch filter material facilitating the separation and removal of sediment.

Purpose

To prevent erosion and filter runoff

Applicability

Flexible and easy to move:

- Can be used on both flat and sloped roadway and bridge surfaces
- Can be used in place of silt fencing (easier to maintain than silt fencing)

Planning Considerations

- Mulch berms/socks are intended for use in areas that will not be reseeded.
- Mulch should be composed of high-carbon, woody material.
- Berms should be installed parallel to curbs to filter runoff before entering storm drains.

Recommended Specifications

- Most of the material used in the mulch filters must be less than 1 inch in diameter. All of the material must be less than 6 inches in diameter.
- This practice is most effective when the berms are 8 to 18 inches in diameter.
- Berms should have a minimum depth of 4 inches .
- Berms and socks can be used on slopes up to 2:1.

Maintenance

Sediment should be removed after reaching $\frac{1}{3}$ the height of the berm

BMPs

Sediment Control



PARKING LOT AND STREET SWEEPING



Photo courtesy of U.S. Geological Survey Wisconsin Water Science Center

Definition

Parking lot and street sweeping involves the collection and removal of various pollutants, including sediment, debris, trash, and trace metals, from roadways and parking lot surfaces.

Purpose

To reduce pollutant contribution to surface waters and catch basins, improve aesthetics, and control dust

Applicability

- Anywhere where sediment can be tracked and accumulated onto paved public or private roads
- Most feasible in cities and parishes where the municipality can budget for equipment purchase, maintenance, replacement, and staffing

Planning Considerations

- Purchase and maintenance costs can be high.
- Equipment may have reduced effectiveness on wet sediment/debris.
- Vacuum sweepers may be more effective at picking up both bulk and fine debris than mechanical broom sweepers, but they are more expensive.

Recommended Specifications

- This practice requires coordination with other BMPs for the removal of fine solid particulates.
- Sweeping frequency will depend on surface loading characteristics, loading rates, aesthetic requirements, and traffic considerations.

Maintenance

Street sweeping equipment has a minimum life span of about four years with proper equipment maintenance:

- Routine vehicle maintenance
- Adjustment, repair, and replacement of brooms as necessary

TIP

Implementation of this practice will reduce the maintenance requirements of other sediment control measures, such as surface drains, by reducing sediment loads.

BMPs

Sediment Control



ROCK FILTER BERM



Photo courtesy of Alabama SWCC

Definition/Purpose

A rock filter berm is a temporary gravel, stone, or crushed rock ridge that filters, redirects, and reduces the velocity of storm water runoff releasing the runoff as sheet flow.

Applicability

- On low-grade (<10%) slopes in vehicle paths
- On low-grade (<10%) slopes that are subject to frequent erosion

Planning Considerations

- Rock choices and overall berm design should consider the grade of the slope and the hydrologic, hydraulic, topographic, and sediment characteristics of the treatment area.
- Berm spacing depends on the steepness of the slope. The greater the slope, the closer the berms.
- Berms are difficult to remove.

Recommended Specifications

- Rock dams are suitable for drainage areas ≤ 5 acres.
- Dams require space considerations for water that is ponded at the berm.
- Rock filter berms act as a runoff filter, and should not be used as a diversion method.
- Maximum height of the dam should not exceed 12 inches.
- Please see next page (Page 39 - 'Sediment Basin and Rock Dams') for additional information and design specifics.

Maintenance

- Regular maintenance is required to clear any debris that may cause filter clogging.
- Regular inspection is necessary to remove sediment build-up on the berm or to check for berm deterioration.

BMPs

Sediment Control

T/P

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

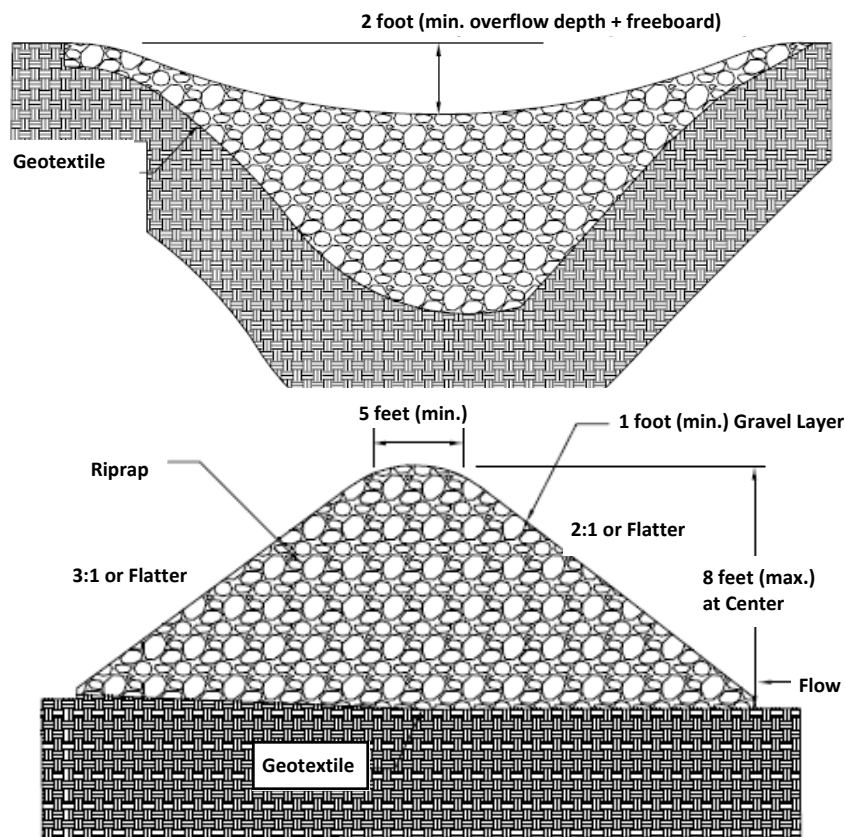
Professional engineering design is recommended for sediment basin/rock dam construction. If this practice is meant to be permanent, then professional engineering design is required.

BMPs

Sediment Control

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

Sediment Control



STRAW BALE SEDIMENT TRAP



Photo courtesy of Alabama SWCC

Definition/Purpose

Straw bale sediment trapping is the implementation of straw or hay bales as check dams, perimeter controls, or as inlet/outlet protectors.

Applicability

- To filter sediments in storm water runoff for small (<5 acres) drainage areas
- To trap sediment in runoff before it can be introduced to receiving waters or drainage systems
- To slow concentrated runoff velocity
- For short-term (<3 months) sediment trapping

Planning Considerations

- Straw bales have very low filtration and flow rates so it can be easy for runoff to overtop.

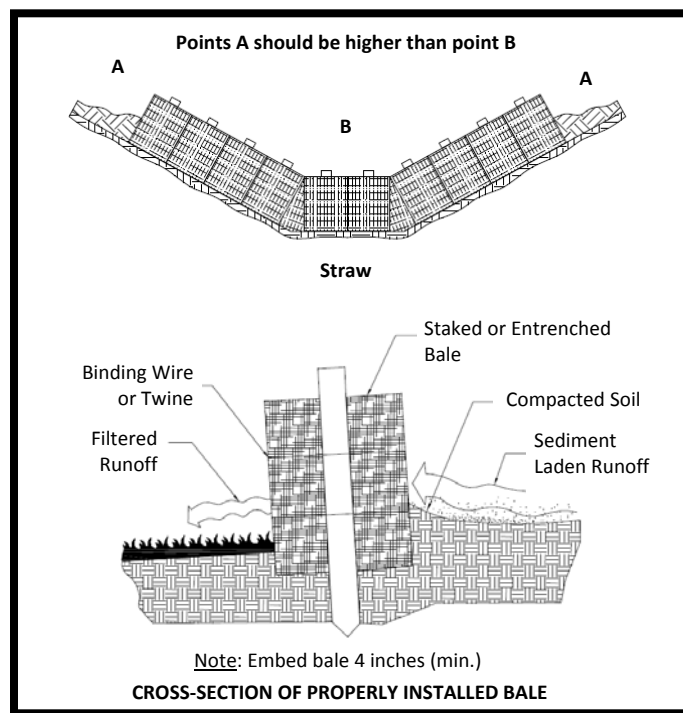
BMPs

Sediment Control

- This practice is ineffective for large storms events.
- Bales need to be stacked down even for low-flow, small storm events.
- Bales cannot be used in channels, streams, or ditches.
- Straw bales require careful handling to avoid breaking bindings.

Recommended Specifications

- Each bale should be secured with two stakes (hardwood or rebar; minimum length = 36 inches).
- Bale size recommendation is 14 inches x 18 inches x 36 inches (minimum).



Maintenance

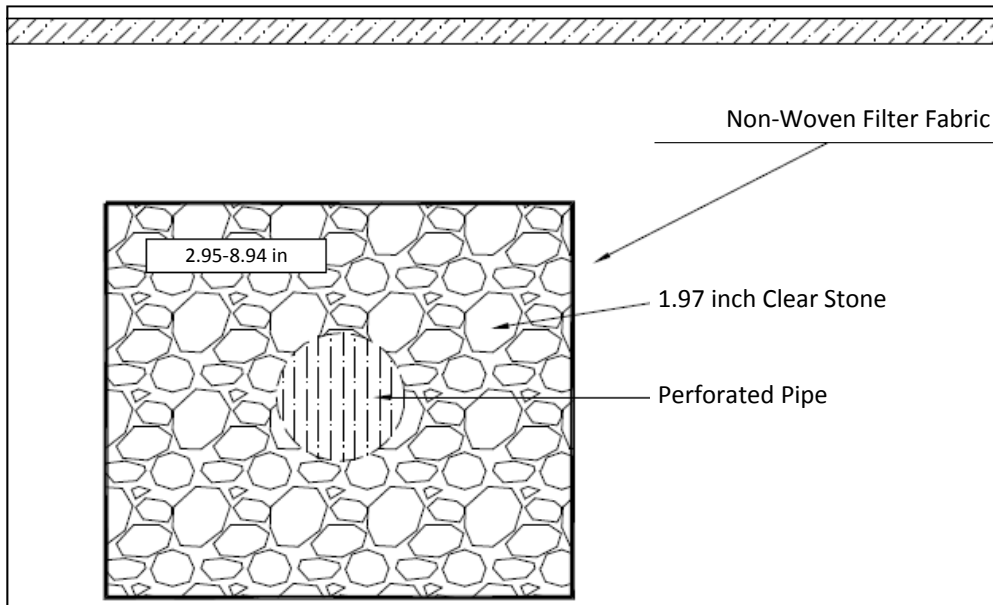
Need to be checked frequently to ensure bales are not rotting, falling apart, and are remaining immobilized

BMPs

Sediment Control



UNDERDRAIN AND STORM WATER FILTER SYSTEM



Definition

Porous conduit, pipe, or trench that is installed below a disturbed site to collect and convey storm water runoff after following infiltration. Incorporation of filters may also be used in areas where natural soil percolation is insufficient to remove pollutants.

Applicability

- In areas where soil characteristics restrict natural infiltration and percolation
- In areas where conveyance systems will help improve infiltration and pollutant removal rates

Planning Considerations

- A thorough analysis of the soil, subsoil, and groundwater should be done prior to installation.

BMPs

Sediment Control

- Installation should be done immediately after area is prepared (trenched).
- Filling with granular material to support pipe should be done immediately following installation.

Recommended Specifications

Materials

Underdrain pipes should be made of perforated:

- Plastic:
 - CPEPSW - Single wall corrugated polyethylene (AASHTO¹ M 252, Type C)
 - PVCP - Polyvinyl chloride (AASHTO M 278)
 - CPEPDW - Double wall corrugated polyethylene pipe (AASHTO M 252, Type S)
- Steel - bituminous coated (AASHTO M 190, Type A coating) corrugated steel (AASHTO M 36, Type III). Coating thickness should be 0.03 inches (minimum) Sheet thickness should be 0.064 inches (minimum).
- Corrugated aluminum (AASHTO M 196, Type III, Alloy 3004-H34). Sheet thickness (16 gauge) should be 0.060 inches (minimum).

Installation

- Drains should have a layer (3 inches, minimum) of granular fill material below the pipe.
- Drains should be surrounded by granular materials on sides and above (minimum 1 foot fill above). See Appendix C,II for specifics on granular fill materials.
- When geotextiles are used, fabric should overlap a minimum of 6 inches at the seams.
- Underdrain outlets should be 6 inches (minimum) above the bottom of the receiving channel or ditch.

Maintenance

Periodic inspection and cleaning to ensure no blockage of outlets

¹AASHTO=American Association of State Highway and Transportation Officials

BMPs

Sediment Control



VEGETATIVE 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



TIP

In many urban areas every square foot is valuable, therefore space needs to be portioned out to allow for installation of a filter strip of appropriate width. When this cannot be done, seeding or sodding may have to be used.

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 "Best Management Practices for Hydromodification Activities", LDEQ

Soil Type	Slope (%)	Surface Distance Draining Across Filter (feet)				
		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

Minimum effective filter strip widths

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

- See Appendix C,III (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



WET DETENTION PONDS



Photo courtesy of City of High Point Stormwater Services Division

Definition

Wet detention ponds are basins which collect and retain storm water runoff.



TIP

Detention ponds are used to catch and hold water, but have an outlet to allow for controlled outflow. By comparison, retention ponds maintain all water permanently (except evaporation losses) on site. In most cases, retention ponds may be substituted. However, they are generally more costly and have more significant maintenance requirements.

Purpose

To achieve sediment removal through the settling of particulates and pollutant and nutrient uptake

Applicability

In humid and moderate environments where conditions are favorable for sustaining a permanent pool

Planning Considerations

- Installation location should be carefully considered to avoid loss of forests or wetlands.
- Wet ponds can be designed to provide flood water storage and act as a flood control measure.

Recommended Specifications

- Wet ponds are compatible with large (25+ acres) drainage areas.
- Ponds can support runoff from slopes up to 15% (maximum).
- Pond bottoms should not intersect groundwater table.
- Incorporation of a sediment forebay (typically 10% of pond size) at design implementation can decrease future maintenance needs on larger pool area.
- Increasing pond length to width ratio, 1.5:1 (minimum), will help increase pond water treatment potential.
- More detailed information on a variety of other design variations that are available can be found through USEPA website (see page iii).

Maintenance

- Semi-annual inspection to ensure that biological activity is balanced
- Annual inspection and debris removal from pond inlets, pool, and forebay
- Occasional inspection for sediment build-up

Appendix A

BMP Quick Reference Listings

BMP Category Color Coding	
Site Preparation & Maintenance	Red
Surface Stabilization	Orange
Runoff Conveyance	Green
Sediment Control	Blue

Management Area Addressing	
PLANNING, SITING AND DEVELOPING ROADS AND HIGHWAYS	
Site Preparation & Maintenance	Red
Surface Stabilization	Orange
Sediment Control	Blue
BRIDGES	
Site Preparation & Maintenance	Red
Sediment Control	Blue
CONSTRUCTION PROJECTS	
Site Preparation and Maintenance	Red
Surface Stabilization	Orange
Runoff Conveyance	Green
Sediment Control	Blue
CONSTRUCITON SITE CHEMICAL CONTROL	
Site Preparation & Maintenance	Red
OPERATION AND MAINTENANCE	
Site Preparation & Maintenance	Red
Surface Stabilization	Orange
ROAD, HIGHWAY, AND BRIDGE RUNOFF SYSTEMS	
Site Preparation & Maintenance	Red
Runoff Conveyance	Green

Appendix A

BMP Quick Reference Listings

	Suggested BMP	Suggested Meeting Management Area
	Check Dam	Erosion control
	Construction Entrances	Sediment transport control
	Construction Roads	Surface stabilization
	Construction sequencing	Minimize sediment transport and soil disturbance
	Diversion	Groundwater/surface water contamination control
	Diversion Dike	Contamination control, sediment transport control
	Dust Control	Dust generation/transport control, sediment control
	Erosion Control Blanket	Soil stabilization, erosion control
	Fertilizer/Pesticide Control	Contamination control
	Fiber Rolls	Sediment transport control, erosion control
	Gravel/Sandbag Berm	Sediment transport control, erosion control
	Mulch Filter Berm	Sediment transport control, erosion control
	Outlet Protection	Erosion control, downstream erosion control
	Porous Pavement	Sediment trapping
	Road/Bridge Maintenance	Contamination, erosion, and sediment transport control
	Rock Filter Berm	Sediment transport control, erosion control
	Sediment Basin	Sediment transport control, sediment filtration
	Straw Bale Sediment Trap	Erosion and sediment control
	Street Sweeping	Contamination control, sediment transport control
	Subsurface Drain	Sediment filtration, groundwater recharge
	Top Soiling	Soil stabilization
	Underdrain/filter Systems	Sediment filtration, groundwater recharge
	Vegetated Filter Strips	Sediment control, sediment filtration
	Wet Detention Ponds	Flood control, channel protection, sediment filtrations

Appendix B

Recommended Improvement Examples

OUTLET PROTECTION

GOOD



BAD



CONSTRUCTION ROAD STABILIZATION

GOOD



BAD



Appendix B

Recommended Improvement Examples

Using more than one BMP in conjunction can lead to superior erosion control, pollution prevention, and stabilization. Examples are provided below.



Example 1

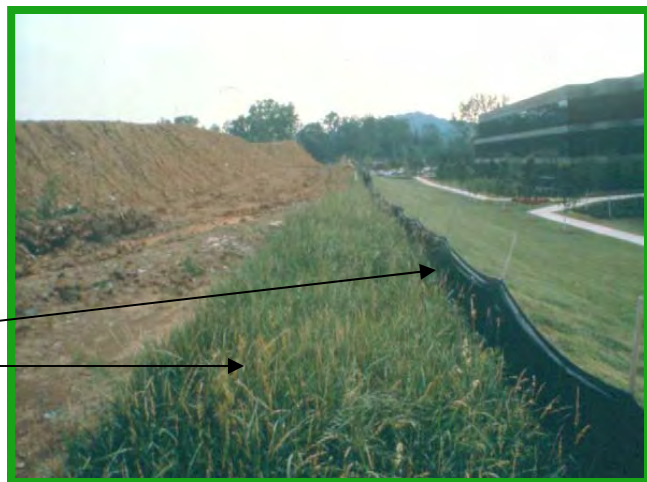
Combination of multiple BMPs has resulted in a well maintained pond.

BMPs in use:
Wet detention pond +
Rock dam +
Outlet protection

Example 2

Combination of multiple BMPs results in excellent sediment control and slope runoff filtration. BMPs in use:

Silt fence +
Vegetated filter strip



Appendix C

Material Specifications

I. 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

II. GRANULAR MATERIAL

Sizing:

Maximum Diameter, inches (mm)	U.S. Standard Sieve No.	Percentage of Granular Material
0.5 (12.7)	----	100
0.0787 (2)	# 10	75-100
0.0029 (0.075)	# 200	0-10

Table adapted from LDOTD Standard Specifications, 2006

Appendix C

Material Specifications

III. SEEDING

A. Preparative Requirements:

- Soil testing
- Tillage
- Debris/weed removal

Tillage Requirements	
Slope	Tillage Depth (min.)
0-3:1	4 in
3:1-1:1	2 in
1:1-∞	none

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

IV. 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

V. RIPRAP

A. General Requirements

- Sturdy, holds up to exposure to Louisiana environmental elements
- Reasonably pure, free from foreign materials
- Min. solid weight = 155 lb/cu³
- 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

Appendix C

Material Specifications

VI. 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 facing page

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.).

VII. 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 59.

C. Determine the size of pipe/culvert required:

See Tables **B** and **C** on page 60. 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

Acres Drained	Light Soils (example sands)			Moderate Soils (example loams)			Heavy Soils (example clays)		
	Flat (0-5 %)	Moderate (5-15%)	Steep (15+%)	Flat (0-5 %)	Moderate (5-15%)	Steep (15+%)	Flat (0-5 %)	Moderate (5-15%)	Steep (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						

Table adapted from LDEQ Forestry BMP Guide, 2001

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

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

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

Detention - Storm water management through the temporary holding and controlled release of runoff

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

Geotextile - A permeable textile of synthetic fibers

Hydraulic - Activated or powered by fluids.

Hydrocarbons - Hydrogen and carbon-based compounds (including oil and grease by-products)

GLOSSARY

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

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

Pathogens - Organisms and materials that can cause disease

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

Retention - The permanent storage of storm water

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

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)

GLOSSARY

Soil - The unconsolidated mineral and organic growth material on the immediate surface of the earth that serves as a natural medium for vegetative growth

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

Subsoil - The layers of soil directly beneath the uppermost (topsoil) layer. Typically provides structure and holds moisture but is devoid of any organic matter

Subsurface drain - A pervious backfilled trench usually containing stone and perforated pipe for intercepting groundwater

Surface runoff - see: *Runoff*

Swale - An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water

Topsoil - see *Soil*

Turbidity - A qualitative measurement of water quality, suspended solids that have not settled out contribute to the overall cloudiness (turbidity) of the water

Urban storm water - Runoff from developed and undeveloped urban areas that is discharged into coastal receiving waters

Water quality - A term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose