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Erosion Prevention BMPs

Use erosion prevention measures during and after construction site preparation in order to safely convey clean water to storm drains or adequate watercourses. One or more measures should be utilized as appropriate during the project's construction phase. Such measures may include but are not limited to: phasing and construction sequencing, surface roughening, temporary seeding, mulching, erosion control blankets, and reinforcement matting. Each of these measures is discussed in the Sections below.

In addition to site-specific erosion control measures, the grading plan includes the following general measures as a minimum:

- Vegetated finished cut and fill slopes should not be steeper than 3H:1V, unless an erosion control blanket or turf reinforcement mat is used.
- Do not place cuts or fills close to property, endangering adjoining property without adequately protecting such properties against erosion, sedimentation, slippage, settlement, subsidence, or other damages.
- Provide subsurface drainage in areas having a high water table to intercept seepage that affects slope stability, bearing strength, and undesirable wetness.
- Do not place fill material where it can slide or wash onto another property.
- Do not place fill adjacent to channel banks where it can create bank failure, reduce the capacity of the stream, or result in downstream sediment deposition.
- Include all borrow and disposal areas as part of the grading plan.

- Provide adequate channels and floodways to safely convey increased runoff from the developed area to an adequate outlet without causing significant channel degradation, or increased off-site flooding.
- Grade the site to direct flows to appropriate controls.

The following Erosion Prevention Measures are discussed in this handbook:

- Surface Roughening
- Temporary Seeding
- Mulching
- Erosion Control Blankets (ECBs)
- Turf Reinforcement Mats (TRMs)
- Flexible Growth Matrix (FGM)
- Bonded Fiber Matrix (BFM)
- Permanent Seeding
- Sodding
- Riprap
- Outlet Protection
- Dust Control
- Polyacrylamide (PAM)

Surface Roughening

Plan Symbol

Description

Surface roughening is the creation of horizontal grooves, depressions, or steps that run parallel to the contour of the land. The following surface roughening measures are approved for use:

- Tracking (driving a crawler tractor up and down a slope, leaving the cleat imprints parallel to the slope contour).
- Stair-step grading.
- Grooving (using disks, spring harrows, or teeth on the bucket of a front-end loader).

Tracking

Description

Tracking is defined as driving tracked machinery up and down slopes, leaving the cleat imprints parallel to the slope contour.

When and Where to Use It

To slow erosion, perform tracking as soon as possible after the vegetation has been removed from the slope. Use tracking with temporary seeding and temporary mulching to stabilize an area. Perform tracking immediately after grading activities have ceased (temporarily or permanently) in an area.

Installation

Avoid excessive compacting of the soil surface when tracking since soil compaction inhibits vegetation growth and causes higher runoff rates. As few passes as possible should be made with the machinery in order to minimize compaction.

Seed and mulch surface roughened areas by the means of tracking within 14 days.

Stair-Step Grading

Description

Stair-Step Grading is defined as cutting stair-steps into slopes with each step having a maximum horizontal distance of 4-feet and a maximum vertical distance of 4-feet.

When and Where to Use It

To slow erosion, perform stair step grading within 7 days after the removal of vegetation from the slope. Stair step grading is applicable on cut slopes with a gradient steeper than 3H:1V but less than 2H:1V. Stair-step grading is applicable on any material soft enough to be moved with a bulldozer. Stair-step grading works well with soils containing large amounts of small rock. Prepare stairs wide enough to work with standard earth moving equipment. Stair-step grading is used with seeding to stabilize an area.

Installation

The ratio of vertical cut distance to horizontal distance is steeper than 1V:1H and the horizontal portion of the "step" slopes towards the vertical wall.

Seed and stabilize areas graded in this manner within 14 days.

Grooving

Description

Slope Grooving is defined as using machinery to create a series of ridges and depressions that run perpendicular to the slope on the contour.

When and Where to Use It

To slow erosion, perform slope grooving within 7 days after the removal of vegetation from the slope.

Groove cut and fill slopes with a gradient steeper than 3H:1V but less than 2H:1V. Grooving is done by any implement that is safely operated on the slope.

Slope Grooving is used with seeding and planting to stabilize an area.

Installation

Install slope grooving with any appropriate implement that is safely operated on the slope not causing undue compaction. Suggested implements include discs, chisel plows, and the teeth on a front-end loader bucket. Install grooves a minimum of three inches deep and no further than 15 inches apart.

Seed and stabilize areas that are graded in this manner within 14 days.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- If rills (small watercourses that have steep sides and are usually only a few inches deep) appear, re-grade and re-seed immediately.

Surface Roughening (Tracking)

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Rills appear.	Re-grade and re-seed area immediately.

Temporary Seeding

Plan Symbol

Description

The purpose of temporary seeding is to reduce erosion and sedimentation by stabilizing disturbed areas that would otherwise lay bare for long periods of time before they are worked or stabilized. Temporary seeding is also used where permanent vegetation growth is not necessary or appropriate.

When and Where to Use It

Temporary seeding is used on exposed soil surfaces such as denuded areas, soil stockpiles, dikes, dams, banks of sediment basins, banks of sediment traps, and temporary road banks. Temporary seeding prevents and limits costly maintenance operations on other sediment control structures. Sediment clean-out requirements for sediment basins, sediment, traps, and silt fence is reduced if the drainage area is seeded when grading and construction operation are not taking place.

Temporary stabilization is required within 14 days after construction activity is complete **unless construction activity is going to resume within 21 days**. Cover seeded areas with an appropriate mulch to provide protection from the weather. When the temporary vegetation does not grow quickly or thick enough to prevent erosion, re-seed as soon as possible. Keep seeded areas adequately moist. Irrigate the seeded area if normal rainfall is not adequate for the germination and growth of seedlings. Water seeded areas at controlled rates that are less than the rate at which the soil can absorb water to prevent runoff. Runoff of irrigation water wastes water and can cause erosion.

Seed Selection

Seed selection is based on geographical location, soil type and the season of the year in which the planting is to be done. Use the tables in Appendix C as a guide for conventional tillage methods (plowing, seedbed preparation, hydroseeding, etc). If a fast growing crop to nurse the permanent specie or species is required, then use the mix rate. Failure to carefully follow agronomic recommendations results in an inadequate stand of temporary vegetation that provides little or no erosion control.

Installation

Tillage

If the area has been recently plowed, no tillage is required other than raking or surface roughening to break any crust that has formed leaving a textured surface. Disk the soil for optimal germination when the soil is compacted less than 6-inches.

Soil Testing

Soil testing is available through Clemson University Cooperative Extension Service.

Lime

Lime is not required for temporary seeding unless a soil test shows that the soil pH is below 5.0. It may be desirable to apply lime during the temporary seeding operation to benefit the long-term permanent seeding. Apply a minimum of 1.5 tons of Lime/acre (70 lbs./1000 ft^2) when used.

Fertilizer

Apply a minimum of 500 pounds per acre of 10-10-10 fertilizer (11.5 pounds per 1000 square feet) or equivalent during temporary seeding unless a soil test indicates a different requirement. Incorporate fertilizer and lime (if used) into the top 4-6 inches of the soil by disking or other means where conditions allow.

Seeding

Loosen the soil surface before broadcasting the seed. Apply seed evenly by the most convenient method available for the type of seed used and the location of the temporary seeding. Typical application methods include but are not limited to cyclone seeders, rotary spreaders, drop spreaders, broadcast spreaders, hand spreaders, cultipacker seeder, and hydro-seeders. Cover applied seed by raking or dragging a chain, and then lightly firm the area with a roller or cultipacker.

Mulching

Use mulch with temporary seed applications to retain soil moisture and reduce erosion during the establishment of vegetation. Typical mulch applications include straw, wood fiber, hydromulches, BFM and FGM. Use hydromulches with a minimum blend of 70% wood fibers.

The most commonly accepted mulch used in conjunction with temporary seeding is small grain straw. This straw should be dry and free from mold damage and noxious weeds. The straw may need to be anchored with netting or emulsions to prevent it from being blown or washed away. Apply the straw mulch by hand or machine at the rate 1.5-2 tons per acre (90 pounds per 1000 square feet). Frequent inspections are necessary to check that conditions for growth are good.

Irrigation

Seeded areas should be kept adequately moist. Irrigate the seeded area if normal rainfall is not adequate for the germination and growth of seedlings. Water seeded areas at controlled rates that are less than the rate at which the soil can absorb water to prevent runoff. Runoff of irrigation water wastes water and can cause erosion.

Re-seeding

Re-seed areas where seeding does not grow quickly, thick enough, or adequately to prevent erosion. Base seed selection should on the requirements of local Specifications.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- Cover seeded with mulch to provide protection. Frequent inspections are necessary to check that conditions for growth are good.
- Supply temporary seeding with adequate moisture. Supply water as needed, especially in abnormally hot or dry weather or on adverse sites. Control water application rates to prevent runoff.
- Base seed selection on local Specifications.
- Re-seed areas where the plants do not grow quick enough, thick enough, or adequately enough to prevent erosion should be re-seeded.

Temporary Slope Stabilization

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Slope was improperly dressed before application.	Roughen slopes. Furrow along the contour of areas to be seeded.
Coverage is inadequate.	Follow recommended application rates. Count the number of seedbags to ensure the correct amount of material is being applied. Reapply to thin areas.
Seeds fail to germinate.	Apply straw mulch to keep seeds in place and to moderate soil moisture and temperature. In arid areas, temporary irrigation may be necessary.
Seeded slope fails.	Fill in rills and re-seed; fertilize and mulch slopes.
Seeding is washed off slope.	Allow at least 24-hours for the materials to dry before a rain event. Follow manufacturer's recommendations. Reapply where necessary.
Excessive water flows across stabilized surface.	Use other BMPs to limit flow on stabilized area and to reduce slope lengths. Do not use to stabilize areas with swift moving concentrated flows.

Mulching

Plan Symbol

Description

Mulching is a temporary soil stabilization erosion control method where materials such as grass, hay, wood chips, wood fibers, or straw are placed on the soil surface. In addition to stabilizing soils, mulching can enhance the absorption of water by the soil, reduce evaporation losses, regulate soil temperatures and reduce the speed of storm water runoff over an area.

When and Where to Use It

Use erosion control mulching on level areas or on slopes up to 50 percent. Where soil is highly erodible, nets should only be used in connection with organic mulch such as straw and wood fiber.

Mulch is an effective ground cover when the establishment of vegetation is improbable due to severe weather conditions (winter conditions), poor soil, or steep slopes.

Installation

Grading is not necessary before mulching but may be required if vegetation is expected to grow.

Anchor loose hay or straw by applying tackifier, stapling netting over the top, or crimping with a mulch-crimping tool.

Effective use of netting and matting material requires firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

Materials that are heavy enough to stay in place (for example, bark or wood chips on flat slopes) do not need anchoring.

Apply hydro-mulch in spring, summer, or fall to prevent deterioration of mulch before vegetation becomes established.

There must be adequate coverage to prevent erosion, washout, and poor plant establishment. If an appropriate tacking agent is not applied, or is applied in insufficient amounts, mulch is lost to wind and runoff.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- Repair or replace damaged areas of mulch or tie-down material immediately.

Straw Mulching

Straw Mulch

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Mulch blows away.	Anchor straw mulch in place by applying a tackifier, crimping, punching, or track walking. May need to use a different BMP.
Coverage is inadequate.	Follow recommended application rates. Ensure that the correct amount of material is implemented. Reapply as necessary.
Mulch is washed away.	Do not place mulch in concentrated flow areas. Reapply as necessary.
Area was improperly dressed before application.	Remove existing vegetation and roughen embankment and fill areas by rolling with a punch type roller or by track walking.
Excessive water flows across stabilized surface.	Use other BMPs to limit flow onto stabilized area and/or to reduce slope lengths. Do not use to stabilize areas with swift moving concentrated flows.

Erosion Control Blankets (ECBs)

Plan Symbol

Description

Temporary erosion control blankets (ECBs) are products composed primarily of biologically, photochemically or otherwise degradable constituents such as wheat straw, coconut fiber, or aged curled excelsior wood product with longevity of approximately 1- to 3-years.

When and Where to Use It

Use ECBs for temporary stabilization of soil immediately following seeding until the vegetative cover has grown and becomes established. ECBs provide temporary protection by degrading over time as the vegetation becomes established. Some products are effective for a few months while others degrade slowly and are effective for up to 3-years.

ECB Categories

- Class A (Slope Applications Only)
- Class B (Channel Applications Only).

Class A ECBs are for **slope applications only**.

- Applicable for slopes **2H:1V or flatter** only. Slopes greater than 2H:1V require Turf Reinforcement Matting (TRM).

Class B ECBs are for **channel applications**.

- Use for channels and concentrated flow areas with a maximum calculated shear stress **less than 1.75 lb/ft^2**. Design shear stresses greater than 1.75 lb/ft^2 require TRM applications.

All acceptable Class A and Class B temporary erosion control blankets consisting of straw, coconut, or straw-coconut blends meet the following requirements:

- Use non-organic, photodegradable or biodegradable polypropylene netting.
- Consist of **double netted matting**, defined as matting with netting on both sides of the blanket. The top netting is degradable polypropylene with a maximum mesh opening of 0.75 inches by 0.75 inches. The bottom is degradable polypropylene with a maximum mesh opening of 0.5 inches by 0.5 inches.
- Be sewn on center a maximum of 2.0 inches

All acceptable Class A and Class B temporary erosion control blankets consisting of curled excelsior fibers meet the following requirements:

- Use non-organic, photodegradable or biodegradable polypropylene netting
- Consist of double netted matting. Double netted matting is matting with netting on both sides of the blanket. The degradable polypropylene top netting requires a maximum mesh opening of 1.0-inches by 1.0-inches. The degradable polypropylene bottom netting requires a maximum mesh opening of 1.0-inches by 1.0-inches
- Consist of curled excelsior interlocking fibers with 80% of the fibers a minimum of 6-inches long
- Sewn on center a maximum of 4.0-inches.

Use Class A and Class B temporary erosion control blankets having the following Minimum Average Roll Values (MARV) for physical properties, as derived from quality control testing performed by a Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) accredited laboratory:

- Minimum mass per unit area (ASTM D6475) of 6 oz/yd^2 (203 g/m^2)
- Minimum thickness (ASTM D6525) of 0.25-inches (6 mm)
- Minimum initial grab tensile strength (ASTM D6818) of 75x75 lb/ft. (1x1 kN/m)
- Minimum roll width of 48-inches (1.22 m)

- For Class B channel applications, a minimum unvegetated shear stress of 1.0 lb/ft^2 (48 N/m^2) based on short-term peak flow duration of 0.5 hour is required.

Installation

Grade and compact ECB protected areas as indicated on the plans.

Remove large rocks, soil clods, vegetation, and other sharp objects that could keep the ECB from intimate contact with subgrade.

Prepare seedbed by loosening 2 to 3 inches of soil above final grade.

Proper ECB installation is different for each product, therefore follow the recommended installation procedure from the specific manufacturer.

When requested, a Manufacturer's Representative may be required to be on-site to oversee and approve the initial installation of the ECB. When requested, a letter from the Manufacturer approving the contractor installation may be required.

Inspection and Maintenance

- Inspect areas protected by ECBs for dislocation or failure every 7 calendar days and within 24-hours after each storm that produces ½-inch or more of rain.
- Conduct regular inspections until grasses are firmly established.
- Adhere to the pinning or stapling pattern as shown on the Manufacturer's installation sheet.
- If there is evidence that the ECB is not securely fastened to the soil, require extra pins or staples to inhibit the ECB from becoming dislodged.
- If washout or breakage occurs, repair all damaged areas immediately by restoring the soil on slopes or channels to its finished grade, re-apply fertilizer and seed, and replacing the appropriate ECB material as needed.

ECB Slope Applications

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Undercutting occurs along the top of the slope.	Dig a 6-x 6-inch trench along the top of the slope and anchor blanket into trench by back filling and tamping the soil.
Blankets separate along the seams.	Overlap adjacent blanket 2- to 3-inch and staple every 3-feet.
Blankets separate where the rolls are attached end to end.	Shingle the blanket so the top blanket covers the bottom blanket by 6-inches and staple through the overlapped areas every 12-inches.
Blanket does not make complete contact with the soil surface.	Prepare the soil surface by removing rocks, clods, sticks and vegetation, fill in rill and uneven areas.
Excessive water flows across stabilized surface.	Use other BMPs to limit flow on stabilized area. Use other BMPs to reduce slope lengths. Do not use to stabilize areas with swift moving concentrated flows.

Turf Reinforcement Mats (TRMs)

Plan Symbol

Description

Turf Reinforcement Mats are products composed primarily of nondegradable products that enhance the ability of living plants to stabilize soils. They bind with roots to reinforce the soil matrix with longevity greater than 5-years.

When and Where to Use It

Use TRMs where vegetation alone will not hold a slope or streambank. TRMs enable the use of "green" solutions in areas where only "hard" solutions such as riprap or concrete linings were viable in the past.

TRM Categories

- Type 1, Type 2, Type 3 and Type 4.

Types 1 & 2 TRMs are a strong three-dimensional stable net structure. A degradable fiber matrix may be included to provide immediate coverage for bare soil.

- **Type 1** matting should be placed on slopes **2H:1V or flatter** or in channels where the calculated design shear stress is **4.0 lb/ft2 or less** and the design flow velocity is **up to 10 fps**.

- **Type 2** matting should be placed on slopes **1.5H:1V or flatter** or in channels where the calculated design shear stress is **6.0 lb/ft2 or less** and the design flow velocity is **up to 15 fps**.

- **Type 3** TRMs are a strong three-dimensional stable net structure providing sufficient thickness, strength, and void space to capture and retain soil and allow for the development of root growth and vegetation within the matrix. Matting of this type should be placed on slopes **1H:1V or flatter** or in channels where the calculated design shear stress is **8.0 lb/ft2 or less** and the design flow velocity is **up to 20 fps.**

- **Type 4** (High Survivability) TRMs are specially designed geosynthetics for erosion control applications on steep slopes and vegetated waterways.

- All components of Type 4 TRMs should be 100% synthetic and resistant to biological, chemical, and ultraviolet degradation.

- Matting of this type should be placed on slopes **1H:1V or greater** or in channels where the calculated design shear stress is **up to 12 lb/ft2** and the design flow velocity is **up to 25 fps**.

- This category is used when field conditions exist with high loading and/or high survivability requirements such as maintenance, structural backfills protecting critical structures, utility cuts, potential traffic areas, abrasion, higher factors of safety and/or general durability concerns.

All primary TRM matrix materials are defined as long-term, non-degradable materials designed to reduce soil erosion and assist in the growth, establishment, and protection of vegetation for a period of time exceeding 5 years.
The major structural components of Type 1 and Type 2 TRMs are 100% synthetic and resistant to biological, chemical, and ultraviolet degradation. A degradable fiber matrix may be included to provide immediate coverage for bare soil. All components of Type 3 and Type 4 TRMs are 100% synthetic and resistant to biological, chemical, and ultraviolet degradation.

Installation

Grade and compact areas to be protected with TRMs as indicated on the plans.

Remove large rocks, soil clods, vegetation, and other sharp objects that could keep the TRM from intimate contact with subgrade.

Prepare seedbed by loosening 2 to 3 inches of soil above final grade.

The proper installation of TRMs is different for each product, therefore the recommended installation procedure from the specific manufacturer should be followed.

When requested, a Manufacturer's Representative may be required to be on-site to oversee and approve the initial installation of the TRM. When requested, a letter from the Manufacturer approving the contractor installation may be required.

Inspection and Maintenance

- Check areas protected by TRMs for dislocation or failure every 7 calendar days and within 24-hours after each storm that produces ½-inch or more of rain.
- Conduct regular inspections until grasses are firmly established.
- Adhere to the pinning or stapling pattern as shown on the Manufacturer's installation sheet. If there is evidence that the TRM is not securely fastened to the soil, require extra pins or staples to inhibit the TRM from becoming dislodged.
- If washout or breakage occurs, repair all damaged areas immediately by restoring the soil on slopes or channels to its finished grade, re-apply fertilizer and seed, and replacing the appropriate TRM material as needed.

TRM Slope Application

TRM Channel Application

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Improper anchoring.	Dig trench along the top and bury the blankets. Use staples to anchor according to manufacturer's recommendations.
Undercutting due to inadequate preparation.	Prepare the soil surface. Remove rocks, clods and other obstructions. Fill in rills in uneven areas to promote good contact between mat and soil.
Excessive water flows across stabilized slope surface.	Use other BMPs to limit flow on stabilized area. Use other BMPs to reduce slope lengths. Do not use to stabilize areas with swift moving concentrated flows.

Flexible Growth Media/Matrix

Plan Symbol

Description

A Flexible Growth Matrix (FGM) combines both chemical and mechanical bonding techniques to lock the matrix in place. FGM is composed of crimped, manmade fibers, organic fibers, and performance-enhancing additives that form a lofty, interlocking matrix. FGM has air spaces and water-absorbing cavities that improve seed germination, reduce the impact of raindrop energy, and minimize soil loss. Water insoluble tackifiers and flocculants chemically bond the matrix to the soil surface.

When and Where to Use It

FGM is applicable for the following situations:

- As a Type A Temporary Erosion Control Blanket
- Slopes up to 2H:1V
- As an infill for TRMs on slopes greater than 2H:1V
- Environmentally sensitive areas not compatible for netting
- When the required longevity of soil protection is up to 1 year
- When the site requires immediate erosion protection and there is a risk of impending weather
- When fast vegetation establishment is required
- When a high factor of design safety is required.

FGM is **not** applicable as a channel liner or for areas receiving concentrated flow. Applicable FGM may be selected from the SCDOT approved products list.

Installation

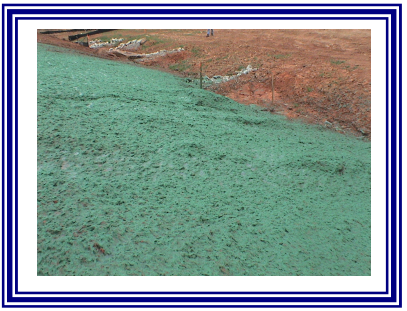
All FGM components are pre-packaged by the Manufacturer to assure material performance. Under no circumstances is field mixing of materials, additives or components accepted. Examine substrates and conditions where materials will be applied. Apply FGM to geotechnically stable slopes that have been designed and constructed to divert runoff away from the face of the slope. Do not proceed with installation until satisfactory conditions are established.

Install FGM with a contractor who is certified and trained by the Manufacturer in the proper procedures for mixing and applying the FGM. Strictly comply with the Manufacturer's mixing recommendations and installation instructions. Use approved hydraulic seeding/mulching machines with fan-type nozzle (50-degree tip) for FGM applications. Apply FGM from opposing directions to the soil surface in successive layers, reducing the "shadow effect" to achieve maximum coverage of all exposed soil. FGM does not require a cure time and is effective immediately such that FGM may be applied immediately before, during or after a rainfall event. Install FGM materials according to the Manufacturer's application rates.

Inspection and Maintenance

- Check areas protected by FGM for dislocation or failure every 7 calendar days and within 24-hours after each storm that produces ½-inch or more of rain.
- Reapply FGM to disturbed areas that require continued erosion control.
- Maintain equipment to provide uniform application rates. Rinse all mixing and application equipment thoroughly with water to avoid formation of residues and discharge rinse water appropriately.
- Degradation of FGM is expected to occur as a result of mechanical degradation, chemical and biological hydrolysis, sunlight, salt, and temperature. Reapply FGM in accordance with the Manufacturer's instructions. Reapplication is not required unless FGM treated soils are disturbed or turbidity or water quality shows the need for an additional application.

FGM Application



FGM

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Slope areas have eroded due to concentrated flows.	Make sure the upper end of the slope has a berm constructed to eliminate concentrated flows from flowing down the slope. Slope length may be to long and concentrated flows are occurring. Use sediment tubes or other practices to provide slope breaks. Re-apply FGM to the eroded areas once the concentration problem has been resolved.
Rain event is impending.	FGM does not require a cure time and is effective immediately such that FGM may be applied immediately before, during or after a rainfall event.
FGM has degraded.	FGM has longevity of soil protection up to 1 year. Reapply FGM in accordance with the Manufacturer instructions. Reapplication is not required unless FGM treated soils are disturbed or turbidity or water quality shows the need for an additional application.

Bonded Fiber Matrix (BFM)

Plan Symbol

Description

A Bonded Fiber Matrix (BFM) is a continuous layer of non-toxic, degradable, elongated fiber materials held together by water insoluble bonding agents. BFM eliminates direct raindrop impact on soil, allows no gaps between the product and the soil, and has a high water-holding capacity. BFMs do not form a water-insensitive crust that can inhibit plant growth. BFMs are completely photo- and biodegradable.

When and Where to Use It

BFMs are applicable when:

- Enhancement of temporary seeding operations to reduce erosion and expedite seed germination
- A high performance mulch is required for permanent seeding
- Seeding application will take place on highly erodible soil or slopes
- Slopes up to 1H:1V
- The required functional longevity of soil protection is 6 months or less
- The soil is dry and rain is not expected within 48 hours after application
- There is a high degree of certainty that heavy rains will not follow application.

BFMs are **not** applicable as Type A Temporary Erosion Control Blankets, channel liners or for areas receiving concentrated flow. Applicable BFM may be selected from the SCDHEC approved products list.

Installation

All BFM components are pre-packaged by the Manufacturer to assure material performance. Under no circumstances is field mixing of materials, additives or components accepted. Examine substrates and conditions where materials will be applied. Do not proceed with installation until unsatisfactory conditions are corrected. Apply BFM to geotechnically stable slopes that have been designed and built to divert runoff water away from the face of the slope.

Install BFM with a contractor who is certified and trained by the Manufacturer in the proper procedures for mixing and applying the BFM. Strictly comply with the Manufacturer's mixing recommendations and installation instructions. Use approved hydraulic seeding/mulching machines with fan-type nozzle (50-degree tip) for BFM applications. Apply BFM from opposing directions to the soil surface in successive layers, reducing the "shadow effect" to achieve maximum coverage of all exposed soil. Do not apply the BFM immediately before, during or after rainfall. Allow the BFM a minimum of 24 hours to dry after installation. Do not exceed maximum slope length of 100 feet when slope gradients are steeper than 4H:1V. Install BFMs at a general application rate of 3500 pounds per acre.

Inspection and Maintenance

- Check areas protected by BFM for dislocation or failure every 7 calendar days and within 24-hours after each storm that produces ½-inch or more of rain.
- Reapply BFM to disturbed areas that require continued erosion control.
- Maintain equipment to provide uniform application rates. Rinse all BFM mixing and application equipment thoroughly with water to avoid formation of residues and discharge rinse water appropriately.
- Degradation of BFM is expected to occur as a result of mechanical degradation, chemical and biological hydrolysis, sunlight, salt, and temperature.

- Reapply BFM in accordance with the Manufacturer's instructions when treated soils are disturbed or turbidity or water quality shows the need for an additional application

BFM Application

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Slope areas have eroded due to concentrated flows.	• Make sure the upper end of the slope has a berm constructed to eliminate concentrated flows from flowing down the slope. • Slope length may be to long and concentrated flows are occurring. Use sediment tubes or other practices to provide slope breaks. • Re-apply BFM to the eroded areas once the concentration problem has been resolved.
Rain event is impending.	BFM requires a cure time. Do not apply the BFM immediately before, during or after rainfall. Allow the BFM a minimum of 24 hours to dry after installation.
BFM has degraded.	BFM has longevity of soil protection up to 6-months. Reapply BFM in accordance with the Manufacturer instructions. Reapplication is not required unless BFM treated soils are disturbed or turbidity or water quality shows the need for an additional application.

Permanent Seeding

Plan Symbol

Description

Controlling runoff and preventing erosion by establishing a perennial vegetative cover with seed.

When and Where to Use It

A major consideration in the selection of the type of permanent grass to establish is the intended use of the land. Land use is separated in to two categories, high-maintenance and low-maintenance.

High-maintenance

High maintenance areas are mowed frequently, lime or fertilized on a regular basis, and require maintenance to an aesthetic standard. Land uses with high maintenance grasses include homes, industrial parks, schools, churches, and recreational areas such as parks, athletic fields, and golf courses.

Low-maintenance

Low maintenance areas are mowed infrequently, if at all, and lime and fertilizer may not be applied on a regular schedule. These areas are not subject to intense use and do not require a uniform appearance. The vegetation must be able to survive with little maintenance over long periods of time. Grass and legume mixtures are favored in these areas because legumes are capable of fixing nitrogen in the soil for their own use and the use of the grasses around them. Land uses requiring low-maintenance grasses include steep slopes, stream and channel banks, road banks, and commercial and industrial areas with limited access.

Seed Selection

The use of native species is preferred when selecting vegetation. Base plant seed selection on geographical location, the type of soil, the season of the year in which the planting is to be done, and the needs and desires of the permanent land user. Failure to carefully follow agronomic recommendations results in an inadequate stand of permanent vegetation that provides little or no erosion control.

Installation

Topsoil

Apply topsoil if the surface soil of the seedbed is not adequate for plant growth.

Tillage

If the area has been recently plowed, no tillage is required other than raking or surface roughening to break any crust that has formed leaving a textured surface. Disk the soil for optimal germination when the soil is compacted less than 6-inches. If the soil is compacted more than 6-inches, sub-soiled and disk the area.

Soil Testing

Soil testing is available through Clemson University Cooperative Extension Service.

Lime

Unless a specific soil test indicates otherwise, apply 1½ tons of ground course textured agricultural limestone per acre (70 lbs./1000 ft^2).

Fertilizer

Apply a minimum of 1000 pounds per acre of a complete 10-10-10 fertilizer (23 pounds per 1000 square feet) or equivalent during permanent seeding of grasses unless a soil test indicates a different requirement. Incorporate fertilizer and lime (if used) into the top 4-6 inches of the soil by disking or other means where conditions allow. Do not mix the lime and the fertilizer prior to the field application.

Seeding

Loosen the surface of the soil just before broadcasting the seed. Evenly apply seed by the most convenient method available for the type of seed applied and the location of the seeding. Typical application methods include but are not limited to cyclone seeders, rotary spreaders, drop spreaders, broadcast spreaders, hand spreaders, cultipacker seeder, and hydro-seeders. Cover applied seed by raking or dragging a chain or brush mat, and then lightly firm the area with a roller or cultipacker. Do not roll seed that is applied with a hydro-seeder and hydro-mulch.

Mulching

Cover all permanent seeded areas with mulch immediately upon completion of the seeding application to retain soil moisture and reduce erosion during establishment of vegetation. Apply the mulch evenly in such a manner that it provides a minimum of 75% coverage. Typical mulch applications include straw, wood fiber, hydromulches, BFM and FGM. Use hydromulches with a minimum blend of 70% wood fibers.

The most commonly accepted mulch used in conjunction with permanent seeding is small grain straw. Select straw that is dry and free from mold damage and noxious weeds. The straw may need to be anchored with netting or asphalt emulsions to prevent it from being blown or washed away. Apply straw mulch by hand or machine at the rate 2 tons per acre (90 pounds per 1000 square feet). Frequent inspections are necessary to check that conditions for growth are good.

Irrigation

Keep permanent seeded areas adequately moist, especially late in the specific growing season. Irrigate the seeded area if normal rainfall is not adequate for the germination and growth of seedlings. Water seeded areas at controlled rates that are less than the rate at which the soil can absorb water to prevent runoff. Runoff of irrigation water wastes water and can cause erosion.

Re-seeding

Inspect permanently seeded areas for failure, make necessary repairs and re-seed or overseed within the same growing season if possible. If the grass cover is sparse or patchy, re-evaluate the choice of grass and quantities of lime and fertilizer applied. Final stabilization by permanent seeding of the site requires that it be covered by a 70% coverage rate.

Inspection and Maintenance

- Inspect seeded areas for failure and make necessary repairs and re-seed immediately. Conduct a follow-up survey after one year and replace failed plants where necessary.
- If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.
- If a stand of permanent vegetation has less than 40 percent cover, re-evaluate choice of plant materials and quantities of lime and fertilizer.
- Re-establish the stand following seed bed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results.
- If the season prevents re-sowing, mulch is an effective temporary cover.
- Final stabilization of the site requires a 70 percent overall coverage rate. This does not mean that 30 percent of the site can remain bare. The coverage is defined as looking at a square yard of coverage, in which 70 percent of that square yard is covered with vegetation.

Permanent Seeding

Permanent Seeding

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Areas have eroded.	Reseed or replace eroded areas.
Vegetation cover is inadequate and rill erosion is occurring.	Overseed and fertilize in accordance with soil test results.
Stand of permanent vegetation has less than 40% cover.	Re-evaluate choice of plant materials and quantities of lime and fertilizer.
Vegetation show signs of wilting before noon.	Water vegetation by wetting soil to a depth of 4-inches.

Sodding

Plan Symbol

Description

Sodding is transplanting vegetative sections of plant materials to promptly stabilize areas that are subject to erosion. Use commercial sod which is a cultured product utilizing specific grass species.

When and Where to Use It

Sodding is appropriate for any graded or cleared area that may erode, and where a permanent, long-lived plant cover is immediately needed. Examples of where sodding is used are yards, buffer zones, streambanks, dikes, swales, slopes, outlets, level spreaders, and filter strips.

Installation

In general, do not use sod on slopes greater than 2H:1V or 3H:1V if it is to be mowed. If sod is placed on steep slopes, lay it with staggered joints and/or staple the sod down.

Clear the soil surface of trash, debris, roots, branches and soil clods in excess of 2-inches length or diameter. Rake soil surface to break crust just before laying sod or irrigate soil lightly if the soil is dry. Do not install sod on hot, dry or frozen soil, gravel, compacted clay, or pesticide treated soils.

Harvest, deliver and install sod within a period of 36-hours. Store rolls of sod in shade during installation. Sod should be free of weeds and be of uniform thickness, about 1-inch, and should have a dense root mat for mechanical strength.

Lay strips of sod beginning at the lowest area to be sodded with the longest dimension of the strip perpendicular to the slope, and stagger in a brick-like pattern. Wedge strips securely in place. Square the ends of each strip to provide for a close, tight fit. Match angled ends correctly to prevent voids.

Roll or compact immediately after installation to ensure firm contact with the underlying topsoil.

Irrigate the sod until the soil is wet to a depth of 2-inches, and keep moist until grass takes root.

Inspection and Maintenance

- Watering may be necessary after planting and during periods of intense heat and/or lack of rain (drought). Keep soil moist to a depth of 2-inches until sod is fully rooted.

- Mow to a height of 2 to 3 inches after sod is well-rooted (2-3 weeks). Do not remove more than 1/3 of the shoot in any one mowing.

- Permanent, fine turf areas require yearly applications of fertilizer and lime.

- Inspect the sod frequently after it is first installed, especially after large storm events, until it has established a permanent cover.

Sodding

Field Condition	Common Solutions
Drought	Keep soil moist to a depth of 2-inches until sod is fully rooted

Riprap

Plan Symbol

Description

Riprap is a permanent, erosion-resistant channel lining aggregate consisting of large, loose, angular stone with a filter fabric or granular underlining. The purpose of riprap is to:

- Protect the soil from the erosive force of concentrated runoff
- Slow runoff velocities while enhancing the potential for infiltration

The filter fabric or granular underlining prevents undermining of the riprap layer by the migration of soil particles under seepage forces through the riprap.

When and Where to Use It

The preferred method of slope and channel protection is the use of vegetation. If vegetation can not withstand the design flows, ECBs and TRMs are the preferred and suggested method of protection. When conditions are too severe for vegetation and TRMs, riprap may be used for erosion control and protection. Riprap is used, as appropriate, at storm drain outlets, on channel banks and/or bottoms, drop structures, at the toe of slopes, and in transitions from concrete channels to vegetated channels. Riprap sizes are designed by the diameter or by the weight of the stones. It is often misleading to think of riprap in terms of diameter, since the stones should be angular instead of spherical.

Installation

Place a lining of geotextile filter fabric or granular filter material between the riprap and the underlying soil surface to prevent soil movement into or through the riprap.

Inspection and Maintenance

- Once a riprap installation has been completed, it should require very little maintenance.
- It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap and filter fabric or dislodged any of the stone.
- Care must be taken to properly control sediment-laden construction runoff that may drain to the point of the new installation. If repairs are needed, they should be performed immediately.

Riprap Lined Channel

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
High flows causing scour beneath riprap or filter fabric dislodging the stone.	Replace filter fabric and rearrange stone appropriately.
Riprap blocks channel, causing erosion along edges.	Make sure excavation is deep enough, rearrange riprap appropriately.
Piping or slumping occurs.	Make sure filter fabric was installed and make sure it isn't damaged.
Stones have moved and erosion of foundation has occurred.	Make sure riprap is properly graded.
Undercut riprap slope and slumping occurring.	Check to be sure that foundation toe is properly reinforced.
Stone displacement occurring.	Make sure fill slopes have been properly compacted, remove debris and make needed repairs.

Outlet Protection

Plan Symbol

Description

Outlet protection dissipates the energy of concentrated storm water flows reducing erosion or scouring at storm water outlets. In addition, outlet protection lowers the potential for downstream erosion. Outlet protection is achieved through a variety of techniques, including turf reinforcement mats (TRMs), riprap, concrete aprons, paved sections and other structural measures.

The techniques outlined in this section are not the only techniques that may be used for outlet protection design. This section shows one method for outlet protection design as an example of the variables that need to be considered in the design. Other methods utilized that are not discussed in this Handbook should include all graphs, charts, and calculations verifying that the protection will handle the peak flow velocity, flow depths, and shear stress.

Installation

- Do not protect pipe or channel outlets at the top of cut slopes or on slopes steeper than 10% with only outlet protection. This causes re-concentration of the flow resulting in increased velocities when the flow leaves the protection area.
- Follow specific standards for installation of the selected materials used for outlet protection.
- Follow all Manufacturer's installation procedures for TRMs and other manufactured products.

- A Manufacturer's Representative may be required to oversee all installation procedures and officially approve the installation of manufactured products used for outlet protection.

Inspection and Maintenance

- Periodically check all outlet protection, aprons, plunge pools, and structural outlets for damage. Immediately make all needed repairs to prevent further damage.
- If any evidence of erosion or scouring is apparent, modify the design as needed to provide long term protection (keeping in mind fish passage requirements if applicable).
- Inspect outlet structures after heavy rains to see if any erosion has taken place around or below the structure.

The table below provides general information for sizing rock and outlet aprons for various sized pipes.

Culvert Size (inches)	Average Rock Diameter (inches)	Apron Width at the narrow end (feet)	Apron Length for slow flow (feet)	Apron Length for high flow (feet)
8"	3"	2-3 ft	3-5 ft	5-7 ft
12"	5"	3-4 ft	4-6 ft	8-12 ft
18"	8"	4-6 ft	6-8 ft	12-18 ft
24"	10"	6-8 ft	8-12 ft	18-22 ft
30"	12"	8-10 ft	12-14 ft	22-28 ft
36"	14"	10-12 ft	14-16 ft	28-32 ft
42"	16"	12-14 ft	16-18 ft	32-38 ft
48"	20"	14-16 ft	18-25 ft	38-44 ft

Riprap Outlet Protection

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Riprap washes away.	Replace riprap with a larger diameter based on the pipe diameter and discharge velocity.
Apron is displaced.	Align apron with receiving water and keep it straight throughout its length. Repair damaged fabric and replace riprap that has washed away.
Scour occurs around apron or riprap.	Remove damaged TRM or riprap, fill in scoured areas, and repair damage to slopes channels or underlying filter fabric. Reinstall outlet protection.
Outlet erodes.	Stabilize TRM outlets with vegetation, replace eroded riprap; grout riprap.

Dust Control

Plan Symbol

Description

Wind erosion occurs when the surface soil is loose and dry, vegetation is sparse or absent, the wind is sufficiently strong, and when construction traffic disturbs the soil. Wind erodes soils and transports the sediment off site in the form of fugitive dust, where it may be washed into receiving water bodies by the next rainfall event. Fugitive dust is a nuisance for neighbors. It settles on automobiles, structures and windows and finds its way into homes. It also makes breathing difficult for those with respiratory problems and becomes a safety problem when it blinds motorists, equipment operators, and laborers.

When and Where to Use It

Utilize dust control methods whenever there are offsite impacts, especially during periods of drought. Implemented dust control until final stabilization is reached.

Inspection and Maintenance

- Add additional dust control or re-spray area as necessary to keep dust to a minimum.
- Spray exposed soil areas only with approved dust control agents as indicated by the SCDHEC Standard Specifications.

Dust Control with Water

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive dust leaves the site.	Increase frequency of dust control application. Consider using a palliative or binder on inactive areas.
Vehicles kick up dust.	Water more frequently. Limit vehicle speeds. Stabilize the roadway.
Watering for dust control causes erosion.	Reduce water pressure on the water truck. Check watering equipment to ensure that it has a positive shutoff. Water less frequently.
Sprayed areas are ineffective at limiting dust.	Re-spray areas and ensure that the application rate is proper. Try another product or method if current dust control is not effective.

Polyacrylamides (PAMs)

Plan Symbol

Description

Anionic polyacrylamides (PAM) are non-toxic chemical materials used for controlling soil erosion and sedimentation on construction and agricultural sites.

When and Where to Use It

Anionic PAM is available in emulsions, powders, gel bars, or logs. Use other BMPs in combination with anionic PAM. The use of seed and mulch for additional erosion protection beyond the life of the anionic PAM is required. Repeat application is recommended if disturbance occurs to target areas. The following are additional recommendations:

- Use setbacks when applying anionic PAM near natural waterbodies.
- Consider that decreased performance can occur due to ultra-violet light and time after mixing when applying anionic PAM.
- In concentration channels, the effectiveness of anionic PAM for stabilization decreases.
- If seed is applied with anionic PAM, use mulch to protect seed.
- Never add water to PAM, PAM must be slowly added to water.
- NOT ALL POLYMERS ARE PAM.

Installation

The manufacturer's guidelines for application should be followed.

- Only use the anionic form of PAM. Cationic PAM is toxic and should NOT be used.
- PAM and PAM mixtures have to be environmentally harmless, harmless to fish, wildlife, and plants.
- Use pure form of anionic PAM with less than or equal 0.05 percent acrylamide monomer by weight, established by FDA and EPA.

- To maintain less than or equal 0.05 percent of acrylamide monomer, the maximum application rate of PAM, in pure form, should not exceed 200 pounds/acre/year. Do not over apply.
- Users of anionic PAM should obtain and follow all MSDS requirements and manufacturer's recommendations.
- Additives such as fertilizers, solubility promoters or inhibitors to PAM should be non-toxic.
- To prevent exceeding the acrylamide monomer limit in the event of a spill, the pure form of anionic PAM should not exceed 200 pounds/batch at 0.05 percent acrylamide monomer (AMD) or 400 pounds/batch at 0.025 percent AMD.

Inspection and Maintenance

- PAMs have been estimated to degrade approximately 10 percent per year. The effects are accelerated in highly exposed areas.
- If PAM treated soil is left undisturbed, reapplication may be necessary after 6-8 weeks.
- Further anionic PAM applications may be required for disturbed areas including highly silty and clayey soils, steep slopes, long grades, and high traffic or precipitation areas.
- All equipment should be maintained to provide the application rates recommended by the manufacturer.
- Rinse all equipment used to mix and apply anionic PAM thoroughly with water.

Liquid PAM

Solid/Block PAM

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Slope was improperly dressed before application.	Roughen slope and fill damaged areas.
Coverage is inadequate.	Follow recommended application rates. Reapply to thin areas.
Sprayed areas degrade or become ineffective.	Follow recommended application rates. Consider other or additional BMPs. Reapply as necessary.
Sprayed slope has spot failures.	Repair slopes, add jute netting and re-spray damaged areas.
Portions of the sprayed area have been disturbed.	Keep workers and equipment off sprayed areas. Repair and re-spray areas that have been damaged.
PAM is washed off slope.	Allow at least 24 hours for the materials to dry before a rain event. Follow manufacturer's recommendations. Reapply as necessary.
Excessive water flows across stabilized surface.	Use other BMPs to limit flow on stabilized area. Use other BMPs to reduce slope lengths. Do not use to stabilize slopes with swift moving concentrated flows.

Sediment Control

Uncontrolled runoff from construction sites is a water quality concern because of the devastating effects that sedimentation can have on local waterbodies, particularly small streams. Numerous studies have shown that the amount of sediment transported by storm water runoff from construction sites with no controls is significantly greater than from sites with controls. In addition to sediment, construction activities yield pollutants such as pesticides, petroleum products, construction chemicals, solvents, asphalts, and acids that can contaminate storm water runoff. During storms, construction sites may be the source of sediment-laden runoff, which can overwhelm a small stream channel's capacity, resulting in streambed scour, streambank erosion, and destruction of near stream vegetative cover. Where left uncontrolled, sediment-laden runoff has been shown to result in the loss of in-stream habitats for fish and other aquatic species, an increased difficulty in filtering drinking water, the loss of drinking water reservoir storage capacity, and negative impacts on the navigational capacity of waterways.

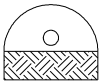
Polluted storm water runoff from construction sites often flows to MS4s and ultimately is discharged into local rivers and streams. Sediment is usually the main pollutant of concern. Sediment runoff rates from construction sites are typically 10 to 20 times greater than those of agricultural lands, and 1,000 to 2,000 times greater than those of forest lands. During a short period of time, construction sites can contribute more sediment to streams than can be deposited naturally during several decades. The resulting siltation, and the contribution of other pollutants from construction sites, can cause physical, chemical, and biological harm to our nation's waters. For example, excess sediment can quickly fill rivers and lakes, requiring dredging and destroying aquatic habitats.

There are numerous methods available to assist in the control of sediment. The following sediment control BMPs are discussed in this handbook:

- Temporary Sediment Basin
- Temporary Sediment Trap
- Silt Fence
- Rock Check Dams
- Sediment Tubes
- Stabilized Construction Entrances
- Inlet Protection
- Rock Sediment Dikes

Sediment Basin

Plan Symbol



Description

A Sediment Basin collects and traps sediment laden runoff from disturbed areas and slows down the flow so that soil particles fall from suspension and deposit in the basin. Drop inlet spillways, pipe spillways, rock fill outlets and weir spillways may be used for the design of the principal spillway.

When and Where to Use It

Temporary sediment basins are required on sites where 10 or more acres are disturbed and drain to a single point. A temporary sediment basin should not be built in wetlands, any active or live streams, ephemeral stream, or in Waters of State (defined to be all annual or perennial water bodies designated by a solid or dashed blue-line on USGS 7.5-minute quadrangle maps). Utilize temporary sediment basins until the contributing flow areas to the basin have undergone final stabilization.

Inspection and Maintenance

The key to a functional sediment basin is continual monitoring, regular maintenance and regular sediment removal. Attention to sediment accumulations within the pond is extremely important. Continually monitor sediment deposition in the basin.

- Remove sediment when it reaches 50 percent of storage volume or reaches the top of the designed cleanout stake where applicable.
- Remove all temporary sediment basins within 30 days after final site stabilization is achieved or after it is no longer needed.
- Remove trapped sediment from the site, or stabilize on site.
- Permanently stabilize disturbed areas resulting from the removal of the sediment basin

Sediment Basin

Sediment Basin Perforated Riser

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Outlet pipe is clogged with the debris.	Clean outlet pipe. Install a trash rack around pipe to hold back larger debris particles.
Spillway erodes due to high velocity flows.	Stabilize outlet with an ECB, TRM or riprap.
Side Slope eroding.	Stabilize slopes with vegetation, ECB, TRM, riprap or equivalent method.
Excessive accumulated sediment buildup.	Remove sediment to maintain the sediment storage capacity.
The upstream drainage area is too large.	Limit the contributing drainage area or expand basin. Ensure drainage area does not exceed recommended acreage. If the drainage area does exceed this limit, install diversion ditches and add additional BMPs to accommodate the diverted flow.

Sediment Trap

Plan Symbol

Description

A sediment trap is formed by excavating a pond or by placing an earthen embankment across a low area or drainage swale. The outlet should be a rock fill weir/spillway section, with the area below the weir acting as a filter for sediment and the upper area as the overflow spillway depth. The trap retains the runoff long enough to allow most of the silt to settle out. Design sediment traps to have an 80 percent design removal efficiency goal of the total suspended solids (TSS) in the inflow.

When and Where to Use It

Temporary sediment traps should not be placed in Waters of the State or USGS blue-line streams (unless approved by SCDHEC, State, or Federal authorities).

Installation

Install a non-woven geotextile filter fabric before installing the stone for the outlet structure. Allow the stone to extend downstream past the toe of the embankment. Mark the sediment cleanout level of trap with a stake in the field. Seed and mulch all disturbed areas.

Inspection and Maintenance

The key to a functional sediment trap is continual monitoring, regular maintenance and regular sediment removal.

- Remove sediment when it reaches 50 percent of storage volume or top of cleanout stake.
- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- Remove within 30 days after final stabilization or after it is no longer needed.
- Remove trapped sediment from the site, or stabilized on site.
- Permanently stabilized disturbed areas resulting from trap removal.

Sediment Trap

Sediment Trap

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Outlet spillway is clogged with the debris.	Remove debris by lightly raking debris from upstream side of spillway. If debris is excessive, remove smaller filter stone on upstream side of spillway and replace with new clean stone.
Spillway erodes due to high velocity flows.	Stabilize outlet with larger riprap on downstream side of spillway.
Side Slope eroding.	Stabilize slopes with vegetation, ECB, TRM, riprap or equivalent method.
Excessive accumulated sediment buildup.	Remove sediment to maintain sediment storage capacity.
Drainage area is too large.	Limit contributing drainage area by installing diversion ditches and adding additional BMPs to accommodate diverted flow.

Silt Fence

Plan Symbol

Description

Silt fence is used as a temporary perimeter control around sites where there will be soil disturbance due to construction activities. Silt fence consists of geotextile fabric stretched across steel posts. The lower edge of the fence is vertically trenched into the ground and covered by compacted backfill.

When and Where to Use It

Silt fence is applicable in areas:

- Where the maximum sheet or overland flow path length to the fence is 100-feet.
- Where the maximum slope steepness (normal [perpendicular] to fence line) is 2H:1V.
- That do not receive concentrated flows greater than 0.5 cfs.
- ¼ acre drainage per 100

Do not place silt fence across channels or use it as a velocity control BMP.

Materials

Steel Posts

Use 48-inch long steel posts that meet the following minimum physical requirements:

- Composed of high strength steel with minimum yield strength of 50,000 psi.
- Have a standard "T" section with a nominal face width of 1.38-inches and nominal "T" length of 1.48-inches.
- Weigh 1.25 pounds per foot (± 8%).

- Have a soil stabilization plate with a minimum cross section area of 17-square inches attached to the steel posts.
- Painted with a water based baked enamel paint.

Use steel posts with a minimum length of 4-feet, weighing 1.25 pounds per linear foot (± 8%) with projections to aid in fastening the fabric. Except when heavy clay soils are present on site, steel posts will have a metal soil stabilization plate welded near the bottom such that when the post is driven to the proper depth, the plate will be below the ground level for added stability. The soil plates should have the following characteristics:

- Be composed of minimum 15 gauge steel.
- Have a minimum cross section area of 17-square inches.

Geotextile Filter Fabric

Filter fabric is:

- Composed of fibers consisting of long chain synthetic polymers composed of at least 85% by weight of polyolefins, polyesters, or polyamides.
- Formed into a network such that the filaments or yarns retain dimensional stability relative to each other.
- Free of any treatment or coating which might adversely alter its physical properties after installation.
- Free of defects or flaws that significantly affect its physical and/or filtering properties.
- Cut to a minimum width of 36 inches.

Use only fabric appearing on SCDOT Approval Sheet #34 meeting the requirements of the most current edition of the SCDOT Standard Specifications for Highway Construction.

Installation

Leave 10 feet between silt fence and creek or wetland.

Excavate a trench approximately 6-inches wide and 6-inches deep when placing fabric by hand. Place 12-inches of geotextile fabric into the 6-inch deep trench, extending the remaining 6-inches towards the upslope side of the trench. Backfill the trench with soil or gravel and compact.

Bury 12-inches of fabric into the ground when pneumatically installing silt fence with a slicing method.

Purchase fabric in continuous rolls and cut to the length of the barrier to avoid joints. When joints are necessary, wrap the fabric together at a support post with both ends fastened to the post, with a 6-inch minimum overlap.

Install steel posts to a minimum depth of 24-inches. Install steel posts a minimum of 1- to 2- inches above the fabric, with no more than 3-feet of the post above the ground. Space posts to maximum 6-feet centers.

Attach fabric to the steel posts using heavy-duty plastic ties that are evenly spaced and placed in a manner to prevent sagging or tearing of the fabric. In call cases, ties should be affixed in no less than 4 places.

Install the fabric a minimum of 24-inches above the ground. When necessary, the height of the fence above ground may be greater than 24-inches. In tidal areas, extra silt fence height may be required. The post height will be twice the exposed post height. Post spacing will remain the same and extra height fabric will be 4-, 5-, or 6-feet tall.

Locate silt fence checks every 100 feet maximum and at low points.

Install the fence perpendicular to the direction of flow and place the fence the proper distance from the toe of steep slopes to provide sediment storage and access for maintenance and cleanout.

Height of Fill (ft)	Slope of Feet	Minimum silt fence offset from toe of slope (ft)	Minimum right of way offset from toe of slope (ft)
<6	2:1 4:1 6:1	2	3
6-10	2:1 4:1 6:1	12* 3	13* 4
>10	2:1 4:1 6:1	1* 4	13* 5

- These minimum offsets may be reduced when curb and gutter or some other feature reduces the flow of water down the slope. The smaller offsets of each group of height of fill can not be reduced.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation. Check for sediment buildup and fence integrity. Check where runoff has eroded a channel beneath the fence, or where the fence has sagged or collapsed by fence overtopping.
- If the fence fabric tears, begins to decompose, or in any way becomes ineffective, replace the section of fence immediately.
- Remove sediment accumulated along the fence when it reaches 1/3 the height of the fence, especially if heavy rains are expected.
- Remove trapped sediment from the site or stabilize it on site.
- Remove silt fence within 30 days after final stabilization is achieved or after temporary best management practices (BMPs) are no longer needed.
- Permanently stabilize disturbed areas resulting from fence removal.

Silt Fence

Silt Fence

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive sediment accumulation.	Remove sediment. Apply hydraulic mulch or straw mulch or other BMPs upstream to reduce eroded sediment.
Bottom of fence is not properly keyed in.	Dig trench, place fabric, and backfill.
Length of slope draining to silt fence is too long.	Shorten slope length using diversion ditches, additional silt fence runs, or other BMPs.
Storage capacity is inadequate due to sediment buildup.	Remove accumulated sediment when it reaches 1/3 the height of the barrier.
There is a lack of sufficient ponding area.	Fence should be installed with at least a 5-foot setback from the toe of the slope where possible. Divert flow at top of slope with diversion ditches.
Erosion occurs around barrier ends.	Turn ends of barriers into the up-slope area every 100 feet.

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Silt fence is not installed along level contour.	Reinstall silt fence so that change in elevation does not exceed 1/3 the fabric height along the reach.
Slope draining to fence is too steep.	Shorten slope length using fiber rolls or equivalent. Increase setback of silt fence from the toe of slope.
Fence is installed in concentrated flow area.	Replace fence with proper BMP such as check dams, if appropriate.
Tie backs or j-hooks not installed or installed incorrectly.	Place Tie backs or j-hooks at a maximum separation of 100-feet.
Stakes are too far apart.	Add stakes a maximum of 6-feet apart.
Concentrated flows causing erosion.	Place cross barrier check dams behind the silt fence.

Rock Check Dam

Plan Symbol

Description

A rock check dam is a small, temporary or permanent rock fill dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows. Design rock check dams to have an 80 percent design removal efficiency goal of the total suspended solids (TSS) in the inflow.

When and Where to Use It

Install rock check dams in steeply sloped swales, or in swales where adequate vegetation can not be established. Use rock check dams in small open channels. Do not place check dams in Waters of the State or USGS blue-line streams (unless approved by SCDHEC, State, or Federal authorities).

Installation

Install the center section of the rock check lower than the edges.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- Inspect for sediment and debris accumulation.
- Inspect rock check dam edges for erosion and repair promptly as required.
- Remove sediment when it reaches 1/3 the original check height.
- In the case of grass-lined ditches and swales, remove rock check dams when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent.

- After construction is complete, remove stone if vegetation is used for permanent stabilization.
- Seed and mulch the area beneath the rock ditch checks immediately after dam removal.

Rock Check Dam

Rock Check Dam

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Too much sediment has accumulated.	Remove accumulated sediment to recover holding capacity.
There is insufficient ponding area.	Space check dams farther apart. Increase height of dam.
The check dam is higher than the drainage channel.	Lower check dam so that it is 6 inches lower than the channel side.
Check dams wash away.	Use larger stone for the body of the check dam. Decrease check dam spacing by adding more dams.
Wrong type of materials is used to construct check dam.	Use larger stones. Do not use straw bales or silt fence for checks.

Sediment Tubes

Plan Symbol

Description

Sediment tubes are elongated tubes of compacted geotextiles, curled excelsior wood, natural coconut fiber or hardwood mulch. Straw, pine needle, and leaf mulch-filled sediment tubes are not permitted.

When and Where to Use It

Install sediment tubes along contours, in drainage conveyance swales, and around inlets to help reduce the effects of soil erosion by energy dissipation and retaining sediment.

Materials

Sediment tubes for ditch checks and Type A Inlet Structure Filters exhibit the following properties:

- Produced by a Manufacturer experienced in sediment tube manufacturing.
- Composed of compacted geotextiles, curled excelsior wood, natural coconut fibers, hardwood mulch or a mix of these materials enclosed by a flexible netting material.
- Straw, straw fiber, straw bales, pine needles, and leaf mulch are not allowed under this specification.
- Utilizes outer netting that consists of seamless, high-density polyethylene photodegradable materials treated with ultraviolet stabilizers or a seamless, high-density polyethylene non-degradable materials.
- Diameter ranging from 18-inches to 24-inches.

- Curled excelsior wood, or natural coconut rolled erosion control products (RECPs) that are rolled up to create a sediment tube are **not** allowed under this specification.
- Select applicable Sediment Tubes from the SCDOT approved products list.

Installation

Proper site preparation is essential to ensure sediment tubes are in complete contact with the underlying soil or underlying surface. Remove all rocks, clods, vegetation or other obstructions so installed sediment tubes have direct contact with the underlying soil or surface.

Install sediment tubes by laying them flat on the ground. Construct a small trench to a depth that is 20% of the sediment tube diameter. Lay the sediment tube in the trench and compact the upstream sediment tube soil interface. Do not completely bury sediment tubes during installation. Review all project specifications for special installation requirements. Install sediment tubes so no gaps exist between the soil and the bottom of the sediment tube. Lap the ends of adjacent sediment tubes a minimum of 6-inches to prevent flow and sediment from passing through the field joint. Never stack sediment tubes on top of one another.

Avoid damage to sediment tubes during installation. Should the sediment tube become damaged during installation, place a stake on both sides of the damaged area terminating the tube segment and install a new tube segment. Perform field monitoring to verify that installation procedures do not damage sediment tubes. Replace all damaged sediment tubes damaged during installation as directed by the Inspector or Manufacturer's Representative at the contractor's expense.

Install sediment tubes in swales or drainage ditches perpendicular to the water flow and extend them up the side slopes a minimum of 1-foot above the design flow depth. Space sediment tubes according to the following table:

Slope	Maximum Sediment Tube Spacing
Less than 2%	150-feet
2%	100-feet
3%	75-feet
4%	50-feet
5%	40-feet
6%	30-feet
Greater than 6%	25-feet

Install sediment tubes using wooden stakes (2-inch x 2-inch) or steel posts (standard "U" or "T" sections with a minimum weight of 1.25 pounds per foot) a minimum of 48-inches in length placed on 2-foot centers. Intertwine the stakes with the outer mesh on the downstream side, and drive the stakes in the ground to a minimum depth of 24-inches leaving less than 12-inches of stake above the exposed sediment tube.

An acceptable alternative installation is driving stakes on 2-foot centers on each side of the sediment tube and connecting them with natural fiber twine or steel wire to inhibit the non-weighted sediment tube from moving vertically. Sediment tubes can also be secured by installing the stakes on 2-foot centers in a crossing manner ensuring direct soil contact at all times.

Select the sediment tube check length to minimize the number of sediment tubes needed to span the width of the drainage conveyance. If the required length (perpendicular to the water flow) is 15-feet, then one 15-foot sediment tube is preferred compared to two overlapping 10-foot sediment tubes.

Install sediment tubes for ditch checks over bare soil, mulched areas, or erosion control blankets. Keep sediment tubes for ditch checks in place until fully established vegetation and root systems have completely developed and can survive on their own.

Inspection and Maintenance

- Inspect sediment tubes after installation for gaps under the sediment tubes and for gaps between the joints of adjacent ends of sediment tubes.
- Inspect every 7-days and within 24-hours of a rainfall event of 0.5-inches or greater.
- Repair all rills, gullies, and undercutting near sediment tubes.
- Remove all sediment deposits that impair the filtration capability of sediment tubes when the sediment reaches 1/3 the height of the exposed sediment tube.
- Remove and/or replace installed sediment tubes as required to adapt to changing construction site conditions.
- Remove sediment tubes from the site when the functional longevity is exceeded as determined by the Engineer, Inspector or Manufacturer's Representative. Gather sediment tubes and dispose of them in regular means as non-hazardous, inert material.
- Prior to final stabilization, backfill all trenches, depressions and other ground disturbances caused by the removal of sediment tubes.

Sediment Tube Check Dam

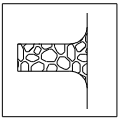
Sediment Tube Check Dam

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Too much sediment has accumulated.	Remove accumulated sediment to recover holding capacity. Remove accumulated sediment from the upstream side of the sediment tube when the sediment has reached a height of approximately one-half the original height of the tube (measured at the center).
There is insufficient ponding area.	Space sediment tubes farther apart or increase the sediment tube diameter.
Sediment tube washes away.	Use larger sediment tubes. Decrease post spacing, and add more posts. Install posts on both the upstream and downstream sides of the sediment tube. Decrease sediment tube spacing by adding more sediment tube check dams.
Other application used instead of sediment tubes	Do not use straw bales or silt fence as sediment tube check alternatives. In some situation rock check dams may be used as a sediment tube alternative.
Wrong type of materials or wrong type of sediment tube utilized.	Straw, pine needle and leaf mulch-filled sediment tubes are not permitted. Curled excelsior wood, or natural coconut rolled erosion control products (RECPs) that are rolled up to create a sediment tube are **not** permitted. Do not use straw bales or silt fence for checks.

Stabilized Construction Entrance

Plan Symbol



Description

A stabilized construction entrance is a temporary stone-stabilized pad located at all points of vehicular ingress and egress on a construction site to reduce the amount of mud, dirt, and rocks transported onto public roads by motor vehicles equipment and runoff.

When and Where to Use It

Use stabilized construction entrances whenever repetitive traffic will be leaving a construction site and moving directly onto a public road. Construction entrances provide an area where mud is removed from vehicle tires before entering a public road.

Installation

Remove all vegetation and any objectionable material from the foundation area.

Divert all surface runoff and drainage from stones to a sediment trap or basin.

Install a non-woven geotextile fabric prior to placing any stone.

Install a culvert pipe across the entrance when needed to provide positive drainage.

The entrance consists of 2 to 3 inch D_{50} aggregate with a minimum thickness of 6-inches.

Minimum dimensions of the entrance are 24-feet wide by 100-feet long, and may be modified as necessary to accommodate site constraints.

Taper the edges of the entrance out towards the road to prevent tracking of mud at the edge of the entrance.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation, or after heavy use.
- Check for mud and sediment buildup and pad integrity.
- Make daily inspections during periods of wet weather. Maintenance is required more frequently in wet weather conditions. Reshape the stone pad as needed for drainage and runoff control.
- Wash or replace stones as needed.
- Wash or replace he stone in the entrance whenever the entrance fails to reduce mud being carried off site by vehicles. Frequent washing will extend the useful life of stone.
- Immediately remove mud and sediment tracked or washed onto public roads by brushing or sweeping.
- Only use flushing when the water is discharged to a sediment trap or basin.
- Repair any broken pavement immediately.
- Inspect and clean sediment traps immediately following each rainfall.
- Dispose of sediment in a suitable area in such a manner that it will not erode.
- Remove stabilized construction entrances as soon as they are no longer needed to provide access to the site. Bring the disturbed area to grade, and stabilize it using appropriate permanent stabilization methods.

Construction Entrance

Construction Entrance

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Access points require constant maintenance.	Select proper stabilization material or consider alternate methods for longevity, performance and site conditions.
Stone is tracked onto roadway.	Limit larger vehicles from construction exit or use larger diameter material.
Aggregate material is being incorporated into the soil.	Use geotextile fabric under base material.
Excessive sediment is tracked onto roadway.	Increase length of stabilized exit. Regularly maintain access area to remove sediment buildup.
Sediment-laden water is leaving the construction site.	Properly grade access points to prevent runoff from leaving site. Route runoff through a sediment-trapping device.
Sediment is being tracked from numerous locations.	Limit the number of access points and require their use. Stabilize designated access points.

Storm Drain Inlet Protection

Description

Storm drain inlet protection is achieved by placing a temporary filtering device around any inlet to trap sediment. This mechanism prevents sediment from entering inlet structures. Additionally, it serves to prevent the silting-in of inlets, storm drainage systems, or receiving channels.

There are six (6) types of inlet structure filters, including:

- Type A-Low Flow
- Type B-Medium Flow, Low Velocity
- Type C-Medium Flow, Medium Velocity
- Type D-High Flow, High Velocity
- Type E-Surface Course Curb Inlet
- Type F-Inlet Tubes

When and Where to Use It

Inlet protection may be installed prior to the construction of roads however, once the sub base is placed, a different type of inlet protection may be required. Inlet protection is required on all inlets that have outfalls that bypass sediment trapping structures and directly discharge off site. Use inlet protection as a last resort for sediment control when no other means are practical and do not use as the only means of protection.

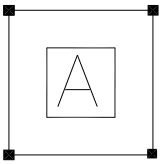
Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each storm that produces ½-inches or more of rain. Handle any damage or needed repairs immediately.
- Inspect after installation for gaps that may permit sediment to enter the storm drainage system.
- Remove accumulated sediment and debris from the surface and vicinity of Inlet Filters after each rain event or as directed by the Engineer, Inspector or Manufacturer's Representative.

- Remove sediment when it reaches approximately 1/3 the height of the Inlet Filter. If a sump is used, remove sediment when it fills approximately 1/3 the depth of the hole. Maintain the pool area, always providing adequate sediment storage volume for the next storm event.
- Remove, move, and/or replace as required to adapt to changing construction site conditions.
- Remove Inlet Filters from the site when the functional longevity is exceeded as determined by the Engineer, Inspector or Manufacturer's Representative.
- Dispose of Inlet Filters no longer in use at an appropriate recycling or solid waste facility.
- Prior to final stabilization, backfill and repair all trenches, depressions, and other ground disturbances caused by the removal of Inlet Filters.
- Remove all construction material and sediment and dispose of them properly. Grade the disturbed areas to the elevation of the inlet structure crest. Stabilize all bare areas immediately.

Type A - Filter Fabric Inlet Protection

Plan Symbol



Design filter fabric inlet protection to have an 80 percent design removal efficiency goal of the total suspended solids (TSS) in the inflow. The Design Aids located in the Silt Fence section of this Handbook may be used to properly design filter fabric inlet protection.

Materials

Use filter fabric that conforms to SCDOT standard specifications for highway construction (latest edition). Refer to the silt fence geotextile fabrics SCDOT Approval Sheet #34.

Use 48-inch long wood posts that meet the following requirements.

- 2-inch by 2-inch size.
- Heavy-duty wire staples at least 1½-inch long, spaced a maximum of 6-inches apart to attach the filter fabric to wooden stakes.

Use 48-inch long steel posts that meet the following minimum physical requirements:

- Be composed of high strength steel with minimum yield strength of 50,000 psi.
- Have a standard "T" section with a nominal face width of 1.38-inches and nominal "T" length of 1.48-inches.
- Weigh 1.25 pounds per foot (± 8%).
- Be painted with a water based baked enamel paint.

Installation

Excavate a trench 6-inches wide and 6-inches deep around the outside perimeter of the inlet.

Extend the filter fabric a minimum of 12-inches into the trench. Backfill the trench with soil or crushed stone and compact over the filter fabric unless the fabric is pneumatically installed.

Install the filter fabric to a minimum height of 18-inches and maximum height of 24-inches above grade. Space the posts around the perimeter of the inlet a maximum of 3-feet apart and drive them into the ground a minimum of 24-inches.

Cut the filter fabric from a continuous roll to the length of the protected area to avoid the use of joints. When joints are necessary, wrap filter fabric together only at a support post with both ends securely fastened to the post, with a minimum 6-inch overlap.

Attach fabric to wood posts using heavy-duty wire staples at least 1½-inch long, spaced a maximum of 6-inches apart.

Attach fabric to steel posts with heavy-duty plastic ties. Attach at least four (4) evenly spaced ties in a manner to prevent sagging or tearing of the fabric. In all cases, affix ties in no less than four (4) places.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation. Replace the fabric if it becomes clogged.
- Remove sediment when it reaches 1/3 the height of the fabric. Take care not to damage or undercut fabric when removing sediment.
- Remove sediment when it fills 1/3 the depth of the sump.
- Maintain the pool area, always providing adequate sediment storage volume for the next storm.
- Remove storm drain inlet protection only after the disturbed areas are permanently stabilized.
- Remove all construction material and sediment, and dispose of them properly.
- Grade disturbed areas to drop inlet structure crest. Stabilize bare areas with appropriate permanent stabilization methods.

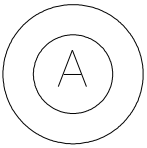
Filter Fabric Inlet Protection

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive sediment is entering the inlet.	Ensure soil stabilization and sediment control devices are installed upstream of inlets. Ensure that the barriers around inlet are installed correctly. Filter fence needs to be keyed in so that water goes through filter fabric and not under it. Use a different type of inlet protection if concentrated flows are observed.
Filter fabric is clogged by sediment or other debris.	Replace filter fabric.
Sediment reaches 1/3 the height of the fabric.	Remove sediment.
Ponded water causes a traffic concern.	Use alternate BMPs upstream. Remove inlet protection if necessary.

Type A – Sediment Tube Inlet Protection

Plan Symbol



Materials

Sediment tubes for Type A Inlet Structure Filters exhibit the following:

- Be produced by a Manufacturer experienced in sediment tube manufacturing.
- Composed of compacted geotextiles, curled excelsior wood, natural coconut fibers, hardwood mulch or a mix of these materials enclosed by a flexible netting material.
- Straw, straw fiber, straw bales, pine needles, and leaf mulch are not allowed under this specification.
- Outer netting consists of seamless, high-density polyethylene photodegradable materials treated with ultraviolet stabilizers or a seamless, high-density polyethylene non-degradable materials.
- Diameter ranging from 18-inches to 24-inches.
- Curled excelsior wood, or natural coconut rolled erosion control products (RECPs) that are rolled up to create a sediment tube are **not** allowed under this specification.
- Select applicable Sediment Tubes from the SCDOT approved products list.

Use 48-inch long wood posts that meet the following requirements.

- 2-inch by 2-inch size.
- Heavy-duty wire staples at least 1½-inch long, spaced a maximum of 6-inches apart to attach the filter fabric to wooden stakes.

Use 48-inch long steel posts that meet the following requirements:

- Be composed of high strength steel with minimum yield strength of 50,000 psi.

- Have a standard "T" section with a nominal face width of 1.38-inches and nominal "T" length of 1.48-inches.
- Weigh 1.25 pounds per foot (± 8%).
- Be painted with a water based baked enamel paint.

Installation

Remove all rocks, clods, vegetation or other obstructions so installed sediment tubes have direct contact with the underlying soil or surface.

Install sediment tubes by laying them flat on the ground. Construct a small trench to a depth that is 20% of the sediment tube diameter. Lay the sediment tube in the trench and compact the upstream sediment tube soil interface. Do not completely bury sediment tubes during installation. Lap the ends of adjacent sediment tubes a minimum of 6-inches to prevent flow and sediment from passing through the field joint. Never stack sediment tubes on top of one another.

Install sediment tubes using wooden stakes (2-inch x 2-inch) or steel posts (1.25 pounds per foot) a minimum of 48-inches in length placed on 2-foot centers. Intertwine the stakes with the outer mesh on the downstream side, and drive the stakes in the ground to a minimum depth of 24-inches leaving less than 12-inches of stake above exposed tube.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- Inspect after installation for gaps under the tubes and for gaps between joints of adjacent ends of sediment tubes. Repair rills, gullies, and all undercutting near sediment tubes.
- Remove and/or replace as required to adapt to changing construction site conditions.
- Remove from the site when the functional longevity is exceeded as determined by Engineer, Inspector or Manufacturer's Representative
- Dispose of in regular means as non-hazardous, inert material.

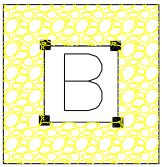
Sediment Tube Inlet Protection

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Too much sediment has accumulated.	Remove accumulated sediment to recover holding capacity. Remove accumulated sediment from the upstream side of the sediment tube when the sediment has reached a height of approximately one-third the original height of the tube (measured at the center).
Sediment tube washes away.	Use larger sediment tubes. Decrease post spacing, and add more posts. Install posts on both the upstream and downstream sides of the sediment tube.
Other application used instead of sediment tubes	Do not use straw bales as sediment tube alternatives.
Wrong type of materials or wrong type of sediment tube utilized.	Straw, pine needle and leaf mulch-filled sediment tubes are not permitted. Curled excelsior wood, or natural coconut rolled erosion control products (RECPs) that are rolled up to create a sediment tube are **not** permitted. Do not use straw bales.

Type B - Hardware Fabric and Stone Inlet Protection

Plan Symbol



Design hardware fabric and stone inlet protection to have an 80 percent design removal efficiency goal of the total suspended solids (TSS) in the inflow. The Design Aids located in the Rock Check Dam section of this Handbook may be used to properly design hardware fabric inlet protection.

Materials

Use hardware fabric or comparable wire mesh with maximum openings of 0.5-inches x 0.5-inches as the supporting material.

Use48-inch steel posts that meet the following minimum physical requirements:

- Be composed of high strength steel with minimum yield strength of 50,000 psi.
- Have a standard "T" section with a nominal face width of 1.38-inches and nominal "T" length of 1.48-inches.
- Weigh 1.25 pounds per foot (± 8%).
- Be painted with a water based baked enamel paint.

Use heavy-duty wire ties to attach the wire mesh material to the steel posts.

Place Aggregate No. 5 washed stone against the hardware fabric on all sides.

Installation

Excavate a trench 6-inches deep around the outside perimeter of the inlet.

Use hardware fabric or comparable wire mesh with maximum openings of 0.5-inches by 0.5-inches as the supporting material. Extended the fabric a minimum of 6-inches into the ground. Backfill the trench with soil or crushed stone and compact over the fabric.

Use steel posts with a minimum post length of 48-inches consisting of standard "T" sections with a weight of 1.25 pounds per foot (±8%). Install the wire mesh fabric above grade a minimum of 18-inches without exceeding 24-inches.

Space the steel posts a maximum of 3-feet apart around the perimeter of the inlet and drive them into the ground a minimum of 24-inches.

Use heavy-duty wire ties spaced a maximum of 6-inches apart to attach the wire mesh material to the steel posts.

Place Aggregate No. 5 washed stone to a minimum height of 12-inches, and a maximum height of 24-inches against the hardware fabric on all sides.

Inspection and Maintenance

- If the stone becomes clogged with sediment, pull the stones away from the inlet and clean or replace them.
- Since cleaning of gravel at a construction site may be difficult, an alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.

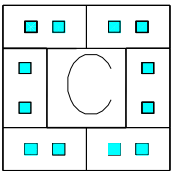
Hardware Fabric and Stone Inlet Protection

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive sediment is entering the inlet.	Ensure that soil stabilization and sediment control devices are installed upstream of inlets. Ensure that the barriers around the inlet are installed correctly.
Sediment reaches 1/3 the height of the structure.	Remove sediment.
Stone filter material becomes clogged with sediment.	Pull stones away from inlet and clean them, or replace them with new stones.
Ponded water causes a traffic concern.	Use alternate BMPs upstream. Remove drain inlet protection if necessary.

Type C - Block and Gravel Inlet Protection

Plan Symbol



Block and gravel filters are used where heavy flows and higher velocities are expected and where an overflow capacity is necessary to prevent excessive ponding around the structure.

Materials

Use masonry blocks ranging from 8 to 12-inches wide.

Use hardware fabric or comparable wire mesh with maximum openings of ½-inches x ½-inches as the supporting material.

Use 1-inch D_{50} washed stone gravel.

Installation

Place the bottom row of the concrete blocks lengthwise on their side so that the open end faces outward, not upward.

The height of the barrier is varied, depending upon design needs by stacking a combination of blocks that are 8- and 12-inches wide.

Place wire mesh over the outside vertical face of the concrete blocks to prevent stones from being washed through the holes in the blocks. Use hardware cloth or comparable wire mesh with ½-inch x ½-inch openings.

Install 1-inch D_{50} washed stone to a height equal to the elevation of the top of the blocks.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each storm that produces ½-inches or more of rain. Any needed repairs should be handled immediately.
- Remove sediment when it reaches 1/3 the height of the blocks. If a sump is used, remove sediment when it fills 1/3 the depth of the hole.
- If the stone filter becomes clogged with sediment, the stones must be pulled away from the inlet and cleaned or replaced. Since cleaning of gravel at a construction site may be difficult, an alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.
- Remove inlet protection structures after the disturbed areas are permanently stabilized. Remove all construction material and sediment, and dispose of them properly.
- Grade the disturbed area to the elevation of the drop inlet structure crest.
- Stabilize all bare areas immediately.

Block and Gravel Inlet Protection

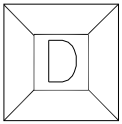
Block and Gravel Inlet Protection

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive sediment is entering the inlet.	Ensure that soil stabilization and sediment control devices are installed upstream of inlets. Ensure that the block and gravel inlet protection is installed correctly.
Sediment reaches 1/3 the height of the blocks.	Remove sediment.
Stone filter material becomes clogged with sediment.	Pull stones away from inlet and clean them, or replace them with new stones.
Ponded water causes a traffic concern.	Use alternate BMPs upstream. Remove inlet protection if necessary.

Type D – Rigid Inlet Filters

Plan Symbol



There are two uses for rigid inlet filters: median applications (Type D1) and sump applications (Type D2). Type D1 filters have more overflow capacity and less filtration area than Type D2 to prevent ponding in medians. These filters are capable of protecting inlet structures not associated with curb inlets

Materials

Rigid inlet filters exhibit the following properties:

- Composed of a geotextile fabric connected to a rigid structure. The geotextile fabric is non-biodegradable and resistant to degradation by ultraviolet exposure and resistant to contaminants commonly encountered in storm water.
- Use a rigid structure composed of high molecular weight, high-density polyethylene copolymer with a UV inhibitor. Do not use structures that are not reusable and recyclable.
- Use a filter fabric constructed of 100% continuous polyester non-woven engineering fabric. The filter fabric is fabricated to provide a direct fit adjacent to the associated rigid structure.
- Rigid inlet filters have a two-stage design. The first stage conveys normal flows at a minimum clean water flow rate of 100 gallons per minute per square foot. The second stage conveys high flow rates, with a minimum apparent opening of 0.5-inch per square inch (No. 12 standard sieve opening).
- Type D1 inlet filters have a first stage minimum height of 9-inches and a maximum height of 12-inches in order to allow greater overflow capacity and prevent ponding in the median.
- Rigid inlet filters completely surround the inlet.

- Rigid inlet filters have lifting devices or structures to assist in the installation and to allow inspection of the storm water system.
- The filter fabric is capable of reducing effluent sediment concentrations by no less than 80% under typical sediment migration conditions.
- Select applicable Type D inlet filters from the SCDOT approved products list.

Installation

Install rigid inlet filters in accordance with the Manufacturer's written installation instructions. Properly install rigid inlet protection so the inlet is completely enclosed.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each storm that produces ½-inches or more of rain. Any needed repairs should be handled immediately.
- Inspect after installation to insure that no gaps exist that may permit sediment to enter the storm drain system.
- Remove and/or replace rigid inlet filters to adapt to changing construction site conditions.
- Clean the rigid inlet protection filter material when it becomes covered or clogged with deposited sediment.
- Replace the rigid inlet protection filter material as directed by the Engineer.

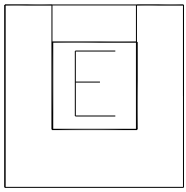
Rigid Inlet Filters

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive sediment is entering the inlet.	Ensure that soil stabilization and sediment control devices are installed upstream of inlets. Ensure that the rigid inlet filters are installed correctly.
Sediment reaches 1/3 the height of the structure.	Remove sediment.
Rigid inlet filter material becomes clogged with sediment.	Pull rigid inlet filters from inlet and clean them, or replace rigid inlet filters with new filter material.
Ponded water causes a traffic concern.	Use alternate BMPs upstream. Remove rigid Inlet filter if necessary.

Type E - Surface Course Curb Inlet Filters

Plan Symbol



Materials

Use surface course inlet filters that have a minimum height or diameter of 9-inches and have a minimum length that is 2-feet longer than the length of the curb opening. Surface course inlet filters are not designed to completely block the inlet opening.

Use surface course inlet filters constructed with a synthetic material that will allow storm water to freely flow through while trapping sediment and debris. Use a material that is non-biodegradable and resistant to degradation by ultraviolet exposure and resistant to contaminants commonly encountered in storm water. Straw, straw fiber, straw bales, pine needles, and leaf mulch are not permissible filter materials.

Surface course inlet filters have aggregate compartments for stone, sand or other weighted materials or mechanisms to hold the unit in place.

Use filter fabric that is capable of reducing effluent sediment concentrations by no less than 80% under typical sediment migration conditions.

Select Type E inlet filters from the SCDOT approved products list.

Installation

Surface course inlet filters are applicable for road Catch Basin after the road surface course is placed. Place surface course inlet filters where sediment may spill over sidewalks and curbs.

Install surface course inlet filters in front of curb inlet openings. The filter has a minimum height or diameter of 9-inches and has a minimum length that is 2-feet longer than the length of the curb opening to allow sufficient length to cover the inlet with at least 1-foot of clearance beyond the inlet on both ends.

Do not completely block the inlet opening with surface course inlet filters. Install surface course inlet filters in a manner to allow overflows to enter the catch basin.

Fill the aggregate compartment to a level (at least ½ full) that will keep the surface course inlet filter in place and create a seal between the surface course inlet filter and the road surface

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each storm that produces ½-inches or more of rain. Any needed repairs should be handled immediately.
- Ponding is likely if sediment is not removed regularly.
- Inspect surface course curb inlet filters on a regular basis and immediately after major rain events.
- Clean the surface course curb inlet filter if a visual inspection shows silt and debris build up around the filter.

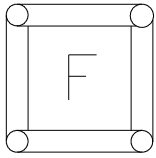
Surface Course Inlet Filters

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive sediment is entering the inlet.	Ensure that soil stabilization and sediment control devices are installed upstream of inlets. Ensure that the surface course inlet filters are installed correctly.
Sediment reaches 1/3 the height of the structure.	Remove sediment.
Surface course inlet filter material becomes clogged with sediment.	Pull surface course filters from inlet and clean them, or replace surface course inlet filters with new filter material.
Ponded water causes a traffic concern.	Use alternate BMPs upstream. Remove surface course inlet filter if necessary.

Type F - Inlet Tubes

Plan Symbol



Inlet tubes are temporary filtering devices placed around inlet structures to trap sediment and keep silt, sediment and construction debris from entering pipe systems through open inlet structures. Additionally, inlet tubes prevent the silting-in of inlets, storm drainage systems and receiving channels.

Materials

Use inlet tubes that exhibit the following properties:

- Produced by a Manufacturer experienced in sediment tube manufacturing.
- Composed of compacted geotextiles, curled excelsior wood, natural coconut fibers or hardwood mulch or a mix of these materials enclosed by a flexible netting material.
- Do not use straw, straw fiber, straw bales, pine needles or leaf mulch under this specification.
- Utilize an outer netting that consists of seamless, high-density polyethylene photodegradable materials treated with ultraviolet stabilizers or a seamless, high-density polyethylene non-degradable materials.
- Curled wood excelsior fiber, or natural coconut fiber rolled erosion control products (RECP) rolled up to create an inlet tube devices are **not** allowed under this specification.

Weighted Inlet Tubes

Weighted inlet tubes are sediment tubes capable of staying in place without external stabilization measures and may have a weighted inner core or other weighted mechanism to keep them in place.

Materials

Weighted inlet tubes meet the minimum performance requirements shown in the table below.

Property	Test Method	Value
Diameter	Field Measured	6.0 inch to 12.0 inch
Mass per Unit Length	Field Measured	6 inch = 6lbs/ft minimum 12inch= 12lbs/ft minimum
Fiber Length	Field Measured	80% of the fiber materials at least 4-inches in length
Length per Tube	Field Measured	6 foot minimum
Netting Unit Weight	Certified	0.35 oz/ft minimum

Select Type F weighted inlet tubes from the SCDOT approved products list

Installation

Install weighted inlet tubes lying flat on the ground, with no gaps between the underlying surface and the inlet tube.

Never stack weighted inlet tubes on top of one another.

Do not completely block inlets with weighted inlet tubes.

Install weighted inlet tubes in such a manner that all overflow or overtopping water has the ability to enter the inlet unobstructed.

To avoid possible flooding, two or three concrete cinder blocks may be placed between the weighted inlet tubes and the inlet.

Non-Weighted Inlet Tubes

Non-weighted inlet tubes are defined as sediment tubes that require staking or other stabilization methods to keep them safely in place.

Materials

Non-weighted inlet tubes meet the minimum performance requirements shown in the table below.

Property	Test Method	Value
Diameter	Field Measured	6.0 inch to 12.0 inch
Mass per Unit Length	Field Measured	6 inch = 1.0lbs/ft minimum 12inch= 2.0 lbs/ft minimum
Fiber Length	Field Measured	80% of the fiber materials at least 4-inches in length
Length per Tube	Field Measured	6 foot minimum
Netting Unit Weight	Certified	0.35 oz/ft minimum

Select Type F non-weighted inlet tubes from the SCDOT approved products list.

Installation

Install non-weighted inlet tubes immediately after grading and construction of catch basin boxes. Maintain non-weighted inlet tubes during subgrade and base preparation until the base course is placed.

For weep hole inlet protection applications, both weighted and non-weighted inlet tubes are applicable. Install non-weighted inlet tubes in situations when stakes can be driven into the ground or subgrade to secure the tube.

Review all project specifications for special installation requirements.

Install non-weighted inlet tubes using 2-inch x 2-inch wooden stakes or steel posts consisting of standard "T" sections weighing 1.25 pounds per foot (±8%), 3-feet in length placed on 2-foot centers. Intertwine the stakes with the outer mesh on the downstream side of the inlet tube.

Drive stakes in the ground to a minimum depth of 1-foot leaving less than 1-foot of stake exposed above the non-weighted inlet tube.

An acceptable alternative installation is driving stakes on 2-foot centers on each side of non-weighted inlet tubes and connecting them with natural fiber twine or steel wire to inhibit the non-weighted sediment tube from moving vertically.

Another acceptable alternative installation for non-weighted inlet tubes is installing stakes on 2-foot centers in a crossing manner maintaining direct soil contact at all times.

Install non-weighted inlet tubes so the top of the tube is below the top of the installed curb line to ensure that all overflow or overtopping water has the ability to enter the inlet unobstructed.

Inspection and Maintenance

- Inspect every 7 calendar days and within 24-hours after each storm that produces ½-inches or more of rain. Any needed repairs should be handled immediately.
- Inlet tubes may be temporarily moved during construction as needed.
- Replace inlet tubes damaged during installation as directed by the Inspector or Manufacturer's Representative at the contractor's expense.

Weighted Inlet Tube

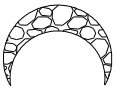
Non-weighted Inlet Tube

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Excessive sediment is entering the inlet.	Ensure that soil stabilization and sediment control devices are installed upstream of inlets. Ensure that inlet tubes are installed correctly.
Sediment reaches 1/3 the height of the inlet tube.	Remove sediment.
Filter material becomes clogged with sediment.	Pull Inlet from inlet and clean them, or replace clogged inlet tubes with inlet tubes
Ponded water causes a traffic concern.	Use alternate BMPs upstream. Remove inlet tubes if necessary.

Rock Sediment Dikes

Plan Symbol



Description

Rock sediment dikes are semi-circular sediment control structures constructed across drainage ditches, swales, low areas or other areas that receive concentrated flow. A rock sediment dike consists of a half-circular shaped rock embankment with a sump area constructed for sediment storage. Design rock sediment dikes to have an 80 percent design removal efficiency goal of the total suspended solids (TSS).

When and Where to Use It

Rock sediment dikes are most effective in areas where sediment control is needed with minimal disturbance. Use as a sediment control structures for the outfalls of diversion swales, diversion dikes, in low areas or other areas where concentrated sediment laden flow is expected. Use rock sediment dikes for drainage less than 2.0 acres. Do not place rock sediment dikes in Waters of the State (unless approved by SCDHEC, State, or Federal authorities).

Installation

Install a non-woven geotextile fabric over the soil surface where the rock sediment dike is to be placed.

Construct the body of the rock sediment dike with minimum 9-inch D_{50} Riprap. Construct the upstream face with a 1-foot thick layer of ¾-inch to 1-inch D_{50} washed stone placed at a slope of 2H:1V.

Construct rock sediment dikes with a minimum top flow length of 3-feet (two-foot flow length through the riprap and one-foot flow length through the washed stone).

Place the rock by hand or mechanical placement (no dumping of rock to form the sediment dike) to achieve the proper dimensions.

Install a sediment sump with a minimum depth of 2-feet on the upstream side of the structure to provide sediment storage. Install the upstream side of the sediment sump with a slope of 5H:1V to inhibit erosion of the sediment storage area.

Mark the sediment cleanout level of the sediment dike with a stake in the field.

Seed and mulch all disturbed areas.

Inspection and Maintenance

- The key to a functional rock sediment dike is continual monitoring, regular maintenance and regular sediment removal.
- Inspect every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- Remove sediment when it reaches 50 percent of the sediment storage volume or the top of the cleanout stake. Removed sediment from the sump should be removed from, or stabilized on site.
- Remove rock sediment dikes within 30 days after final site stabilization is achieved or after they are no longer needed. Permanently stabilize disturbed areas resulting from the removal.

Rock Sediment Dike

Rock Sediment Dike

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Sediment reaches 50 percent of the sediment storage volume or the top of the cleanout stake.	Remove accumulated sediment to recover holding capacity.
Rock sediment dikes wash away.	Replace rock sediment dikes using larger stone.
Final site stabilization is achieved.	Remove rock sediment dikes from site within 30 days after stabilization, and permanently stabilize the areas that were disturbed by the dikes.

Runoff Control and Conveyance Measures

Storm water runoff is rainfall or snowmelt that runs off the ground or impervious surfaces (buildings, roads, parking lots, etc.) and drains into natural or manmade drainage ways. In some cases, it drains directly into streams, rivers, lakes, sounds or the ocean. In other cases, particularly urbanized areas, it drains into streets and manmade drainage systems consisting of inlets and underground pipes commonly referred to as "storm sewers." Storm water entering storm sewers does not usually receive any treatment before it enters streams, lakes and other surface waters.

Storm water runoff problems and impacts are most evident in areas where urbanization has occurred. Changes in land use have a major effect on both the quantity and quality of storm water runoff. Urbanization, if not properly planned and managed, can dramatically alter the natural hydrology of an area. Increased impervious cover decreases the amount of rainwater that can naturally infiltrate into the soil and increases the volume and rate of storm water runoff. These changes lead to more frequent and severe flooding and potential damage to public and private property. Under natural conditions, typically 10% of rainwater falling on a piece of property runs off the land surface into streams, rivers or lakes. The remainder either evaporates into the air or infiltrates into the soil replenishing groundwater supplies. Development of the site increases the percentage of impervious surfaces. As the percentage of impervious surfaces increases, the percentage of runoff increases since there is less vegetated area to soak up the rainwater.

The rate of runoff and streamflow after a storm event also shows dramatic increases under post versus predevelopment conditions. The higher and more rapid peak discharge of runoff and streamflow can overload the capacity of the stream or river, causing downstream flooding and streambank erosion. Local governments spend millions of

dollars each year rectifying damage to public and private property caused by uncontrolled storm water runoff. In heavily developed areas, damage to public and private property occurs during heavy rains. This damage includes road, culvert and water and sewer line washouts, flooded homes and yards, the deposition of sediment and debris on properties and roads, and damage to bridges. When streambanks erode they clog stream channels, culverts, and pipes with sediment contributing to flooding problems. Sediment is washed into ponds, lakes and other impoundments reducing their capacity to store water and requiring costly removal efforts. The increased volume and velocity of runoff and streamflow can also cause accelerated channel erosion and changes in streambed composition. This can destroy fish habitat and disrupt the natural ecology of the stream or river.

The following runoff control BMPs are discussed in this handbook:

- Pipe Slope Drains
- Runoff Diversion Measures
- Level Spreader
- Temporary Stream Crossing
- Subsurface Drains
- Construction De-watering

Pipe Slope Drains

Plan Symbol

Description

Pipe slope drains reduce the risk of erosion by discharging concentrated runoff from the top to the bottom of slopes. Pipe slope drains is temporary or permanent depending on installation and material used.

When and Where to Use It

Use pipe slope drains when it is necessary for water to flow down a slope without causing erosion, especially before a slope has been stabilized or before permanent drainage structures are installed. Install temporary pipe slope drains prior to construction of permanent drainage structures. Bury permanent slope drains beneath the ground surface. Stabilize the inlets and outlets of pipe slope drains with flared end sections, Erosion Control Blankets (ECBs), Turf Reinforcement Mats (TRMs) or riprap. Fully compact the soil around the pipe entrance to prevent bypassing and undercutting of the structure. Stabilize the discharge end of the pipe and along the bottom of any swales that lead to sediment trapping structures.

Installation

Secure and fasten slope drain sections together with gasket watertight fittings. Securely anchor slope drains to the soil with wooden stakes or steel posts.

Direct runoff to slope drains with diversion berms, swales, or dikes. The minimum depth of these dikes or berms should be 1.5-feet. The height of the berm around the pipe inlet should be a minimum of 1.5-feet high and at least 0.5-feet higher than the top of the pipe. The berm at the pipe inlet shall be compacted around the pipe.

The area around the inlet shall be properly stabilized with ECBs, TRMs, riprap or other applicable stabilization techniques.

The area below the outlet must be properly stabilized with ECBs, TRMs, riprap or other applicable stabilization techniques.

If the pipe slope drain is conveying sediment-laden water, direct all flows into the sediment trapping facility.

Permanent slope drains should be buried beneath the soil surface a minimum 1.5-feet.

Inspection and Maintenance

- Inspect pipe slope drain inlet and outlet points every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation.
- Inspect the inlet for undercutting, and water bypassing the point of entry. If there are problems, reinforce the headwall with compacted earth or sandbags.
- Inspect the outlet point for erosion and appropriate outlet protection.
- Remove temporary pipe slope drains within 30 days after final site stabilization is achieved or after the temporary BMP is no longer needed.
- Permanently stabilize disturbed soil areas resulting from slope drain removal.

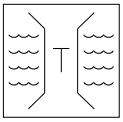
Pipe Slope Drains

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Pipe separates.	Reconnect pipe sections. Securely anchor and stabilize pipe into soil. Ensure that pipe connections are watertight.
Pipe outlet erodes.	Repair the damage and stabilize outlet with a flared end section, riprap, TRM or velocity dissipation device. If necessary, reduce flows being discharged.
Pipe becomes clogged.	Flush out pipe. Place a screen or grate at inlet to capture trash and large particles.
Erosion occurs around inlet.	Compact soil and stabilize area with flared end section, TRM or filter fabric and riprap. Re-grade around inlet to reduce the gradient angle.
Excessive sediment accumulates around inlet/outlet.	Remove accumulated sediment and stabilize upstream area.
Slope drain overtops.	Limit drainage area and flow velocity. Check pipe diameter to ensure proper size to accept flow. Add additional pipes to carry flows as necessary.

Temporary Stream Crossing

Plan Symbol



Description

A temporary stream crossing is a bridge or culvert across a stream or watercourse for short-term use by construction vehicles and heavy equipment. A stream crossing provides a means for construction vehicles to cross streams or watercourses without moving sediment to streams, damaging the stream bed or channel, or causing flooding. Prior to constructing a temporary stream crossing, the owner/person financially responsible for the project must submit an Application for Permit to construct across or along a stream to South Carolina Department of Health and Environmental Control (SCDHEC). Temporary stream crossings require authorization. Refer to the US Army Corps of Engineers and SCDHEC nationwide 401 and 404 regulations for information on permit requirements.

When and Where to Use It

When feasible, attempt to minimize or eliminate the need to cross streams. Temporary stream crossings are a direct source of pollution; therefore, every effort should be made to use an alternate method (e.g., longer detour), when feasible. When it becomes necessary to cross a stream, a well-planned approach minimizes damage to streambanks and reduces erosion. The design of temporary stream crossings requires knowledge of the design flows.

Installation

Install crossings prior to any other activities. Install and maintain pump-around diversions prior to any excavation and during the installation of the crossing. Place crossings in temporary construction easements only.

Minimize streambank clearing. Do not excavate rock bottom streambeds to install the crossing. Lay the culvert pipes on the streambed "as is" when applicable. Place as many pipes as possible within the low area of the stream. Place remaining pipes required to cross the stream on the existing stream bottom.

Install pipes with a maximum spacing of 12-inches between pipes. The minimum sized pipe culvert that may be used is 24-inches.

Install culverts with a length that extend the full width of the crossing, including side slopes.

Use coarse aggregate of clean limestone riprap with a 6-inch D_{50} or greater to form the crossing. Install the stone cover over the culvert equal to ½ the diameter of the culvert or 12-inches, whichever is greater, but no greater than 18-inches.

Limit all fill materials associated with the roadway approach to a maximum height of 2-feet above the existing flood plain elevation.

Inspection and Maintenance

- Inspect crossings every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation. Check the structure integrity and for excessive sediment deposition and replace fill stone as needed.
- Clean mud and/or sediment from the roadway and prevent it from entering the stream.

- The structure shall be removed when it is no longer required to provide access to the construction area. During removal, leave stone and geotextile fabric for approaches in place. Place fill over the approaches as part of the streambank restoration operation. A temporary culvert crossing should be in place no longer than 24 months.

Temporary Stream Crossing

Temporary Stream Crossing

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Slopes of temporary earthen crossing erodes.	Place rock layer on slope sides. Stabilize roadway at crossing.
Sediment and debris block culvert inlet.	Remove sediment and debris as necessary to keep pipe open.
Pipe outlet causes erosion.	Stabilize outlet with riprap or flared end section.
Overtopping occurs.	Incorrect design. Redesign crossing and obtain approval (stamp) of registered civil and/or structural engineer.

Runoff Diversion Measures (Diversion berms/dikes and swales)

Plan Symbol

Description

Diversion dikes and berms (ridges of compacted soil) and diversion swales (excavated depressions) are used to divert upslope runoff from crossing areas where there is a high risk of erosion. Use runoff conveyance structures as temporary clean water diversions, temporary sediment laden diversions, or permanent clean water diversions. Use runoff control measures as either temporary or permanent storm water control structures.

When and Where to Use It

Runoff conveyance measures are installed around the perimeter of a construction sites before major disturbing activities takes place. When constructed along the upslope perimeter of a disturbed or high-risk area (though not necessarily all the way around it), clean water diversions prevent clear water runoff from flowing over unprotected down slope areas. Sediment laden diversions located on the downslope side of a disturbed or high-risk area prevent sediment-laden runoff from leaving the site before sediment is properly removed. For short slopes, runoff control measures at the top of the slope reduce the amount of runoff reaching the disturbed area. For longer slopes, several dikes or swales are placed across the slope at intervals. This practice reduces the amount of runoff that accumulates on the face of the slope and carries the runoff safely down the slope. In all cases, runoff is guided to sediment trapping area or a stabilized outfall before release.

Installation

Stabilized using vegetation, sod, and ECBs or TRMs before any major land disturbing activity takes place.

Install the top width of diversion dikes at least 2-feet wide. Install the bottom width at ground level at least 8-feet wide.

The minimum height for earthen dikes is 18-inches, with side slopes no steeper than 2H:1V.

Minimize construction traffic over diversion dikes and berms. However, for points where vehicles must cross the dike, the slope should be no steeper than 3H:1V and the mound should be constructed of gravel rather than soil.

Prior to swale excavation or dike building, clear and grub all trees, brush, stumps, and other objects in the path of the diversion structure.

Ensure the minimum constructed cross section meets all dimensions shown on the plans.

Immediately after construction establish vegetation by placing an Erosion Control Blanket on the diversion dikes and silt ditches.

Provide positive drainage to the upslope side of the dike so no erosion occurs at the outlet. Provide energy dissipation measures as necessary. Discharge sediment-laden runoff through a sediment trapping facility.

Inspection and Maintenance

- The runoff control measure should be inspected, every 7 calendar days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation and repairs made as necessary.
- Damage caused by construction traffic or other activity must be repaired before the end of each working day.

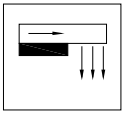
Diversion Berms

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Dikes wash out.	Re-grade, compact and stabilize the soil used to build earthen dikes.
Area behind dikes erode.	Stabilize the area. Use other BMPs to stabilize the uphill side of the dike.
Concentrated flow causes erosion.	Stabilize area and use check dams, ECBs, TRMs or riprap to prevent erosion.
Ditches and swales erode due to high velocity flows.	Stabilize and use check dams, ECBs, TRMs or riprap to prevent erosion.
Swales and ditches fill up with sediment.	Remove accumulated sediment from ditches and swales. Stabilize upstream contributing areas with appropriate erosion prevention BMPs.
Ditches and swales are overtaken by flows.	Determine the upstream contributing areas and size ditches and swales to handle anticipated flow velocities.
Outlet erodes.	Re-grade and stabilize outlet with ECBs, TRMs or riprap.

Level Spreader

Plan Symbol



Description

A level spreader is a permanent outlet for diversions consisting of an excavated channel constructed at zero grade across a slope converting concentrated runoff to sheet flow and releasing it onto stabilized areas. Sediment-laden waters **should not** be directed towards level spreaders.

When and Where to Use It

Construct level spreaders on undisturbed areas that are stabilized by existing vegetation and where concentrated flows are anticipated to occur. Level spreaders are used as a stable outlet for diversion channels if the runoff is relatively free of sediment. If properly constructed, level spreaders significantly reduce the velocity of concentrated storm water.

Installation

Ensure the lower lip is level. If there are any depressions in the lip, flow will tend to concentrate at these points and erosion will occur, resulting in failure of the outlet. Avoid the problem by using a grade board, a gravel lip or a TRM along the exit lip of the level spreader.

Extend the TRM 10-feet below the lip and bury it at least 6- inches within the spreader, and extend at least 12-inches beyond the lip on the outside of the spreader.

Install the grade of the channel transition for the last 20-feet before entering the level spreader less than or equal to 1 percent.

Install the crest of the overflow level (0 percent grade) to ensure uniform spreading of runoff.

Inspection and Maintenance

- Inspect every 7 days and within 24-hours after each rainfall event that produces ½-inches or more of precipitation to ensure that it is functioning correctly.
- The contractor should avoid the placement of any material on the structure or prevent construction traffic across the structure.
- Immediately repair damaged by construction traffic.

Level Spreader

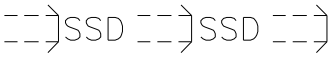
Level Spreader

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Spreader is damaged by construction traffic.	Repair immediately.
Water is channelizing and causing erosion.	Make sure level spreader lip was installed correctly, with a 0% grade to ensure a uniform distribution of flow, Repair immediately, as needed.
Too much sediment has accumulated.	Remove accumulated sediment to recover capacity. A sediment forebay may need to be constructed at the inlet of the level spreader.

Subsurface Drains

Plan Symbol



Description

A subsurface drain is a perforated pipe or conduit placed beneath the surface of the ground at a designed depth and grade.

When and Where to Use It

Subsurface drains are used to do the following:

- Drain areas by intercepting and conveying groundwater.
- Lower the water table.
- Drain or de-water storm water detention structures.
- Prevent sloping soils from becoming excessively wet and subject to slippage.

There are two types of subsurface drains: relief drains and interceptor drains.

- Relief drains are used to de-water an area where the water table is high. They are placed in a gridiron, herringbone, or random pattern.
- Interceptor drains are used to remove water where soils are excessively wet or subject to slippage. They are usually placed as single pipes instead of patterns.

Subsurface drains are suitable only in areas where the soil is deep enough for proper installation. They are not recommended where they pass under heavy vehicle crossings.

Installation

Install relief drains through the center of wet areas that drain in the same direction of the slope.

Install interceptor drains on the up-slope side of wet areas and install them across the slope to drain to the side of the slope.

Locate subsurface drains in areas where there are no trees within 50-feet of the drain.

Construct the installation trench on a continuous grade with no reverse grades or low spots.

Stabilize soft or yielding soils under the drain with gravel or suitable material.

Do not use deformed, warped, or otherwise unsuitable pipe.

Place filter material at least 3-inches of material on all sides of pipe.

Backfill trenches after pipe placement with no pipe remaining uncovered overnight or during a rainstorm. Place backfill material in the trench so that the pipe is not displaced or damaged. Use highly permeable open granular soil for backfill.

The outlet should consist of a 10-foot section of corrugated metal, cast iron, steel or schedule 40 PVC pipe without perforations. At least two-thirds of outlet pipe should be buried.

The outlet consists of a 10-foot section of corrugated metal, cast iron, steel or schedule 40 PVC pipe without perforations.

Inspection and Maintenance

- Inspect subsurface drains on a regular schedule and check for evidence of pipe breaks, clogging by sediment, debris or tree roots.
- Remove blockage immediately, replace any broken sections, and re-stabilize the surface. If the blockage is from tree roots, it may be necessary to relocate the drain.
- Check inlets and outlets for sediment or debris. Remove and dispose of these materials properly.

- Check the drainage line where heavy vehicles cross drains to ensure that pipes are not crushed or damaged.

Subsurface Drain

Subsurface Drain Pipe

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Discharge or treated water causes erosion.	Install outlet protection or velocity dissipation device.
Treatment unit fills with sediment.	Remove sediment when unit reaches 1/3 of its capacity to preserve settling efficiency.
Dewatering discharge flow is higher than expected.	Alter the treatment unit to handle increased flow.
Water spread on the construction site is not infiltrating fast enough and is entering the storm drain system or receiving water body.	Stop dewatering. Install a sediment treatment system and test discharge as necessary.

Construction De-Watering

Description

Construction de-watering involves removing storm water or ground water from bore pits, trenches, and other excavations on a construction site. Typically, this removal of water involves the pumping of the water to an appropriate receiving area. Direct pumping to lakes, rivers, and streams is illegal and must be avoided.

Criteria

Pump sediment-laden groundwater directly to:

- A sediment control structure (sediment basin, sediment trap manufactured de-watering device)
- An infiltration trench
- A buffer strip or zone.

Inspection and Maintenance

Pumping to a Sediment Control Structure:

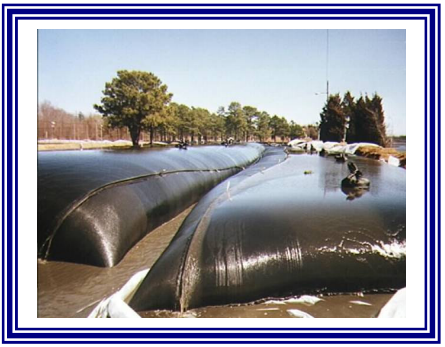
It is recommended that sediment basins or temporary sediment traps receive sediment-laden water from bore pits and trenches. Ensure that the pumping of this water does not cause the sediment control structure to fail. In addition, ensure that erosion does not occur at the outlet of the hose from the pump due to high concentrated flows.

Pumping to an Infiltration Trench:

Ensure that erosion does not occur at the outlet of the hose from the pump due to high concentrated flows.

Pumping to a Vegetated Buffer Zone:

Ensure that erosion does not occur at the outlet of the hose from the pump due to high concentrated flows.



Construction Dewatering

Construction Dewatering

Preventive Measures and Troubleshooting Guide

Field Condition	Common Solutions
Discharge or treated water causes erosion.	Install outlet protection or velocity dissipation device.
Treatment unit fills with sediment.	Remove sediment when unit reaches 1/3 of its capacity to preserve settling efficiency.
Dewatering discharge flow is higher than expected.	Alter the treatment unit to handle increased flow.
Water spread on the construction site is not infiltrating fast enough and is entering the storm drain system or receiving water body.	Stop dewatering. Install a sediment treatment system and test discharge as necessary.

Alternative Erosion Prevention and Sediment Control BMPs

To encourage the development and testing of innovative alternative EPSC BMPs, alternative management practices that are not included in the Handbook, Standard Specifications and Standard Drawings may be allowed upon review and approval. To use an alternative BMP, the design professional should submit substantial evidence that the proposed measure will perform at least equivalent to currently approved BMPs contained in the Handbook, Standard Specifications and Standard Drawings. Evidence may include, but is not limited to:

- Supporting hydraulic and trapping efficiency calculations.
- Peer-review by a panel of licensed professional engineers.
- Research results as reported in professional journals.
- Manufacturer literature.

To justify the efficiency of innovated EPSC BMPs, the owner may be required to monitor the trapping efficiency of the structure. If satisfactory results showing that trapping efficiencies of greater than 80 percent are obtained, the innovative BMP may be used and no other monitoring studies should be required. If monitoring shows that a certain BMP is not sufficient or if SCDHEC finds that a BMP fails or is inadequate to contain sediment, other upstream and downstream BMPs should be implemented to reach the required efficiency.

Post Construction Water Quality Control

Post-construction storm water management in areas undergoing new development or redevelopment is necessary because runoff from these areas significantly affects receiving waterbodies. There are two forms of substantial impacts of post-construction runoff. The first is an increase in the type and quantity of pollutants in storm water runoff. As runoff flows over areas altered by development, it picks up harmful sediment and chemicals such as oil and grease, pesticides, heavy metals, and nutrients. These pollutants become suspended in runoff and are carried to receiving waters, such as lakes, ponds, and streams. Once deposited, these pollutants enter the food chain through small aquatic life, eventually entering the tissues of fish and humans.

The second kind of post construction runoff impact is increasing the quantity of water delivered to the waterbody during storms. Increased impervious surfaces interrupt the natural cycle of gradual percolation of water through vegetation and soil. Instead, water is collected from surfaces such as asphalt and concrete and routed to drainage systems where large volumes of runoff quickly flow to the nearest receiving water. The affects of this process include streambank scouring and downstream flooding, which often lead to a loss of aquatic life and damage to property.

Non-Structural Low Impact Development Controls

Vegetated Conveyances
Stream Buffers
Disconnected Rooftop Drainage to Pervious Areas
Cluster Development
Grass Paving or Alternative Paving Surfaces
Natural Infiltration

Structural Controls

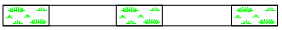
Wet Ponds
Dry Ponds
Storm Water Wetlands
Bioretention Areas
Sand Filters
Infiltration Trench
Enhanced Grassed Swales
Pre-Fabricated Control Devices
Vegetated Filter Strips (VFS)
Porous Pavement

Innovative Technologies

Non –Structural Low Impact Development Controls

Vegetated Conveyance Systems

Plan Symbol



Description

Vegetated conveyances are designed and installed as an alternative to curb and gutter and hard piping storm water conveyance systems. Open vegetated conveyances improve water quality by providing partial pollutant removal as water is filtered by the vegetation and by the opportunity to infiltrate into the soil. Open vegetated conveyances also are designed to reduce flow velocities when compared to hard piping systems.

When and Where to Use It

Open vegetated conveyance systems are incorporated into moderate to low density development sites where land is available and where the land surface is gently sloping (less than 5 percent). The soil must be able to withstand the design tractive forces and flow velocities of the open conveyance, or an applicable

Installation

Construct vegetated conveyances with trapezoidal or parabolic cross section with relatively flat side slopes (flatter than 3H:1V).

Install a flat bottom between 2 and 8 feet wide.

During construction, it is important to stabilize the channel before the turf has been established, either with a temporary grass cover or with the use of natural or synthetic erosion control products.

Inspection and Maintenance

- The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely.
- The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.
- Maintenance includes periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, re-seeding of bare areas, and clearing of debris and blockages.
- Remove accumulated sediment manually to avoid the transport of resuspended sediments in periods of low flow and to prevent a damming effect from sand bars. Minimize the application of fertilizers and pesticides.
- Repair damaged areas within a channel.
- Inspect for a healthy thick grass cover. Re-seed as necessary.

Stream Buffers

Description

A stream buffer is an area along a shoreline, wetland or stream where development is restricted or prohibited. The primary function of the buffer is to physically protect and separate a stream, lake, or wetland from future disturbance or encroachment.

The general function of the buffer is to:

- Protect the overall stream quality by providing shade for the stream and provide wildlife habitat.
- Remove pollutants, sediments, bacteria, and excess nutrients from storm water runoff through infiltration and filtering.
- Help detain and slow down flow rates from developed areas.

- Provide a setback from the stream to prevent damage to structures or improved property due to flooding or changes in the stream channel.

When and Where to Use It

Effective water quality protection stream buffers consist of undisturbed natural vegetation including maintaining the original tree line along the stream or channel banks. Promptly stabilize disturbed buffers with a dense cover of strong rooted grasses, native plants, and native trees.

Buffer Maintenance

An effective buffer management plan includes establishment, management, and distinctions of allowable and unallowable uses in each Zone. Buffer boundaries are well defined and clearly marked during, and after construction is complete. Buffers designed to capture storm water runoff from urban areas require more maintenance if the first zone is designated as a bioretention or other engineered depression area.

Disconnected Rooftop Drainage to Pervious Areas

Description

Disconnected rooftop drainage reduces the runoff flow rates from developed areas. The disconnection involves directing storm water runoff from rooftops towards pervious areas where it is allowed to filter through vegetation and other landscaped material and infiltrate into the soil. Use erosion control devices such as splash blocks or level spreaders at the downspout discharge point to transfer the flow from concentrated flow to sheet flow.

Disconnected rooftop drainage has the following benefits:

- Increase the time of concentration by disconnecting runoff from any structural storm water drainage systems.

- Provide water quality benefits by allowing runoff to infiltrate into the soil. Downspouts from rooftops should discharge to gently sloping, well-vegetated areas, vegetated filter strips, or bio-retention areas.

When and Where to Use It

This practice is applicable and most beneficial in low-density residential or commercial developments having less than 50 percent impervious area. Disconnection is not applicable to large buildings where the volume of runoff from the rooftops will cause erosion or degradation to receiving vegetated areas.

Cluster Development

Description

Cluster development practices concentrate development away from environmentally sensitive areas such as streams, wetlands, and mature wooded areas. The clustering of development in one area reduces the amount of roadways, sidewalks, and drives required when compared to development sprawled over the entire land area.
[3]
Install clustering and conservation of natural area practices at least to some extent on all development sites not only to reduce the impacts to natural resources by minimizing disturbance and impervious areas, but also to maintain some of the natural beauty of the site.

Reducing the amount of disturbed area and impervious area reduces the amount of runoff volume treated for water quantity and water quality control. Concentrating development away from environmentally sensitive areas will also reduce the amount of time and expenses to get federal and state permits for impacting jurisdictional waters.
Concentrate development on the flattest part of the development parcel away from environmentally sensitive areas such as steep slopes, streams, and wetlands. This reduces the impacts to these areas, and reduces the amount of earth moving necessary for the development.

Natural Infiltration

Natural infiltration is a method in which an undisturbed land area covered with natural vegetation accepts runoff from new development and infiltrates the runoff into the soil.

When and Where to Use It

Use natural infiltration areas only where the soils are suitable. The area is typically in a forested condition with the land surface covered by leaves, pine needles, and other forest floor organic materials. Natural infiltration areas are designated for passive recreation only.

Structural Controls

Structural water quality control structures are recommended for use with a wide variety of land uses and development types. These controls have demonstrated the ability to effectively treat runoff volume to reduce the amounts of pollutants discharged to the downstream system. Structural storm water quality controls are classified into the following categories:

General Application Controls

General application structural controls are recommended for use in a wide variety of application situations. These structural controls have demonstrated the ability to effectively treat water quality volumes and are presumed to be capable of removing 80 percent of the total suspended solids (TSS) load typically found in urban post-development runoff.

Limited Application Controls

Limited application structural controls are those that are recommended only for limited use for special site or design conditions. Generally, these practices can not alone achieve 80 percent TSS removal goal and are intended for hotspots for specific land use constraints or conditions. Limited application controls may be used within a system of water quality controls and are very effective pre-treatment structures for the General Application Controls. Limited application structural controls should be designed and used only in development situations where regular maintenance is guaranteed.

Wet Storm Water Detention Ponds

Description

A wet or permanent pool detention pond is one of the most commonly used BMPs to meet water quality protection requirements. The advantages of permanent pool ponds have over other water quality treatment controls are:

- Ponds are durable and require less maintenance than other applicable water quality controls.
- Ponds required for water quantity control are easily modified to treat storm water runoff for water quality.
- Well designed ponds are effective in treating storm water runoff for water quality control.

Wet storm water detention ponds are classified as being:

- Wet Detention Pond. Wet ponds have a permanent (dead storage) pool of water equal to the water quality volume. Temporary storage (live storage) may be added above the permanent pool elevation for larger flows.
- Wet Extended Pond. A wet extended pond is a wet pond where the water quality volume is split evenly between the permanent pool and extended detention storage provided above the permanent pool. During storm events, water is stored above the permanent pool and released over 24-hours. The design has similar pollutant removal efficiencies as traditional wet ponds, but consumes less space.
- Micropool Extended Pond. The micropool extended pond is a variation of the wet extended detention pond where only a small "micropool" is maintained at the outlet to the pond. The outlet structure is designed to detain the water quality volume for 24-hours. The micropool prevents resuspension of previously settled sediments and prevents clogging of the low flow orifice.

When and Where to Use It

Permanent pool ponds improve storm water quality by detaining storm water runoff for an extended period of time to allow pollutants that are uspended in the runoff to settle out. During any given storm event, runoff enters wet ponds and replaces the "treated" water in the permanent pool that has been detained from the previous storm event. As runoff enters the pond, the velocity is significantly decreased, allowing suspended pollutants to settle out of the runoff. Many pollutant particles suspended in storm water runoff are very small in size, therefore the pond must be designed to provide adequate detention time to allow the smaller particles to settle out.

Inspection and Maintenance

Regular inspection and maintenance is critical to the effective operation of storm water ponds as designed. Maintenance responsibility for a pond and its buffer should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval. The agreement may contain but is not limited to the following items:

- Mow side slopes of the pond monthly.
- Since decomposing vegetation captured in the wet pond can release pollutants, especially nutrients, it may be necessary to harvest dead vegetation annually. Otherwise the decaying vegetation can export pollutants out of the pond and also can cause nuisance conditions to occur.
- Clear debris from all inlet and outlet structures monthly.
- Repair all eroded or undercut areas as needed.
- Place a sediment marker in the forebay to determine when sediment removal is required.
- Monitor sediment accumulations in the main pond area and remove sediment when the permanent pool volume has been significantly filled and/or the pond becomes eutrophic.

Summary of Maintenance Requirements

Required Maintenance	Frequency
Clean and remove debris from inlet and outlet structures.	Monthly, or after large storm events
Mow side slopes.	Monthly, or as needed
Removal of invasive vegetation.	Semi-annual
Inspect for damage to control structure.	Annual
Inspect sediment accumulation in the facility and forebay.	Annual
Inspect for operational inlet and outlet structures.	Annual
Repair embankment, side slopes, undercut or eroded areas.	Annual, or as needed
Perform wetland plant management and harvesting.	Annual
Remove sediment from the forebay.	Per design cycle, as needed, after 50% of total forebay capacity is filled
Remove sediment accumulations in the main permanent pool.	5 to 10 year cycle, after 25% of the permanent pool volume is filled

Wet Pond

Wet Pond

Dry Storm Water Detention Ponds

Description

A dry (extended) detention pond provides temporary storage of storm water runoff. Dry ponds have an outlet structure that detains runoff inflows and promotes the settlement of pollutants. Unlike wet ponds, dry detention ponds do not have a permanent pool.

A dry pond is designed as a multistage facility that provides runoff storage and attenuation for both storm water quality and quantity. Design dry detention ponds as either single-stage or two-stage. Single-stage ponds are normally used strictly for flood control and are not recommended for water quality benefits. A two-stage pond contains a water quality volume in the lower stage, and has an upper stage for detention of larger storms for flood control.

The lower stages of a dry pond are controlled by outlets designed to detain the storm water runoff for the water quality volume for a minimum duration of 24-hours, which allow sediment particles and associated pollutants to settle out. Higher stages in the pond detain the peak rates of runoff from larger storms for flood and erosion control. Dry detention ponds are designed for complete drawdown of runoff and normally remain dry between storm events.

When and Where to Use It

Apply dry detention ponds to new or existing developments. Dry ponds are considered permanent, year-round control measures. Use dry detention ponds at sites where significant increases in runoff are expected from site development. Use dry detention ponds for residential, commercial, or industrial development sites.

Do not use dry ponds in areas with a high water table. A permanently wet bottom is a mosquito breeding ground.

While dry extended detention ponds are widely applicable, they have some limitations that may make other storm water management options preferable. Dry pond limitations include:

Possible nuisance due to mosquito breeding .

While wet ponds can increase property values, dry ponds may detract from the value of a home.

Dry detention ponds have only moderate pollutant removal when compared to other structural storm water practices, and have limited effectiveness in removing both particulate and soluble pollutants.

Inspection and Maintenance

A Pond Maintenance Plan/Agreement is required before approval

Regular inspection and maintenance is critical to the effective operation of dry ponds as designed. Maintenance responsibility for a pond should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

Conduct inspections semi-annually and after significant storm events to identify potential problems early. Direct maintenance efforts toward vegetation management and basic housekeeping practices such as removal of debris accumulations and vegetation management to ensure that the pond dewaters completely to prevent mosquito and other habitats.

Summary of Maintenance Requirements

Required Maintenance	Frequency
Note erosion of pond banks or bottom	Semi-Annual Inspection
Inspect for damage to the embankment Monitor for sediment accumulation in the facility and forebay. Ensure that inlet and outlet devices are free of debris and operational	Annual Inspection
Repair undercut or eroded areas Mow side slopes Pesticide/ Nutrient management Litter/ Debris Removal	Standard Maintenance
Seed or sod to restore dead or damaged ground cover.	Annual Maintenance (As needed)
Removal of sediment form the forebay	5 to 7 year Maintenance
Monitor sediment accumulations, and remove sediment when the pond volume has been reduced by 25%.	25 to 50 year Maintenance
Repair undercut or eroded areas Mow side slopes Pesticide/ Nutrient management Litter/ Debris Removal	Standard Maintenance

Dry Pond

Dry Pond

Underground Detention Facilities

Description

Detention tanks and vaults are underground structures used to attenuate peak storm water flows through detention or extended detention of storm water runoff. They are constructed out of concrete pipe (RCP), corrugated metal pipe (CMP), High Density Polyethylene Pipe (HDPE) or concrete vaults. The design and material selections considers the potential loading from vehicles on the vault or pipe.

When and Where to Use It

Due to the costs associated with underground detention systems for construction and maintenance, these systems are used when space is limited and there are no other practical alternatives.

In the ultra-urban environment, costs for developable land may be high enough that these systems become a feasible alternative.

Relatively expensive to construct, use concrete vaults in areas where system replacement costs are high.

Less expensive, use CMP or HDPE systems to control significant volumes of runoff in parking lots, adjacent to rights-of-way, and in medians, where they is replaced or maintained if necessary.

Inspection and Maintenance

- Design the system for easy access for inspection and maintenance.
- Remove any trash/debris and sediment buildup in the underground vaults or tanks annually by pumping them out.
- Perform structural repairs to inlet and outlets as needed based on inspections.

Underground Detention

Underground Detention

Storm Water Wetlands

Description

Storm water wetlands remove pollutants primarily through physical filtration and settling, by biological processes of wetland plants, and bacteria in substrates. The storm water wetland is similar in design to the wet pond but has significant vegetation differences. The major difference in the wetland design is the creation of varying depth zones in the shallow marsh area of the wetland to support emergent wetland vegetation. Because consideration must be paid to creating various depth zones and establishing a plant community that can survive in the different zones, the design, construction, and maintenance of storm water wetlands is more complex than wet ponds. There are several different wetland applications including:

- Storm Water Wetland. Constructed shallow marsh system that is designed to treat both urban storm water runoff and control runoff volume. As storm water runoff flows through the wetland, pollutant removal is achieved through settling and uptake by marsh vegetation.
- Shallow Wetland. Most of the water quality treatment takes place in the shallow high marsh or low marsh depths. The only deep sections of the wetland are the forebay and the micropool at the outlet. A disadvantage of shallow wetlands is that a relatively large amount of land is required to store the desired water quality volume.
- Extended Detention Shallow Wetland. This design is similar to the shallow wetland, but part of the water quality treatment volume is provided as extended detention above the surface of the marsh and is released over a period of 24-hours. This application can treat a greater volume of storm water in a smaller space than the shallow wetland design. Plants that can tolerate both wet and dry periods are required in the extended detention area.

- Pond/Wetland System. The system consists of has two separate cells, a wet pond and a shallow marsh. The wet pond traps sediment and reduces runoff velocities before the runoff enters the shallow marsh. Primary water quality benefits are achieved in the shallow wetland. Less land is required for the pond/wetland system than the shallow wetland and the extended detention shallow wetland.
- Pocket Wetland. A pocket wetland is intended for smaller drainage areas of 5 to 10 acres, and requires excavation down to the water table for a reliable source of water to support the wetland vegetation.

Inspection and Maintenance

Regular inspection and maintenance is critical to the effective operation of storm water wetlands. Maintenance responsibility for the constructed storm water wetland should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

- Maintenance requirements for constructed wetlands are particularly high while vegetation is being established. Monitoring during the first year is critical to the success of the wetland.
- Monitor wetlands after all storm events greater than 2-inches of rainfall during the first year to assess erosion, flow channelization and sediment accumulation. Inspection should be made at least once every six months during the first three years of establishment.
- Place a sediment cleanout stake in the forebay area to determine when sediment removal is required.
- Debris should be removed from the inlet and outlet structures monthly.
- Monitor wetland vegetation and replaced as necessary once every 6-months during the first three years of establishment.
- Annually inspect and maintain the depth of the zones within the wetland.
- Annually remove invasive vegetation.
- Repair all eroded or undercut areas as needed.

Summary of Maintenance Requirements

Required Maintenance	Frequency
Replace wetland vegetation to maintain at least 50% surface area coverage in wetland plants.	Once every 6-months during the first three years of establishment
Clean and remove debris from inlet and outlet structures.	Frequently (3 to 4 times/year)
Mow side slopes.	Frequently (3 to 4 times/year)
Monitor wetland vegetation and perform replacement planting as necessary.	Semi-annual (every 6-months)
Examine stability of the original depth zones.	Annual
Inspect for invasive vegetation, and remove where possible.	Annual
Inspect for damage to the embankment and inlet/outlet structures.	Annual, repair as necessary
Monitor for sediment accumulation in the facility and forebay.	Annual
Inspect for operational inlet and outlet structures.	Annual
Repair undercut or eroded areas.	As needed
Harvest wetland plants that have been “choked out” by sediment buildup.	Annual
Removal of sediment from the forebay.	Per design cycle, as needed, after 50% of total forebay capacity is filled
Remove sediment accumulations in the main permanent pool.	5 to 10 year cycle, after 25% of the permanent pool volume is filled

Planted Storm Water Wetland

Established Storm Water Wetland

Bioretention Areas

Description

Bioretention areas are designed to mimic natural forest ecosystems with a combination of soil filtration and plant uptake by utilizing a planting soil layer, mulch, plantings, and an underdrain system. Bioretention areas appear as landscaped or natural areas giving this BMP an appealing image. Storm water runoff enters the Bioretention area and is temporarily stored in a shallow pond on top of the mulch layer. The ponded water then slowly filters down through the planting soil mix and is absorbed by the plantings. As the excess water filters through the system it is temporarily stored and collected by an underdrain system that eventually discharges to a designed storm conveyance system.

When and Where to Use It

Bioretention areas are applicable for small sites where storm water runoff rates are low and typically are received into the Bioretention area as sheet flow. Bioretention drainage areas range from 1-2 acres and are well stabilized to prevent excessive debris and sediment from collecting in the Bioretention area. Because Bioretention areas are sensitive to fine sediments, they are not be placed on sites where the contributing area is not completely stabilized or is periodically being disturbed. Applicable sites include:

- Parking lots,
- Individual residential home sites, and
- Small commercial facilities.

Inspection and Maintenance

Regular inspection and maintenance is critical to the effective operation of Bioretention areas as designed. Maintenance responsibility of the Bioretention area should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

The surface of the ponding area may become clogged with fine sediments over time. Core aeration or cultivating unvegetated areas may be required to ensure adequate filtration. Other required maintenance includes but is not limited to:

- Conduct pruning and weeding to maintain appearance as needed.
- Replace or replenish mulch as needed.
- Remove trash and debris as needed.

Bioretention Area with un-cut clean outs

Summary of Maintenance Requirements

Required Maintenance	Frequency
Pruning and weeding.	As needed
Remove trash and debris.	As needed
Inspect inflow points for clogging. Remove any sediment.	Semi-annual (every 6-months)
Repair eroded areas. Re-seed or sod as necessary.	Semi-annual (every 6-months)
Mulch void areas.	Semi-annual (every 6-months)
Inspect trees and shrubs to evaluate their health.	Semi-annual (every 6-months)
Remove and replace dead or severely diseased vegetation.	Semi-annual (every 6-months)
Removal of evasive vegetation.	Semi-annual (every 6-months)
Nutrient and pesticide management.	Annual, or as needed
Water vegetation, shrubs and trees.	Semi-annual (every 6-months)
Remove mulch, reapply new layer.	Annual
Test planting mix for pH.	Annual
Apply lime if pH < 5.2.	As needed
Add iron sulfate + sulfur if pH > 8.0.	As needed
Place fresh mulch over entire area.	As needed
Replace pea gravel diaphragm.	Every 2 to 3 years if needed

Infiltration Trenches

Description

Infiltration trenches are excavations typically filled with stone to create an underground reservoir for storm water runoff. The runoff volume gradually exfiltrates through the bottom and sides of the trench into the subsoil over a maximum period of 72 hours (three days), and eventually reaches the water table. By diverting storm water runoff into the soil, an infiltration trench not only treats the water quality volume, but it also preserves the natural water balance by recharging groundwater and preserving channel baseflow. Using natural filtering properties, infiltration trenches remove a wide variety of pollutants from the runoff through adsorption, precipitation, filtering, and bacterial and chemical degradation.

When and Where to Use It

Infiltration trenches are limited to areas with highly porous soils where the water table and or bedrock are located well below the trench bottom. They are only applicable for Hydrologic Soil Group A soils, or soils that have a minimum infiltration rate of 0.3-inches per hour. Infiltration trenches are not intended to trap sediment and are designed with a sediment forebay or other pre-treatment measure to prevent clogging in the gravel. Infiltration trenches are used for medium- to high- density residential, commercial, and institutional developments. They are most applicable for impervious areas where there are low levels of fine particulates in the runoff and the site is completely stabilized and the potential for possible sediment loads is very low. Do not use Infiltration trenches for manufacturing and industrial sites where there is potential for high concentrations of soluble pollutants and heavy metals. Infiltration trenches are designed to capture sheet flow from a drainage area or function as an off-line device. Due to the relatively narrow shape, infiltration trenches are adapted to many different types of sites and is utilized in retrofit situations. Unlike some water quality BMPs, infiltration trenches can easily fit into margin, perimeter or other unused areas of development sites.

Inspection and Maintenance

Regular inspection and maintenance is critical to the effective operation of infiltration trenches as designed. Maintenance responsibility for the infiltration trench should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of the Storm Water Management Permit approval. Typical maintenance responsibilities include:

- Keep a record of the average de-watering time of the infiltration trench to determine if maintenance is required.
- The top 6-inch layer of pea gravel and geotextile separating the pea gravel from the stone media serve as a sediment barrier and require replacement when full of sediment.
- Clear debris and trash from all inlet and outlet structures monthly.
- Check the observation well after three consecutive days of dry weather after a rainfall event. If complete de-watering is not observed within this period, there may be clogging within the trench requiring proper maintenance.
- Remove trees, shrubs, or invasive vegetation semi-annually.
- If complete failure is observed, perform total rehabilitation by excavating the trench walls to expose clean soil, and replacing the gravel, geotextiles, and topsoil.

Summary of Maintenance Requirements

Required Maintenance	Frequency
Ensure that the contributing area is stabilized with no active erosion.	Monthly
Grass filter strips should be mowed and grass clippings should be removed.	Monthly
Check observation wells after 72 hours of rainfall. Wells should be empty after this time period. If wells have standing water, the underdrain system or outlet may be clogged.	Semi-annual (every 6-months)
Remove evasive vegetation.	Semi-annual (every 6-months)
Inspect pretreatment structures for deposited sediment.	Semi-annual (every 6-months)
Replace pea gravel, topsoil and top surface filter fabric.	When clogging or surface standing water is observed
Perform total rehabilitation of infiltration trench.	Upon observed failure

Infiltration Trench

Enhanced Dry Swales

Description

Enhanced dry swales are conveyance channels engineered to capture, treat, and release the storm water quality runoff volume from a particular drainage area. Enhanced swales are different from normal drainage swales in that they have a designed structure implemented in them to enhance detention and storm water pollutant removal. Enhanced dry swale systems are designed primarily for storm water quality and have only a limited ability to provide storm water runoff volume control and downstream channel protection. Enhanced dry swales are vegetated channels designed to include a filter bed of prepared soil that overlays an underdrain system. Dry swales are sized to allow the entire water quality storage volume to be filtered or infiltrated through the swale bottom. Because these swales are predominantly dry, they are preferred in residential settings.

When and Where to Use It

Enhanced swales are applicable in moderate to large lot residential developments and industrial areas with low to moderate density where the impervious cover (parking lots and rooftops) of the contributing drainage areas is relatively small. Enhanced swales are also useful along rural roads and highways that have driveway entrances crossing the swale.

Inspection and Maintenance

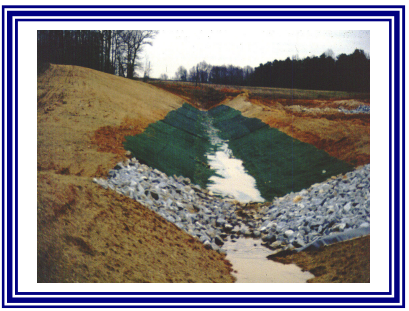
Regular inspection and maintenance is critical to the effective operation of enhanced swales. Maintenance responsibility should be vested with a responsible authority by means of a legally binding and enforceable maintenance agreement that is executed as a condition of plan approval.

The surface of the filter bed may become clogged with fine sediments over time. Light core aeration is required to ensure adequate filtration. Other required maintenance includes but is not limited to:

- Mowing to maintain storage volume and appearance as needed.
- Remove trash and debris as needed.

Summary of Maintenance Requirements

Required Maintenance	Frequency
Mow grass to maintain design height and remove clippings.	As needed (frequent/seasonally)
Nutrient and pesticide management.	Annual, or as needed
Inspect side slopes for erosion and repair.	Annual, or as needed
Inspect channel bottom for erosion and repair.	Annual, or as needed
Remove trash and debris accumulated in forebay.	Annual
Inspect vegetation. Plant an alternative grass species if original cover is not established.	Annual (semi-annually first year)
Inspect for clogging and correct the problem.	Annual
Roto-till or cultivate the surface of the bed if swale does not draw down in 48 hours.	As needed
Remove sediment build-up within the bottom of the swale.	As needed, after 25% of the original design volume has filled



Enhanced Swales

Pre-Fabricated Control Devices

Description

The need for urban water quality BMPs that are very efficient and present less space constraints has produced the industry of innovated storm water BMP technology and products. These pre-manufactured products combine settling, filtration, and various biological processes into one controlled system. By combining these different processes, these BMPs are designed to focus on removing many different types and concentrations pollutants. Even where pre-fabricated control devices are not able to meet the 80 percent TSS removal goal alone, they can provide excellent pre-treatment in a series of water quality control BMPs or inlet to permanent pool detention basins or storm water wetlands.

Post construction pre-fabricated storm water quality BMPs are designed to filter and trap trash, floatable contaminates, sediment, oil and grease, and other pollutants. These BMPs are incorporated into storm water conveyance systems for pretreatment of storm water runoff. In some instances, pre-fabricated storm water quality BMPs serve as the only treatment mechanism before the runoff is discharged. Post construction pre-fabricated storm water quality BMPs are classified in to three separate categories:

1. Catch Basin Inserts
2. Separation Devices
3. Filtration Devices

When and Where to Use It

Pre-fabricated control devices may be used to treat runoff as long as they are designed to treat the first 1-inch of runoff and/or are proven to provide 80 percent TSS removal. Pre-fabricated control devices include the following beneficial attributes for water quality control over conventional water quality BMPs:

- Pre-fabricated control devices are placed almost anywhere on a site where they can receive concentrated flows from storm drainage pipes.

- Pre-fabricated control devises are safe to the public because storm water is treated within the unit and no surfaces are open to the environment, unlike the permanent pool detention pond or storm water wetland.
- Minimal on-site construction is required because pre-fabricated control devices are typically assembled before they reach the site.

Catch Basin Inserts

Catch Basin Inserts are defined as BMPs designed to be installed directly into storm drain catch basins to treat the runoff before it enters the primary conveyance system.

There are three basic Catch Basin Inserts available: tray, bag, and basket. These inlets typically are made of a stainless steel or a high strength corrugated plastic frame that supports a sedimentation chamber and filter media designed to absorb specific pollutants such as oil, grease hydrocarbons, and heavy metals. Catch Basin Inserts sometime include a high flow bypass mechanism to prevent scouring and re-suspension of previously trapped pollutants during larger rainfall events.

Pollutant removal efficiencies are variable and highly dependent on storm frequency, influent pollutant concentrations, rainfall intensity and other factors. Catch Basin Inserts exhibit the following properties:

- Utilize settling, separation, swirling, centrifugal force, and filtering techniques to remove pollutants from storm water runoff.
- Contain no moving components that require an external power source such as electricity, gas powered engines or generators.
- Have posted data from third party test results.

Separation Devices

Separation Devices are defined as BMPs designed and sized to capture and treat storm water runoff to prevent pollutants from being transported downstream. Separation Devices contain a sump for sediment deposition and a series of chambers, baffles, and weirs to trap trash, oil, grease and

other contaminants. These BMPs are designed as flow-through structures where the inflow rate into the structure is regulated. These structures are not designed to store the entire water quality volume. Separation Devices sometime include a high flow bypass mechanism to prevent scouring and re-suspension of previously trapped pollutants during larger rainfall events.

Pollutant removal efficiencies are variable and are highly dependent on storm size, influent pollutant concentrations, rainfall intensity, and other factors. Separation Devices exhibit the following properties:

- Utilize settling, separation, swirling, and centrifugal force techniques to remove pollutants from storm water runoff.
- Contain no moving components that require an external power source such as electricity, gas powered engines or generators.
- Have posted data from third party test results.

Filtration Devices

Filtration Devices are defined as BMPs designed and sized to capture and treat storm water runoff to prevent pollutants from being transported downstream. Filtration Devices are used in areas with impaired receiving waters where high pollutant removal efficiencies are required. Filtration Devices usually contain a sedimentation chamber and a filtering chamber. These devices may contain filter materials or vegetation to remove specific pollutants such as nitrogen, phosphorus, copper, lead, or zinc.

Pollutant removal efficiencies are variable and are highly dependent on storm size, influent pollutant concentrations, rainfall intensity and other factors. Filtration Devices shall exhibit the following properties:

- Utilize filtering techniques to remove pollutants from storm water runoff.
- Have posted data from third party test results.

Products

There are many pre-fabricated water quality structures on the market that may be used as water quality control BMPs.

Installation

Install in accordance with the Manufacturer's written installation instructions and in compliance with all OSHA, local, state, and federal codes and regulations. A Manufacturer's representative is required to certify the installation of all post construction pre-fabricated storm water quality BMPs.

Proper site stabilization is essential to ensure that post construction pre-fabricated storm water quality BMPs function as designed. These structures are not interned to trap eroded sediment from during construction operations. Post construction pre-fabricated storm water quality BMPs are the last storm water runoff structures installed on-site, or shall remain off-line until final stabilization is achieved.

Inspection and Maintenance

- Inspect and maintain in accordance with the Manufacturer's written recommendations.
- The specific maintenance requirements and schedule prepared by the Manufacturer is signed by the owner/operator of the BMP.
- Require frequent inspection and maintenance to maximize pollutant removal.
- Maintain BMPs at least bi-annually to ensure that the BMPs are working properly.
- Keep a maintenance log to track routine inspections and maintenance. Lack of maintenance is the most common cause of failure for post construction pre-fabricated storm water quality BMPs.
- Remove accumulated sediment and other trapped pollutants when the BMP becomes full. Typical removal of pollutants requires the use of a Vactor truck.

Summary of Maintenance Requirements

Required Maintenance	Frequency
Inspect separation and filtration units.	Regularly (quarterly)
Clean out sediment, oil and grease, and floatables. Manual removal of pollutants may be necessary.	As needed
Perform requirements obtained from manufacturer.	As needed
Inspections.	Frequency of inspection and maintenance is dependent on land use, accumulated solids climatological conditions, and design of pre-fabricated device

Catch Basin Insert

Separation Device

Filtration Device

Vegetated Filter Strips

Description

Vegetated Filter Strips (VFS) are zones of vegetation where pollutant-laden runoff is introduced as sheet flow. VFS may take the form of grass filters, grass filter strips, buffer strips, vegetated buffer zones, riparian vegetated buffer strips, and constructed filter strips.

When and Where to Use It

Applicable in areas where filters are needed to reduce pollutant impacts to adjacent properties and water bodies. VFS are used to remove pollutants from overland sheet flow but are not effective in removing sediment from concentrated flows. There are two main classifications of VFS:

- Constructed filter strips: Constructed and maintained to allow for overland flow through vegetation that consists of grass-like plants with densities approaching that of tall lawn grasses.
- Natural vegetative strips: Area where pollutant-laden flow is directed in an overland manner, including riparian vegetation around drainage channels. Vegetation ranges from grass-like plants to brush and trees with ground cover.

VFS remove pollutants primarily by three mechanisms:

1. Deposition of bedload material and its attached chemicals as a result of decreased flow velocities and transport capacity. This deposition takes place at the leading edge of the filter strip.
2. Trapping of suspended solids by the vegetation at the soil vegetation interface. When suspended solids settle to the bed, they are trapped by the vegetated litter at the soil surface instead of being re-suspended as would occur in a concentrated flow channel. When the litter becomes inundated with sediment, trapping no longer occurs by this mechanism.
3. Trapping of suspended materials by infiltrating water. This is the primary mechanism by which dispersed clay sized particles are trapped.

VFS effectiveness fluctuates considerably depending on vegetation type, vegetation height and density, season of the year, eroded particle characteristics, size of drainage area, and site topography.

Inspection and Maintenance

- Maintenance is very important for filter strips, particularly in terms of ensuring that flow does not short circuit the practice. They require similar maintenance to other vegetative practices.
- Inspect vegetation for rills and gullies annually and correct. Seed or sod bare areas.
- Inspect grass after installation to ensure it has established. If not replace with an alternative species.
- Inspect to ensure that grass has established annually. If not, replace with an alternative species.
- Mow grass to maintain a height of 3- to 4-inches.
- Remove sediment build-up from the bottom when it has accumulated to 25% of the original capacity.

Summary of Maintenance Requirements

Required Maintenance	Frequency
Mow grass to maintain design height.	Regularly (frequently)
Remove litter and debris.	Regularly (frequently)
Inspect for erosion, rills and gullies and repair.	Annual, or as needed
Repair sparse vegetation.	Annual, or as needed
Inspect to ensure that grass has established. If not, replace with an alternative species.	Annual, or as needed
Nutrient and pesticide management.	Annual, or as needed
Aeration of soil.	Annual, or as needed

Roadside Vegetated Filter Strip

Grass Pavement and Porous Pavement Surfaces

Description

Grass Paving

Grass paving technology allows for the reduction of paved areas by implementing grass paving in areas that are infrequently used such as fire lanes and overflow parking where applicable. A variety of grass paving materials are available on the market. Grass paving units are designed to carry vehicular loading and may be composed of different types of materials. The pavers are typically covered with sod to make the areas indistinguishable from other grassed areas. Grass pavers allow water quality benefits by allowing storm water to infiltrate into the underlying soils and by the filtering of storm water as it flows through the grass.

Grass pavers provide a more aesthetically pleasing site and reduce the impact of complete asphalt surfaces. Grass pavers should not be used for frequently traveled or parked in areas. Grass pavers reduce the runoff volume and extend the time of concentration for a particular site. Some pavers provide enough infiltration to be considered a pervious area.

Porous Paving

Porous pavement is a permeable pavement surface with an underlying stone reservoir to temporarily store surface runoff before it infiltrates into the subsoil. This porous surface replaces traditional pavement, allowing parking lot storm water to infiltrate directly and receive water quality treatment, and also reducing runoff from the sit

When and Where to Use It

Porous pavement options include porous asphalt, pervious concrete, and grass pavers. The ideal application for porous pavement is to treat low-traffic or overflow parking areas. Porous pavement also has highway applications where it is used as a surface material to reduce hydroplaning.

Porous pavements are a good option in ultra-urban areas because they consume no space since there is very little pervious area in these areas. Since porous pavement is an infiltration practice, do not apply it on storm water hot spots due to the potential for ground water contamination. The best application of porous pavement for retrofits is on individual sites where a parking lot is being resurfaced.

Inspection and Maintenance

- Porous pavement requires extensive maintenance compared with other practices.
- Avoid sealing or repaving with non-porous materials.
- Ensure that paving area is clean of debris, paving dewaters between storms, and that the area is clean of sediments monthly.
- Mow upland and adjacent areas, and seed bare areas as needed.
- Vacuum sweep frequently to keep the surface free of sediment as needed.
- Inspect the surface for deterioration or spalling annually.
- Perform high pressure hosing to free pores in the top layer from clogging as needed.

Porous Paving

Special Construction Operation BMPs

Pollution Prevention (P2) BMPs for water quality management during Special Construction Operations are discussed in this Field Manual in the indicated Sections:

- Vehicle and Equipment Washing
- Truck Washing
- Potable Water and Irrigation
- Illicit Connection/ Illegal Discharge Detection and Reporting
- Fertilizer Management
- Stockpile Management

Vehicle and Equipment Washing

On-site vehicle and equipment washing is discouraged. Clean all vehicles/equipment that regularly enters and leaves the construction site off-site. However, if vehicle or equipment cleaning operations must be performed on a construction site, use the BMPs presented below to minimize or eliminate the discharge of pollutants to storm drain systems or to watercourses.

BMPs

- Wash vehicles and equipment within a structure or building equipped with appropriate disposal facilities, if possible.
- When vehicle and equipment washing must occur onsite and outside, the outside cleaning area should have the following characteristics, and should be arranged with the Engineer or CRM:

  – Located away from storm drain inlets, drainage facilities, or watercourses;
  – Paved with concrete or asphalt and bermed to contain wash waters and to prevent run-on and runoff;
  – Configured with a sump to allow collection and disposal of wash water;
  – Wash waters should not be discharged to storm drains or watercourses; and,
  – Used only when necessary.

- Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site unless wastes are fully contained and disposed of properly outside the highway right-of-way.
- The use of diesel for vehicle and equipment cleaning is prohibited.
- Vehicle and equipment wash water should be contained for percolation or evaporative drying away from storm drain inlets or watercourses and should not be discharged within the highway right-of-way. Apply sediment control BMPs if applicable.

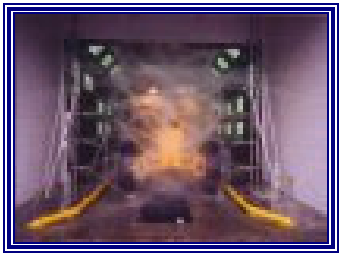
- When cleaning vehicles/equipment with water:

– Use as little water as possible. High pressure sprayers may use less water than a hose, and should be considered; and,
– Use positive shutoff valve to minimize water usage.

- Minimize the use of solvents. Do discharge thinners or solvents into Sanitary or storm sewer systems when cleaning large machine parts where discharge of water is required. Use alternative methods for cleaning larger equipment parts such as high pressure, high temperature water washes, or steam cleaning.
- Equipment washing detergents can be used and wash water discharged into the sanitary system if grit is removed from the solution first. The water discharged into the sewer system must not exceed discharge limits set by the local sewer authority.
- Small parts can be cleaned with degreasing solvents, which are reused after filtering or recycled. These solvents should not be discharged into any sewer.

Inspection and Maintenance

- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate vehicle and equipment washing and cleaning practices are being implemented.
- Inspect wash water sump regularly and remove liquids and sediment as needed or as directed by the Engineer or CRM.



Vehicle & Equipment Washing

Concrete Truck Washout

Concrete trucks should not typically be washed on site. However, if this does need to occur the following BMPs should be used.

BMPs

- Do not dispose of truck washout water by dumping into a sanitary sewer, storm drain or onto soil or pavement that carries storm water runoff.
- The washout from a concrete truck should be disposed of into:

– A designated area that will later be backfilled: a slurry pit.
– An area where the concrete wash can harden, be broken up, and then disposed of as solid waste.
– A location which is not subject to surface water runoff, and more than 50-feet away from a storm drain, open ditch, or receiving water.

- Pump excess concrete in concrete pump bin back into concrete mixer truck.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed offsite.

Inspection and Maintenance

- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.

- Inspect washout sump regularly and remove liquids and sediment as needed.

Concrete Truck Washout

Concrete Truck Washout

Potable Water and Irrigation

Potable water/irrigation management consists of BMPs to manage the discharge of potential pollutants to storm drains or water courses generated during discharges from irrigation water lines, landscape irrigation, lawn or garden watering, planned and unplanned discharges from potable water sources, water line flushing, and hydrant flushing.

BMPs

- Inspect irrigated areas within the construction limits for excess watering. Adjust watering times and schedules to ensure that the appropriate amount of water is being used and to minimize runoff.
- Direct water from off-site sources around or through a construction site to minimizes contact with the construction site.
- Reuse water line flushing discharge for landscaping purposes.
- Shut off the water source to broken lines, sprinklers, or valves as soon as possible to prevent excess water flow.
- Protect downstream storm water drainage system and watercourses from water pumped or bailed from trenches excavated to repair water lines.

Inspection and Maintenance

- Repair broken water lines as soon as possible.
- Inspect irrigated areas regularly for signs of erosion and/or discharge.

Potable Water & Irrigation

Potable Water & Irrigation

Illicit Connection/ Illegal Discharge

The BMPs provided in this section are designed for construction contractors to recognize illicit connections or illegally dumped or discharged materials on a construction site. Illicit connection/illegal discharge detection and reporting is applicable anytime an illicit connection or discharge is discovered or illegally dumped material is found on the construction site and applies to all construction projects.

BMPs

- Inspect the construction site before beginning the job for evidence of illicit connections or illegal dumping or discharges.
- Inspect site regularly during project execution for evidence of illicit connections or illegal dumping or discharges.
- Observe site perimeter for evidence or potential of illicit discharges or illegally dumped material, which may enter the site.
- Solids – Look for debris, or rubbish piles. Solid waste dumping often occurs on roadways with light traffic loads or in areas not easily visible from the traveled way.
- Liquids – signs of illegal dumping or discharge can include:

– Visible signs of staining or unusual colors to the pavement or surrounding adjacent soils;
– Pungent odors coming from the drainage system;
– Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes; and,
– Abnormal water flow during the dry weather season.

- Urban Areas – Evidence of illicit connections or illegal discharges is typically detected at storm drain outfall locations or at manholes. Signs of an illicit connection or illegal discharge can include:

– Abnormal water flow during the dry weather season;
– Unusual flows in subdrain systems used for dewatering;

- Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes; and,
- Excessive sediment deposits, particularly adjacent to or near active off-site construction projects.

- Rural Areas – Illicit connections or illegal discharges involving irrigation drainage ditches are detected by visual inspections. Signs of an illicit discharge can include:

- Abnormal water flow during the dry weather season;
- Non-standard junction structures; and,
- Broken concrete or other disturbances at or near junction structures.

Inspection and Maintenance

- Notify the Engineer or CRM of any illicit connections and illegal dumping or discharge incidents at the time of discovery.
- The contractor is not responsible for investigation and clean up of illicit or illegal dumping or discharges not generated by the contractor. SCDOT may direct contractors to clean up non-hazardous dumped or discharged material on the construction site.

Illicit Connections

Fertilizer Management

This section provides BMPs that will aid in reducing the contributions of pollutants from pesticides and fertilizers to storm water discharges. The term pesticide in this Manual refers to insecticides, fungicides, herbicides, nematicides, desiccants, defoliants, plant regulators, and disinfectants.

BMPs

Pesticide Applications

- Perform pesticide application with a licensed applicator.
- Follow instructions closely when applying pesticides around streams or ditches that may carry runoff. The proper application of a pesticide is described on the container label.
- Notify neighbors on properties adjacent to the one being sprayed prior to spraying.
- Place warning signals in areas recently sprayed or treated with the most dangerous pesticides.

Fertilizer Applications

- Fertilizers used in re-vegetating graded areas often cause inorganic nutrient pollution. Use proper soil-stabilization measures, sediment control, and storm water detention structures as effective means of keeping these materials out of waterways.
- Minimize nutrient pollution by working fertilizer and lime materials into the soil to depths of 4- to 6-inches and proper timing of the application.
- Hydro-seeding operations where seed, fertilizer and lime are applied in a one-step operation, are more conducive to nutrient pollution than conventional seedbed-preparation operations, where fertilizer and lime are tilled into the soil.
- Control can be achieved by applying the required quantity of fertilizer in more than one operation. For example, an area requiring an application of 500 pounds per acre or fertilizer could be dressed with about 125 pounds per acre at four separate times over the growing season.

- Use of fertilizer containing little or no phosphorous may be required by local authorities if development is near sensitive water bodies. In any event, use only the minimum amount of phosphorus needed, as determined by soil tests.
- Near sensitive surface waters, the addition of lime can affect the pH of runoff and receiving waters. Importation of topsoil is better than heavily liming and fertilizing exposed subsoil.

Storage and Handling

- Establish a locked, weather-resistant storage area for pesticides and fertilizer on the construction site.
- Container lids should be tightly closed.
- Keep pesticides in a cool, dry place. Many pesticides rapidly lose their effectiveness if stored in areas exposed to heat.
- In case of a leak, put original container into a larger container and label it properly.
- Keep a list of products in storage.
- Use plastic sheeting to line the storage area.
- Remind workers during pre-construction or safety meetings about proper storage and handling of materials.

Inspection and Maintenance

All storage sheds, dumpsters, or other storage facilities should be regularly monitored for leaks and repaired as necessary.

Fertilizer Management

Stockpile Management

The stockpile management BMPs described in this section are designed to reduce or eliminate air and storm water pollution from stockpiles of soil, and paving materials such as PCC rubble, AC, AC rubble, aggregate base, aggregate subbase or pre-mixed aggregate, asphalt binder (so-called "cold mix" asphalt) and pressure treated wood. These practices should be implemented at all construction sites that stockpile soil or these other materials.

BMPs

General

- Protection of stockpiles is a year-round requirement.
- All active stockpiles should be covered, stabilized, or protected with a temporary linear sediment barrier prior to the onset of precipitation.
- All non-active stockpiles should be covered or protected with a temporary perimeter sediment barrier at all times.
- Cover stockpiles with plastic, mats, blankets, mulches, or sprayed with water or soil binders.
- Surround the base of a stockpile may with a row of fiber rolls, silt fence, or other sediment barrier.
- Keep the height of stockpiles low, and adjust the shape and orientation of the stockpiles to reduce the area of exposure to the prevailing wind.
- Locate stockpiles a minimum of 50-feet away from concentrated flows of storm water, drainage courses, and inlets.
- Bagged materials should be placed on pallets and under cover.
- Cold mix stockpiles should be placed on and covered with plastic or comparable material at all times.
- Treated wood (wood treated with copper, chromium and arsenic or ammonical, copper, zinc, and arsenate) should be covered with plastic or comparable material.

Inspection and Maintenance

Repair and/or replace perimeter controls and covers as needed, or as directed by the CRM to keep them functioning properly. Sediment should be removed when sediment accumulation reaches one-third (1/3) of the barrier height.

Stockpile Management

Stockpile Management

Waste Management BMPs

Waste Management BMPs for construction sites are discussed in this Field Manual in the indicated Sections:

- Solid Waste Management
- Liquid Waste Management
- Hazardous Waste Management
- Sanitary and Septic Waste Management
- Concrete Waste Management
- Spill Prevention, Control and Cleanup

Solid Waste Management

Solid waste management BMPs are designed to minimize or eliminate the discharge of pollutants to the drainage system or to watercourses as a result of the creation, stockpiling, or removal of construction site wastes. The BMPs presented below can be implemented on all construction projects that generate solid wastes. Solid wastes include but are not limited to:

- Construction wastes including brick, mortar, timber, steel and metal scraps, sawdust, pipe and electrical cuttings, non-hazardous equipment parts, Styrofoam and other materials used to transport and package construction materials.
- Highway planting wastes, including vegetative material, plant containers, and packaging materials.
- Litter, including food containers, beverage cans, coffee cups, paper bags, plastic wrappers, and smoking materials, including litter generated by the public.

BMPs

- Instruct employees and subcontractors on identification of solid waste and hazardous waste and proper disposal procedures, and encourage these procedures to be followed.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Wherever possible, minimize production of solid waste materials.
- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project and properly serviced.
- Frequent garbage removal helps maintain clean construction sites and minimizes the exposure of waste to storm water.

- The site should be kept clean of litter debris.
- To prevent clogging of the storm drainage system, litter and debris removal from drainage system, drainage grates, trash racks, and ditch lines should be a priority.
- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods. These containers should be handled and by trash hauling contractors. Only watertight dumpsters are acceptable for use on-site.
- Construction debris and litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly regardless of whether the litter was generated by the Contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, storm water drainage systems or watercourses.
- Solid waste storage areas should be located at least 50-feet from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.
- Dumpster washout on the project site is not allowed.
- Plan for additional containers during the demolition phase of construction.
- Plan for more frequent pickup during the demolition phase of construction.
- Construction waste should be stored in a designated area approved by the CRM and should be removed from the site every two weeks or directed by the Engineer or CRM.
- Segregate potentially hazardous waste from non-hazardous construction site waste.

- Make sure the toxic liquid wastes (e.g., used oils, solvents, and paints) and chemical (e.g., acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.

- For disposal of hazardous waste, see section on *Hazardous Waste Management.* Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and/or surplus building materials when practical. For example, trees and shrubs from land clearing can be converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

Inspection and Maintenance

The Engineer or CRM should monitor onsite solid waste storage and disposal procedures.

Inspect site for litter and debris.

Solid Waste Management

Liquid Waste Management

Liquid waste management BMPs are designed to prevent or minimize the discharge of pollutants to the storm drain system or receiving waters as a result of the creation, collection, and disposal of non-hazardous liquid wastes. Liquid waste management BMPs are applicable to construction projects that generate any of the following non-hazardous byproducts, residuals, or wastes:

- Drilling slurries and drilling fluids;
- Grease-free and oil-free wastewater and rinse water;
- Dredgings; and,
- Other non-storm water liquid discharges not permitted by separate permits.

Disposal of some liquid wastes may be subject to specific laws and regulations, or to requirements of other permits secured for the construction project (e.g., other NPDES permits, Army Corps of Engineers permits, etc.).

This section does not apply to dewatering operations (see *Construction Dewatering*) or to permitted non-storm water discharges (see *Sections* various non-storm water discharges).

BMPs

General Practices

- The Engineer or CRM should oversee and enforce proper liquid waste management procedures and practices.
- Instruct employees and subcontractors how to safely differentiate between non-hazardous liquid waste and potential or known hazardous liquid waste.

- Instruct employees, subcontractors, and suppliers that it is unacceptable for any liquid waste to enter any storm drainage structure, waterway, or receiving water.

- Educate employees and subcontractors on liquid waste generating activities, and liquid waste storage and disposal procedures.

- Incorporate the discussion of proper disposal procedures into regular safety meetings.

- Apply the BMPs identified in *Vehicle and Equipment Washing*, for managing wash water and rinse water from vehicle and equipment cleaning operations.

Containing Liquid Wastes

- Drilling residue and drilling fluids should not be allowed to enter storm drains and watercourses and should be disposed of outside the highway right-of-way in conformance with the applicable SCDOT Standard Specification.

- If an appropriate location is available, as determined by the Engineer or CRM, drilling residue and drilling fluids may be dried by infiltration and evaporation in a containment facility constructed as described in *Concrete Waste Management* section.

- Liquid wastes generated as part of an operational procedure, such as water-laden dredged material and drilling mud, should be contained and not allowed to flow into drainage channels or receiving waters prior to treatment.

- Contain liquid wastes in a controlled area, such as a holding pit, sediment basin, roll-off bin, or portable tank.

- Containment devices must be structurally sound and leak free. Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated.

- Take precautions to avoid spills or accidental releases of contained liquid wastes. Apply the education measures and spill response procedures outlined in the *Spill Prevention, Control and Cleanup* section.

- Do not locate containment areas or devices where accidental release of the contained liquid can threaten health or safety, or discharge to water bodies, channel, or storm drains.

Capturing Liquid Wastes

- Capture all liquid wastes running off a surface, which has the potential to affect the storm drainage system, such as wash water and rinse water from cleaning walls or pavement.

- Do not allow liquid wastes to flow or discharge uncontrolled. Use temporary dikes or berms to intercept flows and direct them to a containment area or device for capture.

- If the liquid waste is sediment laden, use a sediment trap (*see Section Temporary Sediment Dam*) for capturing and treating the liquid waste stream, or capture in a containment device and allow sediment to settle.

Disposing of Liquid Wastes

- Liquid wastes, such as from dredged material, may require testing and certification whether it is hazardous or not before a disposal method can be determined.

- For disposal of hazardous waste, see section on *Hazardous Waste Management.*

- If necessary, further treat liquid wastes prior to disposal. Treatment may include, though is not limited to, sedimentation, filtration, and chemical neutralization.

Inspection and Maintenance

- Spot check employees and subcontractors at least monthly throughout the job to ensure appropriate practices are being employed.
- Remove deposited solids in containment areas and capturing devices as needed, and at the completion of the task. Dispose of any solids as described in section on *Solid Waste Management*.
- Inspect containment areas and capturing devices frequently for damage, and repair as needed.

Liquid Waste Management

Hazardous Waste Management

The BMPs described in this section are designed to minimize or eliminate the discharge of pollutants from construction site hazardous wastes to the storm drain systems or to watercourses. These BMPs apply to all construction sites. Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum products;
- Asphalt products;
- Concrete curing compounds;
- Pesticides;
- Acids;
- Paints;
- Stains;
- Solvents;
- Wood preservatives; and,
- Roofing tar.

Hazardous products may include one or more of the following words on the label: Caustic; Caution; Combustible; Corrosive; Danger; Explosive; Flammable; Poisonous; Volatile; or Warning.

Use of the BMPs described below, does not relieve SCDOT or their contractors from responsibility for compliance with all federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.

BMPs

Education

- Educate employees and subcontractors on hazardous waste storage and disposal procedures and on potential dangers to humans and the environment from hazardous wastes.

- Instruct employees and subcontractors in identification of hazardous waste.

- Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).

- The Engineer should oversee and enforce proper hazardous waste management procedures and practices.

Storage Procedures

- Buy and use only what is needed. Leftovers need to be stored, reused, given away, recycled, or disposed of safely. Look for nontoxic or less toxic options (check with materials specialists).

- Try to keep products in original containers and always keep them well-labeled. If the product must be transferred to smaller containers, use the proper size funnel and avoid spills.

- Labels can fall off with weathering. To prevent this, cover labels with transparent tape. To re-label, use a metal tag attached to the container or use a stencil and spray paint.

- Keep corrosive liquids away from flammable liquids.

- Wastes should be stored in sealed containers constructed of a suitable material and should be labeled as required federal regulations.

- All hazardous waste should be stored, transported, and disposed as required by federal regulations.

- Waste containers should be stored in temporary containment facilities that should comply with the following requirements:

- Temporary containment facility should be impervious to the materials stored there for a minimum contact time of 72-hours.
- Temporary containment facilities should be maintained free of accumulated rainwater and spills. In the event of spills or leaks accumulated rainwater and spills should be placed into drums after each rainfall. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids should be sent to an approved disposal site.
- Provide sufficient separation between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Temporary containment facilities should be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs. A storage facility having a solid cover and sides is preferred to a temporary tarp. Storage facilities should be equipped with adequate ventilation.

- Drums should not be overfilled and wastes should not be mixed.

- Unless watertight, do store containers of dry waste on pallets.

- Paint brushes and equipment for water and oil based paints should be cleaned within a contained area and should not be allowed to contaminate site soils, watercourses or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused should be disposed of as hazardous waste.

- When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths should be disposed of as solid waste with other construction debris.

- For water-based paint, clean brushes to the extent practical, and rinse to a drain leading to a sanitary sewer where permitted, or into a concrete washout pit.

- For oil-base paints, clean brushes to the extent practical and filter and reuse thinners and solvents.
- Ensure that adequate hazardous waste storage volume is available.
- Ensure that hazardous waste collection containers are conveniently located.
- Designate hazardous waste storage areas on site away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.
- Minimize production or generation of hazardous materials and hazardous waste on the job site.
- Use containment berms in fueling and maintenance areas and where the potential for spills is high.
- Segregate potentially hazardous waste from non-hazardous construction site debris.
- Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.
- Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
- Place hazardous waste containers in secondary containment.
- Do not allow potentially hazardous waste materials to accumulate on the ground.
- Do not mix wastes.

Disposal Procedures

- Use all of the product before disposing of the container.
- Waste should be disposed of outside the highway right-of-way within 90 days of being generated, or as directed by the Engineer.
- Waste should be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
- A DHEC certified laboratory should sample waste and classify it to determine the appropriate disposal facility.
- Make sure that toxic liquid wastes (e.g., used oils, solvents, and paints) and chemicals (e.g., acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for solid waste construction debris.
- Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
- Recycle any useful material such as used oil or water-based paint when practical.

Inspection and Maintenance

- A foreman and/or construction supervisor should monitor on-site hazardous waste storage and disposal procedures.
- Waste storage areas should be kept clean, well organized, and equipped with ample clean-up supplies as appropriate for the materials being stored.
- Storage areas should be inspected in conformance with the provisions in the contract documents.

- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.
- Clean hazardous spills should and report conformance with the applicable MSDS and the instructions posted at the project site.
- The National Response Center at (800) 424-8802, should be notified of spills of federal reportable quantities in conformance with the federal regulations.
- Copy of the hazardous waste manifests should be provided

Poor Hazardous Waste Management

Good Hazardous Waste Management

Sanitary/Septic Waste Management

The BMPs provided in this section may be used to minimize or eliminate the discharge of construction site sanitary/septic waste materials to the storm drain system or to watercourses. Sanitary/septic waste management BMPs are applicable on all construction sites that use temporary or portable sanitary/septic waste systems.

BMPs

Education

- Educate employees, subcontractors, and suppliers on sanitary/septic waste storage and disposal procedures and the potential dangers to humans and the environment from sanitary/septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary/septic waste.
- Discuss and reinforce disposal procedures during regular safety meetings.

Storage and Disposal Procedures

- Temporary sanitary facilities should be located away from drainage facilities, watercourses, and from traffic circulation.
- Wastewater should not be discharged or buried within the highway right-of-way.
- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, should comply with the local health agency, city, county, and sewer district requirements.
- If using an on site disposal system, such as a septic system, comply with local health agency requirements.

- Properly connect temporary sanitary facilities that discharge to the sanitary sewer system to avoid illicit discharges.

- Ensure that sanitary/septic facilities are maintained in good working order by a licensed service. Use only reputable, licensed sanitary/septic waste haulers.

Inspection and Maintenance

Monitor onsite sanitary/septic waste storage and disposal procedures at least weekly.

Sanitary and Septic Waste Management

Sanitary and Septic Waste Management

Concrete Waste Management

This section presents BMPs that are designed to minimize or eliminate the discharge of concrete waste materials to the storm drain systems or watercourses. Concrete waste management BMPs should be implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result from demolition activities.
- Slurries containing Portland cement concrete (PCC) or asphalt concrete (AC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition. See also the section on *Paving and Grinding Operations*.
- Concrete trucks and other concrete-coated equipment are washed on site, when approved by the Engineer. See also *Vehicle and Equipment Washing* and *Concrete Truck Washout.*
- Mortar-mixing stations exist.

BMPs

Education

- Educate employees, subcontractors, and suppliers on the concrete waste management BMPs described in this section.

Concrete Slurry Wastes

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC slurry or hardened wastes should be collected and properly disposed of outside the highway right-of-way in conformance with Standard Specifications or placed in a temporary concrete washout facility.

- Install a sign adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.

- A foreman and/or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, and grooving to ensure proper methods are implemented.

- Do not allow saw-cut PCC slurry to enter storm drains or watercourses. See also *Paving and Grinding Operations* and *Liquid Waste Management*. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine. Saw cutting residue should not be allowed to flow across the pavement, and should not be left on the surface of the pavement.

- Vacuum slurry residue and dispose in a temporary facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allow slurry to dry. Dispose of dry slurry residue in accordance with *Solid Waste Management*.

- Collect and dispose of residue from grooving and grinding operations in accordance with *Solid Waste Management.*

Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures

- Temporary concrete washout facilities should be located a minimum of 50 feet from storm drain inlets, open drainage facilities, and watercourses, unless determined infeasible by the Engineer or CRM. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.

- Install a sign adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.

- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the Contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.

- Perform washout of concrete mixer trucks in designated areas only. Washout may be collected in an impermeable bag for disposal. See also *Concrete Truck Washout*.

- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per *Solid Waste Management*.

Inspection and Maintenance

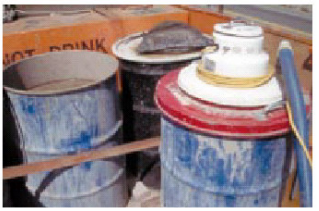
- The Engineer or CRM should monitor on site concrete waste storage and disposal procedures at least weekly.

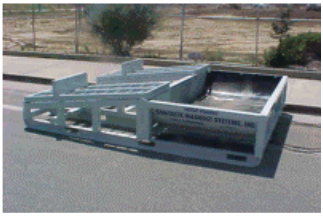
- The Engineer or CRM should monitor concrete working tasks, such as saw cutting, coring, grinding and grooving daily to ensure proper methods are employed.

- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4-inches for above grade facilities and 12-inches for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition.

- Existing facilities should be cleaned, or new facilities should be constructed and ready for use once the washout is 75% full.

- Temporary concrete washout facilities should be inspected for damage (i.e., tears in PVC liner, missing sandbags, etc.). Damaged facilities should be repaired immediately.





Concrete Waste Management

Spill Prevention Control and Cleanup (SPCC)

The BMPs described below should be implemented to prevent and control spills in a manner that minimizes or prevents the discharge of spilled material to the drainage system or watercourses. They apply to all construction projects and should be utilized anytime chemicals and/or hazardous substances are stored on site. Substances may include, but are not limited to:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals
- Fuels
- Lubricants, and
- Other petroleum distillates

To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110, 117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.

Develop and implement a SPCC Plan as part of the SWPPP if appropriate for the construction site involved. The SPCC Plan will identify persons responsible for implementing the plan if a spill of a dangerous or hazardous waste should occur.

If a spill, regardless of size, of a hazardous substance could reach surface waters, DHEC must be notified. When reporting a spill, the following information must be provided:

- Reporting party;
- Material released;

- Concentration of material;
- Contact phone number(s);
- Resource damages (e.g., dead fish);
- Location;
- Responsible party;
- Quantity of spill; and,
- Cleanup status.

Procedures and practices presented in this BMP are general. The site Contractor should identify appropriate practices for the specific materials used or stored on-site.

BMPs

Education

- Educate employees and subcontractors on what a "significant spill" is for each material they use, and what is appropriate response for "significant" and "insignificant" spills.

- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.

- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).

- Provide specific cleanup instructions for different products handled on-site.

- Assign a person to be in charge of cleanup assistance.

- Prepare spill containment and cleanup lists that are easy to find and use.

- Post a summary of the cleanup plan at appropriate locations.

Cleanup and Storage Procedures

- If a spill occurs, demobilize it as soon as possible.
- If there is a chance that the spill could enter a storm drain or sewer, plug the inlet and turn off or divert any incoming water.
- Cover the spill with absorbent material such kitty litter or sawdust. Do not use straw. Dispose of the used absorbent per manufacturer's instructions. If the spill is flammable, dispose of as directed by the local fire marshal.
- Keep the area well ventilated.
- Minor Spills – Minor spills typically involve small quantities of oil, gasoline, paint, etc., which can be controlled by the first responder at the discovery of the spill. Use absorbent materials on small spills rather than hosing down or burying the spill.
- Semi-Significant Spills – Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.
- Contain spills immediately:

– If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
– If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike.
– If the spill occurs during rain, to the extent that it doesn't compromise clean up activities, cover spill with tarps or other material to prevent contaminating runoff.

- Significant/Hazardous Spills – For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up the spill until the appropriate and qualified staff has arrived at the job site.

- Spills should not be buried or washed with water.

- Used clean up materials, contaminated materials, and recovered spill material that are no longer suitable for the intended purpose should be stored and disposed of properly.

- Water used for cleaning and decontamination should not be allowed to enter storm drains or watercourses and should be collected and disposed of as described in *Liquid Waste Management*.

- Proper storage, clean-up and spill reporting instructions for hazardous materials stored or used on the project site should be posted at all times in an open, conspicuous and accessible location.

- Waste storage areas should be kept clean, well organized and equipped with ample clean-up supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers and liners should be repaired or replaced as needed to maintain proper function.

Inspection and Maintenance

- Verify weekly, that spill control clean up materials are located near material storage, unloading and use areas.

- Update SPCC plans and stock appropriate clean-up materials whenever changes occur in the types of chemicals used or stored onsite.

Spill Prevention, Control and Cleanup

Spill Cleanup Kit

8.0 Standard Details

No.	Description
EC-01	Tracking
EC-02	Stair Step Grading
EC-03	Slope Grooving
SC-01	Sediment Basin
SC-02	Sediment Trap
SC-03	Silt Fence
SC-04	Rock Ditch Check
SC-05	Sediment Tube
SC-06	Stabilized Construction Entrance
SC-07	Type A – Filter Fabric Inlet Protection
SC-07	Type A – Sediment Tube Inlet Protection
SC-08	Type B – Wire Mesh and Stone Inlet Protection
SC-09	Type C – Block and Gravel Drop Inlet Protection
SC-10	Type E – Surface Course Curb Inlet Filters
SC-10	Type E – Surface Course Curb Inlet Filters
SC-11	Type F – Inlet Tubes
SC-12	Rock Sediment Dike
SC-12	Rock Sediment Dike (page 2)
SC-12	Rock Sediment Dike (Page 3)
RC-01	Pipe Slope Drain
RC-02	Diversion Dike or Berm

No.	Description
RC-03	Diversion Swale
RC-04	Level Spreader
RC-05	Temporary Stream Low Water Crossing
RC-06	Subsurface Drain Layout
WQ-01	Stream Buffer
WQ-02	Wet Detention Pond
WQ-02A	Extended Detention Shallow Wetland
WQ-02B	Micropool Extended Detention Pond
WQ-03	Dry Ponds
WQ-04A	Shallow Wetland
WQ-04B	Wet Extended Detention Pond
WQ-04C	Pond/Wetland System
WQ-04D	Pocket Wetland
WQ-05	Typical Bioretention Area
WQ-06	Infiltration Trench
WQ-07	Enhanced Dry Swale
WQ-08	Vegetated Filter Strip