North Carolina Department of Transportation

Erosion and Sediment Control Design and Construction Manual



2015 Edition


NCDOT ESC Erosion & Sediment CONTROL MANUAL

North Carolina Department of Transportation

Erosion and Sediment Control Design and Construction Manual

NCDOT

North Carolina Department of Transportation

Roadside Environmental Unit

1557 Mail Service Center

Raleigh, NC 27699-1557

919.707.2920

URS

Designed & Developed by:

URS Corporation – North Carolina

1600 Perimeter Park Drive, Suite 400

Morrisville, NC 27560

919.461.1100

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List of Acronyms

AOS	Apparent Opening Size
ARI	Average Recurrence Interval
BB	Bid Build
BMPs	Best Management Practices
C&G	Clearing and Grubbing
CAMA	Coastal Area Management Act
CCPCUA	Central Coastal Plain Capacity Use Area
CE	Categorical Exclusion
CEI	Construction, Engineering and Inspection
cfs	cubic foot per second
CICA	Construction Industry Compliance Assistance Center
CPESC	Certified Professional in Erosion and Sediment Control
CPSWQ	Certified Professional in Storm Water Quality
CWA	Clean Water Act
DB	Design Build
DCM	Division of Coastal Management
DEMLR	Division of Energy, Mineral and Land Resources
DEO	Division Environmental Officer
DMF	Division of Marine Fisheries
DOH	Division of Highways
DSWM	Division of Solid Waste Management
DWR	Division of Water Resources
E&SC	Erosion and Sediment Control
E&SC/SW	E&SC / Stormwater Certification Program
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EroDes	Erosion Design Spreadsheet
ESAs	Environmentally Sensitive Areas
FMD	Facilities Management Division
GI/LID	Green Infrastructure and Low Impact Development
HQW	High Quality Water
LEDPA	Least Environmentally Damaging Practical Alternative
MCM	Minimum Control Measures
NCDOT	North Carolina Department of Transportation
NCWRC	North Carolina Wildlife Resources Commission
NOAA's	National Oceanic and Atmospheric Administration's
NPDES	National Pollutant Discharge Elimination System
ORW	Outstanding Resource Water
PDEA	Project Development and Environmental Analysis
PIST	Pipe Inlet Sediment Traps
PSRM	Permanent Soil Reinforcement Matting

List of Acronyms, cont.

RECP	Rolled Erosion Control Products
REU	Roadside Environmental Unit
RFC	Released for Construction
RFP	Request for Proposals
RIST	Rock Inlet Sediment Traps
ROW	Right-of-Way
PIST	Pipe Inlet Sediment Trap
RUSLE2	Revised Universal Soil Loss Equation, Version 2
SDOs	Stormwater Discharge Outfalls
SHPO	State Historic Preservation Office
SPCA	Sedimentation Pollution Control Act of 1973
SPCC	Spill Prevention Control and Countermeasure
SSCF	Special Sediment Control Fence
SWPPP	Stormwater Pollution Prevention Plan
TIP	Transportation Improvement Projects
TMDL	Total Maximum Daily Load
Tr	Trout Waters
TRSC-A	Temporary Rock Silt Check, Type A
TRSC-B	Temporary Rock Silt Check, Type B
TRSD-A	Temporary Rock Sediment Dam - Type A
TRSD-B	Temporary Rock Sediment Dam - Type B
UV	Ultraviolet
WS-I, WS-II, SA	Watershed Supply I, II and Shellfishing Waters

Chapter 1

Introduction

Managing Erosion and Sediment Control (E&SC) on North Carolina Department of Transportation (NCDOT) Projects

Due to the magnitude of land-disturbing activity conducted by the NCDOT, the North Carolina Department of Environment and Natural Resources (NCDENR) has delegated authority to implement the Sedimentation Pollution Control Act of 1973 (SPCA) to the Division of Highways (DOH). NCDOT has been delegated authority over all aspects of its E&SC Program and is committed to reducing the stormwater impacts of transportation-related development on both linear (roadway, toll, rail and bridge projects) and nonlinear (vertical projects such as DOH office buildings and equipment shops) construction projects. The potential for widespread impacts due to improperly managed construction activities has led NCDOT to adopt the highest level of E&SC guidelines and standards.

In order to control soil erosion and sediment, the Roadside Environmental Unit (REU) Soil and Water Engineering Section that designs and reviews E&SC plans prepared for NCDOT contract projects, strictly follows the North Carolina SPCA. The purpose of the SPCA is to prevent and minimize visible off-site sediment from any land-disturbing activity.

This manual provides NCDOT designers and contractors guidance on how to evaluate, plan and conduct the State's transportation-related construction needs while controlling soil erosion and sediment.

How to Use This Manual

This manual has been compiled for NCDOT designers, consultants and contractors to present E&SC information for NCDOT construction activities beginning with regulatory drivers and planning requirements, then providing plan development guidelines for bridge and roadway design-bid-build and design-build projects, as well as low impact bridge projects. Guidelines for NCDOT Operations projects are then provided, as well as nonlinear project guidance, E&SC for Reclamation Plans, construction site pollutants and finally ending with design and construction guidelines for E&SC Best Management Practices (BMPs). The BMP chapter is organized by the following categories (note that some BMPs are listed in more than one category as they perform multiple functions):

Site Preparations

- Provides guidance on installation of gravel construction entrance(s) and highly visible fencing (safety fence and jurisdictional flagging).

Perimeter Areas and Runoff Conveyance

- These BMPs are used to divert clean water away from the project site or trap and treat turbid water runoff from the project site. BMPs covered in this section include Temporary Silt Fence; Temporary Diversion; Temporary Silt Ditch; Silt Fence Breaks and Temporary Earth Berm.

Slope Protection

- Sloped areas within a project area are especially prone to erosion and require special considerations for proper protection. This section discusses the use of Temporary Slope Drains; Special Sediment Control Fence (SSCF); Rolled Erosion Control Products (RECP) and Wattle Barriers.

Runoff Conveyance Management

- BMPs in this section are used in channels, ditches and/or ditch outlets to trap sediment. The devices in this section include: Wattle; Temporary Rock Silt Check, Type A (TRSC-A) with Excelsior Matting and Flocculant; Temporary Rock Silt Check, Type B (TRSC-B); and Clean Water Diversion.

Drainage System Protection

- These devices are used at drop and pipe inlets to impound and settle sediment from the stormwater or in ditches to reduce stormwater velocity and trap sediment. Rock Inlet Sediment Traps (RIST), Types A, B and C; Rock Pipe Inlet Sediment Trap (PIST), Types A and B; and

Temporary Rock Silt Check (TRSC-A), Type A with Excelsior Matting and Flocculant, are the BMPs in this section.

Sediment Containment

- Some of the devices in this section are used to detain sediment-laden stormwater so that solids can settle and water may then be discharged and others are used at outlets or stream crossings to trap sediment before the water leaves a project site. BMPs for sediment containment include: Riser Basin; Silt Basin Type B; Skimmer Basin; Tiered Skimmer Basin; Infiltration Basin with Baffles; Temporary Rock Sediment Dam, Types A and B; Coir Fiber Baffle; Earthen Dam with Skimmer; and Stormwater Basin with Skimmer.

Managing the Watercourse

- BMPs in this section provide guidance for temporarily diverting watercourses while minimizing impacts to streams or adjacent wetlands. Measures used to manage the watercourse include Temporary Stream Crossing; Impervious Dikes; Stilling Basin; and Special Stilling Basin.

Soil Stabilization

- This section provides guidance on stabilizing disturbed areas of a project site. Topics covered are: Seeding and Mulching; Temporary Seeding; and Temporary Mulching.

An Overview of the Keys to E&SC Planning and Design

The goal of the E&SC designer should be to develop a plan to contain all sediment within the construction site or right-of-way for all phases of construction and minimize impacts to water quality. Implementing the ten keys in Table 1.1 is the first step in reaching this goal. More information on these keys, along with associated E&SC BMPs can be found in Chapter 4, E&SC BMPs.

Erosion control
▪ Minimize disturbed area and protect natural features and soil
▪ Phase construction activities
▪ Control stormwater run-on
▪ Stabilize soils
▪ Protect slopes
Sediment control
▪ Protect inlets
▪ Establish perimeter controls
▪ Retain sediment on site
▪ Establish stabilized construction exits
▪ Maintenance of controls

Table 1.1 Keys to E&SC planning and design

Unique Elements of Managing E&SC on Linear Projects

There are many unique challenges that arise with roadway and bridge construction projects as erosion and sedimentation is possible at each stage.

Generally, the greatest potential for erosion occurs during clearing, grubbing, grading and culvert/structure installation (AASHTO, accessed 9-2013)

The ten key E&SC concepts mentioned in Table 1.1 may serve as an initial step in creating an E&SC plan, but there are additional considerations that must be addressed:

- A roadway system may include several drainage areas and convey significant off-site runoff. This often results in intensive inspection requirements for multiple drainage outlets or stormwater discharge outfalls (SDOs).

- Roads within several watersheds may be subject to different stormwater regulations. Careful planning and knowledge of regulations (see Chapter 2 for regulatory guidance) is critical.
- The linear nature of the highway network prevents the use of some land-intensive sediment control devices. Designers are tasked with implementation of BMPs that are suitable given limited right-of-way and geographic constraints; however, applicable easements may be obtained.
- Roadway drainage systems are designed to collect and convey runoff from impervious areas to maintain the structural integrity of the roadway and protect public safety. Designers need to select appropriate erosion and sediment control measures that are effective and applicable to the roadway design, but safe to the public as well.

Regulatory Considerations

Overview

The E&SC designer should be aware of the regulatory considerations that govern construction stormwater management. There are federal and North Carolina regulations that must be followed and NCDOT has been delegated authority to administer the SPCA requirements.

On the federal side, the Clean Water Act (CWA) defined a national goal of eliminating the discharge of pollutants into navigable waters of the United States by the year 1985. This law influenced many states to pass stormwater management and sediment control legislation. The implementation of this law was strengthened by the formation of the U. S. Environmental Protection Agency (EPA) in 1972. The focus in the 1970's began to shift from a non-point source, rural, soil loss problem, to a point source, urban, pollutant discharge problem. Additionally, the focus of the CWA turned from agricultural practices to the rapid growth in land-disturbing activities associated with homebuilding, highway construction and shopping center development. Revisions to the CWA in the 1990's have resulted in the creation of the National Pollutant Discharge Elimination System (NPDES) permit program. In response to this federal initiative, the North Carolina General Assembly passed the NC SPCA of 1973. The SPCA is the main driver for the required E&SC Plans; however, the NPDES program also regulates stormwater associated with construction activities.

North Carolina SPCA of 1973

The SPCA of 1973 authorizes the State and its delegated local authorities to enforce the North Carolina Sedimentation Control Law. The Sedimentation Control Commission and the Division of Energy, Mineral, and Land Resources, a division of NCDENR, exercises this delegation authority. The delegation process enables the state to grant authority to municipalities and other localized government agencies to establish programs to regulate erosion and sediment control activities within their own jurisdiction. The NCDOT is the only state-wide program originally delegated in 1974. A re-delegation in 1991 granted authority to NCDOT to operate and manage its current E&SC program.

NCDOT has the authority of administering the only state-wide delegated E&SC program and must uphold and maintain high design and field performance standards.

The law does allow the designer to use discretion as to a unique and innovative design specific to the individual site conditions based upon four principal factors:

- Soils
- Surface Cover
- Topography
- Climate

The designer will manage these four factors to meet the SPCA's mandate that prohibits off-site sedimentation from construction activities.

CWA

The objective of the Federal Water Pollution Control Act, commonly referred to as the CWA, is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The goal is that this will be accomplished by:

- preventing point and non-point pollution sources,

- providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and
- maintaining the integrity of wetlands.

In 1987, the CWA was amended to require EPA to establish a program to address stormwater discharges. In response, EPA promulgated the NPDES stormwater permit application regulations (EPA, 2013). North Carolina has been delegated authority from the EPA to implement these regulatory requirements. Figure 1.1 shows the history of the federal water pollution control regulations along with the North Carolina-specific water pollution control rules and regulations.

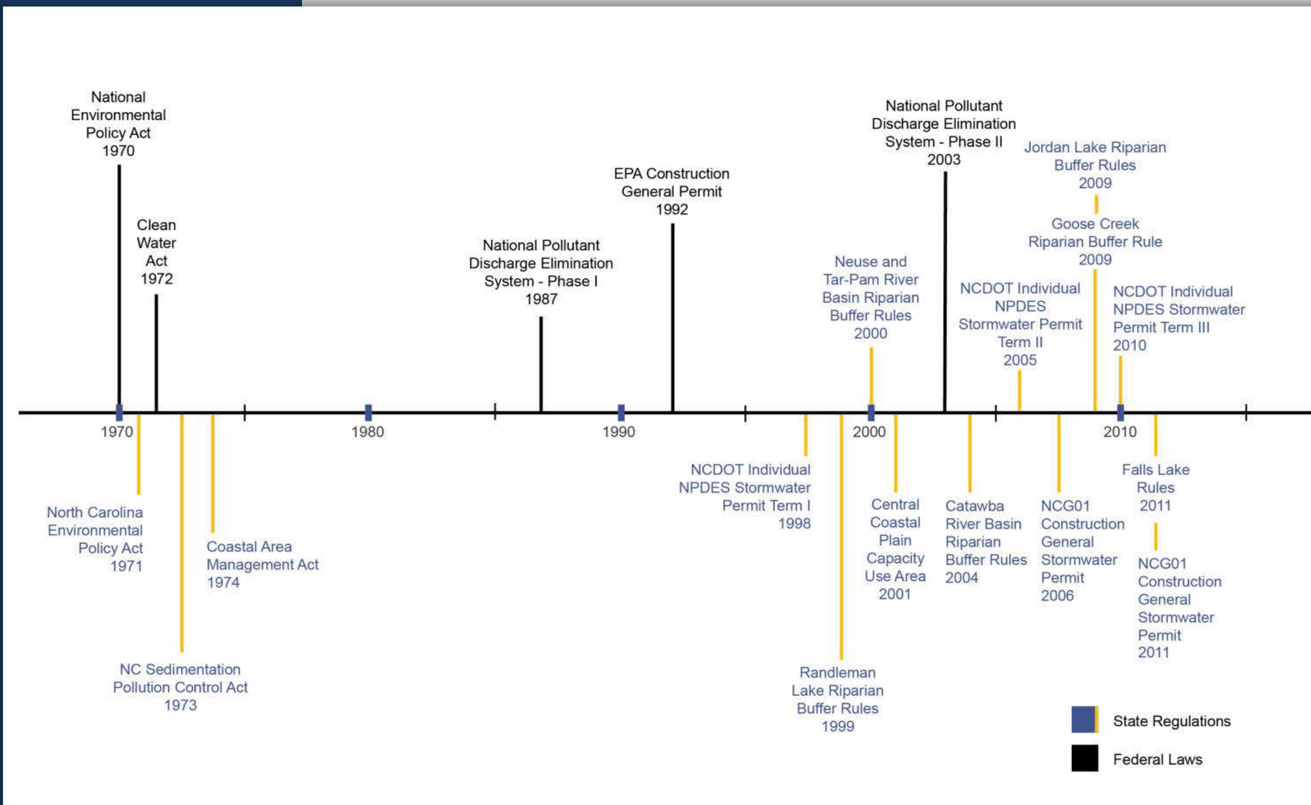

Figure 1.1 Federal and NC water quality regulatory overview

CWA Section 401 and Section 404

Although there are numerous federal and state laws that affect wetlands, the CWA is the primary regulatory tool. Refer to Table 1.2 for a summary of wetland, stream or open water permits and permitting authorities. There are two sections of the CWA that are of particular significance:

- Section 404 of the Clean Water Act enables the Army Corps of Engineers (Corps) to grant permits for certain activities within waterways and wetlands. Construction projects affecting wetlands in any state cannot proceed until a Section 404 permit has been issued. In deciding whether to grant or deny a permit, the Corps must follow certain guidelines.
- Section 401 of the Clean Water Act gives EPA the authority to prohibit an activity, including a construction project, if it can impact water quality or have other unacceptable environmental consequences. For most states including North Carolina, EPA has delegated this authority to state environmental agencies.

These two regulatory activities are usually conducted cooperatively through use of a joint application form. The Corps reviews permit applications to determine if practical alternatives to the project exist. They also impose mitigation requirements on the developer and perform a public interest review. In addition to Corps stream mitigation requirements, NCDENR Division of Water Resources (DWR) has Section 401 stream mitigation requirements that should be referenced. The Corps also determines if other environmental laws must be addressed, including the National Environmental Policy Act, Endangered Species Act, and the National Historic Preservation Act. If the Corps' review reveals that the project should not proceed, they have the authority to either deny or condition the project. Then, using their Section 401 authority, state agencies review the permit application, looking closely at potential water quality impacts. When warranted, the states grant Section 401 certification, which is needed before a Section 404 permit can be issued by the Corps (CICA, http://www.cicacenter.org/wetpermits.html, 8-6-13).

NCDENR's Transportation Permitting Unit works with the NCDOT to assist with the planning, permitting and design of projects. The Unit's responsibilities include the review of NCDOT's Section 401 certification applications, wetland and stream mitigation plans, buffer determinations, as well as conducting relevant NCDOT site visits. Unit staff represents the DWR on the 404/NEPA Merger Team (NCDENR, accessed 8-16-13, http://portal.ncdenr.org/web/wq/ws/tpu).

The following summarizes who issues stream, wetlands or open water permits in North Carolina.	
	Federal permits are issued by the Corps. ▪ Section 10 permits (Rivers & Harbors Act) are required for all work or structures in or affecting navigable waters. ▪ Section 404 permits (CWA) are required for discharging into or filling streams, wetlands or open waters.
	Coastal Area Management Act (CAMA) permits are issued by the N.C. Division of Coastal Management (DCM). ▪ CAMA permits are required for development projects within one of the twenty coastal counties in or affecting an Area of Environmental Concern.
	State certifications and permits are issued by the NC DWR. ▪ 401 Water Quality Certifications (CWA) correspond with the permits issued by the Corps and DCM. They are required for any federally permitted or licensed activity that may result in a discharge to or filling of streams, wetlands or open waters. ▪ Isolated and Other Non-404 Jurisdictional Wetlands and Waters Permits are required for impacts to isolated and other non-404 wetlands, isolated streams or other isolated waters.
	There are more than 16 types of wetlands in North Carolina that are regulated under three categories: ▪ 404 wetlands are regulated under Section 404 of the federal CWA. ▪ Isolated/non-404 wetlands are regulated under North Carolina Administrative Codes. ▪ Coastal (CAMA) wetlands are regulated under CAMA. (NCDENR 401 Fact Sheet, accessed 8-6-13)

Table 1.2 NC water permits

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NPDES Program

The NPDES program was established under the authority of the CWA, Section 402, and includes two phases. Phase I of the NPDES stormwater program was established in 1990. It focused on site and operations planning to reduce pollutant sources. Phase I covered industrial activities in 10 categories, construction activities that disturbed five or more acres and municipalities with populations of 100,000 or more that owned or operated a municipal separate storm sewer system (MS4). Phase II of the program expanded permit requirements to construction disturbing an acre or more and smaller communities (< 100,000 population) and public entities that own or operate an MS4 (NCDENR, 2013, http://portal.ncdenr.org/web/wq/ws/su/npdessw). There are six Phase I communities in North Carolina. Phase II of the NPDES program expanded upon Phase I to incorporate smaller communities of less than 100,000.

Outlined in the NPDES program are six minimum control measures (MCM) that must be met under Phase I and Phase II of the NPDES program. The E&SC regulatory drivers are generated from the Construction Site Stormwater Runoff Control measure. The six measures are shown in Figure 1.2:

Public Outreach & Education	Public Involvement & Participation	Illicit Discharge Detection & Elimination
Construction Site Stormwater Runoff Control	Post-Construction Stormwater Management	Pollution Prevention / Good Housekeeping

Figure 1.2 NPDES minimum control measures

Anyone who discharges or proposes to discharge water into the surface waters of the state must obtain an NPDES permit prior to the initiation of the discharge. There are two types of NPDES permits: general and individual permits.

NPDES General Permit

General permits are issued for a given state-wide activity. Regarding construction activities, all development projects in North Carolina that disturb an acre or greater of land require a local or state-approved E&SC plan. The project will be automatically covered by an NPDES Stormwater General Permit NCG010000 (NCG01) for construction-related activities, provided that the ground stabilization and basin design requirements in that permit are included in the E&SC Plan (NCDENR, 2013).

In North Carolina, the approved E&SC plan for the site, and the NCG01 Construction General Permit are considered the Stormwater Pollution Prevention Plan (SWPPP) for that site.

NCDOT's Individual NPDES Permit

Individual permits are issued on a case-by-case basis when the activities proposed do not qualify under the permitted uses of the general permit.

NCDOT has an individual NPDES permit. The NCDOT individual permit (NCS000250) authorizes NCDOT to discharge stormwater from roadway drainage systems, construction activities, borrow pits and industrial sites. Included as part of this permit are the six minimum control measures shown in Figure 1.2.

Part II, Section D - Construction, provides the objectives for NCDOT's E&SC Program as described in Table 1.3:

NCDOT Individual NPDES Permit – Part II, Section D - Construction	
	1. Continue to control development activities disturbing one or more acres of land surface including activities by NCDOT contractors.
	2. Require construction site operators to implement appropriate E&SC practices.
	3. Require site inspection and enforcement of control measures.
	4. Establish requirements for construction site operators to control waste that may cause adverse impacts to water quality such as discarded building materials, concrete truck washout, chemicals, litter and sanitary waste at the construction site.

Table 1.3 ES&C construction objectives

NCG010000

NCG01 is an NPDES general permit. The NCG01 is applicable to point source discharges from construction activities disturbing one or more acres of land. Figure 1.3 shows key components of the NCG01 permit. NCDOT's individual permit states that the requirements of NCG01 shall be incorporated within NCS000250.

Approved E&SC Plan	Monitoring & Inspections	Operation & Maintenance
• Plans will comply with 7 and 14 day ground stabilization requirements.	• Conduct weekly E&SC measure inspections and within 24 hours after any storm event greater than one half inch during a 24-hour period. • Inspect all outlets where stormwater discharges offsite and maintain records of inspections.	• Install, implement and maintain BMPs and control and restoration measures that minimize pollutants in the discharge.

Figure 1.3 Key components of the NCG01 permit

In addition to the above requirements, the NCG01 NPDES permit also outlines stabilization timeframes. Table 1.4 outlines these timeframes.

Table 1.4. Stabilization Timeframes		
Site Area Description	**Stabilization**	**Timeframe Exceptions**
Perimeter dikes, swales, ditches and slopes	7 days	None
High Quality Water (HQW) Zones	7 days	None
Slopes steeper than 3:1	7 days	If slopes are 10 feet or less in length and are not steeper than 2:1, 14 days are allowed.
Slopes 3:1 or flatter	14 days	7 days for slopes greater than 50 feet in length
All other areas with slopes flatter than 4:1	14 days	None except for perimeter and HQW Zones

Table 1.4 NCG01 NPDES permit stabilization timeframes

■ Threatened and Endangered (T&E) Species Regulations

The Endangered Species Act requires that federally-listed species and habitat not be adversely affected during any activity with federal involvement or subject to federal oversight (i.e., projects that require a NPDES stormwater permit for construction). If project activities could impact these species or habitats, the development of mitigation strategies to minimize the impacts may be required (EPA, accessed 8-16-2013, EPA305-F-03-007).

Private landowners, corporations, state or local governments or other non-federal landowners who wish to conduct activities on their land that might incidentally harm (or "take") a species listed as endangered or threatened must first obtain an incidental take permit from the U.S. Fish and Wildlife Service.

When compiling the E&SC Plan base map (see Chapter 2, E&SC Planning), impacts on T&E species (plant and animal) should be considered. For Transportation Improvement Projects (TIP), the Project Development and Environmental Analysis (PDEA) branch will review and include T&E information in the environmental documents (Chapter 2). Currently, there are 52 federally T&E species known to occur in North Carolina. Fact sheets for each of the known species are listed on the US Fish and Wildlife Service website located at http://www.fws.gov/raleigh/es_tes.html.

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E&SC Planning

Chapter 2

Data Collection and Preliminary Analysis

Prior to planning for activities that could impact water bodies, inquiry should be made regarding any local, state and/or federal regulations in place to protect impacted waters of the state. Water quality classification may impose restrictions or design requirements; therefore, it is important to identify and reference these in the early stages of planning.

The E&SC designer must first develop a base map for the E&SC Plan from detailed topographic maps or geographic data files. For TIP projects, reference existing environmental documents from NCDOT's PDEA for delineated waters. For non-TIP projects, designers will work with the Division Environmental Office or will be responsible for acquiring the environmental documentation on a project. The following information should be recorded on the base map (NCDENR, 2006):

- Soil type and land slopes,
- Natural drainage patterns,
- Unstable stream reaches and flood marks,
- Watershed areas,
- Existing vegetation, noting any special vegetative features,
- Areas such as steep slope, eroding areas, rock outcroppings and seepage zones,
- Unique or noteworthy landscape values to protect,
- Adjacent land uses, especially areas sensitive to sedimentation, turbidity, or flooding and
- Critical or highly erodible soil areas that should be left undisturbed.

Analyze this information and identify:

- Buffer zones,
- Suitable stream crossing areas,

- Access routes for construction and maintenance of sedimentation control devices,
- Borrow and waste disposal areas and
- The most practical sites for control practices.

Note that for TIP projects, PDEA studies various alternatives and the impacts of each alternative, and then they generate an environmental document (Environmental Impact Statement (EIS), Environmental Assessment (EA), Categorical Exclusion (CE), etc.) that aids the designers in selecting the least environmentally damaging practical alternative (LEDPA). If environmental commitments are made, they will be noted on the associated Green Sheets.

Green sheets are internal documents that summarize the department's special project commitments to the various regulatory agencies.

Designers must review and incorporate these commitments into the E&SC plan and design.

For sensitive watersheds where NCDOT has environmental concerns (even if there are no Environmentally Sensitive Areas [ESAs]), NCDOT will incorporate special design standards. For example, if lakes or other recreational impoundments are adjacent to the proposed project, NCDOT will evaluate risks to determine if more stringent design standards are prudent.

Development of the base map and review of the environmental commitments allows the designer to define the limitations of the site and begin "fitting" the development to the site. If possible, conduct a site visit to verify the information gathered for the base map. The NCDENR DWR classifies and regulates all surface waters within the state. Refer to NCDENR DWR's website for a complete list and description of surface water classifications at: http://portal.ncdenr.org/web/wq/ps/csu.

Certain watersheds have more stringent regulations concerning E&SCs and should be identified early on in the planning process. Additional guidance is given in the subsequent sections.

■ E&SC Plan Strategy

This section provides information to assist the E&SC designer in strategizing for optimum E&SC plan design. Before the plan can be developed, there are a multitude of factors that must be considered. Oftentimes, NCDOT has established department-specific guidelines that must be met. The designer must be familiar with North Carolina requirements as well as NCDOT Special Provisions and Standard Specifications before bringing pen to paper.

■ Water Quality Classifications

In the initial planning stages, the designer should identify and address water quality classifications. Table 2.1 lists some of the water quality classifications as outlined by NCDENR DWR and NCDOT requiring additional planning considerations and more aggressive application of BMPs. The categories listed in this table should alert the designer that these areas should be treated with the highest level of design standards.

HQW
▪ HQW ▪ WS-I, Water Supply I ▪ WS-II, Water Supply II ▪ SA, Tidal salt waters used for shell fishing ▪ PNA, Primary Nursery Areas
ESAs
▪ Streams, including HQWs and 303(d)s ▪ Wetlands ▪ ORW, Outstanding Resource Waters ▪ Critical Areas ▪ Regulated Riparian Buffers ▪ CAMA Areas of Environmental Concern ▪ T&E Species Habitat ▪ Trout Waters
303(d) Impaired Waters
▪ Streams impaired for Turbidity
Critical Areas
▪ Land adjacent to water supply intake
Regulated Riparian Buffers
▪ Falls Lake Watershed ▪ Jordan Lake Watershed ▪ Neuse River Basin ▪ Tar-Pamlico River Basin ▪ Catawba River Basin (the main stem of Catawba River and the main stem lakes from Lake James to the North Carolina / South Carolina border only) ▪ Randleman Lake Watershed ▪ Goose Creek Watershed *Refer to NCDENR DWR for a complete List*

Table 2.1 Water quality classifications required for sensitive design standards

HQWs and ESAs

NCDOT has special provisions in place for projects that occur in HQW zones and for projects that include ESAs within its limits of construction, as shown on the E&SC plan. An ESA is an NCDOT term used to direct attention to the E&SC designer and contractor, to provide the highest level of protection at these sensitive environmental areas. If the project falls within an HQW zone or an ESA, such as a stream located on the site, special procedures must be used for construction activities within a 50-foot zone on both sides of that stream measured from the top of the bank.

For projects with T&E species, the NCGO1 requires disturbed areas within 1 mile of and draining to waters where federally listed T&E aquatic species are present to be limited at any time to a maximum total area of 20 acres within the project boundaries. Portions of the project that are outside of the 1 mile and draining to limit can disturb more than the 20 acres.

PNAs, as defined by the North Carolina Administrative Code and regulated by the NCDENR Division of Marine Fisheries (DMF), are delineated waters within coastal areas that provided a habitat for young aquatic life in their developmental stages. More detailed information about PNAs is available at: http://portal.ncdenr.org/web/mf/primary-nursery-areas.

303(d) Listed Waters

If the project discharges to a water body that has been identified on the 303(d) list of impaired waters and is impaired for Turbidity, and is within 1 mile of the project and receives drainage from the project, the E&SC designer should design for the peak rate of runoff from the 25-year storm. To obtain North Carolina impaired 303(d) waters information:

- Refer to http://portal.ncdenr.org/web/wq/ps/mtu/assessment for a list of 303(d) streams in NC including those impaired for Turbidity and other impairments.
- Use the most current year's Final 303(d) list report to check for streams with Turbidity impairment.

Critical Areas

Critical Area is the land adjacent to a water supply intake where risk associated with pollution is greater than from remaining portions of the watershed. The Critical Area includes land within one-half of a mile upstream and draining to a river intake, or within one-half of a mile and draining to the normal pool elevation of water supply reservoirs. Critical Areas are more restrictive than areas outside this designation. Projects within the Critical Area require more sensitive design standards including E&SC protection from the peak rate of runoff from the 25-year storm.

Regulated Riparian Buffers

Riparian Buffers, as defined by NCDENR, are a vegetative area bordering a body of water, such as a stream, lake or pond. The buffer filters stormwater before it enters a body of water. Riparian Area Protection Rules (Buffer Rules) apply to NCDENR DWR jurisdictional streams projects within these areas.

Rainfall Data References

To access the National Oceanic and Atmospheric Administration's (NOAA's) Precipitation Frequency Data Server select this link: http://dipper.nws.noaa.gov/hdsc/pfds/.

Ten Key Concepts to Effective E&SC Design

To effectively manage each individual project, a unique and complete E&SC plan should be developed for each project. An effective plan will implement on-site erosion controls to reduce the rate of erosion as well as sediment control structures to capture and settle sediment from site runoff. The initial focus should be on implementing measures to reduce the potential for erosion. Sediment control measures are then incorporated to capture and settle sediment and prevent sedimentation into receiving waters. For each individual project, the proper, site-specific suite of BMPs must be selected. To meet the goal of protecting North Carolina waterways, the keys in Table 2.2 should be implemented; each of which may be comprised of multiple BMPs (adapted from EPA, 2007).

E&SC Key	Components of Key	Example BMP
Erosion Control Keys		
Minimize disturbed area and protect natural features and soil	▪ Carefully delineate and control disturbed area ▪ Only disturb area where construction is taking place ▪ Maintain natural vegetation to maximum extent, it is the least expensive erosion control BMP ▪ Protect and preserve topsoil, it aids in stormwater infiltration and preserves natural soil structure	▪ This is primarily a nonstructural BMP as it is done through planning and management.
Phase construction activity	▪ Phase or schedule construction work so that soil exposure is minimized at any given time ▪ Limit areas of disturbance to immediate construction activities ▪ Stabilize areas as quickly as possible	▪ This is primarily a nonstructural BMP as it is done through planning and management.
Control offsite stormwater	▪ Plan for potential stormwater flowing onto the project area from upstream locations ▪ Divert and slow down flows to prevent erosion ▪ Manage on-site stormwater runoff in ways that minimize volume and velocity	▪ Temporary Diversion ▪ Earth Berm ▪ Temporary Rock Silt Checks, Type A and B

Stabilize soils promptly	▪ Stabilize exposed soils as soon as possible when construction ends or is temporarily paused
	  ▪ Implement temporary cover BMPs if needed while activities are ongoing or before permanent BMPs are established
	  ▪ Utilize NCG01 stabilization timeline
		▪ Seeding and Mulching
		▪ Temporary Seeding
		▪ Temporary Mulching

Table 2.2 E&SC key concepts

E&SC Key	Components of Key	Example BMP
Erosion Control Keys		
Protect slopes	▪ Always protect slopes with appropriate erosion controls ▪ Use a combination of BMPs on steep slopes or highly erodible soils ▪ Implement diversion channels or berms and slope drains to keep stormwater away from slopes	▪ Matting ▪ Special Sediment Control Fence ▪ Temporary Slope Drains ▪ Earth Berm
Sediment Control Keys		
Protect storm drain inlets	▪ Utilize inlet protection as a secondary BMP ▪ Protect all inlets within your site that may receive stormwater ▪ Provide inlet protection that can handle the volume of water from the respective drainage area	▪ Inlet Sediment Traps
Establish perimeter controls	▪ Maintain natural areas to the maximum extent possible ▪ Supplement natural vegetation with silt fences and wattles around the perimeter, focusing on the downslope areas ▪ For small areas only, use these barriers to protect stream buffers, riparian areas and waterways	▪ Silt Fence ▪ Wattle

Table 2.2 E&SC key concepts continued

E&SC Key	Components of Key	Example BMP
Sediment Control Keys		
Retain sediment on-site	▪ Use for larger areas and design to provide storage for the 10-yr or 25-yr, 24-hr storm based on designation of water quality ▪ Locate sediment control BMPs at low-lying areas and down gradient of bare soil areas where flows meet ▪ Always implement sediment controls at down gradient boundaries of site	▪ Stilling Basin ▪ Skimmer Basin ▪ Silt Basin ▪ Special Stilling Basin ▪ Infiltration Basin ▪ Sediment Dam ▪ Coir Fiber Baffle
Establish stabilized construction entrances/exits	▪ Utilize one or two exit/entrance(s) for vehicles to use and stabilize ▪ Exit should be at least 50 feet long and graded ▪ Use geotextile under a layer of 3-6 inch stone ▪ Use large crushed rock, stone pads or concrete ▪ Use a sweeper to further manage sediment from vehicle tracking	▪ Gravel Construction Entrance
Maintain BMPs	▪ Inspect and maintain all stormwater BMPs as they will quickly deteriorate without maintenance ▪ Utilize NCDOTs inspection program for appropriate maintenance	▪ This is primarily a nonstructural BMP as it is done through planning and construction management.

Table 2.2 E&SC key concepts continued

In addition to these keys, the E&SC plan should constitute a design that addresses and complies with the five Mandatory Standards for Land Disturbing Activities as presented in Article 113-57(A) of the SPCA:

- Prior to any land-disturbing activity including one or more acres, an E&SC plan is required to be approved.

- The plan must provide a buffer zone along all natural watercourses. Buffers should allow for "sufficient width to confine sediment within 25% of the buffer zone nearest to the land-disturbing activity." Any project adjacent to designated trout waters requires an "undisturbed buffer zone 25 feet wide." It should also be noted that certain river basins such as, but not limited to, the Neuse and Tar-Pamlico have specific buffer restrictions (i.e., a 50-foot wide buffer zone).
- Other standards and considerations necessary in the planning and design stages include graded slopes and fills as well as groundcover requirements throughout the life of the project. The angle of graded slopes and fill areas cannot be greater than "that which can be retained by a vegetative groundcover or other erosion control devices and structures."
- A temporary groundcover shall be provided on all slopes and bare areas within 14 calendar days of completion of any phase of grading. A permanent vegetative groundcover shall be provided within 14 calendar days to those areas having reached final grade.
- Finally, the land-disturbing activity must be conducted as shown on the approved set of erosion and sediment control plans.

Note that specific project areas may be required to meet more restrictive ground cover requirements per NCG01.

Managing Turbidity

Managing turbidity on site will further minimize the impacts of construction activities and degradation of the project site ecosystem. Turbidity control measures can include BMPs that require large amounts of surface area to those that utilize passive treatment systems in runoff conveyances; therefore, attention must be given to securing adequate space for these measures in the planning phase. Surface skimmers are effective measures for managing turbidity that can be incorporated into planning, especially in sensitive areas. Typically, baffles are used in all outlet measures to manage turbidity.

Utilizing flocculants is also another step in managing turbidity. Use of flocculants, however, requires matching the flocculant chemistry to the soil chemistry. During the planning phase, the designer needs to perform on-site tests to determine the soil types and confirm that the appropriate flocculant is selected for the project site needs.

NCDOT has developed a Turbidity Reduction Options Sheet for borrow pits, which is available in Appendix A of this manual.

NCDOT Watershed-Related Special Provisions

NCDOT has developed Special Provisions to provide guidance for E&SC designers. This section will focus on the watershed/regulatory guidelines while Chapter 4 on E&SC BMPs will discuss those provisions that provide guidance on installation and placement of structural BMPs. Special provisions often reference NCDOT's Standard Specifications that must be followed. Review special provisions as needed at the following link: http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/special_provisions/.

Falls Lake Watershed

The Falls Lake Watershed has more stringent groundcover requirements as summarized in Table 2.3

Falls Lake Watershed Groundcover Requirements	
Permanent Groundcover Required to be established no later than 7 days after the final phase of grading of any portion of the site.	
Temporary Groundcover Slope-specific groundcover requirements upon completion of any phase of grading.	
For slopes steeper than 3:1	7 days
For slopes equal to or flatter than 3:1	10 days
For areas with no slope	14 days

Table 2.3 Falls Lake Watershed groundcover requirements

Jordan Lake Watershed

The special provision for Jordan Lake Watershed requires a web-based training exercise to be successfully completed by the person(s) responsible for conducting the application of fertilizer to a project located within the Jordan Lake Watershed.

The following link,

http://portal.ncdenr.org/web/jordanlake/fertilizer-management,

specifies Fertilizer Management requirements in the Jordan Lake Watershed and provides direction to the online training.

The Central Coastal Plain Capacity Use Area (CCPCUA)

The CCPCUA was created in response to the Water Act of 1967 and over pumping of important aquifers in the coastal plain area of North Carolina. The CCPCUA includes a 15 county region in the state's central coastal plain. For ground water users using more than 10,000 gallons of ground and surface waters per day, the CCPCUA requires registration and reporting of capacities. For withdrawals of ground water of more than 100,000 gallons per day, the CCPCUA requires a permit.

NCDOT applies for CCPCUA permits for all proposed TIP projects requiring sizeable earthwork quantities in the affected 15 county area. Each contractor that utilizes a pump to dewater a borrow pit or utilizes a pump to withdraw surface water in the counties mentioned above is required to record the volume of water pumped from each site on a daily basis. These daily recorded quantities should then be submitted for each pit on a monthly basis to the District or Resident Engineer. The complete set of guidelines for CCPCUA are available in the special provision at the link below and a map of CCPCUA is shown in Figure 2.1:

http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/pdf/CCPCUA.pdf.

Figure 2.1 Map of CCPCUAs

Other E&SC Planning Considerations

While there are no dedicated special provisions for the following topics, they still require special planning considerations and have regulatory implications for the E&SC Plan.

Trout Waters

Implement the following trout buffer guidelines when planning for the construction of roads and bridges within and around trout waters that are located within the 25 westernmost counties of the state. The trout buffer zone is a 25-foot wide swath measured horizontally from the top of the bank. The E&SC design measures must adhere to the design standards for sensitive watersheds to contain the peak rate of runoff for the 25-year storm. Groundcover requirements differ within designated trout buffers.

Permanent riparian vegetation of native species should be planted immediately following the completion of any phase of grading; use of tall fescue is not allowed in the buffer. Biodegradable erosion control matting may also be included in conjunction with seeding to promote the establishment of vegetation. If such areas are contained by perimeter measures, straw mulch may be utilized. Although hydroseeding is allowed, it may not be discharged into surface waters. Should the designer require a variance of the trout buffer requirements, a request can be made to the Director of the Division of Energy, Mineral and Land Resources (DEMLR).

In-stream work and land disturbance inside the 25-foot wide buffer zone is prohibited from October 15 through April 15 due to the spawning seasons of trout species.

If the project design necessitates the disturbance of more land within the buffer zone than allowed by North Carolina Administrative Code, a variance request must be submitted to the Land Quality Section of DEMLR. The variance should include the information listed in Figure 2.2. The variance is **only** required if the stream(s) impacted are designated Trout (Tr) by NCDENR DWR.

Documentation will include	▪ A narrative including a description of the disturbance ▪ Description of actions taken to minimize impacts on the buffer ▪ Documentation on why disturbance will have temporary impacts on the buffer and stream from erosion and sedimentation ▪ Include linear temporary and permanent impacts to trout stream along with the estimated acreage of buffer disturbance
Plans will include	▪ A construction schedule showing how the buffer is to be disturbed ▪ Identification of the top bank of trout stream ▪ Identification of the 25-foot buffer ▪ The length and width of the buffer to be disturbed ▪ The erosion and sedimentation control measures to be used in the buffer with details and calculations ▪ Any measures needed to control water and sediment from areas outside of the buffer ▪ Reforestation planting details ▪ Special provisions including specifications pertaining to seed mixes, construction activities, and erosion control measures
Other considerations to address	▪ Equipment, excavated material storage and sediment control measures should not be stored in the buffer. Appropriate E&SC measures should be used if materials are placed above the buffer. ▪ The buffer should remain undisturbed where possible. ▪ If the buffer is in a 100-year flood plain, a larger riparian area may be needed. ▪ Ensure sufficient stream shade is maintained to prevent adverse temperature fluctuations. Coldwater BMPs may be required. ▪ All materials for construction must be on site before land-disturbing activities begin. ▪ Native plants, grasses and woody species, must be used for permanent stabilization in the trout buffer. Temporary ground cover should be provided until permanent ground cover is established.

Figure 2.2 Land Quality Section of NCDENR variance request

A map of the trout waters of North Carolina is included in Figure 2.3. Projects within trout waters are regulated by the North Carolina Wildlife Resources Commission (NCWRC). Trout waters have two designations: NCDENR DWR designated trout waters (Tr) and NCWRC designated trout waters. Projects with only NCWRC designated trout waters are not regulated under the Trout Buffer variance requirements of the Land Quality Section of DEMLR.

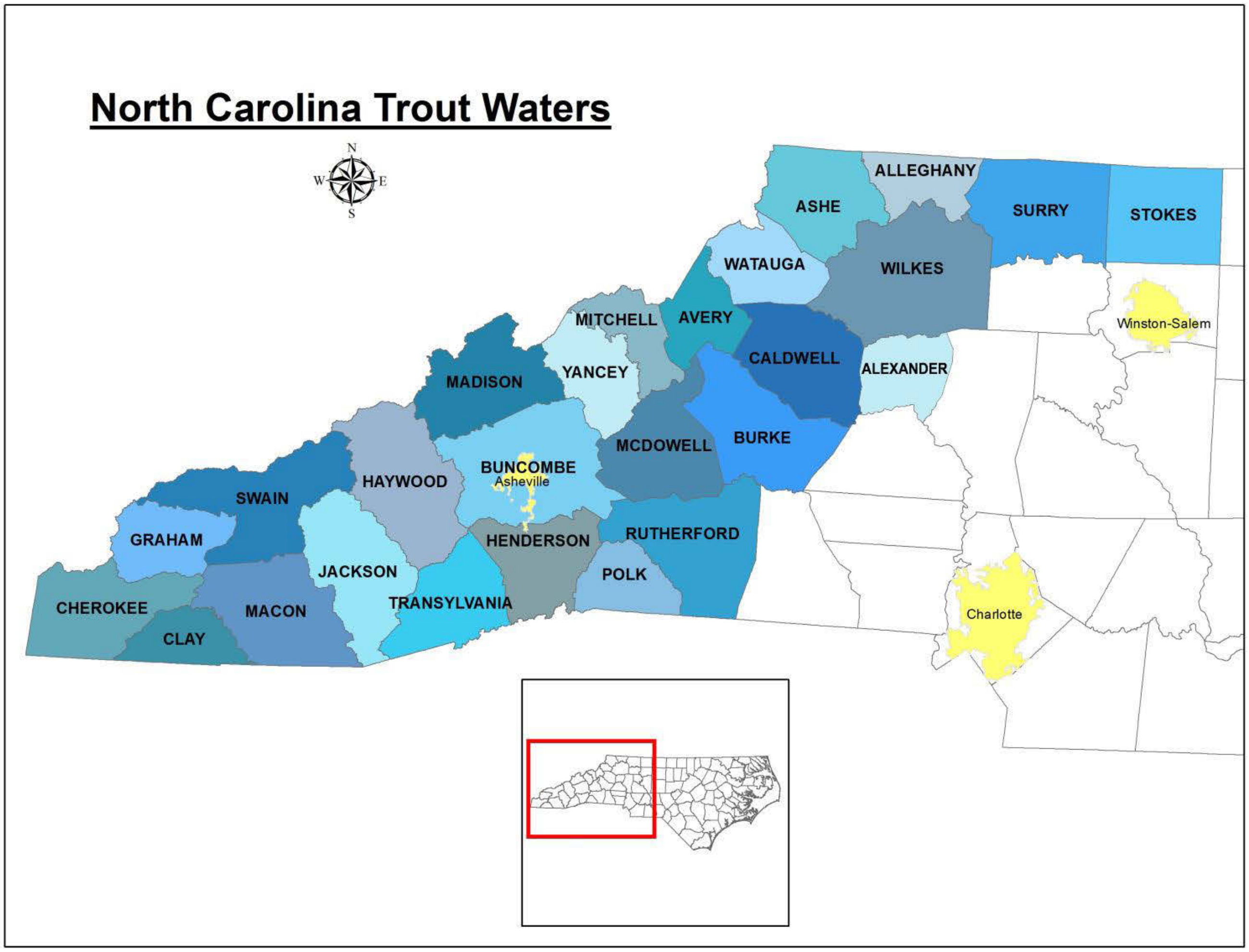

Figure 2.3 NC map showing counties with trout (Tr) designations

Post-Construction BMPs

Post-construction stormwater BMPs are permanent stormwater control measures that remain in place once the project activities are complete. These measures are installed or converted from existing measures in order to preserve the water quality of the post-construction stormwater runoff. The E&SC designer should explore opportunities at the early planning phase to utilize E&SC BMPs for conversion to post-construction structures, when feasible.

Post-Construction Stormwater Management is outlined in NCDOT's NPDES permit. NCDOT is required to address post-construction stormwater runoff from new development and redevelopment that disturb more than 1 acre. NCDOT includes the following post-construction controls in their BMP Toolbox: level spreaders, filter strips, preformed scour holes, dry detention basins, swales, infiltration basins, hazardous spill basins, bridge stormwater controls, stormwater wetlands, bioretention basins and wet detention basins.

Incorporating low impact development and green infrastructure (LID/GI) techniques in the design phase of the project as part of the temporary E&SC BMPs and permanent post-construction stormwater BMPs can effectively preserve natural vegetation and drainage patterns. For more information, refer to the Green Infrastructure and Low Impact Development Considerations section in this chapter.

LID/GI controls focus on preserving the natural, pre-development hydrology of an area by incorporating stormwater controls that infiltrate, store or evaporate the stormwater near its source.

Figure 2.4 identifies a few temporary E&SC measures that can be transitioned to post-construction stormwater BMPs. NCDOT has begun incorporating this practice as part of a comprehensive stormwater management approach where post-construction considerations are considered during the planning phases of a project.

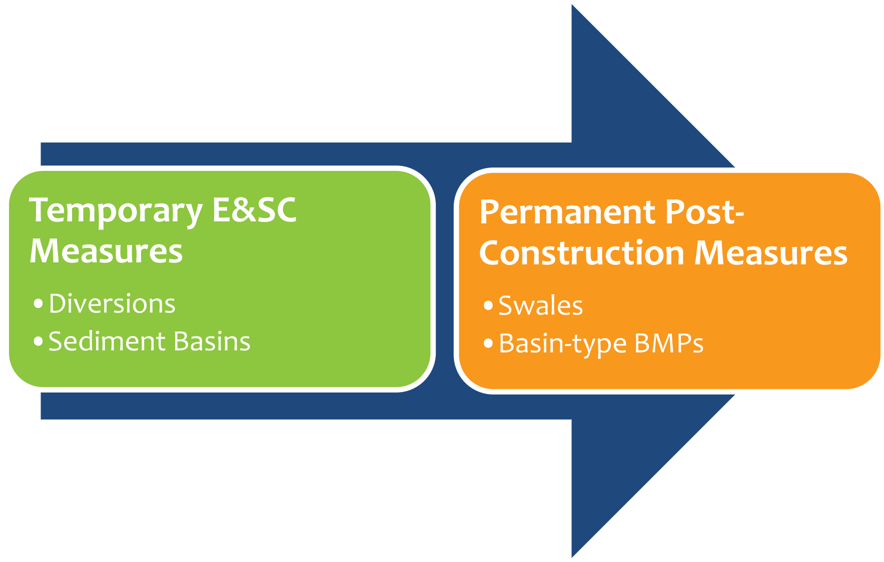

Figure 2.4 Temporary E&SC measures that can be transitioned to post-construction stormwater BMPs

NCDOT Division-Specific E&SC Preferences

North Carolina is divided into 14 NCDOT divisions. Figure 2.5 shows the NC counties and the 14 divisions in which they are located. Within each division, regional design and construction considerations have been requested. While dynamic and subject to change, some division preferences have been listed in Appendix B.

Figure 2.5 NCDOT's 14 divisions

LID and GI Considerations

LID is a term used to describe an innovative approach to site development and stormwater management. The goals of LID are to minimize impacts to land, water and air while also reducing infrastructure and maintenance costs. (See the NC_LID_Guidebook.pdf from NCDENR's website.)

There are three distinct principles that distinguish LID from traditional (conventional) approaches to E&SC:

1. LID works with existing conditions of a project site to manage stormwater and employ principles such as preserving natural vegetation/landscape features. Examples of these include preserving soils with good infiltration rates and minimizing impervious areas to the extent possible.
2. In addition to traditional end of pipe E&SC measures / treatment measures, LID treats stormwater runoff in smaller areas throughout the site (e.g., amended soils, rain gardens, bioretention cells).

3. LID reduces stormwater runoff by using techniques that promote infiltration and groundwater recharge. It also uses and reuses stormwater runoff (e.g., cisterns, rain barrels, irrigating landscaping)

GI is often associated with LID. It is an approach to maintain healthy waters and surrounding environments by using vegetation and soil to provide stormwater management in a more natural way (EPA, 2013a). Figure 2.6 includes some examples:

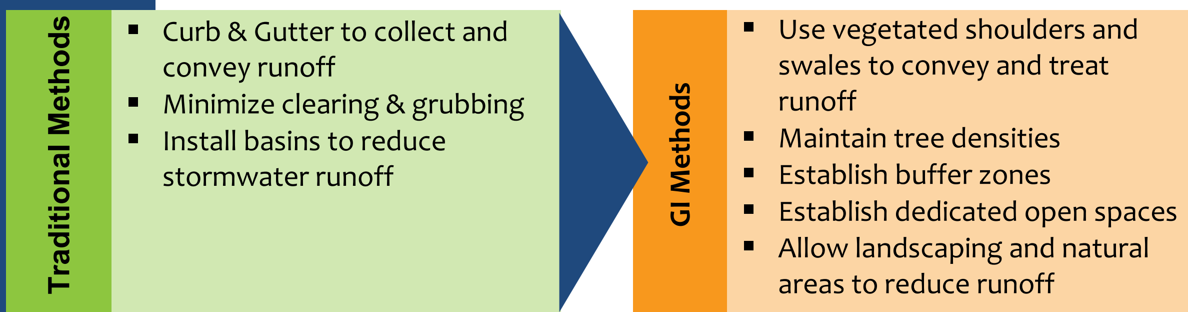

Figure 2.6 LID and GI considerations

The Department proactively incorporates LID and GI as part of the temporary construction phase as well as in the final post-construction phase. These innovative methods promote infiltration and evapotranspiration. NCDOT encourages the use of these methods. Consider the example in Figure 2.7.

Case Study

Design Needs: A sediment basin needed to address sediment containment needs for the project.

Design Decision: Utilize alternative design methods to include LID and GI.

Design Justification: Basin installation would have required tree canopy within project to be removed and required years to replace. The natural area was preserved to minimize tree removal. Rather than one treatment area that would have required tree removal, smaller measures in other locations throughout the project are proposed.

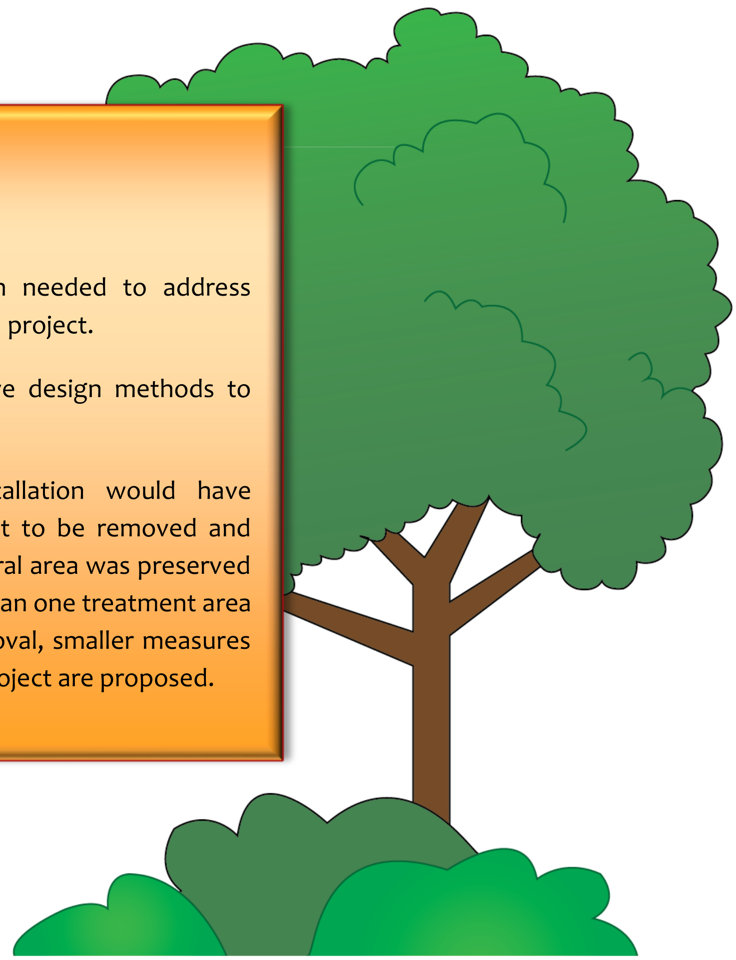

Figure 2.7 LID and GI case study

3.1

Bid Build Projects

Section

Developing the E&SC Plan for Bid Build Projects

Bid Build (BB) projects, or design-bid-build projects as they are frequently called, involve NCDOT or a contracted firm supplying the E&SC design plans for a transportation project, and then separate construction firms competitively bid on the construction proposal. NCDOT's District or Resident Engineer and REU's Field Operations Engineer work together so that NCDOT E&SC plan is implemented in the field and project commitments are managed throughout the project.

Prior to development of the E&SC plans, the steps in Figure 3.1 should be addressed:

Environmental Document Review

- Review the Green Sheets for E&SC commitments made during permit negotiations.
- Scan permit conditions for any unique E&SC items that may not be captured on the Green Sheets.

Base Plans

- Lead Designer furnishes contours, vertical and horizontal alignment with hydraulic design, cross sections and profile.
- Identify areas where easements are needed to allow the basins to be placed outside of fill slopes and remain functional for up gradient disturbances.

Water Quality Review

- Ask if there are any applicable:
  - HQWs? (HQW, ORW, WS-I, WS-II, SA, PNA)
  - Trout (Tr) streams? Riparian Buffer rules?
  - Critical Area? (CA)
  - 303(d) streams listed for Turbidity impairment?
  - T&E species sensitive to sediment present?
- If yes to any, all jurisdictional streams require a 50 ft. ESA on both sides of stream.

Other Environmental Considerations

- Identify adjacent wetland boundaries and surface waters as high risk, including impoundments downstream of the right of way (ROW).

E&SC Design Standards

- Calculate peak flow, Q_p for the 25-year storm for the five water quality items listed above or other commitments made for Design Standards in Sensitive Watersheds.
- Calculate Q_p for the 10-year storm on all other sites.

Figure 3.1 Steps to follow before developing the E&SC plans.

Bid Build Project Work Flow for E&SC Plans

The NCDOT REU shall review and accept all E&SC plans prepared by others. Figure 3.2 shows the major phases of a BB project, which are described in detail in this section.

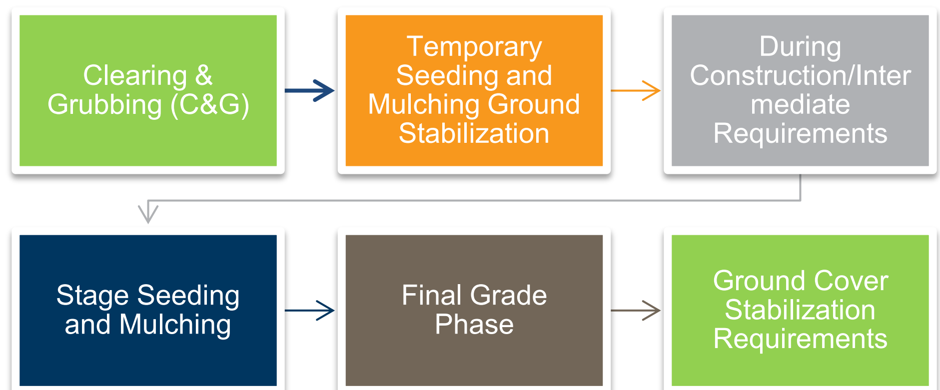

Figure 3.2 The major work flow steps of a BB transportation project.

C&G Phase Design

Good planning is essential to designing and executing an effective E&SC plan. Recall the ten key concepts of E&SC planning and design (presented in Chapter 2) as the C&G plans (which are the first phase of E&SC plans) are developed. Along with the ten key concepts, implement the following NCDOT-required guidelines:

General

Adhere to the following general guidelines when developing the C&G plan:

- Use correct NCDOT symbology.
- Obtain adequate easement for design of E&SC controls outside of the slope stake limits to prevent controls from being impacted by roadway or embankment footprint as construction progresses.
- Account for existing topography and include contours for the C&G phase only.
- Determine drainage areas and disturbed areas.
- Consider clean water diversions to route run-on water around disturbed areas.

- Protect existing streams and wetlands; do not place E&SC devices in live streams unless authorized through Section 401 and 404 permits.
- If needed, include 50-foot ESAs on C&G plans only.
- Do not place E&SC devices that require excavation (e.g., basins, silt ditches) in wetlands or buffer zones.
- Provide disturbed and undisturbed drainage areas for the entire project limits in MicroStation format.

Access and Haul Roads

Temporary access and haul roads, other than public roads, constructed or used in connection with the project shall be considered a part of the project and addressed in the E&SC plans. While the specific details around the number and location of access and haul roads may not be known at this stage, the E&SC design engineer should consider their placement.

- Note that construction access is normally the first land-disturbing activity and should be carefully planned.
- Refer to the gravel construction entrance section in Chapter 4 for construction details.
- Include access and haul road details and quantities.

Inlet and Perimeter Controls

Inlet protection at this stage involves protecting existing inlet structures while perimeter controls provide the outer boundary of protection.

- Protect all existing drainage structure inlets that may receive stormwater with Rock Inlet Sediment Traps - Type A, Type B and Type C (RIST-A, RIST-B, and RIST-C), and Rock Pipe Inlet Sediment Traps – Type A and Type B (PIST-A, PIST-B).
- Provide inlet protection that can handle the volume of water from the respective drainage area.
- Maintain natural areas to the maximum extent possible.
- Utilize adequate perimeter runoff controls such as temporary silt ditches, temporary silt fence. , etc.
- Supplement natural vegetation with silt fences and wattles around the perimeter, focusing on the down gradient areas.
    - Use these barriers to protect stream buffers, riparian areas and waterways where sheet flow occurs.

Runoff Management Conveyances

Install stormwater conveyances with inlet and outlet protection devices early in the project to avoid the development of gullies and washes (NCDENR, 2008).

- Provide velocity control in conveyances and include all calculations.
- Utilize Temporary Rock Silt Checks - Type B (TRSC-B) to reduce velocity in existing and proposed roadway ditches. Spacing between the silt checks should be so that the elevation at the top of the lower check is the same as the toe elevation of the upped check. In other words, the silt checks should be installed so that runoff flows in ditch in a "stair" step pattern. Also utilize TRSC-Bs in proposed temporary silt ditches, temporary diversions, and clean water diversions.
- Incorporate devices with flocculant in ditches that drain directly to jurisdictional streams and wetlands.
- Where approved by the REU, utilize wattles with flocculant and/or TRSC-A with matting and flocculant in temporary and permanent, existing and proposed ditches at a spacing of 50 feet in areas where:
    - Sediment basins are not feasible at drainage outlets; and
    - Sediment and silt basins at drainage outlets cannot be properly sized to surface area and/or sediment storage requirements due to safety concerns, right-of-way restrictions, utility conflicts or other construction limitations exist.

Sediment Basins, Skimmer Basins and Barriers

Install perimeter sediment basins and barriers as soon as access to the site is gained. Additional basins will likely be needed when grading begins.

- Utilize skimmer basins and rock measures with sediment control stone (Temporary Rock Sediment Dam - Type B [TRSD-B], TRSC-A, etc.) at drainage outlets and include calculations.
- Provide adequate sediment storage for 3,600 cubic feet per disturbed acre and size basins such that the surface area equals 435 square feet per cubic foot per second (cfs) of the peak inflow rate, Q_p, using 10 or 25-year peak rainfall data (NCDENR - *Erosion and Sediment Control Planning and Design Manual* or NOAA's National Weather Service website [http://dipper.nws.noaa.gov/hdsc/pfds/] for partial duration (ARI) time series type).

- Provide adequate silt storage with skimmer basins for 1,800 cubic feet per disturbed acre with the surface area equal to 325 square feet per cfs of the peak inflow rate, Q_p, using the 10 or 25-year peak rainfall data (see link/reference in preceding bullet).
- Request sediment and/or skimmer basin designer spreadsheets as needed from the NCDOT REU.
- The minimum and maximum length-to-width (l:w) ratio of all sediment basins shall be 2:1 and 6:1, respectively. With REU approval, basins may be of different l:w ratios due to topography, ROW or other constraints.
- Install coir fiber baffles in all silt basins and sediment dams at drainage outlets.
  - For silt basins with a 20-foot or longer length, three coir fiber baffles shall be installed with a spacing of 1/4 the basin length.
  - For silt basins with a length less than 20 feet, a minimum of two coir fiber baffles shall be installed, with a spacing of 1/3 the basin length.
  - The E&SC design engineer is not required to show the individual baffles on the E&SC plans.
- Designers may be asked to provide a written explanation for all drainage outlets where the runoff cannot be treated with a sediment basin and/or the sediment basin cannot be constructed to the required sediment storage or surface area requirements.
- Place all perimeter sediment basins outside of fill slopes.
- Incorporate and transition temporary basins into permanent stormwater devices, as applicable. See Chapter 2 for more guidance on transitioning E&SC devices to permanent controls.
- Sediment basins that drain directly into jurisdictional waters or have a total drainage area of 1 acre or more shall be designed and constructed with outlet structures that only withdraw water from the surface; otherwise, stone outlets may be provided.

Culvert and Pipe Construction

Provide a pipe and culvert phasing plan or note in accordance with NCDOT's *Best Management Practices for Construction and Maintenance Activities* for managing the watercourse during construction. The phasing plan for box culverts is typically provided by the NCDOT Hydraulics Unit.

- Include any culvert and/or pipe construction sequence plan sheets in the C&G plans, including BMP and construction narratives, for all box culverts and any pipes 60 inches or larger, or any combination of pipes that total 60 inches or more.

Provide E&SC sequence phasing, including BMP and construction narratives, for all box culverts and any pipes, or combination of pipes, greater than or equal to 60 inches.

During Construction

The NCDOT District or Resident Engineer is responsible for obtaining approval for E&SC plan revisions and maintaining accurate E&SC plans for the life of the construction project.

- During construction, any substantial deviation from the E&SC plan will require design revisions. NCDOT REU central unit will faciliatate the design revisions and submit them through the REU Field Operations Engineer. Updated versions of E&SC plans may be requested by the District or Resident Engineer at any time during construction.
- Prior to installation of any E&SC devices, the NCDOT Division's construction staff shall verify boundaries of jurisdictional areas in the field and delineate with safety fence or flagging.
- For guidance on safety fence and flagging in jurisdictional areas, see Section 4.2.2 in Chapter 4.
- Whenever the Engineer determines that significant erosion and sedimentation continues despite the installation of approved protective practices, the District or Resident Engineer, in consultation with the REU Field Operations Engineer, is required to take additional protective action.

Intermediate Phase Design

Intermediate E&SC plans are required to address additional E&SC design for phases not covered in the C&G and/or final grade E&SC plans. For any intermediate phase, comply with the Final Grade Phase Design and provide for phases not adequately addressed in C&G or final phase plans. Examples of project stages that would trigger the need for intermediate phase design include any key operation changes that are more than a minor deviation, detours for bridge or overpass construction, utility construction and bridge demolition or bridge operations.

Intermediate E&SC plans are often required due to the dynamic nature of highway construction projects.

Redesign for any Major Deviation on Selected Measures

For revisions to E&SC devices that require design calculations or approval by REU for dimension modifications and/or relocations, other than minor shifts for accurate placement, includes, but not limited to, the devices noted below:

- Riser basin
- Skimmer basin and all devices with skimmers
- TRSD-A
- TRSD-B
- TRSC-A
- Culvert construction sequences
- Temporary and permanent stream channel relocations

Utility Construction

Utility-related construction is one of the greatest challenges the E&SC design engineer encounters. When utilities have to be relocated or new facilities installed, this work typically is done ahead of the proposed construction and grading activities. In many cases, the following utilities require land disturbances at watercourses near bridges, box culverts and pipes, including:

- Water
- Sewer

- Electric (underground)
- Gas
- Communication lines

Occasionally, underground utilities are scheduled to be relocated within project limits during the construction timeframe and additional E&SC measures can be designed and shown on the E&SC plans to help prevent offsite sediment from this work.

Bridge Phasing Operations

Construction activities occurring at bridges may also warrant intermediate phase design plans. E&SC should be considered for the following operations:

- Bridge demolition
- Bridge construction operations (jetting, dredging, shaft/caisson drilling)
- Temporary bridges
- Temporary causeways
- Temporary equipment work pads
- Temporary stockpiles
- Managing the watercourse

Final Grade Phase Design

It is important to establish seeding and mulching as early as possible on graded surfaces as grading progresses rather than waiting until the entire slope reaches final grade.

The most effective E&SC practice available is proper establishment of a good vegetative cover.

General

Observe applicable design components listed for C&G as well as:

- Protect existing and proposed drainage structure inlets and utilize adequate perimeter controls – refer to the Inlet and Perimeter Controls section under the C&G section.
- Refer to the Sediment Basins, Skimmer Basins and Barriers section within the C&G section if additional basins or barriers need to be erected at this stage.

Slope Protection

Slope protection is a critical step in the E&SC process and the grading plan forms the basis of the E&SC plan (NCDENR, 2008). All practices necessary for controlling erosion on the graded surface must be included in the final grade phase plan and steps utilized in the C&G phase may be repeated.

- Utilize temporary slope drains and earth berms at the top of fill slopes and where there are super elevations on tall fill slopes. For slope drain design and location guidance, refer to Section 4.4.1 on page 4-51. Maximum spacing between slope drains should be 200 feet.
- Utilize a rock energy dissipater at the outlet of the slope drain.
- Unless otherwise directed by the REU's Soil & Water Engineering Section, provide matting for erosion control on all slopes (cut and fill) that are 2:1 or steeper and a height of 8 feet or greater.
- Refer to Appendix C for regional seed mixes that provide stabilization of graded areas, including specific seed species for slopes.

Runoff Management Conveyances

As median and roadway ditch lines reach final grade, install E&SCs that sufficiently manage the stormwater runoff velocity and sediment loss as there is great potential for soil erosion in this phase.

- Utilize TRSC-B's to reduce velocity in existing and proposed roadway ditches with a spacing between the silt checks so that the elevation at the top of the lower check is the same as the toe elevation of the upped check. Also utilize TRSC-Bs in proposed temporary silt ditches, temporary diversions, and clean water diversions.
- Provide temporary matting for erosion control in all ditch lines, including but not limited to temporary ditch lines utilized to divert off-site runoff around construction areas, where the velocity is greater than 2.0 feet/sec, and the shear stress is 1.55 pounds per square foot (psf) or less.

- For ditch lines with a shear stress above 1.55 psf, permanent soil reinforcement mat or riprap shall be utilized.

Storm Drainage Network

As the storm drain drop inlets and catch basins are being finalized, inlet protection is critical to keep the new pipe network sediment free where runoff is contacting unpaved areas.

- Utilize infiltration, skimmers or sediment control stone devices (TRSD-B, TRSC-A, etc.) and a spillway with an adequately designed base length to distribute outflow for devices at all drainage turnouts.
- Protect all new drainage inlets within the final storm drain network until pavement is in place (RIST-A, B, C and PIST-A, B).

Cover Stabilization Requirements

Ground cover stabilization shall comply with the timeframe guidelines specified in NCG01. Excluding the slopes noted below, temporary and permanent ground cover stabilization shall be provided within seven calendar days from the last land-disturbing activity. The E&SC design engineer shall include the ground cover stabilization requirements summary sheet with all E&SC plans submitted to the Department for review and acceptance.

- For the slopes noted below, temporary and/or permanent ground cover stabilization shall be provided within 14 calendar days from the last land-disturbing activity:
    - Slopes between 2:1 and 3:1, with a slope length of 10 ft. or less
    - Slopes 3:1 or flatter, with a slope length of 50 ft. or less
    - Slopes 4:1 or flatter
- Temporary and/or permanent ground cover stabilization shall be provided in accordance with the provisions in each project's contract and NCG01.

Reclamation Plans for any Off-Site Borrow or Waste Pits

Borrow or waste areas that are part of the project shall require a separate reclamation plan, unless the borrow or waste activity is regulated under the Mining Act of 1971, or is a landfill regulated by NCDENR's Division of Solid Waste Management (DSWM). For newly-created borrow pits that require dewatering, borrow pits dewatering basins are required and shall be in accordance with the applicable special provision available at the website noted in the Special Provisions section below. The contractor shall submit the location and permit number for waste/borrow sites covered by the Mining Act or regulated by DSWM concurrently to the Transportation Program Management Director and the District or Resident Engineer. For reclamation procedures, refer to Section 3.7 in Chapter 3 of this manual.

Special Provisions

NCDOT has developed special provisions to provide guidance for E&SC designers. Chapter 2 focuses on the watershed/regulatory guidelines while Chapter 4 focuses on E&SC BMPs and discusses those provisions that provide guidance on installation and placement of structural BMPs. Special provisions often reference NCDOT's Standard Specifications, but include project specific information. Review special provisions as needed at the following link: http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/special_provisions/

Title Sheet

BB projects shall include a title sheet for the proposed E&SC plans. The title sheet shall include the following information:

- Correct notes: NCG01, HQW, ESA, C&G, etc.
- Correct standards for project
- List of standard NCDOT symbology
- Name and certification number of Level III-certified individual responsible for designing and/or reviewing E&SC plans

Detail and Summary Sheets

BB projects shall include detail sheets and notes for the proposed E&SC plans. The detail sheet and notes shall include the following information:

- E&SC device detail drawing sheets
- Matting quantity summary sheets
- Ground Cover Stabilization Timeframe sheet

Reforestation

Reforestation should be provided when ESAs are applied to jurisdctional streams on the project during the C&G phase. Streambank Reforestation is applied to stream relocation and mitigation sites. Reforestation is also included when there is significant pavement removal for onsite detours, road closings, etc. and on large projects with interchanges and wide ROW corridors.

Additional Plan Requirements

In addition to the guidelines presented throughout this section, NCDOT REU requires the following conditions be addressed by the E&SC design engineer:

- Plan submittals shall include all pertinent design information required for review, such as design calculations, (furnished on REU design calculation spreadsheet), drainage areas, etc.
- Plans shall address any environmental issues raised during the permitting process.
- The E&SC design engineer shall comply with the *North Carolina Administrative Code Title 15A Department of Environment and Natural Resources Chapter 4, Sediment Control.*
- All E&SC measures with stone extending beyond the construction limits shall be considered temporary fill. If impacted wetland areas are permitted as "Hand Clearing," then the aforementioned temporary fill shall be permitted as "Temporary Fill in Hand Cleared Areas for Erosion and Sediment Control."

Administrative Requirements

Consider the following administrative details while drafting the E&SC plan and throughout the life of the project:

- A sample set of E&SC plans (including any special details or special provisions used by the NCDOT REU) and the MicroStation Erosion Control Workspace is available upon request from the NCDOT REU.
- Sufficient time shall be allowed for the E&SC design engineer to make any changes to the E&SC plans deemed necessary by the NCDOT REU.
- All E&SC plans, including any red-line revisions, shall be maintained by the District or Resident Engineer and kept on site at all times throughout the duration of the project.

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3.2 Section

Design Build Projects

Developing the E&SC Plan for Design Build Projects

Design Build (DB) projects utilize a team for design and construction services and all work is performed under one contract. Utilizing one main point of contact for large transportation projects provides for efficiencies in cost and scheduling. The DB team also maintains responsibility for accurate design plans, including E&SC plans. The DB team must also abide by NCDOT's REU E&SC guidelines.

Prior to development of the E&SC plans, the steps in Figure 3.3 should be addressed:

Environmental Document Review

- Review the Green Sheets for E&SC commitments made during permit negotiations.
- Scan permit conditions for any unique E&SC items that may not be captured on the Green Sheets.

Base Plans

- Lead Designer furnishes contours, vertical and horizontal alignment with hydraulic design, cross sections and profile.
- Identify areas where easements are needed to allow the basins to be placed outside of fill slopes and remain functional for up gradient disturbances.

Water Quality Review

- Ask if there are any applicable:
  - HQWs? (HQW, ORW, WS-I, WS-II, SA, PNA)
  - Trout (Tr) streams? Riparian Buffer rules?
  - Critical Area? (CA)
  - 303(d) streams listed for Turbidity impairment?
  - T&E species sensitive to sediment present?
- If yes to any, all jurisdictional streams require a 50 ft. ESA on both sides of stream.

Other Environmental Considerations

- Identify adjacent wetland boundaries and surface waters as high risk, including impoundments downstream of the right of way (ROW).

E&SC Design Standards

- Calculate Q_p for the 25-year storm for five water quality items listed above or other commitments made for design standards in sensitive watersheds.
- Calculate Q_p for the 10-year storm on all other sites.

E&SC Design Discussion

- Hold a pre-design meeting between the NCDOT REU S&W Engineering Section, the DB team, and any other pertinent NCDOT personnel before any E&SC designs are submitted to NCDOT REU.

Figure 3.3 Steps to follow before developing the E&SC plans

DB Work Flow for E&SC Plans

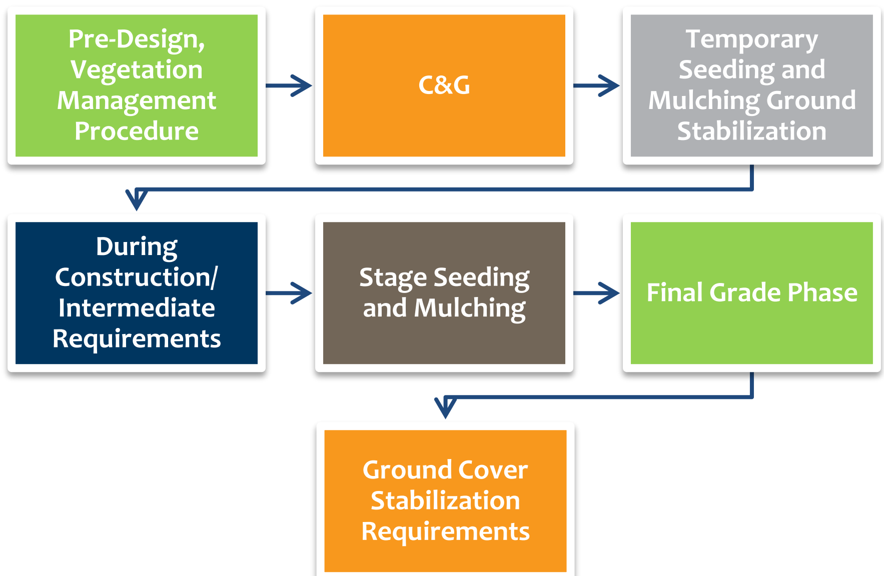
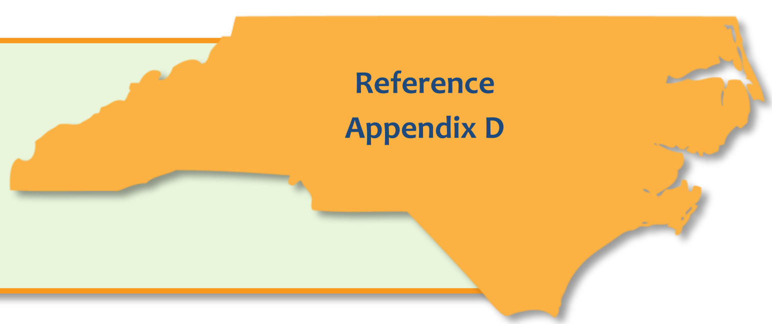


Figure 3.4 The major work flow steps of a DB transportation project

The DB work flow in Figure 3.4 outlines the process for developing the E&SC Plans. The NCDOT REU shall review and accept all E&SC plans. C&G and final grade released for construction (RFC) E&SC plans shall be submitted to all NCDOT personnel listed in the DB submittal guidelines (see Appendix D) before any land-disturbing activities, including C&G can commence. If the DB team chooses to perform the work in discrete sections, then a complete set of C&G and final grade RFC E&SC plans shall be submitted, accepted and distributed prior to land-disturbing activities (including C&G) commencing in that section.

E&SC plans must be submitted and accepted by REU before any land-disturbing activity begins. Review the DB Submittal Guidelines.



The typical schedule the E&SC design engineer will follow for DB projects is demonstrated in Figure 3.5. No land-disturbing activities, including C&G, shall occur in any location that does not have accepted C&G and final grade RFC E&SC plans. Note that E&SC plans shall, at a minimum, address the requirements presented in this section.

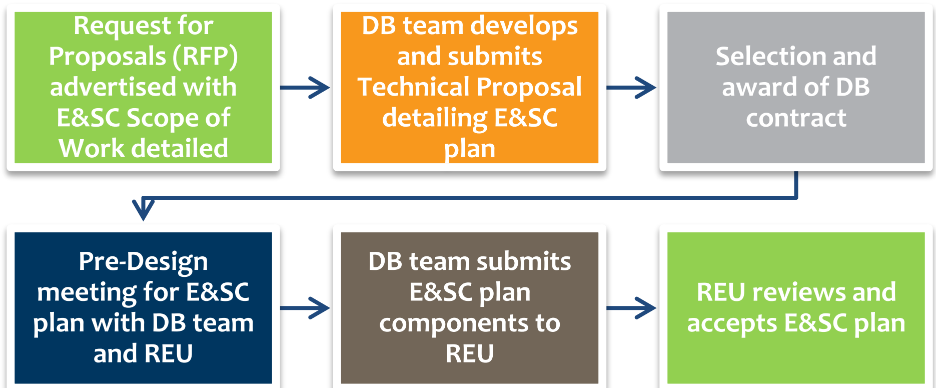


Figure 3.5. Typical schedule for E&SC design engineer on a DB project.

Vegetation Management Procedure

To conform to the vegetative components of the NCG01 permit, the DB team shall formally submit a project-wide vegetation management procedure for the REU's review and acceptance prior to any land-disturbing activities. All versions of the vegetation management procedure shall include, but not be limited to:

- Provisions for the early establishment of grasses/vegetation
    - Outline plans for ground stabilization during and after C&G.
    - Outline plans for stabilization during phased work at or near jurisdictional water bodies.
    - Outline plans for staged construction and staged stabilization as cuts and fills are developed.
    - Outline plans for the stabilization of roadway subgrade if pavement operation is not a continuous operation.
    - Outline plans for winterization during periods of freezing temperatures or conditions are too wet to work.

- Procedure and schedule details for fertilizer topdressing, supplemental seeding, mowing and repair seeding.
    - Fertilizer topdressing
        - Analyses
        - Rates
        - Frequency
        - Application method
        - Target dates
    - Supplemental seeding
        - Threshold for need
        - Species mix
        - Rate
        - Application method
        - Target dates
    - Mowing
        - Threshold for need
        - Target height
        - Frequency
        - Slope limitations
    - Repair seeding
        - Threshold for need
        - Species mix
        - Rate
        - Application method
        - Target dates

DB projects progress rapidly during the construction phase resulting in a need for a well-planned and implemented vegetation management procedure.

The vegetation management procedure shall be closely coordinated with the grading and hauling operations. The DB team shall provide a narrative overview of the vegetation management procedure in the technical proposal when they respond to the RFP. After the Department's initial review, the DB team shall concurrently provide updated versions of the vegetation management procedure to the District or Resident Engineer and REU on a monthly basis. These updated versions will not require formal submittal to the Transportation Program Management Office, but will be subject to review comments by the aforementioned field personnel.

The DB team shall maintain comprehensive "red-line" as-built plans that detail when and where permanent, temporary and repair seeding and topdressing have been performed.

C&G Phase Design

Good planning is essential to designing and executing an effective E&SC plan. Recall the ten key concepts of E&SC planning and design (presented in Chapter 2) as the first phase of E&SC plans are developed and implement the NCDOT-required guidelines below:

General

Adhere to the following general guidelines when developing the C&G plan:

- Submit these plans and the vegetation management procedure for approval prior to any land-disturbing operations.
- Use correct NCDOT symbology.
- Obtain adequate easement for design of E&SC outside of the slope stake limits to prevent controls from being impacted by roadway or embankment footprint as construction progresses.
- Account for existing topography and include contours for the C&G phase only.
- Determine drainage areas and disturbed areas.
- Consider clean water diversions to route run-on water around disturbed areas.
- Protect existing streams and wetlands; do not place E&SC devices in live streams unless done through Section 401 and 404 permits.

- If needed, include 50-foot ESAs on C&G plans only.
- Do not place E&SC devices that require excavation (e.g., basins, silt ditches) in wetlands or buffer zones.
- Provide disturbed and undisturbed drainage areas for the entire project limits in MicroStation format.
- Immediately after the clearing and grubbing E&SC measures have been installed for the entire project, or for individual sections (if the DB team has divided the project into construction segments), the DB team's E&SC designer shall field-verify constructed dimensions and installation of all E&SC devices.

Access and Haul Roads

Temporary access and haul roads, other than public roads, constructed or used in connection with the project shall be considered a part of the project and addressed in the E&SC plans.

- Note that construction access is normally the first land-disturbing activity and should be carefully planned.
- Refer to the gravel construction entrance for construction details.
- Include access and haul road details and quantities.

Inlet and Perimeter Controls

Inlet protection at this stage involves protecting existing inlet structures while perimeter controls provide the outer boundary of protection.

- Protect all existing drainage structure inlets that may receive stormwater with Rock Inlet Sediment Traps - Type A, Type B and Type C (RIST-A, RIST-B, and RIST-C), and Rock Pipe Inlet Sediment Traps – Type A and Type B (PIST-A, PIST-B).
- Provide inlet protection that can handle the volume of water from the respective drainage area.
- Maintain natural areas to the maximum extent possible.
- Utilize adequate perimeter runoff controls (e.g., temporary silt ditches, temporary sediment fence)
- Supplement natural vegetation with silt fences and wattles around the perimeter, focusing on the down gradient areas.
    - Use these barriers to protect stream buffers, riparian areas and waterways where sheet flow occurs.

Runoff Management Conveyances

Install stormwater conveyances with inlet and outlet protection devices early in the project to avoid the development of gullies and washes (NCDENR, 2008).

- Provide velocity control in conveyances and include all calculations.
- Utilize Temporary Rock Silt Checks - Type B (TRSC-B) to reduce velocity in existing and proposed roadway ditches. Spacing between the silt checks should be so that the elevation at the top of the lower check is the same as the toe elevation of the upped check. In other words, the silt checks should be installed so that runoff flows in ditch in a "stair" step pattern. Also utilize TRSC-Bs in proposed temporary silt ditches, temporary diversions, and clean water diversions.
- Incorporate devices with flocculant in ditches that drain directly to jurisdictional streams and wetlands.
- Where approved by the REU, utilize wattles with flocculant and/or Temporary Rock Silt Check - Type A (TRSC-A) with matting and flocculant in temporary and permanent, existing and proposed ditches at a spacing of 50 feet in areas where:
    - Sediment basins are not feasible at drainage outlets; and
    - Sediment and silt basins at drainage outlets cannot be properly sized to surface area and/or sediment storage requirements due to safety concerns, right-of-way restrictions, utility conflicts or other construction limitations exist.

Sediment Basins, Skimmer Basins and Barriers

Install principal sediment basins and barriers as soon as access to the site is gained. Additional basins will likely be needed when grading begins.

- Utilize skimmer basins and rock measures with sediment control stone (Temporary Rock Sediment Dam - Type B [TRSD-B], TRSC-A, etc.) at drainage outlets and include calculations.
- Provide adequate sediment storage for 3,600 cubic feet per disturbed acre and basins shall be sized with the surface area equal to 435 square feet per cfs of the peak inflow rate, Q_p, using the 10 or 25-year peak rainfall data (NCDENR - *Erosion and Sediment Control Planning and Design Manual* or NOAA's National Weather Service website [http://dipper.nws.noaa.gov/hdsc/pfds/] for ARI time series type).

Sediment basins that drain directly into jurisdictional water or have a total drainage area of 1 acre or more shall be designed and constructed with outlet structures that only withdraw water from the surface.

Skimmer basins shall provide adequate silt storage for 1,800 cubic feet per disturbed acre with the surface area equal to 325 square feet per cfs of the peak inflow rate, Q_p, using the 10 or 25-year peak rainfall data (see link/reference in preceding bullet).

- Request sediment and/or skimmer basin designer spreadsheets as needed from the NCDOT REU.
- The minimum and maximum length to width ratio of all sediment basins shall be 2:1 and 6:1, respectively. With REU approval, basins may be of different l:w ratios due to topography, ROW or other constraints.
- Install coir fiber baffles in all silt basins and sediment dams at drainage outlets.
    - For silt basins with a 20-foot or longer length, three coir fiber baffles shall be installed with a spacing of 1/4 the basin length.
    - For silt basins with a length less than 20 feet, a minimum of two coir fiber baffles shall be installed, with a spacing of 1/3 the basin length.
    - The DB team will not be required to show the individual baffles on the E&SC plans.
- Provide a written explanation for all drainage outlets where the runoff cannot be treated with a sediment basin and/or the sediment basin cannot be constructed to the required sediment storage or surface area requirements.
- Place all perimeter sediment basins outside of fill slopes.
- Sediment basins that drain directly into jurisdictional waters or have a total drainage area of 1 acre or more shall be designed and constructed with outlet structures that only withdraw water from the surface; otherwise, stone outlets may be provided.

Incorporate and transition temporary basins into permanent stormwater devices, as applicable. See Chapter 2 for more guidance on transitioning E&SCs to permanent controls.

For sediment basins that do not drain directly into jurisdictional water or have less than 1 acre of total drainage area, surface dewatering outlets and stone outlets may be provided.

Culvert and Pipe Construction

Provide a pipe and culvert phasing plan or note in accordance with NCDOT's *Best Management Practices for Construction and Maintenance Activities.* Include any culvert and/or pipe construction sequence plan sheets in the C&G plans including BMP and construction narrative, for all box culverts and any pipes 48 inches or larger, or any combination of pipes that total 48 inches or more.

Prior to the installation of pipes smaller than 48 inches in jurisdictional areas, the DB team shall submit a phasing plan for managing the watercourse to the District or Resident Engineer for review and acceptance.

Provide E&SC sequence phasing, including BMP and construction narrative, for all box culverts and any pipes, or combination of pipes, less than or equal to 48 inches.

During Construction

The E&SC design engineer is responsible for obtaining approval for E&SC plan revisions and maintaining accurate E&SC plans for the life of the construction project. This is an iterative process and will coincide with monthly field verifications and monthly vegetation management procedure updates. Figure 3.6 represents this ongoing process.

- After the initial E&SC device inspection(s) during C&G, the designer shall review the project conditions a minimum of every 30 days during the heavy grading operations, or as directed by the Engineer, to verify:

- Field conditions of disturbed areas are draining to E&SC devices, and
- Sediment control devices provide the current field condition requirements for sediment storage and surface area.

- The DB team shall provide written documentation of all field verifications/inspections performed to NCDOT REU, S&W Engineering and Field Operations Sections, and the District or Resident Engineer.
  - At a minimum, this documentation shall detail what was observed during the field verification/inspection and all resulting required actions with a timeframe for implementation.
- During construction, any E&SC design revisions must be submitted to NCDOT REU by the 15th of the month via the Transportation Program Management Director. Updated versions of E&SC plans may be requested by the Engineer or REU at any time during the process.
- Prior to installation of any E&SC devices, the DB team shall verify boundaries of jurisdictional areas in the field and delineate with safety fence or flagging.
  - For guidance on safety fence and flagging in jurisdictional areas, see Section 4.2.2 in Chapter 4.
- Whenever the Engineer determines that significant erosion and sedimentation continues despite the installation of approved protective practices, the DB team is required to take additional protective action.

Redesign for any Major Deviation on Selected Measures

The DB team's E&SC designer shall submit design calculations, for the Department's review and acceptance, for all modifications to the E&SC plan that result in dimension modifications and/or relocations (other than minor shifts to accurately place) of the devices noted below:

- Riser basin
- Skimmer basin and all devices with skimmers
- TRSD-A
- TRSD-B
- TRSC-A
- Culvert construction sequences
- Temporary and permanent stream channel relocations

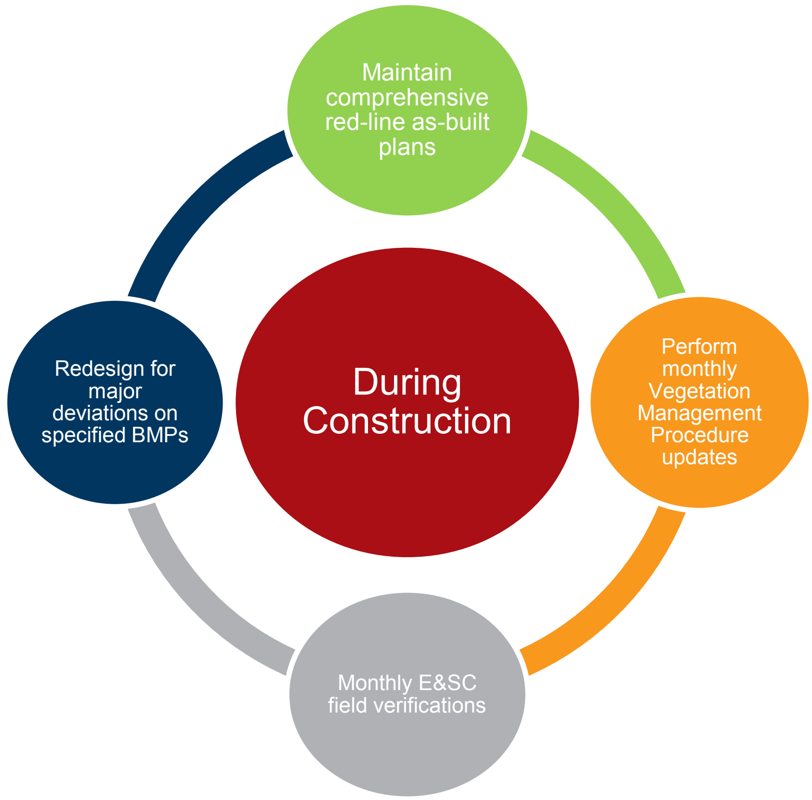


Figure 3.6 Process for E&SC Plan revisions during construction.

Intermediate Phase Design

Intermediate E&SC plans may only be required if design modifications and/or site conditions require additional E&SC design or design revisions to the RFC C&G and/or RFC final grade E&SC plans. Intermediate plans shall be submitted for review and shall be accepted prior to construction of any aspect impacted by the revised E&SC design. For any intermediate phase, comply with the section on Final Grade Phase Design.

- Provide for phases not adequately addressed in C&G or final phase plans.
- Determine if detours require intermediate phase design plans.
- Determine if utility construction and bridge phasing operations require intermediate phase design plans.

Minor changes such as relocating silt fence, adding velocity controls in ditches or adjusting slope drains shall be reviewed by the Engineer in the field.

Utility Construction

Utility-related construction is one of greatest challenges the E&SC design engineer encounters. When utilities have to be relocated or new facilities installed, this work typically is done ahead of the proposed construction and grading activities. In many cases, the following utilities require land disturbances at watercourses near bridges, box culverts and pipes, including:

- Water
- Sewer
- Electric
- Gas
- Communication lines

Occasionally, underground utilities are scheduled to be relocated within project limits during the construction timeframe and additional E&SC measures can be designed and shown on the E&SC plans to help prevent offsite sediment from this work.

Bridge Phasing Operations

Construction activities occurring at bridges may also warrant intermediate phase design plans. E&SC should be considered for the following operations:

- Bridge demolition
- Bridge construction operations (jetting, dredging, shaft/caisson drilling)
- Temporary bridges
- Temporary causeways
- Temporary equipment work pads
- Temporary stockpiles
- Managing the watercourse

Final Grade Phase Design

It is important to establish seeding and mulching as early as possible on graded surfaces as grading progresses rather than waiting until the entire slope reaches final grade.

The most effective E&SC practice available is proper establishment of a good vegetative cover.

General

Observe applicable design components listed for C&G as well as:

- Protect existing and proposed drainage structure inlets and utilize adequate perimeter controls – refer to the Inlet and Perimeter Controls section under the C&G section.
- Refer to the Sediment Basins, Skimmer Basins and Barriers section within the C&G section if additional basins or barriers need to be constructed at this stage.

Slope Protection

Slope protection is a critical step in the E&SC process and the grading plan forms the basis of the E&SC plan (NCDENR, 2008). All practices necessary for controlling erosion on the graded surface must be included in the final grade phase plan and steps utilized in the C&G phase may be repeated.

- Utilize temporary slope drains and earth berms at the top of fill slopes and where there are super elevations on tall fill slopes. For slope drain design and location guidance, refer to Section 4.4.1 on page 4-51. Maximum spacing between slope drains should be 200 feet.
- Utilize a rock energy dissipater at the outlet of the slope drain.
- For DB projects, unless otherwise approved by the REU Field Operations Engineer, provide matting for erosion control on all slopes (cut and fill) that are 2:1] or steeper and a height of 8 feet or greater.
- Refer to Appendix C for regional seed mixes that provide stabilization of graded areas, including specific seed species for slopes.

Runoff Management Conveyances

As median and roadway ditch lines reach final grade, install E&SCs that sufficiently manage the stormwater runoff velocity and sediment loss as there is great potential for soil erosion in this phase.

- Utilize TRSC-B's to reduce velocity in existing and proposed roadway ditches with a spacing between the silt checks so that the elevation at the top of the lower check is the same as the toe elevation of the upped check. Also utilize TRSC-Bs in proposed temporary silt ditches, temporary diversions, and clean water diversions.
- Provide matting for erosion control in all ditch lines, including but not limited to temporary ditch lines utilized to divert off-site runoff around construction areas, where the velocity is greater than 2.0 feet/sec, and the shear stress is 1.55 psf or less.
    - For ditch lines with a shear stress above 1.55 psf, permanent soil reinforcement mat or riprap shall be utilized.

Storm Drainage Network

As the storm drain drop inlets and catch basins are being finalized, inlet protection is critical to keep the new pipe network free of sediment where runoff is contacting unpaved areas.

- Utilize infiltration, skimmers or sediment control stone devices (TRSD-B, TRSC-A, etc.) and a spillway with an adequately designed base length to distribute outflow for devices at all drainage turnouts.
- Protect all new drainage inlets within the final storm drain network until pavement is in place (RIST-A, B, C and PIST-A, B).

■ Ground Cover Stabilization Requirements

Ground cover stabilization shall comply with the timeframe guidelines specified in NCG01. Excluding the slopes noted below, temporary and permanent ground cover stabilization shall be provided within seven calendar days from the last land-disturbing activity. The DB team shall label all slopes subject to the 7-day ground cover stabilization requirements on all E&SC plans submitted to the Department for review and acceptance.

- For the slopes noted below, temporary and/or permanent ground cover stabilization shall be provided within 14 calendar days from the last land-disturbing activity:
    - Slopes between 2:1 and 3:1, with a slope length of 10 ft. or less
    - Slopes 3:1 or flatter, with a slope length of 50 ft. or less
    - Slopes 4:1 or flatter
- Temporary and/or permanent ground cover stabilization shall be provided in accordance with the provisions in each project's contract, the DB team's vegetation management procedure and NCG01.

Additional Stabilization Requirements

Due to delays and unforeseen conditions, it is often the case during construction that areas originally scheduled to meet the stability requirements are delayed and require additional stabilization. Once the DB team identifies these areas for stabilization due to inactivity, the DB team shall obtain concurrence from the Engineer and adhere to NCDOT special provisions as well as the following options based on the estimated amount of time the area will remain inactive. Special provisions often reference NCDOT's standard specifications that must be followed. Review REU seeding and mulching special provisions as needed at the following NCDOT web page link: http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/special_provisions/.

If the area stabilized exceeds the estimated timeframe, the DB team shall implement the next level of stabilization as directed by the Engineer.

Short-term Stabilization

Short-term stabilization is for areas that will remain inactive for up to 21 days. Implement the following:

- Erodible areas shall be stabilized utilizing non-vegetative cover.
    - Non-vegetative cover options include straw mulch, hydraulic applied E&SC products or RECP.
    - If straw mulch is used, it shall provide 100% groundcover and be tacked sufficiently to hold the mulch in place for the duration of the inactive period.
    - All other methods shall be installed according to the manufacturer's directions.

Mid-term Stabilization

- Mid-term stabilization is for areas that will remain inactive for up to 90 days. Implement the applicable stabilization protocol (rates in pounds/acre) as detailed in the appropriate special provisions. At the Engineer's sole discretion, the use of limestone on sandy soils that require topsoil for stabilization may be eliminated. The DB team shall consult with, and obtain approval from, the REU prior to eliminating limestone.
- Upon obtaining approval from the Engineer, the DB team may use wood mulch and/or ground C&G debris as an option for mid-term stabilization. If approved, the aforementioned mulch and/or debris shall be installed at a thickness that prevents erosion.

Long-term Stabilization

Erodible areas shall be stabilized utilizing the region-specific seed and mulching stabilization protocols available at the special provisions link provided under *Additional Stabilization Requirements.*

Soil Analysis

If vegetation establishment indicates a deficiency in soil nutrients or an incorrect pH level is present, the DB team shall take soil samples and apply additional soil amendments to the affected area per soil sampling analysis results and as directed.

Fertilizer Topdressing

In accordance with the requirements noted below, the DB team shall apply fertilizer topdressing to all permanently-seeded areas to promote vegetative growth.

- Prior to completion of the project and once during every growing season from April 1st through September 31st, the DB team shall apply a minimum of one fertilizer topdressing application, in accordance with the requirements noted in the special provisions.

Supplemental Seeding

For all supplemental seeding, the type of seed and proportions shall be the same as specified above for long-term stabilization. The rate of application for supplemental seeding shall be between 25 to 75 pounds per acre. Prior to topdressing, the DB team shall determine the actual rate per acre for supplemental seeding and submit the supplemental seeding rate and areas to the Department for review and acceptance.

- To prevent disturbance of existing vegetation, minimum tillage equipment, consisting of a sod seeder, shall be used to incorporate seed into the soil where degree of slope allows. Where degree of slope prevents the use of a sod seeder, a "clodbuster" (ball and chain) may be used.

Mowing

The minimum mowing height shall be 4 inches for warm-season turf species and 6 inches for cool-season species.

Reclamation Plans for any Off-site Borrow or Waste Pits

Borrow or waste areas that are part of the project shall require a separate reclamation plan, unless the borrow or waste activity is regulated under the Mining Act of 1971, or is a landfill regulated by the NCDENR DSWM. For newly-created borrow pits that require dewatering, borrow pit dewatering basins shall be required and shall be in accordance with the applicable special provision available at the website noted in the NCDOT Special Provisions section below. The DB team shall submit the location and permit number for waste/borrow sites covered by the Mining Act or regulated by DSWM (NCDENR) concurrently to the Transportation Program Management Director and the District or Resident Engineer. For reclamation procedures, refer to Section 3.7 in Chapter 3 of this manual and the guidance at the following link:

http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/fieldops/downloads/.

Special Provisions

NCDOT has developed a wide range of special provisions to provide guidance for E&SC designers. Chapter 2 focuses on the watershed/regulatory guidelines while Chapter 4 discusses those provisions that provide guidance on installation and placement of E&SC BMPs. Special provisions often reference NCDOT's standard specifications that must be followed. Review special provisions as needed at the following link:

http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/special_provisions/.

- Review Seeding and Mulching special provisions for specific regional requirements
- Disregard references in the E&SC special provisions from the aforementioned website to "method of measurement," "basis of payment," or any other statement regarding direct payment for E&SC measures.

Title Sheet

DB projects shall include a title sheet for the proposed E&SC plans. The title sheet shall include the following information:

- Correct notes: NCG01, HQW, ESA, C&G, etc.
- Correct standards for project
- List of standard NCDOT symbology
- Name and certification number of Level III-certified individual responsible for designing and/or reviewing E&SC plans

Detail and Summary Sheets

DB projects shall include detail sheets and notes for the proposed E&SC plans. The detail sheet and notes shall include the following information:

- E&SC device detail drawing sheets
- Matting quantity summary sheets
- Ground Cover Stabilization Timeframe sheet

Reforestation

Reforestation should be provided when ESAs are applied to jurisdctional streams on the project during the C&G phase. Streambank Reforestation is applied to stream relocation and mitigation sites. Reforestation is also included when there is significant pavement removal for onsite detours, road closings, etc. and on large projects with interchanges and wide ROW corridors.

- Reforestation sheets
- Streambank Reforestation sheets

Additional Plan Requirements

In addition to the guidelines presented throughout this section, NCDOT REU requires the following conditions be addressed by the DB team:

- Plan submittals shall include all pertinent design information required for review, such as design calculations (furnished on REU design calculation spreadsheet), drainage areas, etc.
- At minimum, the DB team shall bring one E&SC plan sheet with a C&G E&SC design to the E&SC plan pre-design meeting.
- Plans shall address any environmental issues raised during the permitting process.
- The DB team shall comply with the *North Carolina Administrative Code Title 15 A Department of Environment and Natural Resources Chapter 4, Sediment Control.*
- All E&SC measures with stone extending beyond the construction limits shall be considered temporary fill. If impacted wetland areas are permitted as "Hand Clearing," then the aforementioned temporary fill shall be permitted as "Temporary Fill in Hand Cleared Areas for Erosion and Sediment Control."

Administrative Requirements

Consider the following administrative details while drafting the E&SC plan and throughout the life of the project:

Review the DB submittal guidelines prior to development.

Reference Appendix D

- A sample set of E&SC plans (including any special details or special provisions used by the NCDOT REU) and the MicroStation Erosion Control Workspace is available upon request from the NCDOT REU.
- Sufficient time shall be allowed for the DB team to make any changes to the E&SC plans deemed necessary by the NCDOT REU.

NCDOT ESC Erosion & Sediment CONTROL MANUAL

3.3

Low Impact Bridge Projects

Section

Developing the E&SC Plan for Low Impact Bridge Projects

The low impact bridge program was developed to expedite bridge replacement. Low Impact Bridge (LIB) projects are intended to be limited in scope. The design phase, construction phase and delivery of the bridge itself are completed within 12 months. The E&SC plan design should allow for minimal disturbance and appropriate protection at low impact bridge stream crossings.

Prior to development of the E&SC plans, the steps in Figure 3.7 should be addressed:

Environmental Document Review

- Review the Green Sheets for E&SC commitments made during permit negotiations.
- Scan permit conditions for any unique E&SC items that may not be captured on the Green Sheets.

Base Plans

- Lead Designer furnishes contours, vertical and horizontal alignment with hydraulic design, cross sections, and profile
- Identify areas where easements are needed to allow the basins to be placed outside of fill slopes and remain functional for up gradient disturbances.

Water Quality Review

- HQWs? (HQW, ORW, WS-I, WS-II, SA, PNA)
- Trout (Tr) streams? Riparian Buffer rules?
- Critical Area? (CA)
- 303(d) streams listed for Turbidity impairment?
- T&E species sensitive to sediment present?
- If yes to any, all jurisdictional streams require 50 ft. ESA on both sides of stream.

Other Environmental Considerations

- Identify adjacent wetland boundaries and surface waters as high risk, including impoundments downstream of right of way (ROW).

E&SC Design Standards

- Calculate peak flow, Q_p for 25-year storm for five water quality items listed above or other commitments made for design standards in sensitive watersheds.
- Calculate Q_p for 10-year storm on all other sites.

Figure 3.7 Steps to follow before developing the E&SC plans.

Low Impact Bridge Work Flow for E&SC Plans

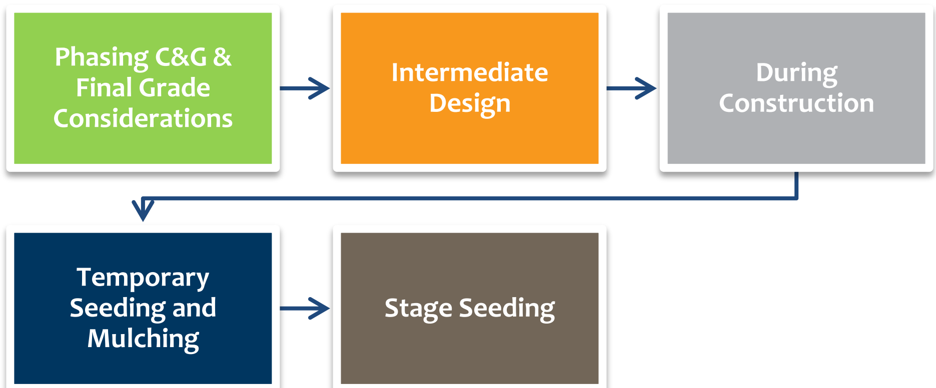


Figure 3.8 Major work flow phases for low impact bridge projects.

The low impact bridge work flow in Figure 3.8 outlines the process for developing the E&SC Plans. The NCDOT REU shall review and accept all E&SC plans. No land-disturbing activities shall occur in any location that does not have accepted and approved E&SC plans.

Phasing

As previously noted, LIB projects are intended to be limited in scope. As such, disturbance associated with these projects should be minimal. Nonetheless, E&SC plans are required per NCDOT policy and typically include C&G and Final Grade designs. Single phase E&SC designs are considered on a case by case basis if C&G and Final Grade designs are similar. From the beginning through the end of construction, the Contractor shall maintain comprehensive "red-line" as-built plans that detail E&SC plan implementation, any and all field revisions, and when and where stabilization has been performed.

Incorporate E&SC devices with flocculant on LIB projects to the greatest extent practical.

General

The following guidelines should be considered for E&SC design:

- Perimeter protection between stream and approach fill
- TRSC-A placed at outlet of existing and proposed ditches
- Devices with flocculant utilized within existing and proposed ditches and spaced every 50 feet and as appropriate for project conditions
- TRSC-A in ditches with greater than 2.5% grade incorporating flocculant
- Drainage breaks in silt fences (Stone or Wattle)
- Velocity control at the beginning and end of project ditch lines
- Include 50-foot ESAs and riparian buffer zones if needed
- Consider clean water diversions to route run-on water around disturbed areas

Construction Entrances

Construction entrances shall be considered part of the project and addressed in the E&SC plans.

- Note that construction access is normally the first land-disturbing activity and should be carefully planned.
- Refer to the gravel construction entrance in Chapter 4, Section 4.2.1 for construction details.

Inlet and Perimeter Controls

Inlet protection at this stage involves protecting existing inlet structures while perimeter controls provide the outer boundary of protection.

- Protect all existing drainage structure inlets that may receive stormwater with RIST-A, B, or C, PIST-A, B, etc.
- Provide inlet protection that can handle the volume of water from the respective drainage area.
- Maintain natural areas to the maximum extent possible.
- Utilize adequate perimeter runoff controls (e.g., temporary silt ditches and temporary silt fencing).
- Supplement natural vegetation with silt fences and wattles around the perimeter, focusing on down gradient areas.
    - Use these barriers to protect stream buffers, riparian areas and waterways where sheet flow occurs.

Runoff Management Conveyances

Install stormwater conveyances with inlet and outlet protection devices early in the project to avoid the development of gullies and washes (NCDENR, 2008).

- Provide velocity control in conveyances and include all calculations.
- Incorporate flocculant on wattles.
    - Utilize wattles with flocculant within ditch lines that have a grade of 2.5% or less. TRSC-As with matting and flocculant should be designed within ditch lines that are greater than 2.5% grade. Spacing of these measures is required every 50 feet within temporary, permanent, existing and proposed ditch lines.

Sediment Basins, Skimmer Basins and Barriers

Due to the size and nature of LIB projects, sediment traps and skimmer basins are not usually included within the E&SC plan design. However, certain projects may involve a large enough drainage area or unique site conditions that may require a sediment trap or basin. In such cases, the following guidelines provide instruction for the design of these measures.

- Utilize skimmer basins and rock measures with sediment control stone (TRSD-B, TRSC-A, etc.) at drainage outlets and include calculations.
- Provide adequate sediment storage for 3,600 cubic feet per disturbed acre and size basins such that surface area equals 435 square feet per cfs of the peak inflow rate, Q_p, using 10 or 25-year peak rainfall data (NCDENR - *Erosion and Sediment Control Planning and Design Manual* or NOAA's National Weather Service web site http://dipper.nws.noaa.gov/hdsc/pfds/ for ARI time series type).
- Skimmer basins shall provide adequate silt storage for 1,800 cubic feet per disturbed acre with surface area equal to 325 square feet per cfs of the peak inflow rate, Q_p, using the 10 or 25-year peak rainfall data (see link/reference in preceding bullet).
- Request sediment and/or skimmer basin designer spreadsheets from the NCDOT REU as needed.
- The minimum and maximum length-to-width ratio of all sediment basins shall be 2:1 and 6:1, respectively. With REU approval, basins may be of different l:w ratios due to topography, ROW or other constraints.

  - Coir fiber baffles shall be installed in all silt basins and sediment dams at drainage outlets.
  - For silt basins with a 20-foot or longer length, three coir fiber baffles shall be installed with a spacing of 1/4 the basin length.
  - For silt basins with a length less than 20 feet, a minimum of two coir fiber baffles shall be installed, with a spacing of 1/3 the basin length.
  - The E&SC designer is not required to show the individual baffles on the E&SC plans, but shall incorporate the coir fiber baffle detail on the E&SC plans.
- The E&SC Designer may be requested to provide a written explanation for all drainage outlets where the runoff cannot be treated with a sediment basin and/or the sediment basin cannot be constructed to the required sediment storage or surface area requirements.
- Place all perimeter sediment basins outside of fill slopes.
- Avoid excavation for sediment control devices in wetlands or buffer zones.
- Submit any major sediment basin design change, addition, deletion, relocation or any change that involves calculations, to the NCDOT REU for review and acceptance once E&SC plans are issued.
- Incorporate and transition temporary basins into permanent stormwater devices, as applicable. See Chapter 2 for more guidance on transitioning E&SC devices to permanent controls.
- Sediment basins that drain directly into jurisdictional waters or have a total drainage area of 1 acre or more shall be designed and constructed with outlet structures that only withdraw water from the surface.
  - For sediment basins that do not drain directly into jurisdictional water and have less than 1 acre of total drainage area, surface dewatering outlets and stone outlets may be provided.

Culvert and Pipe Construction

Work involving culvert and pipe construction or replacement should be shown on the E&SC plans.

- Include any culvert and/or pipe construction sequence plan sheets in the plans including BMP and construction narrative, for all box culverts and any pipes 48 inches or larger, or any combination of pipes that total 48 inches or more.

During Construction

- Planning considerations for work area and watercourse management over jurisdictional areas during operations such as the demolition of existing bridge, jetting, dredging and shaft/caisson drilling include the use of turbidity curtains and temporary silt fences around bridge approaches.

Redesign for any Major Deviation on Selected Measures

The E&SC designer shall submit design calculations, for the REU's review and acceptance, for all modifications to the E&SC plan that result in dimension modifications and/or relocations, other than minor shifts for accurate placement, to the devices noted below:

- Riser basin
- Skimmer basin and all devices with skimmers
- TRSD-A
- TRSC-A
- Culvert construction sequences
- Temporary and permanent stream channel relocations

Intermediate Phase Design

Intermediate E&SC plans may be required if design modifications and/or site conditions require additional E&SC design or design revisions to the plans. Intermediate plans shall be submitted for review and shall be accepted prior to construction of any aspect impacted by the revised E&SC design. For any intermediate phase, comply with the section on Final Grade Phase Design. Utilities and bridge phasing operations may require such design modifications.

Utility Construction

Utility relocation associated with LIB projects is usually minor and may include overhead or underground utilities. Perimeter protection, to prevent off-site sediment, such as silt fence with wattle breaks, should be designed in areas between the disturbance and jurisdictional areas. Include E&SC design for any underground utility work included in the proposed project.

Bridge Phasing Operations

There are activities associated with construction of the bridge structure that require consideration in the E&SC plan design. Such activities may require instream work. In designated trout streams, planning should allow for these projects to be active only during the 6 months outside of October 15-April 15 due to the spawning seasons of trout species. The designer should also be aware of and plan for any anadromous fish moratoria that may be associated with instream pile driving, drilling or jetting operations. E&SC measures to consider for these types of instream construction activities include coffer dams and turbidity curtains. Silt fence or SSCF provides protection around bridge approaches.

Final Grade Phase Design

It is important to establish seeding and mulching as early as possible on graded surfaces and embankments around bridge approaches as grading progresses rather than waiting until the entire area reaches final grade.

The most effective erosion control practice available is proper establishment of a good vegetative cover

Slope Protection

Slope protection is a critical step in the E&SC process and the grading plan forms the basis of the E&SC Plan (NCDENR, 2008). All practices necessary for controlling erosion on the graded surface must be included in the plan.

- Utilize temporary slope drains and earth berms at the top of fill slopes and where there are super elevations on tall fill slopes. For slope drain design and location guidance, refer to Section 4.4.1 on page 4-51. Maximum spacing between slope drains should be 200 feet.
- Utilize a rock energy dissipater at the outlet of the slope drain.
- Unless otherwise approved by the REU Field Operations Engineer, provide matting/permanent soil reinforcement mat (PSRM) for erosion control on all slopes (cut and fill) that are 2:1 or steeper and a height of 8 feet or greater. In trout waters, the designer should plan for biodegradable matting only.

Conveyances

As roadway ditch lines reach final grade, install E&SCs that sufficiently manage the stormwater runoff velocity and sediment loss as there is great potential for soil erosion in this phase. The measures outlined in the initial conveyance section should be utilized.

Storm Drainage Network

Inlet protection of all existing and proposed funnel drain inlets and drop inlets is critical to keep the new pipe network sediment free where runoff is contacting unpaved areas.

- Devices at all drainage turnouts shall utilize infiltration, skimmer, or sediment control stone (TRSD-B, TRSC-A, etc.) and a spillway with an adequately designed base length to distribute outflow.
- Protect all new funnel drain inlets and drop inlets within the final storm drain network using (RIST-A, B, C and PIST-A, B).

Ground Cover Stabilization Requirements

Ground cover stabilization shall comply with the timeframe guidelines specified in NCG01. Excluding the slopes noted below, temporary and permanent ground cover stabilization shall be provided within seven calendar days from the last land-disturbing activity. The Engineer shall label all slopes subject to the 7-day ground cover stabilization requirements on all E&SC plans submitted to the Department for review and acceptance.

- For the slopes noted below, temporary and/or permanent ground cover stabilization shall be provided within 14 calendar days from the last land-disturbing activity:
    - Slopes between 2:1 and 3:1, with a slope length of 10 feet or less
    - Slopes 3:1 or flatter, with a slope length of 50 feet or less
    - Slopes 4:1 or flatter
- Temporary and/or permanent ground cover stabilization shall be provided in accordance with the provisions in this contract and NCG01.

Reclamation Plans for any Off-site Borrow or Waste Pits

Borrow or waste areas that are part of the project shall require a separate reclamation plan, unless the borrow or waste activity is regulated under the

Mining Act of 1971, or is a landfill regulated by the NCDENR DSWM. For newly-created borrow pits that require dewatering, borrow pit dewatering basins shall be required and shall be in accordance with the applicable special provision available at the website noted in the Special Provisions section below. The E&SC designer shall submit the location and permit number for waste/borrow sites covered by the Mining Act or regulated by DSWM (NCDENR) concurrently to the Transportation Program Management Director and the Resident Engineer. For reclamation procedures, refer to Section 3.7 in Chapter 3 of this manual.

Special Provisions

NCDOT has developed special provisions to provide guidance for E&SC designers. Chapter 2 focuses on the watershed/regulatory guidelines while Chapter 4 focuses on E&SC BMPs and discusses those provisions that provide guidance on installation and placement of structural BMPs. Special provisions often reference NCDOT's standard specifications that must be followed. Review special provisions as needed at the following link: http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/special_provisions/.

Title Sheet

The title sheet shall include the following information:

- Correct notes: NCG01, HQW, ESA, C&G, etc.
- Correct standards for project
- List of standard NCDOT symbology
- Name and certification number of Level III-certified individual responsible for designing and/or reviewing E&SC plans

Detail and Summary Sheets

The detail sheets and notes shall include the following information:

- E&SC device detail drawing sheets
- Matting quantity summary sheets
- Ground Cover Stabilization Timeframe sheet

Reforestation

Reforestation should be provided when ESAs are applied to jurisdictional streams on the project during the C&G phase. Streambank Reforestation is applied to stream relocation and mitigation sites.

- Reforestation Sheets
- Streambank Reforestation Sheets

Additional Plan Requirements

In addition to the guidelines presented throughout this section, NCDOT REU requires the following conditions be addressed by the E&SC designer:

- Plan submittals shall include all pertinent design information required for review, such as design calculations (furnished on REU design calculation spreadsheet), drainage areas, etc.
- Plans shall address any environmental issues raised during the permitting process.
- The E&SC designer shall comply with the *North Carolina Administrative Code Title 15 A Department of Environment and Natural Resources Chapter 4, Sediment Control*.
- All E&SC measures with stone extending beyond the construction limits shall be considered temporary fill. If impacted wetland areas are permitted as "Hand Clearing," then the aforementioned temporary fill shall be permitted as "Temporary Fill in Hand Cleared Areas for Erosion and Sediment Control."

Administrative Requirements

Consider the following administrative details while drafting the E&SC plan and throughout the life of the project:

- A sample set of E&SC plans (including any special details or special provisions used by the NCDOT REU) and the MicroStation Erosion Control Workspace are available upon request from the NCDOT REU.
- Sufficient time shall be allowed for the E&SC designer to make any changes to the E&SC plans deemed necessary by the NCDOT REU.
- All RFC E&SC plans, including any red-line revisions, shall be kept on site at all times throughout the duration of the project.

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3.4 Section

Operations Projects

Developing the E&SC Plan for Operations Projects

Operations projects, also referred to as state forces projects, refer to the construction work the Department performs on secondary and primary roadway projects. Bridge management projects are included as part of the operations projects category and are covered in a separate section within this chapter. The construction activities are completed using Department forces and resources, unless the project is contracted.

Prior to development of the E&SC Plans, the steps in Figure 3.9 should be addressed:

Environmental Document Review

- The Division Environmental Officer (DEO) performs minimum criteria checklist as part of the State Environmental Policy Act, SEPA.
- The DEO defines wetland and jurisdictional boundaries and provides assessments to the Design Engineer.

Base Plans

- Division Design Construct Offices develop the E&SC plan.
- The E&SC plan and plan checklist are sent to the NCDOT REU for review.
- All plans developed should use the EroDes spreadsheet.
- Typically, base plans are CADD drawings that may include horizontal and vertical alignments. Cross-section profile data is typically limited or not included on base plans.
- Hydraulic information for the proposed pipes and culverts are included on base plans.

Water Quality Review

- Ask if there are any applicable:
  - HQWs? (HQW, ORW, WS-I, WS-II, SA, PNA)
  - Trout (Tr) streams? Riparian Buffer rules?
  - Critical Area? (CA)
  - 303(d) streams listed for Turbidity impairments?
  - T&E species sensitive to sediment present?
- If yes to any, all jurisdictional streams require 50-ft. ESA on both sides of stream.

Other Environmental Considerations

- ESAs are assessed for the proposed pipe or culvert operation.
- Managing the watercourse and work zone is key to operations construction projects.
- The ability to obtain easements is limited.

Phasing

- Operations projects do not include C&G phase plans.
- Typically, disturbance is minimal, construction is completed and the area is stabilized in a short timeframe.
- Intermediate phase design elements are included in operations jobs.
- Projects are given a 30- or 60-day stabilization timeframe from start of grading operations.

Figure 3.9 Steps to follow before developing the E&SC plans.

Phasing is key to operations projects. Typically, they include a 30- or 60-day stabilization timeframe from the initial ground disturbance to groundcover establishment.

Operations Projects Work Flow for E&SC Plans

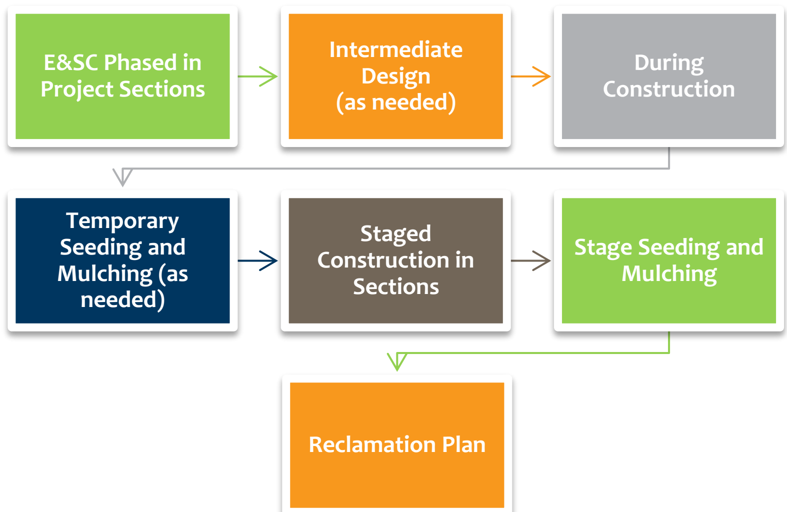

Figure 3.10 The major work flow steps of an Operations Transportation Project.

The operations project work flow in Figure 3.10 outlines the process for developing the E&SC Plans. The NCDOT REU shall review and accept all E&SC plans. E&SC plans shall be accepted by NCDOT REU before any land-disturbing activities commence, including C&G.

Note that E&SC plans shall, at a minimum, address the requirements presented in this section.

Phasing

Typically, operations projects are phased, or worked within discrete sections to minimize disturbance, stabilize the area and complete the project within a 30-

to 60-day timeframe. Some projects may deviate from the typical timeframe, but the projects are constructed similarly to those with the 30- to 60-day limits. Operations projects have no separate C&G phase. Intermediate phase design elements are included on these types of projects.

Because secondary and primary road construction activities have shorter construction schedules / time periods than conventional contracted and constructed projects, there is not typically a distinction between initial C&G operations of the site and final phase design. Rather, projects are given a 30- and 60-day stabilization timeframe once areas have been disturbed.

■ Phases of E&SC Design for Operations Projects

Because of the nature of operations projects, they usually do not warrant separate C&G and final grade phases. However, the following guidelines should be considered and implemented in the design of the E&SC plans as C&G and final grade activities are proposed for the site.

Good planning is essential to designing and executing an effective E&SC plan. Recall the ten key concepts of E&SC planning and design (presented in Chapter 2) as the E&SC plans are developed and implement the NCDOT-required guidelines. Specifically, for operations projects, EroDes should be used to design and develop the E&SC plan for all projects.

EroDes Design Spreadsheet

All operations projects should be designed using the EroDes design spreadsheet developed and provided by NCDOT at:

http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/fieldops/.

EroDes utilizes the Revised Universal Soil Loss Equation, Version 2 (RUSLE2) to calculate required storage volumes. There is a Help tab within the EroDes file that provides specific step-by-step guidance. The E&SC Design Engineer should then use the EroDes data to develop the E&SC plan.

- Use one worksheet for each project. Rename the Required Storage tab for the first drainage length. Each drainage length should be named by station left or right. Then, copy the first drainage length tab and rename it for the next drainage length.
- When the worksheet is completed for a drainage section:

   - If Option 4 can be used and is chosen, the storage for the drainage length will be obtained from TRSC-As or wattles.
   - If Option 5 can be used and is chosen, the storage for the drainage length will be obtained from TRSD-Bs.
   - If Option 6 can be used and is chosen, the storage for the drainage length will be obtained from Temporary Silt Basins, Type B.
- **Option 4 is the recommended option for bridge management projects with minimal disturbance on the approaches and some secondary and primary road projects**. Use of Option 4 will likely require diversion of off-site water through or around the project. This recommendation is made due to lack of available right-of-way (ROW) for basin installation.
- **Option 5 is <u>not</u> recommended for either secondary or primary road projects.** The storage obtained using this method requires basins too large to be installed on these types of projects.
- **Option 6 is the recommended option for secondary and primary road projects**.
- When the calculations for a project have been completed and the E&SC plan has been finalized, the EroDes spreadsheet for the project should be delivered to the NCDOT REU Field Operations Office. A hard copy should be included with the set of plans that is to remain on site during construction. The calculations are considered part of the E&SC plan.
- For more specific guidelines on using the EroDes spreadsheet, refer to NCDOT REU's website: http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/fieldops/.

C&G Guidelines

Operations projects do not have a separate C&G plan. However, C&G may be proposed for operations projects. When developing the E&SC plan for operations projects, adhere to the following general guidelines when considering C&G for the site:

- Submit the E&SC plans for approval prior to any land-disturbing operations.
- Furnish calculations on REU calculation tool spreadsheets.
- Use correct NCDOT symbology (Section 4.1 of Chapter 4).
- Account for existing topography.
- Determine drainage areas and disturbed areas.

- Consider clean water diversions to route run-on water around disturbed areas.
- Protect existing streams and wetlands; do not place E&SC devices in live streams unless authorized through Section 401 and 404 permits.
- Do not place sediment control devices that require excavation (e.g., basins, silt ditches) in wetlands or buffer zones.

The Designer should reference regulatory information regarding trout variances and riparian buffers. For specific environmental questions, refer to Chapter 2.

Construction Entrances

Construction entrances shall be considered part of the project and addressed in the E&SC plans.

- Note that construction access is normally the first land-disturbing activity and should be carefully planned.
- Refer to the gravel construction entrance in Chapter 4, Section 4.2.1 for construction details.

Inlet and Perimeter Controls

Inlet protection involves protecting existing inlet structures while perimeter controls provide the outer boundary of protection.

- Protect all existing drainage structure inlets that may receive stormwater with RIST-A, B, or C, PIST-A, B, etc.
- Provide inlet protection that can handle the volume of water from the respective drainage area.
- Maintain natural areas to the maximum extent possible.
- Utilize adequate perimeter controls (temporary silt ditch, temporary silt fence, etc.).
- Use perimeter erosion control below fill slopes 3-feet high or taller and between the project and any water body within 25 feet of the project.

- Show TRSC-As, 3-foot sections of special sediment fence or silt fence breaks on the plan at the low points of both the temporary silt fence and the temporary silt ditch.
- Use either silt fence backed by woven wire, with a post spacing of 6 feet or SSCF instead of standard silt fence in trout buffer zones and in ESAs that are at Trout water crossings.
- Supplement natural vegetation with silt fences and wattles around the perimeter, focusing on down gradient areas.
    - Use these barriers to protect stream buffers, riparian areas and waterways where sheet flow occurs.

Runoff Management Conveyances

Install stormwater conveyances with inlet and outlet protection devices early in the project to avoid the development of gullies and washes (NCDENR, 2008).

- Provide velocity control in conveyances and include all calculations.
- Utilize TRSC-Bs to reduce velocity in existing ditches with spacing as provided in EroDes. Also utilize TRSC-Bs in proposed temporary silt ditches and temporary diversions.
- Incorporate flocculant on wattles.
- Where approved by the REU Field Operations Engineer, utilize wattles with flocculant and/or TRSC-As with matting and flocculant in temporary and permanent, existing and proposed ditches at a spacing as provided in EroDes in areas where:
    - Sediment basins are not feasible at drainage outlets; and
    - Sediment and silt basins at drainage outlets cannot be properly sized to surface area and/or sediment storage requirements due to safety concerns, right-of-way restrictions, utility conflicts or other construction limitations exist.
- Ensure every ditch line on a project has a ditch treatment/ditch liner.

The recommendations from EroDes (Ditch Liner tab) should be followed unless there is a reason the ditch liner cannot be installed (i.e., an existing solid rock ditch line). Install velocity controls as soon as access to the site is gained. Additional velocity controls will likely be needed when grading begins. The Design Engineer will use EroDes to develop velocity controls for the project.

- Either wattles with flocculant, TRSC-Bs or TRSC-As with matting and flocculant must be used in the ditch lines as velocity controls.

Wattles (Excelsior or Coir Fiber)

- Wattle use with flocculant is required on projects in ditches that do not have riprap and which have water quality classifications of HQW or Trout. The HQW classification includes HQW, ORW, WS-I and WS-II. Wattles can be used on Non-Trout water and Non-HQW projects if the designers choose to use them. At least one wattle with flocculant must be used in drainage lengths that are designed using any method other than Option 5 in EroDes.
- Wattles with flocculant are used in place of check dams in the ditch line. The turnout measure of a drainage length will still have a rock weir, not a wattle and **without** flocculant.
- The flocculant powder should be replaced on the wattles after each 0.5-inch rain event. It is recommended that the technician conducting the NPDES inspections after the rain events also replaces the flocculant.
- The EroDes spreadsheet for plan design includes recommendations on the wattle number and spacing.
- Wattles are not needed in riprapped ditch lines unless there will be a delay between pulling the ditch line and riprap installation.
- 'Wattle Installation Guide' and a 'Materials Needed for Wattle Installation' documents are available for download from the REU Field Operations webpage under Important Downloads. These will give installation guidance and a list of materials needed for wattle installation and the information needed for ordering the materials: http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/fieldops/.
- The wattles are 12 or 18 inches in diameter. NCDOT recommends use of the 12-inch wattles for typical foothill and mountain ditch lines. During installation, the installer should verify the water flows over the low point of the wattle and not around it. The wattles are malleable and can be compressed in the middle and pinned down to ensure the water flow is over the middle of the wattle. Another alternative to obtain a low point involves excavating a perpendicular trench in the ditch line to bury part of the wattle to achieve the height needed.
- For projects that take less than a year, excelsior wattles are used. For projects greater than 1 year, coir fiber wattles are used. Typically, operations projects use excelsior wattles.
- Chapter 4, Section 4.5.1 discusses specific information about wattles.

Typically, operations projects use excelsior wattles due to short duration projects and to provide velocity control and flocculant delivery.

TRSC-Bs

- TRSC-Bs are not needed in riprapped ditch lines unless there will be a delay between constructing the ditch line and installing the riprap.
- If the storage requirement from EroDes is obtained from TRSC-As, then these should be substituted for the TRSC-Bs.
- Chapter 4, Section 4.5.3 discusses specific information about TRSC-Bs.

TRSC-As with Matting and Flocculant

- TRSC-As with matting and flocculant are used in place of wattles on projects which have water quality classifications of HQW or Trout when wattles cannot be installed. Wattles are the preferred ditch check on HQW and Trout projects. TRSC-As can be used on Non-Trout water and Non-HQW projects if the designers choose to use them. At least one wattle or TRSC-A with matting and flocculant must be used in drainage lengths that are designed using any method other than Option 5 in EroDes.
- TRSC-As with matting and flocculant are used in place of check dams in the ditch line. The turnout measure of a drainage length should still have a rock weir not a wattle, and **without** flocculant.
- The flocculant powder should be replaced on the TRSC-A after each 0.5-inch rain event. The technician conducting the NPDES inspections after the rain events should also be responsible for replacing the flocculant powder.
- The EroDes spreadsheet for plan design includes recommendations on the TRSC-A number and spacing.
- TRSC-As are not needed in riprapped ditch lines unless there is a delay between constructing the ditch line and installing the riprap.
- Chapter 4, Section 4.5.2 discusses specific information about TRSC-As.

Coir Fiber Baffles

- Coir fiber baffles shall be installed in every TRSD-B and every Silt Basin Type B installed at the turnouts (including cross pipe outlets). Implement the following coir fiber baffle requirements:
    - Basins 10 feet in length or less require one baffle.
    - Basins greater than 10 feet in length up to 20 feet in length require two baffles.
    - Basins greater than 20 feet in length require three baffles.
- A 'Materials Needed for Coir Fiber Baffles' guide is available for download from the REU Field Operations webpage under Important Downloads. The guide provides a list of materials needed for coir fiber baffle installation. (Note: 9-gauge single strand wire can be substituted for the 8-gauge wire.) http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/fieldops/
- Chapter 4, Section 4.7.7 discusses specific information about coir fiber baffles.

Sediment Storage Requirements

Sediment storage requirements are addressed in the EroDes spreadsheet. Storage for the project will be obtained from TRSC-As, wattles, TRSD-Bs or Silt Basins Type B.

There is limited ROW for sediment storage in operations projects.

Culvert and Pipe Construction

For operations projects, E&SC phasing for pipe and culvert construction shall be included and provided for review. Installation of these items shall be in accordance with NCDOT's *Best Management Practices for Construction and Maintenance Activities*. Prior to the installation of pipes smaller than 48 inches in jurisdictional areas, the E&SC Design Engineer shall submit a phasing plan for managing the watercourse to NCDOT REU Field Operations for review and acceptance.

During Construction

The E&SC Design Engineer is responsible for obtaining approval for E&SC plan revisions and maintaining accurate E&SC plans for the life of the construction project.

- During construction, any major deviations from the E&SC plan must be submitted to NCDOT REU Field Operations.
- Prior to installation of any E&SC devices, the DEO shall verify boundaries of jurisdictional areas in the field and delineate them with safety fence or flagging.
    - For guidance on safety fence and flagging in jurisdictional areas, refer to Chapter 4, Section 4.2.2.
- Whenever the Engineer determines that significant erosion and sedimentation continues despite the installation of approved protective practices, additional protective action should be taken.

Intermediate Phase Design

Intermediate erosion control plans may be required if design modifications and/or site conditions require additional E&SC design or design revisions to the E&SC plans. Intermediate plans shall be submitted for review and shall be accepted prior to construction of any aspect impacted by the revised erosion control design. Specifically, for operations projects, some examples of elements to include in the intermediate phase design might involve managing the work zone and watercourse for construction activities with roadway cross line pipes.

Utility Construction

Utility relocation work on operations projects is typically handled by owners of the utility prior to construction. E&SC plans are generally not required for such work activities as moving utility poles and telecommunication pedestals or relocating underground communication cables.

Final Grade Phase

The most effective erosion control practice available is proper establishment of a good vegetative cover. It is important to establish seeding and mulching as early as possible on graded surfaces as grading progresses rather than waiting until the entire slope reaches final grade.

The most effective erosion control practice available is proper establishment of a good vegetative cover.

General

Observe applicable design components listed previously and protect existing and proposed drainage structure inlets. Utilize adequate perimeter controls; refer to the Inlet and Perimeter Controls section as needed.

Slope Protection

Slope protection is a critical step in the E&SC process and the grading plan forms the basis of the E&SC plan (NCDENR, 2008). All practices necessary for controlling erosion on the graded surface must be included in the plan and steps utilized in previous phases may be repeated.

- Utilize temporary slope drains and earth berms at the top of fill slopes and where there are super elevations on tall fill slopes. For slope drain design and location guidance, refer to Section 4.4.1 on page 4-51. Maximum spacing between slope drains should be 200 feet.
- Utilize a rock energy dissipater at the outlet of the slope drain.
- Unless otherwise approved by the REU Field Operations Engineer, provide matting for erosion control on all slopes (cut and fill) that are 2:1 or steeper and a height of 8 feet or greater. In Trout waters, the E&SC designer should plan for biodegradable matting only.

Storm Drainage Network

As the storm drainage network is finalized, inlet protection is critical to keep the new network free of sediment where runoff is contacting unpaved areas. Devices at all drainage turnouts shall utilize infiltration or sediment control stone devices (TRSD-B, TRSC-A, etc.) and a spillway with an adequately designed base length to distribute outflow.

Cover Stabilization Requirements

Ground cover stabilization shall comply with the timeframe guidelines specified in NCG01. Excluding the slopes noted below, temporary and permanent ground cover stabilization shall be provided within seven calendar days from the last land-disturbing activity. The designer shall label all slopes subject to the 7-day ground cover stabilization requirements on all E&SC plans submitted to the Department for review and acceptance.

- For the slopes noted below, temporary and/or permanent ground cover stabilization shall be provided within 14 calendar days from the last land-disturbing activity:
    - Slopes between 2:1 and 3:1, with a slope length of 10 feet or less
    - Slopes 3:1 or flatter, with a slope length of 50 feet or less
    - Slopes 4:1 or flatter

There may be cases where EroDes yields an excessive number of TRSC-A (TRSC-A that is wrapped with coir fiber, excelsior or straw matting to aide in the introduction of flocculant) to achieve storage requirements, and site constraints disallow skimmer and infiltration basin installation. Therefore, it will be necessary to utilize the option below that best fits the situation:

- 30-day option - Under these circumstances, it will be necessary to provide a minimum of 23% of the storage calculated using the RUSLE2 analysis during the initial project phase. This section must then be permanently stabilized within 30 days from the time C&G begins. This is derived from Table 2-1 of the Level III Reference Manual which indicates that for any given 30-day period in NC, the maximum amount of rainfall energy that can be expected is 23% of the annual total.
- 60-day option - Under these circumstances, it will be necessary to provide a minimum of 43% of the storage calculated using the RUSLE2 analysis during the initial project phase. This section must then be permanently stabilized within 60 days from the time C&G begins. This is derived from Table 2-1 of the Level III Reference Manual which indicates that for any given 60-day period in NC, the maximum amount of rainfall energy that can be expected is 43% of the annual total. Note that this option is not available for projects involving HQW or Trout waters.

Additional Stabilization Requirements

Seeding & Mulching

Trout buffer zones require additional ground stabilization measures.

- Graded slopes and fills within the trout buffer zone will be planted or otherwise provided with temporary or permanent ground cover (native plant and tree species), devices or structures sufficient to restrain erosion within seven calendar days of completion of any phase of grading. The stabilization timeline applies to contract and operations projects.
- Graded slopes and fills within the trout buffer zone (excluding road shoulders) shall be protected with RECP, bonded fiber matrix or flexible growth medium after seeding.

Reclamation Plans for Any Off-site Borrow or Waste Pits

Borrow or waste areas that are part of the project shall require a separate reclamation plan, unless the borrow or waste activity is regulated under the Mining Act of 1971, or is a landfill regulated by the NCDENR's Division of Solid Waste Management (DSWM). For newly-created borrow pits that require dewatering, borrow pit dewatering basins shall be required. The Engineer shall record the location and permit number for waste/borrow sites covered by the Mining Act or regulated by DSWM (NCDENR) on the E&SC title sheet. For reclamation procedures, refer to Section 3.7 in Chapter 3 of this manual.

Detail Sheets and Notes

Operations projects generally do not include detail sheets. Quantity sheets are not included, and reforestation sheets, if any, are minimal. Project-specific notes for E&SC measures should be provided as applicable to the project.

Title Sheet

Operations projects shall include a title sheet for the proposed E&SC plans. The title sheet shall include the following information:

- Correct notes: NCG01, HQW, ESA, C&G, etc.
- List of standard NCDOT symbology in Section 4.1 of Chapter 4.

- Name and certification number of Level III-certified individual responsible for designing and/or reviewing E&SC plans.

3.5 Section

Bridge Management Construction Projects

Developing the E&SC Plan for Bridge Management Construction Projects

Bridge management construction projects involve the installation and replacement of culvert structures that are primarily greater than 48 inches in diameter. These construction activities are generally conducted on secondary and primary roads and are completed within a few days or weeks. C&G activities associated with bridge management construction projects are minimal. Thus, E&SC planning can be limited to design considerations for the existing ditch lines, stockpile containment and watercourse management.

Prior to development of the E&SC plans, the steps in the diagram below should be addressed:

Environmental Document Review	• The DEO performs the minimum criteria checklist as part of the State Environmental Policy Act, SEPA. • The DEO defines wetland and jurisdictional boundaries and provides assessments to the Design Engineer.
Base Plans	• The Bridge Management Office develops the E&SC plan. • The E&SC plan and plan checklist are sent to the NCDOT REU for review. • All plans developed should use EroDes. • Typically, base plans are a straight line diagram that may include horizontal and vertical alignments. Cross-section profile data is typically limited or not included on base plans. • Hydraulic information for the proposed pipes and culverts are included on base plans.
Water Quality Review	• Ask if there are any applicable: ○ HQWs? (HQW, ORW, WS-I, WS-II, SA, PNA) ○ Trout (Tr) streams? Riparian Buffer rules? ○ Critical Area? (CA) ○ 303(d) streams listed for Turbidity impairments? ○ T&E species sensitive to sediment present? • If yes to any, all jurisdictional streams require a 50-ft. ESA on both sides of stream.
Other Environmental Considerations	• ESAs are assessed for the proposed pipe or culvert operation. • Managing the watercourse and work zone is key to bridge management construction projects. • The ability to obtain easements is limited.
Phasing	• Bridge management construction projects have no C&G phase. • Typically, disturbance is minimal, construction is completed and the area is stabilized in a short timeframe. • Intermediate phase design elements are included in bridge management jobs. • Projects are given a 30- or 60-day stabilization timeframe.

Figure 3.11 Steps to follow before developing the E&SC plans.

Managing the watercourse and work zone is key to bridge management construction projects.

Bridge Management Construction Operations Work Flow for E&SC Plans

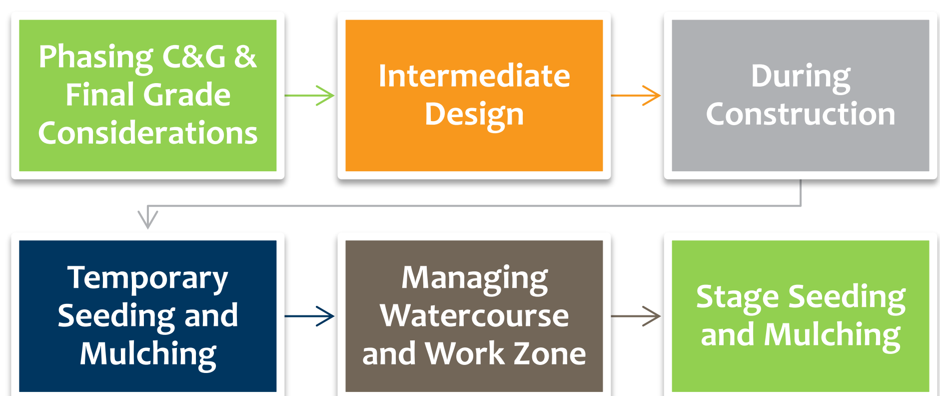

Figure 3.12 Operations flow for E&SC plans.

The bridge management construction operations work flow in Figure 3.12 outlines the process for developing the E&SC Plans. The NCDOT REU shall review and accept all E&SC plans. No land-disturbing activities shall occur in any location that does not have accepted and approved E&SC plans. Note that E&SC plans shall, at a minimum, address the requirements presented in this section.

Phasing

Typically, bridge management projects are limited to a single stream crossing and have minimal ground disturbance but involve construction activities in and around the watercourse. The construction period is limited to a few days or a few weeks and infrequently exceeds 30 days. Bridge management projects have no separate C&G phase. Intermediate phase design elements are included on these types of projects.

Because bridge management construction activities have shorter construction schedules / time periods than conventional contracted and constructed projects, there is not typically a distinction between initial C&G operations of the site and final phase design. Rather, projects are constructed and stabilized with a 30-day timeframe once areas have been disturbed. Refer to the bridge E&SC plan design checklist available through the REU ERCON (i.e., the erosion control system from the REU Field Operations Office).

Phases of E&SC Design for Bridge Management Projects

Because of the nature of bridge management projects, they usually do not warrant separate C&G and final grade phases. The following guidelines, however, should be considered and implemented in the design of the E&SC plans as C&G and final grade activities are proposed for the site.

Good planning is essential to designing and executing an effective E&SC plan. Recall the ten key concepts of E&SC planning and design (presented in Chapter 2) as the E&SC plans are developed and implement the NCDOT-required guidelines. Specifically, for bridge management projects, the EroDes spreadsheet should be used to design and develop the E&SC plan for all projects.

EroDes Design Spreadsheet

While not all projects require the use of EroDes, all bridge management projects should be designed using the EroDes design spreadsheet developed and provided by NCDOT at:

http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/fieldops/.
EroDes utilizes RUSLE2 to calculate required storage volumes. There is a Help tab within the EroDes file that provides specific step-by-step guidance. The E&SC Design Engineer should then use the EroDes data to develop the E&SC plan.

- Use one worksheet for each project. Rename the Required Storage tab for the first drainage length. Each drainage length should be named by station left or right. Then, copy the first drainage length tab and rename it for the next drainage length.

- When the worksheet is completed for a drainage section:
    - If Option 4 can be used and is chosen, the storage for the drainage length will be obtained from TRSC-As or wattles.
    - If Option 5 can be used and is chosen, the storage for the drainage length will be obtained from TRSD-B.
    - If Option 6 can be used and is chosen, the storage for the drainage length will be obtained from Silt Basin Type B.
- **Option 4 is the recommended option for bridge management projects with minimal disturbance on the approaches.** Use of Option 4 will require diversion of off-site water through or around the project. This recommendation is made due to lack of available right-of-way (ROW) for basin installation.
- **Option 5 is not recommended for bridge management projects.** The storage obtained using this method is too large to be installed on these types of projects.
- **Option 6 is the recommended option for bridge management projects with moderate disturbance on the approaches.**
- When the calculations for a project have been completed and the E&SC plan has been finalized, the EroDes spreadsheet for the project should be delivered to the NCDOT REU Field Operations Office. A hard copy should be included with the set of plans that is to remain on site during construction. The calculations are considered part of the E&SC plan.
- For more specific guidelines on using the EroDes spreadsheet, refer to NCDOT REU's website: http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/fieldops/.

C&G Guidelines

Bridge management projects do not have a separate C&G plan. However, C&G may be proposed for bridge management projects.

The designer should reference regulatory information regarding trout variances and riparian buffers.
For specific environmental questions, refer to Chapter 2.

When developing the E&SC plan for bridge management projects, adhere to the following general guidelines when considering C&G for the site:

- Submit the E&SC plans for approval prior to any land-disturbing operations.
- Use correct NCDOT symbology in Section 4.1 of Chapter 4.
- Account for existing topography.
- Determine drainage areas and disturbed areas.
- Consider clean water diversions to route run-on water around disturbed areas.
- Provide protection between stream and approach fill velocity control within the ditch lines using TRSC-Bs or wattles.

Construction Entrances

Construction entrances shall be considered part of the project and addressed in the E&SC plans.

- Note that construction access is normally the first land-disturbing activity and should be carefully planned.
- Refer to the gravel construction entrance in Chapter 4, Section 4.2.1 for construction details.

Inlet and Perimeter Controls

Inlet protection involves protecting existing inlet structures while perimeter controls provide the outer boundary of protection.

- Protect all existing drainage structure inlets, including bridge funnel drains that may receive stormwater with RIST-A, B, or C, PIST-A, B, etc.
- Provide inlet protection that can handle the volume of water from the respective drainage area.

- Maintain natural areas to the maximum extent possible.
- Utilize adequate perimeter controls (temporary silt ditch, temporary sediment fence, etc.).
- Supplement natural vegetation with silt fences and wattles around the perimeter, focusing on downslope areas.
  - For small drainage areas only, use these barriers to protect stream buffers, riparian areas and waterways.

Runoff Management Conveyances

Install stormwater conveyances with inlet and outlet protection devices early in the project to avoid the development of gullies and washes (NCDENR, 2008).

- Provide velocity control in conveyances and include all calculations.
- Utilize TRSC-Bs to reduce velocity in existing ditches with spacing as provided by EroDes. Also utilize TRSC-Bs in proposed temporary silt ditches and temporary diversions.
- Incorporate flocculant on wattles.
- Where approved by the REU Field Operations Engineer, utilize fiber wattles with flocculant and/or TRSC-As with matting and flocculant in temporary and permanent, existing and proposed ditches with spacing as provided by EroDes in areas where:
  - Sediment basins are not feasible at drainage outlets; and
  - Sediment and silt basins at drainage outlets cannot be properly sized to surface area and/or sediment storage requirements due to safety concerns, right-of-way restrictions, utility conflicts or other construction limitations exist.

Velocity Controls

Install velocity controls as soon as access to the site is gained. Additional velocity controls will likely be needed when grading begins. The E&SC Design Engineer will use EroDes to develop velocity controls for the project.

- Either wattles with flocculant, TRSC-Bs or TRSC-As with matting and flocculant must be used in the ditch lines as velocity controls.

Wattles (Excelsior and Coir Fiber)

- Wattle use with flocculant is required on projects in ditches that do not have riprap and which have water quality classifications of HQW or Trout. The HQW classification includes HQW, ORW, WS-I, WS-II, SA and

PNA. Wattles can be used on Non-Trout water and Non-HQW projects if the designers choose to use them. At least one wattle with flocculant must be used in drainage lengths that are designed using any method other than Option 5 in EroDes.

- Wattles with flocculant are used in place of check dams in the ditch line. The turnout measure of a drainage length will still have a rock weir, not a wattle and **without** flocculant.
- The flocculant powder should be replaced on the wattles after each 0.5-inch rain event. It is recommended that the technician conducting the NPDES inspections after the rain events also replaces the flocculant powder.
- The EroDes spreadsheet for plan design includes recommendations on the wattle number and spacing.
- Wattles are not needed in riprapped ditch lines unless there will be a delay between pulling the ditch line and riprap installation.
- A 'Wattle Installation Guide' and a 'Materials Needed for Wattle Installation' document are available for download from the REU Field Operations webpage under Important Downloads. These will give installation guidance and a list of materials needed for wattle installation and the information needed for ordering the materials: http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/fieldops/.
- The wattles are 12 or 18 inches in diameter. NCDOT recommends use of the 12-inch wattles for typical foothill and mountain ditch lines. During installation the installers should verify the water flows over the low point of the wattle and not around it. The wattles are malleable and can be compressed in the middle and pinned down to ensure the water flow is over the middle of the wattle. Another alternative to obtain a low point involves excavating a perpendicular trench in the ditch line to bury part of the wattle to achieve the height needed.
- For projects that take less than a year, excelsior wattles are used. For projects greater than 1 year, coir fiber wattles are used. Typically, operations projects use excelsior wattles.
- Chapter 4, Section 4.5.1 discusses specific information about wattles.

TRSC-Bs

- TRSC-Bs are not needed in riprapped ditch lines unless there will be a delay between constructing the ditch line and installing the riprap.

- If the storage requirement from EroDes is obtained from TRSC-As, then these should be substituted for the TRSC-Bs.
- Chapter 4, Section 4.5.3 discusses specific information about TRSC-Bs.

TRSC-A with Matting and Flocculant

- TRSC-As with matting and flocculant are used in place of wattles on projects which have water quality classifications of HQW or Trout when wattles cannot be installed. Wattles are the preferred ditch check on HQW and Trout projects. TRSC-As can be used on Non-Trout water and Non-HQW projects if the designers choose to use them. At least one wattle or TRSC-As with matting and flocculant must be used in drainage lengths that are designed using any method other than Option 5 in EroDes.
- TRSC-As with matting and flocculant are used in place of check dams in the ditch line. The turnout measure of a drainage length should still have a rock weir, not a wattle and **without** flocculant .
- The flocculant powder should be replaced on the TRSC-A after each 0.5-inch rain event. The technician conducting the NPDES inspections after the rain events should also be responsible for replacing the flocculant powder.
- The EroDes spreadsheet for plan design includes recommendations on the TRSC-A number and spacing.
- TRSC-As are not needed in riprapped ditch lines unless there is a delay between constructing the ditch line and installing the riprap.
- Chapter 4, Section 4.5.2 discusses specific information about TRSC-As.

Coir Fiber Baffles

- Coir fiber baffles shall be installed in every TRSD-B and every Silt Basin Type B installed at the turnouts (including cross pipe outlets). Implement the following coir fiber baffle requirements:
    - Basins 10 feet in length or less require one baffle.
    - Basins greater than 10 feet in length and up to 20 feet in length require two baffles.
    - Basins greater than 20 feet in length require three baffles.
- A 'Materials Needed for Coir Fiber Baffles' guide is available for download from the REU Field Operations webpage under Important Downloads. The guide provides a list of materials needed for coir fiber

baffle installation. (Note: 9-gauge single strand wire can be substituted for the 8-gauge wire.) http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/fieldops/

- Chapter 4, Section 4.7.7 discusses specific information about coir fiber baffles.

Sediment Storage Requirements

Sediment storage requirements are addressed in the EroDes spreadsheet. Storage for the project will be obtained from TRSC-As, wattles, TRSD-Bs or Silt Basins Type B. Bridge projects that do not disturb ditch lines will not need sediment storage calculations.

Bridge projects that do not disturb ditch lines will not need sediment storage calculations.

Culvert and Pipe Construction

For bridge management projects, E&SC phasing for pipe and culvert installation shall be included and provided for review. Installation of these items shall be in accordance with NCDOT's *Best Management Practices for Construction and Maintenance Activities*. Prior to the installation of proposed pipes and culverts, the E&SC design engineer shall submit a phasing plan for managing the watercourse to NCDOT REU Field Operations for review and acceptance.

Stockpile Management

One of the challenges of bridge management projects is the management of stockpiles. The replacement of culverts involves excavation that results in temporary stockpiles used for backfill once the new structures have been set into place. Stockpiled materials shall be contained within the work area and not placed within wetlands, protected riparian buffers or any other jurisdictional areas.

- Utilize silt fence or as a perimeter measure for stockpile locations.
- Apply straw mulch at a rate of 2 tons/acre or cover with impermeable materials, if necessary, prior to rainfall events.

- Refer to the NCDOT Construction Manual at: https://connect.ncdot.gov/projects/construction/Pages/Construction-Manual.aspx for stockpile management details.

During Construction

The E&SC Design Engineer is responsible for obtaining approval for E&SC plan revisions and maintaining accurate E&SC plans for the life of the construction project.

- During construction, any major deviations from the E&SC plan must be submitted to NCDOT REU Field Operations.
- Prior to installation of any E&SC devices, the DEO shall verify boundaries of jurisdictional areas in the field and delineate them with safety fence or flagging.
    - For guidance on safety fence and flagging in jurisdictional areas, refer to Chapter 4, Section 4.2.2.
- Whenever the Engineer determines that significant erosion and sedimentation continues despite the installation of approved protective practices, additional protective action should be taken.

Intermediate Phase Design

Intermediate erosion control plans may be required if design modifications and/or site conditions require additional E&SC design or design revisions to the E&SC plans. Intermediate plans shall be submitted for review and shall be accepted prior to construction of any aspect impacted by the revised erosion control design. Specifically, for operations projects, some examples of elements to include in the intermediate phase design might involve managing the work zone and watercourse for pipe and culvert construction activities.

Utility Construction

Utility relocation work on bridge management projects is typically handled by owners of the utility prior to construction. E&SC plans are generally not required for such work activities as moving utility poles and telecommunication pedestals or relocating underground communication cables.

Construction and Watercourse Management

Culvert replacement involves isolation of the work area from flow within the stream or watercourse. In such cases, the flow must be diverted. Steps taken to minimize impacts to the watercourse when diverting flow either through or around the work area involve maintaining normal flow both upstream and downstream, as well as conducting activities within intermittent streams during times when there is no flow.

- Streamflow diversion is typically achieved by utilizing bypass pumping techniques or suspended bypass pipes.
- Work zone dewatering activities include effluent being pumped into a geotextile bag and treated prior to being released offsite at a non-erosive velocity through sheet flow.

Final Grade Phase

It is important to establish seeding and mulching as soon as backfilling is completed and the final typical section is established.

The most effective erosion control practice available is proper establishment of a good vegetative cover.

General

Observe applicable design components listed previously and protect existing and proposed drainage structure inlets. Utilize adequate perimeter controls; refer to the Inlet and Perimeter Controls section as needed.

Slope Protection

Slope protection is a critical step in the E&SC process and the grading plan forms the basis of the E&SC plan (NCDENR, 2008). All practices necessary for controlling erosion on the graded surface must be included in the plan and steps utilized in the previous phase may be repeated.

- Utilize temporary slope drains and earth berms at the top of fill slopes and where there are super elevations on tall fill slopes. For slope drain design and location guidance, refer to Section 4.4.1 on page 4-51. Maximum spacing between slope drains should be 200 feet.
- Utilize a rock energy dissipater at the outlet of the slope drain.
- Unless otherwise approved by the REU Field Operations Engineer, provide matting for erosion control on all slopes (cut and fill) that are 2:1 or steeper and a height of 8 feet or greater. In Trout waters, the designer should plan for biodegradable matting only.

Storm Drainage Network

- Inlet protection of all existing and proposed funnel drain inlets is critical to keep the new pipe network clean where runoff is contacting unpaved areas. Devices at all drainage turnouts shall utilize infiltration, skimmers or sediment control stone (TRSD-B, TRSC-A, etc.) and a spillway with an adequately designed base length to distribute outflow.
- Protect all funnel drain inlets within the final storm drain network (RIST-A, B, C and PIST-A, B).

Ground Cover Stabilization Requirements

Ground cover stabilization shall comply with the timeframe guidelines specified in NCG01. Excluding the slopes noted below, temporary and permanent ground cover stabilization shall be provided within seven calendar days from the last land-disturbing activity. The designer shall label all slopes subject to the 7-day ground cover stabilization requirements on all E&SC plans submitted to the Department for review and acceptance.

- For the slopes noted below, temporary and/or permanent ground cover stabilization shall be provided within 14 calendar days from the last land-disturbing activity:
  - Slopes between 2:1 and 3:1, with a slope length of 10 feet or less
  - Slopes 3:1 or flatter, with a slope length of 50 feet or less
  - Slopes 4:1 or flatter

Additional Stabilization Requirements

Seeding & Mulching

Trout buffer zones require additional ground stabilization measures.

- Graded slopes and fills within the trout buffer zone will be planted or otherwise provided with temporary or permanent ground cover (native plant and tree species), devices or structures sufficient to restrain erosion within ten calendar days of completion of any phase of grading.

Reclamation Plans for any Off-site Borrow or Waste Pits

Borrow or waste areas that are part of the project shall require a separate reclamation plan, unless the borrow or waste activity is regulated under the

Mining Act of 1971, or is a landfill regulated by the NCDENR DWSM. For newly-created borrow pits that require dewatering, borrow pit dewatering basins shall be required. The Engineer shall record the location and permit number for waste/borrow sites covered by the Mining Act or regulated by DSWM (NCDENR) on the E&SC title sheet. For reclamation procedures, refer to Section 3.7 in Chapter 3 of this manual.

Detail Sheets and Notes

Bridge management projects generally do not include detail sheets. Quantity sheets are not included, and reforestation sheets, if any, are minimal. Project-specific notes for E&SC measures should be provided as applicable to the project.

Title Sheet

Bridge management projects shall include a title sheet for the proposed E&SC plans. The title sheet shall include the following information:

- Correct notes: NCG01, HQW, ESA, C&G, etc.
- List of standard NCDOT symbology in Section 4.1 of Chapter 4
- Name and certification number of Level IIIA-certified individual responsible for designing and/or reviewing E&SC plans

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3.6 Section

Nonlinear Projects

E&SC Requirements for Nonlinear Projects

Nonlinear projects can originate from many different groups within NCDOT's organization. Examples of nonlinear projects for the Division of Highways may include site development for buildings at Division, District, Construction and Maintenance Facilities, equipment shops, rest areas and welcome centers. Nonlinear Division of Motor Vehicles projects may include weigh stations, Driver's License offices and Commercial Driver License Skill Testing sites. NCDOT's Facilities Management Division (FMD) serves to coordinate the design and construction of these facilities regardless of the source of the project.

NCDOT's FMD leads in overseeing nonlinear project development.

The E&SC design engineer for a nonlinear project shall develop the E&SC design in accordance with all applicable BB design requirements (see Section 3.1 of this chapter), including implementation of existing NCDOT E&SC design measures, Standard Specifications, Standard Special Provisions and Standard Drawings, and submit the E&SC plans to the NCDOT FMD. FMD forwards the plans to the REU S&W Engineering Section for review and FMD coordinates with the E&SC design engineer for incorporation of REU's comments. During the construction phase, the REU Field Operations office provides oversight and reviews the project for compliance with the plans.

The E&SC design engineer should reference and be guided by:

- Division 16 of the NCDOT Standard Specifications available at: https://connect.ncdot.gov/resources/Specifications/Pages/Specifications-and-Special-Provisions.aspx.
- Applicable NCDOT roadway standard drawings for E&SC BMPs available at: https://connect.ncdot.gov/resources/Specifications/Pages/2012-Roadway-Drawings.aspx.
- Applicable E&SC details which are available at: http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/details/.
- An example set of E&SC plans for a nonlinear project are available at: http://www.ncdot.gov/DOH/operations/dp_chief_eng/roadside/soil_water/downloads/files/CherryPolo.pdf.

Levels I, II and III certifications are required for E&SC plans for nonlinear projects. For more information regarding training and certification, refer to Chapter 5.

Vegetation establishment shall meet the requirements of Division 16 of the Standard Specifications for Roads and Structures (current edition) as well as the regional Project Special Provisions for Seeding and Mulching which are available at the following link:

http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/special_provisions/.

Since many of the nonlinear projects are open to the public and mowed on a more frequent basis than roadway medians and shoulders, include provisions to provide a lawn type appearance for all applicable maintained areas.

All facets of the Division of Highway's Borrow and Waste Site Reclamation Plan Procedures for contract projects will be followed including the Project Special Provisions for Contractor Borrow Source, Procedure for Monitoring Borrow Pit Discharge and Borrow Excavation and State Historic Preservation Office (SHPO) Documentation for Borrow/Waste Sites. Refer to Section 3.7 of this chapter for guidance on reclamation plan procedures.

Articles 105-16 of the Standard Specifications (current edition), Failure to Maintain the Project or Perform Erosion Control Work and 107-12 Control of Erosion, Siltation, and Pollution should also be included in any contract documentation.

In summary, for nonlinear NCDOT construction projects, the E&SC design engineer should adhere to the following guidelines:

- All applicable bid-build E&SC requirements;
- Division 16 of the Standard Specifications for Roads and Structures (current edition);
- Applicable regional special provisions for seeding and mulching;
- Applicable roadway standard drawings (current edition) for E&SC BMPs;
- Applicable NCDOT E&SC special details;
- NCDOT Reclamation Plan Procedures;
- Failure to Maintain the Project or Perform Erosion Control Work (Standard Specifications Article 105-16); and
- Control of Erosion, Siltation, and Pollution (Standard Specifications Article 107-12).

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NCDOT ESC Erosion & Sediment CONTROL MANUAL

3.7

Section

Reclamation Plans

E&SC Guidance for Reclamation Plans

Reclamation plans are required for construction projects where land-disturbing activities exceed the project limits. Construction activities that include waste and borrow pits, as well as applicable staging areas and haul roads require reclamation plans.

Applicability

NCDOT has developed and defined reclamation procedures for contracted projects and operations projects. Contracted projects are defined as those projects using a contractor (DB, BB, Low Impact Bridge, etc.) to perform construction activities. Operations projects are projects that utilize NCDOT forces to perform construction activities. If the project is contracted and is operations related, then the reclamation plan follows contracted procedures.

Borrow Sites

Borrow sites for construction activities involve the transportation of borrowed materials from outside of the project limits to locations within the project limits. When construction activities require the use of borrow materials outside of the project limits, NCDOT requires that a reclamation plan be developed for the project.

Waste Sites

Waste sites are locations associated with construction activities where waste material consists of all excavated material not used in the construction of the project. Permanent and temporary waste stockpiles beyond the project limits warrant development of a reclamation plan.

Staging Areas

Staging areas are temporary areas beyond the project limits that are used during the project to store equipment, supplies, materials or other activities related to the project.

Haul Roads

Haul roads provide access to reclamation sites. Typically, these are located on larger contracted projects, but can be needed on operations projects as accessibility issues arise. If a haul road is proposed to be developed and is associated with one of these sites, staging areas or waste or borrow locations, then it should be delineated on the reclamation plans.

Stockpiles

Stockpiles are permanent and temporary locations associated with construction activities where unused materials are stored. Stockpiles can be located within the project limits and outside of the projects limits. If stockpiles are located within the project limits, they can be included on the project E&SC plans. If the stockpiles are located outside of the project limits, then stockpiles become waste sites and warrant the development of a reclamation plan.

Reclamation Procedures

NCDOT has developed guidelines for reclamation procedures for construction activities. The reclamation procedures are applied to both contracted and operations projects where reclaimed sites exist. While there are some differences between the two types of projects (contracted and operation projects), the approach to the reclamation procedures is the same. The primary difference between the two types of projects is that in contracted projects, an environmental consultant is hired to perform the environmental evaluation. For operations projects, the DEO performs the environmental evaluation. For specific reclamation procedures for contracted and operations projects, refer to the NCDOT REU Field Operations website.

- Reclamation Procedures for Contracted Projects: http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/fieldops/downloads/Files/ContractedReclamationProcedures.pdf.
- Reclamation Procedures for Operations Projects: http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/fieldops/downloads/Files/OperationsReclamationProcedures.pdf.

Checklist Overview

For both contracted projects and operations projects, Figure 3.13 outlines the process for developing the reclamation plans in the initial stages and carrying it through to the final completion and observation period for the proposed construction activities for the reclaimed site.

Initial Reclamation Plan Considerations

Several factors should be considered in the initial stages of reclamation plan development:

- Consider how the proposed construction activities (including the reclaimed sites) will environmentally impact the existing and adjacent areas.
- Consult with the District Resident Engineer and obtain REU Field Operations Engineer approval.
- Verify setback and buffer requirements.
- Verify permitted uses for waste and borrow activities.

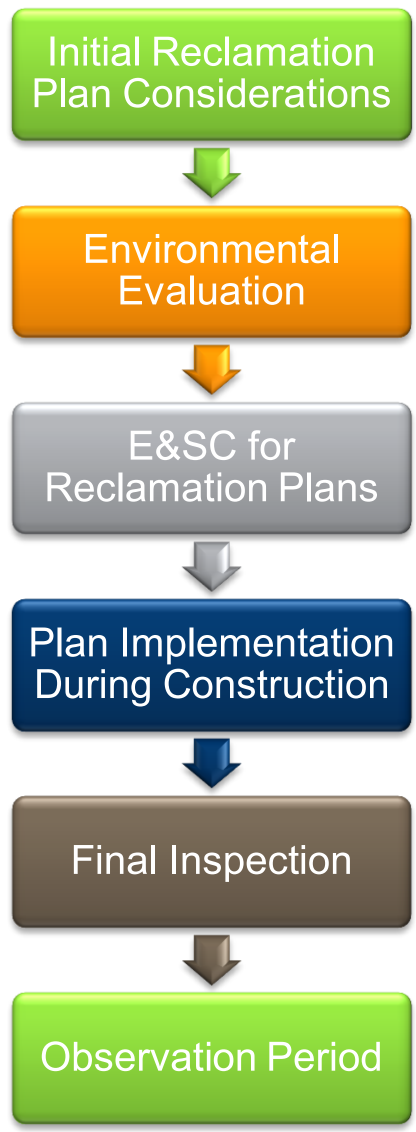

Figure 3.13 Considerations during the initial stages of the reclamation plan development.

Environmental Evaluations

For contracted projects, an environmental consultant employed by the contractor (DEO for operations projects) performs the environmental evaluation of the proposed activities. The District or Resident Engineer will evaluate the environmental evaluation, reclamation plans and associated checklist.

The environmental evaluation is a report that documents descriptions of the site and adjacent areas, location of jurisdictional areas and surface waters at the site and adjacent areas, and regulatory requirements. Table 3.1 outlines components of environmental evaluations. Regulatory agencies should be consulted for guidelines to address environmental impacts.

No reclaimed site activities can occur within HQWs Zones (WS-I, WS-II, ORW, Class SA and Primary Nursery Waters) unless authorized by an environmental permit.

Environmental Evaluations

Descriptions	Environmental Delineations	Documentation
• Existing topography • Soil conditions • Hydrologic conditions • Vegetative communities • Qualifications and experience of investigators and methodologies applied	• Locate jurisdictional areas and surface waters • Locate CCPCUA impacted counties • Locate riparian buffers	• Identify federally-protected species • Include SHPO review • Includes Skaggs Method and calculations, if applicable

Table 3.1 Environmental evaluations

Borrow Pits

Borrow pit activities require specific environmental and design considerations when developing the reclamation plan for construction activities. The location of the borrow sites with respect to the water table should be addressed and noted on the reclamation plans.

Water Table

The relationship of the borrow pit activities to the water table must be considered when evaluating environmental impacts. As part of the EA, the environmental consultant will consider borrow pit impacts on wetlands and surface waters within 400 feet of the site. If jurisdictional areas are identified within the proposed borrow pit location or within the 400-foot perimeter and dewatering, wet mining or excavating below the seasonal water table or adjacent streambed elevation is planned, the contractor should maintain a 400-foot buffer between the land-disturbing activity or obtain concurrence for the proposed activities from the Corps.

As part of the concurrence process through the Corps, the contractor's Level III-certified individual must provide hydrologic analysis and calculations that demonstrate that the proposed borrow pit will not adversely affect the surrounding jurisdictional features.

Figure 3.14 gives an overview of the Corps approved method for determining the minimum buffer required between the borrow pit activities and adjacent jurisdictional features.

For specifics on using the Skaggs Method to determine borrow pit setbacks in Type 1 and 3 borrow pits, refer to the NCDOT REU Field Operations website:

http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/fieldops/downloads/.

Dewatering Within the Borrow Pit

If a borrow pit requires dewatering, the volume of the borrow pit dewatering basin will be based on a 2-hour retention time. Additional dewatering requirements for borrow pits are outlined in the Dewatering Borrow Pits section on the NCDOT REU Field Operations website. This section includes a turbidity reduction options sheet (Appendix A of this manual), information about the lateral effects of borrow pits, Skaggs Method information and software and pit dewatering basin design guidelines.

E&SC for Reclamation Plans

E&SC measures should be included on the reclamation plans. The reclamation plan procedures on the NCDOT REU Field Operations website provides specific guidelines for construction activities with drainage areas less than and greater than 1 acre in size.

Determine Borrow Pit Type

Type 1 Wetland Upgradient of the Pit
The ground surface of the wetland adjacent to a pit is higher than the water level in the pit.

Type 2 **Wetland Downgradient of the Pit**
The ground surface of the wetland is at an elevation lower than the average water level in the borrow pit.

Type 3 Wetlands Upgradient and Downgradient of the Pit
A combination of Types 1 and 2, the pit is adjacent to two wetlands with one wetland upgradient and the other downgradient of the pit.

Determine Setbacks

Type 1
Use Skaggs Method

Type 2
Maintain minimum 25' from wetland, 50' from stream

Type 3
Use Skaggs Method

Figure 3.14 Method for determining minimum buffer requirements for borrow pit activities adjacent to jurisdictional features.

Plan Implementation During Construction

The E&SC measures proposed for the project reclamation plans are installed during the construction phase. The measures are designed to be installed and operated throughout the duration of the construction activities and until stabilization requirements have been met for the reclaimed area.

Specifically for borrow pits, refer to the Procedures for Monitoring Borrow Pit Discharge Special Provision.

Final Inspection

Final inspection can occur when the construction activities are completed according to the reclamation plans. The property owners should be notified of the completion of construction activities and notified of the 1-year observation period.

Observation Period

Upon completion of the construction activities and final project inspection, the site will be monitored for 1 year or one growing season following the final inspection date for any repairs or modifications that need to be made. If repairs are needed, the contractor (Engineer for Operations projects) will perform the work to provide a stable site with groundcover suitable to restrain erosion.

NCDOT ESC Erosion & Sediment CONTROL MANUAL

3.8 Section

Construction Site Pollutants

E&SC Plan Guidance for Managing Construction Site Pollutants

While sediment tends to be the primary focus when managing stormwater discharge from construction activities, there are several “good housekeeping” requirements necessary to prevent other pollutants from adversely affecting receiving waters that deserve discussion. Section II.B.1 of NCG01, Construction Site Pollutants, addresses these items by requiring site-specific management of construction activities in the following areas:

- Equipment operation and maintenance
- Material handling
- Building material waste handling
- Stockpile location and handling, and
- Concrete handling

Section II.B.1 of NCG01, Construction Site Pollutants, requires site-specific management of construction activities.

Implement the BMPs provided in Table 3.2 to prevent construction site pollutants from reaching state waters.

Table 3.2 BMPs for Construction Site Pollutants

Construction Activity	BMPs

Equipment Operation and Maintenance	▪ Maintain equipment to prevent leaks of potential contaminants.
	▪ Do not discharge fuels, lubricants, coolants, hydraulic fluids and all petroleum products onto the ground or surface waters.
	▪ Note that construction sites may be subject to 40 CFR Part 112 regulations that require the preparation and implementation of a Spill Prevention Control and Countermeasure (SPCC) Plan to prevent oil spills from aboveground and underground storage tanks. The site is subject to this rule if the project:
	    ▪ *Has a total storage capacity (count only containers >55 gal) greater than 1,320 gallons or a completely buried storage capacity greater than 42,000 gallons and*
	    ▪ *Could reasonably be expected to discharge oil in quantities that may be harmful to navigable waters of the United States and adjoining shorelines (EPA, 2007).*
	▪ Clean up all spent fluids and dispose of properly; refer to Appendix E for guidance on developing a spill response plan.
	▪ Conduct refueling operations in an area where leaks or spills will not discharge, flow or be washed into the stormwater drainage system.
	▪ Centralize refueling activities in one location equipped with containment features.
	▪ Minimize mobile refueling operations during times of heavy rainfall.
	▪ Position mobile refueling vehicles no more than 50 feet from the vehicle being refueled. Personnel should be instructed to avoid the topping off of fuel tanks. Topping off increases the risk of fuel being spilled on the ground.
	▪ Create an on-site fueling and maintenance area that is clean and dry. The on-site fueling area should have a spill kit, and staff should be trained on how to use it. If possible, conduct vehicle fueling and maintenance activities in a covered area; outdoor vehicle fueling and maintenance is a potentially significant source of stormwater pollution (EPA, 2007).

Material Handling	▪ Herbicide, pesticide and fertilizer usage during construction shall be consistent with the Federal Insecticide, Fungicide, and Rodenticide Act of 1947 and used in accordance with label restrictions. ▪ Store materials indoors and under a cover when possible. Secondary containment is required if materials are stored outdoors.

For further guidance refer to the Waste Handling and Disposal and Hazardous Materials Management chapters from NCDOT's *Industrial and Roadway Maintenance Manual* in Appendix F.

Table 3.2 BMPs for Construction Site Pollutants

Construction Activity	BMPs
Building Material Waste Handling	▪ Dispose of all wastes composed of building materials in accordance with NC Administrative Code Section 15A NCAC 13B. o Approved disposal methods per 15A NCAC 13B include sanitary landfills, land clearing and inert debris landfills, incineration or other sanitary methods approved by the NC Division of Waste Management. ▪ Note that land clearing waste includes stumps, trees, limbs, brush, grass and other naturally occurring vegetation generated solely from land clearing activities. Land clearing waste is considered nonhazardous. ▪ Note that inert debris includes unpainted concrete, brick, concrete block, uncontaminated soil, untreated and unpainted wood, rock and gravel. Inert debris is considered non-hazardous waste. ▪ Create staging areas dedicated for management of land clearing and demolition debris, construction and domestic waste and hazardous waste. ▪ Inspect areas often and label all hazardous waste materials. NCDOT uses a wide range of hazardous materials including adhesives, antifreeze, asphalt mix and liquid asphalt, asphalt releasing agent, batteries, cleaners, deicing materials, fertilizer, filters, fuel, oil, paint, pesticides and solvents. ▪ Store paints, solvents, pesticides, fuels and oils, other hazardous materials or any building materials that have the potential to contaminate stormwater indoors or under cover when possible or in areas with secondary containment. ▪ Provide training on proper handling and storage practices within staging areas. ▪ Staging areas must be at least 50 feet away from storm drain inlets and surface waters. ▪ Provide storage in accordance with secondary containment regulations and provide cover for hazardous materials when necessary. Storage containers should be regularly inspected for leaks, corrosion, support or foundation failure or any other signs of deterioration and tested for soundness (EPA, 2007).

Table 3.2 BMPs for Construction Site Pollutants	
Construction Activity	**BMPs**
	▪ Dumping of paint and other liquid building material wastes in storm drains is strictly prohibited. ▪ Manage and dispose of litter and sanitary waste properly to prevent them from entering storm drains or waters of the state. ▪ Tie or stake-down portable toilets and provide secondary containment beneath them where possible.
Stockpile Location and Management	▪ Locate earthen-material stockpile areas at least 50 feet away from storm drain inlets and surface waters unless it can be shown that no other alternatives are reasonably available. ▪ Protect stockpiles from stormwater runoff using a perimeter sediment barrier such as berms, dikes, silt fences or wattles. ▪ Install E&SC measures and stabilize them per an approved reclamation plan (see Section 3.7 for reclamation plan guidance).
Concrete Handling	▪ Control and manage concrete materials onsite, including excess concrete, to avoid contact with surface waters, wetlands and buffers. ▪ Do not discharge any concrete or cement slurry from the site. ▪ Dispose of, or recycle, hardened concrete residue in accordance with local and state solid waste regulations. ▪ Establish washout areas and indicate their locations with signs. ▪ Provide adequate containment for the amount of wash water that will be used. Inspect washout structures daily to detect leaks or tears and to identify when materials need to be removed. Dispose of materials properly. The preferred method is to allow the water to evaporate and to recycle the hardened concrete. Full service companies may provide dewatering services and should dispose of wastewater properly. Concrete wash water can be highly polluted. It should not be discharged to any surface water, storm sewer system, or allowed to infiltrate into the ground. It should not be discharged to a sanitary sewer system without first receiving written permission from the system operator (EPA, 2007). ▪ Note that discharges from on-site concrete plants require coverage under a separate NPDES permit – NCG140000.

The E&SC designer should include details and quantities for concrete washout structures for projects receiving commercial concrete mixes.

NCDOT ESC
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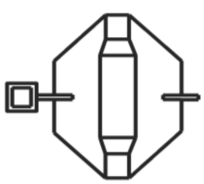
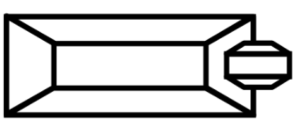
4.1 Section

Best Management Practices (BMP) Symbology*

Clean Water Diversion

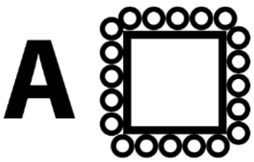


Earthen Dam with Skimmer



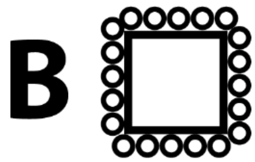
Infiltration Basin

Jurisdictional Flagging

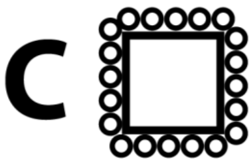


Rock Inlet Sediment Trap, Type A

4.1 BMP Symbology



Rock Inlet Sediment Trap, Type B



Rock Inlet Sediment Trap, Type C

Rock Pipe Inlet Sediment Trap, Type A

Rock Pipe Inlet Sediment Trap, Type B

Safety Fencing

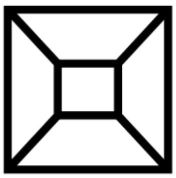
Silt Basin, Type B

Skimmer Basin

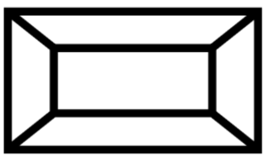
Special Sediment Control Fence

4.1 BMP Symbology

Special Sediment Control Fence Break



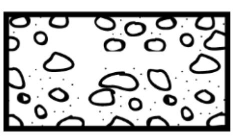
Special Stilling Basin



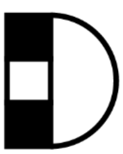
Stilling Basin

Temporary Diversion

Temporary Earth Berm



Temporary Rock Sediment Dam, Type A

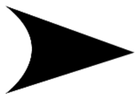
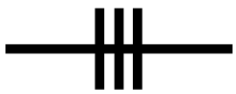
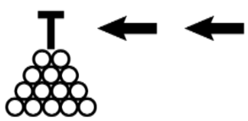
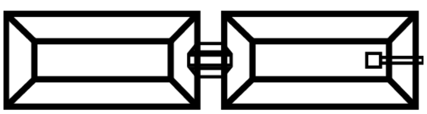
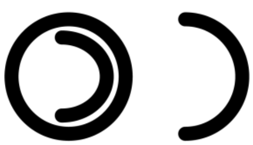


Temporary Rock Sediment Dam, Type B

Temporary Rock Silt Check, Type-A

Temporary Rock Silt Check, Type A with Excelsior Matting and Flocculant

4.1 BMP Symbology

	**Temporary Rock Silt Check, Type B**
— TSD —	**Temporary Silt Ditch**
	**Temporary Silt Fence**
	**Temporary Slope Drain**
	**Tiered Skimmer Basin**
—CFW—	**Wattle Break (Coir Fiber)**
— EW —	**Wattle Break (Excelsior)**
 With Flocculant Without Flocculant	**Wattles (with and without flocculant)**

* Some BMPs do not have a standard specification, project special provision, detail drawing number or symbol assigned to them. If a BMP is not listed on this symbology page, there is no symbol for that BMP type.

4.2 Section

Site Preparations

Site preparations within a construction site must be considered early in the planning phase. From stabilizing the entry to protecting unique landscape features and areas of special water quality concern, site preparations are valuable to the designer, technicians and contractors in preserving and maintaining the site conditions.

Gravel construction entrances must be established in order to stabilize access areas.

Areas of special water quality concern require additional planning considerations and more aggressive use of BMPs. Safety fence and jurisdictional flagging must be considered in the early planning phases and applied in the construction phase in order to delineate and help protect these areas. Other areas within the project site that need special attention must also be protected with a safety fence or delineated with jurisdictional flagging.

4.2.1 Gravel Construction Entrance (1607.01)

Practical Tips

- **Install early in construction**
- **Install at ALL points of ingress and egress from the construction site.**
- **Refreshing stone or cleaning may be required if gravel construction entrance is not functioning properly.**

Definition

A gravel construction entrance is a graveled area where vehicles enter and exit a construction site. The entrance consists of a gravel pad underlined with geotextile. The graveled construction entrance provides a buffer area for the deposition of mud and sediment associated with construction vehicles exiting the site onto adjacent public roadways.

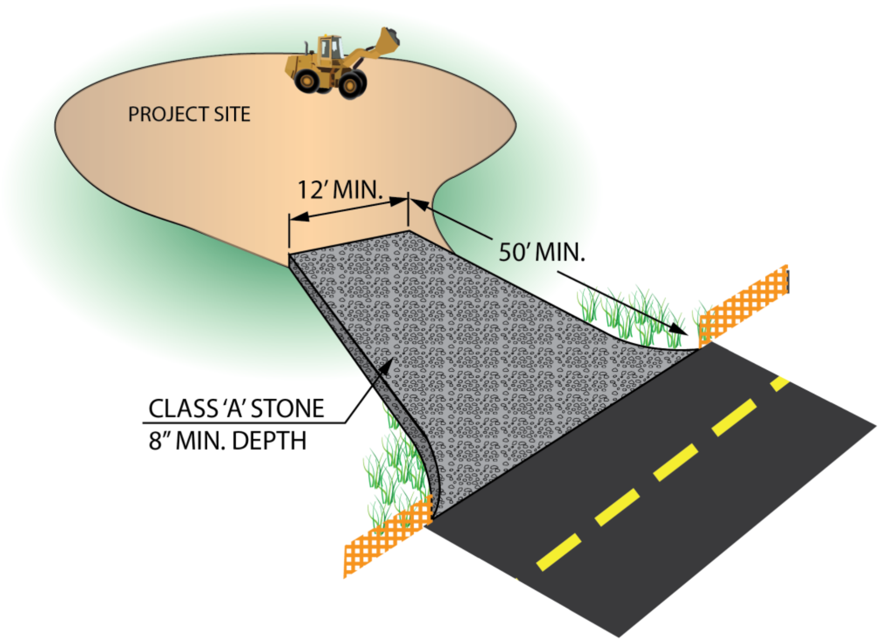
Areas of Use

- Install gravel construction entrances at all points of ingress and egress from the construction site. Entrances should be provided for the areas used by construction vehicles.

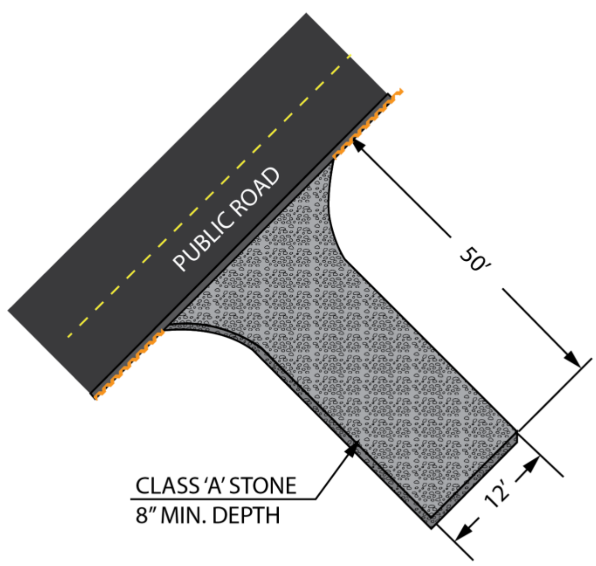
Design Criteria

- Provide a turning radius to accommodate large trucks.
- Locate entrances to provide for utilization by all construction vehicles.
- Locate gravel construction entrances at all points of ingress and egress until the site is stabilized.
- Identify the number and location of construction entrances, as determined by the Engineer.
- Use Class A stone or other coarse aggregate approved by the Engineer.
- Locate and install the construction entrance in a way to prevent vehicles from bypassing the construction entrance when leaving the project site.
- Place filtration geotextile beneath the stone. Stone should be a minimum depth of 8 inches.
- Construct the gravel construction entrance to dimensions of 12-feet wide by 50-feet long.

4.2.1 Gravel Construction Entrance (1607.01)



ISOMETRIC VIEW



PLAN VIEW

4.2.1 Gravel Construction Entrance (1607.01)

Material Specifications

- Geotextile should meet the requirements of Section 1056 of the Standard Specifications for Type 2 Geotextile.
- Class A, or other approved stone, should meet the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class A, or other coarse aggregate as directed.

Class A or other approved stone and Geotextile Type 2

Construction Specifications

Geotextile	• The stone for the construction entrance shall be Class A placed at a minimum depth of 8 inches, with the geotextile placed under the stone.
Entrance	• The gravel entrance shall be 50-feet long, 12-feet wide, and shall provide turning radii sufficient to accommodate the construction vehicles entering and exiting the construction site.

Construction entrances serve to prevent mud from being tracked onto adjacent roadways. They should accommodate larger vehicles and be maintained to function properly.

Technician's Checklist

- Install geotextile beneath the stone.
- Maintain the entrance to prevent tracking of mud onto streets. Periodic replacement of stone may be necessary.
- Locate at all points of ingress and egress into the site. Provide frequent checks of the device.
- Install in a manner to prevent vehicles from bypassing the construction entrance when they leave the project site.

Measurement & Payment

Pay Items	Pay Units
Geotextile, Type 2	**Square Yard**
Stone for Erosion Control, Class A	**Ton**

4.2.1 Gravel Construction Entrance (1607.01)

Maintenance

- The gravel construction entrance must be maintained in a condition to prevent tracking or direct flow of mud onto adjacent roadways.
- Replacement of stone may be necessary to ensure the gravel entrance functions properly.
- Replenishment of stone may be necessary.
- Frequent checks of the device and timely maintenance should be completed.
- Any material tracked onto the roadway shall be cleaned up immediately.

Typical Problems

- The stone is not installed correctly resulting in vehicle tires not being cleaned effectively.
- Excessive sediment accumulates on the stone.
- The stone is not replenished as necessary to provide a clean entrance for construction vehicles entering adjacent roadways.

4.2.1 Gravel Construction Entrance (1607.01)

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4.2.2 Safety Fence & Jurisdictional Flagging

Practical Tips

- Safety fence and jurisdictional flagging define boundaries and provide a visual cue for identifying the boundaries.
- For safety fencing, wood or steel posts can be used.

Definition

Safety fence is a polypropylene fence along the perimeter of riparian buffers, wetlands or water boundaries.

Jurisdictional flagging consists of stakes and highly visible flagging that is used to identify interior boundaries for jurisdictional areas such as buffers, wetlands, regulated streams and waters. For more details on jurisdictional areas, refer to Chapter 3.

Areas of Use

Install safety fence in these locations:

- Along the perimeter of riparian buffers, wetlands and water boundaries
- Along the perimeter of other areas within the project that infringe on buffers, wetlands, endangered vegetation, culturally sensitive areas or waters

Install jurisdictional flagging in these locations:

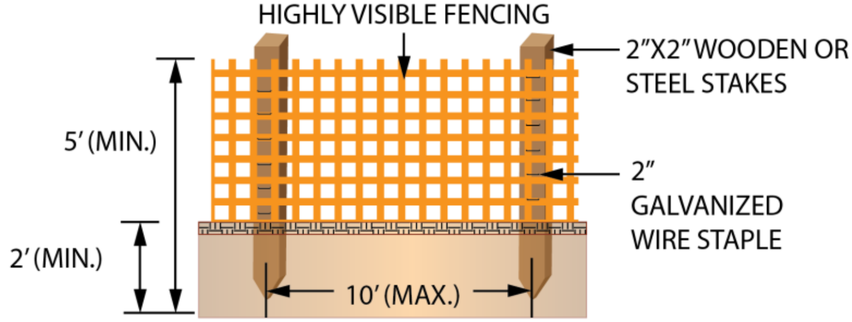
- Along interior boundaries for jurisdictional areas
- To delineate staging areas, waste sites, or borrow pits whether they are located outside or inside of the jurisdictional boundaries

Safety Fences should be installed prior to any land disturbing activities.

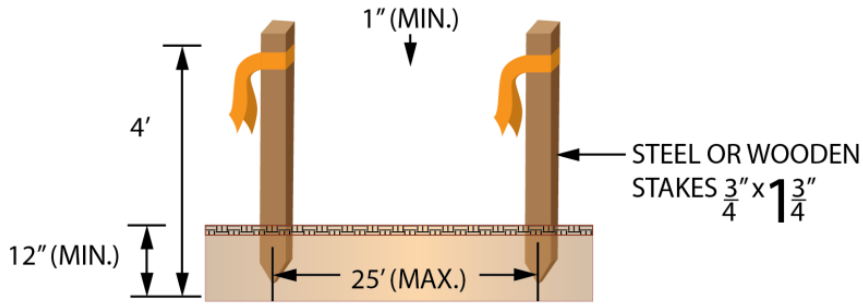
4.2.2 Safety Fence & Jurisdictional Flagging

Design Criteria

- No additional clearing and grubbing should be planned for the installation of a safety fence.
- The safety fence should be located on the plans in the field to delineate and bring special attention to buffers, wetlands and water boundaries.



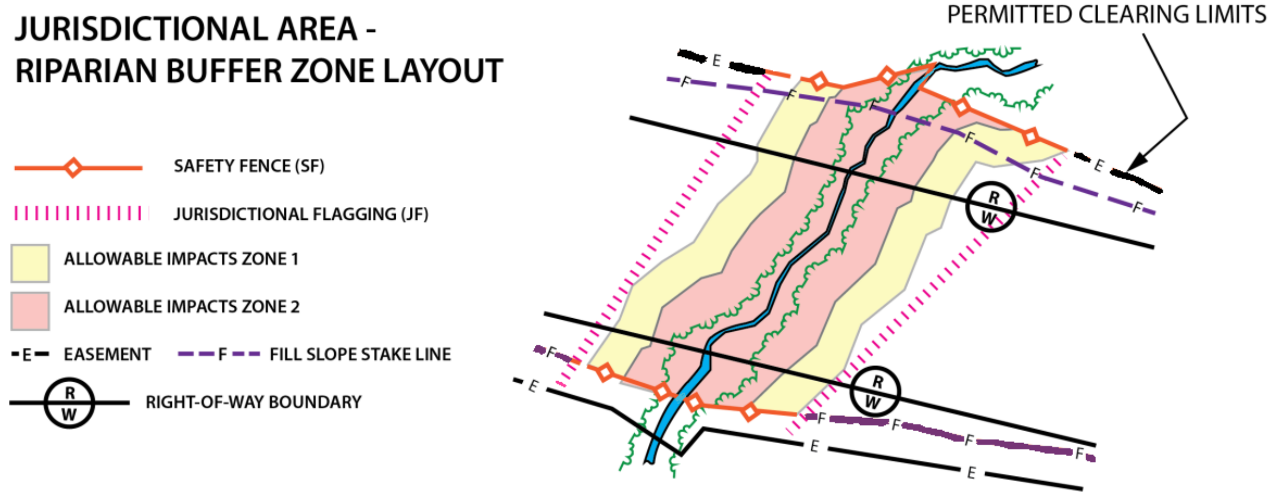
SAFETY FENCE PLAN VIEW (NOT TO SCALE)



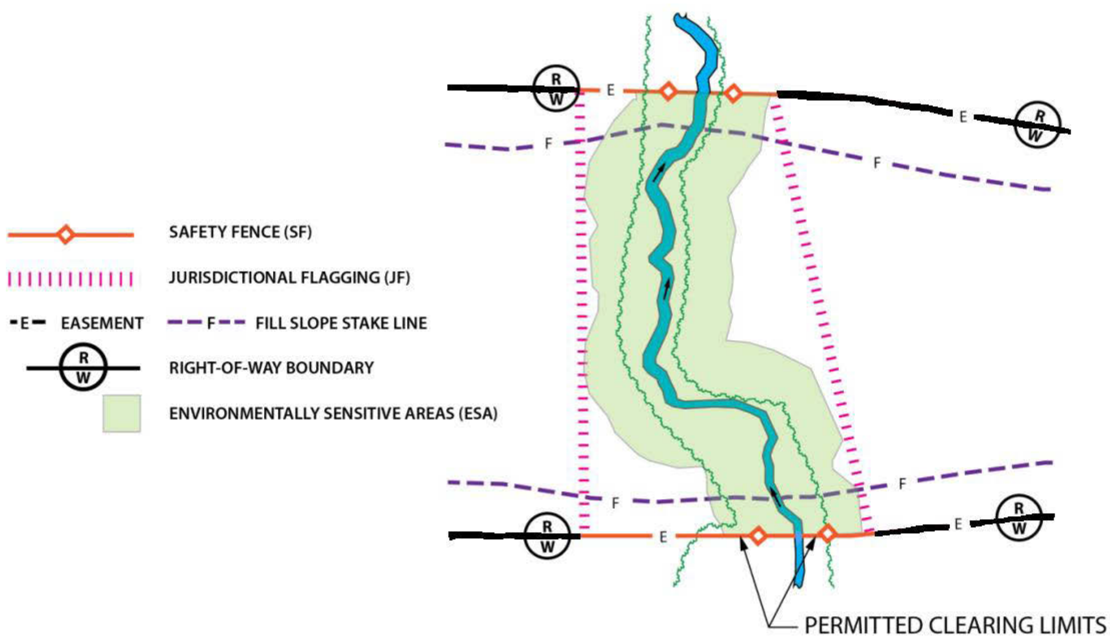
JURISDICTIONAL FLAGGING PLAN VIEW (NOT TO SCALE)

4.2.2 Safety Fence & Jurisdictional Flagging

JURISDICTIONAL FLAGGING PLAN VIEW (NOT TO SCALE)

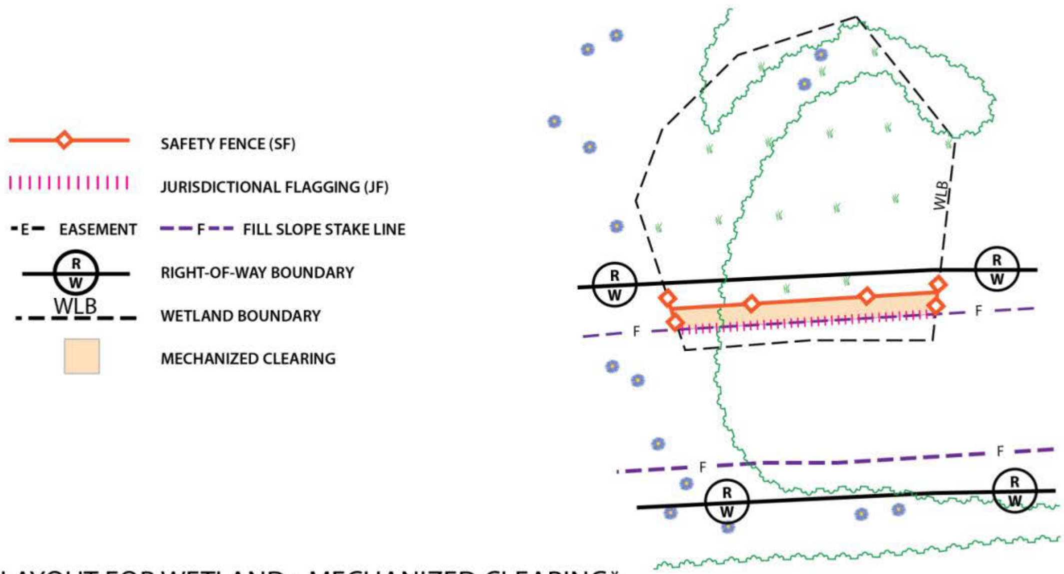


LAYOUT FOR JURISDICTIONAL AREA - RIPARIAN BUFFER ZONE



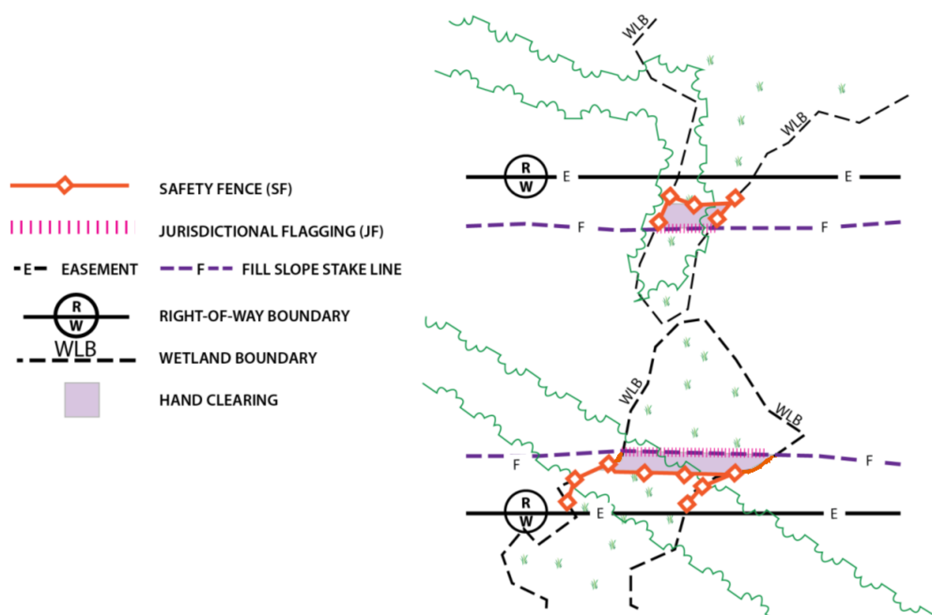
LAYOUT FOR JURISDICTIONAL STREAM - ESA WITHOUT RIPARIAN BUFFERS

4.2.2 Safety Fence & Jurisdictional Flagging



LAYOUT FOR WETLAND - MECHANIZED CLEARING*

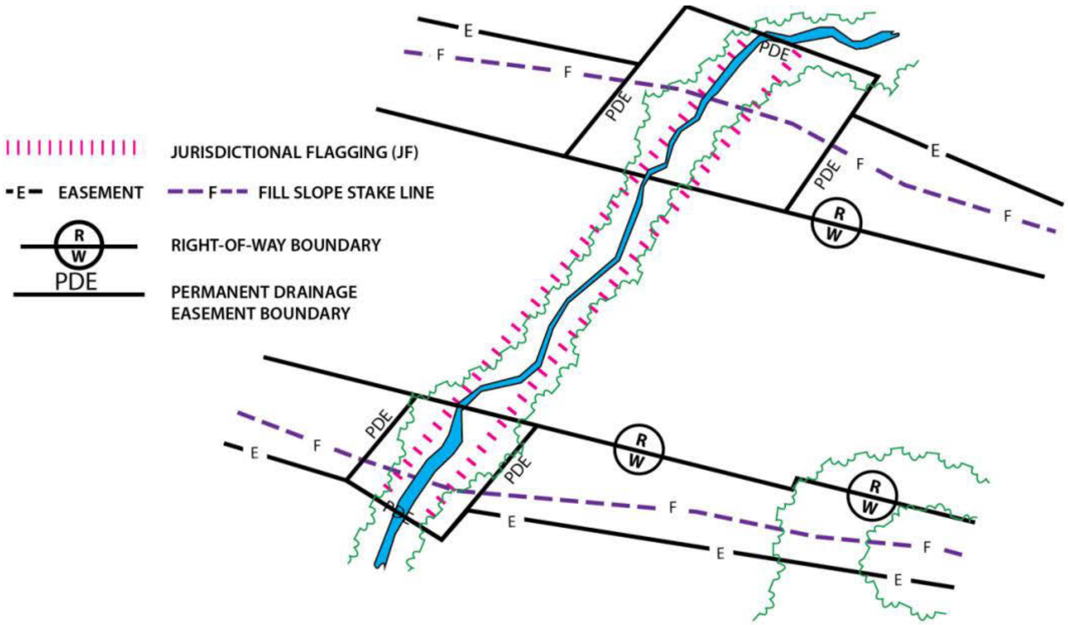
* - REFER TO PERMIT DRAWINGS FOR JURISDICTIONAL BOUNDARIES



LAYOUT FOR WETLAND - HAND CLEARING*

* - REFER TO PERMIT DRAWINGS FOR JURISDICTIONAL BOUNDARIES

4.2.2 Safety Fence & Jurisdictional Flagging



LAYOUT FOR JURISDICTIONAL STREAM - NO HIGH QUALITY WATER (HWQ) / NO BUFFER

Material Specifications

Safety Fence

- The polyethylene or polypropylene fence shall be a highly visible pre-constructed safety fence approved by the Engineer.
- The fence material should have an ultraviolet coating.

Jurisdictional Flagging

- Wood stakes should be 4 feet in length with a minimum nominal ¾ inch by 1 ¾ inch cross section.
- The flagging should be at least 1 inch in width.
- The flagging material should be vinyl and highly visible. Mechanized clearing can be orange in color, but hand-cleared areas should be flagged with a different color to distinguish these areas.

4.2.2 Safety Fence & Jurisdictional Flagging

Construction Specifications

No additional clearing and grubbing is required for the safety fence installation. The safety fence should conform to the general contour of the ground.

Safety Fence

Posts	• Set the posts at a maximum spacing of 10 feet. • Maintain the posts in a vertical position. • Set or hand set the posts with a post driver. • Thoroughly tamp all backfill material if hand set. • Cut the tops of posts at a 30 degree angle. The Contractor can make this cut before or after the post is installed.
Geotextile	• Should be attached to the wood posts with one 2-inch galvanized wire staple across each cable or to the steel posts with wire or other acceptable means
Stakes	• Should be placed to establish the location of the safety fence in accordance with Sections 105-9 or 801-1 of the Standard Specifications

Jurisdictional Flagging

Stakes	• Place the stakes on a maximum of 25-foot intervals. • Attach highly visible orange flagging. • Install the posts a minimum of 2 feet into the ground. • Stake interior boundaries on a tangent running parallel to the buffer, but do not encroach on the buffer at any location.
Flagging	• Interior boundaries of hand clearing should be identified with a different colored flagging to distinguish them from mechanized clearing. • Flagging should be installed in accordance with Sections 105-9 or 801-1 of the Standard Specifications. • Delineation of jurisdictional boundaries at staging areas, waste sites or borrow pits should be performed in accordance with subsections 230-4(B)(5) or 802-2(F) of the Standard Specifications.

4.2.2 Safety Fence & Jurisdictional Flagging

Technician's Checklist

- The safety fence and flagging should be inspected regularly and maintained for the duration of the project.
- It is important for the safety fence posts to be buried 2 feet into the ground to provide stability.

Additional flagging may be placed on overhanging vegetation to enhance visibility, but it does not provide a substitute for the installation of the fence or flagging stakes.

Measurement & Payment

Safety Fence

Safety fence will be measured and paid as the actual number of linear feet of polyethylene or polypropylene fence installed in place. Such payment will be full compensation and includes furnishing and installing the fence geotextile with the necessary posts, post bracing, staples, tie wires, tools, equipment and incidentals to complete this work.

No direct pay item will be made for the staking of the safety fence. All stakeouts for safety fence should be considered incidental to the work being paid for as "Construction Surveying." If there is no pay item for "Construction Surveying," the safety fence stakeout will be performed by State Forces.

Pay Items	Pay Units
Safety Fence	**Linear Foot**

4.2.2 Safety Fence & Jurisdictional Flagging

Jurisdictional Flagging

No direct pay item will be made for the delineation of interior boundaries. The delineation will be considered incidental to the work being paid for as "Construction Surveying." If there is no pay item for "Construction Surveying," the delineation should be included in the unit prices bid for the various items in the contract. No direct pay item will be made for delineation of interior boundaries at staging areas, waste sites or borrow pits. The cost for this delineation should be included in the unit prices bid for the various items in the contract.

Maintenance

- Posts damaged by power driving shall be removed and replaced prior to final acceptance.
- The safety fence and flagging should be maintained in a satisfactory condition for the duration of the project as determined by the Engineer.

Typical Problems

- The fence geotextile is not properly secured to the posts.
- The fence or flagging is damaged and not repaired or replaced.

4.3 Section

Perimeter Areas

Perimeter areas require consideration and attention early in the planning phase. BMPs located in perimeter areas are used to divert clean water away from the project site or intercept stormwater runoff.

Temporary silt fence, temporary diversion, temporary silt ditch, silt fence breaks and temporary earth berms are types of BMPs that can be used to protect the perimeter areas of a project site.

4.3.1 Temporary Silt Fence (1605.01)

Practical Tips

- **In order for the silt fence to be effective, it is essential to verify that the geotextile is buried in an excavated trench.**
- **Silt fence should be installed properly, backfilled and compacted well.**

Definition

Temporary silt fence is made of a permeable geotextile buried at the bottom, stretched and supported by steel posts. The silt fence breaks up sheet flow, decreases runoff velocity and allows suspended sediment particles to settle.

Areas of Use

Install temporary silt fence in the following locations:

- In locations to break up sheet flow and decrease runoff velocities
- Not in areas of concentrated flow
- At the bottom of fill sections to prevent off-site sedimentation

Avoid in areas of concentrated flow. Silt fence is commonly relied on exceedingly in erosion and sediment control designs.

Areas of use for temporary silt fence should have the following considerations:

- Use in areas where runoff can accumulate behind the silt fence without damaging the fence or the inundated area behind the fence
- Locate where only shallow pools will form, as it cannot function properly where there are high levels of water
- Use in wetlands or other buffer areas where the ground water level is near the surface and prohibits the excavation of silt ditches
- Use in areas where the subsurface is not rock or tree roots, so that posts can be driven into the ground and

4.3.1 Temporary Silt Fence (1605.01)

the geotextile can be trenched into the soil
- Use at the toe of a fill section on a steep slope where topography prohibits silt ditch excavation
- Use in areas where right-of-way or construction easement is limited
- Use in business and residential areas where safety and aesthetics are a concern. Avoid measures in residential areas that will interfere with property owners maintaining their property or present safety concerns. Silt fence can be an alternative measure in these locations.

Design Criteria

- The drainage area should not be greater than ¼ acre per 100 feet of silt fence.
- The silt fence should be stable for the 10-year peak storm runoff.
- The maximum slope length behind the silt fence should not exceed the specifications shown in the table below.

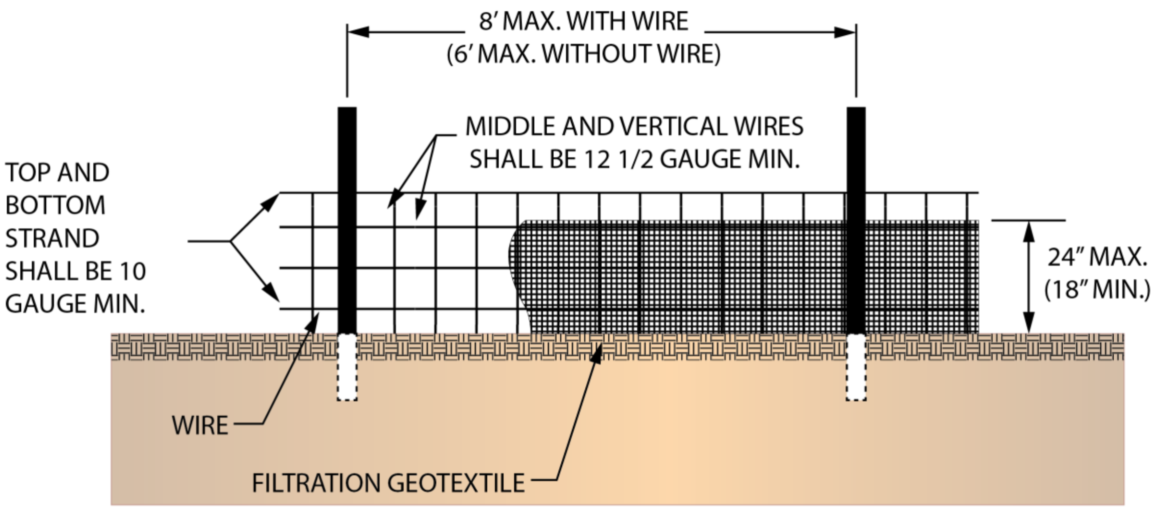
Table 4.1. Maximum Slope Length Behind Silt Fence

Slope	Slope Length (feet)
<2%	100
2 to 5%	75
5 to 10%	50
10 to 20%	25
>20%	15

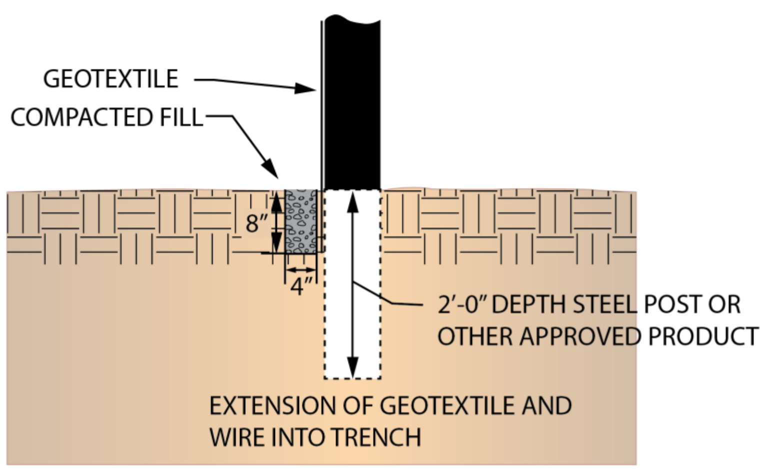
Table 6.62, Erosion and Sediment Control Planning and Design Manual, NCDENR

- The depth of impounded water shall not exceed 1.5 feet behind the fence.
- The silt fence shall not be used alone below graded slopes greater than 10 feet in height.

4.3.1 Temporary Silt Fence (1605.01)



FRONT VIEW



CROSS SECTION

NCDOT ESC Erosion & Sediment CONTROL MANUAL

4.3.1 Temporary Silt Fence (1605.01)

Material Specifications

- The geotextile shall meet the requirements of Section 1056 of the Standard Specifications for Type 3 Geotextile.
- Posts shall be steel, or other approved product, and have a minimum length of 5 feet.
- Posts, woven wire and wire staples shall meet the requirements of Section 1605-2 of the Standard Specifications.
- Geotextile shall be a minimum of 36-inches wide.
- Proper geotextile certifications are required to assure adherence to Section 1056 of the Standard Specifications.
- Woven wire shall be a minimum of 32 inches in height and with a minimum of 5 horizontal wires with 12-inch stay spacing.
- Top and bottom strands of woven wire shall be a minimum of 10 gauge, and middle and vertical wires shall be a minimum of 12 ½ gauge.

Filtration Geotextile: Type 3

Construction Specifications

Geotextile	• **The geotextile shall be buried a minimum 8 inches deep and 4 inches laterally. Soil should be firmly tamped.** • **Geotextile should be installed a maximum of 18 inches above the ground surface for mechanical slicing method of installation.** • **The geotextile shall be attached to posts and woven wire by wire or other acceptable means.** • **The geotextile shall be overlapped a minimum of 18 inches at all splice joints.** • **The height of the geotextile should not exceed 24 inches above the ground surface.** • **Each end of the silt fence shall be cut upgradient in a "J" pattern to prevent release of untreated storm flows.**
Posts	• **Post spacing should be a maximum of 6 feet without woven wire backing and 8 feet with woven wire.** • **Posts shall be installed so that no more than 3 feet extends above the ground.**

Temporary silt fence interrupts sheet flows, reduces velocities and allows suspended sediment particles to settle.

4.3.1 Temporary Silt Fence (1605.01)

Prior to installing the silt fence, a trench needs to be excavated so that the geotextile can be buried with compacted soil or gravel backfill. Thorough compaction of the backfill is critical to the performance of the silt fence. Temporary silt fence can be installed with or without a woven wire backing. Periodic inspections and maintenance of the fence will need to be done, especially after each rainfall.

Technician's Checklist

- The silt fence should be installed in accordance with the Erosion and Sediment Control Plans.
- In order for the silt fence to be effective, it is essential to verify that the geotextile is buried in an excavated trench.
- In addition to the geotextile being buried, it should be adequately buried with compacted soil backfill to secure the silt fence and keep it in place.
- The silt fence should be inspected for sediment accumulation and repairs on a regular basis and after significant rain events.

Measurement & Payment

When the accumulated silt is removed along the silt fence, it is paid for as "Silt Excavation."

Pay Items	Pay Units
Temporary Silt Fence	**Linear Foot**
Seeding and Mulching	**Acre**
Silt Excavation	**Cubic Yard**

Maintenance

- Inspect the silt fence on a regular basis and after each significant rainfall. Make any repairs immediately.
- Inspect the silt fence to be sure the bottom of the geotextile is keyed in properly.
- At a minimum, remove and dispose of all silt accumulations when depth reaches 1/2 the height of the geotextile. Do not undermine the fence during cleanout.
- Dispose of sediment by hauling it to an approved waste site with appropriate perimeter protection.
- Remove and replace deteriorated or clogged silt fence.
- Replace silt fence removed for access at the end of each day's operation.
- Install additional posts or wire backing if fence is sagging.

At a minimum, remove and dispose of all silt accumulations when the depth reaches ½ of the height of the geotextile. Do not undermine during cleanout.

4.3.1 Temporary Silt Fence (1605.01)

Typical Problems

- The device is installed improperly (bottom of geotextile is not buried properly).
- Failures occur when the device is installed across streams, waterways and other areas which receive concentrated flow.
- Silt accumulates excessively and geotextile becomes clogged with silt particles and other debris.
- The device is knocked down or cut by fallen trees, rocks, equipment, excess water flows or for work access.
- Inadequate access is provided in order to maintain and remove the fence.

4.3.1 Temporary Silt Fence (1605.01)

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NCDOT ESC Erosion & Sediment CONTROL MANUAL

4.3.2 Temporary Diversion (1630.05)

→ TD →

Practical Tips

- Can be used in buffer zones in proposed permitted ditches
- Used to divert runoff inside footprint of project to perimeter sediment basins

Definition

A temporary diversion is an excavated channel with a berm on its lower side that directs runoff into a basin, through a sediment dam or through rock silt checks.

Areas of Use

Install temporary diversions in these locations:

- Below slopes to divert sediment laden runoff to sediment control devices
- Across unprotected slopes
- At or near the perimeter of construction limits to keep sediment from leaving the site
- As a precursor for areas designated as final drainage channels
- Above disturbed cut or fill slopes to prevent runoff over the exposed slope material
- Across long grades as a break to reduce slope length and reduce the size of drainage areas
- Not in wetland areas unless documented on permits

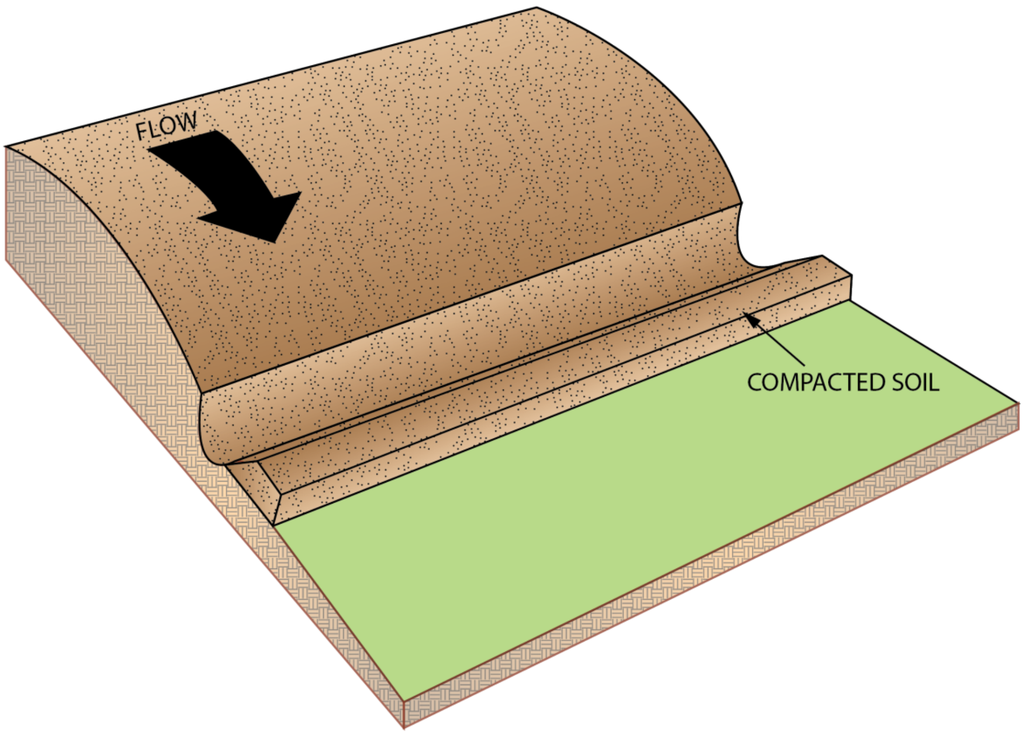
Temporary diversions are used in the clearing and grubbing phase. They function to divert sheet flow into sediment control devices.

Design Criteria

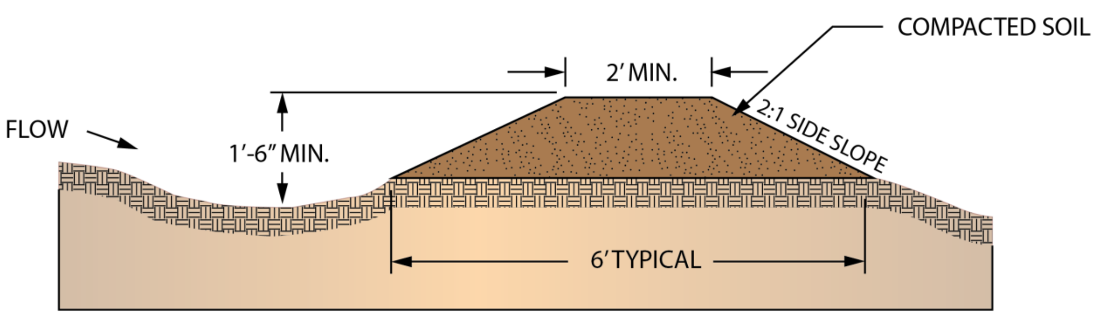
- Drainage area shall be 10 acres or less
- Grade should be limited to prevent erosive velocities
- Capacity of the temporary diversion should accommodate the peak runoff from a 10-year storm

4.3.2 Temporary Diversion (1630.05)

→ TD →



ISOMETRIC VIEW



CROSS SECTION

4.3.2 Temporary Diversion (1630.05)

→ TD →

Material Specifications

- The temporary diversion and berm shall be considered unclassified earth material and stabilized with seed, fertilizer and mulch or other approved stabilization techniques.

Construction Specifications

Berm	• **Bottom of excavation to top of berm should be 1.5-feet minimum depth** • **Berm should be 2-feet minimum width at the top, and 6 feet at the bottom** • **Berm created by the excavated material placed on the downslope side of the ditch should be stabilized in accordance with Sections 1620 and 1660 of the Standard Specifications**
Side Slopes	• **Side slopes should be 2:1 or of sufficient angle to allow vegetative growth to prevent erosion.**

Technician's Checklist

- Devices should be inspected regularly and after significant rainfall
- Sediment should be removed when the temporary diversion is 50 percent of the design depth
- Immediate repairs should be performed if any damage is identified within the diversion
- Stabilization within the diversion should be maintained to prevent erosion

Temporary diversions control water flow patterns.

Measurement & Payment

When silt is removed from Temporary Diversion, it is paid for as "Silt Excavation." There is no additional pay for other maintenance or removing the device.

Pay Items	Pay Units
Seed for Temporary Seeding	Pound
Fertilizer for Temporary Seeding	Ton
Seeding and Mulching	Acre
Silt Excavation	Cubic Yard

4.3.2 Temporary Diversion (1630.05)

→ TD →

Maintenance

It is important that the temporary diversion be maintained to prevent erosion and sedimentation from occurring.

- Devices should be inspected on regular basis and after each significant rainfall
- At a minimum, sediment should be removed from the channel when the temporary diversion is 50 percent of the design depth
- Temporary diversions should be immediately repaired if damaged by equipment or breached by runoff

The temporary diversion should be maintained until the stabilization of final drainage ways.

Typical Problems

- Significant erosion of the diversion caused by steep grade
- Accumulated sediment deposits not removed in a timely manner
- Erosion in the diversion due to vertical side slope installation
- Sediment retention device not provided down gradient of diversion
- Improper use of a temporary diversion in areas of high water flows that are sustained for long periods
- Difficulty in accessing temporary diversions due to high adjacent fill section
- Diversion saturated by high water table
- Inadequate or no means of stockpiling silt cleanout material

NCDOT ESC Erosion & Sediment CONTROL MANUAL

4.3.3 Temporary Silt Ditch (1630.03)

— TSD —

Practical Tips

- If space is available, silt ditches provide considerable savings over silt fences.
- Temporary silt ditches are used almost exclusively at the bottom of slopes.
- The silt ditch should NOT be used within jurisdictional waters or wetlands.

Temporary silt ditches are used in conjunction with other measures to contain sediment at outlets.

Definition

A temporary silt ditch is commonly placed at the toe of a fill slope to prevent off-site sedimentation. The silt ditch should direct sheet flow to silt basins, rock sediment dams or other sediment control measures located at the outlet of the silt ditch.

Areas of Use

Install temporary silt ditches in these locations:

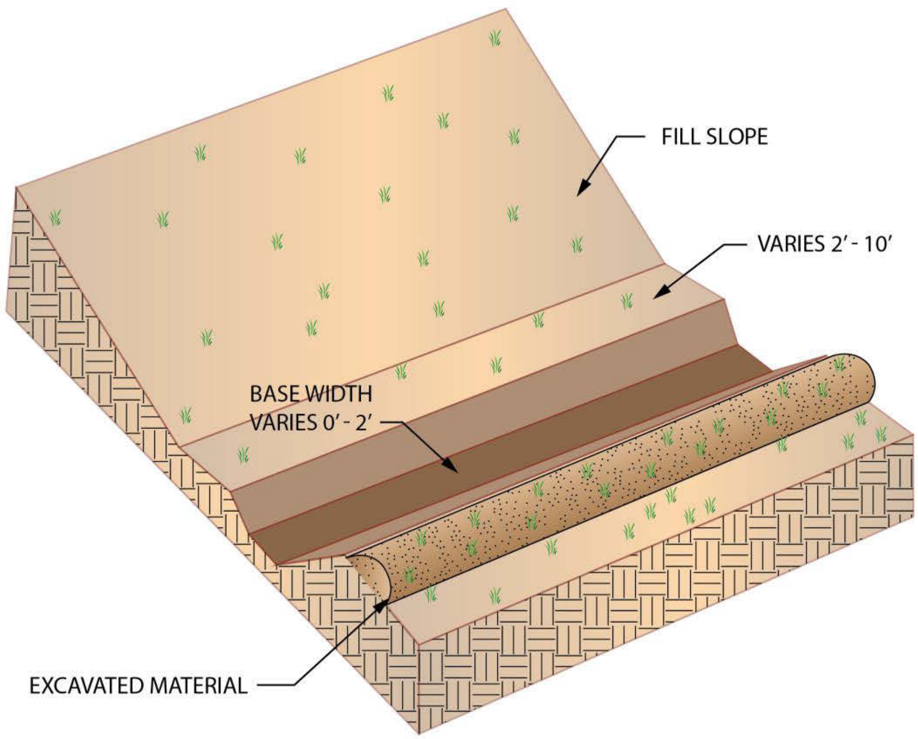
- At the toe of fill slopes where the fill exceeds 3 feet in height
- Adjacent to streams to intercept flow and/or divert the flow to a controlled outlet point
- Along project perimeters to minimize sediment loss from the project site

Design Criteria

- Drainage area shall be 10 acres or less
- Grade should be limited to prevent erosive velocities
- Capacity of the temporary silt ditch should accommodate the peak runoff from a 10-year storm
- Velocity checks (rock silt checks or wattles) should be placed within temporary silt ditches

4.3.3 Temporary Silt Ditch (1630.03)

— TSD —



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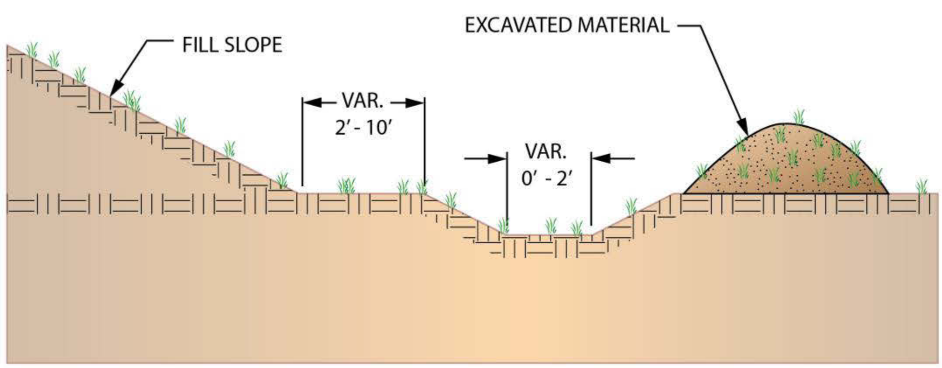


CROSS SECTION

4.3.3 Temporary Silt Ditch (1630.03)

— TSD —

Material Specifications

- The temporary silt ditch and berm shall be considered unclassified earth material and stabilized with seed, fertilizer and mulch.

Construction Specifications

Berm	• **Stabillize the berm created by the excavated material placed on the downslope side of the ditch in accordance with Sections 1620 and 1660 of the Standard Specifications.**
Side Slopes	• **Side slopes should be non-vertical and not be greater than 1.5:1 slope.**
Depth	• **The silt ditch should be approximately 1-foot deep.**

The ditch outlet control measures should be installed first. The ditch should then be excavated downgradient to upgradient.

Temporary silt ditches are usually placed at the toe of fills, around waste areas and selected locations in borrow pits.

Technician's Checklist

- Devices should be inspected regularly and after significant rainfall.
- Sediment should be removed when the temporary silt ditch is 50 percent of the design depth.
- Immediate repairs should be performed if any damage is identified within the ditch or outlet devices.
- Stabilization within the ditch should be maintained to prevent erosion.

Measurement & Payment

When sediment is removed from temporary silt ditch, it is paid for as "Silt Excavation." There is no additional pay for other maintenance or removing the device.

Pay Items	Pay Units
Silt Excavation	**Cubic Yard**
Seed for Temporary Seeding	**Pound**
Fertilizer for Temporary Seeding	**Ton**
Seeding and Mulching	**Acre**

4.3.3 Temporary Silt Ditch (1630.03)

— TSD —

Maintenance

Maintenance of temporary silt ditches is essential because water flow may become concentrated. Any breakthrough can cause more erosion and potential sediment loss than if the silt ditch was never installed.

- Devices should be inspected on a regular basis and after each significant rainfall.
- At a minimum, sediment should be removed from the channel when it accumulates to 50 percent of the design depth.
- Temporary silt ditches should be immediately repaired if damaged by equipment, breached by runoff or covered by fill.
- Sediment control devices should be inspected at the outlet of the silt ditch and cleaned out and repaired as necessary.
- Ditches should be backfilled and stabilized prior to the completion of the project.

Temporary silt ditches can be used in the place of silt fence when space is available and when critical resources are not located near the project perimeter.

Typical Problems

- Excessive sediment accumulations in the ditch
- Erosion in the ditch due to vertical side slope installation
- Difficulty in accessing temporary silt ditches due to high adjacent fill section
- Lack of maintenance for devices at the outlet of the ditch, allowing sediment to escape
- Accumulated sediment deposits not removed in a timely manner
- Inadequate or no means of stockpiling silt cleanout material

4.3.4 Silt Fence Breaks

— EW — —CFW—

Practical Tips

- Silt fence breaks should be used within clearing and grubbing and final grade phases of E&SC plans.
- Silt fence breaks should be installed with a maximum spacing of 200 feet.

Definition

Silt fence breaks are sediment control measures within long segments of silt fence used to intercept runoff. The break in the long silt fence section serves as a drainage break and also provides additional sediment control in low areas. There are two types of silt fence breaks: special sediment control fence (SSCF) breaks and wattle breaks. Two types of wattle breaks can be used: coir fiber wattle breaks and excelsior wattle breaks.

Areas of Use

Use silt fence breaks in long sections of silt fence at the following locations:

- At the toe of fills in long sections of silt fence to provide a drainage break or turnout
- In low areas in conjunction with silt fence
- In areas where concentrated flow exceeds the limits of temporary silt fence
- In wetland areas wattle breaks are preferred because removal is easier and provides minimal disturbance
- In areas near flowing water, SSCF breaks permit tides and surges to cross the silt fence without compromising it

Silt fence breaks are used in locations where silt fence could become inundated with flow during storm events.

4.3.4 Silt Fence Breaks

— EW — —CFW—

Design Criteria

SSCF Breaks

- Do not exceed ½ acre drainage area
- Install a minimum of every 200 feet along silt fence
- Limit SSCF breaks to 15-foot sections when used as turnouts for silt fence in wetlands to facilitate removal of stone and minimize disturbance

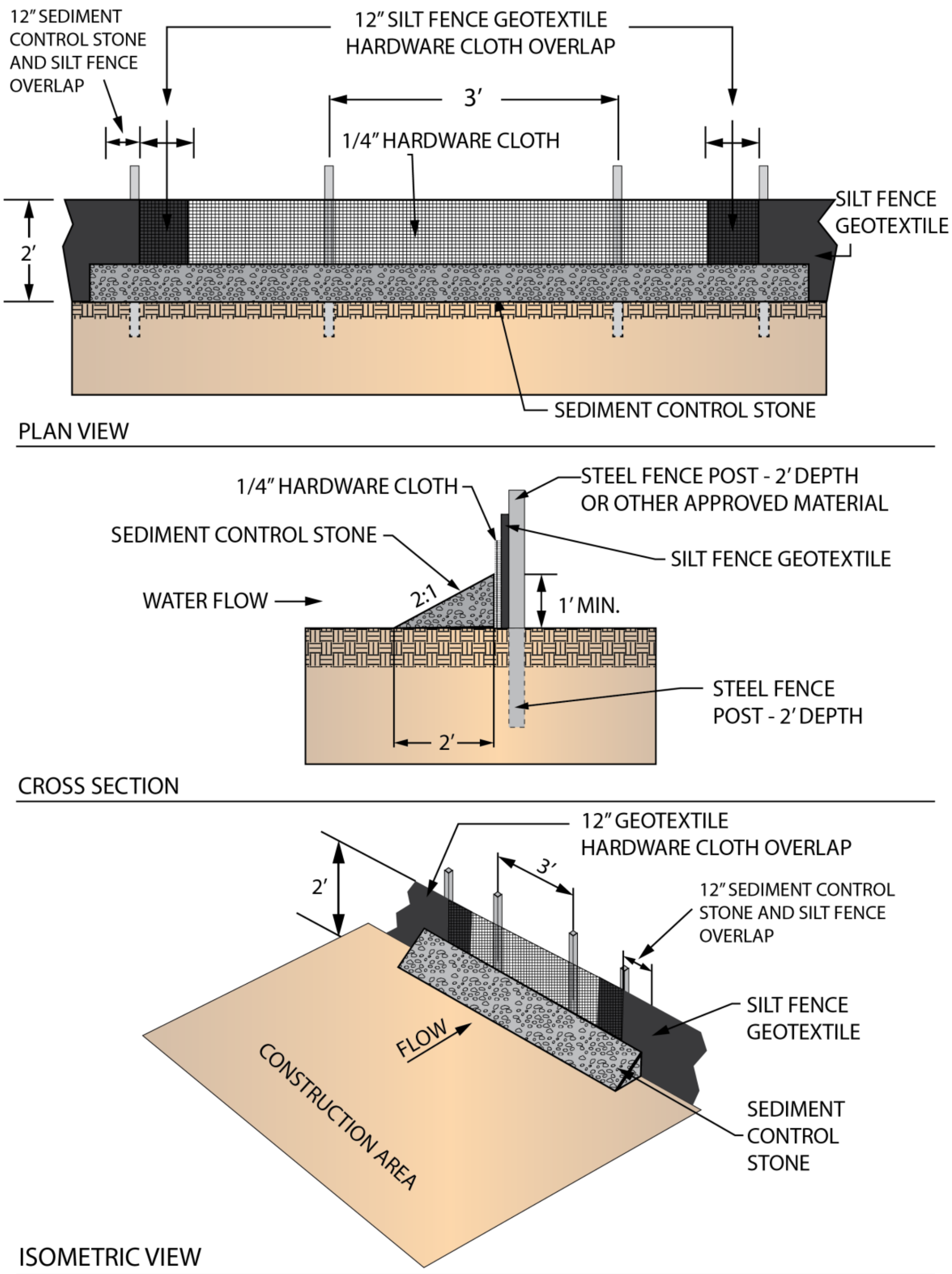
Unless there is a sediment control measure to settle sediment before it leaves the right-of-way, flocculant should not be applied to wattle breaks.

Wattle Breaks

- Install a minimum 12-inch diameter wattle at wattle break locations
- Install a minimum of every 200 feet along silt fence
- Should be 10 feet in length.
- Have a design life for 1 year (excelsior wattles). Coir fiber wattles may be used longer.

4.3.4 Silt Fence Breaks

— EW — —CFW—



4.3.4 Silt Fence Breaks

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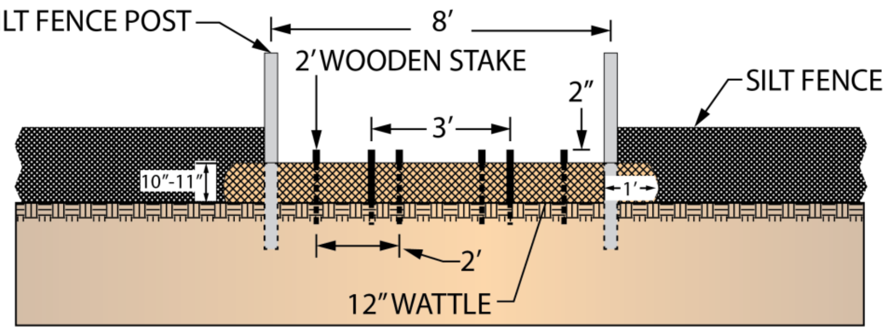
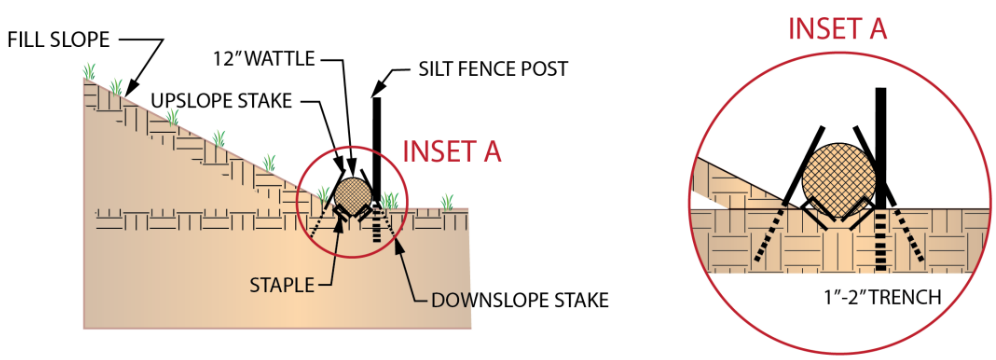


FRONT VIEW



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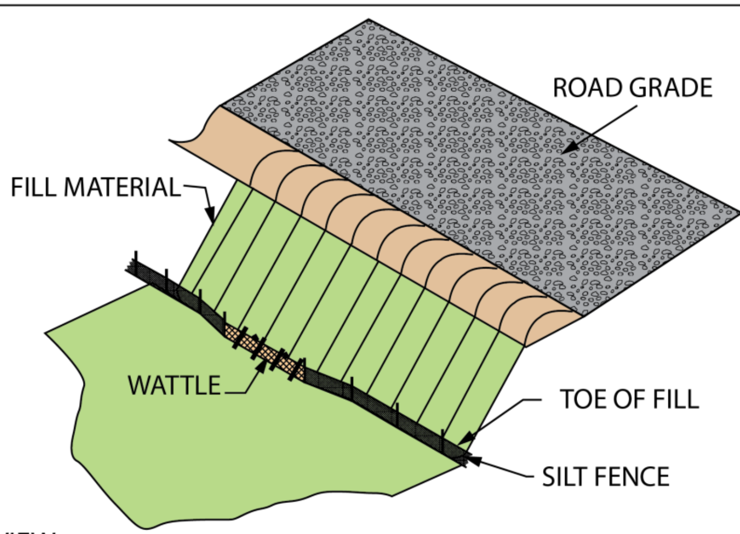


ISOMETRIC VIEW

4.3.4 Silt Fence Breaks

— EW — —CFW—

Material Specifications

SSCF Breaks

Hardware Cloth	• Hardware cloth with ¼-inch openings • Minimum 24-gauge wire • Minimum width of 48 inches • Meet requirements of Section 1606-2(B) of the Standard Specifications
Steel Posts	• Steel or other approved material • Minimum of 5-feet long • 1 $^{3}/_{8}$ inches-wide on the face parallel to the hardware cloth • Self-fastener angle steel type • Meet Section 1605-2(A) of the Standard Specifications
Staples	• No. 9 wire staples with at least 1 ½-inches length or other approved attachment device
Sediment Control Stone	• No. 5 or No. 57 stone • Meets the requirements of Section 1005 of the Standard Specifications for stone sizes

Wattle Breaks

Stakes	• Wooden • 2-foot stakes with a 2-inch by 2-inch nominal cross section • Sharpened or beveled on one end
Staples	• 0.125-inch diameter steel wire • "U"-shape • 12 inches in length (at minimum) and 1-inch width • Meet Section 1605-2 of the Standard Specifications

Coir Fiber Wattle Break

Inner Material	• Coconut fibers
Dimensions	• Minimum diameter of 12 inches and a maximum of 20 inches • Length of 10 feet • Density of 3.5 lb/ft^3

4.3.4 Silt Fence Breaks

— EW — —CFW—

Excelsior Wattle Break

Inner Material	• **Curled wood**
Dimensions	• **Minimum diameter of 12 inches and a maximum of 20 inches** • **Length of 10 feet** • **Density of 2.5 lb/ft^3**

Construction Specifications

SSCF Breaks

Work includes furnishing materials, installation of coir fiber wattles and removing wattles. Installation of the SSCF breaks shall follow the detail provided in the plans and as directed.

Sediment Control Stone	• **Install on the upgradient face of the hardware cloth to a height of 1 foot**
Steel Posts	• **Install a minimum of 2-feet deep and a maximum spacing of 3 feet**
Hardware Cloth	• **Install at a height of 2 feet and placed 2-feet under the sediment control stone** • **Install top of the hardware cloth a minimum of 1-foot below the shoulder to prevent flow from entering the roadway** • **Install top of hardware cloth a minimum of 1-foot below any clean water diversion** • **Attach to posts with wire staple or other approved method**
Overlap and Spacing	• **Overlap silt fence 12 inches on either side** • **In wetland areas, limit SSCF sections to 15-foot sections spaced a maximum of 200 feet apart**

4.3.4 Silt Fence Breaks

— EW — —CFW—

Wattle Breaks

Work includes furnishing materials, installation of coir fiber wattles and removing wattles. Installation of wattle breaks shall follow the detail provided in the plans and as directed.

Matting	• **Install matting in accordance with Section 1631 of the Standard Specifications**
Staples	• **Install staples approximately every 1 foot on both sides of the wattle and at each end to secure it to the soil**
Stakes	• **Install a minimum of 2 upslope stakes and 4 downslope stakes at an angle to wedge wattle to bottom of ditch** • **Install with a maximum spacing of 3 feet for upslope and 2 feet for downslope** • **Drive stakes into the ground a minimum of 10 inches with no more than 2 inches projecting from the top of the wattle**
Overlap	• **Overlap wattle and silt fence geotextile a minimum of 1 foot. Silt fence geotextile should have an opening of 8 feet.**
Trench	• **Install a trench with a depth of 1 to 2 inches for the length of the wattle**

Wattles can be installed on the downgradient side of the temporary silt fence as directed. Temporary silt fence should be installed in accordance with Section 1605 of the Standard Specifications.

Technician's Checklist

SSCF Breaks

Prior to installing the SSCF break, check permitted areas. Stone installation is considered temporary fill and permit conditions must allow its use.

- Check the environmental permits to verify that the fence is placed in the proper location and in accordance with the permit drawings and provisions. Fence materials shall meet the requirements of Section 1606.
- Install the fence in advance of the need to contain sediment.
- Make any necessary additions or adjustments to the SSCF based on field conditions.
- Install materials according to the plan details (see Roadway Standard Drawing No. 1606.01).
- Remove silt accumulation when silt reaches half the height of the stone and dispose of waste properly.
- Measure the silt removed for payment.
- Remove fence, posts and stone when the permanent controls have been established. Do not leave the stone on site and do not place any stone in permitted areas.

4.3.4 Silt Fence Breaks

— EW — —CFW—

Wattle Breaks

- Devices should be inspected regularly and after significant rainfall.
- Sediment, debris, straw and other items should be removed from the wattle.
- Verify proper installation of anchors to secure wattles to the ground.

Measurement & Payment

Silt fence breaks will be measured and paid for by the number of linear feet of ¼-inch hardware cloth and tons of sediment control stone or by the number of liner feet of wattles which are installed and accepted. Such price and payment will be full compensation for all work covered by this section, including furnishing all materials, labor, equipment and incidentals necessary to install, maintain and remove the silt fence breaks, except for the removal of silt from special sediment control fence breaks.

SSCF Break

Pay Items	Pay Units
¼-inch Hardware Cloth	**Linear Foot**
Sediment Control Stone	**Ton**
Silt Excavation	**Cubic Yard**

Coir Fiber Wattle Break

Pay Items	Pay Units
Coir Fiber Wattle	**Linear Foot**

Excelsior Wattle Break

Pay Items	Pay Units
Wattle	**Linear Foot**

4.3.4 Silt Fence Breaks

— EW — —CFW—

Maintenance

It is important for the silt fence breaks to be maintained until final inspection of the project or until the silt fence breaks are removed. Upon removal, the Contractor should remove and dispose of all silt accumulations in accordance with Section 1630 of the Standard Specifications.

SSCF Break

- Inspect the device periodically and after each significant rainfall event for damage and sediment accumulation to confirm the device is functioning properly.
- At a minimum, remove sediment from the device when accumulations reach one-half the height of the sediment control stone.
- Replace or clean the sediment control stone as needed to allow water to drain through the device between rainfall events.
- Rebuild and/or repair the device when it is damaged.
- Repair areas where SSCF becomes undermined due to concentrated flows.

Wattle breaks are easier to remove than SSCF breaks.

Wattle Break

It is important that wattle breaks be kept clean and allow water to flow through the natural fibers. The wattle breaks can become blocked with debris, sediment, straw and other items.

- If the natural fibers of the wattle become too saturated with debris and sediment and removal of the items is not possible, wattle breaks should be replaced.
- Stakes should be used to anchor the wattle breaks adequately to the ground to prevent scouring and washout during storm events.

4.3.4 Silt Fence Breaks

— EW — —CFW—

Typical Problems

- The silt fence breaks are not overlapped properly to the temporary silt fence.
- The hardware cloth is not adequately buried to prevent undermining.
- Sediment accumulations are not removed in a timely fashion, causing sediment to be released offsite.
- The silt fence break is not rebuilt or repaired when damaged by storms, equipment, etc.

SSCF Break

- Sediment control stone is not cleaned and becomes clogged, preventing proper drainage.
- Runoff becomes concentrated in areas and undermines the hardware cloth and sediment control stone.

Wattle Break

- Improper installation and failure to properly anchor the break to the ground reduces the effectiveness of the measure to control erosion and reduce velocities.

4.3.5 Temporary Earth Berm

Practical Tips

- Place earth berms inside footprint of fill slopes to divert runoff to sediment basins.
- Place velocity checks (either a Temporary Rock Silt Check or wattle) with earth berms.

Definition

A temporary earth berm is a compacted earthen dike used along the site perimeter for either off-site flow diversion or sediment storage at the toe of a fill slope. Earth berms direct water to specific sediment control devices or direct water flowing from offsite away from or around areas of construction.

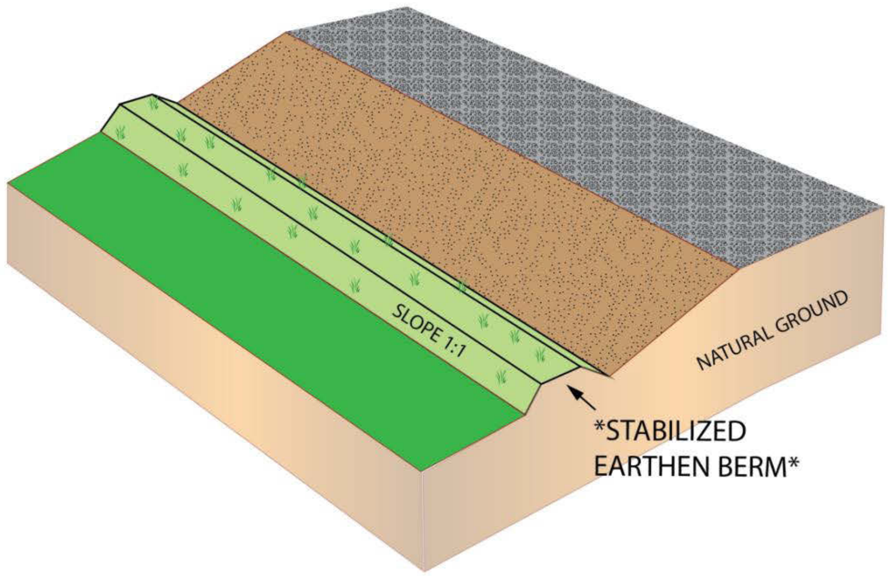
Areas of Use (italicized text was excerpted from NCDENR, 2013)

- Along fill slopes, generally parallel to the right-of-way
- *Below slopes to divert excess runoff to stabilized outlets*
- *Where needed to divert sediment-laden water to sediment basins or traps*
- *At or near the perimeter of the construction area to keep sediment from leaving the site* (NCDENR, 2013)

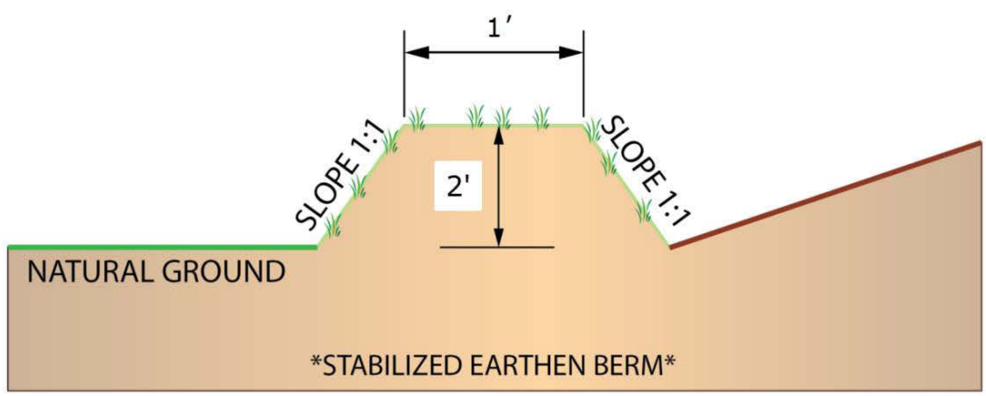
Design Criteria

- Utilize on Clearing & Grubbing and Final Grade Phases of E&SC plans
- Consider how construction machinery will access the location to remove the berm without damaging completed and stabilized slope areas

4.3.5 Temporary Earth Berm



ISOMETRIC VIEW (NOT TO SCALE)



CROSS SECTION (NOT TO SCALE)

4.3.5 Temporary Earth Berm

Construction Specifications (italicized text was excerpted from NCDENR, 2013)

Installation	• **Install the temporary earth berms in accordance with the details in the plans and at locations indicated in the plans, and as directed by the Engineer.** • ***Remove and properly dispose of all trees, brush, stumps, and other objectionable material.*** • ***Compact the berm by tracking with construction equipment.*** • ***Do not place the top of the berm lower at any point than the design elevation after it has been compacted.*** • **Earth berm side slopes should be constructed with 1:1 side slopes, compacted well and immediately stabilized.**
Stabilization	• **Immediately stabilize the earth berms upon installation as provided in Section 1620 of the Standard Specifications. Other stabilization methods may be utilized with prior approval from the Engineer.** • **Remove the temporary earth berms upon completion of the project. The earth material can be utilized in the filling of silt ditches and detention devices, or graded to match the existing contours and permanently seeded and mulched.**

Technician's Checklist

- Inspect the temporary earth berm once a week and after every rainfall.
- Check the outlets and make timely repairs as needed to avoid gully formation.
- When the area above the temporary earth berm is permanently stabilized, remove the berm or, if applicable, blend to match existing contours.

Measurement & Payment

The installation of temporary earth berms will be paid for as Borrow Excavation as provided in Section 230 of the Standard Specifications or included in the lump sum price for grading. Stabilization of the temporary earth berms will be paid for as Temporary Seeding as provided in Section 1620 of the Standard Specifications. Such price and payment shall be considered full compensation for all work covered by this section including all materials, construction, maintenance, and removal of the temporary earth berms.

4.3.5 Temporary Earth Berm

Pay Items	Pay Units
Borrow Excavation	**Cubic Yard**
Seed for Temporary Seeding	**Pound**
Fertilizer for Temporary Seeding	**Ton**

Maintenance

- Immediately remove sediment from the flow area and repair the berm when necessary.
- Reconstruct earth berms that have weakened due to scouring.
- Repair seed and mulch the berm, as needed.

Typical Problems

- The berm is not compacted appropriately and leads to breaches
- The berm is not constructed of sufficient height to contain runoff
- The berm is not constructed with good, positive drainage, which results in ponding and potential slope failure

4.4

Section

Slope Protection

Also see Temporary Earth Berm in Section 4.3

All slopes within a construction site must be identified early in the planning phase. Topographic conditions (e.g., soil type, percent grade, locations of natural channels) must be documented so that slopes can be properly protected. The longer and steeper the slope, the greater the effort needed to prevent erosion. BMPs will often need to be combined on steep slopes, long slopes and/or slopes with highly erodible soils.

When possible, implement temporary slope drains, temporary earth berms and wattle barriers to keep stormwater off of the slope. Special sediment control fencing and rolled erosion control products are effective BMPs for slope protection.

4.4.1 Temporary Slope Drain (1622.01)

Practical Tips

- **Install early in construction**
- **Pay particular attention to the inlet, outlet and pipe joints.**

Definition

A temporary slope drain is a flexible tubing or pipe used to convey concentrated runoff from the top to the bottom of a cut or fill slope without causing significant erosion along the slope. An earth berm is an earthen barrier designed to channel runoff to the slope drain inlet. The temporary slope drain pipe should be long enough to extend to the bottom of the slope and directed into a prescribed sediment control device.

Areas of Use

- Above cut or fill slopes where runoff flowing over the slope would cause erosion if left unchecked
- Not for fill or cut slopes that are 4:1 or flatter

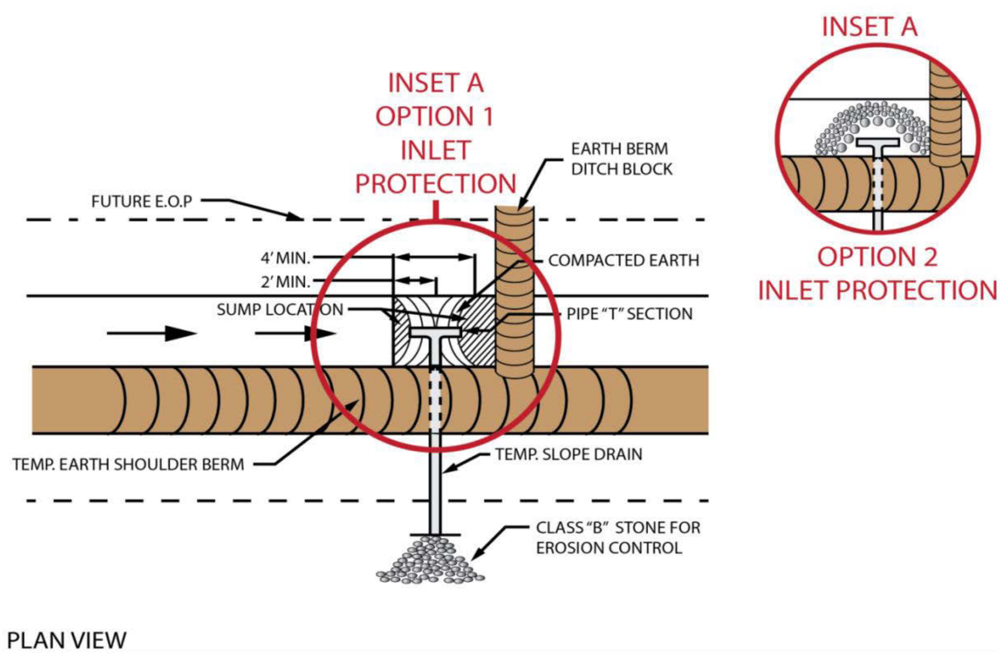
4.4.1 Temporary Slope Drain (1622.01)

Design Criteria

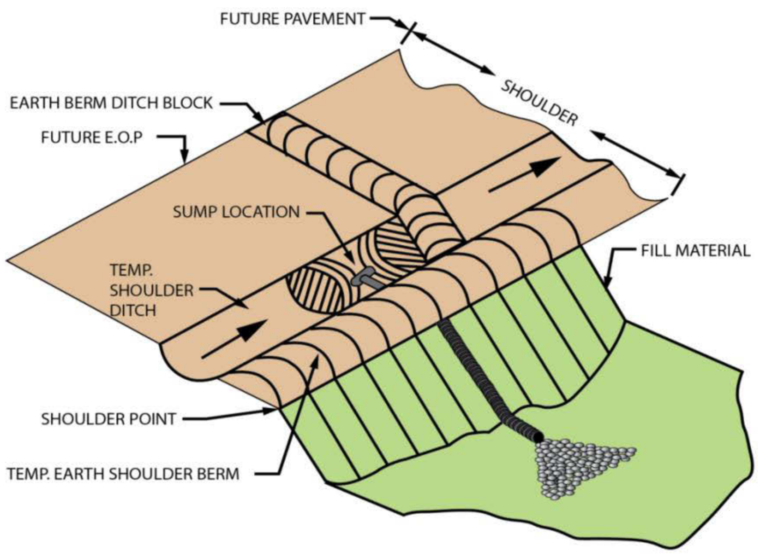
- Slope drain should have capacity to pass the peak runoff from the 10-year storm
- Projects in Divisions 1, 2, 3, and 6 should have slope drains on fill slopes 5 feet or higher and steeper than 4:1
- All other divisions should use slope drains for fills slopes that are 8 feet or higher and steeper than 4:1
- Show slope drains on both sides of fill slopes regardless of super elevation slope
- Projects in Divisions 1, 2, 3, and 6 should have slope drains on fill areas with roadbed super elevation that is greater than 0.04 feet/feet and 3 feet or higher
- All other divisions should use slope drains for fill areas with roadbed super elevation that is greater than 0.04 feet/feet and 5 feet or higher
- Unless individually designed, should size slope drains in accordance with the following:

Maximum Drainage Area Per Pipe (acres)	Pipe Diameter (inches)
0.50	12
0.75	15
1.00	18*

**NCDOT uses a minimum pipe diameter of 18" and limits the drainage area to 1 acre for individual slope drains.*
Adapted from Table 6.32, Erosion and Sediment Control Planning and Design Manual, NCDENR



4.4.1 Temporary Slope Drain (1622.01)



ISOMETRIC VIEW

Material Specifications

- Construct the slope drain from heavy-duty, flexible materials such as non-perforated, corrugated plastic pipe or specially designed flexible tubing.
- Construct earth berms with on-site unclassified earth material.
- Use Class B stone that meets the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class B as structural stone at the slope drain inlet.
- Use No. 5 or No. 57 stone that meets the requirements of Section 1005 of the Standard Specifications for these stone sizes as structural stone at slope drain inlet.

If the berm is topped or breached, the water will not get to the slope drain. The grade of the ditch formed by the berm must have sufficient fall to keep the water moving toward the drain.

4.4.1 Temporary Slope Drain (1622.01)

Construction Specifications

Installation	• Install slope drains in conjunction with grading and adjust to coincide with the height of the embankment as construction progresses. • Install stakes to anchor the conduit at intervals not to exceed 10 feet with the outlet end securely fastened in place. The conduit must extend beyond the toe of the slope. • Construct the slope drain so that erosion or scouring does not occur underneath or around the sides of the pipe inlet. • When using the earthen berm in conjunction with the slope drain, construct the lowest point of the berm ridge a minimum of 1-foot above the top of the drain so that design flow can freely enter the drain. • Install a standard T-section at inlets as necessary for multi-directional flow and elbows for single directional flow.
Stone	• Protect outlet locations subject to scour with Class B stone or a silt detention device. A special stilling basin may also be used as outlet protection. Construct outlet protection devices as shown in the plans and at other locations as directed.
Spacing	• Implement a maximum slope drain spacing of 200 feet measured along the top of the slope.

Technician's Checklist

- Construct inlets and outlets properly to prevent scour. (See Roadway Standard Drawing No. 1622.01.)
- Inspect the berm at least weekly to determine if overtopping is occurring. If so, additional slope drains are needed.
- Utilize drains that are long enough to reach the toe of the slope and turn the pipe in the ditch line in the direction of flow.
- If a basin is planned at the toe of the fill, review the permits to determine if it is allowed.
- Stake the pipe at 10-foot horizontal intervals.
- Place the drains at the low point and no more than 200 feet apart.
- Keep the inlet clear so that water does not bypass the drain.
- Keep the outlet clear.
- As the pipe is extended, confirm that standards for staking and inlet/outlet protection are met.
- When the drain is removed, dress and seed the area.

4.4.1 Temporary Slope Drain (1622.01)

Measurement & Payment

Pay Items	Pay Units
Temporary Slope Drains	**Linear Foot**

Maintenance

- Inspect slope drains after each significant rainfall of 0.5 inches or greater, over a 24-hour period.
- Rebuild earth berms and inlets that have weakened due to scouring.
- Extend slope drains and rebuild inlet protection as slope is built, after each 2-foot increase in height.
- Rebuild or repair slope drains if needed when seeding and mulching is performed.
- Refurbish Class B stone outlet protection and clean as needed.

Typical Problems

- Slope drains that empty off-site without passing water through a specified sediment control device such as a silt basin, sediment dam, etc.
- Washes under and around inlet pipe where earth material is not compacted properly
- Pipe is too short and scours bottom of slope
- Pipe is leaking at joints or not properly connected
- Outlet ends of pipe are clogged or inundated with silt so that flow cannot continue
- Silt basins, built at top of slope drain, can contribute to problems of scouring around inlet
- Shifting of slope drain due to improper staking or the absence of staking

4.4.2 Special Sediment Control Fence (1606.01)

Practical Tips

- **SSCF is generally used in conjunction with silt fence to provide outlets for water that can be trapped by silt fence.**
- **SSCF is useful in areas near flowing water to permit tides and surges to cross the fence without compromising it.**

Definition

Special sediment control fence (SSCF) is hardware cloth faced with sediment control stone. Runoff velocity is reduced allowing soil particles to settle. It may also temporarily pond the runoff, helping to settle or trap sediment before the water passes through the stone. SSCF also allows areas of diffuse flow to be maintained.

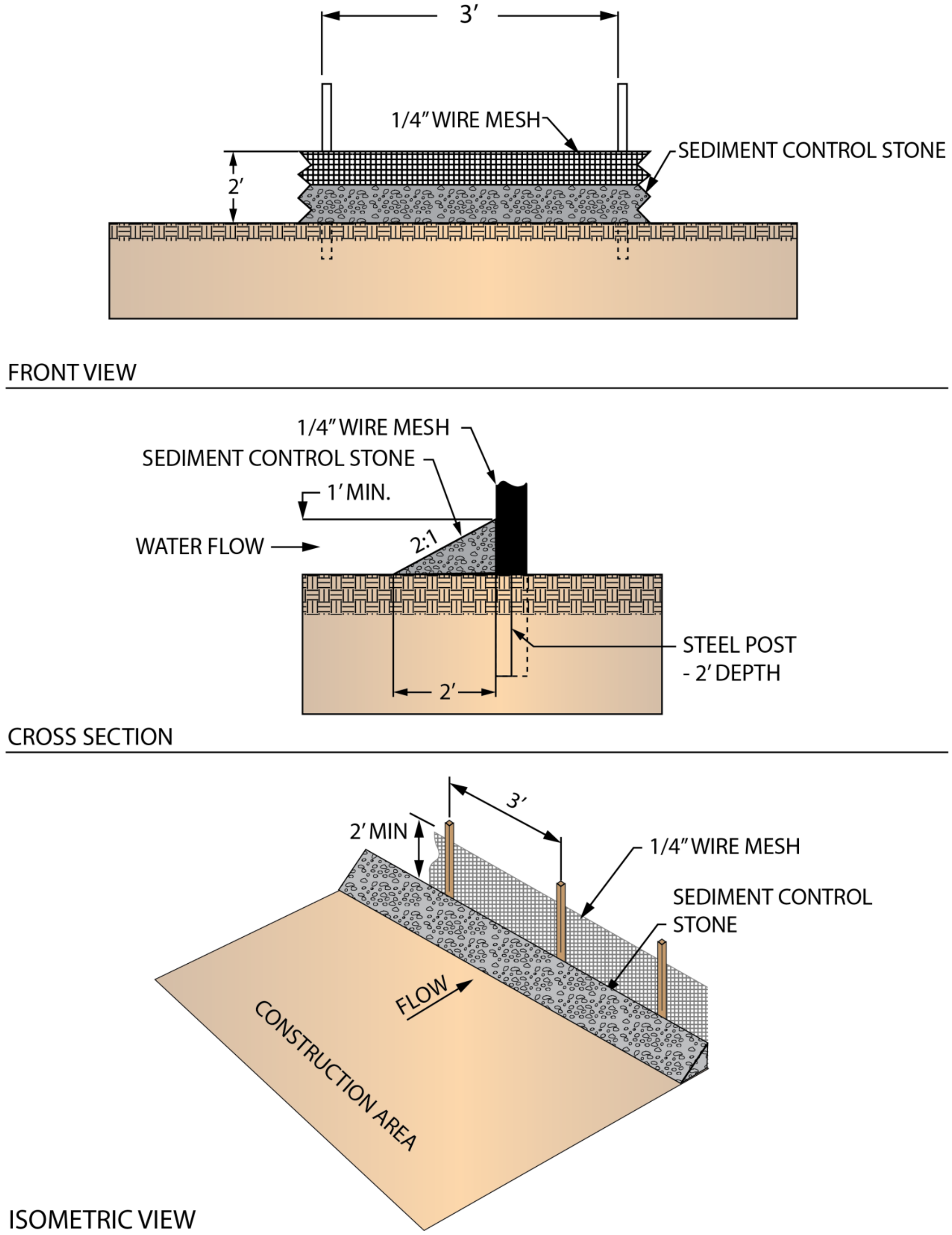
Areas of Use

- In areas where excavated basins are not feasible
- Between toe of fill slopes and stream relocations where excavated basins are not feasible
- In areas where concentrated flow would exceed limits of temporary silt fence
- With temporary silt fence in wetland areas
- Not where flow will run parallel to the stone and not allow ponding of runoff

Design Criteria

- The drainage area should not exceed ½ acre to a section of SSCF.
- SSCF may be used as outlets for silt fence at a minimum of every 200 feet to prevent overflow and alleviate force created by runoff.
- SSCF should be limited to 15-foot sections when used as turnouts for silt fence in wetlands to facilitate removal of stone and minimize disturbance.

4.4.2 Special Sediment Control Fence (1606.01)



4.4.2 Special Sediment Control Fence (1606.01)

Material Specifications

- Hardware cloth shall be a wire mesh with ¼-inch openings and constructed from minimum 24-gauge wire that is at least 48 inches in width, as required in Section 1606-2 of the Standard Specifications.
- Steel posts shall be a minimum of 5-feet long, 1-3/8 inches wide on the face parallel to the hardware cloth, and be of the self-fastener angle steel type. See Section 1606-2 of the Standard Specifications.
- Sediment control stone shall be No. 5 or No. 57 stone that meets the requirements of Section 1005 of the Standard Specifications for these stone sizes.

All posts may appear similar however it is imperative that a properly sized post is utilized to reduce the likelihood that the fence will bend from pressure.

Construction Specifications

Hardware Cloth	• **The hardware cloth shall be installed at a height of 2 feet and placed 2-feet under the sediment control stone.** • **Sediment control stone shall be installed on the outer face of the hardware cloth to a height of 1 foot.** • **The top of the hardware cloth shall be a minimum of 1-foot below the shoulder to prevent flow from backing up into the roadway.** • **The top of the hardware cloth shall also be a minimum of 1-foot below any clean water diversion to prevent runoff from backing up, mixing with clean water and bypassing the SSCF through the clean water diversion.**
Steel Posts	• **The steel posts shall be installed a minimum of 2-feet deep and with a maximum spacing of 3 feet.**
Silt Fence	• **SSCF sections used with silt fence in wetland areas shall be limited to 15-foot sections spaced a maximum of 200 feet apart to allow for complete removal of sediment control stone and to minimize impacts to wetlands.** • **When SSCF is used in conjunction with silt fence, sediment control stone should extend (overlap silt fence) 12 inches on either side**

4.4.2 Special Sediment Control Fence (1606.01)

Technician's Checklist

- Check the environmental permits to verify that the fence is placed in the proper location and in accordance with the permit drawings and provisions. Fence materials shall meet the requirements of Section 1606.
- Install the fence in advance of the need to contain sediment.
- Make any necessary additions or adjustments to SSCF based on field conditions.
- Install materials according to plan details. (See Roadway Standard Drawing No. 1606.01.)
- Remove silt accumulation when silt reaches half the height of the stone and dispose of waste properly.
- Measure the silt removed for payment.
- Remove fence, posts and stone when the permanent controls have been established. Do not leave the stone on site and do not place any stone in permitted areas.

Measurement & Payment

Pay Items	Pay Units
¼-inch Hardware Cloth	**Linear Foot**
Sediment Control Stone	**Ton**
Silt Excavation	**Cubic Yard**

Maintenance

- Inspect the device periodically and after each significant rainfall event for damage and sediment accumulation to confirm the device is functioning properly.
- At a minimum, remove sediment from the device when accumulations reach one-half the height of the sediment control stone.
- Replace or clean the sediment control stone as needed to allow water to drain through the device between rainfall events.
- Rebuild and/or repair the device when it is damaged.
- Repair areas where SSCF becomes undermined due to concentrated flows.

Typical Problems

- Sediment accumulations are not removed in a timely fashion, causing sediment to be released offsite.
- The sediment control stone is not cleaned and becomes clogged, preventing proper drainage.
- The device is not rebuilt or repaired when damaged by storms, equipment, etc.
- The device is not built wide enough to prevent water from washing around it. Water should always flow through or over the device, not around.
- Runoff becomes concentrated in areas and undermines the hardware cloth and sediment control stone.

4.4.3 Rolled Erosion Control Products (RECP) (1631.01)

Practical Tips

- **Proper trenching, anchoring and stapling are critical for matting to function properly.**

Definition

Matting is a type of rolled erosion control product (RECP) designed to reduce seed and soil loss and to aid in the reestablishment of vegetation on highly erodible surfaces such as steep slopes and channels, or areas where vegetation may be difficult to establish.

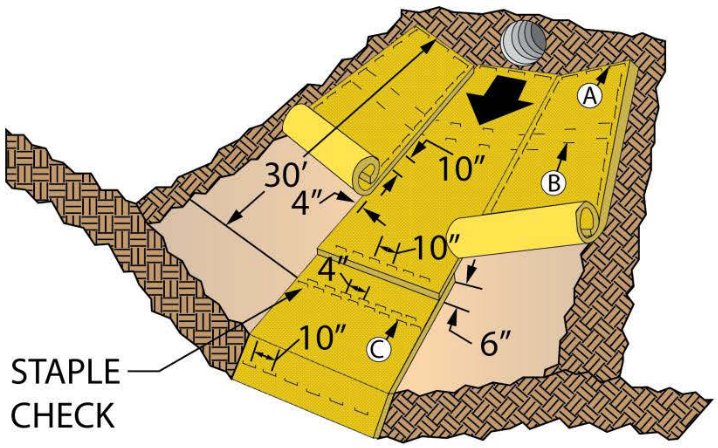
Areas of Use

- Coir Fiber Matting should be used for stream banks and flood plain areas.
- Temporary Erosion Control Matting (Excelsior) can be used on most slopes and ditches.
- Permanent Soil Reinforcement Matting (PSRM) or Turf Reinforcement Matting shall be used on ditches with steep grades (4% to 5%).

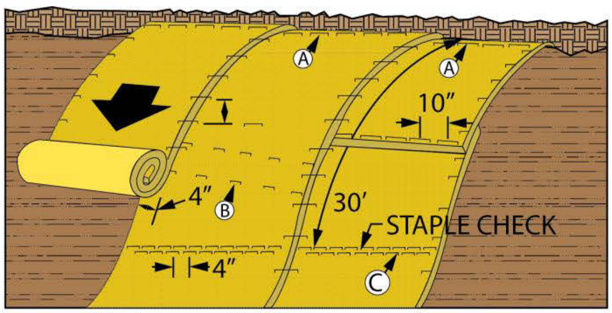
Design Criteria

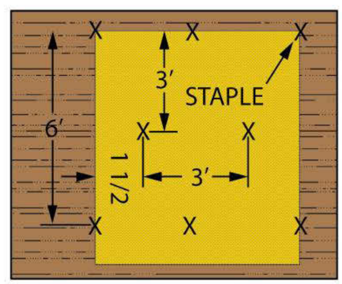
- Provide a smooth soil surface free from stones, clods or debris that will optimize contact of the matting with the soil. Matting should lie in direct contact with the soil surface. Care should be taken to avoid over compaction of soil within area of seedbed preparation.

4.4.3 Rolled Erosion Control Products (RECP) (1631.01)



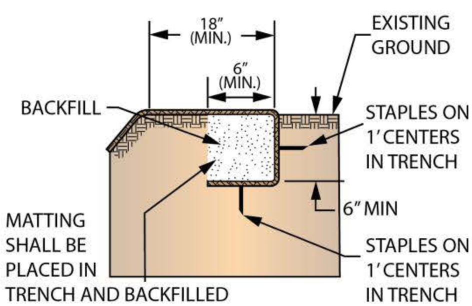
ISOMETRIC VIEW - MATTING IN DITCHES (NOT TO SCALE)





ISOMETRIC VIEW - MATTING ON SLOPES

DIAGRAM REFERENCE B



STAPLE CHECK PATTERN

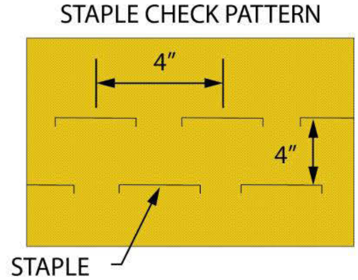


DIAGRAM REFERENCE A

DIAGRAM REFERENCE C

4.4.3 Rolled Erosion Control Products (RECP) (1631.01)

Material Specifications

Matting for erosion control shall be excelsior matting or straw matting. Furnish a Type 3 material certification in accordance with NCDOT's 2012 Standard Specifications, Article 106-3, *Contractor Furnished Certification*, certifying that the matting meets this article. Other acceptable material manufactured especially for erosion control may be used when approved by the Engineer in writing before installation. Matting for erosion control shall not be dyed, bleached or otherwise treated in a manner that will result in toxicity to vegetation.

Specific material requirements for all matting types are listed below:

Excelsior Matting

- Excelsior Matting shall meet the requirements of NCDOT's Standard Specifications Materials Section 1631.01.
- Excelsior Matting shall consist of a machine produced mat of curled wood Excelsior at least 47 inches in width and weigh 0.975 lb/sy with a tolerance of ± 10%.
- At least 80% of the individual Excelsior fibers shall be 6 inches or more in length. Excelsior fibers shall be evenly distributed over the entire area of the blanket.
- One side of the excelsior matting shall be covered with an extruded plastic mesh (netting). The mesh size shall be no more than 1 inch x 1 inch.

Straw Matting

- Straw Matting shall meet the requirements of NCDOT's Standard Specifications Materials Section 1631.01.
- Straw Matting shall consist of a machine produced mat of 100% grain straw.
- The straw matting shall have a width of at least 48 inches and no more than 90 inches and weigh at least 0.50 lb/sy and no more than 0.75 lb/sy.
- The straw shall be evenly distributed over the entire area of the blanket. One side of the blanket shall be covered with photodegradable netting with a maximum mesh (netting) size of 0.75 inches x 0.75 inches sewn together with a degradable thread.
- The grain straw shall contain no weed seeds.
- Each roll shall be packaged separately.

Most RECPs are either biodegradable or photodegradable and will decompose over time, reducing the need for ongoing maintenance.

Permanent Soil Reinforcement Matting

- The product shall be a permanent erosion control reinforcement mat and shall be constructed of synthetic or a combination of coir and synthetic fibers evenly distributed throughout the mat between a bottom ultraviolet (UV) stabilized netting and a heavy duty UV stabilized top net.

4.4.3 Rolled Erosion Control Products (RECP) (1631.01)

- The matting shall be stitched together with UV stabilized polypropylene thread to form a permanent three-dimensional structure.
- The mat shall have the following minimum physical properties. Refer to NCDOT Project Special Provisions for additional guidance.

PSRM Property	Test Method	Value	Unit
Light Penetration	ASTM D6567	9	%
Thickness	ASTM D6525	0.40	in
Mass Per Unit Area	ASTM D6566	0.55	lb/sy
Tensile Strength	ASTM D6818	385	lb/ft
Elongation (Maximum)	ASTM D6818	49	%
Resiliency	ASTM D1777	>70	%
UV Stability *	ASTM D4355	>80	%
Porosity (Permanent Net)	ECTC Guidelines	>85	%
Maximum Permissible Shear Stress (Vegetated)	Performance Bench Test	>8.0	lb/ft^2
Maximum Allowable Velocity (Vegetated)	Performance Bench Test	>16.0	ft/s

** ASTM D1682 Tensile Strength and % strength retention of material after 1000 hours of exposure.*

Submit a certification (Type 1, 2, or 3) from the manufacturer showing:

- The chemical and physical properties of the mat used, and
- Conformance of the mat with these specifications.

Wire Staples

- Staples shall be machine made of No. 11 gauge new steel wire formed into a U-shape.
- The size when formed shall not be less than 6 inches in length with a throat of not less than 1 inch in width.

4.4.3 Rolled Erosion Control Products (RECP) (1631.01)

Construction Specifications

Matting	• Furnish, place and maintain the appropriate type of matting on previously shaped and seeded drainage ditches, slopes or other locations shown in the contract documents, or as directed. • Place matting immediately following seeding. • Preserve the required line, grade and cross section of the area covered. • Unroll matting in the direction of the flow of water and apply without stretching so that it will lie smoothly but loosely on the soil surface. • Where one roll of matting ends and a second-roll begins, overlap the end of the upper roll over the end of the second roll so there is a 6-inch overlap.
Staples	• Bury the up-channel or top of slope end of each piece of matting in a trench at least 6-inches deep and 6-inches wide, staple per detail, backfill and tamp firmly. • Construct staple checks 4 inches on center and every 30 feet longitudinally in the matting or as directed. Fold over and bury matting to the full depth of the trench, close and tamp firmly. Overlap matting at least 4 inches where 2 or more widths of matting are laid side by side. • Place staples across matting at ends and junctions approximately 10 inches apart. • Place staples along the outer edges and down the center of each strip of matting 3 feet apart. • Place staples along all lapped edges 10 inches apart. • Install product with netting on the top side when excelsior or straw matting is used.

4.4.3 Rolled Erosion Control Products (RECP) (1631.01)

Technician's Checklist

- Inspect weekly and after every storm event that results in a discharge from the site until adequate vegetation is established.
- Conduct seeding first, then immediately apply matting.
- Evenly grade all areas of application to allow for full contact between the matting and natural ground.
- Immediately repair and reseed undermined areas requiring maintenance from rill or gulley erosion.
- Provide adequate trenching of up gradient edges and overlap of down gradient edges of matting.

Matting should be placed immediately following seeding.

Measurement & Payment

Matting will be measured and paid for as the actual number of square yards measured along the surface of the ground over which matting is installed and accepted. Overlaps will not be included in the measurement, and will be considered as incidental to the work. Such payment shall be full compensation for furnishing and installing the mat, including overlaps, and for all required maintenance.

Pay Items	Pay Units
Matting For Erosion Control	**Square Yard**
Permanent Soil Reinforcement Mat	**Square Yard**

Maintenance

- Repair erosion and/or undermining at the top of the slope.
- Repair undermining beneath matting. Pull back the matting, fill and compact eroded area, reseed and then secure matting firmly.
- Reposition or replace matting that has moved along the slope or channel and secure firmly.
- Replace damaged matting.

Typical Problems

- It is important that the stakes or staples be properly installed to prevent "tenting" of the matting as the vegetation begins to grow and push upwards. This condition can impact vegetative establishment and the matting can become entangled in mowing equipment.
- Runoff can lift the leading edge of the matting if it is not trenched, anchored and backfilled properly at the top of the slope, allowing water to flow between the ground and the matting.

4.4.4 Wattle Barrier

Definition

A wattle barrier is a tubular product consisting of excelsior or coir (coconut) fibers encased in synthetic or biodegradable netting. A wattle barrier temporarily traps sheet flow from disturbed slopes, allowing sediment to settle on the upgradient side.

Areas of Use

Install wattles in these locations:

- Just beyond the toe of bridge approach fills or on slopes to intercept runoff
- In locations where silt fence cannot be installed
- In wetlands areas
- Where vertical clearance between the ground and the bottom of the bridge is less than 4 feet
- As a break along large slopes in order to reduce runoff velocity
- As a perimeter barrier and runoff diversion

Practical Tips

- **Flocculant can be used with wattle barriers to provide additional turbidity control.***
- **Excelsior wattle barriers are used for short term projects.**
- **Coir fiber wattle barriers are used for long term projects.**

*** -Do not apply flocculant to wattle barriers at perimeter of projects.**

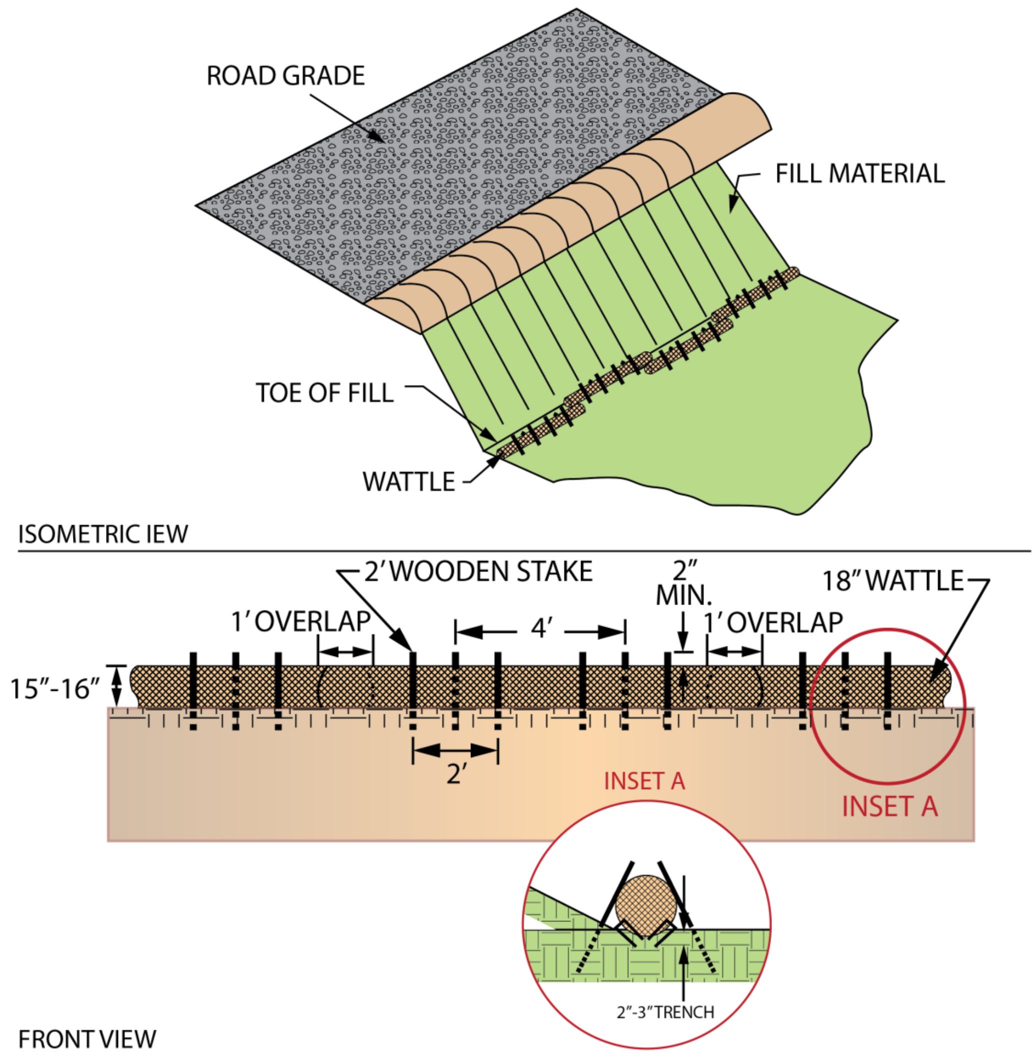
Wattle barriers are used on Clearing & Grubbing and Final Grade phases of the Erosion and Sediment Control plan.

4.4.4 Wattle Barrier

Design Criteria

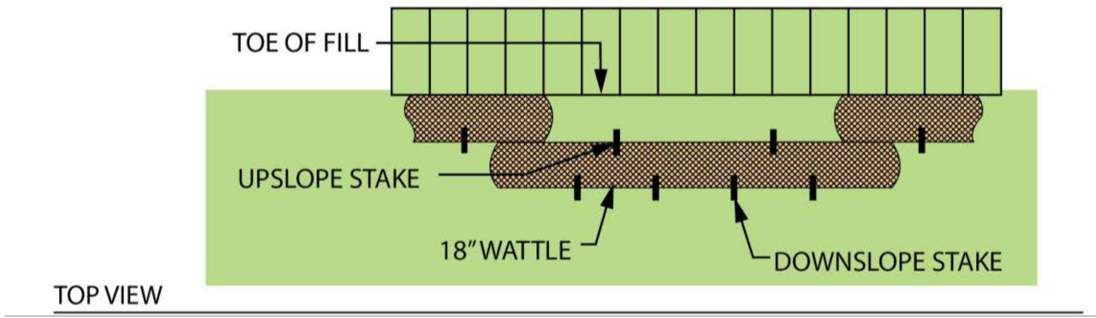
- 18-inch wattles should be used for wattle barriers.
- The wattle barrier should be placed in a 2- to 3-inch trench.
- A maximum spacing of 25 feet should be used for breaks along large slopes measured along the slope.
- Coir fiber wattle barriers should be used in projects lasting longer than 1 year. The design life for excelsior wattle barriers is 1 year.

Install wattle barriers so flow will not wash around the wattle barrier and scour slopes.



NCDOT ESC Erosion & Sediment CONTROL MANUAL

4.4.4 Wattle Barrier



Material Specifications

Staples shall meet the requirements of Section 1605-2 of the Standard Specifications.

Excelsior Wattle Barrier

- The inner material is composed of curled wood.
- The diameter shall be a minimum of 18 inches.
- The length shall be a minimum of 10 feet.
- The density of the excelsior wattle shall be 2.9 lb/ft^3 +/- 10%.
- For slope breaks, 12-inch diameter wattles can be used.

Coir Fiber Wattle Barrier

- The inner material is composed of coconut fibers.
- The diameter shall be a minimum of 18 inches.
- The length shall be a minimum of 10 feet.
- The density of the coir fiber wattle shall be 5 lb/ft^3 +/-10%.
- For slope breaks, 12-inch diameter wattles can be used.

NCDOT ESC Erosion & Sediment CONTROL MANUAL

4.4.4 Wattle Barrier

Construction Specifications

Work includes furnishing materials, installation, maintenance and removing wattle barriers. Install barrier in conformance with details provided in the plans and as directed. Remove and dispose of silt accumulations at the wattle barriers when directed and in accordance with Section 1630 of the Standard Specifications.

Spacing	• **Wattle barriers used to reduce runoff velocity along large slopes should have a maximum spacing of 20 feet measured along the slope.**
Staples	• **Provide staples made of 0.125-inch diameter steel wire formed into a U-shape, no less than 12 inches in length and with a throat of 1 inch in width.** • **Install staples approximately every 1 foot on both sides of the wattle and at each end to secure it to the soil.**
Stakes	• **Use 2-foot wooden stakes with a 2-inch by 2-inch nominal cross section.** • **Sharpen or bevel one end of the stake to facilitate driving down into the underlying soil.** • **Install a minimum of 2 upslope stakes and 4 downslope stakes at an angle to wedge wattle to bottom of ditch.** • **Drive stakes into the ground a minimum of 10 inches with no more than 2 inches projecting from the top of the wattle.**
Overlap	• **Align wattle barriers in an overlapping and alternating pattern.** • **Overlap adjoining sections of wattles a minimum of 1 foot.** • **Excavate a trench the entire length of each wattle with a depth of 2 inches to 3 inches for the wattle to be placed.**

Technician's Checklist

- Devices should be inspected regularly and after significant rainfall.
- Sediment, debris, straw and other items should be removed from the wattle barrier.
- Proper installation of anchors securing wattle barriers to the ground should be verified.

The construction of wattle barriers is of the utmost importance in that they are designed as slope protection to reduce velocity and as a method to introduce flocculant for turbidity control.

4.4.4 Wattle Barrier

Measurement & Payment

Wattle barrier will be measured and paid for by the number of linear feet of wattles which are installed and accepted. Such price and payment will be full compensation for all work covered by this section, including furnishing all materials, labor, equipment and incidentals necessary to install the wattle barrier

Wattle Barrier

Pay Items	Pay Units
Wattle Barrier	**Linear Foot**

Coir Fiber Wattle Barrier

Pay Items	Pay Units
Coir Fiber Wattle Barrier	**Linear Foot**

Maintenance

It is important that the wattle barriers be kept clean to allow water to flow through the natural fibers. The wattle barriers can become blocked with debris, sediment, straw and other items.

- The up gradient side of the wattle barrier should be maintained to allow the water to flow through, reduce velocity and allow sedimentation to occur.
- If the natural fibers of the wattle barrier become too saturated with debris, sediment, etc., and removal of these items is not possible, wattle barriers should be replaced.
- Stakes should be used to anchor the wattle barrier adequately to the ground to prevent scouring and washout during storm events.

Wattle barriers are easier to remove and dispose of than measures containing stone.

Typical Problems

- Improper installation and failure to properly anchor the wattle barrier with staples and stakes reduces the effectiveness of the measure to control erosion and reduce velocities.
- Improper maintenance can limit the wattle barrier's effectiveness to reduce velocity.
- Stakes should not be installed through the wattle barrier.

4.5 Section

Runoff Conveyance Management

Also see Rolled Erosion Control Products in Section 4.4

Runoff management conveyances should be considered early in the planning phase. BMPs in runoff management conveyances are used to control runoff velocity, trap silt, and in some measures, introduce flocculant to the runoff. Runoff management conveyance measures are typically placed in channels, ditches and ditch outlets.

When possible, flocculant should be added to BMPs such as the Temporary Rock Silt Check - Type A and wattle, when sediment storage requirements cannot be achieved and to provide additional stormwater runoff treatment.

4.5.1 Wattles

With Flocculant Without Flocculant

Practical Tips

- Wattles are primarily used for flocculant incorporation.
- Excelsior wattles are used for short-term projects.
- Coir fiber wattles are used for long-term projects.

Definition

A wattle is a tubular product consisting of excelsior or coir (coconut) fibers encased in synthetic or biodegradable netting.

Areas of Use

Install wattles in these locations:

- In areas to reduce runoff velocity in temporary and permanent ditches
- On slopes to intercept runoff and act as a velocity break
- As inlet and outlet protection and perimeter controls
- In silt fence breaks to provide a drainage break along silt fence
- As perimeter barriers in lieu of silt fence
- As slope breaks along large slopes

Apply flocculant to wattles at these locations:

- Up gradient areas that drain to a silt fence, sediment basin or trap, rock dam or inlet protection
- Inlets that drain to sediment basins or slope drains
- Not in jurisdictional areas (streams, wetlands or ponds), as perimeter measures, at outlets of ditches or drainage inlets carrying flow directly offsite

Wattles can provide velocity control and sediment storage as additional benefits.

4.5.1 Wattles

With Flocculant Without Flocculant

Design Criteria

Contract Projects

> **Only install wattles to a height in ditches so flow will not wash around the wattles and scour ditch slopes.**

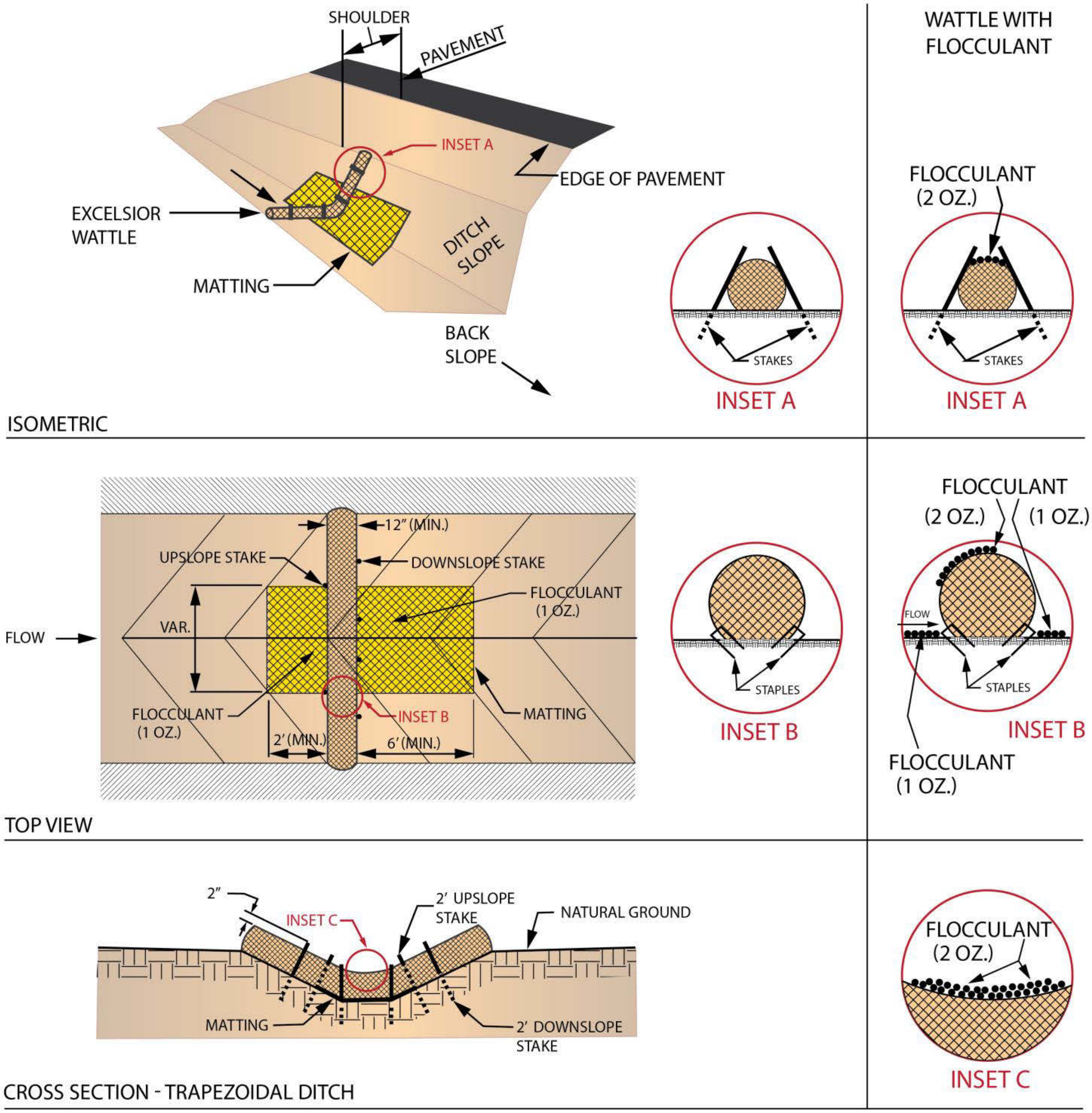
- Use with flocculant at 50-foot intervals in ditch lines draining directly to jurisdictional streams and wetlands
- Use with flocculant at 50-foot intervals in areas where sediment basins are not feasible at drainage outlets
- Use with flocculant at 50-foot intervals in areas where sediment basins at drainage outlets with sediment traps cannot be properly tied into existing surface areas
- Use with flocculant at 50-foot intervals in areas where sediment storage requirements are needed but construction limitations such as safety concerns, right-of-way restrictions or utility conflicts exist

Operations Projects

- 12-inch wattles should be used for typical foothill and mountain ditch lines
- At least one wattle with flocculant must be used in drainage lengths that are designed using any method other than Option 5 in EroDes
- Wattles should only be used for ditch grades of less than 2.5%
- Coir fiber wattles should be used in projects lasting longer than 1 year. The design life for excelsior wattles is 1 year.

4.5.1 Wattles

With Flocculant Without Flocculant



4.5.1 Wattles

With Flocculant Without Flocculant

Material Specifications

Matting shall meet the requirements of Section 1060-8 of the Standard Specifications. Flocculant shall be in powder form and anionic or neutrally charged. Stakes and staples shall meet the requirements of Section 1605-2 of the Standard Specifications.

Excelsior Wattle

- The inner material shall be composed of curled wood.
- The diameter shall be a minimum of 12 inches and a maximum of 20 inches.
- The length shall be 10 feet.
- The density of the excelsior wattle shall be 2.5 lb/ft^3.

Coir Fiber Wattle

- The inner material shall be composed of coconut fibers.
- The diameter shall be a minimum of 12 inches and a maximum of 20 inches.
- The length shall be 10 feet.
- The density of the coir fiber wattle shall be 3.5 lb/ft^3.

Construction Specifications

Work includes furnishing materials, installation of coir fiber wattles, matting installation and removing wattles. Installation shall follow the detail provided in the plans and as directed.

Matting	• **Install matting in accordance with Section 1631 of the Standard Specifications.**
Staples	• **Provide staples made of 0.125-inch diameter steel wire formed into a U-shape no less than 12 inches in length.** • **Install staples approximately every 1 foot on both sides of the wattle and at each end to secure it to the soil.**
Stakes	• **Use 2-foot wooden stakes with a 2-inch by 2-inch nominal cross section.** • **Install a minimum of 2 upslope stakes and 4 downslope stakes at an angle to wedge the wattle to the bottom of the ditch.** • **Drive stakes into the ground a minimum of 10 inches with no more than 2 inches projecting from the top of the wattle.**

4.5.1 Wattles

With Flocculant Without Flocculant

Construction Specifications, cont.

Flocculant	• **Flocculant shall be in powder form and anionic and neutrally charged.** • **Soil samples should be obtained from areas where wattles will be placed and from off-site material used to construct the roadway. Samples should be analyzed to determine the appropriate flocculant to be used in each wattle.** • **Flocculant used should be listed on the NCDENR DWR website as an approved product for use in North Carolina.** • **Flocculant should be applied over the lower center portion of the wattle where the water will flow at a rate of 2 ounces per wattle.** • **Apply 1 ounce of flocculant on each side of the wattle.** • **Flocculant should be evaluated and applied after every rainfall event that is equal to or exceeds 0.5 inches.**
Overlap	• **Overlap adjoining sections of wattles a minimum of 1 foot.**

Technician's Checklist

- Devices should be inspected regularly and after significant rainfall.
- Flocculant should be reapplied after rainfall events equal to or exceeding 0.5 inches.
- Sediment, debris, straw and other items should be removed from the wattle.
- Proper installation of anchors to secure wattles to the ground should be verified.

The construction of wattles is of utmost importance in that they are designed to reduce velocity and introduce flocculant for turbidity control.

Measurement & Payment

Wattles will be measured and paid for by the number of linear feet of wattles which are installed and accepted. Such price and payment will be full compensation for all work covered by this section, including furnishing all materials, labor, equipment and incidentals necessary to install the wattles.

Matting will be measured and paid for in accordance with Section 1631-4 of the Standard Specifications, or in accordance with specifications provided elsewhere in this contract.

4.5.1 Wattles

With Flocculant Without Flocculant

Flocculant will be measured and paid for by the actual weight in pounds of flocculant applied to the wattles. Such price and payment will be full compensation for all work covered by this section, including furnishing all materials, labor, equipment and incidentals necessary to apply the flocculant.

Wattle

Pay Items	Pay Units
Wattle	Linear Foot
Matting for Erosion Control	Square Yard
Flocculant	Pound

Coir Fiber Wattle

Pay Items	Pay Units
Coir Fiber Wattle	Linear Foot
Matting for Erosion Control	Square Yard
Flocculant	Pound

Maintenance

It is important that the wattles be kept clean to allow water to flow through the natural fibers and contact the flocculant. The wattles can become blocked with debris, sediment, straw and other items.

- The upstream side of the wattle should be maintained to allow the water to flow through, reduce velocity, distribute flocculant and allow sedimentation to occur.
- If the natural fibers of the wattle become too saturated with debris, sediment, etc., and removal of these items is not possible, wattles should be replaced.
- Stakes should be used to anchor the wattle adequately to the ground to prevent scouring and washout during storm events.
- The excelsior pad beneath the wattles is critical to the proper functioning of the wattles.

Wattles are easier to remove and dispose of than stone.

4.5.1 Wattles

With Flocculant Without Flocculant

Typical Problems

- Improper installation and failure to properly anchor the wattle with staples and stakes reduces the effectiveness of the measure to control erosion and reduce velocities.
- Improper maintenance can limit the wattle's effectiveness to reduce velocity and distribute flocculant in runoff.
- Failure to install excelsior pad can limit the wattle’s effectiveness.
- Stakes should not be installed through the wattle.

4.5.2 Temporary Rock Silt Check - Type A

Practical Tips

- A pile of stone dumped into a ditch line does not constitute a proper rock silt check.
- TRSC-A's should be built in the same manner as temporary rock sediment dams. Rather than a defined sediment area, the TRSC-A uses a natural formed pit for storage.

Definition

Temporary Rock Silt Checks - Type A (TRSC-A) are small dam structures with a distinguishable weir outlet. They reduce the water velocity and provide sufficient capacity to trap silt in existing and proposed ditches. They are utilized as drainage outlets in concentrated flow areas where sediment basins and dams are not feasible.

Areas of Use

- In temporary and permanent ditches to reduce runoff velocity
- In outlets of temporary diversions, temporary silt ditches, channels and temporary slope drains
- In Environmentally Sensitive Areas (ESAs) where excavation is not permitted and storage capacity is limited
- Where the TRSC-A's can be easily cleaned and maintained
- Where runoff is exiting the project and larger sediment devices are not feasible, such as drainage turnouts

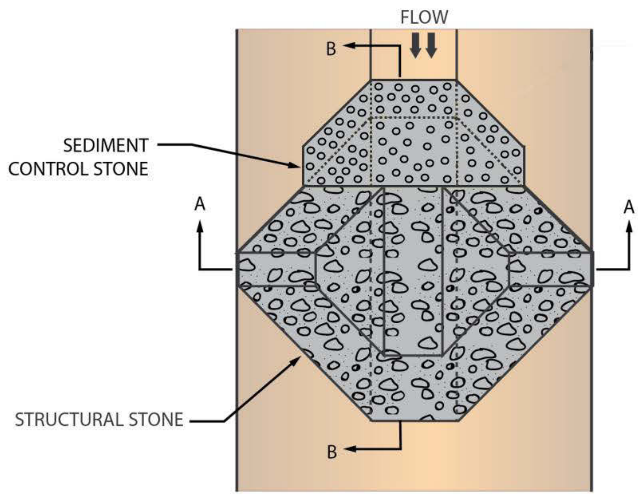
TRSC-A's can be combined with temporary silt fence for use in ESAs and wetlands which will allow for drainage of accumulated flow behind the fence.

4.5.2 Temporary Rock Silt Check - Type A

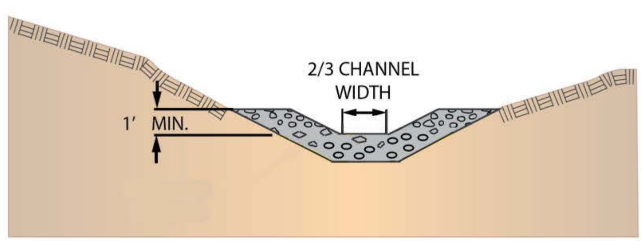
and natural drainage patterns

Design Criteria

- The drainage area should be 1 acre or less.
- The volume should be designed for 3,600 cubic feet per acre of disturbance.
- The sediment storage capacity should be limited to 275 cubic feet.
- TRSC-A's should be used on short and long-term projects where the ditch grade is greater than 2.5%.

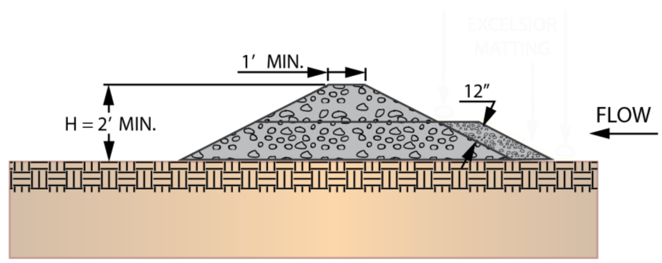


PLAN VIEW (NOT TO SCALE)



CROSS SECTION A-A (NOT TO SCALE)

4.5.2 Temporary Rock Silt Check - Type A



CROSS SECTION B-B (NOT TO SCALE)

Material Specifications

- Structural stone shall be Class B stone that meets the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class B.
- Sediment control stone shall be No.5 or No.57 stone, which meets the requirements of Section 1005 of the Standard Specifications for these stone sizes.

Construction Specifications

The construction of temporary rock silt checks is of the utmost importance in that they are designed to slow down and therefore pond water on the upstream side. This creates hydraulic pressure and water will try to get over, under, around and/or through the check.

A rule of thumb for placing ditch checks is that they are placed where the base of the upstream dam is not higher than the top of the downstream dam.

4.5.2 Temporary Rock Silt Check - Type A

Structural Stone	• **Use Class B structural stone.** • **Install stone at a minimum depth of 12 inches.** • **Install sediment control stone on the up gradient face of the structural stone.**
Side Slopes	• **2:1 or flatter**
Weir	• **Weir length should be 2/3 of the channel width.** • **The weir height shall be a minimum of 1 foot.** • **The depth of the weir shall be a minimum of 1 foot.**

It is important that the water be directed where it will not cause additional erosion under or around the sides of the check. For this reason, the weir must be properly sized and built. No value is received from stone that is placed on the sides higher than the expected high water elevation.

Technician's Checklist

- Build checks at the frequency shown in the Erosion and Sediment Control Plans.
- Install weir sections to allow water to flow over the stone, not around it.
- Construct the elevation of the weir 1-foot lower than the elevation where the stone ties into the ditch banks.
- Install a silt basin, if needed, up gradient of the check.
- Once the checks shown on the plans are installed, determine if there are a sufficient number to keep the velocity of the water low enough to minimize erosion of the ditch.
- Keep the checks clean.

Measurement & Payment

Pay Item:	Pay Unit:
Stone for Erosion Control, Class B	**Ton**
Sediment Control Stone, Standard Size No. 5 or No. 57	**Ton**
Silt Excavation	**Cubic Yard**

4.5.2 Temporary Rock Silt Check - Type A

Maintenance

It is important that the checks be kept clean and allow the water to flow through the stone because they are intended to pond water for only a short period of time. These checks can become clogged with silt, straw, grass clippings and other items.

It is not proper, when maintaining the device, to just add stone to the face of the clogged device instead of cleaning the existing stone. The clog will remain if not cleaned.

- Inspect the device after each significant rainfall.
- At a minimum, remove silt from the device when silt accumulates to one-half the height of the weir.
- Replace or clean sediment control stone when water no longer drains through the device between rainfall events.
- Rebuild and reshape rock weir and check when the device is damaged.

Device Removal

The determination to remove a rock silt check device from service should be made after considering whether there is any advantage to the division maintenance forces to leave it in place. Many times, the completed project will not become stable from an erosion control standpoint for some time, so some of the temporary devices may need to be left in place and removed by Department forces at a later date. If the device is to be left on the project after its completion, the device must be clean and in proper shape at the time of the final inspection. If it is to be removed, all accumulated silt should be removed and the area dressed and seeded.

Typical Problems

- Silt accumulation is not removed when needed.
- Rock structure is not rebuilt when damaged by storms and equipment.
- Rock structure and weir are not constructed to specifications.
- Rock structure is constructed higher than the drainage ditch causing water to flow around the measure and erode the ditch.
- Rock structure is not built wide enough to intercept the ditch slope at the top of the TRSC-A.

4.5.3 Temporary Rock Silt Check - Type A with Excelsior Matting and Flocculant

Practical Tips

- A pile of stone dumped into a ditch line does not constitute a proper rock silt check.
- TRSC-A's with excelsior matting and flocculant should be placed in existing and proposed ditches up gradient of the final drainage outlet measure. **Do not use as an outlet device!**

Definition

Temporary Rock Silt Checks - Type A (TRSC-A) with excelsior matting and flocculant are small dam structures with a distinguishable weir outlet. They reduce the water velocity, provide sufficient capacity to trap silt and introduce flocculant into the runoff.

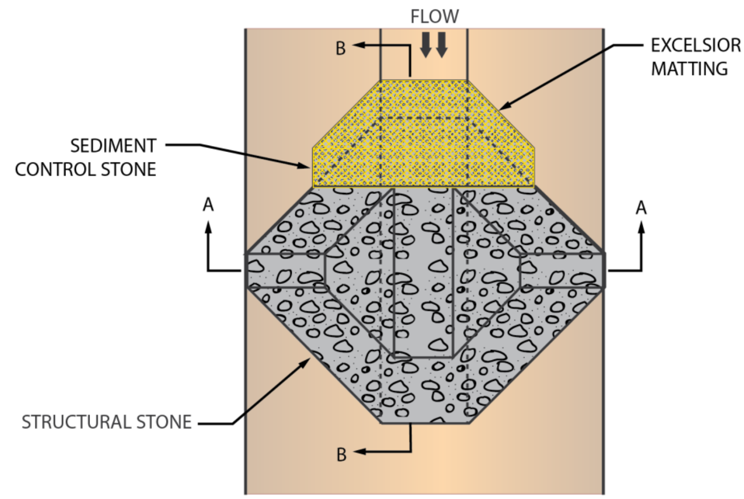
Areas of Use

- In temporary and permanent ditches to reduce runoff velocity and incorporate flocculant
- Where the TRSC-A's can be easily cleaned and maintained
- In up gradient areas to incorporate flocculant into the runoff where sediment storage requirements cannot be achieved and designed structure length and width are at a maximum

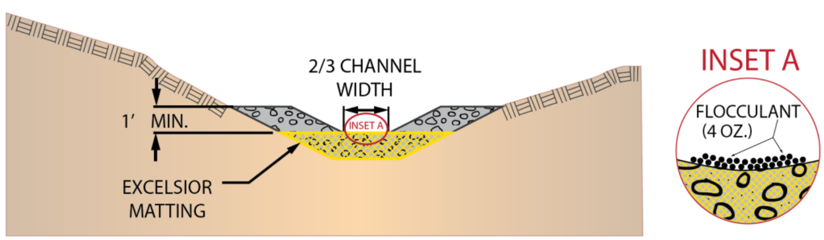
Design Criteria

- The drainage area should be 1 acre or less.
- TRSC-A's should be placed with excelsior matting and flocculant every 50 feet or spaced appropriately, in temporary and permanent ditches.
- TRSC-A's should be used on short and long-term projects where the ditch grade is greater than 2.5%.

4.5.3 Temporary Rock Silt Check - Type A with Excelsior Matting and Flocculant



PLAN VIEW (NOT TO SCALE)



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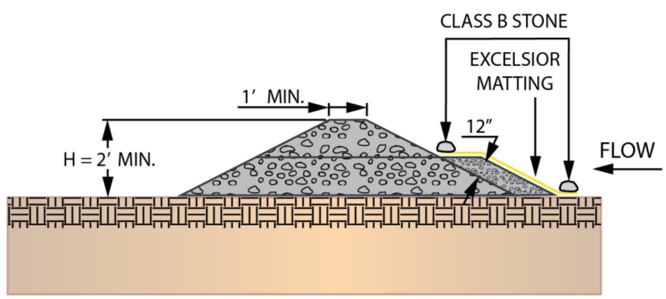


CROSS SECTION B-B (NOT TO SCALE)

4.5.3 Temporary Rock Silt Check - Type A with Excelsior Matting and Flocculant

Material Specifications

- Structural stone shall be Class B stone that meets the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class B.
- Sediment control stone shall be No.5 or No.57 stone, which meets the requirements of Section 1005 of the Standard Specifications for these stone sizes.
- Excelsior matting shall meet the requirements of NCDOT's Standard Specifications Section 1631.01.
- Flocculant shall be in powder form and anionic or neutrally charged.

Construction Specifications

The construction of temporary rock silt checks is of the utmost importance in that they are designed to slow down and therefore pond water on the upstream side. This creates hydraulic pressure and water will try to get over, under, around and/or through the check.

A rule of thumb for placing checks is that they are placed where the base of the upstream dam is not higher than the top of the downstream dam.

Structural Stone	• Use Class B structural stone. • Install stone at a minimum depth of 12 inches. • Install sediment control stone on the up gradient face of the structural stone.
Side Slopes	• 2:1 or flatter
Weir	• Weir length should be 2/3 of the channel width. • The weir height shall be a minimum of 1 foot. • The depth of the weir shall be a minimum of 1 foot.
Matting	• Install over sediment control stone on the up gradient side of the TRSC-A. • Anchor excelsior section at top and bottom with Class B stone.
Flocculant	• Prior to the flocculant application, obtain a soil sample from the project location, and from the off-site material, and analyze for appropriate flocculant to be applied to each rock silt check. • Initially apply 4 ounces of flocculant to the face of the excelsior and also after every rainfall event that equals or exceeds 0.50 inches. • Flocculant used should be listed on the NCDENR DWR website as an approved product for use in North Carolina

4.5.3 Temporary Rock Silt Check - Type A with Excelsior Matting and Flocculant

It is important that the water be directed where it will not cause additional erosion under or around the sides of the check. For this reason, the weir must be properly sized and built. No value is received from stone that is placed on the sides higher than the expected high water elevation.

Technician's Checklist

- Build checks at the frequency shown in the Erosion and Sediment Control Plans.
- Install weir sections to allow water to flow over the stone, not around it.
- Construct the elevation of the weir 1-foot lower than the elevation where the stone ties into the ditch banks.
- Flocculant should be reapplied after rainfall events equal to or exceeding 0.5 inches.
- Install a silt basin, if needed, up gradient of the check.
- Once the checks shown on the plans are installed, determine if there are a sufficient number to keep the velocity of the water low enough to minimize erosion of the ditch.
- Keep the checks clean.

Measurement & Payment

When the silt is removed from in front of the check, it is paid for as "Silt Excavation." There is no additional pay for maintaining or removing the device.

Pay Item:	Pay Unit:
Stone for Erosion Control, Class B	**Ton**
Sediment Control Stone, Standard Size No. 5 or No. 57	**Ton**
Silt Excavation	**Cubic Yard**
Matting for Erosion Control	**Square Yard**
Flocculant	**Pound**

4.5.3 Temporary Rock Silt Check - Type A with Excelsior Matting and Flocculant

Maintenance

It is important that the checks be kept clean and allow the water to flow through the stone because they are intended to pond water for only a short period of time. These checks can become clogged with silt, straw, grass clippings and other items.

It is not proper, when maintaining the device, to just add stone to the face of the clogged device instead of cleaning the existing stone. The clog will remain if not cleaned.

- Inspect the device after each significant rainfall.
- At a minimum, remove silt from the device when silt accumulates to one-half the height of the weir.
- Replace or clean sediment control stone when water no longer drains through the device between rainfall events.
- Rebuild and reshape rock weir and check when the device is damaged.

Device Removal

The determination to remove a rock silt check device from service should be made after considering whether there is any advantage to the division maintenance forces to leave it in place. Many times, the completed project will not become stable from an erosion control standpoint for some time, so some of the temporary devices may need to be left in place and removed by Department forces at a later date. If the device is to be left on the project after its completion, the device must be clean and in proper shape at the time of the final inspection. If it is to be removed, all accumulated silt should be removed and the area dressed and seeded.

Typical Problems

- Silt accumulation is not removed when needed.
- Rock structure is not rebuilt when damaged by storms and equipment.
- Rock structure and weir are not constructed to specifications.
- Rock structure is constructed higher than the drainage ditch causing water to flow around the measure and erode the ditch.
- Rock structure is not built wide enough to intercept the ditch slope at the top of the TRSC-A.
- Improper maintenance can limit the wattle's effectiveness to reduce velocity and distribute flocculant in runoff.

4.5.4 Temporary Rock Silt Check - Type B (1633.02)

Practical Tips

- A rule of thumb for placing Type B Temporary Rock Silt Checks is to place them where the base of the upstream dam is not higher than the top of the downstream dam.

Definition

A Temporary Rock Silt Check Type - B (TRSC-B), also referred to as a check dam, is a small dam with a distinguishable weir. The primary purpose of this device is to reduce erosion in a drainage ditch by restricting the velocity of flow in the channel. They are constructed of Class B stone and typically used in ditches during construction where the grade meets or exceeds 2.5%.

Areas of Use

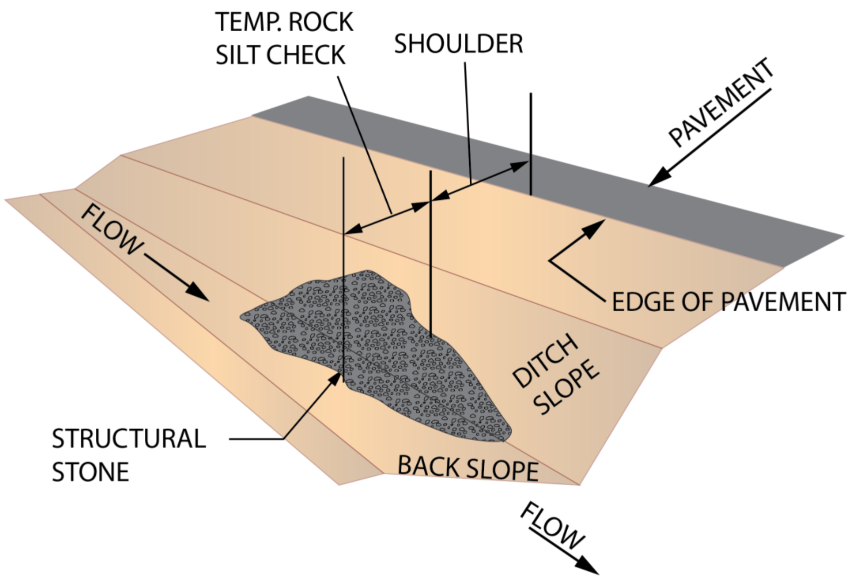
Install TRSC-B's in drainage ditches to reduce runoff velocity. TRSC-B's can be applied at the following:

- In channels, roadside ditches, temporary silt ditches and temporary diversions
- In temporary channels that are susceptible to erosion but where permanent stabilization is impractical due to their limited duration of use
- In eroding channels where construction delays or weather conditions prevent timely installation of non-erosive liners
- In conjunction with Type B silt basin

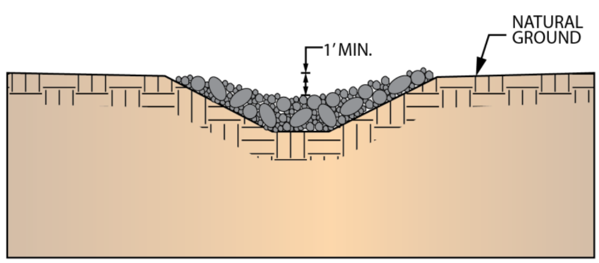
Design Criteria

- The drainage area shall be limited to ½ acre or less to each TRSC-B in a ditch line.
- TRSC-B spacing should be (2.5 ÷ % of ditch grade) x 100 feet.

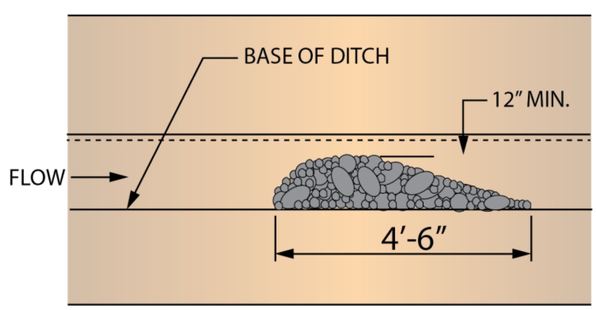
4.5.4 Temporary Rock Silt Check - Type B (1633.02)



ISOMETRIC VIEW



CROSS SECTION TRAPEZOIDAL DITCH



ELEVATION VIEW

4.5.4 Temporary Rock Silt Check - Type B (1633.02)

Material Specifications

- Structural stone shall be Class B stone that meets the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class B.

Make sure the weir is properly constructed and positioned so that water flow will be directed where it will not cause additional erosion under or around the sides of the check.

Construction Specifications

Installation	• The center of the rock silt check shall be at least 1-foot lower than the outer edges (top of the channel sides). • The maximum height at the center of the rock check should not exceed 2 feet. • The side slopes of the check shall be 2:1 or flatter.
Slope	• Maximum spacing between the checks should place the toe of the upstream check at the top of the downstream check.

Technician's Checklist

- Build checks at the location shown in the Erosion and Sediment Control plans.
- Install weir sections to permit water to flow over the stone, not around it.
- Construct the elevation of the top of device lower than the elevation where the stone ties into the ditch banks.
- Install a silt basin, if needed, just upstream of the check.
- Once the checks are installed as shown on the plans, determine if there are a sufficient number to keep the velocity of the runoff low enough to minimize erosion of the ditch.
- Keep the checks clean.

Measurement & Payment

When the silt is removed from in front of the check, it is paid for as "Silt Excavation." There is no additional pay for maintaining or removing the device.

Pay Items	Pay Units
Stone for Erosion Control Class B	**Ton**
Silt Excavation	**Cubic Yard**

4.5.4 Temporary Rock Silt Check - Type B (1633.02)

Maintenance

It is important that these checks be kept clean and allow the water to flow through the stone because they are designed to pond water for only a short period of time. These checks can become plugged with silt, straw, grass clippings and other items. It is not appropriate to add stone to the face of a plugged check instead of cleaning the existing stone. The clog will remain.

- Inspect rock check after each significant rainfall
- Remove silt from device when it accumulates
- Rebuild and reshape device and weir when damaged or as necessary
- Cleanout when clogged by straw, limbs or other debris

Consider whether there is any advantage to leaving the rock check in place permanently before removing it.

Device Removal

Often, a completed project will not become stable from an erosion control standpoint for some time, so some of the temporary devices may need to be left in place and removed by Department forces at a later date. If the device is left on the project after its completion, the device must be clean and in proper shape at the time of the final inspection. If it is removed, all accumulated silt should be removed and the area dressed and seeded.

Typical Problems

- Rock silt check is not rebuilt when damaged by storms, equipment, etc.
- Rock silt check and weir section not constructed properly
- Rock silt checks are not constructed higher than drainage ditch, causing water to flow around the measure allowing erosion of the channel
- Rock silt checks not built wide enough to intercept ditch slope at top of rock check
- Maintenance not performed in a timely manner, allowing the buildup of silt accumulation and debris that makes the rock silt check ineffective
- Improper spacing allows velocity to build and erode channel

4.5.5 Clean Water Diversion

→ CWD →

Practical Tips

- Clean water diversions are used to direct water flowing from off site around or away from a specific area of construction.
- These are also used to reduce the size of drainage areas.

Definition

A clean water diversion is a conveyance system that is used to intercept sheet flow up gradient of a project site, transport it around the construction site and discharge it in a manner that minimizes water quality and environmental impacts.

Areas of Use

Install clean water diversions in the following locations:

- For isolating construction activities near water bodies, such as streambank stabilization, culvert or bridge installation
- In locations outside of cut and fill areas
- In areas parallel to the right-of-way

Velocity Control:

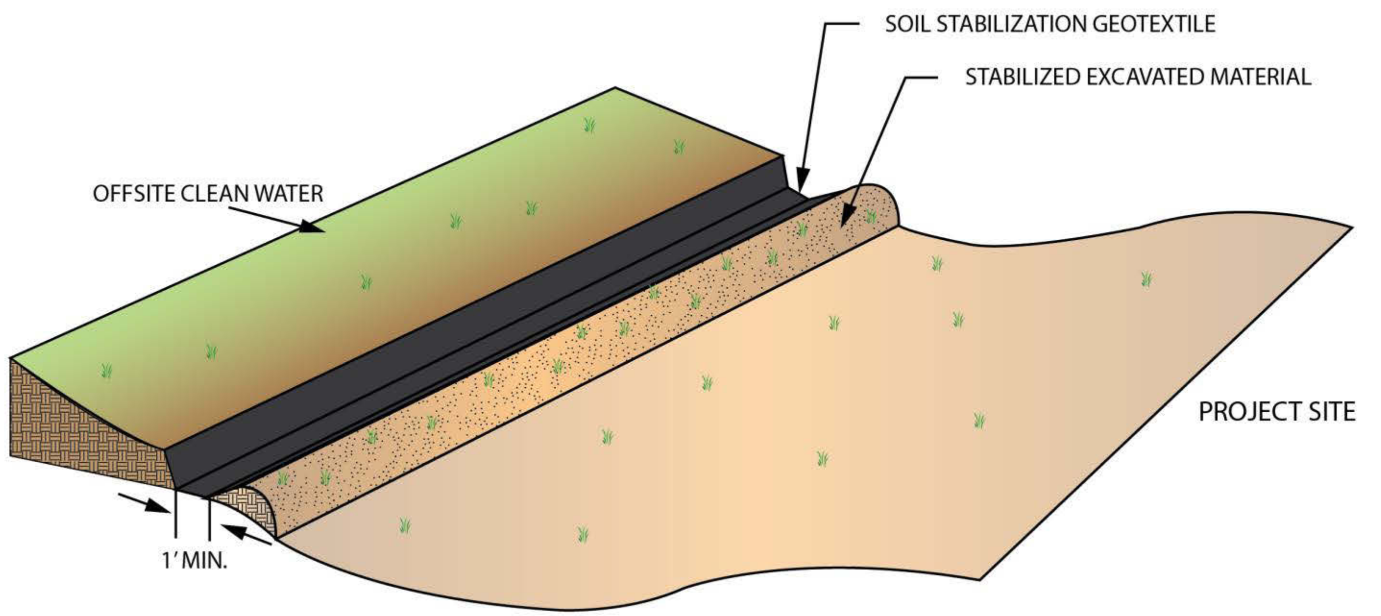
- Place Type B rock silt checks every 2 feet of elevation change
- Do not use wattles
- Utilize temporary piping for terrain greater than 8%
- Place Temporary Rock Silt Check Type A at outlets

4.5.5 Clean Water Diversion

CWD

Design Criteria

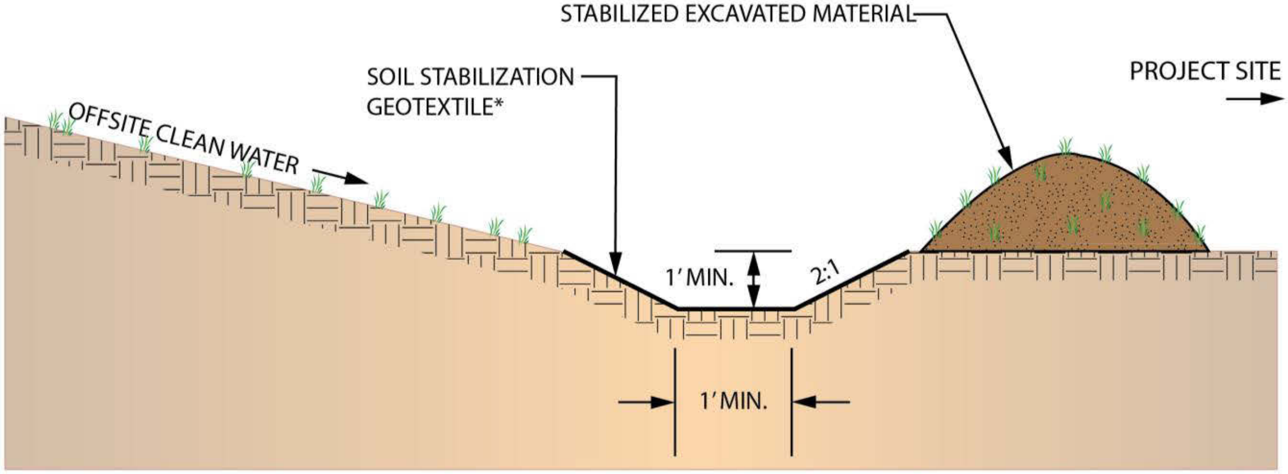
- Clean water diversions are used on clearing and grubbing and final grade phases of erosion and sediment control plans.
- The grade should be limited to prevent erosive velocities.
- The capacity of the clean water diversion should accommodate the peak runoff from a 10-year storm.
- The liner for the diversion should be designed to stabilize erosive forces.
- Devices utilizing flocculant should not be designed with clean water diversions.



ISOMETRIC VIEW

4.5.5 Clean Water Diversion

CWD



CROSS SECTION (NOT TO SCALE)

** Geotextile fabric should extend up and over the inside face of the berm for projects with jurisdictional trout waters.*

Material Specifications

- Silt excavation shall meet the requirements of Section 1630-3 of the Standard Specifications.
- The geotextile shall meet the requirements of Section 1056 of the Standard Specifications for Type 4 Geotextile.
- Proper geotextile certifications are required to meet Section 1056 of the Standard Specifications.
- Stabilization of the excavated materials shall meet the requirements of Section 1620 of the Standard Specifications.

4.5.5 Clean Water Diversion

CWD

Construction Specifications

Geotextile	• **Line the clean water diversion with geotextile unrolled in the direction of flow.** • **Overlap the geotextile a minimum of 18 inches longitudinally (parallel to direction of flow) on the upgradient and downgradient ends.** • **Lay the geotextile smoothly but loosely on the soil surface without creases.** • **Bury the geotextile edges in a trench (parallel to direction of flow) a minimum of 5-inches deep and tamped securely.** • **Secure the geotextile with 11 gauge wire staples. Staples shall be U-shaped with a minimum length of 6 inches and a minimum throat width of 1 inch.** • **Place staples along the outer edges and throughout the geotextile at a maximum of 3 feet laterally and longitudinally.**
Excavated Material	• **Excavated material should be immediately stabilized.**

Technician's Checklist

- The clean water diversion should be installed in accordance with the Erosion and Sediment Control plans.
- In order for the clean water diversion to be effective, it is essential to verify that the geotextile is keyed in at the edges in an excavated trench.
- In addition to the geotextile being buried, it should be installed with the up gradient geotextile overlapping the downstream geotextile longitudinally by a minimum of 18 inches.
- The geotextile should be inspected for sediment accumulation and damage on a regular basis and after significant rain events.

Do NOT install wattles in a clean water diversion.

4.5.5 Clean Water Diversion

CWD

Measurement & Payment

When the accumulated silt is removed along the clean water diversion, it is paid for as "Silt Excavation." The pay items and payment listed are considered full compensation for the work, including all materials, construction, maintenance and removal of the clean water diversions.

Pay Items	Pay Units
Geotextile for Soil Stabilization, Type 4	Square Yard
Silt Excavation	Cubic Yard
Seed for Temporary Seeding	Pound
Fertilizer for Temporary Seeding	Ton
Seeding and Mulching	Acre

Maintenance

- Inspect the clean water diversion on a regular basis and after each significant rainfall. Make any repairs immediately.
- Confirm that the geotextile is keyed in properly.
- Remove and dispose of all silt accumulations.
- Dispose of sediment by hauling it to an approved waste site with appropriate perimeter protection.
- Remove and replace deteriorated geotextile as needed.

In order for the clean water diversion to be effective, it is essential to verify that the geotextile is buried in an excavated trench.

Typical Problems

- The device is installed improperly (the bottom of geotextile is not keyed in at the edges properly).
- Silt accumulates excessively and geotextile becomes impacted with sediment and other debris.
- The device is disturbed by fallen trees, rocks, equipment, excess water flows or for work access.
- Insufficient velocity controls and the outlet measure is overwhelmed by runoff and fails.

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4.6 Section

Drainage System Protection

Drainage systems convey concentrated flow from the project site. These systems are vulnerable to sedimentation and can allow sediment to leave the project site unnoticed, but also offer opportunities to trap sediment. Drop and pipe inlets require additional attention to filter sediment from the stormwater before it enters these systems. Ditches also require measures to reduce stormwater velocity and filter sediment.

Drainage system protection provides opportunities for the designers, technicians and contractors to protect locations in the drainage system that have the potential to trap sediment. BMPs in this section are designed to also reduce runoff velocity of the stormwater.

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Erosion & Sediment CONTROL MANUAL

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

Practical Tips

- RIST-A's are used in areas of high flow.
- RIST-B's are used in areas of moderate flow.
- RIST-C's are used in areas of low to moderate flow.

Definition

Rock Inlet Sediment Traps (RIST) are devices constructed around the outside perimeter of inlets to provide sediment protection for the water flowing to the inlet. There are three different types of Rock Inlet Sediment Traps: Types A, B and C. Varying in sizes, Types A and B are doughnut-shaped stone dam devices constructed with a sediment stone storage area as well as a structural area of stone around the perimeter of the inlet. Type C is a hardware cloth device that also includes a smaller doughnut-shaped or rectangular-shaped stone dam structure.

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

Areas of Use

Rock Inlet Sediment Trap - Type A (RIST- A)

- At drop inlets that have a large drainage area
- At drop inlets that receive high velocity water flow
- At drop inlets that receive heavy water flow from one or multiple directions
- At least 30 feet from a maintained vehicular travel lane, in order to prevent a safety hazard in newly constructed medians and ditches

Large stone size could pose a traffic hazard. Choose the device type with the proper stone size when placing rock inlet sediment traps near traffic.

Rock Inlet Sediment Trap - Type B (RIST- B)

- At drop inlets where an RIST-A would be unsafe due to adjacent traffic
- At drop inlets that receive moderate to heavy flow from one or multiple directions
- At drop inlets where flow velocities are too high for an RIST-C
- Around catch basins in curb and gutter sections
- In urban areas and on widening projects
- Where there is no minimum offset distance from travel lane

Rock Inlet Sediment Trap - Type C (RIST- C)

- At drop inlets that receive light to moderate flow from one or multiple directions
- At drop inlet locations where flow is low enough that a RIST-B is not required
- Around catch basins in curb and gutter sections
- In urban areas with clearing and grubbing
- On widening projects
- For fill slope drainage inlets at shoulder break points

The actual conditions which occur during construction of the project will determine the number of RISTs installed.

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

Design Criteria

Type A

- If the drainage area exceeds 1 acre, then a Silt Basin - Type B is needed in conjunction with the RIST-A.
- The stone dam should be a minimum of 2-feet high.
- The top elevation of the RIST-A shall be a minimum of 12-inches lower than the ground elevation that would allow bypass.
- Because of the stone dam, the RIST-A should be placed at locations that will not create a safety hazard.

Type B

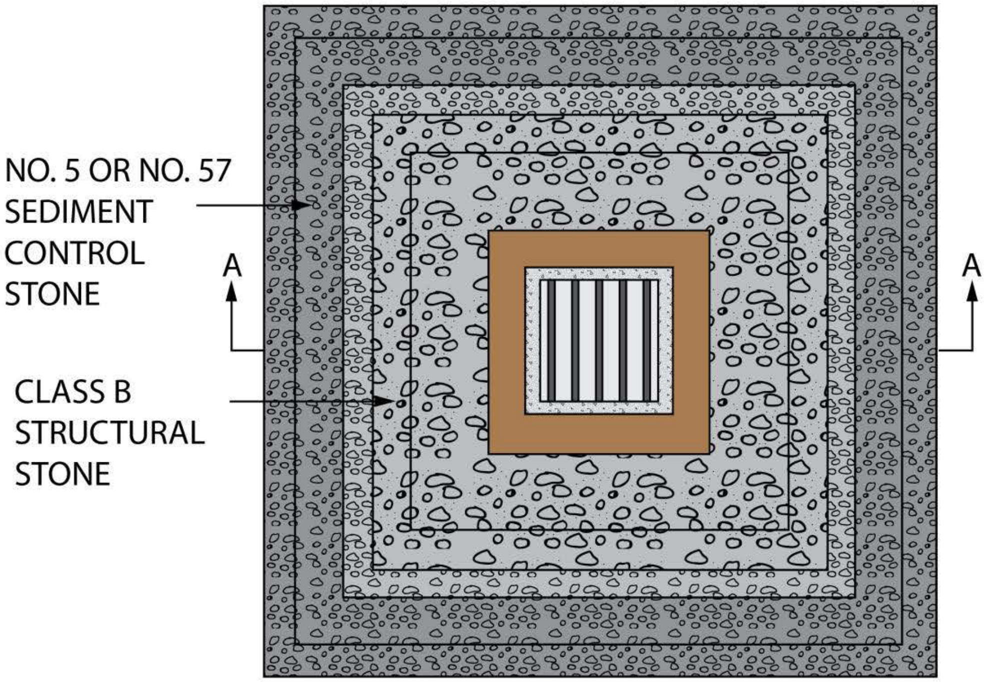
- If the drainage area exceeds 1 acre, then a Silt Basin - Type B is needed in conjunction with the RIST-B.
- The stone dam should be a minimum of 1.5-feet high.
- The top elevation of the RIST-B should be a minimum of 12-inches lower than the ground elevation downslope from the inlet.

Type C

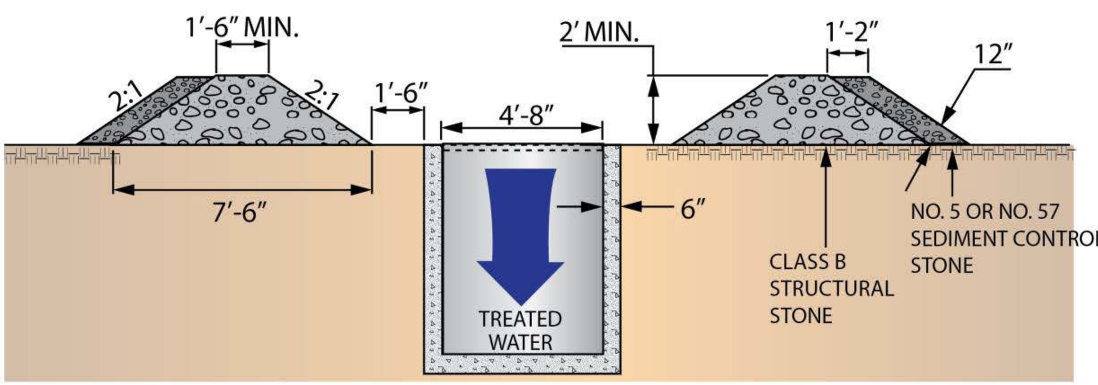
- The drainage area should not exceed more than 1 acre.
- The stone height should be 1 foot.
- Flow velocities should be low.
- The device uses hardware cloth with a small doughnut-shaped stone structure at the base.

Types A, B and C can be modified to accommodate a drop inlet receiving water from only one direction. For Types A, B and C, a silt basin can be constructed up gradient to the device to increase the sediment storage capacity when the drop inlet is in a ditch location.

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)



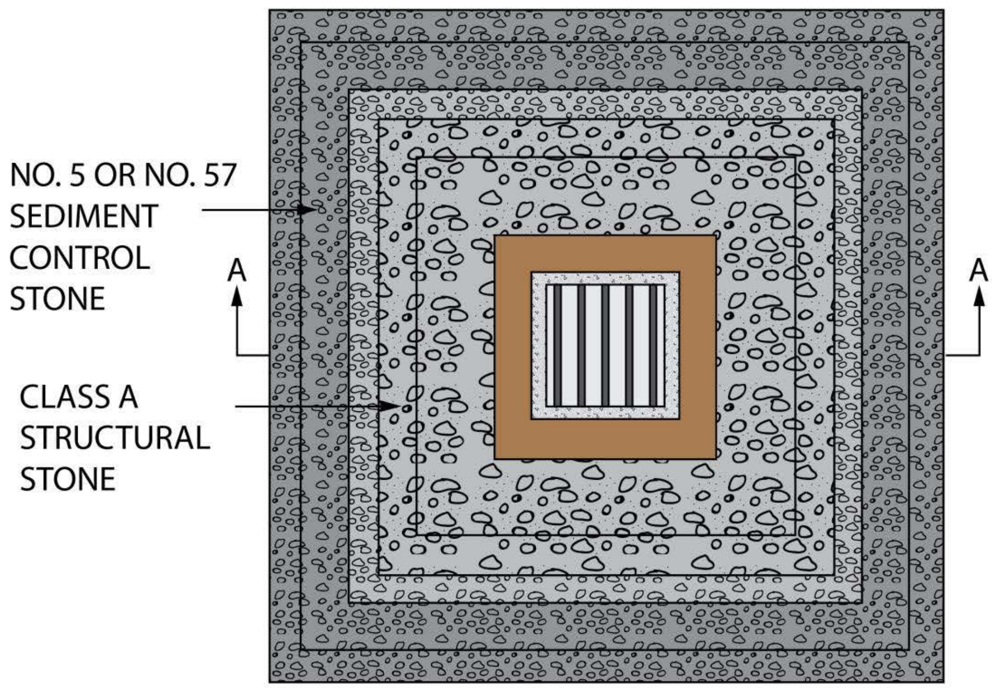
PLAN VIEW - TYPE A



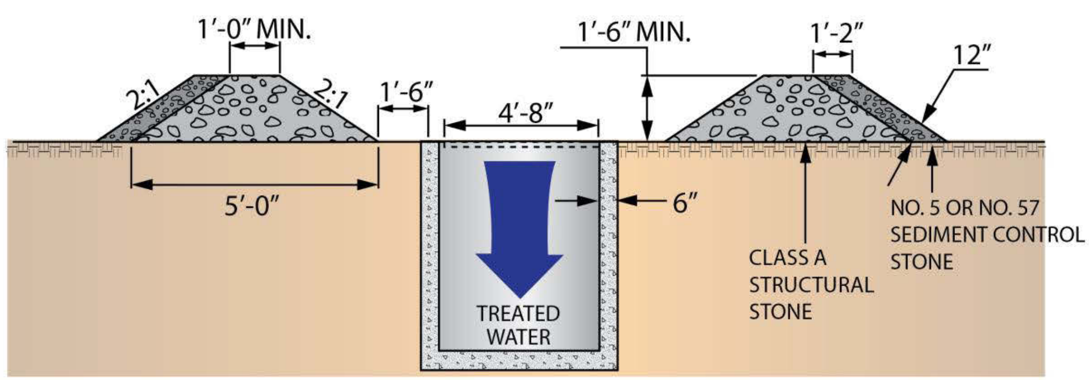
CROSS SECTION A-A - TYPE A

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

B



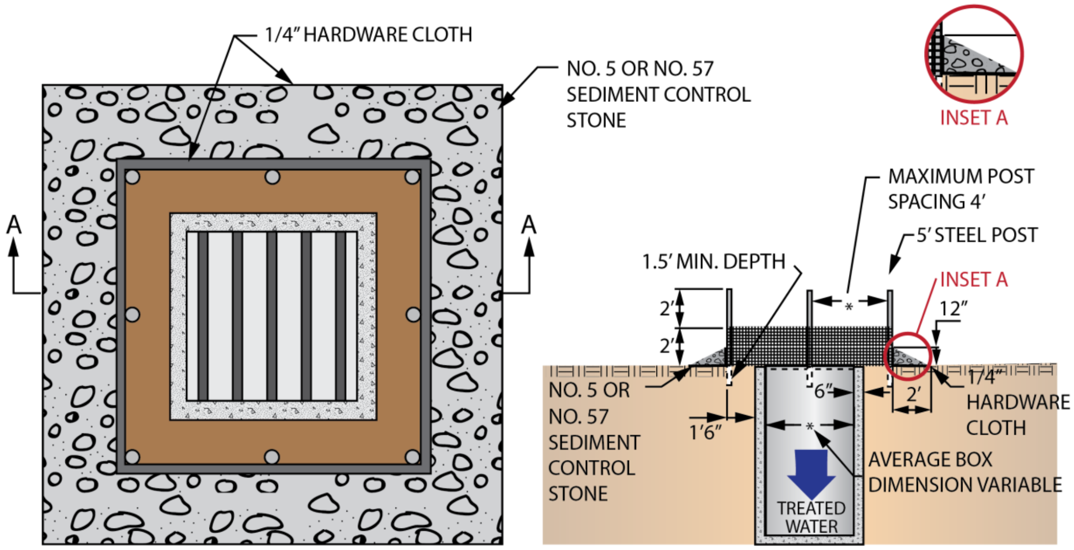
PLAN VIEW - TYPE B



CROSS SECTION A-A - TYPE B

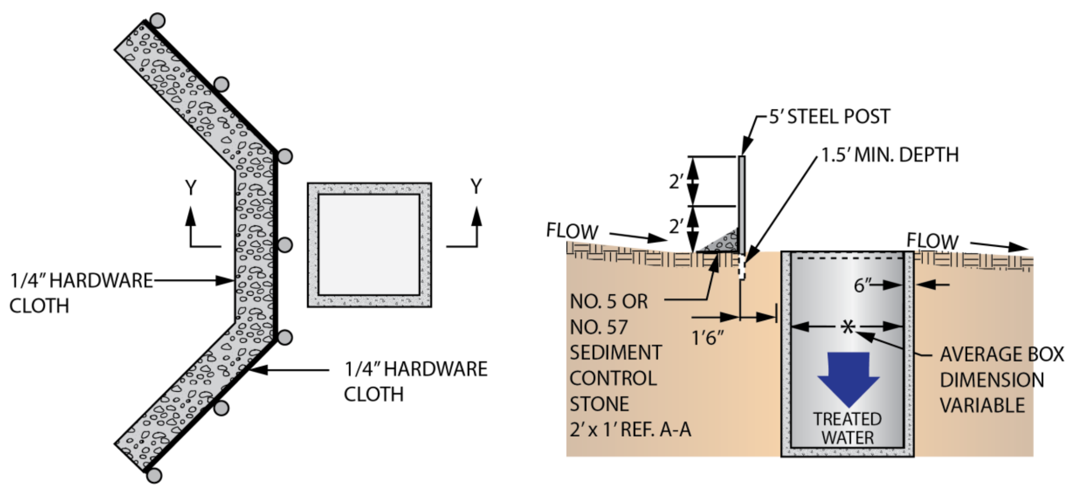
4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

C



MULTI-DIRECTIONAL FLOW
PLAN VIEW - TYPE C

CROSS SECTION A-A



SINGLE-DIRECTIONAL FLOW
PLAN VIEW - TYPE C

CROSS SECTION Y-Y

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

A, B, C

Material Specifications

Type A

Structural Stone	• Use Class B structural stone. • Meet the requirements of Section 1042 of Standard Specifications for Stone for Erosion Control, Class B.
Sediment Control Stone	• Use No. 5 or No. 57 stone. • Meet the requirements of Section 1005 of the Standard Specifications for stone sizes.

Type B

Structural Stone	• Use Class A structural stone. • Meet the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class A.
Sediment Control Stone	• Use No. 5 or No. 57 stone. • Meet the requirements of Section 1005 of the Standard Specifications for stone sizes.

Type C

Hardware Cloth	• Use a wire mesh with ¼-inch openings. • Use 24-gauge wire, at a minimum. • Use a minimum width of 24 inches. • Meet the requirements of Section 1632-2 of the Standard Specifications.
Steel Posts	• Use a minimum of 5-foot long posts. • Use 1 $^{3}/_{8}$-inchs wide posts on the face parallel to the hardware cloth. • Use self-fastener angle steel type posts. • Meet the requirements of Section 1632-2(A) of the Standard Specifications.
Staples	• Use No. 9 wire staples with at least 1 ½-inches length or another approved attachment device.
Sediment Control Stone	• Use No. 5 or No. 57 stone. • Meet the requirements of Section 1005 of the Standard Specifications for stone sizes.

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

A, B, C

Construction Specifications

Type A

Spacing	• **1.5 feet of space required from the inside edge of the stone dam to the edge of the inlet** • **Top of berm should be a minimum of 1-foot below the shoulder or any diversion point**
Sediment Control Stone	• **No. 5 or No. 57 stone to be installed on the outer face of the stone dam in a layer 1-foot thick**
Structural Stone	• **Class B stone installed in a doughnut-shaped ring around the inlet** • **Installed with a 1.5-foot wide berm on the top and a minimum height of 2 feet**

Place the structural stone, Class B, around the outside perimeter of the inlet with approximately 2:1 side slopes and plate the upstream side with sediment control stone.

Type B

Berm	• **1.5 feet of space required from the inside edge of the stone dam to the edge of the inlet** • **Top of berm should be a minimum of 1-foot below the shoulder or any diversion point**
Sediment Control Stone	• **No. 5 or No. 57 stone to be installed on the outer face of the stone dam in a layer 1-foot thick**
Structural Stone	• **Class A stone installed in a doughnut-shaped ring around the inlet** • **Installed with a 1-foot wide berm on the top and a height of 1.5 feet**

Place the structural stone, Class A, around the outside perimeter of the inlet with approximately 2:1 side slopes and plate the upstream side with sediment control stone.

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

A, B, C

Type C

Hardware Cloth	• **Installed at a height of 2 feet** • **Placed under the sediment control stone** • **1.5 feet of space required from the inside edge of the hardware cloth to the edge of the inlet** • **Top of hardware cloth to be installed a minimum of 1-foot below the shoulder or any diversion point**
Posts	• **Made of steel or other approved material** • **Installed a minimum of 1.5-feet deep** • **Installed with a maximum spacing of 4 feet**
Sediment Control Stone	• **Installed on the outer face of the hardware cloth to a height of 1 foot and a width of 2 feet**

Construct rock inlet devices as shown on plans and at other locations as directed. Attach hardware cloth to posts with wire staple or other acceptable methods.

Technician's Checklist

- Verify the proper type of rock inlet sediment trap is used.
- Maintain the device during the drainage structure construction.
- Keep the sediment stone clean and free of debris.
- Check to make sure that water is not impounded by a clogged device or flowing into travel lanes.
- Remove RISTs as the project nears completion or as directed.
- Dress the area to blend with existing contours, and seed and mulch the area.

A clogged RIST can quickly impound water. The device should be free of debris and water should flow through, not around, the device in order to function properly.

Measurement & Payment

Pay Items Type A	Pay Units
Stone for Erosion Control, Class B	**Ton**
Sediment Control Stone	**Ton**
Silt Excavation	**Cubic Yard**

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

A, B, C

Pay Items Type B	Pay Units
Stone for Erosion Control, Class A	**Ton**
Sediment Control Stone	**Ton**
Silt Excavation	**Cubic Yard**

Pay Items Type C	Pay Units
¼-inch Hardware Cloth	**Linear Foot**
Sediment Control Stone	**Ton**
Silt Excavation	**Cubic Yard**

Maintenance

- Inspect the device after each significant rainfall event for damage, sediment accumulation and proper function.
- Remove sediment from the device when accumulations reach one-half the height of the sediment control stone.
- Replace or clean the sediment control stone as needed to allow water to drain through the device between rainfall events.
- Rebuild and/or repair the device when it is damaged.
- If the device is to remain after project completion, it should be clean and in proper shape at the time of final inspection. If it is removed, all accumulated silt should be removed to keep it from entering the drainage system.

Typical Problems

- Sediment accumulations are not removed in a timely fashion, causing sediment to be released into the storm drain system.
- Sediment control stone is not cleaned and becomes clogged, preventing proper drainage.
- The device is not rebuilt or repaired when damaged by storms and equipment.
- The device is not built wide enough to prevent water from washing around the device. Water should always flow through or over the device, not around.

4.6.1 Rock Inlet Sediment Trap - Types A, B and C (1632.01, 1632.02, 1632.03)

A, B, C

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4.6.2 Rock Pipe Inlet Sediment Trap Types A and B (1635.01 & 1635.02)

Practical Tips

- Water should flow through the stone and not around the device.
- To function properly, the device needs to be clear of debris.

Definition

Rock Pipe Inlet Sediment Traps (PIST) are horseshoe-shaped devices with built-in sediment storage areas that are placed around the outside perimeter of pipe inlets to provide sediment containment and protection for the water flowing to the pipe inlet. There are two different types of Rock Pipe Inlet Sediment Traps: Types A and B.

Areas of Use

Rock Pipe Inlet Sediment Trap - Type A (PIST-A)

- At pipe inlets no larger than 36 inches in diameter where flow is received from several directions
- At least 30 feet from a vehicular travel lane in order to prevent a safety hazard in order to provide a clear recovery zone for motorists
- In areas where a BMP can be cleaned and maintained on a regular basis

Rock PISTs reduce water velocity and provide sediment storage.

Rock Pipe Inlet Sediment Trap - Type B (PIST-B)

- At pipe inlets no larger than 24 inches in diameter where flow is received from several directions
- At locations where a PIST-A would be unsafe due to adjacent traffic
- In areas where a BMP can be cleaned and maintained on a regular basis

4.6.2 Rock Pipe Inlet Sediment Trap Types A and B (1635.01 & 1635.02)

Design Criteria

Type A

Do NOT place PIST-A at outlets with greater than 1 acre of drainage area.

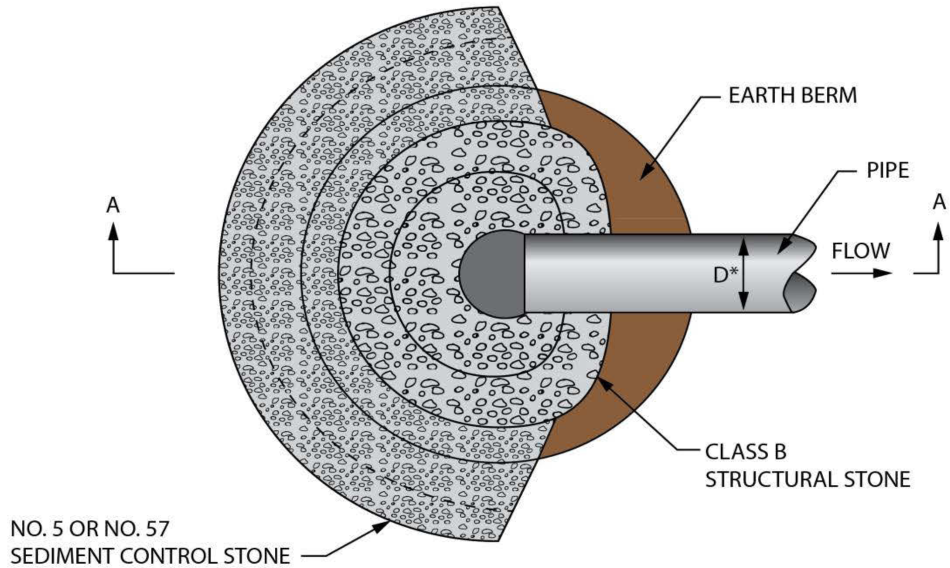
- The drainage area should not exceed 5 acres.
- The sediment basin should provide a storage volume of 3,600 cubic feet per acre of disturbed area and a surface area of 435 square feet per cfs of Q_{10} or Q_{25} peak inflow.
- The stone dam should be a minimum of 18 inches high.
- The top of the PIST-A shall be a minimum of 1 foot below the top of the fill over the pipe.
- To provide additional storage volume, additional erosion and sediment control measures may be installed up or down gradient to meet the volume requirements.
- Because of the larger size of the Class B stone, the PIST-A should be placed at locations that will not create a safety hazard to traffic.

Type B

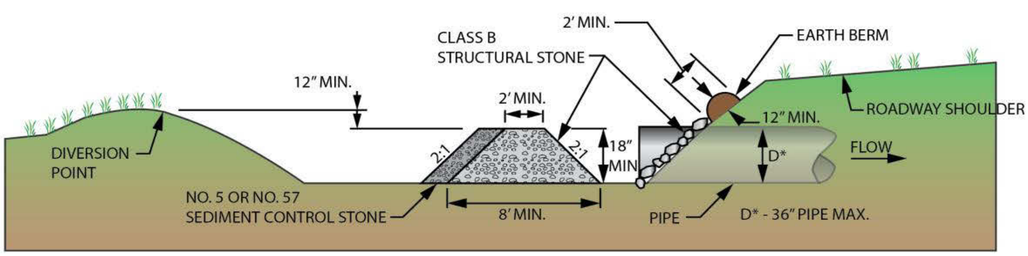
- The drainage area should not exceed 1 acre.
- The sediment trap should provide a storage volume of 3,600 cubic feet per acre of disturbed area and a surface area of 435 square feet per cfs of Q_{10} or Q_{25} peak inflow.
- The stone dam should be a minimum of 18 inches high.
- The top shall be a minimum of 1 foot below the top of the fill over the pipe.
- Some of the required volume may be provided by up gradient or down gradient controls.

If required, a sediment storage pit may be designed for both Types A and B following the same design guidelines for a Silt Basin - Type B.

4.6.2 Rock Pipe Inlet Sediment Trap Types A and B (1635.01 & 1635.02)

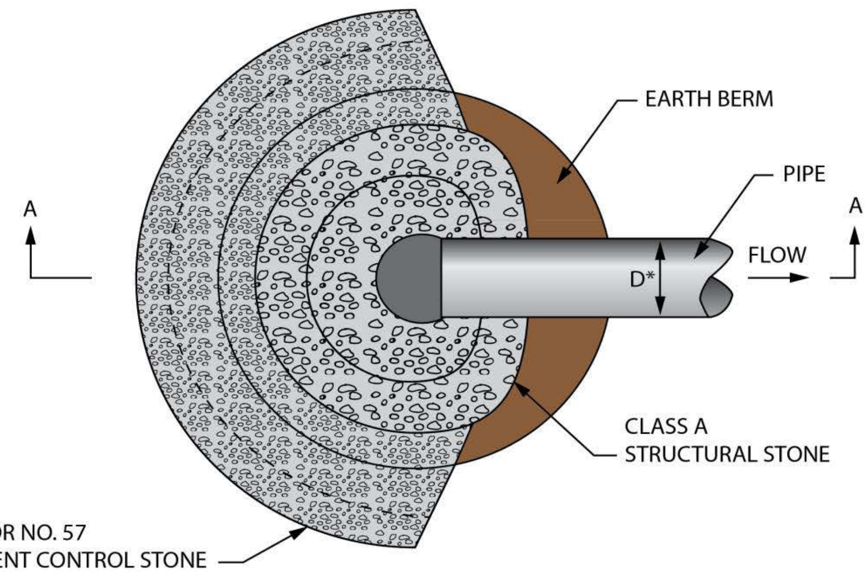


PLAN VIEW - TYPE A (NOT TO SCALE)

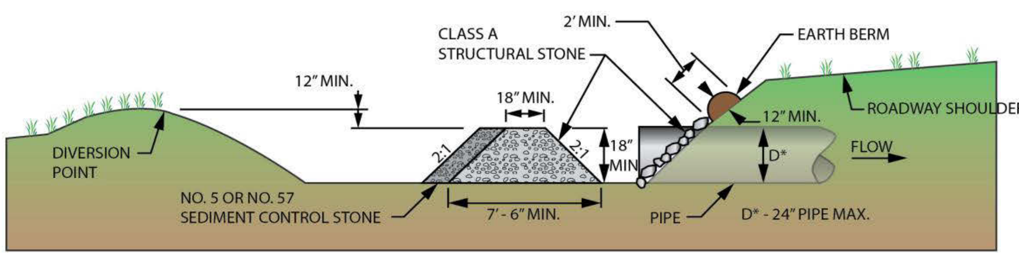


CROSS SECTION A-A - TYPE A (NOT TO SCALE)

4.6.2 Rock Pipe Inlet Sediment Trap Types A and B (1635.01 & 1635.02)



PLAN VIEW - TYPE B (NOT TO SCALE)



CROSS SECTION A-A - TYPE B (NOT TO SCALE)

4.6.2 Rock Pipe Inlet Sediment Trap Types A and B (1635.01 & 1635.02)

A B

Material Specifications

Type A

Structural Stone	• Use Class B structural stone. • Meet the requirements of Section 1042 of Standard Specifications for Stone for Erosion Control, Class B.
Sediment Control Stone	• Use No. 5 or No. 57 stone. • Meet the requirements of section 1005 of the Standard Specifications for stone sizes.

Type B

Structural Stone	• Use Class A structural stone. • Meet the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class A.
Sediment Control Stone	• Use No. 5 or No. 57 stone. • Meet the requirements of Section 1005 of the Standard Specifications for stone sizes.

Construction Specifications

Type A

Berm	• Top of the berm should be a minimum of 12 inches below the roadway shoulder or any diversion point • Side slopes should be no steeper than 2:1 • Berm should have a minimum height of 18 inches
Sediment Control Stone	• No. 5 or No. 57 stone should be installed on the outer face of the stone dam in a layer 1-foot thick
Structural Stone	• Class B stone should be installed in a horseshoe-shaped ring around the inlet • Stone should be installed with a berm at the top that is 2-feet wide • Stone should have an 8-foot minimum base width

4.6.2 Rock Pipe Inlet Sediment Trap Types A and B (1635.01 & 1635.02)

Type B

Berm	• **Top of the berm should be a minimum of 12 inches below the shoulder or any diversion point** • **Side slopes should be no steeper than 2:1** • **Berm should have a minimum height of 18 inches**
Sediment Control Stone	• **No. 5 or No. 57 stone should be installed on the outer face of the stone dam in a layer 1-foot thick**
Structural Stone	• **Class A stone should be installed in a doughnut-shaped ring around the inlet** • **Installed with a berm on the top that is 18-inches wide.** • **Stone should have a minimum base width of 7.5 feet.**

Technician's Checklist

- Match the trap type and the pipe size requirements for each type of device.
- The purpose of the open area in front of the pipe where there is no stone is to allow clean out of the device when necessary. Construct the device so the open area is large enough that clean out can be done by equipment on the project.
- Clean sediment from the upgradient side of the device as necessary so the device will function properly.
- Maintain a sufficient area between the pipe and the trap to allow for cleaning.
- On both Type A and B PISTs, tie the stone into slopes to prevent water from bypassing the device. Construct the earth berm on the slope above the pipe inlet between the stone and tie in to the slope
- Carry the stone stabilization on the slope to a height above the top of the pipe and at least as high as the top of the trap. Water should flow over the trap before it will wash between the trap stone and slope. Water should rise and fall along the slope and not flow along it.
- Remove Rock Pipe Inlet Sediment Traps as the project nears completion or as directed.
- Dress the area to blend with existing contours, and seed and mulch the area.

Measurement & Payment

Pay Items Type A	Pay Units
Stone for Erosion Control, Class B	**Ton**
Sediment Control Stone	**Ton**
Silt Excavation	**Cubic Yard**

4.6.2 Rock Pipe Inlet Sediment Trap Types A and B (1635.01 & 1635.02)

A B

Pay Items Type B	Pay Units
Stone for Erosion Control, Class A	**Ton**
Sediment Control Stone	**Ton**
Silt Excavation	**Cubic Yard**

Maintenance

- Inspect the device after each significant rainfall event for damage, sediment accumulation and proper function.
- Remove sediment from the device when accumulations reach one-half the height of the basin area formed by the device.
- Replace the sediment control stone as needed to allow water to drain through the device between rainfall events.
- Clean out the device when it is clogged with debris.
- If the device is to remain on the project at the completion of construction activities, the device should be clean and in proper shape at the time of final inspection. If it is removed, all accumulated silt should be removed and the area seeded.

Typical Problems

- Silt accumulations are not removed causing silt to enter the pipe.
- The structure is not rebuilt when damaged by storms and equipment.
- The stone is not cleaned or replaced when clogged.
- The stone is not tied into slopes.

4.7 Section

Sediment Containment

Sediment containment must be considered early in the planning phase. Some of the devices in this section are used to detain stormwater runoff so that solids can settle and stormwater may then be discharged. Other devices in this section are used at outlets or stream crossings to trap sediment before the stormwater leaves a project site.

Use the following BMPs when considering measures to provide sediment containment: Riser Basin, Silt Basin - Type B, Skimmer Basin, Tiered Skimmer Basin, Infiltration Basin, Temporary Rock Sediment Dam - Types A and B, Earthen Dam with Skimmer, and Stormwater Basin with Skimmer. Coir Fiber Baffles should be planned for each sediment containment measure as appropriate.

4.7.1 Riser Basin (1630.01)

Practical Tips

- Place the riser basin outside of the roadway footprint to allow use for the duration of the project.
- Provide access for equipment to remove and dispose of sediment accumulations.

Definition

A riser basin is an earthen embankment and excavated area used to capture sediment. A riser basin prevents sediment from leaving the construction site and entering off-site jurisdictional areas or adjacent properties. A series of coir fiber baffles are used in the riser basin. A non-perforated riser pipe is used in conjunction with a skimmer for controlled dewatering, which allows sediment to settle in the basin. An emergency overflow spillway is designed to release runoff if the riser capacity is exceeded.

Areas of Use

- In large drainage areas where other erosion and sediment control devices will not be adequate due to the volume of runoff

Consider riser basins when the drainage area exceeds the 10-acre threshold and the watershed cannot be portioned out with smaller basins due to site constraints.

NCDOT ESC Erosion & Sediment CONTROL MANUAL

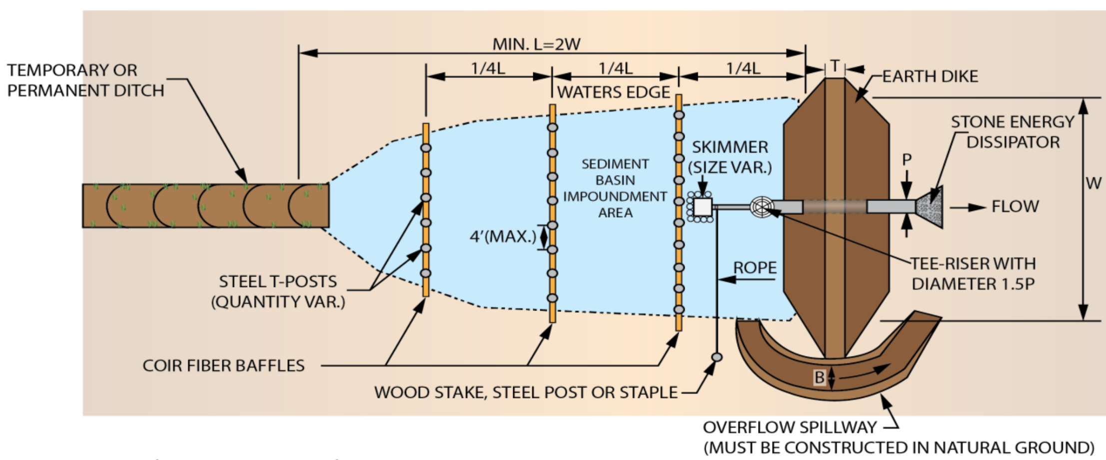
4.7.1 Riser Basin (1630.01)

Design Criteria

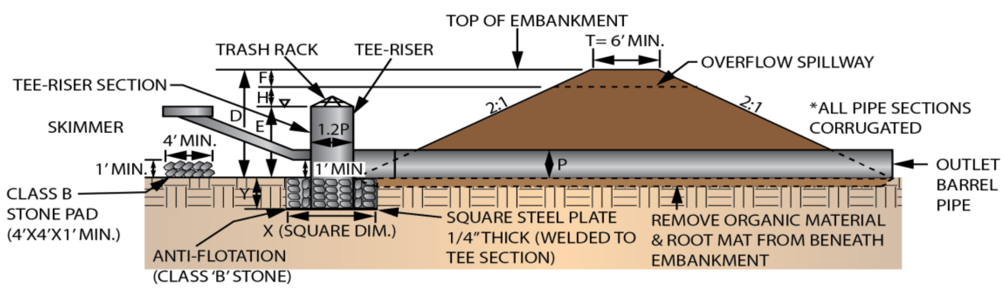
- The drainage area should not exceed 100 acres.
- The basin should be located in an area where it can be accessed and maintained for the life of the basin.
- The minimum surface area and minimum volume are measured below the top of the principal spillway (top of the riser).
- The minimum volume is 1,800 cubic feet per acre of drainage area.
- The minimum surface area is 435 square feet per cfs of Q_{10} or Q_{25} peak inflow.
- The minimum length to width ratio is 2:1 with a maximum of 6:1.
- The minimum depth is 2 feet.
- The dewatering mechanism should be a skimmer or flashboard riser.
- The minimum dewatering time is 48 hours.
- The principal spillway (riser/barrel pipe) must be able to convey the peak runoff from the 2-year storm with the water's surface at the crest elevation of the overflow spillway.
- The overflow spillway must convey the peak runoff from the design storm with a minimum of 1 foot of freeboard.
- A minimum of 3 coir fiber baffles shall be installed in the riser basin.
- The basin design life should be 3 years.

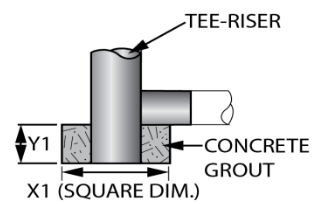
When the surface area and/or sediment storage requirement for a basin cannot be achieved, design the basin to the maximum practical length and width. Also use flocculant with devices (wattle, TRSC-A with matting) upgradient of the basin.

4.7.1 Riser Basin (1630.01)



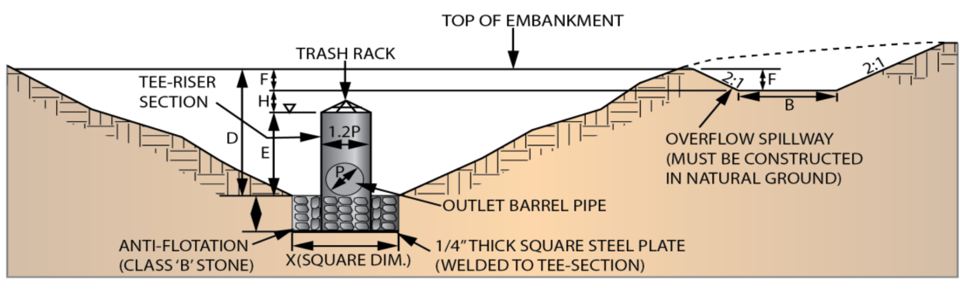
PLAN VIEW (NOT TO SCALE)

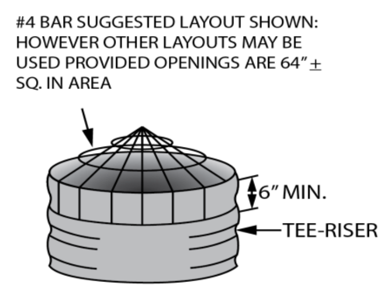




PROFILE VIEW (NOT TO SCALE)

ALTERNATE ANTI-FLOTATION METHOD





SECTIONAL VIEW (NOT TO SCALE)

TRASH RACK DETAIL

4.7.1 Riser Basin (1630.01)

Material Specifications

- The embankment should be constructed of suitable fill material.
- Stone used in the anti-flotation, stone pad and overflow spillway should meet the requirements of Section 1042 of the Standard Specifications for Plain Rip Rap, Class ___.
- The riser and barrel should be corrugated metal pipe, and in accordance with Section 310 of the Standard Specifications.
- The skimmer should meet the requirements of the Erosion and Sediment Control plans.
- Baffles should meet the requirements of Section 1640-2 of the Standard Specifications.

Construction Specifications

Riser Basin	• **Stabilize the embankment, interior slopes and surrounding areas with permanent vegetation following installation.** • **Install a minimum of 3 coir fiber baffles in the basin with a spacing of ¼ the basin length and in accordance with Section 1640 of the Standard Specifications.** • **Restrict the maximum dam height to 25 feet. Dams exceeding 25 feet in height and impounding 50 acre-feet or more become subject to the NC Dam Safety Act. (Height is measured from the top of the dam to the lowest point on the downstream toe. Volume is measured at the top of the dam.)** • **Attach the skimmer to the riser 1 foot above the bottom of the basin.** • **Restrict the minimum barrel size to 15 inches for corrugated metal pipe to reduce the potential for failure due to debris or blockages.** • **Construct the diameter of the riser to be 1.2 times that of the barrel pipe diameter.** • **Armor the overflow spillway with Class B stone as specified on the plans.** • **Use Class B stone for anti-flotation for the riser and barrel pipes.** • **Construct the earth dike along one or more sides, if needed. Excavation may be required to provide a minimum surface area and/or a minimum storage volume.** • **Construct the dike of material suitable for and meeting roadway embankment specifications.** • **To facilitate the determination of the maintenance cleanout requirement, place a marker in the basin indicating the 50% volume level.** • **Provide a stone energy dissipator pad at the outlet of the riser barrel in accordance with Roadway Standard Drawing No. 876.02 for Pipe Outlet Without Ditch.** • **Seed and place matting for erosion control on all interior and exterior slopes of the basin. Refer to the Rolled Erosion Control Products Section 4.4 for matting requirements.**

4.7.1 Riser Basin (1630.01)

It is important that the anti-flotation device is installed properly before any water flows into the basin. The riser, stone and skimmer need to be located for easy access. Construct overflow spillways to limit erosion, especially in newly constructed dikes. Fabric and stone may be required to stabilize the overflow spillway if vegetation is not established. The dike and overflow spillway must be stabilized as soon as possible.

Standard Basin Dimensions

P	H	T (MIN)	D*	E	F	B (MIN)	X (MIN)	Y (MIN)	X1 (MIN)	Y1 (MIN)
IN	FT	FT	FT	FT	FT	FT	FT	FT	FT	FT
15	1.0	6.0	6.0	4.0	1.0	3.0	2.7	1.0	2.5	1.0
18	1.0	6.0	6.5	4.5	1.0	4.0	3.5	1.0	3.2	1.0
24	1.0	6.0	8.0	6.0	1.0	8.0	5.5	1.0	5.0	1.0
30	1.0	6.0	9.5	7.0	1.5	8.0	7.6	1.0	6.9	1.0

**** Shall not exceed 12'. Refer to detail drawing.***

Technician's Checklist

- Do not change the shape or size of the basin without consulting the Engineer.
- Verify the area where the basin is to be placed is permitted for the activity.
- Verify the area where the basin is proposed will be suitable for the device. Consider soil type, water table and accessibility.
- Maintain access to the basin at all times, so that it can be cleaned as needed.
- Remove the basin at the end of the project, if required.
- Meet the requirements of the plans or Standard Drawings for the pipe, riser, anti-flotation device, sediment control stone and trash rack.
- Install the Class B stone pad beneath the skimmer location to prevent the skimmer from being buried in and clogged with sediment and debris if the water elevation becomes low.
- Compact the dam with good soil so that it can withstand the volume of water.
- Construct the overflow spillway on natural ground and stabilize immediately per plans.
- Seed and mulch the dam.

It is very important to obtain a positive seal around the pipe going through the basin's dike to the outfall. This is a weak area and will need special attention to eliminate leaks and blowouts.

4.7.1 Riser Basin (1630.01)

Measurement & Payment

Pay Items	Pay Units
Silt Excavation	Cubic Yard
Riprap, Class ____	Ton
___" x ___" x ____" C.S. Pipe Tee-Riser, ___" Thick	Each
___" CMP Outlet Pipe	Linear Foot
___" Skimmer	Each
Seed for Temporary Seeding	Pound
Fertilizer for Temporary Seeding	Ton
Coir Fiber Baffle	Linear Foot

Maintenance

- Inspect the basin and riser on a regular basis and after every significant rainfall event (1/2 inch or greater).
- Inspect the riser for proper operation. Remove debris from around the riser or the trash rack.
- Check the skimmer for proper functioning and to verify that it is not clogged with sediment.
- Make sure the vent pipe on the skimmer is turned upright.
- Inspect the barrel for seepage around the pipe at the outlet.
- Inspect the embankment, baffles, overflow spillway and outlet for erosion damage.
- At a minimum, remove sediment when the basin volume reaches 50% of the total storage volume and as needed.

Typical Problems

- The spillway and/or embankment eroded due to inadequate vegetation or side slopes being too steep.
- The elevations of the riser pipe and overflow spillway are too high in relation to the top of the dam.
- The riser has no anti-flotation measure.
- The skimmer becomes clogged with sediment or debris.
- The skimmer overturns and the vent pipe is facing the bottom of the basin and is submerged in water.
- The stone pad underneath the skimmer device gets covered with sediment and the skimmer becomes embedded in sediment at the bottom of the basin.
- The outlet protection on the barrel pipe is inadequate.
- No access is provided for cleanout.
- Material is stockpiled next to the basin without adequate erosion and sediment control measures.
- Equipment is unable to reach into the middle of the basin for silt removal.
- Safety is a concern for humans and animals.

4.7.2 Silt Basin - Type B (1630.02)

Practical Tips

- **Basins at drainage outlets or adjacent to drainage inlets should have baffles.**
- **Basins must be cleaned out in order to maintain their effectiveness.**

Definition

A Silt Basin - Type B is a temporary basin constructed to settle out and collect sediment flowing through a drainage way. The silt basin is built at the base of the ditch with its length being at least 2 times the width of the basin. The Type B basin is generally built in conjunction with temporary rock silt checks, stone inlet protection and other devices that control or slow down water flow.

Areas of Use

- In conjunction with temporary rock silt checks and other devices used in drainage ditches
- Adjacent to drainage inlets such as catch basins and drop inlets
- At drainage outlets in conjunction with coir fiber baffles and stone devices
- At pipe outlets, changes in grade, in medians and lateral ditches.

Consider the visibility of locations and safety concerns when determining the basin geometry and placement.

4.7.2 Silt Basin - Type B (1630.02)

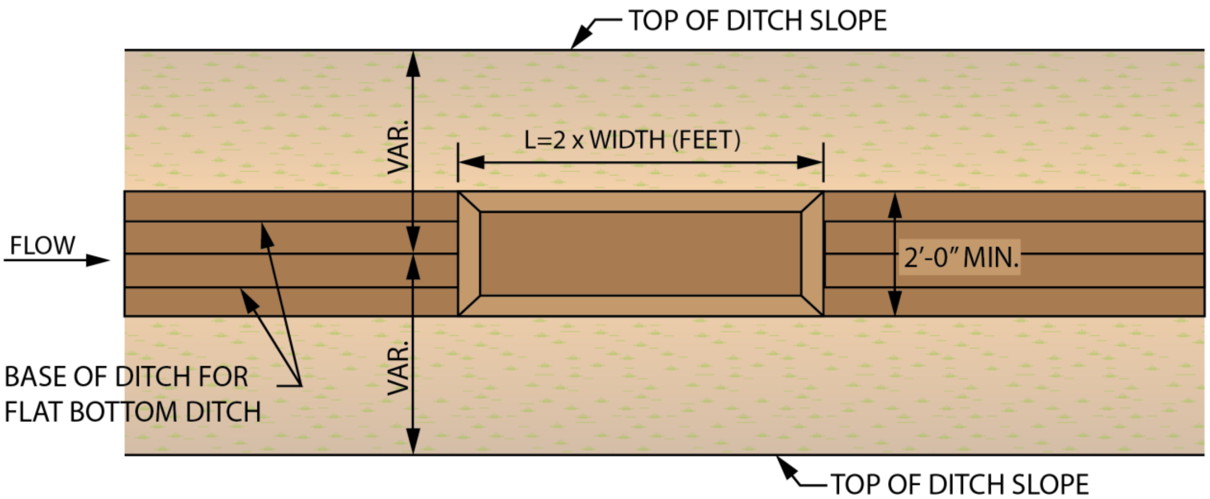
Design Criteria

- The drainage area should be 3 acres or less.
- The basin length to width ratio should be at least 2:1 but should not exceed 6:1.
- The basin depth should be at least 2 feet.
- The minimum volume should be 1,800 cubic feet per acre of disturbed area when used adjacent to drainage structures and 3,600 cubic feet per acre when used at drainage outlets in conjunction with stone devices.
- The minimum surface area should be 325 square feet per cfs of Q_{10} or Q_{25} peak inflow when used adjacent to drainage structures, and 435 square feet per cfs when used at drainage outlets in conjunction with stone devices.
- A minimum of 3 baffles should be installed in the silt basins at drainage outlet locations with a spacing of ¼ the basin length.
- For silt basins less than 20 feet in length, 2 baffles shall be installed with a spacing of 1/3 the basin length.
- If silt basin is not located at a drainage outlet, baffles are not required.

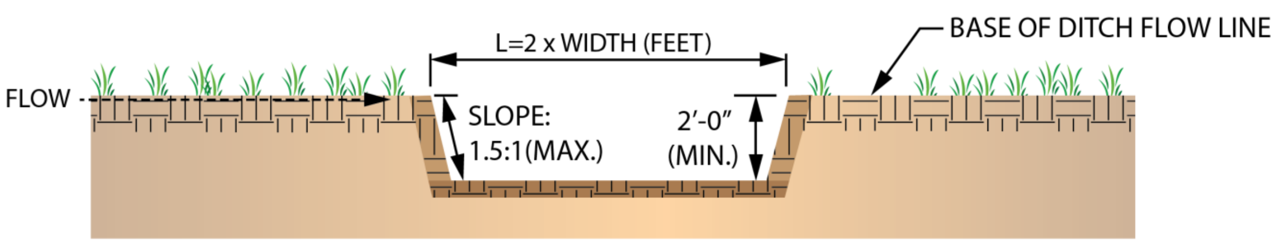
Unless permitted, don't place silt basins in riparian buffer zones or wetlands. Do not place in live streams.

Avoid placing silt basins close to homes or businesses and in areas of human safety concerns.

4.7.2 Silt Basin - Type B (1630.02)



PLAN VIEW



PROFILE VIEW

4.7.2 Silt Basin - Type B (1630.02)

Material Specifications

- Coir fiber baffles should meet the requirements of Section 1640-2 of the Standard Specifications.
- Fill material should be considered unclassified earth in accordance with Section 225 of the Standard Specifications or in Section 230 for Borrow Excavation, depending on the source of the material used to fill the basin.

Construction Specifications

Silt Basin - Type B	• **Construct basins with an excavated depth of at least 2 feet from the base of the ditch flow line.** • **Construct basins with non-vertical side slopes and not greater than 1.5:1 slope.** • **For silt basins at drainage outlets, install a minimum of 3 coir fiber baffles in the basin, with a spacing of ¼ the basin length and in accordance with Section 1640 of the Standard Specifications.** • **Install a minimum of 2 coir fiber baffles in basins with less than 20 feet of length at a spacing of 1/3 the basin length.**

Technician's Checklist

- Review permits to determine if the silt excavation is permitted as shown in the Erosion and Sediment Control Plans.
- Install the devices as shown in the Roadway Standard Drawings. Water should flow through the device, not around it.
- Monitor silt basins closely and clean out the basins on a regular basis until grass is established along the ditch line and sedimentation is no longer an issue.

The purpose of silt detention devices is to provide a surface area large enough to slow the velocity of the runoff and allow for settlement of silt.

- Perform an inspection of all erosion and sediment control features at least weekly and after each significant rainfall.
- Notify the Engineer when erosion and sediment control devices are not installed or maintained by the abatement date shown on the erosion and sediment control inspection report.
- Clean silt detention devices when they are no more than 50% full.
- Remove devices as appropriate for the next phase of construction or when the final stand of vegetation has been established.

4.7.2 Silt Basin - Type B (1630.02)

Measurement & Payment

Pay Items	Pay Units
Silt Excavation	**Cubic Yard**
Coir Fiber Baffle	**Linear Foot**

Maintenance

- Inspect the basin on a regular basis and after every significant rainfall event (1/2 inch or greater).
- At a minimum, clean out the basins when they are approximately one-half full.
- Check for damage to coir fiber baffles and repair and/or replace the baffles.

Typical Problems

- The basins are not constructed to the dimensions specified on the plans and result in inadequate basin capacities.
- The basins are constructed with vertical side slopes, increasing erosion of side slopes and sediment in basins.
- Silt accumulations are not removed when needed.
- Basins built in ditch lines in sandy soils may cause sloughing of slopes.
- Basins are too deep causing erosion at the inlet end and presenting safety problems.
- If water remains in the basins and saturates the area, it may indicate problems with the grade.
- Water flows under or around the coir fiber baffles and the settling time decreases instead of increasing.

4.7.3 Skimmer Basin

Practical Tips

- Skimmer basins are more expensive than Temporary Rock Sediment Dams, Type B (TRSD-B), but have a smaller footprint.
- Skimmer basins are the recommended device at drainage outlets that drain directly to jurisdictional water bodies and buffer zones.

Definition

A skimmer basin is a temporary basin with a trapezoidal spillway lined with geotextile and equipped with a floating skimmer for dewatering from the top of the water column. The skimmer basin is designed to dewater at a controlled rate, which helps optimize efficiency of the device by maximizing sediment settling time and releasing the cleanest water from the top of the water column.

Areas of Use

- At the outlet of large drainage areas that discharge into or near sensitive watersheds
- In areas near high quality waters, buffer zones and/or Environmentally Sensitive Areas (ESA)
- In areas where drainage areas are too large for a basin with a standard rock weir

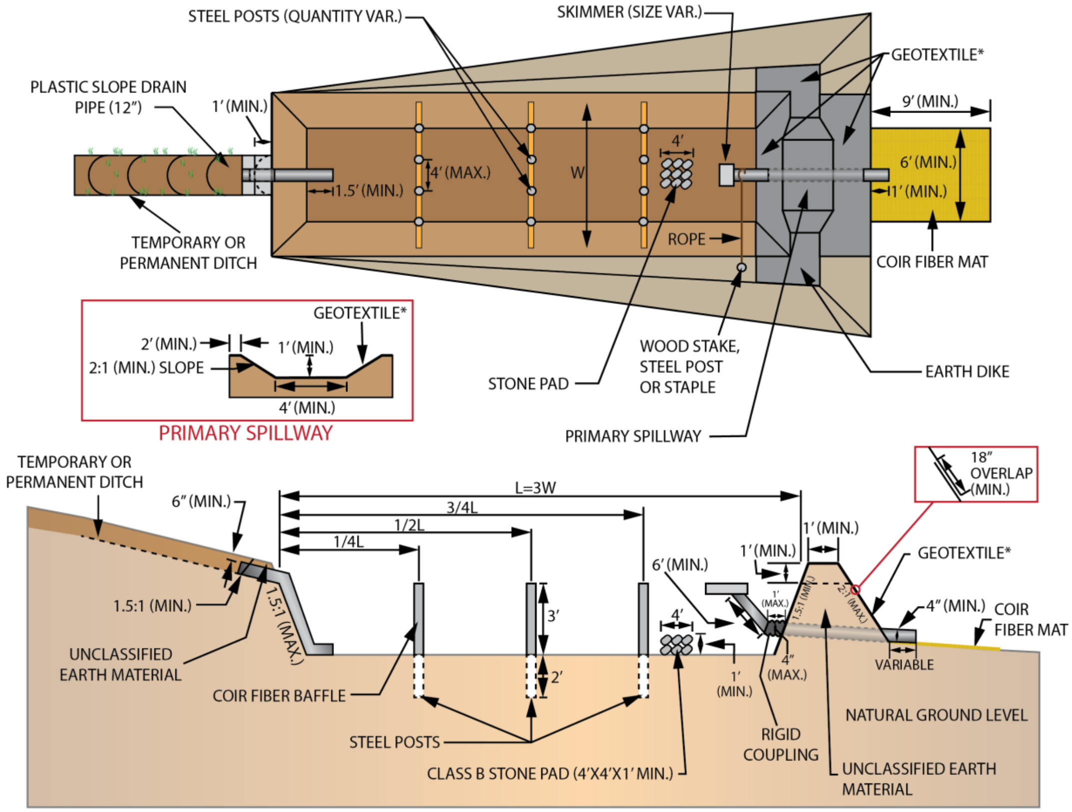
The skimmer orifice is designed to dewater the basin in 2 to 3 days per the NCDOT Basin Design design guidelines.

4.7.3 Skimmer Basin

Design Criteria

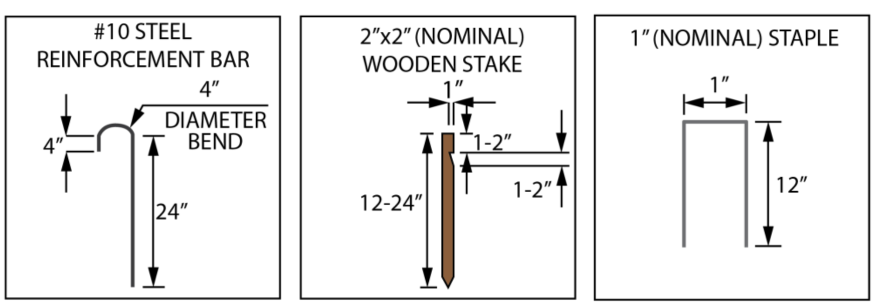
- The drainage area should be 10 acres or less.
- The basin length-to-width ratio should be at least 2:1 but should not exceed 6:1.
- The basin depth should be at least 2 feet.
- The minimum volume should be 1,800 cubic feet per acre of disturbed area.
- The minimum surface area should be 325 square feet per cfs of Q_{10} or Q_{25} peak inflow.
- The dewatering time should be between 48 hours and 72 hours.
- The primary spillway should carry the peak runoff from the design storm with a minimum 1 foot of freeboard depth in the spillway.
- The primary spillway length (feet) should be determined by using Q/0.4, where Q is the flow rate (cfs) into the basin.
- The minimum primary spillway weir length should be 4 feet.
- A minimum of 3 coir fiber baffles should be installed in the skimmer basin with a spacing of ¼ the basin length.
- For skimmer basins less than 20 feet in length, 2 baffles shall be installed with a spacing of 1/3 the basin length.
- NCDOT Basin Design Spreadsheet should be used to design the basin. http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/erosion_control/downloads.html

4.7.3 Skimmer Basin



PLAN VIEW, CROSS SECTION AND PRIMARY SPILLWAY (NOT TO SCALE)

** LOW PERMEABILITY GEOTEXTILE FOR EAST AREAS - DIVISIONS 1, 2, 3, 4 & 6.*
PLACE A 6-INCH BAND OF SEALANT AROUND THE INTERIOR FACE OF THE OUTLET BARREL PIPE.



COIR FIBER MAT ANCHOR OPTIONS

4.7.3 Skimmer Basin

Material Specifications

- The skimmer should meet the requirements of the Erosion and Sediment Control plan.
- Coir fiber baffles should meet the requirements of Section 1640-2 of the Standard Specifications.
- Coir fiber mat should meet the requirements of Section 1060-14 of the Standard Specifications.
- Permanent or temporary seed should meet the requirements of Section 1060-4 of the Standard Specifications.
- Fertilizer for temporary seed should meet the requirements of Section 1060-2 of the Standard Specifications.
- Matting for erosion control should meet the requirements of Section 1060-8 of the Standard Specifications.
- All embankment material should be considered unclassified earth.

  The geotextile should meet the requirements of Section 1056 of the Standard Specifications for Type 4 Geotextile for Soil Stabilization. For eastern Divisions 1, 2, 3, 4, and 6, the geotextile for the spillway liner shall meet the following minimum properties for low permeability, woven polypropylene geotextiles:

Geotextile Property	Test Method	Value	Unit
Tensile Strength	ASTM D4632	315	lb
Tensile Elongation (Maximum)	ASTM D4632	15	%
Trapezoidal Tear	ASTM D4533	120	lb
CBR (California Bearing Ratio) Puncture	ASTM D6241	900	lb
UV Resistance (% retained at 500 hrs.)	ASTM D4355	70	US Std. Sieve
Apparent Opening Size (AOS)	ASTM D4751	40	%
Permittivity	ASTM D4491	0.05	sec^{-1}
Water Flow Rate	ASTM D4491	4	$gal/min/ft^2$

4.7.3 Skimmer Basin

Construction Specifications

Installation	• Construct the basin according to the Erosion and Sediment Control plan with the basin surface free of obstructions, debris and pockets of low-density material. • Assemble and install the skimmer as instructed by the manufacturer. • Place a 6-inch band of sealant around the interior face of the outlet barrel pipe. • Depending on the expected time period for which the skimmer basin is designed, permanently or temporarily seed all bare side slopes of the basin.
Dimensions	• Limit the dam height to 5 feet. • Install the skimmer a minimum of 1 foot from the bottom of the basin. • The minimum basin width should be 3 times the depth of the basin. For a basin depth of 3 feet, the minimum basin width should be 9 feet.
Matting	• Install coir fiber matting under the outlet of the skimmer with minimum dimensions of 9 feet long by 6 feet wide. • Install matting for erosion control on exposed side slopes after seeding is completed.
Geotextile	• Unroll the geotextile on the spillway in the direction of flow, with edges buried at least 6 inches deep. The geotextile should be one continuous piece of material or overlapped a minimum of 18 inches. For Divisions 1, 2, 3, 4, and 6 in the eastern part of the state, use a low permeability geotextile. • Replace the plastic slope drain pipe at the inlet of the basin with geotextile as directed.
Baffles	• Install 3 coir fiber baffles in the skimmer basin with a spacing of ¼ the basin length. • Install a minimum of 2 coir fiber baffles in basins with less than 20 feet of length at spacing of 1/3 the basin length.
Stone	• Install a Class B stone pad (4 feet by 4 feet by 12 inches high) directly underneath the skimmer device.
Anchors	• Anchor the coir fiber mat with wooden stakes, steel reinforcement rebar or metal staples. • Anchor the geotextile with 6" staples at a maximum spacing of 3 ft.
Primary Spillway	• Construct the primary spillway with a trapezoidal cross-section, with 2:1 side slopes, and a minimum base width of 4 feet.

4.7.3 Skimmer Basin

Technician's Checklist

- Do not change the shape or size of the basin without consulting with the Engineer.
- Verify the area where the basin is to be placed is permitted for the activity.
- Verify the area where the basin is proposed will be suitable for the device. Consider the soil type, water table and accessibility.
- Maintain access to the basin at all times so that it can be cleaned as needed.
- Remove the basin at the end of the project, if required.
- Meet the requirements of the plans or Standard Drawings for the pipe, earth dike, skimmer, spillway and baffles.
- Install the Class B stone pad beneath the skimmer location to prevent the skimmer from being buried in and clogged with sediment and debris if the water elevation becomes low.
- Compact the dam with clay soil so that it can withstand the volume of water.
- Seed and mat the remainder of interior and exterior slope areas not covered with geotextile.

Measurement & Payment

Pay Items	Pay Units
Silt Excavation	**Cubic Yard**
Coir Fiber Mat	**Square Yard**
Geotextile for Drainage	**Square Yard**
Low Permeability Geotextile	**Square Yard**
__" Skimmer	**Each**
Riprap, Class ___	**Ton**
Seed for Temporary Seeding	**Pound**
Fertilizer for Temporary Seeding	**Ton**
Matting for Erosion Control	**Square Yard**
Temporary Slope Drains	**Linear Foot**

4.7.3 Skimmer Basin

Maintenance

- Inspect the basin on a regular basis and after every significant rainfall event (1/2 inch or greater).
- Clean out the basins when sediment accumulations reach approximately one-half the height of the first baffle.
- Check the skimmer to make sure that it is not clogged with sediment.
- Check the fabric lined spillway for damage.
- Check the coir fiber mat at the outlet of the skimmer to determine if a replacement is needed.
- During winter, support the skimmer at an angle such that water does not stand inside the barrel. This could result in the water freezing and plugging the skimmer.
- Repair seed and replace matting on the side slope areas that have eroded or have become damaged by equipment from silt cleanout.
- Remove sediment that may accumulate on the stone pad underneath the skimmer device.
- Inspect the baffles after each rain event for erosion damage and sediment accumulations.

Typical Problems

- Basins are not constructed to the dimensions specified on the plans and result in inadequate basin capacities.
- Silt accumulations are not removed when needed.
- Erosion occurs at the inlet end when the basin is too deep.
- The basin is too deep, therefore safety is a concern.
- The skimmer becomes clogged.
- The stone pad beneath the skimmer device becomes covered with sediment and the skimmer becomes embedded in the bottom of the basin.
- The geotextile for the primary spillway is not keyed in well, water washes underneath it, and the dam fails.
- Water flows under or around the coir fiber baffles and settling time decreases instead of increases.
- Equipment damages side slopes of the basin during silt cleanout.
- Erosion of the side slopes occur causing excess sediment to wash into the basin.

4.7.3 Skimmer Basin

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4.7.4 Tiered Skimmer Basin

Practical Tips

- Flocculant can be introduced at the slope drain inlets of the upper basins if other basins are installed down gradient.
- Linear configuration lends itself to roadway projects.

Definition

A tiered skimmer basin is a series of temporary basins with trapezoidal spillways lined with geotextile. The lower basin is equipped with a floating skimmer for dewatering from the top of the water column. It is often used at the outlet of larger drainage areas that discharge into or near sensitive watersheds, where the elevation difference between the inlet and the outlet will be too large for just one skimmer basin. Tiered skimmer basins dewater into one another through geotextile-lined spillways into the next basin. The tiered skimmer basin is designed to dewater at a controlled rate with a step-pool approach, which helps maximize efficiency of the device by allowing a greater settling time for sediment and releasing the cleanest water from the top of the water column.

NCDOT ESC Erosion & Sediment CONTROL MANUAL

4.7.4 Tiered Skimmer Basin

Areas of Use

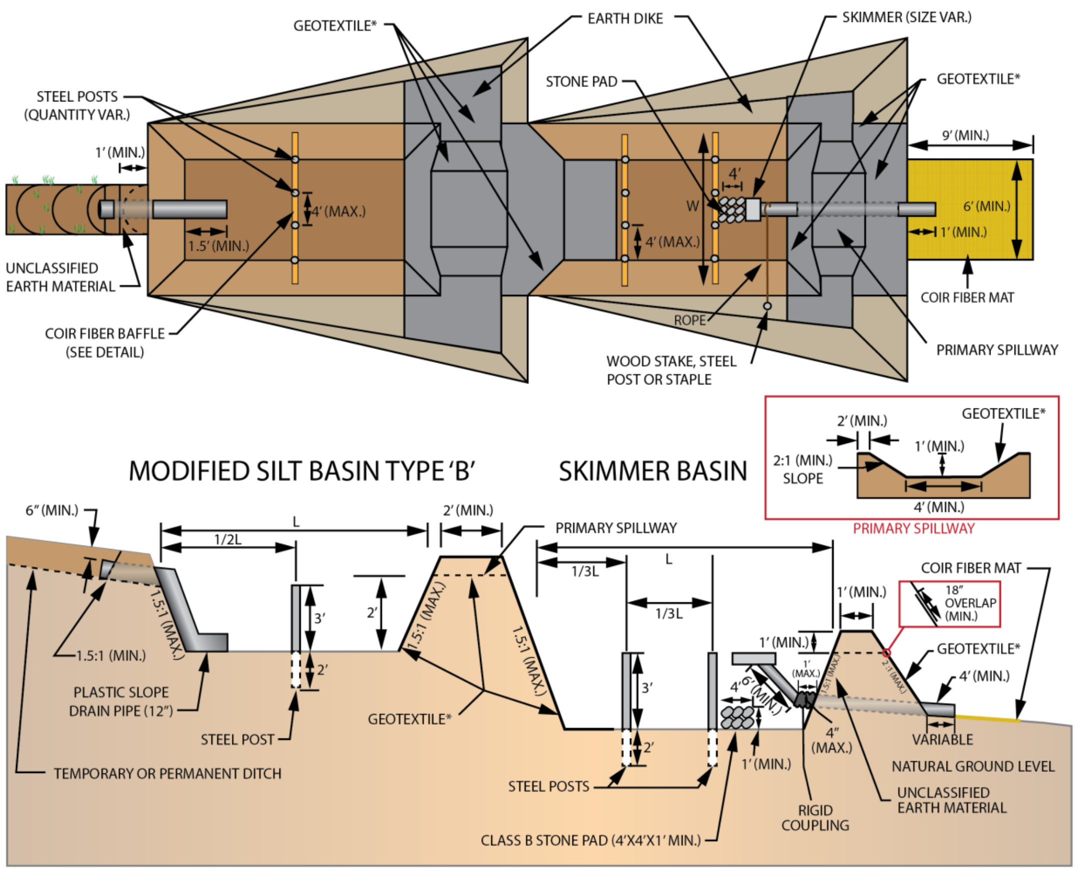
- At outlets in larger drainage areas that discharge directly to jurisdictional waters
- In areas near high quality waters, buffer zones and/or Environmentally Sensitive Areas (ESA)
- In areas where drainage areas are too large for a basin with a standard rock weir, and where the elevation difference between the inlet and the outlet ends will be 6 feet or greater.

Use tiered skimmer basins when steeper terrain prohibits the use of other surface dewatering basin types.

Design Criteria

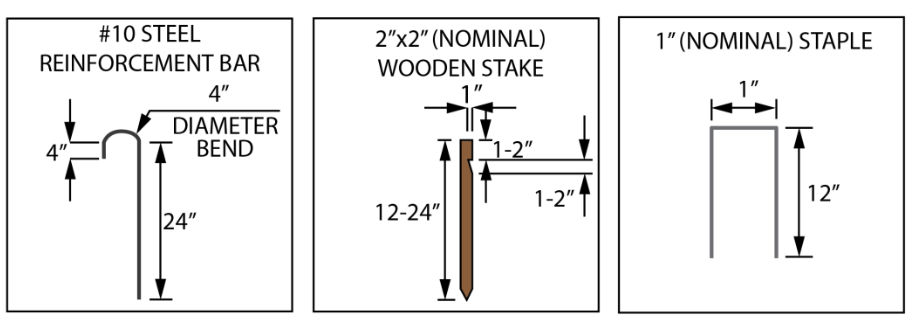
- The drainage area should be 10 acres or less.
- For each tiered basin, the length to width ratio should be at least 2:1, but not exceed 6:1.
- The basin depths should be at least 2 feet.
- The minimum total volume should be 1,800 cubic feet per acre of disturbed area.
- The minimum total surface area should be 325 square feet per cfs of Q_{10} peak inflow.
- The dewatering time should be between 48 hours and 72 hours.
- The emergency spillway of the lower basin should carry the peak runoff from the design storm with a minimum of 1-foot of freeboard in the spillway.
- The primary spillway lengths (feet) should be determined using Q/0.4 where Q is the flow rate (cfs) into the upper basin. The primary spillway base lengths should be the same for all basins.
- The minimum primary spillway weir length should be 4 feet.
- A minimum of 3 coir fiber baffles should be installed in the tiered skimmer basin system.
- NCDOT Basin Design Spreadsheet should be used to design the basin. http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/erosion_control/downloads.html

4.7.4 Tiered Skimmer Basin



PLAN VIEW, CROSS SECTION AND PRIMARY SPILLWAY (NOT TO SCALE)

** LOW PERMEABILITY GEOTEXTILE FOR EAST AREAS - DIVISIONS 1, 2, 3, 4, 6 AND 8.*
PLACE A 6-INCH BAND OF SEALANT AROUND THE INTERIOR FACE OF THE OUTLET BARREL PIPE.



COIR FIBER MATT ANCHOR OPTIONS

4.7.4 Tiered Skimmer Basin

Material Specifications

- The skimmer should meet the requirements of the Erosion and Sediment Control plan.
- Coir fiber baffles should meet the requirements of Section 1640-2 of the Standard Specifications.
- Coir fiber mat should meet the requirements of the Section 1060-14 of the Standard Specifications.
- Temporary slope drains should meet the requirements of Section 1622 of the Standard Specifications.
- Permanent or temporary seed should meet the requirements of Section 1060-4 of the Standard Specifications.
- Fertilizer for temporary seed should meet the requirements of Section 1060-2 of the Standard Specifications.
- Matting placed at the outlet for erosion control should meet the requirements of Section 1060-8 of the Standard Specifications.
- All embankment material should be considered unclassified earth.
- The geotextile should meet the requirements of Section 1056 of the Standard Specifications for Type 4 Geotextile for Soil Stabilization. For eastern Divisions 1, 2, 3, 4, and 6, the geotextile for the spillway liner shall meet the following minimum properties for low permeability, woven polypropylene geotextiles:

Geotextile Property	Test Method	Value	Unit
Tensile Strength	ASTM D4632	315	lb
Tensile Elongation (Maximum)	ASTM D4632	15	%
Trapezoidal Tear	ASTM D4533	120	lb
CBR (California Bearing Ratio) Puncture	ASTM D6241	900	lb
UV Resistance (% retained at 500 hrs.)	ASTM D4355	70	US Std. Sieve
Apparent Opening Size (AOS)	ASTM D4751	40	%
Permittivity	ASTM D4491	0.05	sec^{-1}
Water Flow Rate	ASTM D4491	4	$gal/min/ft^2$

4.7.4 Tiered Skimmer Basin

Construction Specifications

Installation	• Construct the basins according to the Erosion and Sediment Control plan with the basin surface free of obstructions, debris and pockets of low-density material. • Construct all upper basins as modified silt basins, Type B with the lowest basin built as a Skimmer Basin. • Use additional modified silt basins, Type B as needed depending on the slope. • Assemble and install the skimmer as instructed by the manufacturer. • Place a 6-inch band of sealant around the interior face of the outlet barrel pipe. • Depending on the expected time period for which the skimmer basin is designed, permanently or temporarily seed all bare side slopes of the basins.
Dimensions	• Limit dam height of lower basin with skimmer to 5 feet. • Install the skimmer a minimum of 1 foot from the bottom of the basin. • The minimum basin widths should be 3 times the depth of the basin. For a basin depth of 3 feet, the minimum basin width should be 9 feet.
Matting	• Install coir fiber matting under the outlet of the skimmer with minimum dimensions of 9 feet long by 6 feet wide. • Install matting for erosion and sediment control on exposed side slopes after seeding is completed.
Geotextile	• Unroll the geotextile on the spillways in the direction of the flow with edges buried at least 6 inches deep. The geotextile should be one continuous piece of material or overlapped a minimum of 18 inches. • Install geotextile to cover the height of the outside of the lower basin berm outlet.
Baffles	• Install a minimum of 3 coir fiber baffles in the tiered skimmer basin system. The baffle spacing should be 1/3 the basin length for basins with two baffles and a spacing of 1/2 the basin length for basins with one baffle.
Stone	• Install a Class B stone pad (4 feet by 4 feet by 12 inches high) directly underneath the skimmer device.
Anchors	• Anchor coir fiber mat with wooden stakes, steel reinforcement rebar or metal staples. • Anchor geotextile with 6-inch staples and a maximum spacing of 3 feet.
Spillways	• Construct primary spillways with a trapezoidal cross section with 2:1 or flatter side slopes and a minimum base width of 4 feet.

4.7.4 Tiered Skimmer Basin

Technician's Checklist

> **Monitor for erosion and berm failure around each spillway between basins.**

- Do not change the shape or size of the basin without consulting the Engineer.
- Verify the area where the basin is to be placed is permitted for the activity.
- Verify the area where the basin is proposed will be suitable for the device. Consider the soil type, water table and accessibility.
- Maintain access to the basin at all times so that it can be cleaned as needed.
- Remove the basin at the end of the project, if required.
- Meet the requirements of the plans or Standard Drawings for the pipe, earth dike, skimmer, spillway and baffles.
- Install the Class B stone pad beneath the skimmer location to prevent the skimmer from being buried in and clogged with sediment and debris if the water elevation becomes low.
- Compact the dam with good soil so that it can withstand the volume of water.
- Seed and mat the remainder of interior and exterior slope areas not covered with geotextile.

Measurement & Payment

Pay Items	Pay Units
Silt Excavation	**Cubic Yard**
Coir Fiber Mat	**Square Yard**
Geotextile for Drainage	**Square Yard**
Low Permeability Geotextile	**Square Yard**
Temporary Slope Drains	**Linear Foot**
___" Skimmer	**Each**
Riprap, Class ___	**Ton**
Seed for Temporary Seeding	**Pound**
Fertilizer for Temporary Seeding	**Ton**
Matting for Erosion Control	**Square Yard**

4.7.4 Tiered Skimmer Basin

Maintenance

- Inspect the basin on a regular basis and after every significant rainfall event (1/2 inch or greater).
- Clean out the basins when sediment accumulations reach approximately one-half the height of the first baffle.
- Check the skimmer to make sure that it is not clogged with sediment.
- Check the geotextile lined spillway for damage.
- Check the coir fiber mat at the outlet of the skimmer to determine if a replacement is needed.
- During winter, support the skimmer at an angle such that water does not stand inside the barrel. This could result in the water freezing and plugging the skimmer.
- Repair seed and replace matting on the side slope areas that have eroded or have become damaged by equipment from silt cleanout.
- Remove sediment that may accumulate on the stone pad underneath the skimmer device.
- Inspect the baffles after each rain event for erosion damage and sediment accumulations.

Typical Problems

- Basins are not constructed to the dimensions specified on the plans and result in inadequate basin capacities.
- Silt accumulations are not removed when needed.
- The basin is too deep, therefore safety is a concern.
- The skimmer becomes clogged.
- The stone pad beneath the skimmer device becomes covered with sediment and the skimmer becomes embedded in the bottom of the basin.
- The geotextile for the primary spillway is not keyed in well and water washes underneath it and the dam fails.
- Water flows under or around the coir fiber baffles and settling time decreases instead of increases.
- Equipment damages the side slopes of the basin during silt cleanout.
- Erosion of the side slopes occurs causing excess sediment to wash into the basin.

4.7.4 Tiered Skimmer Basin

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4.7.5 Infiltration Basin with Baffles

Practical Tips

- Knowing the ground water elevation is recommended for berm height construction around the basin.
- When sediment storage devices are needed, consider this BMP before others due to its high sediment capture efficiency and simple surface dewatering outlet.
- Infiltration basins require good soil permeability.

Definition

An infiltration basin with baffles is a sediment retention basin with a series of coir fiber baffles that can be utilized in areas where the soil permeability is at least 0.5 in/hr. If soil conditions are appropriate (see guidance below), most or all of the runoff entering the basin can be infiltrated, which makes this BMP desirable in areas that drain to jurisdictional water bodies.

Areas of Use

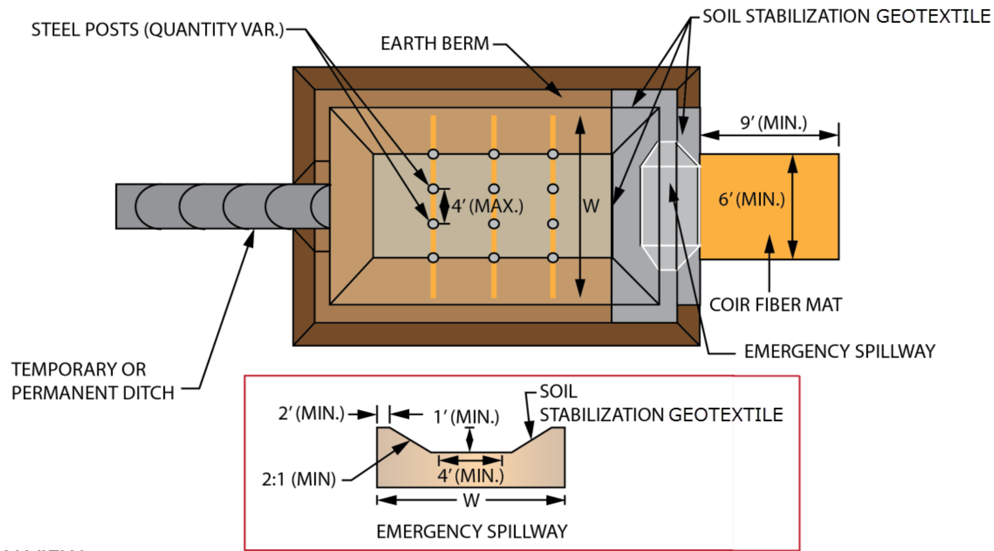
- Where soil conditions are sufficiently permeable (a minimum of 0.5 in/hr). Obtain soil infiltration rates from the USDA-NRCS Soil Surveys. Select the lower permeability of the soil horizon with the slowest permeability for conservative design.
- At drainage outlets that drain directly to jurisdictional water bodies and Riparian Buffer Zones
- At the toe of fill slopes but do not use in proposed ditches
- Do not place in "Soils Prone to Flooding"

4.7.5 Infiltration Basin with Baffles

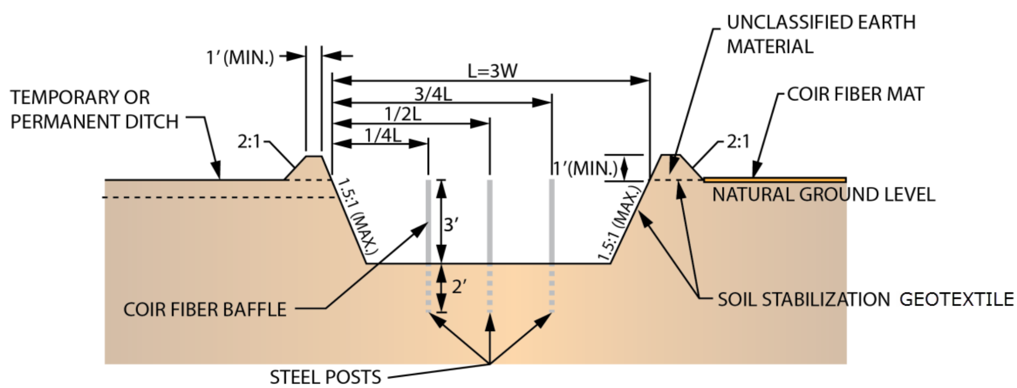
Design Criteria

- The drainage areas should not exceed 10 acres.
- The basin surface should be free of obstructions, debris and pockets of low-density material.
- The minimum surface area is 325 square feet per cfs of Q_{10} or Q_{25} peak inflow.
- The sediment storage requirement is 1800 cubic feet per disturbed acre.
- The primary spillway should carry the peak runoff from the design storm with a minimum 1 foot of freeboard depth in the spillway.
- The primary spillway length (feet) should be determined by using Q/0.4, where Q is the flow rate (cfs) into the basin.
- A minimum of 3 coir fiber baffles should be installed in the infiltration basin with a spacing of ¼ the basin length.
- For infiltration basins less than 20 feet in length, 2 baffles shall be installed with a spacing of 1/3 the basin length.
- The minimum weir length is 4 feet.
- The maximum dewatering time is 3 days.
- NCDOT Infiltration Basin Design Spreadsheet should be used to design the basin. http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/erosion_control/downloads.html

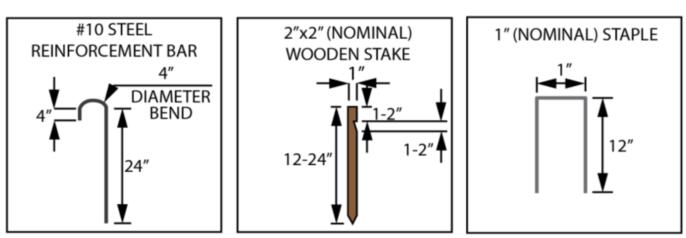
4.7.5 Infiltration Basin with Baffles



PLAN VIEW



CROSS SECTION



COIR FIBER MAT ANCHOR OPTIONS

4.7.5 Infiltration Basin with Baffles

Material Specifications

Installation of the infiltration basin with baffles includes constructing the sediment basin, installation of coir fiber baffles, providing and placing geotextile spillway liner and providing coir fiber mat stabilization for the primary spillway outlet.

- Staples shall meet the requirements of NCDOT Standard Specification 1060-8.
- Coir fiber mat shall meet the requirements of NCDOT Standard Specification 1060-14.
- Coir fiber baffle shall meet the requirements of NCDOT Standard Specification 1640-2.
- Staples, stakes or reinforcement bars shall be used as anchors.

- **Avoid compaction of the proposed basin footprint by construction equipment.**
- **The floor of the basin must remain as clean as possible to function properly.**

Geotextile

- In NCDOT Divisions 5, 7, 8, 9, 10, 11, 12, 13 and 14, for the geotextile spillway liner, utilize Geotextile for Soil Stabilization, Type 4, in accordance with NCDOT Standard Specification 1056.
- For eastern Divisions 1, 2, 3, 4, and 6, the geotextile for the spillway liner shall meet the following minimum properties for low permeability, woven polypropylene geotextiles:

Geotextile Property	Test Method	Value	Unit
Tensile Strength	ASTM D4632	315	lb
Tensile Elongation (Maximum)	ASTM D4632	15	%
Trapezoidal Tear	ASTM D4533	120	lb
CBR (California Bearing Ratio) Puncture	ASTM D6241	900	lb
UV Resistance (% retained at 500 hrs.)	ASTM D4355	70	US Std. Sieve
Apparent Opening Size (AOS)	ASTM D4751	40	%
Permittivity	ASTM D4491	0.05	sec^{-1}
Water Flow Rate	ASTM D4491	4	$gal/min/ft^2$

4.7.5 Infiltration Basin with Baffles

Steel Reinforcement Bars

- Provide uncoated #10 steel reinforcement bars that are 24 inches nominal length. The bars shall have a 4-inch diameter bend at one end with a 4-inch straight section at the tip to catch and secure the coir fiber mat.

Wooden Stakes

- Provide hardwood stakes that are 12 inches – 24 inches long with a 2-inch x 2-inch nominal square cross section.
- Sharpen or bevel one end of the stake to facilitate driving through the coir fiber mat and down into the underlying soil. The other end of the stake needs to have a 1-inch to 2-inch notch following to catch and secure the coir fiber mat.

Staples

- Provide staples made of 0.125-inch diameter new steel wire formed into a U shape not less than 12 inches in length with a throat that is 1-inch wide.

Construction Specifications

Excavation	• Excavate the basin according to the E&SC plans with the basin surface free of obstructions, debris and pockets of low-density material. • Excavation into or below the water table should not occur, and avoid compacting the bottom of the basin with equipment tires, excavation bucket, etc.
Coir Fiber Baffles	• Construct the coir fiber baffles according to Roadway Standard Drawing No. 1640.01 and Section 1640 of the Standard Specifications. Refer to Section 4.7.7 of this chapter for specific coir fiber baffle guidelines.
Earth Berm	• Construct earth berm around the perimeter of the infiltration basin as shown in the detail. The earth berm height shall be limited to 3 feet.
Primary Spillway	• Construct the primary spillway according to the Infiltration Basin with Baffles Detail sheet in the E&SC plans. • Line the primary spillway with low permeability polypropylene geotextile unrolled in the direction of flow and lay it smoothly but loosely on the soil surface without creases. • At the primary spillway outlet, provide a smooth soil surface free from stones, clods or debris that will prevent contact of the coir fiber matting with the soil.

4.7.5 Infiltration Basin with Baffles

Geotextile	• Bury the edges of geotextile in a trench at least 5 inches deep and tamp firmly. • Make the vertical overlaps a minimum of 18 inches with upstream geotextile overlapping the downstream geotextile. • Secure the geotextile with 11-gauge U-shaped wire staples with a length of not less than 12 inches and a throat not less than 1-inch in width. • Place staples along the outer edges and throughout the geotextile spaced a maximum of 3 feet horizontally and vertically. • Extend the geotextile to the bottom and across the entire width of the basin according to the Infiltration Basin with Baffles detail.
Matting	• Unroll the matting and apply it without stretching such that it will lie smoothly but loosely on the soil surface.
Anchors	• Use wooden stakes, reinforcement bars or staples as anchors in accordance with the details in the plans and as directed. • Place anchors across the matting at the ends approximately 1 foot apart. • Place anchors along the outer edges and down the center of the matting 3 feet apart.

Technician's Checklist

- Perform an inspection of this device at least weekly and after each significant rainfall.
- Clean infiltration basins on a very frequent interval to keep the floor free of sediment deposition.
- Monitor the inlet of the basin for scour or erosion; supplement with a short section of temporary slope drain pipe to safely convey runoff into basin if needed.
- Monitor the geotextile-lined spillway and repair as needed if it becomes damaged.
- Remove devices as appropriate for the next phase of construction or when the final stand of vegetation has been established.

Measurement & Payment

Pay Items	Pay Units
Coir Fiber Mat	**Square Yard**
Geotextile or Low Permeability Geotextile	**Square Yard**
Coir Fiber Baffle	**Linear Foot**
Silt Excavation	**Cubic Yard**

4.7.5 Infiltration Basin with Baffles

Maintenance

- Inspect the basins after each significant rainfall.
- Clean the basins when any sediment accumulations appear on the basin floor.
- Check the geotextile-lined spillway for damage.
- Check the coir fiber mat at the outlet of the basin for damage.
-

Typical Problems

- Inadequate basin capacities: the basins are not constructed to dimensions specified on plans.
- Silt accumulations in the basin floor are not removed promptly.
- Geotextile for the spillway is not keyed in well and water washes underneath it causing the dam to fail.
- Water flows under or around coir fiber baffles and settling time decreases instead of increases.
- Equipment damages the side slopes of the basin during silt cleanout.
- Erosion of the side slopes occurs causing excess sediment to wash into the basin.

4.7.5 Infiltration Basin with Baffles

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4.7.6 Temporary Rock Sediment Dam –Type A (1634.01)

Practical Tips

- **TRSD-A's are usually used in larger drainage areas where an embankment may be used to keep the effluent shallow with low velocities to allow trapping of sediment within construction boundaries.**
- **TRSD-A's are also placed at outlets to existing and proposed ditches with large cross sections.**

Definition

A Temporary Rock Sediment Dam - Type A (TRSD-A) is a large dam structure with a weir outlet that forms a storage area behind it. The Type A dams utilize riprap lined with sediment control stone to trap sediment and protect off-site property. The TRSD-A is usually installed in an area where naturally formed drainage features allow for a large ponding or retention area to form where the dam is constructed at the outlet point. The TRSD-A can be constructed with some additional embankment material to help connect the stone dam to the existing features. The Type A dams can also be installed in existing and proposed roadway ditches with large cross sections.

4.7.6 Temporary Rock Sediment Dam –Type A (1634.01)

Areas of Use

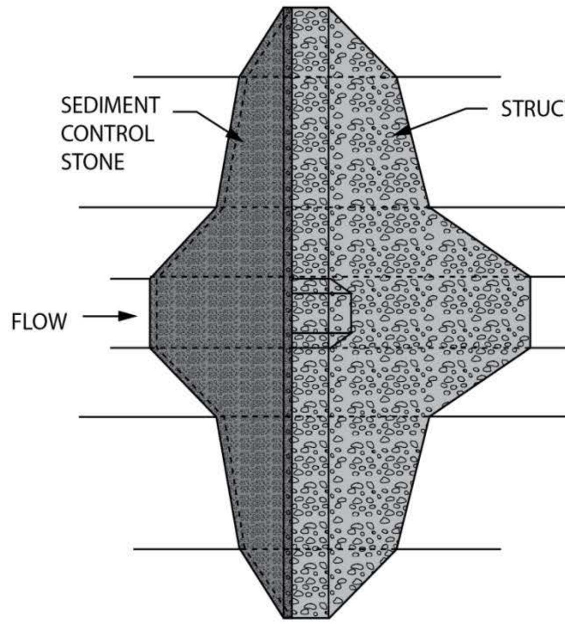
- At natural drainage outlets that form valleys or other topographic features that allow for a large detention area to be formed with the rock dam
- In watersheds where the drainage area is larger than 1 acre
- In large base ditches where the TRSD-A can be placed at the outlet and the stone will connect to the side slopes

Do not use Temporary Rock Sediment Dams for surface dewatering.

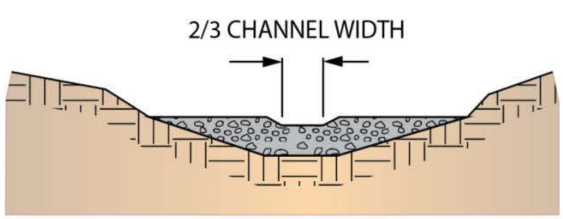
Design Criteria

- The drainage area shall be limited to 10 acres or less.
- The minimum length to width ratio for the impoundment area is 2:1.
- The location should be accessible for maintenance for the entire life of the dam.
- The volume should be designed for 3,600 cubic feet per acre of disturbance.
- The surface area of the impoundment should be 435 square feet per cfs of the Q_{10} or Q_{25} peak inflow.
- Inflow to the dam should be located at the farthest point from the release point to prevent short-circuiting of the flow path and reduced settling efficiency.
- A minimum of 3 porous baffles should be constructed on the upstream side of the TRSD-A with equal spacing throughout the length of the impoundment behind the dam.
- The embankment side slopes should be 2:1 or flatter.
- The weir section should be 2/3 the width of the channel flow width with a minimum width of 4 feet.
- The weir section should be designed to pass the peak discharge of the design storm. A maximum flow depth of 6 inches, a minimum freeboard of 1 foot and maximum side slopes of 2:1 are recommended.
- The design life of the structure shall be 3 years or less.
- TRSD-A should not be placed at jurisdictional outlets where a surface dewatering device can be installed.
- Additional dam criteria are shown on the detail.

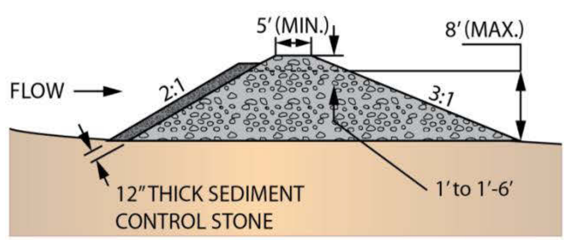
4.7.6 Temporary Rock Sediment Dam –Type A (1634.01)



PLAN VIEW - TYPE A



CROSS SECTION - TYPE A



PROFILE VIEW - TYPE A

4.7.6 Temporary Rock Sediment Dam –Type A (1634.01)

Material Specifications

Structural Stone	• **Use Class I Riprap.** • **Meet the requirements of Section 1042 of the Standard Specifications for Rip Rap, Class 1.**
Sediment Control Stone	• **Use No. 5 or No. 57 stone.** • **Meet the requirements of Section 1005 of the Standard Specifications for stone sizes.**
Baffles	• **Meet the requirements of Section 1640-2 of the Standard Specifications.**

Construction Specifications

Specifications	• **The maximum dam height is 8 feet with a weir elevation no more than 6 feet above grade.** • **Place the sediment control stone on the upstream face of the structural stone at a minimum thickness of 12 inches.** • **Construct the TRSD-A with a minimum top thickness of 5 feet with 2:1 slopes on the upstream side and 3:1 slopes on the downstream side.** • **Design the stone dam to a maximum of 8 feet above grade.** • **Compact the fill material for the area of embankment and rock dam tie in.** • **Install 3 coir fiber baffles in the impoundment area behind the TRSD-A with a minimum spacing of 15 feet as directed.**

Technician's Checklist

- Review permits to determine if dam installation is permitted.
- Locate dams as shown on the E&SC plans to control the velocity of water.
- Construct the dam with a weir that is low enough for the water to go over the dam before it will go around it and wash out the adjacent ditch slope.
- Install the proper type of dam based on the planned volume and velocity of water.
- Before the dam is removed, stabilize the drainage area with permanent vegetation.

Temporary Rock Sediment Dams must be kept clean to allow the water to flow through the stone as they are designed to pond water for only a short period of time.

4.7.6 Temporary Rock Sediment Dam –Type A (1634.01)

Measurement & Payment

Pay Items	Pay Units
Riprap, Class 1	Ton
Sediment Control Stone	Ton
Coir Fiber Baffle	Linear Foot
Seed for Temporary Seeding	Pound
Fertilizer for Temporary Seeding	Ton
Silt Excavation	Cubic Yard

Maintenance

- Inspect the TRSD-A on a regular basis and after each significant rainfall event.
- At a minimum, remove accumulated sediment when the measure reaches half full.
- As dam becomes clogged with sediment and runoff no longer passes through it, replace sediment control stone.
- Remove accumulated debris from the rock dam.
- Maintain the weir section of the dam when damaged by equipment or storms.

Typical Problems

- Silt accumulations are not removed in a timely manner.
- The rock weir is poorly constructed.
- Stone is not replaced or maintained as sediment accumulates in it reducing porosity.
- The stone dam is not properly tied into the embankment of the basin.
- The structure is not rebuilt when damaged by storms, equipment, etc.

4.7.7 Temporary Rock Sediment Dam - Type B (1634.02)

Definition

A Temporary Rock Sediment Dam - Type B (TRSD-B) is a small rock dam structure with a weir outlet and a built-in sediment basin. TRSD-B's are used at the outlet of drainage ways to detain sediment-laden waters and allow sediment particles to settle prior to the effluent being discharged into drainage ways or surrounding properties. The TRSD-B is composed of an excavated basin and a Class B rock dam faced with No. 5 or 57 washed stone.

Practical Tips

- TRSD-B's are usually used in smaller drainage areas where an embankment may be used to keep the effluent shallow with low velocities to allow trapping of sediment within construction boundaries.
- TRSD-B's are typically placed at drainage outlets that do not drain directly to a jurisdictional water body.

4.7.7 Temporary Rock Sediment Dam - Type B (1634.02)

Areas of Use

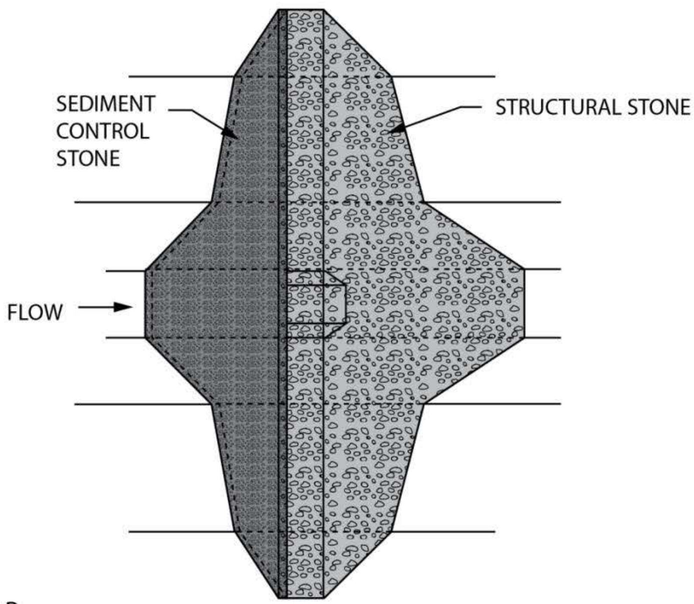
- At outlets of temporary diversions, temporary silt ditches, channels, temporary slope drains, at drainage pipe outlets or other runoff conveyance measures
- In areas where access can be maintained for regular maintenance
- Where runoff is leaving the construction site
- At existing small natural drainage turnouts

Do not use Temporary Rock Sediment Dams for surface dewatering.

Design Criteria

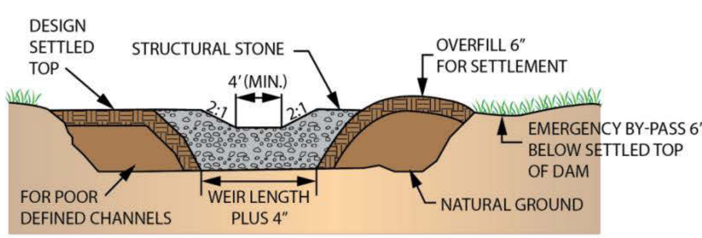
- The drainage area shall not exceed 1 acre.
- The location should be accessible for maintenance for the entire life of the dam.
- The volume should be designed for 3,600 cubic feet per acre of disturbance.
- The surface area of the impoundment should be 435 square feet per cfs of the Q_{10} or Q_{25} peak inflow
- The basin length to width ratio should be at least 2:1, but not exceed 6:1.
- Inflow to the basin should be located at the farthest point from the release point to prevent short-circuiting of the flow path and reduced settling efficiency.
- A minimum of 3 porous baffles should be constructed within the basin of the TRSD-B with a spacing of 1/4 the basin length. For basins with less than 20 feet of length, the baffle spacing shall be 1/3 the basin length.
- The basin side slopes should 1.5:1 or flatter.
- TRSD-B should not be placed at jurisdictional outlets where a surface dewatering device can be installed.
- The weir section should be designed to pass the peak discharge of the design storm. A maximum flow depth of 6 inches, a minimum freeboard of 1 foot and a maximum side slope of 2:1 are recommended.
- The NCDOT Basin Designer Spreadsheet should be used to design the TRSD-B basin: http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/erosion_control/downloads.html

4.7.7 Temporary Rock Sediment Dam - Type B (1634.02)

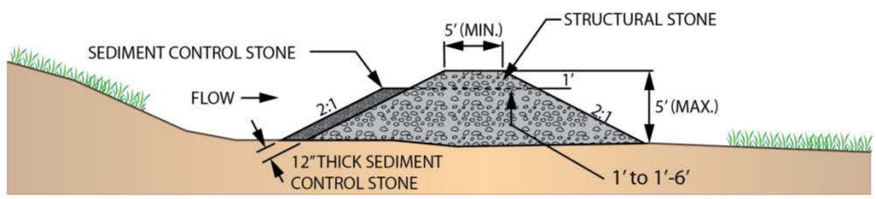


PLAN VIEW - TYPE B

DRAINAGE AREA (ACRES)	WEIR LENGTH (FOOT)
1	4.0
2	6.0
3	8.0
4	10.0
5	12.0



CROSS SECTION - TYPE B



PROFILE SECTION - TYPE B

4.7.7 Temporary Rock Sediment Dam - Type B (1634.02)

Material Specifications

Structural Stone	• **Use Class B structural stone.** • **Meet the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class B.**
Sediment Control Stone	• **Use No. 5 or No. 57 stone.** • **Meet the requirements of Section 1005 of the Standard Specifications for stone sizes.**
Baffles	• **Meet the requirements of Section 1640-2 of the Standard Specifications.**

Construction Specifications

Specifications	• **Place sediment control stone on the upstream face of the structural stone at a minimum thickness of 12 inches.** • **Construct the rock dam with a minimum top thickness of 5 feet with 2:1 slopes.** • **Construct the basin side slopes to 1.5:1 grade or flatter.** • **Construct the stone dam to a maximum of 5 feet above grade.** • **Compact fill material for embankment of basins.** • **Install 3 coir fiber baffles in the TRSD-B, with a spacing of ¼ the basin length.** • **Stabilize all interior and exterior slopes in accordance with Sections 1620 and 1660 of the Standard Specifications.**

Technician's Checklist

- Review permits to determine if dam installation is permitted.
- Locate dams as shown on the E&SC plans to control the velocity of water.
- Construct the dam with a weir that is low enough for the water to go over the dam before it will go around it and wash out the adjacent ditch slope.
- Install the proper type of dam based on the planned volume and velocity of water.
- Before the dam is removed, stabilize the drainage area with permanent vegetation.

Temporary Rock Sediment Dams must be kept clean to allow the water to flow through the stone as they are designed to pond water for only a short period of time.

4.7.7 Temporary Rock Sediment Dam - Type B (1634.02)

Measurement & Payment

Pay Items	Pay Units
Stone for Erosion Control, Class B	**Ton**
Sediment Control Stone	**Ton**
Coir Fiber Baffle	**Linear Foot**
Seed for Temporary Seeding	**Pound**
Fertilizer for Temporary Seeding	**Ton**
Silt Excavation	**Cubic Yard**

Maintenance

- Inspect the TRSD-B on a regular basis and after each significant rainfall event.
- At a minimum, remove accumulated sediment when the measure reaches half full.
- As dam becomes clogged with sediment and runoff no longer passes through it, replace sediment control stone.
- Remove accumulated debris from the rock dam.
- Maintain the weir section of the dam when damaged by equipment or storms.

Typical Problems

- Silt accumulations are not removed in a timely manner.
- The rock weir is poorly constructed.
- The interior of the basin erodes due to vertical side slope installation.
- Stone is not replaced or maintained as sediment accumulates in it reducing porosity.
- The stone dam is not properly tied into the embankment of the basin.
- The structure is not rebuilt when damaged by storms, equipment, etc.

4.7.8 Coir Fiber Baffle (1640.01)

Practical Tips

- **Install the required number of baffles detailed in the specifications immediately upon excavation of the basin.**

Definition

A coir fiber baffle is a porous barrier installed in sediment dams and silt basins. The baffles reduce the velocity of the runoff in the sediment control device, which facilitates the settling of sediment before being discharged offsite. The baffle consists of a coir fiber mat supported by steel T-posts. Baffles help prevent short-circuiting of flows through the device to the outlet point with little or no settling time. In addition, the baffles improve sediment retention because they distribute the flow, which reduces turbulence of the runoff inside the device.

Areas of Use

- In all sediment dams, silt basins and skimmer basins located at drainage outlets
- Not in areas of concentrated flow with the exception of sediment storage devices in ditch lines

4.7.8 Coir Fiber Baffle (1640.01)

Design Criteria

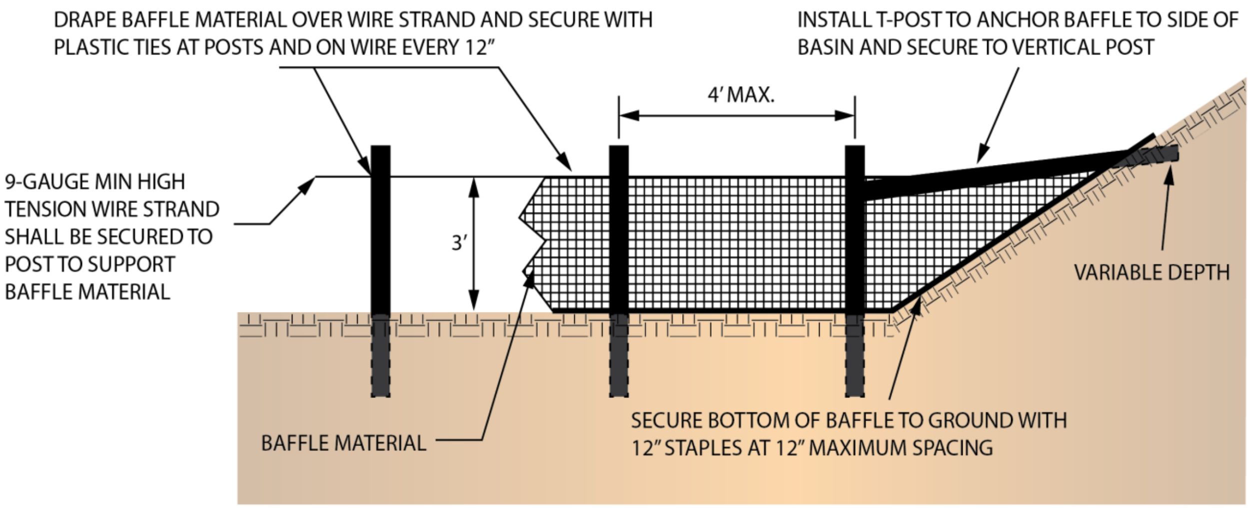
Use the following guidelines for coir fiber baffles required in Silt Basins at drainage turnouts, Type A and B Temporary Rock Sediment Dams, Skimmer and Infiltration Basins and Stilling Basins:

- 3 baffles if basin length > 20 feet
- 2 baffles if basin length 10 - 20 feet
- 1 baffle if basin length ≤ 10 feet
- When site constraints prevent basins from meeting the desired 3 foot depth, adjust the baffle to match basin depth

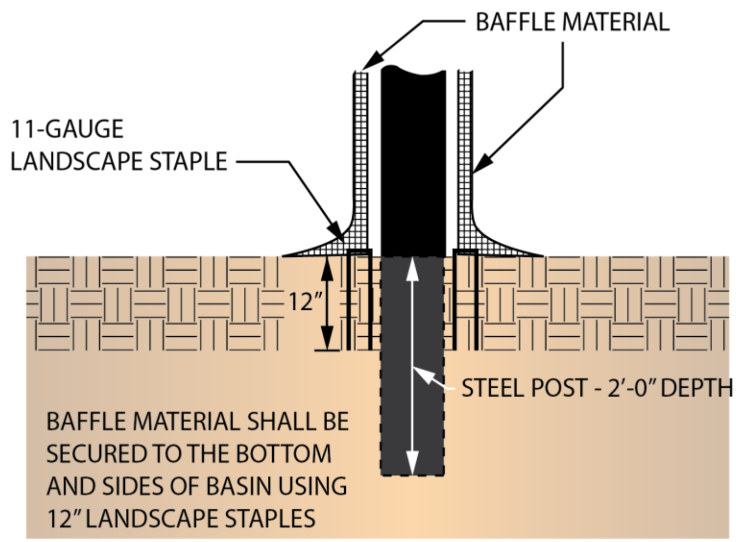
Sediment Control Measures that Require Coir Fiber Baffles

- Riser Basin
- Silt Basin - Type B (at drainage outlets)
- Skimmer Basin
- Tiered Skimmer Basin
- Infiltration Basin
- Temporary Rock Sediment Dam – Type A
- Temporary Rock Sediment Dam – Type B
- Earthen Dam with Skimmer
- Stormwater Basin with Skimmer
- Stilling Basin

4.7.8 Coir Fiber Baffle (1640.01)



SIDE VIEW



CROSS SECTION

4.7.8 Coir Fiber Baffle (1640.01)

Material Specifications

- Coir fiber mat, posts, wire and wire staples shall meet the requirements of Section 1640-2 of the Standard Specifications.
- The coir fiber mat shall have a minimum width of 6.5 feet.
- Matting should be provided to meet the requirements of the Standard Specifications Table 1640-1 in Section 1640-2, as shown below:

Table 1640-1 Coir Fiber Mat Properties

Property	Requirement
Composition	100% coconut fiber (coir) twine woven into high strength matrix
Thickness	0.30" minimum
Tensile Strength	1,348 x 626 lb/ft minimum
Elongation	34% x 38% maximum
Flexibility (mg-cm)	65030 x 29590
Flow Velocity	Observed 11 ft/sec
Weight	20 oz/yd^2
Size	6.6 x 164 ft (120 yd^2)
"C" Factor	0.002
Open Area (measured)	50%

Staples

- Provide staples made of 0.125-inch diameter new steel, 11-gauge wire formed into a U-shape not less than 12 inches in length with a throat of 1 inch in width.

Posts

- Provide steel posts at least 5 feet in length, approximately 1 $^3/_8$-inches wide measured parallel to the fence with a minimum weight of 1.25 lb/ft of length.
- Equip the post with an anchor plate having a minimum area of 14.0 square inches and of the self-fastener angle steel type to provide a means of retaining the wire and coir fiber mat in the desired position without displacement.

Wire

- Provide a 9-gauge high tension wire strand of variable lengths.

NCDOT ESC Erosion & Sediment CONTROL MANUAL

4.7.8 Coir Fiber Baffle (1640.01)

Construction Specifications

When to Install	• **Install the coir fiber baffles immediately upon construction of the sediment dams and basins.** • **Install 3 baffles in the sediment control device at a spacing of ¼ the basin length.** • **Install only 2 baffles at a spacing of 1/3 the basin length, if the impoundment area of the device is less than 20 feet in length.** • **Use only 1 baffle for basin lengths less than 10 feet.**
How to Install	• **Install 5-foot steel T-posts to a minimum depth of 2 feet and maximum spacing of 4 feet.** • **Attach 9-gauge minimum high tension wire to the top of the posts so that the coir fiber mat can be draped over it to measure a minimum of 3 feet in height.** • **Secure the bottom of the coir fiber mat with 12-inch staples at a maximum spacing of 12 inches.** • **Install 5-foot T-posts into the side slopes of the basin to anchor the nearest vertical post.**

Technician's Checklist

- Baffle locations shall be consistent with the requirements of the E&SC plans.
- Confirm there are 3 baffles in the basins and sediment dams with a spacing of 1/4 of the length when the device is > 20 feet.
- Confirm there are 2 baffles in the basins and sediment dams with a spacing of 1/3 of the length when the device is < 20 feet.
- Confirm there is 1 baffle in devices that are < 10 feet.
- Confirm that the coir fiber mat meets the requirements for weight and opening.
- The fence posts shall meet the specification requirements and be installed to a depth of 2 feet.
- There should be at least 3 feet of coir fiber draped on each side of the wire strand.
- Secure the bottom with staples at 12 inches on center.

Over time, accumulated silt should be removed and deteriorated baffles repaired.

Measurement & Payment

Pay Items	Pay Units
Coir Fiber Baffle	**Linear Foot**

4.7.8 Coir Fiber Baffle (1640.01)

Maintenance

- Inspect baffles on a regular basis and after each significant rainfall event. Make any repairs immediately.
- Inspect coir fiber baffle to be sure the ends of the mat are anchored into the ground or side slopes with staples.
- At a minimum, remove sediment from the device when it reaches ½ the baffle height, and do not damage the baffles during sediment cleanout.
- Remove and replace deteriorated or clogged baffles.
- Install additional posts or wire backing if baffle is sagging.

Typical Problems

- Baffles are not secured appropriately to the ground and side slopes.
- The appropriate number of baffles is not used.
- Baffles are not spaced in accordance with design criteria.
- Silt and debris is not removed and allowed to accumulate.

4.7.9 Earthen Dam with Skimmer (Detail)

Practical Tips

- Utilize where ditch grades are less than 2%
- Matting should be unrolled and applied loosely without stretching.
- Geotextile should lay smoothly, but loosely on soil surface without creases.

Definition

An earthen dam with skimmer is used in roadway ditches to remove sediment from construction site runoff at locations specified in the Erosion and Sediment Control plans. Components of the earthen dam with skimmer include the construction of an earthen dam, installation of coir fiber baffles, and installation of a skimmer.

Areas of Use

- In roadway ditches, typically ditches with large cross-section (i.e., base ditches)

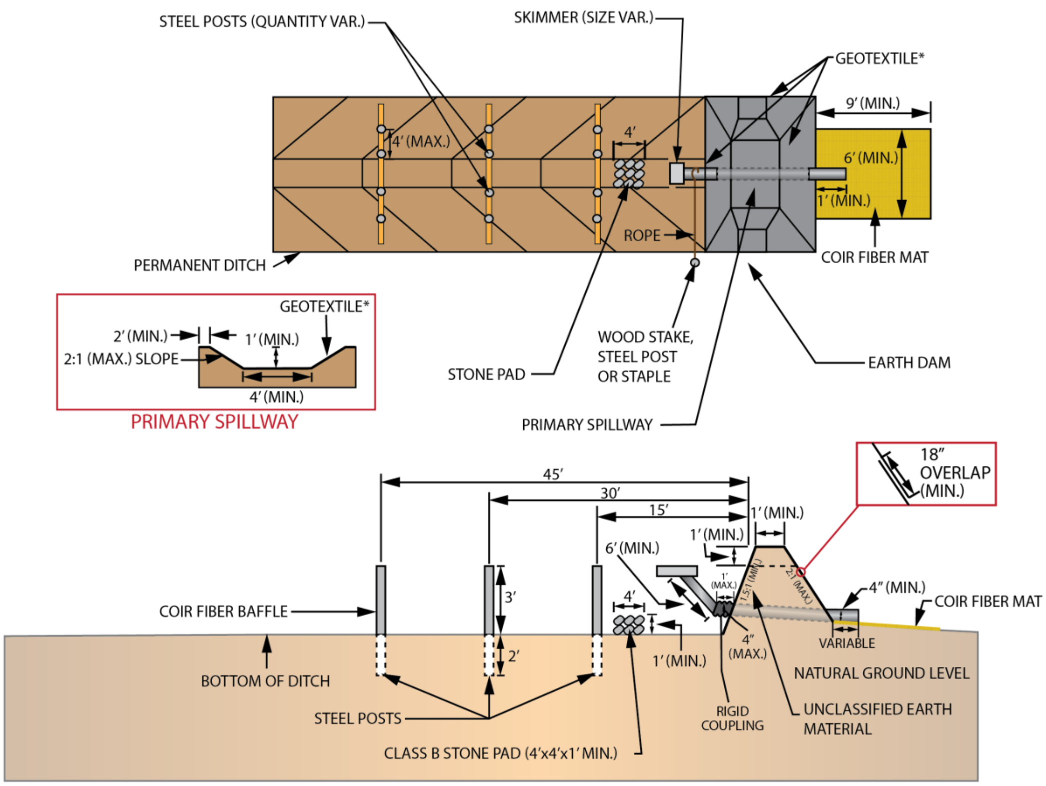
The skimmer orifice is designed to dewater the device in 2 to 3 days per the NCDOT Earthen Dam with Skimmer Design Spreadsheet.

4.7.9 Earthen Dam with Skimmer (Detail)

Design Criteria

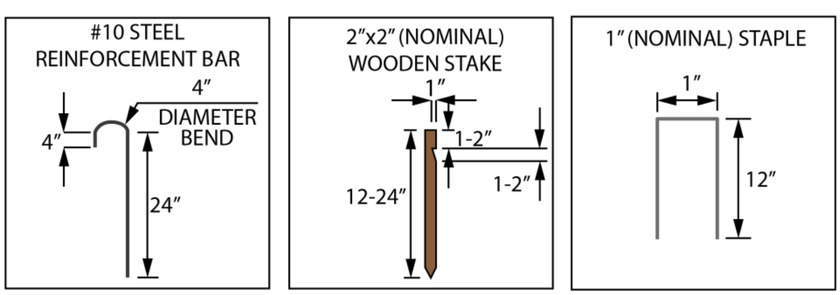
- The drainage area should be 10 acres or less.
- The ditch sediment storage depth should be at least 2 feet.
- The earthen dam height should be limited to 5 feet.
- The minimum detention volume should be 1,800 cubic feet per acre of disturbed area.
- The minimum ponded surface area should be 325 square feet per cfs of Q_{10} or Q_{25} peak inflow.
- The dewatering time should be between 48 hours and 72 hours.
- The primary spillway should carry the peak runoff from the design storm with a minimum 1 foot of storage depth in the spillway.
- The primary spillway weir length (feet) should be equal to Q/0.4, where Q is the flow rate (cfs) in the ditch.
- The minimum primary spillway weir length should be 4 feet.
- A minimum of 3 coir fiber baffles should be installed in the ditch with the earthen dam with skimmer with a spacing of 15 feet.
- The NCDOT Earthen Dam with Skimmer Designer Spreadsheet should be used to design the earthen dam with skimmer.
  http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/erosion_control/downloads.html

4.7.9 Earthen Dam with Skimmer (Detail)



PLAN VIEW, CROSS SECTION AND PRIMARY SPILLWAY (NOT TO SCALE)

** LOW PERMEABILITY GEOTEXTILE FOR EAST AREAS - DIVISIONS 1, 2, 3, 4, AND 6.*
PLACE A 6-INCH BAND OF SEALANT AROUND THE INTERIOR FACE OF THE OUTLET BARREL PIPE.



COIR FIBER MATT ANCHOR OPTIONS

4.7.9 Earthen Dam with Skimmer (Detail)

Material Specifications

- The skimmer should meet the requirements of the Erosion and Sediment Control plan.
- The geotextile should meet the requirements of Section 1056 of the Standard Specifications for Type 2 Fabric. For areas in the east, Divisions 1, 2, 3, 4, and 6, low permeability geotextile should be used.
- Coir fiber baffles should meet the requirements of Section 1640 of the Standard Specifications.
- Coir fiber mat should meet the requirements of Section 1060-14 of the Standard Specifications.
- Permanent or temporary seed should meet the requirements of Section 1060-4 of the Standard Specifications.
- Fertilizer for temporary seed should meet the requirements of Section 1060-2 of the Standard Specifications.
- Matting for erosion control should meet the requirements of Section 1060-8 of the Standard Specifications.
- All embankment material should be considered unclassified earth.
- Structural stone shall be Class B stone that meets the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class B.
- Staples should meet the requirements of Section 1060-8 of the Standard Specifications.

Geotextile Property	Test Method	Value	Unit
Tensile Strength	ASTM D4632	315	lb
Tensile Elongation (Maximum)	ASTM D4632	15	%
Trapezoidal Tear	ASTM D4533	120	lb
CBR (California Bearing Ratio) Puncture	ASTM D6241	900	lb
UV Resistance (% retained at 500 hrs.)	ASTM D4355	70	US Std. Sieve
Apparent Opening Size (AOS)	ASTM D4751	40	%
Permittivity	ASTM D4491	0.05	sec^{-1}
Water Flow Rate	ASTM D4491	4	$gal/min/ft^2$

4.7.9 Earthen Dam with Skimmer (Detail)

Construction Specifications

Installation	• Construct the earthen dam with skimmer according to the Erosion and Sediment Control plan with the ditch and dam surfaces free of obstructions, debris and pockets of low-density material. • Assemble and install the skimmer as instructed by the manufacturer. • Place a 6-inch band of sealant around the interior face of the outlet barrel pipe. • Depending on the expected time period for which the earthen dam is designed, permanently or temporarily seed all bare side slopes of the ditch.
Dimensions	• Limit the dam height to 5 feet. • Install the skimmer a minimum of 1 foot from the bottom of the ditch.
Matting	• Install coir fiber matting under the outlet of the skimmer with minimum dimensions of 9 feet long by 6 feet wide. • Install matting for erosion control on exposed side slopes after seeding is completed.
Geotextile	• Unroll the geotextile on the spillway in the direction of flow, with edges buried at least 6 inches deep. The geotextile should be one continuous piece of material or overlapped a minimum of 18 inches. For Divisions 1, 2, 3, 4, and 6 in the eastern part of the state, use a low permeability geotextile. • Shall be placed at the bottom and across the entire width of the ditch berm and according to the Earthen Dam with Skimmer detail.
Baffles	• Install 3 coir fiber baffles in the ditch beginning 15 feet upgrade from the primary spillway, each with a spacing of 15 feet. Refer to the section on coir fiber baffles.
Stone	• Install a Class B stone pad (4 feet by 4 feet by 12 inches high) directly underneath the skimmer device.

4.7.9 Earthen Dam with Skimmer (Detail)

Anchors	• **Anchor the coir fiber mat with wooden stakes, steel reinforcement rebar or metal staples. Anchors shall be at the ends of the matting approximately 1 foot apart and along outer edges and down the center of the matting 3 feet apart.** • **Anchor the geotextile with 6-inch staples and a maximum spacing of 3 feet horizontally and vertically.** • **Wooden stakes shall be 12-inch to 24-inch long with a 2"x 2" nominal square cross section. One end of the stake must be sharpened or beveled. The other end needs to have a 1-inch to 2-inch long head at the top with a 1-inch to 2-inch notch to secure the mat.** • **Steel reinforcement bars shall be uncoated, #10 rebar that are 24 inches long. The bars shall have a 4-inch diameter bend at one end with a 4-inch straight section at the tip to catch and secure the coir fiber mat.** • **Staples shall be made of 0.125-inch diameter 11-gauge new steel wire formed into a U shape not less than 12 inches long with a throat of 1 inch wide.**
Primary Spillway	• **Construct the primary spillway with a trapezoidal cross-section to a depth of 12 inches and a minimum base width of 4 feet.**
Skimmer	• **Provide Schedule 40 PVC arm pipe with a length of 6 feet to attach the skimmer to the coupling at the barrel pipe.** • **For skimmer sizes 2.5 inches and smaller, the arm pipe diameter shall be 1.5 inches.** • **For skimmer sizes of 3 inches and larger, refer to the manufacturer recommendation for arm pipe diameter.** • **Provide a 4-inch diameter Schedule 40 PVC pipe to attach to the coupling connection of the skimmer and serve as the barrel pipe through the earthen dam.**

4.7.9 Earthen Dam with Skimmer (Detail)

Technician's Checklist

- Do not change the location, shape or size of the earthen dam without consulting with the Engineer.
- Verify the area where the earthen dam is to be placed is permitted for the activity.
- Verify the area where the dam is proposed will be suitable for the device. Consider the soil type, water table, ditch grade and accessibility.
- Maintain access to the earthen dam at all times so that it can be cleaned as needed.
- Remove the device at the end of the project.
- Meet the requirements of the plans or Standard Drawings for the pipe, earth dam, skimmer, spillway and baffles.
- Install the Class B stone pad beneath the skimmer location to prevent the skimmer from being buried in and clogged with sediment and debris if the water elevation becomes low.
- Construct the dam with clay soil and compact to prevent basin water seepage into the dam.
- Seed and mat the remainder of interior and exterior slope areas not covered with geotextile.
- The geotextile should be one continuous piece of material or overlapped a minimum of 18 inches.

Measurement & Payment

The construction of the earthen dam will be paid for as Borrow Excavation as provided in Section 230 of the Standard Specifications or included in the lump sum price for grading.

Pay Items	Pay Units
Silt Excavation	**Cubic Yard**
Coir Fiber Mat	**Square Yard**
Geotextile for Drainage	**Square Yard**
Low Permeability Geotextile	**Square Yard**
__" Skimmer	**Each**
Riprap, Class ___	**Ton**
Seed for Temporary Seeding	**Pound**
Fertilizer for Temporary Seeding	**Ton**
Coir Fiber Baffles	**Linear Foot**
Matting for Erosion Control	**Square Yard**

4.7.9 Earthen Dam with Skimmer (Detail)

Maintenance

- Inspect the dam on a regular basis and after every significant rainfall event (1/2 inch or greater).
- Clean out the ditch and baffles when sediment accumulations reach approximately one-half the height of the first baffle. Silt should also be removed from the earthen dam on a regular basis.
- Check the skimmer to make sure that it is not clogged with sediment.
- Check the geotextile lined spillway for damage.
- Check the coir fiber mat at the outlet of the skimmer to determine if it is in need of replacement.
- During winter, support the skimmer at an angle such that water does not stand inside the barrel. This could result in the water freezing and plugging the skimmer or cracking the PVC.
- Reseed and replace matting on the side slope areas that have eroded or have become damaged by equipment from silt cleanout.
- Remove sediment that may accumulate on the stone pad underneath the skimmer device.
- Inspect the baffles after each rain event for erosion damage and sediment accumulations.

Typical Problems

- Dams are not constructed to the dimensions specified on the plans and result in inadequate capacities.
- Silt accumulations are not removed when needed.
- The ditch is too deep and causing a safety concern.
- The skimmer becomes clogged.
- The stone pad beneath the skimmer device becomes covered with sediment and the skimmer becomes embedded in the bottom of the ditch.
- The geotextile for the primary spillway is not keyed in well, water washes underneath it, and the dam fails.
- Water flows under or around the coir fiber baffles and settling time decreases instead of increases.
- Equipment damages side slopes of the ditch or dam during silt cleanout.
- Erosion of the side slopes causes excess sediment to wash into the ditch.

4.7.10 Stormwater Basin with Skimmer

Practical Tips

- **Good compaction and suitable material for the berm for the stormwater basin is required.**
- **If the designed size of the stormwater basin is too large for allowable footprint, consider using flocculant up gradient.**

Definition

A stormwater basin with skimmer uses the location of proposed permanent stormwater basins to remove sediment from construction site runoff at locations specified in the Erosion and Sediment Control plans. Components of the stormwater basin with skimmer include the construction of a basin, installation of coir fiber baffles, and installation of a skimmer. At the conclusion of construction, the riser is removed and grouted.

Areas of Use

- At proposed permanent stormwater basins, if indicated in the Erosion and Sediment Control plans

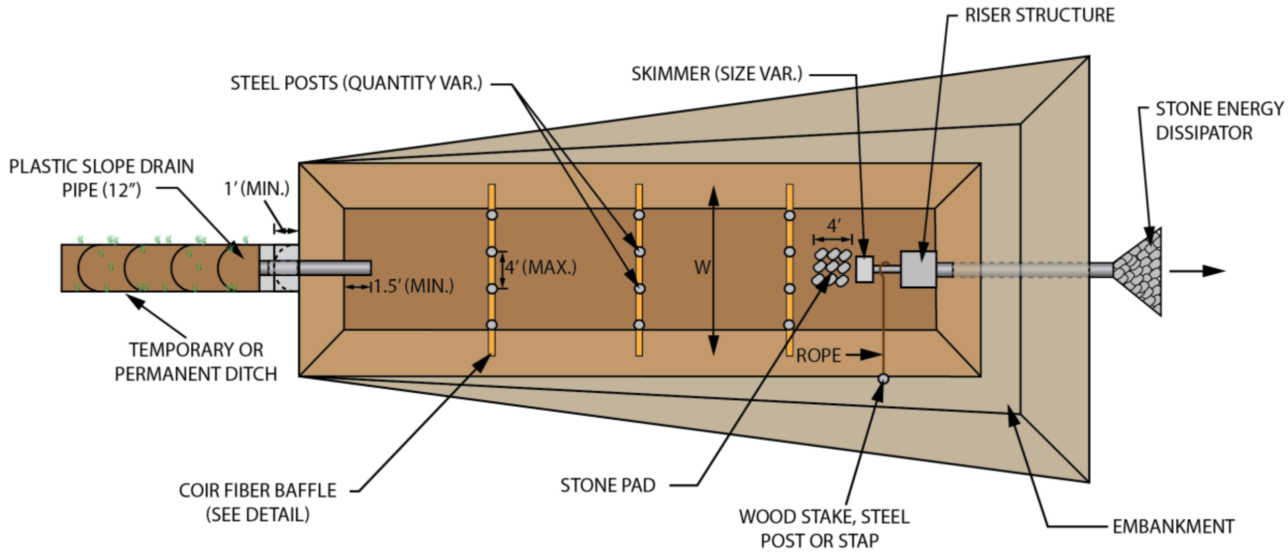
The skimmer orifice is designed to dewater the basin in 2 to 3 days per the NCDOT Stormwater Basin with Skimmer Design Spreadsheet.

4.7.10 Stormwater Basin with Skimmer

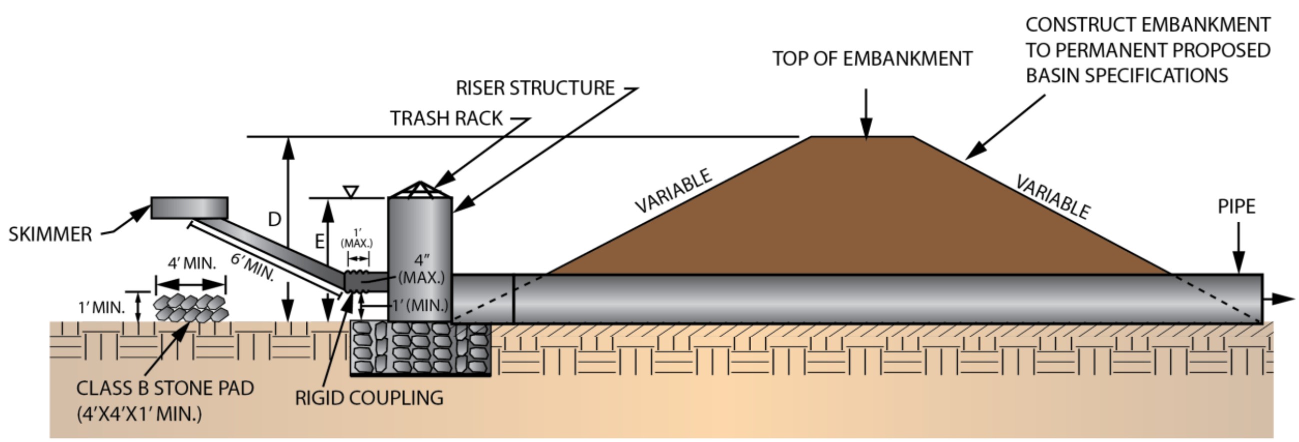
Design Criteria

- The drainage area should be 10 acres or less.
- The basin depth should be at least 2 feet.
- The basin length-to-width ratio should be at least 2:1 but should not exceed 6:1.
- The minimum detention volume should be 1,800 cubic feet per acre of disturbed area.
- The minimum ponded surface area should be 435 square feet per cfs of Q_{10} or Q_{25} peak inflow.
- The dewatering time should be between 48 hours and 72 hours.
- The primary spillway is the skimmer. The skimmer dewaters the water quality volume designed.
- The emergency spillway is the riser. The riser provides an emergency bypass for the runoff from the design storm.
- The riser should conform to the guidance given in the most current NCDOT Best Management Practices (BMP) Toolbox for stormwater basin with skimmer design standards.
- From the drawing, "E" is the design storm elevation or the invert elevation of the riser; "D" is the height of the embankment. For requirements associated with dimension "D", refer to the most recent version of the NCDOT BMP Toolbox.
- A minimum of 3 coir fiber baffles should be installed in the stormwater basin with skimmer.
- The NCDOT Stormwater Basin with Skimmer Designer Spreadsheet should be used to design the stormwater basin with skimmer.
  http://www.ncdot.gov/doh/operations/dp_chief_eng/roadside/soil_water/erosion_control/downloads.html

4.7.10 Stormwater Basin with Skimmer



PLAN VIEW (NOT TO SCALE)



SECTIONAL VIEW (NOT TO SCALE)

4.7.10 Stormwater Basin with Skimmer

Material Specifications

- The skimmer should meet the requirements of the Erosion and Sediment Control plan.
- Coir fiber baffles should meet the requirements of Section 1640-2 of the Standard Specifications.
- Coir fiber mat should meet the requirements of Section 1060-14 of the Standard Specifications.
- Permanent or temporary seed should meet the requirements of Section 1060-4 of the Standard Specifications.
- Fertilizer for temporary or permanent seed should meet the requirements of Section 1060-2 of the Standard Specifications.
- Matting for erosion control should meet the requirements of Section 1060-8 of the Standard Specifications.
- All embankment material should be considered unclassified earth.
- Structural stone shall be Class B stone that meets the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class B.
- Staples should meet the requirements of Section 1060-8 of the Standard Specifications.
- Plastic Slope Drain Pipe should meet the requirements of Section 1622-2 of the Standard Specifications.
- Pipe connecting the skimmer to the riser structure shall be Schedule 40 PVC.

Construction Specifications

Installation	• **Construct the stormwater basin with skimmer according to the Erosion and Sediment Control plan with the basin surfaces free of obstructions, debris and pockets of low-density material.** • **Assemble and install the skimmer as instructed by the manufacturer.** • **Place a 6-inch band of sealant around the interior face of the outlet barrel pipe.** • **Depending on the expected time period for which the stormwater basin is designed, permanently or temporarily seed all bare side slopes of the ditch.**
Dimensions	• **Limit the dam height to 12 feet. Refer to NCDOT BMP Toolbox for dam height dimensions.** • **Install the skimmer a minimum of 1 foot from the bottom of the basin.** • **The basin width should be 3 times the depth of the basin. For a basin depth of 3 feet, the minimum basin width should be 9 feet.**
Matting	• **Install matting for erosion control on exposed side slopes after seeding is completed.**
Baffles	• **Install 3 coir fiber baffles in the stormwater basin with a spacing of ¼ the basin length. Refer to the section on coir fiber baffles.**

4.7.10 Stormwater Basin with Skimmer

Anchors	• **Anchor the coir fiber mat with wooden stakes, steel reinforcement rebar or metal staples.** • **Anchors shall be at the ends of the matting approximately 1 foot apart and along outer edges and down the center of the matting 3 feet apart.** • **Anchor the geotextile with 6-inch staples and a maximum spacing of 3 feet horizontally and vertically.** • **Wooden stakes shall be 12-inch to 24-inch long with a 2"x 2" nominal square cross section. One end of the stake must be sharpened or beveled. The other end needs to have a 1-inch to 2-inch long head at the top with a 1-inch to 2-inch notch to secure the mat.** • **Steel reinforcement bars shall be uncoated, #10 rebar that are 24 inches long. The bars shall have a 4-inch diameter bend at one end with a 4-inch straight section at the tip to catch and secure the coir fiber mat.** • **Staples shall be made of 0.125-inch diameter 11-gauge new steel wire formed into a U shape not less than 12 inches long with a throat of 1 inch wide.**
Stone	• **Install a Class B stone pad (4 feet by 4 feet by 12 inches high) directly underneath the skimmer device.** • **Install stone energy dissipater at outlet.**
Skimmer	• **Provide Schedule 40 PVC arm pipe with a length of 6 feet to attach the skimmer to the coupling at the barrel pipe.** • **For skimmer sizes 2.5 inches and smaller, the arm pipe diameter shall be 1.5 inches.** • **For skimmer sizes of 3 inches and larger, refer to the manufacturer recommendation for arm pipe diameter.** • **Provide a 4-inch diameter Schedule 40 PVC pipe to attach to the rigid coupling connection of the skimmer and serve as the barrel pipe through the earthen dam and tie into the riser.**
Riser	• **Construction specifications should conform to the methods outlined in the most recent version of the NCDOT BMP Toolbox.**

4.7.10 Stormwater Basin with Skimmer

Technician's Checklist

- Do not change the location, shape or size of the stormwater basin without consulting with the Engineer.
- Verify that the area where the stormwater basin is to be placed is permitted for the activity.
- Verify that the area where the basin is proposed will be suitable for the device. Consider the soil type, water table, ditch grade and accessibility.
- Maintain access to the basin at all times so that it can be cleaned as needed.
- At conclusion of construction, the remove the riser and grout.
- Meet the requirements of the plans or Standard Drawings for the pipe, earth dam, skimmer, spillway and baffles.
- Install the Class B stone pad beneath the skimmer location to prevent the skimmer from being buried in and clogged with sediment and debris if the water elevation becomes low.
- Compact the dam with clay soil to prevent seepage and failure.
- Seed and mat the interior and exterior slope areas.

Measurement & Payment

The construction of the earthen dam will be paid for as Borrow Excavation as provided in Section 230 of the Standard Specifications or included in the lump sum price for grading.

Pay Items	Pay Units
Silt Excavation	**Cubic Yard**
Coir Fiber Mat	**Square Yard**
Low Permeability Geotextile	**Square Yard**
__" Skimmer	**Each**
Riprap, Class ___	**Ton**
Seed for Temporary Seeding	**Pound**
Fertilizer for Temporary Seeding	**Ton**
Seeding and Mulching	**Acres**
Coir Fiber Baffles	**Linear Foot**
Matting for Erosion Control	**Square Yard**
Temporary Slope Drains	**Linear Foot**

4.7.10 Stormwater Basin with Skimmer

Maintenance

- Inspect the basin on a regular basis and after every significant rainfall event (1/2 inch or greater).
- Clean out the basin and baffles when sediment accumulations reach approximately one-half the height of the first baffle. Silt should also be removed from the earthen dam on a regular basis.
- Check the skimmer to make sure that it is not clogged with sediment.
- Check the stone at the outlet to determine if it is in need of replacement or repair.
- During winter, support the skimmer at an angle such that water does not stand inside the barrel. This could result in the water freezing and plugging the skimmer or cracking the PVC.
- Reseed and replace matting on the side slope areas that have eroded or have become damaged by equipment from silt cleanout.
- Remove sediment that may accumulate on the stone pad underneath the skimmer device.
- Inspect the baffles after each rain event for erosion damage and sediment accumulations.

Typical Problems

- Basins are not constructed to the dimensions specified on the plans and result in inadequate capacities.
- Silt accumulations are not removed when needed.
- Erosion occurs at the inlet end when the basin is too deep.
- The basin is too deep and causing a safety concern.
- The skimmer becomes clogged.
- The stone pad beneath the skimmer device becomes covered with sediment, and the skimmer becomes embedded in the bottom of the basin.
- Water flows under or around the coir fiber baffles and settling time decreases instead of increases.
- Equipment damages side slopes of the basin during silt cleanout.
- Erosion of the side slopes causes excess sediment to wash into the basin.

4.8 Section

Managing the Watercourse

Occasionally projects require work in an existing waterway or the crossing of small streams and wetlands for brief periods of time. As a result, water must be temporarily diverted. This section outlines the proper procedures for temporarily diverting watercourses while minimizing impacts to the wetland or stream.

4.8.1 Temporary Stream Crossing (1645.01)

Practical Tips

- Do not utilize temporary stream crossings in areas of high flow.

Definition

Temporary stream crossings are utilized where construction traffic needs to travel over small streams and wetlands. The crossing consists of geotextile on the existing ground and pipe(s) installed to convey stream flow, with stone placed around the pipe(s).

Areas of Use

Install temporary stream crossings:

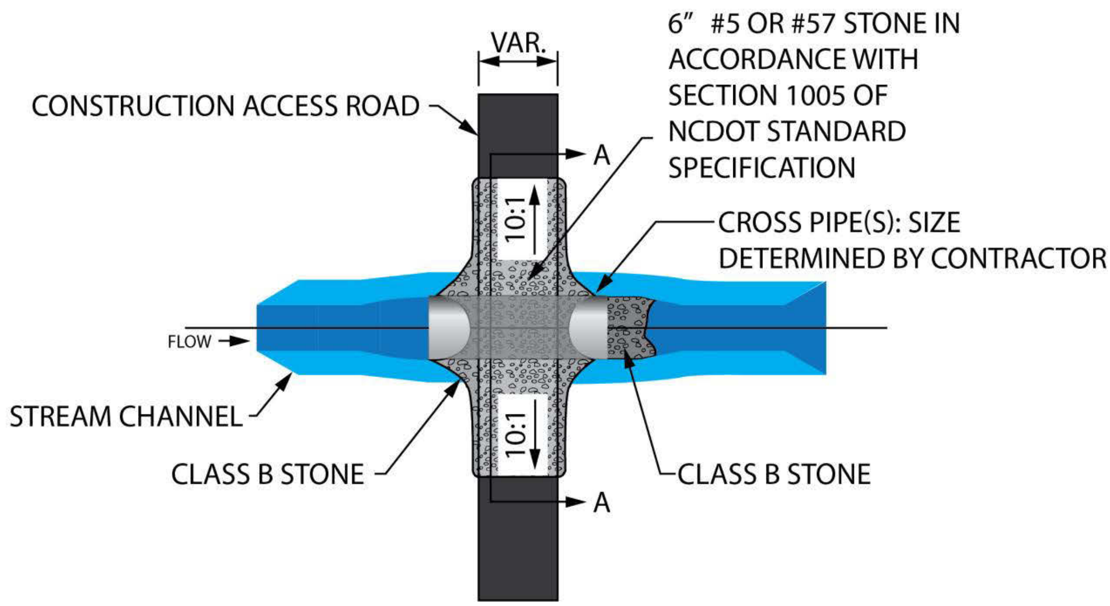
- On small streams or wetlands where construction vehicles need to travel from one side of the stream to the other for a short period of time

Plan ahead to have sediment control measures designed and installed at the four ditch line entry points at the temporary stream crossings.

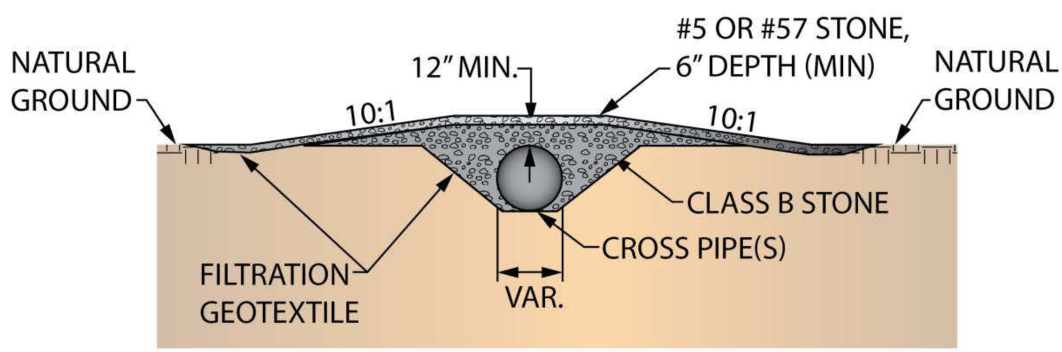
Design Criteria

- Pipe(s) for temporary stream crossing shall be designed to pass the peak or bankfull flow, whichever is less, from a 2-year storm, without overtopping.

4.8.1 Temporary Stream Crossing (1645.01)



PLAN VIEW



CROSS SECTION - PLAN VIEW REFERENCE A (NOT TO SCALE)

4.8.1 Temporary Stream Crossing (1645.01)

Material Specifications

- Filtration geotextile shall meet the requirements of Section 1056 of the Standard Specifications for Type 2 Geotextile.
- Class B stone shall meet the requirements of Section 1042 of the Standard Specifications for Stone for Erosion Control, Class B.
- No. 57 stone shall meet the requirements of Section 1005 of the Standard Specifications for this stone size.
- Temporary pipe(s) should have adequate strength to withstand stone and equipment loads.

Construction Specifications

The temporary stream crossing must be allowed in the project permits. The pipe for the crossing should be sized for the 2-year storm. Pipe sizing calculations should be reviewed by the Engineer. The crossing is paid for per unit pipe and stone. The smaller the pipe, the more stone is required. Larger pipe is less costly overall and reduces the amount of time spent hauling and/or removing stone.

Stream Crossing	• **Slope of approaches to the stream crossing should be no steeper than 10:1.** • **At a minimum, construct the width of the stream crossing to be the same as the construction access road.**
Geotextile	• **Place geotextile on the streambed channel, along streambanks and into flood plain at a minimum of 15 feet in width.**
Piping	• **More than one temporary pipe may be used, and size and number shall be included on the plans.**
Stone	• **Structural stone of the crossing shall be Class B and placed around the temporary pipe(s).** • **Class B stone shall be placed to a minimum of 12 inches over the pipe(s).** • **No. 57 stone shall be placed on top of the Class B stone at a minimum depth of 6 inches and tied into existing ground.**

4.8.1 Temporary Stream Crossing (1645.01)

Technician's Checklist

- Reference the permits to make sure they allow the crossing installation.
- Make sure the pipe sizing calculations have been received.
- Install the geotextile prior to the pipe and stone.

Using larger pipe will reduce the amount of stone required.

Measurement & Payment

Pay Items	Pay Units
Geotextile for Drainage, Type 2	Square Yard
Erosion Control Stone, Class B	Ton
Sediment Control Stone	Ton
Temporary Pipe for Stream Crossing	Linear Foot

Maintenance

- Inspect filtration geotextile, stone and pipe(s) after each significant rainfall.
- Replace geotextile and replenish the stone when they become contaminated with sediment.
- Damaged temporary pipe(s) should be repaired or replaced immediately.
- Replace any Class B or No. 57 stone that gets dislodged or damaged.
- Clean pipe(s) if clogged with debris.

The No. 57 stone will require replenishing if sediment builds up as a result of construction traffic.

Typical Problems

- Pipe(s) are damaged by vehicle traffic due to inadequate wall thickness.
- An inadequate amount of Class B stone around the pipe(s) causes the temporary stream crossing to dislodge and erode during a heavy rain event.
- The geotextile is not placed underneath the stone and pipe(s) properly causing runoff to undermine the device.
- Inadequate maintenance is performed.

4.8.1 Temporary Stream Crossing (1645.01)

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NCDOT ESC Erosion & Sediment CONTROL MANUAL

4.8.2 Impervious Dike

Practical Tips

- **Impervious dikes are used in stream channels, upstream of the project site, to anchor temporary pipe, and to create the side of temporary channels.**
- **When used for temporary diversion, install at the upstream location first.**

Definition

Impervious dikes are used to divert normal stream flow around a construction site. Acceptable materials for impervious dikes include, but are not limited to, sheet piles, sandbags and/or the placement of an acceptable size stone lined with polypropylene ("poly") or other impervious geotextile.

Sheet piles are a "Z" cross-section piling that is driven into the ground and interlocked to create a wall or bulkhead. Sheet piles can be used to detain water in low flow conditions or coupled with bypass pumps to keep a site moderately dry during construction.

Sand bags can be manually stacked to form a temporary impervious dike when encapsulated with an impervious poly-geotextile liner (note: liner is not always utilized with sandbags). This impervious dike can be used to impound or divert water and can be easily removed.

An impervious dike can also be created through the use of stone encapsulated with a high tensile impervious geotextile. This configuration can be used to either impound or divert water. This barrier can be constructed to conform to the shape of the existing channel.

4.8.2 Impervious Dike

Areas of Use

Do not use sheet piles in locations where rocks or obstructions prevent piles from being driven.

Sheet Piles

- Where minimum channel disturbance required
- Where this is the preferred method of sealing the work area from the water recourse for pipe sizes of 48 inches and greater
- Not in small channels with little or no flow
- Not where the access to drive piles requires more disturbance to the watercourse than other impervious dikes

Sandbags

- When low flow conditions exist
- When the height of the dike is less than 5 feet
- When heavy equipment cannot be utilized
- Not when using concrete in sand mixture

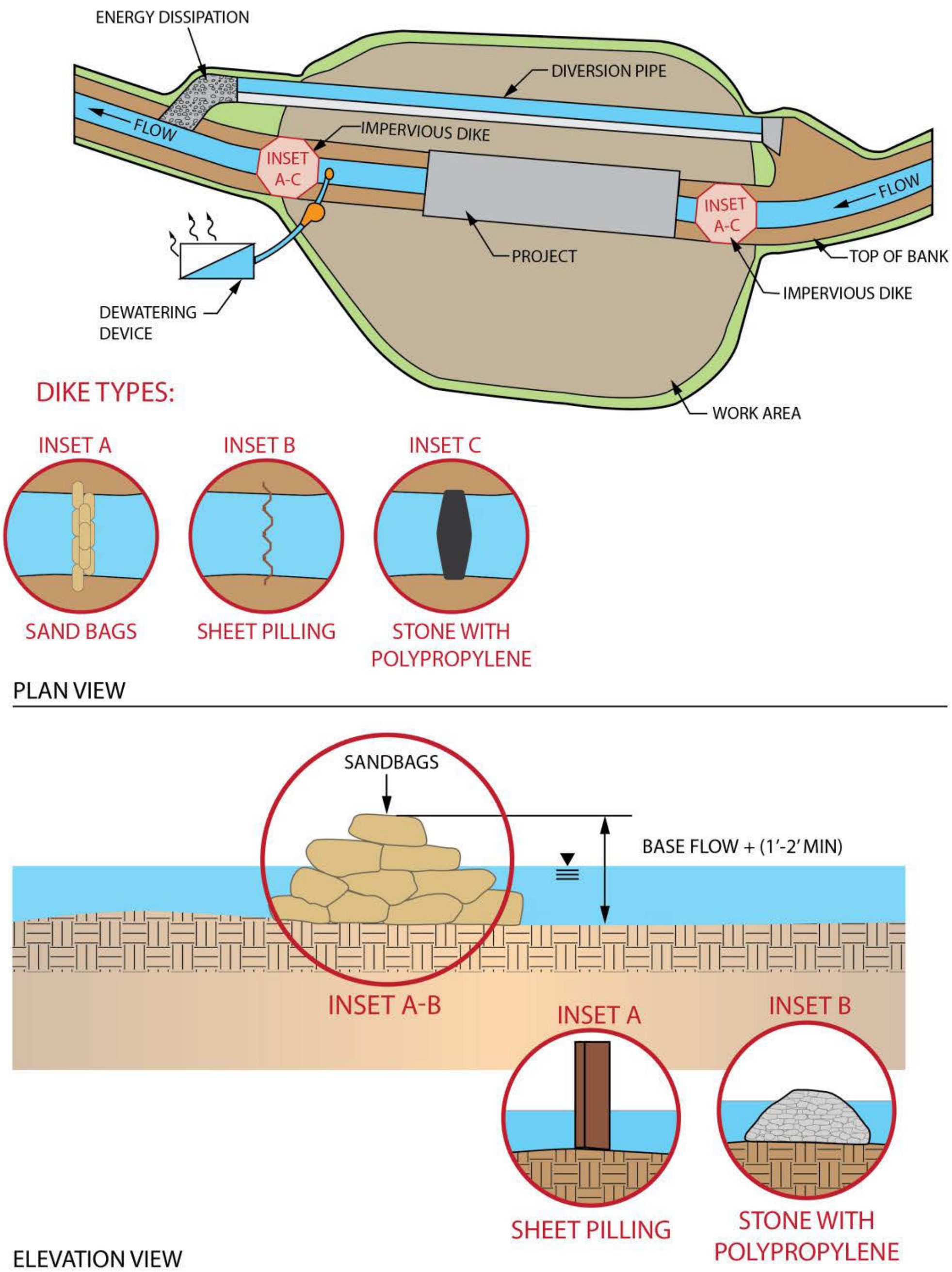
Stone Lined with Polypropylene

- When the size of the pipe is less than 48 inches
- When heavy equipment is available for installation
- When the channel has an irregularly shaped cross section

Design Criteria

- The dike height should be 1 foot higher (2 feet minimum height including base flow) than the stream base flow for sandbags and stone lined with polypropylene.
- Sheet piles should include a panel driven deeper to create a weir for overflow conditions.

4.8.2 Impervious Dike



4.8.2 Impervious Dike

Material Specifications

- Steel sheet piles detailed for temporary applications shall be hot rolled and meet the requirements of ASTM A328.
- The geotextile shall have low permeability and should be a polypropylene and/or polyethylene material.
- Proper geotextile certifications must meet Section 1056 of the Standard Specifications.

Construction Specifications

Sheet Pile

Specifications	• **Install the sheet pile by placing and driving piles with a backhoe, excavator, hammer or other suitable equipment.** • **Pile shall be free of dirt, grease and other potential contaminants before installation.** • **Penetrate to a sufficient depth in order to bear the load of water being diverted.** • **Overlap or interlock piles in a manner that prevents any seepage of water into the work area and prevents seepage of sediment from the work area into the stream.** • **Remove trapped debris and sediment prior to removing sheet pile.**

Sandbags

Specifications	• **Remove branches and large rocks from the area where the sand bags will be placed.** • **If using a liner, lay out the impervious poly-geotextile liner with the center of the liner located over the center of the sand bag dike.** • **Place the sandbags to the desired height. The dikes shall have a width suitable to support the height. Each row shall be offset so the joints are staggered. Pack sandbags tightly together.** • **Wrap impervious poly-geotextile liner around sandbag dike and secure with a final layer of sandbags.**

4.8.2 Impervious Dike

Stone Lined with Polypropylene

	• **Prepare the channel and overbanks for installation.** • **Remove all branches and debris from the area where the stone dike will be placed.** • **Make sure that there are no sharp rocks or roots that can puncture the geotextile.** • **Do not excavate the existing channel or banks.** • **Place the high tensile impervious geotextile with the center over the center of the proposed dike. Utilize a small amount of stone to hold down the geotextile while adjustments are being made.** • **There should be enough extra geotextile on each side of the dike to wrap up and over the stone dike to make it impervious.** • **Pile stone on top of the geotextile to create the dike structure.** • **Roll geotextile up over the stone to form an impervious dike.** • **Roll the top layer from the upstream to downstream direction. Secure geotextile with metal fence stakes or other suitable material.**

Technician's Checklist

- Never use earth material for an impervious dike unless vegetation can be established prior to direct contact with the stream takes place.
- Don't allow stone to enter water body or stream.
- Reclaim any sand or "unconsolidated material" from the stream as a result of bag rupture.
- Leave a sheet pile panel(s) at a lower elevation for overflow conditions.

Measurement & Payment

Impervious dikes will be measured and paid as the actual number of linear feet of impervious dike(s) constructed, measured in place from end to end of each separate installation that has been completed and accepted. Such price and payment will be full compensation for all work including but not limited to furnishing materials, construction, maintenance and removal of the impervious dike.

Pay Items	Pay Units
Impervious Dike	**Linear Feet**

4.8.2 Impervious Dike

Maintenance

Sheet Piles

- Inspect sheet piles daily for water leaks and signs of instability and implement repair procedures accordingly.

Sandbags

- Periodically inspect sandbag dike for damage and leaks and repair as needed.
- Remove impounded trash and sediment.

Stone Lined with Polypropylene

- Periodically inspect dike for damage and leaks and repair as needed.
- Remove impounded trash and sediment.

Typical Problems

Sheet Piles

- Improperly installed piles will leak.
- Piles not driven deep enough will fail under the pressure of the water.

Sandbags

- Leakage occurs due to improper construction or liner failure.
- Blow-outs may occur from large storm events.

Stone Lined with Polypropylene

- Leakage occurs through punctures in the poly.
- Blow-outs may occur from large storm events.
- Erosion occurs around the side of the dike.

4.8.3 Stilling Basin (1630.04)

Definition

A stilling basin is a rectangular-shaped basin formed by mounded soil with a permeable stone drain located at the outlet end. A stilling basin is used where water is pumped from construction sites. Sediment-laden water is pumped into the impoundment where heavier particles settle out, and then the water is allowed to drain back to the receiving stream.

Areas of Use

Install stilling basins in these locations:

- Where streams are diverted at culvert construction sites
- Where sediment-laden water at construction sites must first be treated before returning to natural streams
- At coffer dam sites
- Where large volumes of water will be pumped from the work area

Practical Tips

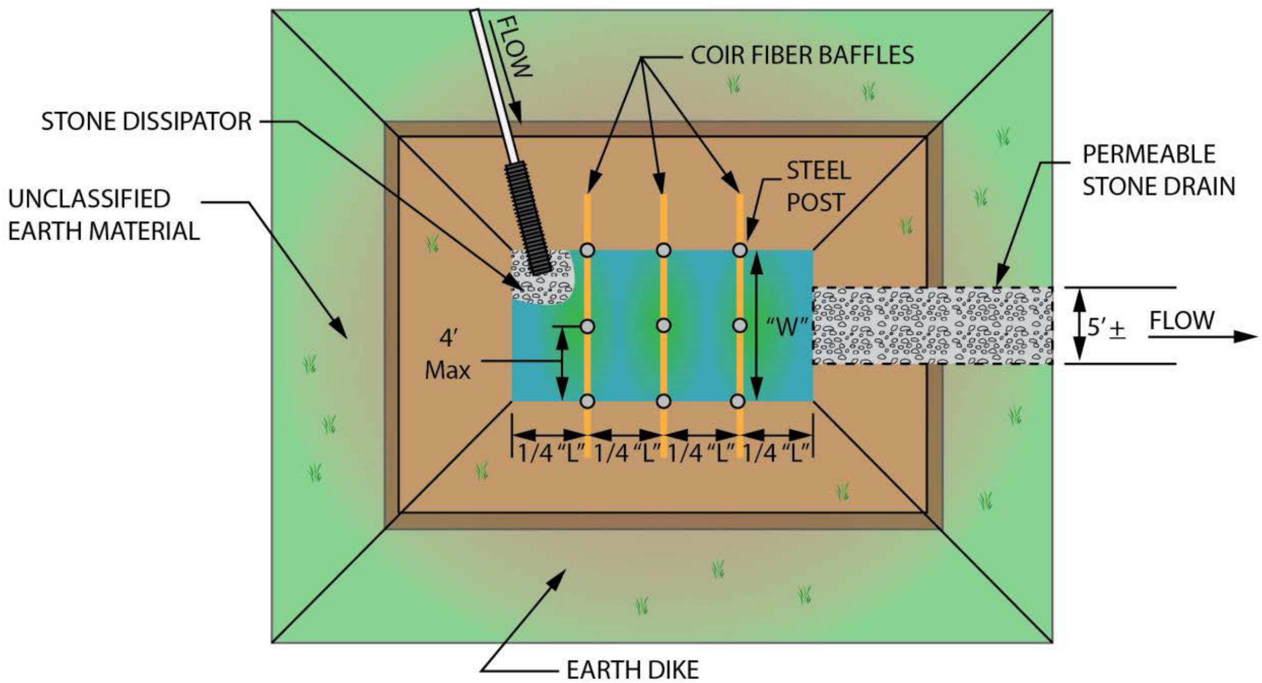
- **When determining the size of the basin, do not calculate any volume for depth below the water table or above the flow line of the overflow pipe.**
- **Coir fiber baffles are necessary to settle suspended solids.**
- **A flashboard riser or fabric lined spillway are acceptable substitutes for the permeable stone drain.**

- **Direct the pump outlet to a stone dissipater, not to the dikes or basin bottom.**
- **Monitor pump flow rate so that water is retained within the basin and suspended solids can settle.**

4.8.3 Stilling Basin (1630.04)

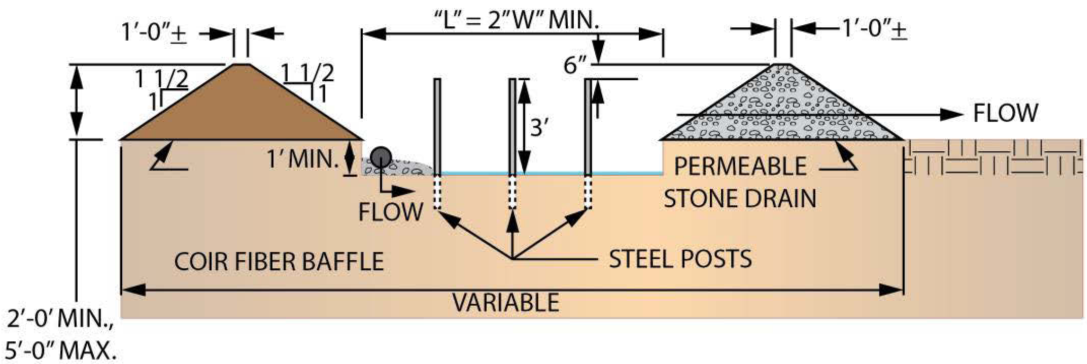
Design Criteria

- The stilling basin should not be placed in wetlands or Environmentally Sensitive Areas (ESA).
- The stilling basin should not be placed in areas of concentrated flows such as channels and ditches.
- The stilling basin size is variable and dependent on specific site requirements as well as proposed construction operations. Minimum design volumes are provided on the E&SC plans.
- The volume of the basin is only that which is above ground water elevation.



PLAN VIEW

4.8.3 Stilling Basin (1630.04)



CROSS SECTION

Material Specifications

- Unclassified earth material will be utilized for the embankments.
- Baffles shall meet the requirements of NCDOT's Standard Specifications Materials Section 1640-2.
- Stone to be utilized for permeable drain shall meet the requirements of Section 1042, Rip Rap Materials of NCDOT's Standard Specifications (see Table 1042-1, *Acceptance Criteria for Rip Rap and Stone for Erosion Control*).
- For all flocculant applications, follow the manufacturer's dosing instructions.

4.8.3 Stilling Basin (1630.04)

Construction Specifications

Basin	• **The height of the earthen dikes required for the stilling basin should not exceed 5 feet.** • **The length to width ratio of the basin should be a minimum of 2:1.** • **Non-vertical side slopes should be constructed and not greater than 1.5:1.** • **The use of geotextile or other plastic lining may be utilized to prevent erosion and resuspension.** • **A minimum of 1 foot below the bottom of the stone drain should be excavated.**
Baffles	• **Install a minimum of 3 coir fiber baffles in the basin, with a spacing of ¼ the basin length and in accordance with Section 1640 of the Standard Specifications.**
Outlet	• **The Engineer shall approve the size stone for the permeable drain.**
Flocculant	• **Prior to the flocculant application, obtain a soil sample from the project location, and analyze the sample for appropriate flocculant to be used for turbidity control.** • **Use liquid or solid flocculant to reduce turbidity.** • **Introduce liquid flocculant to the turbid water on the suction side of the pump while dewatering into the stilling basin.** • **For solid flocculant use, discharge turbid water over a solid block of flocculant so the product can disperse into the stilling basin.**

Technician's Checklist

Locate the basin so that the treated water can reach the outfall easily without creating further erosion.

- Place the basin on solid ground and construct as shown in the plans.
- Inspect the devices regularly and after significant rainfall.
- Tie the permeable stone drain into the dike. Use geotextile as necessary to keep the water from eroding under or around the stone.
- Install coir fiber baffles.
- Place the pump hose discharge as far as possible from the stone drain.
- Remove sediment as necessary to maintain effectiveness of the stilling basin. At a minimum, the basin should be cleaned out when it is 50% full of sediment.
- Check the basin often during the time that the pumps are running.
- Perform repairs immediately if any damage is identified within the basin or permeable drain.
- Maintain stabilization within the basin to prevent suspension of sediment. Discharge from large pumps can erode basin bottom.
- Never pump sediment–laden water directly into a stream.

4.8.3 Stilling Basin (1630.04)

Measurement & Payment

Pay Items	Pay Units
Stilling Basin	**Cubic Yard**
Silt Excavation	**Cubic Yard**

Maintenance

Maintenance of stilling basins is essential because water flow may become concentrated.

- Maintain the stilling basins, coir fiber baffles and remove and dispose of silt accumulations at the stilling basins in accordance with Section 1630 of NCDOT's Standard Specifications.
- Inspect the basin after each significant rainfall.
- At a minimum, clean out the basins when they are approximately 1/2 full.
- Stabilize earth embankment with temporary seed and mulch.
- Clean or replace stone for permeable outlet as needed.
- Inspect baffles after each day's use for erosion damage.
- Remove straw and other debris when needed.
- Remove the stilling basins as the project nears completion or at such time the Engineer deems the device is no longer useful. Prepare a seed bed and seed and mulch the area after removing the stilling basin in accordance with NCDOT Standard Specification Section 1660.

The stilling basin needs to be cleaned prior to losing its effectiveness. These basins are usually removed when the area to be pumped is completed.

Typical Problems

- Basins are not constructed to the volume on the plans resulting in inadequate storage capacities.
- If the basin is constructed with vertical side slopes, increased sediment loss occurs in the basin from accelerated erosion of side slopes.
- Accumulated sediment is not removed when needed.
- The basin does not drain due to clogged stone on permeable drain.
- Effluent causes erosion as it exits the basin.
- Discharge from large pumps erodes the basin bottom causing suspended silt and sediments.
- Stone is not keyed into the natural ground allowing water to wash under the stone drain.

4.8.4 Special Stilling Basin (1630.06)

Practical Tips

- **The special stilling basin can be used to filter pumped water during construction of drilled piers, footing excavation or culvert construction.**

Definition

A special stilling basin is commonly used when the dewatering of a work area is necessary and construction of a stilling basin is not feasible. It is a bag made of a nonwoven geotextile lying on a bed of sediment control stone. As effluent from the work area is pumped into the special stilling basin, water is slowly filtered out through the walls of the bag, leaving sediment trapped inside.

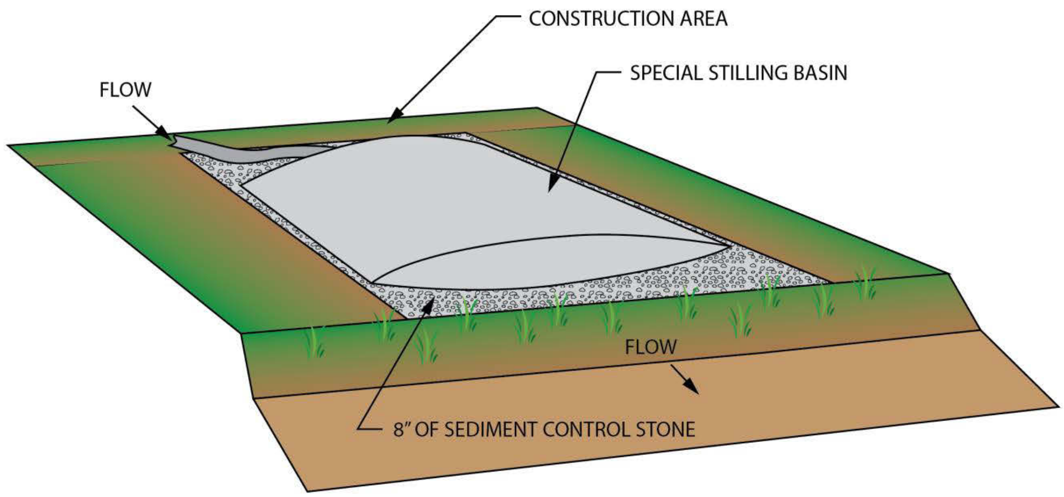
Areas of Use

Install special stilling basins in these locations:

- Where the excavation needed for construction of a stilling basin is not possible
- Where the effluent can be pumped out at a rate of 1,500 gallons per minute or less
- Where the construction activities will not require an extended period of time
- Around bridges with drilled pier construction where effluent will be pumped from the drilled shafts
- At outlets of Temporary Slope Drain pipes for sediment storage

Plan ahead to utilize a method that will allow the special stilling basin to be removed safely from the work area.

4.8.4 Special Stilling Basin (1630.06)



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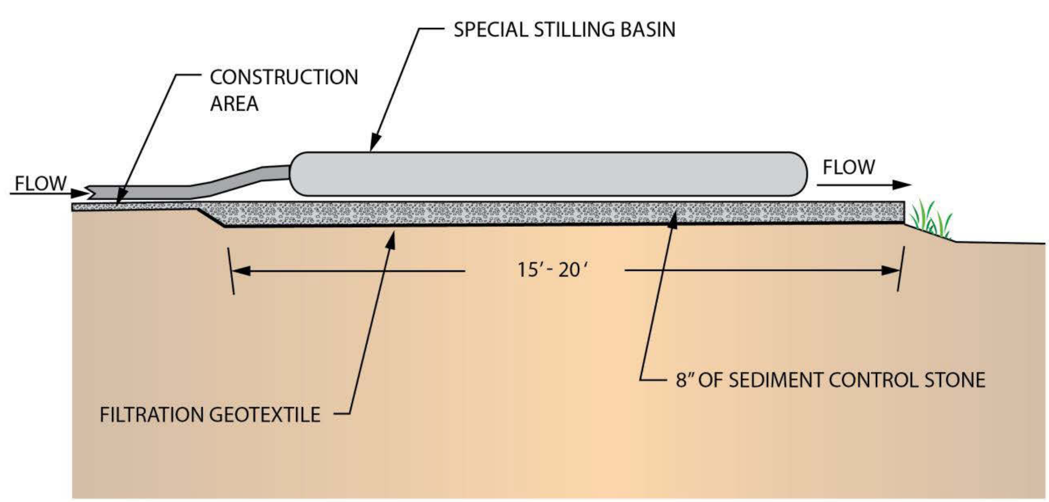

CROSS SECTION

4.8.4 Special Stilling Basin (1630.06)

Material Specifications

- Use a water permeable geotextile bag that 1) is designed to handle the pump flow rate or drain pipe flow; and 2) traps sand, silt and fines as sediment-laden water enters the bag.
- Provide a special stilling basin bag constructed to a minimum size of 10 feet x 15 feet made from a nonwoven geotextile. The bag shall meet the requirements of Section 1060-15 of the Standard Specifications.
- Stabilize the bag to provide resistance to UV degradation as indicated in Table 1639-1, NCDOT Standard Specifications Section 1639.
- Use No. 5 or No. 57 sediment control stone that meets the requirements of Section 1005 of the Standard Specifications for these stone sizes.
- Provide geotextile under the stone that meets the requirements of Section 1056 of the Standard Specifications for Type 2 Geotextile.

Construction Specifications

Special Stilling Basin	• **The bag shall be placed on a rock pad constructed of at least 8 inches of sediment control stone. The bag may also be placed on wooden pallets to elevate it above natural ground.** • **The rock pad should extend at least 1 foot past the bag on all sides.** • **The special stilling basin should be placed on level ground.** • **The bag should be installed in accordance with Section 1639 of the Standard Specifications.** • **The special stilling basin shall be placed so that incoming water flows into and through the bag without causing erosion.** • **Temporary slope drain pipe(s) or pump discharge hoses will be attached to the special stilling basin(s) so that water is routed directly into the special stilling basin(s).** • **The special stilling basin may be cut to allow slope drain pipe to be inserted if needed and tied off tightly. The remaining sleeve or spout of the bag, if present, may be used to connect more than one special stilling basin in series, as directed. If not used in this manner, the sleeve shall be tied off tightly to allow the bag to contain the effluent and force it to filter through the sides of the special stilling basin.** • **When being utilized in drilled pier construction, the special stilling basin should be constructed such that it is portable and can be used adjacent to each drilled pier.**

4.8.4 Special Stilling Basin (1630.06)

Technician's Checklist

- The permit should be checked for siting locations.
- Geotextile and stone or pallets should be used for the foundation.
- Special stilling basins must be inventoried and onsite.
- Special stilling basins should be a minimum of 10 feet x 15 feet.
- The discharge shall conform to permit requirements.
- A plan for removing full bags should be developed if one does not exist.

In areas of special water quality concern, place the special stilling basin(s) up grade and direct its runoff into a sediment control measure before being allowed to discharge.

Measurement & Payment

Pay Items	Pay Units
Special Stilling Basin	Each
Geotextile for Drainage	Square Yard
Sediment Control Stone	Ton

Maintenance

- The special stilling basin shall be disposed of and replaced when it is ¾ full of sediment or when it is impractical for the bag to filter the sediment out at a reasonable flow rate.
- The inlet of the bag should be inspected periodically for damage and/or blockage.
- Sediment control stone shall be replaced if damaged by high flows or bag failure.

Manage the pump's throttle to achieve maximum performance of the special stilling basin; flocculant use will aid in treating suspended clays.

4.8.4 Special Stilling Basin (1630.06)

Typical Problems

- Site conditions require too much flow to be pumped into the special stilling basin that causes the bag to rupture.
- The bag is not placed on level ground causing it to roll after water is pumped into it.
- Use continues when the bag is full.
- The spout becomes damaged or disconnected from the inlet pipe or hose.

4.8.4 Special Stilling Basin (1630.06)

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4.9

Section

Soil Stabilization

This section provides guidance on stabilizing disturbed areas of a project site. As a construction project progresses, completed areas and areas of inactivity must be stabilized. NCDOT's NPDES permit has specific requirements and time frames that must be followed.

It is one of NCDOT's BMPs to stabilize areas as quickly as possible to avoid erosion problems that could overwhelm erosion and sediment control devices.

4.9.1 Temporary Seeding

Practical Tips

- **Do not use temporary seeding as stage seeding. As a fill or cut is being constructed, the slope should be placed on grade and permanently seeded when it is approximately 10 feet high.**

Definition

Temporary seeding is intended to be a supplement to, and not a substitute for, other means for the control of erosion and sedimentation. Temporary seeding should be used when no work will be done on an erodible area for a period that does not exceed the requirements in the current NPDES permit for an area that is not to final line and grade. Permanently seed and mulch the area if it will remain idle beyond the growing season for temporary seed mix species.

If the effort to obtain a stand of grass is not successful the first time, additional efforts must be made to protect the area. Soil tests are recommended if an area has to be seeded more than once.

Areas of Use

Perform temporary seeding promptly under any of the following conditions as directed:

- When it is impossible or impractical to bring an area to the final line, grade and finish so that permanent seeding and mulching operations can be performed without subsequent serious disturbance by additional grading
- When erosion occurs or is considered to be potentially substantial on areas of graded roadbed where construction operations are temporarily suspended, or where the grading of the roadbed has been completed in advance of the paving construction
- During seasons of the year when permanent seeding and mulching is prohibited by the contract
- When an immediate cover would be desirable to minimize erosion, siltation or pollution on any area

4.9.1 Temporary Seeding

Material Specifications

- Fertilizer must meet the requirements of Section 1060-2 of the Standard Specifications.
- Seed must meet the requirements of Section 1060-4 of the Standard Specifications.
- Mulch for erosion control must meet the requirements of Section 1060-5 of the Standard Specifications.
- The analysis of fertilizer and the type of seed will be as stated in the contract.

The actual conditions of the site during the construction of the project will determine the quantity of seed or fertilizer to be used.

Construction Specifications

Seedbed Preparation

Specifications	• **Scarify areas to be seeded to a depth of not less than 5 inches unless directed otherwise. The soil conditions and topography will determine the required depth of the seedbed.** • **Prepare the surface to be seeded with adequate furrows, ridges, terraces, trenches or other irregularities in which seeding materials can lodge with reasonable assurance that the materials will not be easily displaced by wind, rain or surface runoff.**

Fertilizer and Seed Application

Specifications	• **The analysis of fertilizer, the type of seed and the rates of application of fertilizer and seed shall be as stated in the contract.** • **Do not apply fertilizer or seed if the Engineer determines conditions to be unfavorable for such operations.** • **Distribute the fertilizer or seed uniformly over the seedbed at the required rates of applications.** • **Cover fertilizer and seed unless otherwise directed. If covering is required, provide it to the depth acceptable to the Engineer for the prevention of displacement by wind, rain or surface runoff.** • **Mulch all areas temporarily seeded, in accordance with Standard Specifications Section 1615, unless otherwise indicated in the contract or as directed.** • **Standard Specifications Article 1660-5 governs the approval of equipment and the protection of traffic, structures, guardrails, traffic control devices and other appurtenances.**

4.9.1 Temporary Seeding

Technician's Checklist

- Permanently seed and mulch the area in lieu of temporary seeding, if possible.
- Advise the Contractor whether the temporary seeding that has been requested will be at contract unit price or at the Contractor's expense due to negligence in performing continuous grading.
- Provide ground cover to any exposed erodible slope that has remained ungraded for more than the number of days allowed in the latest NPDES permit.
- Establish a 5-inch seedbed.

Every effort must be made to obtain a proper seedbed. On solid undisturbed earth, the seedbed depth should be approximately 5 inches.

Measurement & Payment

- Seed for Temporary Seeding will be measured and paid in pounds. The weight of seed will be determined by bag count of standard weight bags or by weighing the seed.
- Fertilizer for Temporary Seeding will be measured and paid in tons. The weight of dry fertilizer will be determined by bag count of standard weight bags or by weighing the fertilizer in trucks on certified platform scales or other certified weighing devices.
- Temporary Mulching will be measured and paid in accordance with Standard Specifications Section 1615.
- Mowing will be measured and paid in accordance with Standard Specifications Article 1660-8. Where earthwork and temporary seeding have been adequately constructed, completely drained and properly maintained and damage occurs due to natural causes, the Contractor will be paid at the contract unit prices for applicable items (the excavated material required for repairs to the damaged earthwork, Seed for Temporary Seeding and Fertilizer for Temporary Seeding) for correcting the damaged temporary seeding.
- Repairs shall be made, at no cost to the Department, to any damage to earthwork or temporary seeding which is due to carelessness or neglect on the part of the Contractor.

Pay Items	Pay Units
Seed for Temporary Seeding	**Pounds**
Fertilizer for Temporary Seeding	**Tons**
Temporary Mulching	**Acres**

4.9.1 Temporary Seeding

Maintenance

- Maintain areas where temporary seeding is performed in a satisfactory condition (including mowing) at the locations and times as directed.
- Repair areas of temporary seeding which have been damaged or have failed. Repair includes reshaping or the placing of additional earth material and repeating the seeding process.

4.9.1 Temporary Seeding

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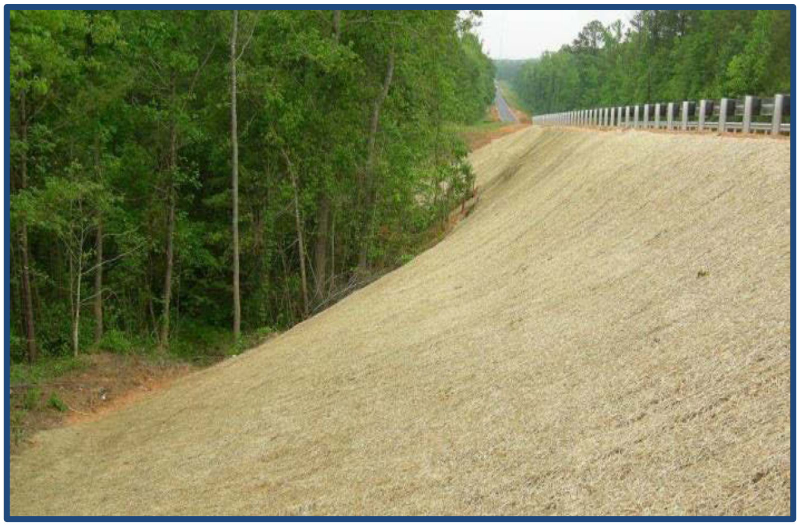
4.9.2 Temporary Mulching



Definition

Use temporary mulch to cover temporary seeding or bare ground. Temporary mulch is not intended as a long-term ground cover. If the area to be covered will remain undisturbed for more than 30 days, temporary seeding is recommended with temporary mulch.

Temporary mulch works by impeding the flow of water over the area, conserving moisture, providing shade and absorbing the impact of the rain drops. Mulch provides the benefit of holding the soil together as it is incorporated during the seed bed preparation for permanent seeding and mulching.

Practical Tips

- **Mulch can be displaced by traffic, wind and rain. As soon as the mulch is placed, cover it with sufficient binding material to maximize retention of mulch.**
- **Exposed erodible slopes must not remain bare longer than allowed by the current NPDES permit.**

Areas of Use

- During construction operations where it is impossible or impractical to perform permanent seeding and mulching

Material Specifications

- Mulch for erosion control must meet the requirements of Section 1060-5 of the Standard Specifications.
- In High Quality Waters (HQW), use an approved hydraulically applied binding agent.

In High Quality Water zones, which will be designated on the plans, asphalt is not recommended as a binding agent.

4.9.2 Temporary Mulching

Construction Specifications

Uniform Cover	• **Spread mulch uniformly over the area by hand or by means of appropriate mechanical spreaders or blowers to obtain a satisfactory uniform cover.** ○ **A satisfactory application of temporary mulch on non-seeded areas consists of a sufficient amount to completely and uniformly cover the ground.** ○ **When temporary mulching is performed in conjunction with temporary seeding, apply mulch in accordance with Standard Specifications Article 1660-6. Complete mulching and tacking within 24 hours of temporary seeding work. Exercise care to prevent displacement of soil and seed or other damage to areas of temporary seeding.**
Binding Agent	• **Apply a sufficient amount of asphalt or other binding material when using grain straw to assure that the temporary mulch is properly held in place.** ○ **Take adequate precautions to prevent hazards to traffic and damage to structures, guardrails, traffic control devices or any other appurtenances during the application of binding material. Provide adequate covering or change methods of application as required to prevent such damage. Repair any damage that occurs, including any necessary cleaning.**

Technician's Checklist

Great care should be used not to create ruts or to disturb the slope during the mulching or binder placement operations.

- Visually check coverage at the beginning of the operation so that adjustments can be made if necessary (2 tons/acre, 75% complete coverage, and no ground visible 10 feet ahead).
- Ask "Is the area in a **High Quality Water zone**?" It is recommended that the asphalt not be used in HQW zones unless approved by the Roadside Environmental Field Operations Engineer.
- Inspect the area to confirm that the proper binding agent is on site with the proper application equipment.
- Check the rate of binding agent application to confirm that it will serve its intended purpose.
- Check the Project Special Provisions to determine if crimping is required.

4.9.2 Temporary Mulching

Measurement & Payment

- Temporary Mulching will be measured and paid in acres, measured along the surface of the ground over which temporary mulch has been placed as directed and accepted.

Pay Items	Pay Units
Temporary Mulching	**Acres**

Maintenance

- At the time that seeding and/or mulching is being performed, temporary erosion and sediment control devices are normally in place. These devices lose their effectiveness when they are clogged with mulch. All mulch must be removed from these devices as soon as possible.
- Take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water or other causes and promptly remove any blockage of drainage facilities.

4.9.2 Temporary Mulching

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4.9.3 Seeding and Mulching

Practical Tips

- Adapt operation as needed for variations in weather or soil conditions to maximize the successful establishment of grasses or legumes.
- Mowing at the proper time is of great importance in the establishment of a permanent vegetative cover.

Definition

Seeding and mulching should be performed on all earth areas disturbed by construction and, as directed, where areas seeded under previous contracts have unsatisfactory vegetative cover.

Seeding and mulching are to be immediately performed on any area brought to line and grade, provided it is within a specified seasonal limitation for seeding and mulching, rather than waiting for the major portion of the project to be completed.

When seeding and mulching, the required line, grade and cross section of the area treated should be preserved.

Areas of Use

- Where the permanent establishment of vegetation from seed is needed on shoulders, slopes, ditches, borrow pits or other roadside areas

There is no difference between the methods and materials used to seed and mulch borrow pits and waste areas and those required for the roadway itself.

4.9.3 Seeding and Mulching

Coordination with Grading Operations

- Perform seeding and mulching operations on a section-by-section basis immediately upon completion of earthwork sections in accordance with the 2012 NCDOT Standard Specifications Article 225-2.

The contract will state the seasonal limitations for seeding operations, fertilizer specifications, seed specifications and the rates of application of limestone, fertilizer and seed.

Material Specifications

- Fertilizer must meet the requirements of Section 1060-2 of the Standard Specifications.
- Limestone must meet the requirements of Section 1060-3 of the Standard Specifications.
- Seed must meet the requirements of Section 1060-4 of the Standard Specifications.
- Mulch for erosion control must meet the requirements of Section 1060-5 of the Standard Specifications.
- Undiluted emulsified asphalt should be used for tacking material. In High Quality Water zones (these will be designated on the plans) asphalt is not desired as a binding agent. These areas are in close proximity to important waters and the asphalt runoff may endanger the fish population.
- The analysis of fertilizer and the type of seed will be as stated in the contract.

4.9.3 Seeding and Mulching

Construction Specifications

Seedbed Preparation

Specifications	• **Cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded.** • **Shape and smooth uneven and rough areas outside of the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, to provide for more effective seeding and for ease of subsequent mowing operations.** • **Scarify or otherwise loosen the soil to a depth of not less than 5 inches except as otherwise provided below or otherwise directed.** • **Break clods and work the top 2 to 3 inches of soil into an acceptable seedbed using soil pulverizers, drags or harrows or other approved methods.** • **Remove all rock and debris 3 inches or larger on median, shoulder and ditch cut or fill slopes which are 3:1 or flatter, before the application of seed and fertilizer. Remove rock 6 inches and larger displaced during seeding operations.** • **Scarify, groove, trench or puncture all slope surfaces. The depth of preparation and the degree of smoothness of the seedbed may be reduced on cut slopes that are 2:1 and steeper, as permitted by the Engineer.** • **On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If, at the time of seeding and mulching operations, such preparation is still in a condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.** • **Limit seedbed preparation to a depth of 2 to 3 inches for areas within 2 feet of the edge of the pavement.** • **Do not prepare the seedbed when the soil is frozen, extremely wet or when the Engineer determines that it is an otherwise unfavorable working condition.**

4.9.3 Seeding and Mulching

Limestone, Fertilizer and Seed Application

General Specifications	• Apply limestone, fertilizer and seed within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer. • When the Engineer determines that weather and soil conditions are unfavorable, do not distribute any limestone or fertilizer and do not sow any seed. • Take adequate precautions to prevent hazards to traffic and damage to structures, guardrails, traffic control devices or any other appurtenances during the application of fertilizer. Provide adequate covering or change methods of application as required to avoid such damage. • Repair any damage that occurs, including any cleaning that may be necessary.
Limestone and Fertilizer	• Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, distribute limestone and fertilizer uniformly over the prepared seedbed at the specified rate of application and then harrow, rake or otherwise thoroughly work or mix into the seedbed.
Seed	• Distribute seed uniformly over the seedbed at the required rate of application, and immediately harrow, drag, rake or otherwise work so as to cover the seed with a layer of soil. Cover to a depth as directed by the Engineer. If two kinds of seed are to be used that require different depths of covering, sow separately. • When a combination seed and fertilizer drill is used, drill fertilizer with seed after applying and incorporating limestone into the soil. If using two kinds of seed requiring different depths of cover, the seed requiring the lighter cover may be sown broadcast, with a special attachment to the drill, or drilled lightly following the initial drilling operation. • When using a hydraulic seeder for application of seed and fertilizer, do not allow the seed to remain in water containing fertilizer for more than 30 minutes before application unless otherwise permitted. • Compact the seedbed immediately after seed has been properly covered in a manner and degree approved by the Engineer.

4.9.3 Seeding and Mulching

Modifications

- When adverse seeding conditions are encountered due to steepness of slope, height of slope or soil conditions, the Engineer may direct or permit that modifications be made to the requirements previously presented regarding:
  - Incorporating limestone into the seedbed
  - Covering limestone, seed and fertilizer
  - Compacting the seedbed
- Such modifications may include but not be limited to the following:
  - The incorporation of limestone into the seedbed may be omitted as follows:
    - On cut slopes steeper than 2:1
    - On 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition
    - On areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone
  - The rates of application of limestone, fertilizer and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.
  - Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces or on other areas where soil conditions would make compaction undesirable.

Technician's Checklist

Obtain approval from the Engineer before using equipment for the application, covering or compaction of limestone, fertilizer and seed.

- Finish earthwork to line and grade.
- Vegetate exposed erodible slopes within the time required in the latest NPDES permit.
- Check project special provisions for areas of the project to be given a lawn type appearance.
- All seed on the project must be approved for use.
- Meet the specifications for limestone and fertilizer.
- Periodically sample the limestone used by the Contractor to see that it conforms to NCDOT specifications.
- Properly store and protect the materials from the elements.
- Apply the mulch material at the rate of 2 tons per acre.
- Measure the area to be seeded for payment and to verify application rate.
- Seedbed shall be in a loose condition prior to seeding.
- Apply materials uniformly at the specified rates and properly incorporate into the soil.
- Remove rocks and other debris prior to the mulching operations.
- The Contractor shall properly coordinate the work: seeding soon after the seedbed is prepared, cultipacking immediately after the seeding is done, mulching soon after the cultipacking and applying the tacking material immediately.
- Use a sufficient amount of tack to tie down the mulch.

4.9.3 Seeding and Mulching

Measurement & Payment

Seeding and Mulching will be measured and paid in acres according to Standard Specifications Section 1660-8, measured along the surface of the ground completed and accepted. No direct payment will be made for furnishing and applying the limestone and fertilizer as such work and materials will be incidental to the work covered by Seeding and Mulching.

Pay Items	Pay Units
Seeding and Mulching	**Acres**

Maintenance

- Where vegetation is damaged or fails to successfully establish, repair in accordance with this section.
- Maintain areas seeded and mulched in a continuous manner, as directed by the Technician, rather than waiting to repair all damaged areas at one time near the end of the project.
- Conduct maintenance including mowing, repair seeding, topdressing or complete reseeding, if required. A pay item for each of these functions is included in the Standard Specifications.
- If maintenance is needed due to negligence or damage by the Contractor, there will be no pay for the repairs.

Consult the Roadside Environmental Field Operations Engineer regarding any questions concerning maintenance of seeding and mulching.

E&SC Training & Certification

Chapter 5

E&SC training involves educating, training and certifying individuals involved with managing stormwater, erosion and sediment on NCDOT construction projects. The training and certification program required by NCDOT is the E&SC / Stormwater Certification Program (E&SC/SW) which is a partnership program between NC State University and NCDOT and is the primary program. The Certified Professional in Erosion and Sediment Control (CPESC) program administered by EnviroCert International, Inc. is also an NCDOT-recognized certification program for managing stormwater, erosion and sediment for construction and maintenance activities.

E&SC / Stormwater Certification Program (E&SC/SW)

NCDOT, in conjunction with NC State University, developed the NCDOT E&SC / Stormwater (E&SC/SW) Certification Program to raise the level of environmental awareness for managing stormwater on construction and maintenance sites. Levels I, II and III certifications are offered as part of this program to assist those individuals involved in the development, design, site management, installation and inspection of E&SC plans.

Levels I, II and III Certification

Levels I, II and III certification courses are offered through NC State University to meet NCDOT requirements for trained and qualified individuals to develop, design, implement or inspect the E&SC plan for all projects disturbing one or more acres of land. The program provides comprehensive training to inspectors, project managers, contractors and designers. Course topics focus on maintaining compliance with E&SC/stormwater regulations on NCDOT construction projects. These certifications are valid for three years; recertification is required.

The NC State University Soil Science Department administers and manages the Level I and II Certifications. The NC State Biological and Agricultural Engineering Department manages the Level III Certification. For specific agenda, fees and schedules regarding these courses, refer to the following websites for each level of certification.

For Level I and II Certification

http://www.cvent.com/events/level-i-and-ii-erosion-sediment-control-stormwater-certification-for-ncdot-projects/event-summary-2a3ac3872e974d739c05122a282673ef.aspx

For Level III Certification

http://www.bae.ncsu.edu/workshops/dot/level_iii.html

Level I Certification

- Designed for those who inspect and install BMPs

Level II Certification

- Designed for project engineers, superintendants, supervisors, crew foremen and chief inspectors that manage site E&SC/SW operations

Level III Certification

- Designed for engineers and technicians who develop E&SC plans, including reclamation plans

Figure 5.1 Descriptions of Level I, II and III Certifications

Level I Certification

The Level I Certification course is designed for NCDOT, contractors and Construction, Engineering and Inspection (CEI) personnel who install or inspect E&SC on construction sites. The course outlines the BMPs used by NCDOT to minimize and control erosion and sedimentation. The function and installation of the BMPs are emphasized in this course, as well as the basics of soil erosion, vegetation establishment, stream restoration and borrow pit dewatering. Additional topics include E&SC plan implementation, regulatory agency requirements and consequences of permit violations.

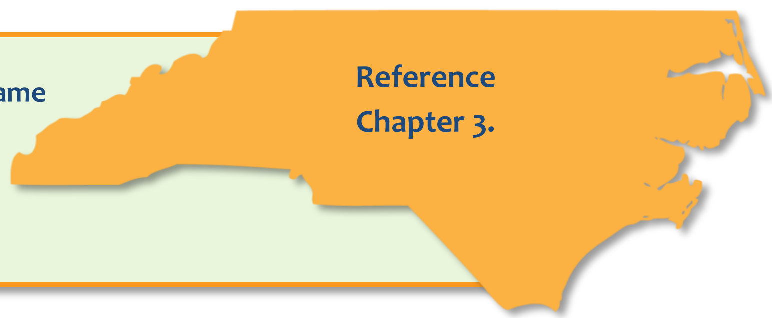
Level II Certification

The Level II Certification course is designed for NCDOT, contractors and CEI personnel, who supervise, install or direct grading work, culvert replacement work and bridge construction work over rivers and streams. The course emphasizes permit requirements, roles and responsibilities, applicable specifications and BMPs to control erosion and prevent sedimentation. The course also includes soil erodibility, vegetative establishment techniques, grading techniques to minimize erosion, timing of installations, reclamation plans and proper installation of BMPs. Implementation of the E&SC plan, regulatory agency requirements and consequences of permit violations are also covered in the Level II course.

Level III Certification

The Level III Certification course is designed for engineers and technicians who develop the E&SC plans on NCDOT projects, including reclamation plans. The course focuses on selection of BMPs to meet regulatory requirements for NCDOT. The course addresses hydrology, erosion, regulations, channels, sediment and turbidity control and lateral effects of borrow pits on adjacent wetlands.

NCDOT E&SC plans must contain the name of the plan designer and the Level III certificate number on the title sheet of the plans.



As indicated in Chapter 3, NCDOT E&SC plans must contain the name of the plan designer and the Level III certificate number on the title sheet of the plans.

■ EnviroCert International, Inc. Certification Programs

EnviroCert International, Inc. is a nonprofit corporation that offers a certification that relates to managing erosion and sediment control for construction and maintenance activities: the CPESC. Although reciprocity for the CPESC certification applies only to Levels I and II, this certifications provides excellent advanced level training for erosion and sediment control practitioners.

CPESC certification can be substituted for Levels I and II certifications. Reciprocity does NOT apply for the Level III certification.

If an individual with CPESC certification is in good standing, their credentials reside on the EnviroCert International, Inc. website directory. This certification requires annual renewal fees and completion of professional development units per year.

CPESC

The CPESC program is an international certification program administered by EnviroCert International, Inc. and is designed to provide professional credentials to individuals working with construction site E&SC issues. Registrants in the program are trained to understand the minimum requirements of the NPDES permit program as well as demonstrate proficiencies in planning and management, erosion prediction, runoff management, soil stabilization, erosion control and sediment control.

For schedules, procedures and fees associated with CPESC, refer to the CPESC website: http://www.cpesc.org/

NCDOT Erosion and Sediment Control / Stormwater Certification Provision

The NCDOT Erosion and Sediment Control / Stormwater Certification Provision (SP01 G180) can be found at the NCDOT link:

https://connect.ncdot.gov/resources/Specifications/Pages/Specifications-and-Special-Provisions.aspx

For contract projects, a chain of responsibility should be established, implemented and maintained throughout the life of the contract as part of the NCDOT Erosion Control and Stormwater Certification Provision.

Recertification

Level I, II and III certifications are valid for three years. A recertification class and examination are required every three years for renewal of certification. Refer to the NC State University website for specific schedules and fees associated with the recertification process.

A recertification class and examination are required every three years for renewal of certification.

Other Training

Opportunities for additional training in the erosion, sediment and stormwater disciplines are available for practitioners to pursue as well. Local, state and national training entities provide workshops and courses for those involved at various levels in the planning, design, installation, inspection and maintenance of E&SC practices and stormwater quality. Opportunities for such courses are often advertised through email list servers, university extension notifications and professional association publications.

APPENDIX A Turbidity Reduction Options

NCDOT Turbidity Reduction Options for Construction Activities

Passive, Active, and Semi-Passive Treatment Methods for the use of Flocculants

Treatment Method	Product Type	Application	Positive Aspects	Negative Aspects	Comments
Passive Treatment					
Surface Application	• Powder • Granular • Liquid	Hydro-mulching/seeding, Straw/tackifier, Broadcast spreaders.	Treatment may be applied to a large area in conjunction with groundcover requirements.	Less effective when applied over wet soils. May only be used on slopes or bare areas that drain to sediment storage devices.	Application rates may vary.
Runoff Conveyance Application	• Powder • Granular • Tablet • Block	Silt Check Type A with Excelsior Matting and Flocculant Application; Wattle w/Flocculant Application.	Provide additional treatment as a supplement to downstream sediment storage devices.	May not be effective during extreme rainfall events on steep terrain.	Broad range of products and product types may be used within channels and diversions throughout site dependent upon unique site conditions.
Semi-Passive Treatment					
Treatment Method	**Product Type**	**Application**	**Positive Aspects**	**Negative Aspects**	**Comments**
Watercourse Work Zone Application	• Tablet • Liquid • Block	Bypass pumping and work-zone dewatering.	A broad range of flocculants available for effectiveness on a variety of site conditions to supplement conventional BMP's.	Variable cost dependent upon pumping rate, type of application method, and amount of flocculant for effectiveness.	Broad range of products and product types utilized in various watercourse management and work zone dewatering applications.
Active Treatment					
Treatment Method	**Product Type**	**Application**	**Positive Aspects**	**Negative Aspects**	**Comments**
Chemical Treatment Systems including Sand Media Filtration	• Liquid- • Injection • Powder • Granular	Sand Media Filtration; Chitosan-Enhanced Sand Media Filtration.	Land space requirements are typically less than conventional sediment control BMPs. The use of automated chemical injection provides better control of the treatment process. Effluent can be automatically monitored.	High Cost; Must be closely monitored. May only be used to treat effluent draining to sediment storage devices.	Ability to treat and discharge large volumes of construction site runoff at very low turbidity levels.

NCDOT TURBIDITY REDUCTION OPTIONS FOR BORROW PITS*

Tier I Methods
January 1, 2009

Method	Description	Positive Aspects	Negative Aspects	Comments
Pit Dewatering Basin (Compensatory BMP)	These are detention basins that include a forebay and baffle where pit water is pumped and allowed time for suspended material to settle. The baffle is constructed with coir fiber material. Flashboard riser can be used to control the water level. Outlet comprised of rigid riser/barrel.	Basins are easy to build and maintain. They provide further treatment before pit water is discharged to the environment on a continuous basis	Basins are only 69-72% effective at removing total suspended solids under normal conditions. If turbidity (>50 NTUs) is encountered then additional BMPs may be needed. These types of basins alone are ineffective at removing fine or colloidal particles.	Outlet water should be drawn from the surface. Basin sized according to pump capacity and detention time.
Non Compensatory BMPs				
1) Land Application (Irrigation)	Water from pit is pumped to irrigate agricultural crops	Rain and pit water are used by agricultural crops and there is no non-discharge permit required.	Irrigation activity can have no discharge into surface waters and there is no violations of the Capacity Use permit. Limits exist as to the distance that irrigation pipe can be extended.	No chemicals can be added to water being applied.
2) Silt Bag	Pit water is pumped through a water permeable fabric bag resting on a bed of washed aggregate to increase bag discharge area. PAM can also be introduced in the pump system for enhanced sediment removal	Easy to install and remove bag. Effective at removing large size particles. Only a small footprint is required.	Silt bag is limited to a certain flow rate and bag does not remove fine or colloidal particles unless a PAM treatment is also used.	Addition of PAM may cause floc to seal bag.
3) Aluminum Sulfate (Alum)	A granular coagulant material added by spreader to pit water and settle out suspended material. Maximum rate is 25 lb./1,000 cu. ft. of water and keep below 250 PPM sulfate.	Inexpensive and relatively easy to apply. Works well on clay particles. PAM can also be used when a re-suspension occurs	A toxicity (tox.) test is required because of a potential pH shift. Also, a background test of iron and aluminum present in the pit should be conducted. May take 1-2 days to clear water.	pH needs to be above 5.5 to avoid toxic level of aluminum. May need lime for pH adjustment.
4) Gypsum	A powdered coagulant material added by spreader to pit water and settles out suspended material. Maximum rate is 30 lb per 1,000 cu ft of water to keep below 250 ppm sulfate	Relatively easy to spread and takes around two-days to clear the water column before pumping from water surface.	Requires much larger quantities of material (100 times) that of aluminum sulfate and a toxicity (tox) test. Can resuspend in large pits on windy days.	Also can produce pH shifts.
5) Polyacrylamides (PAMs)	A broad range of flocculants in liquid, powder, & solid forms to chemically bind sediment particles together and settle out	Works well under a variety of conditions. Does not affect pH and is not toxic to aquatic organisms at recommended levels.	Needs technical oversight for setup and water test for best product and equipment match. May not work on some clay materials.	Keep sulfate levels below 250 ppm. Use only anionictypes. Should not be applied directly to surface waters of the state. Instead, application should be through a pit dewatering basin or other structure. Use PAMs approved by DWQ.

NCDOT TURBIDITY REDUCTION OPTIONS FOR BORROW PITS*

Tier II Methods**

January 1, 2009

Method *Non Compensatory BMPs*	Description	Positive Aspects	Negative Aspects	Comments
6) Well Point Pumping (Soil Filtration)	Pit is dewatered by a series of shallow wells surrounding the pit at approximately 20' intervals	Water can be directly discharged to the environment without tox. testing	Runoff is a problem and can create turbid waters in the pit. Must be treated before being discharged to the environment usually with flocculant because drawdown of pit exceeds filtering capacity of soil.	If iron levels are high in pit water, discharge must pass through a stilling basin.
7) Impoundment (Detention)	Large detention basin used for storage, evaporation, and sedimentation of pumped water from the pit	There would be a slow release from this basin after material has settled out and discharged through an outflow pipe	In some areas, land for impoundment may be hard difficult to find due to the size and location of the basin. Very fine material will not settle in some cases.	Storm events often resuspend settled particles.
8) Cell Mining	The borrow pit is divided into cells and water is pumped out of one cell into another so a specific cell can be mined dry	There is no immediate discharge from the pit	Extra movement of discharged water from one cell to another within the pit. Wastewater from the pit will have to be discharged some time during the active life of the pit.	Limiting factor may be volume of water to be moved.
9) Sand - Media Filtration	Water from the pit is passed through a floc sock if needed and into multi-chamber sand media filter for treatment	Treated water can be discharged directly to the environment.	The rental rate for this equipment is very costly. May want to consider buying equipment and moving system around to different locations.	Proper pump rate and prefiltration must take place and monitored closely. Can be used after flocculants.
10) Wet Mining	Material from pit is removed wet and placed on higher ground to drain before being moved to job site	There is no discharge from the pit	Material from pit is handled twice, land needed for stockpiling material, and time needed for pile to dry.	No water quality impact (self contained)

NOTES:

* 1) An evaluation of the pit soil's cation exchange capacity should be considered as the contractor develops his bid.

** 2) Tier II Methods will be considered when 401 WQ Certification requires protection for rare or unique resources.

3) Many of these turbidity reduction techniques can be combined to provide further treatment.

APPENDIX B Division Preferences Table

Appendix B - Division Preferences	
Divisions 1 & 2	▪ Prefer to use Wattles in ditch lines unless slope of ditch lines are greater than 2.5%, TRSC-B should be used in conjunction with Coir Fiber Wattles. ▪ Prefer to use Wattles as breaks in the Silt Fence. ▪ Prefer to use Coir Fiber Wattles over Excelsior Wattles. ▪ Prefer additional quantities of Slope Drains on all projects.
Divisions 3 & 6	▪ Prefer Wattle breaks in silt fence instead of Special Sediment Control Fence.
Division 4	▪ Special Sediment Control fence outlets are desired as primary silt fence outlet. Wattles may be an acceptable alternative to special sediment control fence outlets; however, consultation with Roadside Environmental Field Operations Engineer is required. Determining whether to use Coir Fiber Wattles or Excelsior Wattles should be based on application, location and life expectancy of project. Recommend contacting Roadside Environmental Field Operations Engineer for guidance. ▪ Wattles are acceptable as an alternative to rock ditch checks but consideration should be given to drainage area and ditch line grade when selecting coir fiber vs. excelsior.
Division 5	▪ Special Sediment Control fence outlets are desired as primary silt fence outlet. Wattles may be an acceptable alternative to special sediment control fence outlets; however, consultation with Roadside Environmental Field Operations Engineer is required. Determining whether to use Coir Fiber Wattles or Excelsior Wattles should be based on application, location and life expectancy of project. Recommend contacting Roadside Environmental Field Operations Engineer for guidance. ▪ Ditch lines with grades > 4% should be lined with geotextile and Class B stone. Ditch lines >6% should be lined with geotextile and Class I stone. ▪ Wattles are acceptable as an alternative to rock ditch checks but consideration should be given to drainage area and ditch line grade when selecting coir fiber vs. excelsior.
Division 7 & 8	▪ Use Special Sediment Control Fence to wrap fill slopes under bridges, especially if area is subject to flooding. ▪ In general, use rock measures (Silt Check Type A with or without Matting and PAM) on clearing and grubbing phase. ▪ In general, use wattles (Coir Fiber or Excelsior with or without PAM) on final phase.

Appendix B - Division Preferences	
Division 9 & 10	▪ Prefer Coir Fiber Wattle over Excelsior Wattles. ▪ Prefer Coir Fiber Wattle breaks over Special Sediment Control Fence break near sensitive jurisdictional areas. ▪ Prefer Matting and Coir Fiber Matting to cover all erodible slopes on bridge project.
Division 11 & 12	▪ Prefer to use Special Sediment Control Fence for breaks in Silt Fence instead of wattles.
Division 13 & 14	▪ Wattles are acceptable as an alternative to rock ditch checks but consideration should be given to drainage area and ditch line grade. Rock checks should be used on grades steeper than 2.5%. ▪ Use Temporary Silt Fence with either Silt Check Type A outlets or Special Sediment Control Fence Section outlets to wrap up under bridges.
Division 14	▪ Provide quantity of Matting to cover entire project.
All Divisions	▪ Use Temporary Rock Silt Check Type A at outlet of ditches if sediment basins are not feasible. ▪ Place a flocculant measure at inlet of each sediment basin. ▪ Include a quantity of slope drains on all bridge projects. ▪ Include a quantity of Coir Fiber Mat for all projects. ▪ Hydraulic Mulch is not desired as a groundcover or as an emulsified asphalt tack alternative for binding wheat straw.

APPENDIX C REGIONAL SEED MIXES THAT PROVIDE STABILIZATION OF GRADED AREAS

STABILIZATION REQUIREMENTS:

Stabilization for this project shall comply with the time frame guidelines as specified by the NCG-010000 general construction permit effective August 3, 2011 issued by the North Carolina Department of Environment and Natural Resources Division of Water Quality. Temporary or permanent ground cover stabilization shall occur within 7 calendar days from the last land-disturbing activity, with the following exceptions in which temporary or permanent ground cover shall be provided in 14 calendar days from the last land-disturbing activity:

- Slopes between 2:1 and 3:1, with a slope length of 10 ft. or less
- Slopes 3:1 or flatter, with a slope of length of 50 ft. or less
- Slopes 4:1 or flatter

The stabilization timeframe for High Quality Water (HQW) Zones shall be 7 calendar days with no exceptions for slope grades or lengths. High Quality Water Zones (HQW) Zones are defined by North Carolina Administrative Code 15A NCAC 04A.0105 (25). Temporary and permanent ground cover stabilization shall be achieved in accordance with the provisions in this contract and as directed.

Note: These stabilization requirements apply to Seed Mixes East, West and WestEd.

SEED MIX, CRIMPING, AND GUARDRAIL SEED TO BE USED BY COUNTY						Native
	County	Seed Mix	Crimping	Guardrail Seed	Division	Seed Mix
1	Alamance	East	NO	Centipede	7	West
2	Alexander	West	NO	Hard Fescue/Bluegrass	12	West
3	Alleghany	West	NO	Hard Fescue/Bluegrass	11	West
4	Anson	East	NO	Centipede	10	West
5	Ashe	West	NO	Hard Fescue/Bluegrass	11	West
6	Avery	West	NO	Hard Fescue/Bluegrass	11	West
7	Beaufort	East	YES	Centipede	2	East
8	Bertie	East	YES	Centipede	1	East
9	Bladen	East	YES	Centipede	6	East
10	Brunswick	East	YES	Centipede	3	East
11	Buncombe	WestEd	NO	Hard Fescue/Bluegrass	13	West
12	Burke	WestEd	NO	Hard Fescue/Bluegrass	13	West
13	Cabarrus	West	NO	Hard Fescue/Bluegrass	10	West
14	Caldwell	West	NO	Hard Fescue/Bluegrass	11	West
15	Camden	East	YES	Centipede	1	East
16	Carteret	East	YES	Centipede	2	East
17	Caswell	West	NO	Hard Fescue/Bluegrass	7	West
18	Catawba	West	NO	Hard Fescue/Bluegrass	12	West
19	Chatham	East	YES	Centipede	8	West
20	Cherokee	WestEd	NO	Hard Fescue/Bluegrass	14	West
21	Chowan	East	YES	Centipede	1	East
22	Clay	WestEd	NO	Hard Fescue/Bluegrass	14	West
23	Cleveland	West	NO	Hard Fescue/Bluegrass	12	West
24	Columbus	East	YES	Centipede	6	East
25	Craven	East	YES	Centipede	2	East
26	Cumberland	East	YES	Centipede	6	East
27	Currituck	East	YES	Centipede	1	East
28	Dare	East	YES	Centipede	1	East
29	Davidson	West	NO	Hard Fescue/Bluegrass	9	West
30	Davie	West	NO	Hard Fescue/Bluegrass	9	West
31	Duplin	East	YES	Centipede	3	East
32	Durham	East	NO	Centipede	5	East
33	Edgecombe	East	YES	Centipede	4	East
34	Forsyth	West	NO	Hard Fescue/Bluegrass	9	West
35	Franklin	East	NO	Centipede	5	East
36	Gaston	West	NO	Hard Fescue/Bluegrass	12	West
37	Gates	East	YES	Centipede	1	East
38	Graham	WestEd	NO	Hard Fescue/Bluegrass	14	West
39	Granville	East	NO	Centipede	5	East
40	Greene	East	YES	Centipede	2	East
41	Guilford	East	NO	Centipede	7	West
42	Halifax	East	YES	Centipede	4	East
43	Harnett	East	YES	Centipede	6	East
44	Haywood	WestEd	NO	Hard Fescue/Bluegrass	14	West
45	Henderson	WestEd	NO	Hard Fescue/Bluegrass	14	West
46	Hertford	East	YES	Centipede	1	East
47	Hoke	East	YES	Centipede	8	West
48	Hyde	East	YES	Centipede	1	East
49	Iredell	West	NO	Hard Fescue/Bluegrass	12	West
50	Jackson	WestEd	NO	Hard Fescue/Bluegrass	14	West
51	Johnston	East	YES	Centipede	4	East

52	Jones	East	YES	Centipede	2	East
53	Lee	East	YES	Centipede	8	West
54	Lenoir	East	YES	Centipede	2	East
55	Lincoln	West	NO	Hard Fescue/Bluegrass	12	West
56	Macon	WestEd	NO	Hard Fescue/Bluegrass	14	West
57	Madison	WestEd	NO	Hard Fescue/Bluegrass	13	West
58	Martin	East	YES	Centipede	1	East
59	McDowell	WestEd	NO	Hard Fescue/Bluegrass	13	West
60	Mecklenburg	West	NO	Hard Fescue/Bluegrass	10	West
61	Mitchell	WestEd	NO	Hard Fescue/Bluegrass	13	West
62	Montgomery	East	YES	Centipede	8	West
63	Moore	East	YES	Centipede	8	West
64	Nash	East	YES	Cenitpede	4	East
65	New Hanover	East	YES	Centipede	3	East
66	Northampton	East	YES	Centipede	1	East
67	Onslow	East	YES	Centipede	3	East
68	Orange	East	NO	Centipede	7	West
69	Pamlico	East	YES	Centipede	2	East
70	Pasquotank	East	YES	Centipede	1	East
71	Pender	East	YES	Centipede	3	East
72	Perquimans	East	YES	Centipede	1	East
73	Person	East	NO	Centipede	5	East
74	Pitt	East	YES	Centipede	2	East
75	Polk	WestEd	NO	Hard Fescue/Bluegrass	14	West
76	Randolph	East	YES	Centipede	8	West
77	Richmond	East	YES	Centipede	8	West
78	Robeson	East	YES	Centipede	6	East
79	Rockingham	West	NO	Hard Fescue/Bluegrass	7	West
80	Rowan	West	NO	Hard Fescue/Bluegrass	9	West
81	Rutherford	WestEd	NO	Hard Fescue/Bluegrass	13	West
82	Sampson	East	YES	Centipede	3	East
83	Scotland	East	YES	Centipede	8	West
84	Stanly	West	NO	Hard Fescue/Bluegrass	10	West
85	Stokes	West	NO	Hard Fescue/Bluegrass	9	West
86	Surry	West	NO	Hard Fescue/Bluegrass	11	West
87	Swain	WestEd	NO	Hard Fescue/Bluegrass	14	West
88	Transylvania	WestEd	NO	Hard Fescue/Bluegrass	14	West
89	Tyrrell	East	YES	Centipede	1	East
90	Union	West	NO	Hard Fescue/Bluegrass	10	West
91	Vance	East	NO	Centipede	5	East
92	Wake	East	NO	Centipede	5	East
93	Warren	East	NO	Centipede	5	East
94	Washington	East	YES	Centipede	1	East
95	Watauga	West	NO	Hard Fescue/Bluegrass	11	West
96	Wayne	East	YES	Centipede	4	East
97	Wilkes	West	NO	Hard Fescue/Bluegrass	11	West
98	Wilson	East	YES	Centipede	4	East
99	Yadkin	West	NO	Hard Fescue/Bluegrass	11	West
100	Yancey	WestEd	NO	Hard Fescue/Bluegrass	13	West

SEEDING AND MULCHING: **(East)**

The kinds of seed and fertilizer, and the rates of application of seed, fertilizer, and limestone, shall be as stated below. During periods of overlapping dates, the kind of seed to be used shall be determined. All rates are in pounds per acre.

All Roadway Areas

March 1 - August 31		**September 1 - February 28**	
50#	Tall Fescue	50#	Tall Fescue
10#	Centipede	10#	Centipede
25#	Bermudagrass (hulled)	35#	Bermudagrass (unhulled)
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Waste and Borrow Locations

March 1 – August 31		**September 1 - February 28**	
75#	Tall Fescue	75#	Tall Fescue
25#	Bermudagrass (hulled)	35#	Bermudagrass (unhulled)
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Note: 50# of Bahiagrass may be substituted for either Centipede or Bermudagrass only upon Engineer's request.

Approved Tall Fescue Cultivars

2nd Millennium	Duster	Magellan	Rendition
Avenger	Endeavor	Masterpiece	Scorpion
Barlexas	Escalade	Matador	Shelby
Barlexas II	Falcon II, III, IV & V	Matador GT	Signia
Barrera	Fidelity	Millennium	Silverstar
Barrington	Finesse II	Montauk	Southern Choice II
Biltmore	Firebird	Mustang 3	Stetson
Bingo	Focus	Olympic Gold	Tarheel
Bravo	Grande II	Padre	Titan Ltd
Cayenne	Greenkeeper	Paraiso	Titanium
Chapel Hill	Greystone	Picasso	Tomahawk
Chesapeake	Inferno	Piedmont	Tacer
Constitution	Justice	Pure Gold	Trooper
Chipper	Jaguar 3	Prospect	Turbo
Coronado	Kalahari	Quest	Ultimate
Coyote	Kentucky 31	Rebel Exeda	Watchdog
Davinci	Kitty Hawk	Rebel Sentry	Wolfpack
Dynasty	Kitty Hawk 2000	Regiment II	
Dominion	Lexington	Rembrandt	

SEEDING AND MULCHING: **(East)**

On cut and fill slopes 2:1 or steeper Centipede shall be applied at the rate of 5 pounds per acre and add 20# of Sericea Lespedeza from January 1 - December 31.

Fertilizer shall be 10-20-20 analysis. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as a 10-20-20 analysis and as directed.

TEMPORARY SEEDING:

Fertilizer shall be the same analysis as specified for *Seeding and Mulching* and applied at the rate of 400 pounds and seeded at the rate of 50 pounds per acre. Sweet Sudan Grass, German Millet or Browntop Millet shall be used in summer months and Rye Grain during the remainder of the year. The Engineer will determine the exact dates for using each kind of seed.

FERTILIZER TOPDRESSING:

Fertilizer used for topdressing on all roadway areas except slopes 2:1 and steeper shall be 10-20-20 grade and shall be applied at the rate of 500 pounds per acre. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as 10-20-20 analysis and as directed.

Fertilizer used for topdressing on slopes 2:1 and steeper and waste and borrow areas shall be 16-8-8 grade and shall be applied at the rate of 500 pounds per acre. A different analysis of fertilizer may be used provided the 2-1-1 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as 16-8-8 analysis and as directed.

SUPPLEMENTAL SEEDING:

The kinds of seed and proportions shall be the same as specified for *Seeding and Mulching*, with the exception that no centipede seed will be used in the seed mix for supplemental seeding. The rate of application for supplemental seeding may vary from 25# to 75# per acre. The actual rate per acre will be determined prior to the time of topdressing and the Contractor will be notified in writing of the rate per acre, total quantity needed, and areas on which to apply the supplemental seed. Minimum tillage equipment, consisting of a sod seeder shall be used for incorporating seed into the soil as to prevent disturbance of existing vegetation. A clodbuster (ball and chain) may be used where degree of slope prevents the use of a sod seeder.

MOWING:

The minimum mowing height on this project shall be 4 inches.

SEEDING AND MULCHING: **(West)**

The kinds of seed and fertilizer, and the rates of application of seed, fertilizer, and limestone, shall be as stated below. During periods of overlapping dates, the kind of seed to be used shall be determined. All rates are in pounds per acre.

Shoulder and Median Areas

August 1 - June 1		**May 1 - September 1**	
20#	Kentucky Bluegrass	20#	Kentucky Bluegrass
75#	Hard Fescue	75#	Hard Fescue
25#	Rye Grain	10#	German or Browntop Millet
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Areas Beyond the Mowing Pattern, Waste and Borrow Areas:

August 1 - June 1		**May 1 - September 1**	
100#	Tall Fescue	100#	Tall Fescue
15#	Kentucky Bluegrass	15#	Kentucky Bluegrass
30#	Hard Fescue	30#	Hard Fescue
25#	Rye Grain	10#	German or Browntop Millet
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Approved Tall Fescue Cultivars

2nd Millennium	Duster	Magellan	Rendition
Avenger	Endeavor	Masterpiece	Scorpion
Barlexas	Escalade	Matador	Shelby
Barlexas II	Falcon II, III, IV & V	Matador GT	Signia
Barrera	Fidelity	Millennium	Silverstar
Barrington	Finesse II	Montauk	Southern Choice II
Biltmore	Firebird	Mustang 3	Stetson
Bingo	Focus	Olympic Gold	Tarheel
Bravo	Grande II	Padre	Titan Ltd
Cayenne	Greenkeeper	Paraiso	Titanium
Chapel Hill	Greystone	Picasso	Tomahawk
Chesapeake	Inferno	Piedmont	Tacer
Constitution	Justice	Pure Gold	Trooper
Chipper	Jaguar 3	Prospect	Turbo
Coronado	Kalahari	Quest	Ultimate
Coyote	Kentucky 31	Rebel Exeda	Watchdog
Davinci	Kitty Hawk	Rebel Sentry	Wolfpack
Dynasty	Kitty Hawk 2000	Regiment II	
Dominion	Lexington	Rembrandt	

SEEDING AND MULCHING: **(West)**

Approved Kentucky Bluegrass Cultivars:

Alpine	Bariris	Envicta	Rugby
Apollo	Bedazzled	Impact	Rugby II
Arcadia	Bordeaux	Kenblue	Showcase
Arrow	Champagne	Midnight	Sonoma
Award	Chicago II	Midnight II	

Approved Hard Fescue Cultivars:

Chariot	Nordic	Rhino	Warwick
Firefly	Oxford	Scaldis II	
Heron	Reliant II	Spartan II	
Minotaur	Reliant IV	Stonehenge	

On cut and fill slopes 2:1 or steeper add 20# Sericea Lespedeza January 1 - December 31.

Fertilizer shall be 10-20-20 analysis. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as a 10-20-20 analysis and as directed.

TEMPORARY SEEDING:

Fertilizer shall be the same analysis as specified for *Seeding and Mulching* and applied at the rate of 400 pounds and seeded at the rate of 50 pounds per acre. German Millet, or Browntop Millet shall be used in summer months and rye grain during the remainder of the year. The Engineer will determine the exact dates for using each kind of seed.

FERTILIZER TOPDRESSING:

Fertilizer used for topdressing shall be 16-8-8 grade and shall be applied at the rate of 500 pounds per acre. A different analysis of fertilizer may be used provided the 2-1-1 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as 16-8-8 analysis and as directed.

SUPPLEMENTAL SEEDING:

The kinds of seed and proportions shall be the same as specified for *Seeding and Mulching*, and the rate of application may vary from 25# to 75# per acre. The actual rate per acre will be determined prior to the time of topdressing and the Contractor will be notified in writing of the rate per acre, total quantity needed, and areas on which to apply the supplemental seed. Minimum tillage equipment, consisting of a sod seeder shall be used for incorporating seed into the soil as to prevent disturbance of existing vegetation. A clodbuster (ball and chain) may be used where degree of slope prevents the use of a sod seeder.

MOWING:

The minimum mowing height on this project shall be six inches.

SEEDING AND MULCHING: **(WestEd)**

The kinds of seed and fertilizer, and the rates of application of seed, fertilizer, and limestone, shall be as stated below. During periods of overlapping dates, the kind of seed to be used shall be determined. All rates are in pounds per acre.

Shoulder and Median Areas

August 1 - June 1		**May 1 - September 1**	
20#	Kentucky Bluegrass	20#	Kentucky Bluegrass
75#	Hard Fescue	75#	Hard Fescue
25#	Rye Grain	10#	German or Browntop Millet
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Areas Beyond the Mowing Pattern, Waste and Borrow Areas:

August 1 - June 1		**May 1 - September 1**	
100#	Tall Fescue	100#	Tall Fescue
15#	Kentucky Bluegrass	15#	Kentucky Bluegrass
30#	Hard Fescue	30#	Hard Fescue
25#	Rye Grain	10#	German or Browntop Millet
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Approved Tall Fescue Cultivars

2nd Millennium	Duster	Magellan	Rendition
Avenger	Endeavor	Masterpiece	Scorpion
Barlexas	Escalade	Matador	Shelby
Barlexas II	Falcon II, III, IV & V	Matador GT	Signia
Barrera	Fidelity	Millennium	Silverstar
Barrington	Finesse II	Montauk	Southern Choice II
Biltmore	Firebird	Mustang 3	Stetson
Bingo	Focus	Olympic Gold	Tarheel
Bravo	Grande II	Padre	Titan Ltd
Cayenne	Greenkeeper	Paraiso	Titanium
Chapel Hill	Greystone	Picasso	Tomahawk
Chesapeake	Inferno	Piedmont	Tacer
Constitution	Justice	Pure Gold	Trooper
Chipper	Jaguar 3	Prospect	Turbo
Coronado	Kalahari	Quest	Ultimate
Coyote	Kentucky 31	Rebel Exeda	Watchdog
Davinci	Kitty Hawk	Rebel Sentry	Wolfpack
Dynasty	Kitty Hawk 2000	Regiment II	
Dominion	Lexington	Rembrandt	

SEEDING AND MULCHING: (WestEd)

Approved Kentucky Bluegrass Cultivars:

Alpine	Bariris	Envicta	Rugby
Apollo	Bedazzled	Impact	Rugby II
Arcadia	Bordeaux	Kenblue	Showcase
Arrow	Champagne	Midnight	Sonoma
Award	Chicago II	Midnight II	

Approved Hard Fescue Cultivars:

Chariot	Nordic	Rhino	Warwick
Firefly	Oxford	Scaldis II	
Heron	Reliant II	Spartan II	
Minotaur	Reliant IV	Stonehenge	

On cut and fill slopes 2:1 or steeper add 20# Sericea Lespedeza and 15# Crown Vetch January 1 - December 31.

The Crown Vetch Seed should be double inoculated if applied with a hand seeder. Four times the normal rate of inoculant should be used if applied with a hydroseeder. If a fertilizer-seed slurry is used, the required limestone should also be included to prevent fertilizer acidity from killing the inoculant bacteria. Caution should be used to keep the inoculant below 80° F to prevent harm to the bacteria. The rates and grades of fertilizer and limestone shall be the same as specified for *Seeding and Mulching*.

Fertilizer shall be 10-20-20 analysis. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as a 10-20-20 analysis and as directed.

TEMPORARY SEEDING:

Fertilizer shall be the same analysis as specified for *Seeding and Mulching* and applied at the rate of 400 pounds and seeded at the rate of 50 pounds per acre. German Millet, or Browntop Millet shall be used in summer months and rye grain during the remainder of the year. The Engineer will determine the exact dates for using each kind of seed.

FERTILIZER TOPDRESSING:

Fertilizer used for topdressing shall be 16-8-8 grade and shall be applied at the rate of 500 pounds per acre. A different analysis of fertilizer may be used provided the 2-1-1 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as 16-8-8 analysis and as directed.

SEEDING AND MULCHING: **(WestEd)**

SUPPLEMENTAL SEEDING:

The kinds of seed and proportions shall be the same as specified for *Seeding and Mulching*, and the rate of application may vary from 25# to 75# per acre. The actual rate per acre will be determined prior to the time of topdressing and the Contractor will be notified in writing of the rate per acre, total quantity needed, and areas on which to apply the supplemental seed. Minimum tillage equipment, consisting of a sod seeder shall be used for incorporating seed into the soil as to prevent disturbance of existing vegetation. A clodbuster (ball and chain) may be used where degree of slope prevents the use of a sod seeder.

MOWING:

The minimum mowing height on this project shall be six inches.

Native Grass Seeding and Mulching **(East)**

Native Grass Seeding and Mulching shall be performed on the disturbed areas of wetlands and riparian areas, and adjacent to Stream Relocation construction within a 50 foot zone on both sides of the stream or depression, measured from top of stream bank or center of depression. The stream bank of the stream relocation shall be seeded by a method that does not alter the typical cross section of the stream bank. Native Grass Seeding and Mulching shall also be performed in the permanent soil reinforcement mat section of preformed scour holes, and in other areas as directed.

The kinds of seed and fertilizer, and the rates of application of seed, fertilizer, and limestone, shall be as stated below. During periods of overlapping dates, the kind of seed to be used shall be determined. All rates are in pounds per acre.

March 1 - August 31		**September 1 - February 28**	
18#	Creeping Red Fescue	18#	Creeping Red Fescue
6#	Indiangrass	6#	Indiangrass
8#	Little Bluestem	8#	Little Bluestem
4#	Switchgrass	4#	Switchgrass
25#	Browntop Millet	35#	Rye Grain
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Approved Creeping Red Fescue Cultivars:

Aberdeen	Boreal	Epic	Cindy Lou

Fertilizer shall be 10-20-20 analysis. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as a 10-20-20 analysis and as directed.

Native Grass Seeding and Mulching shall be performed in accordance with Section 1660 of the *Standard Specifications* and vegetative cover sufficient to restrain erosion shall be installed immediately following grade establishment.

Measurement and Payment

Native Grass *Seeding and Mulching* will be measured and paid for in accordance with Article 1660-8 of the *Standard Specifications*.

Native Grass Seeding And Mulching **(West)**

Native Grass Seeding and Mulching shall be performed on the disturbed areas of wetlands and riparian areas, and adjacent to Stream Relocation and/or trout stream construction within a 50 foot zone on both sides of the stream or depression, measured from top of stream bank or center of depression. The stream bank of the stream relocation shall be seeded by a method that does not alter the typical cross section of the stream bank. Native Grass Seeding and Mulching shall also be performed in the permanent soil reinforcement mat section of preformed scour holes, and in other areas as directed.

The kinds of seed and fertilizer, and the rates of application of seed, fertilizer, and limestone, shall be as stated below. During periods of overlapping dates, the kind of seed to be used shall be determined. All rates are in pounds per acre.

August 1 - June 1		**May 1 – September 1**	
18#	Creeping Red Fescue	18#	Creeping Red Fescue
8#	Big Bluestem	8#	Big Bluestem
6#	Indiangrass	6#	Indiangrass
4#	Switchgrass	4#	Switchgrass
35#	Rye Grain	25#	German or Browntop Millet
500#	Fertilizer	500#	Fertilizer
4000#	Limestone	4000#	Limestone

Approved Creeping Red Fescue Cultivars:

Aberdeen	Boreal	Epic	Cindy Lou

Fertilizer shall be 10-20-20 analysis. A different analysis of fertilizer may be used provided the 1-2-2 ratio is maintained and the rate of application adjusted to provide the same amount of plant food as a 10-20-20 analysis and as directed.

Native Grass Seeding and Mulching shall be performed in accordance with Section 1660 of the *Standard Specifications* and vegetative cover sufficient to restrain erosion shall be installed immediately following grade establishment.

Measurement and Payment

Native Grass *Seeding and Mulching* will be measured and paid for in accordance with Article 1660-8 of the *Standard Specifications*.

APPENDIX D DESIGN BUILD SUBMITTAL GUIDELINES

Erosion Control Design

All Erosion and Sedimentation Control Plans shall be reviewed and accepted by the Department for each distinct project section before **any** land disturbing activities, including clearing and grubbing, can commence on that project section. The RFC Final Grade Erosion Control Plans shall only be deemed final after the roadway drainage design has been finalized and accepted by the Department. Specifically, acceptance of all Erosion Control submittals, prior to and including the RFC Final Grade Erosion Control Plans, shall be contingent on acceptance of the roadway drainage design. Design modifications developed after acceptance of the RFC Final Grade Erosion Control Plans shall require the Design-Build Team to submit Intermediate Erosion Control Plans for review and acceptance as noted below. Each plan submittal shall include all pertinent design information required for review, such as design calculations, drainage areas, etc.

The NCDOT Roadside Environment Unit (REU) will provide a sample set of Erosion and Sedimentation Control plans and MicroStation Erosion Control workspace to the Design-Build Team upon request. The Design-Build Team shall coordinate a pre-design meeting between the NCDOT REU Soil and Water Engineering Section, the Design-Build Team and other pertinent NCDOT personnel before beginning the erosion control design. The Department shall only review Erosion and Sediment Control Plans after the aforementioned pre-design meeting. Release for Construction (RFC) Final Grade Erosion Control Plans shall be accepted by the NCDOT REU and submitted to all NCDOT personnel listed below before **any** land disturbing activities, including clearing and grubbing, shall commence.

75% Clearing & Grubbing Review Plans

Prerequisites:

- Accepted Roadway Line and Grade or Preliminary Roadway Plans and x-sections
- Pre-design meeting with the NCDOT REU Soil and Water Engineering Section, the Design-Build Team and any other pertinent NCDOT personnel
- Provide two sets of half-size Roadway Plans, that delineate the proposed slope / stake lines, and x-sections to Transportation Program Management concurrently with this submittal

- Provide one set of half-size Roadway Plans, that delineate the proposed slope / stake lines, and x-sections to the Roadside Environmental Field Operations Engineer concurrently with this submittal

Total Number Required: (3 Full-size and 2 Half-size)

- Resident Engineer (1 Full-size)
    - Sent directly by the DBT
- Transportation Program Management (1 Half-size)
- Roadside Environmental Unit (1 Full-size)
- Roadside Environmental Field Operations Engineer (1 Full-size)
    - Sent directly by the DBT
- Division Environmental Officer (1 Half-size)
    - Sent directly by the DBT

100% Clearing & Grubbing Review Plans

Prerequisites:

- Provide two sets of half-size Roadway Plans, that delineate the proposed slope / stake lines, and x-sections to Transportation Program Management concurrently with this submittal
- Provide one set of half-size Roadway Plans, that delineate the proposed slope / stake lines, and x-sections to the Roadside Environmental Field Operations Engineer concurrently with this submittal

Total Number Required: (3 Full-size and 2 Half-size)

- Resident Engineer (1 Full-size)
    - Sent directly by the DBT
- Transportation Program Management (1 Half-size)
- Roadside Environmental Unit (1 Full-size)
- Roadside Environmental Field Operations Engineer (1 Full-size)
    - Sent directly by the DBT
- Division Environmental Officer (1 Half-size)
    - Sent directly by the DBT

RFC Clearing & Grubbing Plans

Prerequisites:

- Provide two sets of half-size Roadway Plans, that delineate the proposed slope / stake lines and drainage, as well as x-sections to Transportation Program Management concurrently with this submittal
- Provide one set of half-size Roadway Plans, that delineate the proposed slope / stake lines and drainage, as well as x-sections to the Roadside Environmental Field Operations Engineer concurrently with this submittal

Total Number Required: (2 Full-size and 6 Half-size)

- Resident Engineer (2 Full-size)
  - Sent directly by the DBT
- Transportation Program Management (1 Half-size)
- Roadside Environmental Unit (2 Half-size)
- Roadside Environmental Field Operations Engineer (1 Half-size)
  - Sent directly by the DBT
- Division Environmental Officer (1 Half-size)
  - Sent directly by the DBT
- Roadway Construction Engineer (1 Half-size)
  - Sent directly by the DBT

75% Final Grade Erosion Control Plans

Prerequisites:

- Provide two sets of half-size Roadway Plans, that delineate the proposed slope / stake lines and drainage, as well as x-sections to Transportation Program Management concurrently with this submittal
- Provide one set of half-size Roadway Plans, that delineate the proposed slope / stake lines and drainage, as well as x-sections to the Roadside Environmental Field Operations Engineer concurrently with this submittal

Total Number Required: (3 Full-size and 2 Half-size)

- Resident Engineer (1 Full-size)
  - Sent directly by the DBT
- Transportation Program Management (1 Half-size)
- Roadside Environmental Unit (1 Full-size)
- Roadside Environmental Field Operations Engineer (1 Full-size)
  - Sent directly by the DBT
- Division Environmental Officer (1 Half-size)
  - Sent directly by the DBT

100% Final Grade Erosion Control Plans

Prerequisites:

- Accepted Final Roadway Plans and x-sections when the Design-Build Team is acquiring the permit
- Accepted 100% Hydraulic Plans when the Design-Build Team is acquiring the permit
- Provide two sets of half-size Roadway Plans, that delineate the proposed slope / stake lines and drainage, as well as x-sections to Transportation Program Management concurrently with this submittal
- Provide one set of half-size Roadway Plans, that delineate the proposed slope / stake lines and drainage, as well as x-sections to the Roadside Environmental Field Operations Engineer concurrently with this submittal

Total Number Required: (3 Full-size and 2 Half-size)

- Resident Engineer (1 Full-size)
  - Sent directly by the DBT
- Transportation Program Management (1 Half-size)
- Roadside Environmental Unit (1 Full-size)
- Roadside Environmental Field Operations Engineer (1 Full-size)
  - Sent directly by the DBT
- Division Environmental Officer (1 Half-size)
  - Sent directly by the DBT

RFC Final Grade Erosion Control Plans

This submittal shall include seven sets of Project Special Provisions. Erosion Control Special Provisions are available through the Design-Build website.

Total Number Required: (2 Full-size, 7 Half-size and 8 sets of PSPs)

- Resident Engineer (2 Full-size and 2 sets of PSPs)
  - Sent directly by the DBT
- Transportation Program Management (1 Half-size and 1 set of PSPs)
- Roadside Environmental Unit (2 Half-size and 1 set of PSPs)
- Roadside Environmental Field Operations Engineer(1 Half-size and 1 set of PSPs)
  - Sent directly by the DBT
- Division Environmental Officer (1 Half-size and 1 set of PSPs)
  - Sent directly by the DBT
- Division Construction Engineer (1 Half-size and 1 set of PSPs)
  - Sent directly by the DBT
- Roadway Construction Engineer (1 Half-size and 1 set of PSPs)
  - Sent directly by the DBT

Intermediate Plans (if required)

This submittal shall be required if design modifications and / or site conditions require additional erosion control design or design revisions to the RFC Clearing and Grubbing and / or the RFC Final Grade Erosion Control Plans. This submittal shall also be required to review all basins requiring individual calculations. The NCDOT REU shall review and accept Intermediate Plans prior to construction of any aspect impacted by the revised erosion control design.

Prerequisites:

- Accepted Roadway and / or Hydraulic Plans of the design modifications
- Provide two sets of half-size Roadway Plans, that delineate the proposed slope / stake lines and drainage, as well as x-sections to Transportation Program Management concurrently with this submittal
- Provide one set of half-size Roadway Plans, that delineate the proposed slope / stake lines and drainage, as well as x-sections to the Roadside Environmental Field Operations Engineer concurrently with this submittal

- Provide one set of basin calculations to Transportation Program Management and the Roadside Field Operations Engineer concurrently with this submittal

<u>Total Number Required</u>: (3 Full-size and 5 Half-size)

- Resident Engineer (2 Full-size)
  - Sent directly by the DBT
- Transportation Program Management (1 Half-size)
- Roadside Environmental Unit (2 Half-size)
- Roadside Environmental Field Operations Engineer (1 Full-size)
  - Sent directly by the DBT
- Division Environmental Officer (1 Half-size)
  - Sent directly by the DBT
- Roadway Construction Engineer (1 Half-size)
  - Sent directly by the DBT

EROSION CONTROL DESIGN – EXPRESS DESIGN-BUILD BRIDGE PROJECTS

All Erosion and Sedimentation Control Plans shall be reviewed and accepted by the Department for each bridge or culvert site before **any** land disturbing activities, including clearing and grubbing, can commence on that site. The RFC Erosion Control Plans shall only be deemed final after the roadway drainage design has been finalized and accepted by the Department. Specifically, acceptance of all Erosion Control submittals shall be contingent on acceptance of the roadway drainage design. Design modifications developed after acceptance of the RFC Erosion Control Plans shall require the Design-Build Team to submit Intermediate Erosion Control Plans for review and acceptance as noted below. Each plan submittal shall include all pertinent design information required for review, such as design calculations, drainage areas, etc.

The NCDOT Roadside Environment Unit (REU) will provide a sample set of Erosion and Sedimentation Control plans and Microstation Erosion Control workspace to the Design-Build Team upon request. The Design-Build Team shall coordinate a pre-design meeting between the NCDOT REU Soil and Water Engineering Section, the Design-Build Team and other pertinent NCDOT personnel before beginning the erosion control design. The Department shall only review Erosion and Sediment Control Plans after the aforementioned pre-design meeting. Release for Construction (RFC) Erosion Control Plans shall be accepted by the NCDOT REU and submitted to all NCDOT personnel listed below before **any** land disturbing activities, including clearing and grubbing, shall commence.

EROSION AND SEDIMENTATION CONTROL PLANS

Prerequisites:

- Provide Roadway and 100% Hydraulic Design Plans and x-sections

List of Recipients:

- Division Construction Engineer
- Division Bridge Program Manager
- Resident Engineer
- Transportation Program Management
- Roadside Environmental Unit
- Roadside Environmental Field Operations Engineer
- Division Environmental Officer

RFC Erosion Control Plans

This submittal includes the RFC Roadway Plans and x-sections, Project Special Provisions and Permit Drawings. Erosion Control Special Provisions are available through the Design-Build website.

List of Recipients:

- Resident Engineer
- Transportation Program Management

Roadside Environmental Unit

Roadside Environmental Field Operations Engineer

- Division Environmental Officer
- Division Construction Engineer
- Division Bridge Program Manager
- Area Bridge Construction Engineer

APPENDIX E SPILL RESPONSE PLAN

Chapter 1 Spill Prevention and Cleanup

Overview

DESCRIPTION

Each NCDOT industrial facility must establish spill prevention and response procedures to ensure that oil and other hazardous substances do not enter our waterways. A Spill Prevention and Response Plan can be found in the facilities site-specific Stormwater Pollution Prevention Plan (SPPP) and Spill Prevention Control and Countermeasure (SPCC) Plan, if applicable for the facility. NCDOT is required by law to follow the directives in that plan. For spills that occur on NCDOT right-of-way, NCDOT personnel should follow the guidelines in this chapter and refer to details in the SPPP/SPCC Plans if necessary.

Even spills that happen away from streams and lakes could affect our waterways if they are washed into a storm drain or ditch. Every NCDOT worker that handles oil and hazardous substances must be able to identify potential sources of stormwater pollution and must work to prevent these sources from entering our streams, rivers, and lakes.

GOALS

The goals of this chapter are to: 1) provide tools and information needed to prevent spills from occurring, and 2) provide tools to properly respond to a spill if one does occur. Each NCDOT worker needs to be aware of:

- The contaminants in the environment where they work and how those materials are contained,
- How to recognize a spill, and
- What to do in the event of a spill.

KEY DEFINITIONS

Oil: Oil is defined as oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil. This definition includes CRS-2.

Hazardous Materials/Hazardous Substances: Refer to Chapter 12 of this manual.

Spill: Any time a substance that could contaminate the surrounding environment escapes from the intended containment for that substance.

Note that some spills require regulatory reporting. This chapter provides guidance on the different types of spills and provides best management practices (BMPs) for spill prevention and cleanup of spills that occur at NCDOT industrial facilities and along NCDOT roadways.

Note that the forms referenced in this chapter are associated with the Stormwater Pollution Prevention Plans (SPPPs) that industrial facilities are required to maintain per NCDOT's National Pollutant Discharge Elimination System (NPDES) Permit.

1.1 Potential Pollutants of Concerns

The following are a list of potential pollutants that could be spilled when performing various industrial and road maintenance activities:

- Storage and Handling of Materials
  - Petroleum products, including liquid asphalt
  - Roadway deicing materials, including salt, calcium chloride, and brine
  - Fertilizers
  - Pesticides
  - Other hazardous substances (such as paint, solvent, cleaners)
- Vehicle and Equipment Maintenance
  - Motor oil, transmission fluid, antifreeze, hydraulic oil, and other vehicle and equipment fluids
  - Fuel
  - Wastewater, detergents, and asphalt release agents from vehicle and equipment cleaning operations

Hydraulic oil leak
from NCDOT truck

- Illegal Connections or Dumping on NCDOT Property
  - Waste dumped at rest areas, on roadways, or other NCDOT property
  - Litter on roadways
  - Illegally piped connections from adjacent properties that discharge pollutants into NCDOT right-of-way

- Road Maintenance
  - Road oil
  - Fuel
  - Paint and sealant
  - Other vehicle and equipment fluids
  - Concrete debris and construction waste
  - Pesticides
  - Deicing materials
  - Sediment

Antifreeze leak on pavement from NCDOT truck

SPILL PREVENTION PRACTICES

Equipment failures may result in discharges of oil or hazardous substances in varying amounts over varying periods of time. Structural, mechanical, or instrument failures may include tank rupture or piping and fitting failures associated with the use of various petroleum and non-petroleum products. These failures can occur as the result of structural deficiencies, material defects, unchecked corrosion, and extreme stresses resulting from unusual internal or external pressures or from external loads.

Preventing these types of releases will help keep our waterways clean. Spills can be prevented through routine inspections, good housekeeping, preventative maintenance, and employee training.

1.2 Inspections

Daily visual inspections of equipment and material storage areas or work areas are the key to preventing and minimizing spills. Having procedures in place to prevent and respond to spills is only part of the challenge. Making sure these procedures are properly implemented and effective must be an on-going effort. Periodic inspections help ensure that the procedures are doing the job. Visual monitoring of stormwater discharge outfalls is useful in evaluating the effectiveness of procedures in preventing stormwater contamination.

In order to comply with a facility SPPP or SPCC Plan, there are several forms required to be completed during site inspections. Those forms are referenced below, and can be found in your SPPP binder or on the SPPP website, https://apps.dot.state.nc.us/hydro/sppp/.

- General walk-throughs of NCDOT facility work areas should be conducted by facility personnel. The following items should be evaluated during the walk-through:
  - Tanks and drums: observe for leaks and corrosion
  - Secondary containment structures: make sure valves are closed and locked
  - Unusual stains on walls, floors, and grounds
  - Deterioration of equipment foundations and structural components
  - Debris present in stormwater drainage inlets, pipes, or ditches
  - Excessive noise, vibration, or exhaust associated with equipment

- Deteriorating gaskets, supports, and loose valve stems on valves and pipelines
- Torn bags of dry materials or bags exposed to rainwater
- Conditions of spill response kits and quantity of absorbent materials

- Each maintenance yard must perform an inspection of potential stormwater contamination and stormwater systems on a semi-annual basis. These inspections are required by NCDOT's NPDES stormwater permit. **SPPP Form 19** is used during each semi-annual inspection.
- Inspections should also evaluate the likelihood of non-stormwater discharges being directed to the stormwater system (for example, wastewater from outdoor equipment washing activities). If identified, unallowable non-stormwater discharges must be eliminated (refer to SPPP or **Non-Stormwater Discharges Chapter, IA-015** of this manual). SPPP **Forms 5** and **6** are used to track non-stormwater discharges identified at a facility.
- NCDOT's NPDES Permit requires that stormwater discharges from industrial outfalls be inspected at least twice per year during wet weather events for evidence of pollutants (**SPPP Form 17**). The discharges are observed using the following parameters:
    - Color
    - Odor
    - Clarity
    - Floating solids
    - Suspended solids
    - Foam
    - Oil sheen
    - Other indicators of pollution
    - Erosion at or immediately below the outfall

Oil sheen on surface water

- If the facility has an SPCC Plan in place, monthly site inspection checklists (**SPCC Form 23**) and an annual site inspection (**SPCC Form 24)** must be completed for regulated oil containers at the facility (refer to facility SPCC Plan oil container inventory).
- Be aware that leaks and spills can occur during roadway maintenance activities. Clean up spilled material (fuel, paint, asphalt, fertilizer, etc.) immediately and dig up all contaminated soil, place into drums, and dispose of properly. Contact the Division Hazardous Materials Manager if there are questions concerning spill notification, cleanup, and disposal requirements.

1.3 Good Housekeeping

Good housekeeping is maintaining a clean and orderly work environment, whether within a facility or on the roadway. A good housekeeping program also includes materials management practices such as proper storage of drums and other chemicals. There is a Good Housekeeping section on SPPP inspection **Form 19.** Good housekeeping includes the following BMPs:

- Dispose of dirty mop washwater from industrial shop floor cleaning by passing through an oil/water separator connected to sanitary system. Other bathroom or bullpen mop washwater can be drained directly to the sanitary sewer system.
- Sweep up contaminated dry granular absorbents after each use and place in designated containers.
- Check catch basins and other inlets to the stormwater drainage system regularly to make sure that they are free of debris and do not have any evidence of staining, which may indicate that a spill has occurred.

Sweep up dry absorbents

- Inspect the exterior grounds on a regular basis. Dispose of litter and other trash in designated containers.
- Make sure that scrap parts and empty drums are not accumulating on-site.
- Cover dumpsters and recycle bins to prevent rainfall from coming into contact with their contents.
- Store chemicals in approved containers indoors or under cover so that they will not contaminate rainwater.
- Recycle, reclaim, or reuse process materials to reduce the amount brought into the facility.
- Locate material storage areas away from storm ditch, ditches, or other access to surface waters.
- Cover storm drain inlets and manholes during paving operations.
- Use erosion and sediment control measures to manage runoff.
- Utilize pollution prevention equipment and materials such as drip pans and absorbent material for paving machines to capture leaks and spills of paving materials and fluids.
- Use only NCDOT-approved products. The approved product list is located on the NCDOT website at: http://apps.dot.state.nc.us/vendor/approvedproducts.

1.4 Preventative Maintenance

Preventative maintenance consists of inspections and tests of NCDOT equipment and operational systems to evaluate conditions such as cracks or slow leaks that could cause breakdowns or failures resulting in discharges of pollutants to the stormwater drainage system.

Preventative maintenance also applies to the storm drainage infrastructure itself and to stormwater controls such as infiltration devices, diversion structures, detention facilities, and other stormwater treatment systems that may be located at the NCDOT facility.

The following types of equipment and structures may require preventative maintenance (refer to the facility's SPPP for more guidance on their specific risk to stormwater runoff):

- Fuel pumps
- Oil pumps
- Other pumps
- Mobile equipment
- Secondary containment structures
- Pipes and supply lines

Liquid asphalt spilled on ground near dispensing area

Preventative maintenance includes the following BMPs:

- Perform preventative maintenance daily during normal working hours and under normal operating conditions.
- Inspect, test, clean, and perform minor repairs on equipment and structures at regularly scheduled intervals.

Hydraulic fluid spill on pavement from heavy equipment

1.5 Spill Response

Despite our best efforts to protect the environment, spills sometimes occur. Quick, effective responses to spills can minimize their impacts and prevent the spill from entering surface waterbodies. WHEN IN DOUBT, REPORT A SPILL to the proper authorities using the procedure below.

It is also important that proper follow-up procedures, such as reporting and recordkeeping, are followed after a spill.

1.5.1 Spill Response Process

- For significant spills of oil or hazardous substances that cannot be controlled by personnel in the immediate area, contact emergency response units by dialing 911. It may also be necessary to contact emergency spill response contractors to assist with clean-up.
- Report all spills to the Stormwater Pollution Prevention Team (SPPT) Leader. The SPPT Leader coordinates with the Division Hazardous Materials Manager to direct all response, cleanup, notification, and disposal efforts for spills occurring at an industrial facility or for spills occurring on the roadway during maintenance activities, including any spill reporting to North Carolina Division of Water Quality (DWQ), National Response Center (NRC) or United States Coast Guard, United States Environmental Protection Agency (USEPA), or other appropriate agencies. Refer to the facility SPPP-SPCC Plan for specific spill response, cleanup, and notification procedures.

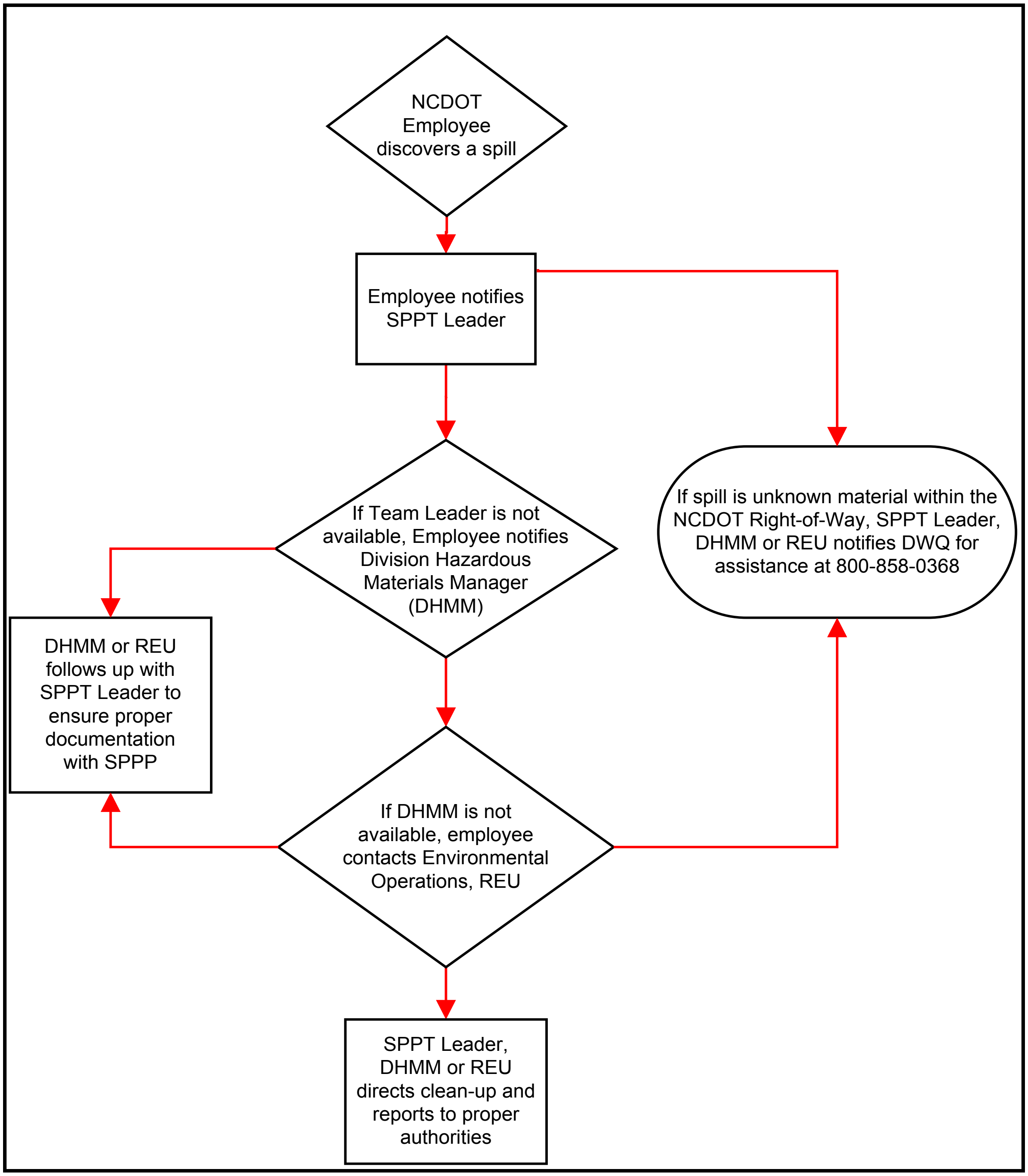
1.5.2 Significant Spills

Significant spills include, but are not limited to: releases of oil or hazardous substances in excess of reportable quantities under section 311 of the Clean Water Act (Ref: 40 CFR 110.10 and CFR 117.21) or section 102 of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Ref: 40 CFR 302.4) or spills that cannot be controlled with on-site resources, or cause a contamination to the environment, or cause injury to personnel.

- Refer to the following flow chart for NCDOT Spill Reporting protocol. A list of SPPT Leaders can be found on the SPPP website at https://apps.dot.state.nc.us/hydro/sppp/.
- If the SPPT Leader needs assistance, he/she should contact the Division Hazardous Materials Manager or Roadside Environmental Unit (REU), Environmental Operations Section in Raleigh. If spill material is unknown on NCDOT right-of-way, immediately contact supervisor. Do not attempt to clean up the spill. If spilled material is suspected of being hazardous waste as defined by 15 NCAC 13A, immediately contact Division Hazardous Materials Manager.
- Use only trained personnel to respond to spills.
- Safety goggles, nitrile gloves, and tyvek coveralls and other appropriate personal protection equipment (PPE) should be used when responding to spills.
- Follow these four basic steps to control a spill:

  1. Stop the spill at the source.
     - Plug
     - Patch
     - Cover
     - Confine
  2. Contain the spill.
     - Protect storm drainage inlets

NCDOT Spill Reporting



DHMM	=	Division Hazardous Material Manager
DWQ	=	Division of Water Quality
REU	=	Roadside Environmental Unit
SPPT	=	Stormwater Pollution Prevention Team

3. Collect the spilled material.
   - Methods used to remove the spill will vary depending on material spilled (refer to MSDS)
   - All evidence of a spill will be completely removed
   - Absorbent pads, booms, and socks and dry granular absorbents can be used

4. Dispose of the spilled material and subsequent contaminated material properly.
   - Use appropriate containers to store used absorbents and contaminated cleanup materials. Refer to the **Waste Handling and Disposal Chapter, IA-013** of this manual for further guidance.
   - Contact your Division Hazardous Materials Manager if there are questions concerning the proper disposal of used absorbents and contaminated materials.
   - Follow the general guidelines in the Oil Spill Response, Reporting, and Cleanup table below for responding to and reporting an oil spill.

Oil Spill Response, Reporting, and Cleanup

Oil Spill Volume	Response	Reporting	Cleanup
< 25 gallons on-site	Facility Personnel	SPPT Leader	Sorbent Material, Pads
≥ 25 gallons, or causes sheen on water, or ≤ 100 feet from water	Facility Personnel	SPPT Leader, DWQ	Sorbent Material, Pads
Greater than 1,000 gallons or > 42 gallons in two spills within one year	Facility Personnel, Fire Dept/Contractor	SPPT Leader, USEPA, NRC, DWQ	Qualified Hazardous Waste Contractor
Any amount that reaches a navigable water	Facility Personnel, Fire Dept/Contractor	SPPT Leader, USEPA, NRC, DWQ	Qualified Hazardous Waste Contractor

Spill Cleanup Method for Oil Spill

- Use commercial non-biodegradable absorbent materials to remove oil from drainage system or water body.
- Granular absorbents or sand can be spread on paved surfaces to absorb oil and help eliminate slippery areas.
- Where oil exists in depth, a flameproof, well-grounded pump and motor can be used to remove oil. In this case, a truck may be required to transport the waste oil to an approved reclamation/ disposal area or waste oil tank.


Typical NCDOT spill kit

- If oil enters the storm drainage system, oil will be removed from the surface by skimming or pumping and will be placed in containers for proper disposal.
- Spark-producing shovels or other similar metallic tools (which may spark with surface) should not be used for cleaning.
- Contaminated absorbents will be collected by broom or shovel and transferred into approved containers for proper disposal.

Spill Cleanup Method for Hazardous Substance Spill

- Refer to the MSDS for particular hazard, precautionary measures, PPE, and cleanup procedures.
- Absorbents may be used where open water may be affected.
- If a hazardous substance enters the storm drainage system, the contaminated storm drainage effluent will be pumped into containers to be properly disposed.
- Restoration of areas damaged by oil or hazardous substance spill will return the affected areas equal to their condition prior to the spill. Rehabilitation may include planting and seeding of the disturbed area, if necessary.

Paint spills on the ground from improper loading and mixing practices

- Impervious areas (concrete or asphalt) that have been contacted by the spilled material will be decontaminated. If spilled material was an inorganic acid or alkali, a dilute solution of an appropriate neutralizing agent should be used as an initial rinse. If the spill material involved an organic material (oil or solvent), an aqueous surfactant solution should be used for the initial rinse. Spent decontamination solutions will be collected and transferred to DOT-approved containers for proper disposal. Steam cleaning or triple water rinse may be needed to follow-up this decontamination step.
- If spilled material contacted soils, all obviously contaminated soil will be removed as directed by SPPT Leader and Division Hazardous Materials Manager. The contaminated soil will be transferred to DOT-approved containers unless disposed in bulk. During removal operations, soil samples should be collected, including at appropriate depths and locations beyond the immediately affected area as necessary.

Absorbent pads stored on-site for spill response

Contact the Division Hazardous Materials Manager for the current NCDOT hazardous waste contractor.

- If a Hazardous Spill Basin (HSB) captures a spill or a spill has just occurred up gradient of the HSB, NCDOT personnel should close the HSB sluice gate and contact the Division Hazardous Materials Manager. Call 911 and any other proper authorities if this has not already been done. At no time should NCDOT personnel attempt any hazardous material cleanup or enter a spill area unless he or she is properly trained.
- If unknown spills are encountered on the roadside, contact DWQ for assistance in having the spill evaluated and cleaned or removed.

1.6 Recordkeeping

Each SPPT Leader must maintain detailed spill records to demonstrate to DWQ that proper spill prevention and response procedures have been implemented at the facility. All significant spills that occur at the facility must be documented using **SPPP Form 9**. All non-compliance incidents that occur at the facility must be documented using **SPPP Form 10**.

A copy of **SPPP Form 10** shall also be provided to DWQ within five (5) days of the time NCDOT becomes aware of the circumstances.

The following are examples of non-compliance events:

- Failure of a stormwater control device
- Flow by-pass of stormwater control device
- Improper discharge or dumping
- Spill into stormwater drainage system
- Spill into waters of the state
- Illicit discharge/connection

It is important that completed forms are available for regulators to review upon their request.

- Keep copies of SPPP-SPCC Plan inspection records (including completed inspection **Forms 17, 19, 23,** and **24** as applicable).
- Keep copies of any completed SPPP-SPCC Plan significant spill or non-compliance reports (including completed **Forms 9, 10,** and **26**).

Paint spill discharged
to the storm drainage system

Ensure that all current MSDSs are maintained onsite. In the event of a hazardous substance spill, contact your Division Hazardous Materials Manager for assistance with the determination of a Reportable Quantity (RQ).

An Illicit Discharge/ Connection is defined as:

- Any unauthorized dumping along roadway
- Any illegal drainage connection to the roadway's drainage system
- Any illegal placement of a hazardous substance along the roadway

Pollutant types may include:

- Oil/grease
- Chemicals
- Sewage
- Fuels
- Wastewater
- Hazardous waste
- Barrels/drums

Drums abandoned onto NCDOT property are considered illegal dumping

1.7 Reporting

Certain types of spills must be reported to DWQ. Please keep in mind that the information presented here is to supplement the SPPP or SPCC Plan, and in the event of a spill at an industrial facility the procedures written in the SPPP or SPCC Plan must be followed. As a BMP, the SPPT Leader should post warning signs that contain emergency telephone numbers at fuel stations, bulk storage tanks, other refueling areas, and other hazardous substance storage areas.

Depending on the size of the spill, type of material spilled, and whether or not the spill has entered a waterway, it may be necessary to file a report with NCDENR. Any spill that endangers human health or the environment must be reported to DWQ's Supervisor of Stormwater Management at (919) 733-5083. Refer to the table in the Spill Response section for reporting requirements related to oil spills. Note that "oil" includes all fuel products as well as CRS-2.

Information on a significant spill that has been documented on **SPPP Form 9** can be used in reporting the spill to the appropriate agencies. If a spill results in a non-compliance event, a copy of **SPPP Form 10** must also be submitted to DWQ within five business days of the time NCDOT becomes aware of the circumstances. The completed **SPPP Form 10** will contain a description of the non-compliance, and its causes; the period of non-compliance, including exact dates and times, and if the non-compliance has not been corrected, the anticipated time compliance is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the non-compliance.

For NCDOT facilities covered by SPCC Plans, a written report must also be submitted to USEPA Region IV within 60 days if the facility has discharged to water:

- More than 1,000 gallons of oil in a single discharge, or
- More than 42 gallons of oil in each of two discharges, occurring within any consecutive twelve-month period.

SPCC Form 26 lists the required information that must be submitted to USEPA within 60 days if either of the above thresholds is reached. The SPPT Leader must also provide a copy of the completed **SPCC Form 26** provided to USEPA to DWQ and retain a copy with SPCC Plan at the facility.

Trained facility personnel provide initial response to spills. In the case of large-volume spills, this facility will request aid from the local Fire Department, and other appropriate emergency response agencies. The SPPT Leader should post emergency spill response contact numbers (completed **SPCC Form 25**) in his/her office and near appropriate telephones.

If an illicit discharge/connection is found, immediately report findings to supervisor or SPPT Leader using the Illicit Discharge Detection and Elimination Program (IDDEP) form at (http://inside.ncdot.gov/sites/SearchCenter/Pages/Results.asp?k=iddep), (http://apps.dot.state.nc.us/quickfind/forms). Forward the completed form to the REU, Environmental Operations Section in Raleigh.

The following table contains the telephone numbers for agencies and companies that the SPPT Leader may need to contact in the event of a spill. Call DWQ's 24-hour number immediately if a spill occurs directly to a surface waterbody. The Regional DWQ office must also be contacted (see http://portal.ncdenr.org/web/quest/regional_offices).

State and Federal Spill Response Telephone Numbers

Spill Response Entity	Telephone Number
DWQ 24 Hour Emergency Response Spill Reporting	(800) 858-0368
National Response Center (NRC)	(800) 424-8802
United States Environmental Protection Agency, Region 4	(404) 562-9655

1.8 Training

Training is essential to keep NCDOT personnel and contractors that work on NCDOT property up to date on the proper techniques for effective spill prevention and response. NCDOT's NPDES permit requires facility personnel to receive annual SPPP-SPCC Plan training, which includes proper spill response, notification, cleanup procedures, and preventative maintenance activities.

Provide training to maintenance yard personnel at least annually. Document training using **SPPP Form 3** and the SPPP website. This training should enable personnel to identify and manage potential spills from equipment and containers of petroleum and other hazardous substances. Personnel should be trained on proper reporting and recordkeeping procedures for spills. In addition, the training should review spill prediction scenarios. Additional training topics include:

- Proper and safe cleanup of spilled materials;
- General facility operations;
- Operation and maintenance of equipment to prevent discharges;
- Securing drums and containers;
- Checking for leaks and spills;
- Proper handling and storage of hazardous substances;
- Identification of toxics and hazardous substances and wastes stored, handled, used, and produced on-site;
- Preventative maintenance of equipment and stormwater control measures;
- Preventing exposure of petroleum-based fuels, oil, and lubricants, hazardous substances, and waste materials to stormwater;

Stained pavement from spills outside drum storage/dispensing area

- Safe fuel handling procedures; and
- Past discharges or failures, malfunctioning components, recently developed precautionary measures, and lessons learned.

APPENDIX F WASTE HANDLING AND DISPOSAL AND HAZARDOUS MATERIALS MANAGEMENT

[CHAPTERS FROM INDUSTRIAL AND ROADWAY MAINTENANCE ACTIVITIES MANUAL]

Chapter 12 Hazardous Materials Management

Overview

DESCRIPTION

This chapter provides best management practices (BMPs) for hazardous materials management including product purchasing, storage and handling, inspections, training requirements, and recycling.

There are numerous regulations that govern the management of hazardous materials. If the BMPs in this chapter are followed, along with manufacturer's guidelines, there should be minimal potential for these materials to contaminate stormwater runoff. Note that hazardous waste management and disposal is described in a separate chapter in this manual (**Waste Handling and Disposal Chapter, IA-013**).

Proper hazardous materials storage and management is necessary to prevent harmful pollutants from being released into the stormwater drainage system.

POTENTIAL POLLUTANTS

NCDOT uses a wide range of hazardous materials that, if exposed to stormwater, can pollute surface waters. These include, but are not limited to: adhesives, antifreeze, asphalt mix and liquid asphalt, asphalt releasing agent, batteries, cleaners, deicing materials, fertilizer, filters, fuel, oil, paint, pesticides, and solvents.

GOALS

The goals of this chapter are to help NCDOT personnel that manage or use hazardous materials understand what hazardous materials are, that they are properly storing and managing these materials, and that efforts are made to seek alternatives to some of the hazardous materials NCDOT uses, where applicable.

KEY DEFINITIONS

Hazardous Materials (HAZMATs) or Hazardous Substances are: (1) any substances designated under 40 Code of Federal Regulations (CFR) Part 116 pursuant to Section 311 of the Clean Water Act, and (2) any substances that pose a threat to human health and/or the environment. Hazardous substances can be toxic, corrosive, ignitable, explosive, or chemically reactive. [NCDOT SPPP; note (1) is NCDENR DWQ definition]

The Institute of Hazardous Materials Management (IHMM) provides the following explanation about hazardous materials (in italics):

Hazardous materials are defined and regulated in the United States primarily by laws and regulations administered by the U.S. Environmental Protection Agency (USEPA), the U.S. Occupational Safety and Health Administration (OSHA), the U.S. Department of Transportation (USDOT), and the U.S. Nuclear Regulatory Commission (US NRC). Each has its own definition of a hazardous material.

- *OSHA's definition includes any substance or chemical which is a "health hazard" or "physical hazard," including: chemicals which are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents which act on the hematopoietic system; agents which damage the lungs, skin, eyes, or mucous membranes; chemicals which are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive or water-reactive; and chemicals which in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists or smoke which may have any of the previously mentioned characteristics. (Full definitions can be found at 29 CFR 1910.1200.)*
- *USEPA incorporates the OSHA definition and adds any item or chemical which can cause harm to people, plants, or animals when released by spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment. (40 CFR 355 contains a list of over 350 hazardous and extremely hazardous substances.)*
- *USDOT defines a hazardous material as any item or chemical which, when being transported or moved, is a risk to public safety or the environment, and is regulated as such under the: Hazardous Materials Regulations (49 CFR 100-180)*
- *US NRC regulates items or chemicals which are "special nuclear source" or by-product materials or radioactive substances. (See 10 CFR 20).*

NCDOT's NPDES Stormwater Discharge Permit defines a Hazardous Substance as any substance designated in 40 CFR Part 116 pursuant to Section 311 of the Clean Water Act. 40 CFR Part 116 lists constituents and chemical abstract service (CAS) numbers so product Material Safety Data Sheets (MSDSs) must be referenced to determine if they contain hazardous constituents per this definition.

12.1 Hazardous Materials Product Purchasing

Efforts to procure more environmentally friendly products and raw materials will yield widespread benefits including reduced material handling costs, reduced inspection burdens, and reduced threat of harmful chemical releases.

NCDOT facilities should make an effort to reduce the variety of HAZMATs used and the quantity stored at NCDOT facilities. A short list of selected products that meet NCDOT performance standards can reduce purchase price, handling costs, disposal costs, and simplify inventory. The use of non-toxic products will reduce disposal costs and minimize risks to the environment.

NCDOT is a large buyer and the prioritization of selecting alternative products made from recycled or reclaimed materials has several benefits including reducing risks to the environment, reduced disposal costs, and reduced liability for NCDOT.

Using alternative products instead of toxic or hazardous substances can reduce the presence of toxics in stormwater and receiving waters (WEF and ASCE, 1998). Common toxic substances include cleaners, automotive products, paints, fertilizers, pesticides, and fuels. Educating employees to work with purchasing managers to select safer, less-toxic alternatives is the first step in preventing toxic substances from entering stormwater runoff.

12.2 Hazardous Materials Storage and Handling

NCDOT industrial facilities should follow the general and material-specific hazardous materials storage and handling BMPs described below to minimize the potential for stormwater pollution.

12.2.1 General

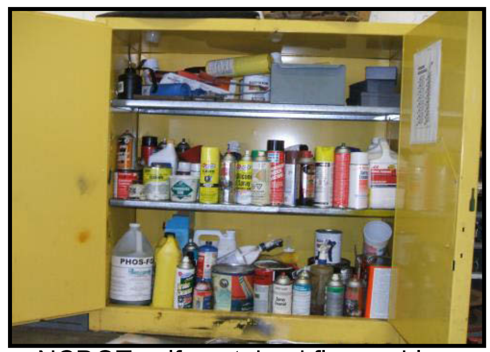
The general BMPs listed below should be followed:

- Keep facility SPPP up-to-date regarding the location of each hazardous material storage area located at the facility.
- Keep an up-to-date inventory of hazardous materials and discard materials when their expiration dates have passed.
- Know the hazards associated with all materials stored and used at the facility by reviewing MSDSs and communicate hazards to employees.
- Always store hazardous materials based on compatibility (i.e., “like with like”) and store them in their original containers when possible.
    - If incompatible hazardous materials are allowed to mix, violent chemical reactions, toxic fumes, fire, or explosion could occur.
- Consolidate hazardous materials and plan to have one storage area per material.
- If hazardous materials must be transferred to another container, always follow manufacturer’s guidelines and use containers designed for the respective material.
- Consolidate like hazardous materials into designated storage areas throughout the facility to reduce excess inventory and unnecessary hazardous material storage locations.

- Label all hazardous material containers for contents and hazard, including any containers used to transfer or temporarily store hazardous materials.
- Use signs to designate each hazardous material storage area – this will aid in keeping "like materials" in one area.
- Store hazardous materials indoors (on impervious surfaces) within secondary containment. If a hazardous material container must be stored outdoors, refer to the **Outdoor Container Storage Chapter, IA-007** of this manual for additional guidance.

Drums of oil and hazardous substances stored on secondary containment pallets inside an NCDOT Equipment Shop

- Locate HAZMAT storage areas away from floor drains, storm drain inlets, drainage ditches, and surface waters.
- If available, store bulk hazardous materials in prefabricated HAZMAT storage building with integral secondary containment.
- Store small hazardous material containers in an approved flammables cabinet with integral secondary containment. Follow cabinet manufacturer's guidelines and National Fire Protection Association (NFPA) requirements when storing materials in flammables cabinets.
- Make sure that any fabricated storage cabinet used to store hazardous material is properly constructed and approved for its designated use by the SPPP Leader or Division Hazardous Materials Manager.



NCDOT self-contained flammables cabinet used to store HAZMATs

12.2.2 BATTERIES

Regarding the management of batteries, note the following BMPs:

- Place batteries into a suitable non-conductive container (such as a polyethylene drum or tub) that is properly labeled.
- Store batteries securely and out of harm's way to prevent damage or discharge of any stored electrical energy. Immediately contain leaking or cracked batteries.

NCDOT batteries stored under cover on secondary containment pallet

- Segregate different batteries into separate containers based on the proper recycling or disposal requirements for each type of battery.

12.2.3 ASPHALT PRODUCTS

Regarding the management of asphalt products, note the following BMPs:

- Label containers with product and hazard information.
- Store products in designated, secured areas, protected from the weather and extreme heat, cold, or moisture.
- Store products away from floor drains, storm drain inlets, drainage ditches, or surface waters.
- Store products on impervious surfaces with secondary containment, if feasible.
- Locate containers and tanks outside of high-traffic areas and in areas that are protected from inadvertent vehicle/equipment impacts.
- Close valves, lids, and caps when not in use. Place drip pans under valves, if needed.
- Consider the use of an "environmentally friendly" biodegradable asphalt release agent such as soy and corn oil-based products.
- Handle open containers and product transfers in a manner to prevent spills by using tarps, drip pans, or other containment devices. Asphalt product transfers should be performed over an impervious surface, if possible.
- Refer to **Waste Handling and Disposal Chapter, IA-013** of this manual for guidance on handling excess asphalt release/cleaning agent materials or waste generated during cleaning operations.

12.2.4 PAINT

Regarding the management of paint, note the following BMPs:

New paint drums stored indoors in NCDOT Traffic Services Shop

- Minimize the inventory of paints, as appropriate. Perform periodic evaluations of any excess paint left over from projects to verify if materials should be properly disposed.
- Designate paint storage areas. Store paints indoors or in covered areas with proper secondary containment. Storage areas should be secure to discourage theft and vandalism. Store flammable and combustible products in approved storage cabinets.

- Store paints in their original containers or in other compatible containers that are clearly labeled.
- Use refillable spray bottles such as metal bottles that use compressed air or plastic bottles with hand pumps for paint spraying whenever possible.
- Use the entire aerosol spray can before starting a new one.
- Attempt to use all the paint in cans and other containers and allow them to dry before disposal.
- Use funnels and pumps to minimize spills during refilling.
- Block all drains in the vicinity of paint loading or mixing activities.
- Immediately clean up any paint spill.
- Avoid overspraying in designated paint areas and manage any paint byproducts in such a way as to minimize their exposure to the stormwater drainage system.
- Check that parts are dry, clean, and free of rust prior to painting the parts.
- Contain waste from sanding and sand blasting and properly dispose of it.
- Always isolate paint waste and prevent contact with stormwater.
- Verify that paints, thinners, and solvents are recycled, reused. or disposed of properly.

12.2.5 Fertilizer and Pesticides

Regarding the management and fertilizer and pesticides, note the following:

- For more specific guidance on the handling and storage of fertilizer, refer to the **Fertilizer Use and Storage Chapter, IA-002** of this manual.
- For more specific guidance on the handling and storage of pesticides, refer to the **Pesticide Use and Storage Chapter, IA-003** of this manual.

12.3 Hazardous Material Spill Response

Provide a spill kit near or at locations where HAZMATs are stored. A spill kit will consist of absorbent pads, booms, and/or dry granular absorbents in sufficient quantity to contain a spill from the largest container at that storage location. Non-sparking shovels should be provided to aid in cleaning up the spill. Provide a container for disposing of the used absorbents. For certain hazardous materials, specialty spill kits (e.g., acid spill kits for battery storage areas) should be used at NCDOT facilities. Refer to the **Spill Prevention and Cleanup Chapter, IA-001** of this manual, Section 3.3.2 of your Stormwater Pollution Prevention Plan (SPPP), and/or NCDOT's Hazardous Material Spill Response Environmental Policy and Procedure (EPP 1910.1200 – January 2000 Update) for additional information on spill kits.

All hazardous material containers must be labeled properly. Labels will help the employee handle and use the material safely and respond to spills efficiently. The SPPP Team Leader should contact the NCDOT Division Hazardous Materials Manager for assistance with proper labeling requirements or for additional guidance on managing specific hazardous materials spills.

HAZMATs stored indoors on spill containment pallets with a spill response kit containing absorbents located nearby

NCDOT bulk aboveground storage tanks containing hazardous materials should be labeled with the contents, capacity, hazard, and an emergency telephone number, as appropriate.

12.4 Hazardous Material Storage Area Inspections

Regular inspections of HAZMAT storage and handling areas are critical to preventing the release of harmful chemicals. Employees should visually inspect HAZMAT storage areas daily and should perform written inspections twice per year, at a minimum, using **SPPP Form 19** to verify BMPs are in-place to prevent stormwater contamination. During daily rounds, NCDOT personnel should strive to incorporate the storage and handling BMPs described in this chapter and should also look carefully for the following[1]:

- Is there adequate aisle space and organization in material storage areas?
- Are containers in generally good condition (free of leaks, spills, and corrosion) and stored away from direct traffic routes to prevent accidental spills?
- Are items in storage properly labeled to indicate contents?
- Are all containers closed?
- Are containers stored under cover and away from exposure to precipitation?
- Are containers stacked according to manufacturer's instructions on pallets and/or off the ground to avoid corrosion due to moisture buildup?


Drum storage areas should be visually inspected daily

- Are loading/ unloading areas protected from rainfall, run-on, and runoff?

[1] SPPP Form 19 Hazardous Materials Handling and Storage checklist items.

- Are leaks/ spills/ drips cleaned up promptly?
- Are excess hazardous materials removed from the facility promptly?
- Are current and correct MSDSs readily available to employees?

12.5 Hazardous Material Disposal

The **Waste Handling and Disposal Chapter, IA-013** of this manual address the disposal of waste materials and provides some guidance on recycling materials. For the purposes of this manual, waste materials includes hazardous waste, and certain unused or expired hazardous materials. The following general BMPs are required for the disposal of hazardous materials:

- Consult the waste product description to determine whether the waste product is hazardous or non-hazardous. If uncertain, contact the Division Hazardous Materials Manager for assistance. If the waste product is hazardous, contain the waste in a compatible container, label the container, and remove it to the hazardous waste containment area for disposal by a qualified NCDOT hazardous materials contractor (notify the SPPP Team Leader or a supervisor). The accumulation start date must also be clearly marked on the hazardous waste container.
- Consider reuse, recycling, evaporation of the free liquid, disposal as solid waste, or disposal to the sanitary sewer system if the waste product is non-hazardous and approved or otherwise permitted by the municipal sewer system. Contact the Division Hazardous Materials Manager for further guidance as necessary.
- Implement BMPs in the "Product Purchasing and Recycling" section of this chapter to minimize the use of hazardous chemicals and to substitute non-hazardous chemicals for hazardous chemicals.

Solvent parts cleaner located in NCDOT Equipment Shop

- Reuse and recycle solvents, paints, antifreeze, motor oil, water, and lubricants whenever possible and practicable.

12.6 Training

Periodic training should be provided so that NCDOT personnel continue to be mindful of the stormwater pollution prevention BMPs discussed in this chapter. Refer to the Introduction of this manual for further training guidance. Examples of training approaches for this chapter include:

- OSHA requires Hazard Communication (also known as HazCom) training for employees exposed to hazardous chemicals. USDOT requires Hazardous Material training for employees who ship, load, transport, unload, or package/label these materials.
- Provide training for NCDOT facility personnel that handle hazardous materials at least annually on the identification of hazardous materials, the proper storage and management of hazardous materials, and recycling and reuse techniques.
- Provide spill prevention and response training on a routine basis and at least annually. Spill prevention and response training should include hazardous substance spills in addition to petroleum spills. Employee awareness will improve a facility's preventative maintenance and spill prevention and response programs. Spill prevention training should highlight previous spill events, equipment failures, remedies taken, and newly developed prevention measures. NCDOT personnel should contact their Division Hazardous Materials Manager if potential spills or dumping is identified within NCDOT right-of-way. See **Spill Prevention and Response Chapter, IA-001** of this manual for additional details.
- Provide additional HAZMAT Management training for Equipment Shop supervisors and other NCDOT facility personnel that manage or procure large quantities of hazardous materials used at NCDOT facilities.

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Chapter 13 Waste Handling and Disposal

Overview

DESCRIPTION This chapter focuses on the handling and disposal of hazardous and non-hazardous wastes generated during NCDOT work and collected at NCDOT facilities. Almost all NCDOT maintenance activities produce waste, whether on the roadway or at maintenance yards. Without proper waste handling, storage, and disposal procedures, the waste can quickly become a stormwater pollutant.
POTENTIAL POLLUTANTS NCDOT generates a wide range of waste materials that, if exposed to stormwater, can pollute surface waters. Waste petroleum products, used filters and rags, expired chemicals, paint related waste, land clearing waste, garbage/refuse, asphalt cleaning waste, construction and demolition debris, and inert debris are just a few types of waste handled by NCDOT.
GOALS The goal of this chapter is to provide guidance on the proper handling, storage, and disposal of NCDOT wastes and to minimize the potential of wastes to discharge to the stormwater drainage system.
KEY DEFINITIONS *Please note that the regulations described herein are subject to change. Federal, state, and local regulations are updated or amended over time so always consult the most current version of each regulation.* **Code of Federal Regulations (CFR)**: A collection of all federal regulations codified and enforced by all federal agencies. It is divided into 50 titles that represent broad areas subject to Federal regulation, including Title 40 (Protection of Environment), which contains all of the regulations governing USEPA's programs, and Title 49 (Transportation), which contains regulations governing DOT's programs

KEY DEFINITIONS, CONT.

Construction and Demolition (C&D) Waste: Solid waste (non-hazardous) from construction, remodeling, repair, or demolition of buildings, roads, bridges, or other structures. Examples include, but are not limited to, concrete, wood, metals, glass, and salvaged building components such as insulation, plywood, particle board, treated and painted wood, shingles, wire, and sheet rock. [NCDENR, "Prevent Illegal Dumping" Brochure, 2008 and http://www.epa.gov/osw/conserve/rrr/imr/cdm/]

Electronic Waste: Discarded electronics are often referred to as e-waste. E-waste has the potential to contain harmful metals such as lead, cadmium, and mercury. Mercury-containing e-waste can also be considered Universal Waste under Resource Conservation and Recovery Act (RCRA). http://portal.ncdenr.org/web/deao/recycling/electronics

Garbage/Trash/Refuse: Generally, any non-hazardous, non-recyclable waste that is considered a useless or discarded material and is not listed in the definitions contained in this chapter. Also, referred to as municipal solid waste.

Hazardous Waste: A solid waste that can pose a substantial or potential hazard to human health or the environment. It possesses at least one of four characteristics (characteristic waste), or appears on special United States Environmental Protection Agency (USEPA) lists (listed waste).

> **Characteristic Waste:** Hazardous waste that does not appear on one of the hazardous waste lists, but is still considered hazardous because it demonstrates one or more of the following characteristics: ignitibility, corrosivity, reactivity, or toxicity. [USEPA, Managing your Hazardous Waste: A Guide for Small Businesses, December 2001] http://www.epa.gov/wastes/hazard/generation/sqg/handbook/k01005.pdf

> **Listed Waste:** Waste that is considered hazardous because it appears on one of four lists published in RCRA, 40 CFR Part 261. F list (non-specific source wastes) includes wastes from common industrial and manufacturing process, such as solvents used in cleaning or degreasing operations (40 CFR 261.31); K list (source-specific wastes) includes wastes from specific industries, such as petroleum refining or pesticide manufacturing (40 CFR 261.32); P list and U list (discarded commercial chemical products (40 CFR 261.33). http://www.epa.gov/osw/hazard/wastetypes/listed.htm.

Illegal Dumping: The deposition or placement of solids or fluids of any kind into the stormwater drainage system that will create litter or a nuisance, or that will pollute or cause an unsanitary condition on the system. [SPPP Appendix A]

Inert Debris: Unpainted concrete, brick, concrete block, uncontaminated soil, untreated and unpainted wood, rock, and gravel. Inert debris is considered non-hazardous waste. [NCDENR, "Prevent Illegal Dumping" Brochure, 2008]

Land Clearing and Inert Debris (LCID): These wastes are grouped and defined in 15A NCAC 13B.0101, http://portal.ncdenr.org/web/wm/sw/rules/rulelist, (see examples in land clearing waste and inert debris definitions).

Land Clearing Waste: Stumps, trees, limbs, brush, grass, and other naturally occurring vegetation generated solely from land clearing activities. Land clearing waste is considered non-hazardous. [NCDENR, "Prevent Illegal Dumping" Brochure, 2008]

Non-Hazardous Waste: Non-hazardous waste is any solid waste that does not meet the characteristics of hazardous waste previously defined. USEPA defines non-hazardous solid waste as "any garbage or refuse; sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility; and other discarded material including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities." **Note that many people and organizations refer to non-hazardous waste simply as "solid waste."** [USEPA, "Wastes – Non-Hazardous Waste" Website. http://www.epa.gov/wastes/nonhaz/index.htm, July 2010]

KEY DEFINITIONS, CONT.

Resource Conservation and Recovery Act (RCRA): The U.S. law that regulates hazardous waste from "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste, as well as the management of non-hazardous solid wastes. RCRA regulations are contained in Title 40 CFR Parts 239 through 299. http://www.epa.gov/lawsregs/laws/rcra.html; http://www.epa.gov/epawaste/inforesources/pubs/orientat/index.htm

In North Carolina, RCRA has been adopted as the North Carolina Hazardous Waste Management Rules and is enforced by the state instead of USEPA. The rules are available on the web at: http://www.wastenotnc.org/HWHOME/WEBRules/NCHWRule.html

Solid Waste: NCDENR defines solid waste as "any solid, liquid, or contained gaseous material that you no longer use, and either recycle, throw away or store until you have enough to treat or dispose." Generally, any waste is considered solid waste except for domestic and industrial wastewater that is covered under the Clean Water Act. See RCRA, 40 CFR 261.4(a) for further details.

Universal Waste: Widely generated hazardous wastes for which USEPA has developed special hazardous waste management standards to streamline the processes for managing and disposing of these materials. Universal wastes include waste batteries, bulbs, mercury-containing equipment, and certain recalled, obsolete or unused pesticide products. [USEPA, "Wastes – Hazardous Waste – Universal Wastes" Website. http://www.epa.gov/wastes/hazard/wastetypes/universal/index.htm November 2008] [NCDENR refers to RCRA, 40 CFR 273] http://portal.ncdenr.org/c/document_library/get_file?uuid=1b667ae9-b2ac-40c4-b99d-947877eae302&groupId=38361

White Goods: Refrigerators, ranges, water heaters, freezers, air conditioner units, washing machines, dishwashers, clothes dryers, and other similar domestic and commercial large appliances (typically white in color) that are no longer in use. [NCDENR, White Goods Special Report, October 2001]

13.1 Hazardous Waste Storage

Hazardous wastes pose a substantial hazard to human health and/or the environment. As such, special consideration must be given for the storage, transport, and disposal of hazardous waste.

NCDOT facilities that generate or handle hazardous waste should follow these hazardous waste best management practices (BMPs) to minimize the potential for stormwater pollution:

- Keep facility SPPP up-to-date so it describes the location of any hazardous waste accumulation area located at the facility.
- Any work area that generates hazardous waste is required to designate a satellite accumulation point that meets the requirements specified in RCRA, 40 CFR 262.34.
- Follow hazardous material (HAZMAT) storage guidelines for

Hazardous waste satellite accumulation point
[Note: Non-DOT facility]

hazardous waste accumulation areas (see guidance in **Hazardous Materials Management Chapter, IA-012** of this manual).

- Locate hazardous waste accumulation areas indoors or under cover, where minimal impact to the environment would be realized if a release occurred. Do not locate accumulation sites within close proximity of storm drains, ditches, floor drains, open doorways exposed to weather, or near any surface waters.
- NCDOT facilities must provide for each hazardous waste accumulation site an impermeable base or containment system capable of preventing environmental contamination due to container overfilling or leakage. Concrete containment systems should be treated with a sealant to prevent spills from absorbing into or passing through the concrete. The base of the containment system should be sloped to a closed sump to allow liquids resulting from leaks or spills to be drained and removed. Options for providing secondary containment for hazardous waste accumulation areas to minimize or prevent stormwater pollution include:
    - Store hazardous waste indoors within secondary containment.
    - Store hazardous waste outdoors under cover and within secondary containment.
    - Store hazardous waste in prefabricated HAZMAT storage building with integral secondary containment.
    - Store small hazardous waste containers in a flammables cabinet with integral secondary containment.
- Different types of hazardous waste must be accumulated in separate containers. Non-hazardous waste must not be mixed with hazardous waste. For example, used oil, waste paint, and waste solvent should each be accumulated in separate labeled containers.
- For incompatible wastes, segregated containment must be provided by using separate containment areas, separately diked areas, or sloped containment to separate sumps. Hazardous chemical reactions which cause heat, fire, explosion, pressure, or the evolution of toxic or flammable decomposition products due to incompatible chemical reactions must be prevented. Incompatible wastes and materials must not be placed in the same container. In addition, hazardous waste must not be placed in an unwashed container that previously held an incompatible waste or material.
- All hazardous waste containers must be labeled properly. Labels will help the employee handle the material safely and respond to spills efficiently. Labeling is regulated under other environmental laws (e.g., United States Department of Transportation (USDOT), Occupational Safety and Health Administration (OSHA), RCRA). A sign must also be posted designating the facility as a hazardous waste accumulation site and must provide a point of contact and telephone number to be notified in case of emergency. The SPPP Team Leader should contact the Division Hazardous Materials Manager for assistance with proper labeling and signage requirements or for additional guidance on managing specific hazardous waste.

- Complete and adequate spill kits should be positioned in easily accessible locations near the hazardous waste storage area(s) at the facility. Facility personnel should know the location of and have access to facility spill kits. The spill kit(s) should have sufficient materials to contain a spill from the largest container within the hazardous waste storage area. Following a spill cleanup, the items used from the spill kit must be replenished as soon as possible. Contact the Division Hazardous Materials Manager to verify that your spill kits are appropriate for the hazardous waste stored on site. In the event of a spill, follow guidance from **Spill Prevention and Cleanup Chapter, IA-001** of this manual.
- Refer to "NCDENR Hazardous Waste Compliance Manual for Generators of Hazardous Waste" for additional guidance on compliance with hazardous waste regulations. http://portal.ncdenr.org/c/document_library/get_file?uuid=afb78a5d-bf60-4996-8ad1-6a6b21bfb471&groupId=38361

13.2 Hazardous Waste Transport and Disposal

The following BMPs are provided for hazardous waste transport and disposal:

- A Hazardous Waste Manifest must be completed and signed before hazardous waste can be accepted by another party (e.g., disposal contractor). The form is designed to track the hazardous waste from where it was generated until it reaches the final facility that will store, treat, or dispose of the waste.
- Hazardous Waste Manifests also track the quantities generated which also determines the generator status of the facility (see NCDENR Hazardous Waste Compliance Manual for Generators of Hazardous Waste for guidance, http://portal.ncdenr.org/c/document_library/get_file?uuid=afb78a5d-bf60-4996-8ad1-6a6b21bfb471&groupId=38361).
- Contact the Division Hazardous Materials Manager for assistance in completing Hazardous Waste Manifests, and the Division Hazardous Materials Manager should keep copies to track the amount generated.
- USEPA's website also contains useful information concerning Hazardous Waste Manifests. [USEPA, http://www.epa.gov/osw/hazard/transportation/manifest/, January 2010]
- USDOT, in conjunction with USEPA, requires special training, packaging, and labeling of hazardous waste during transport. NCDOT is exempt from some requirements because it is an agency of the state. However, hazardous waste should always be safely stored to prevent spills and clearly labeled so that any spills that occur can be safely contained and cleaned up.
- It is important to be aware that some materials that are not normally considered hazardous are designated as such when being shipped due to the specific risks associated with transporting these items on highways with the general public. See the

USDOT Pipeline and Hazardous Material Safety Administration (PHMSA) website or contact PHMSA is Hazmat Information Center (phmsa.hm_infocenter@dot.gov) or 1-800-HMR-4922) for additional information. [USDOT, http://www.phmsa.dot.gov/portal/site/PHMSA]

- In the event of a spill of hazardous waste, notify the local emergency response agency and the operator of the incident (refer to **Spill Prevention Control and Countermeasure (SPCC) Form 25** for emergency contact information if spill occurs at an NCDOT industrial facility). Safety is the first priority. Tend to any life threatening issues and protect bystanders from the inherent hazards. Once the scene is secure, address the spill. Spill containment procedures may vary depending on the type of waste. Generally, try to prevent the spill from reaching waterways or storm drains or ditches. Use proper materials (e.g., absorbent booms and sand bags) to contain the spill, or use a shovel or other equipment to create an earthen berm. Absorbents are also effective at containing spills. The local fire department should arrive on scene a few minutes after the call is made. Fire departments are typically equipped to handle spills and will contact local emergency officials who will help coordinate cleanup efforts for certain hazardous substance spills.
- Hazardous waste disposal is regulated by RCRA as well as USDOT, USEPA, and OSHA. Typically, hazardous waste is sent to special treatment, storage, and disposal (TSD) facilities.
- Additional information is available on USEPA's website. [USEPA, http://www.epa.gov/osw/hazard/tsd/index.htm, August 2008]
- Contact the Division Hazardous Materials Manager for any questions or concerns regarding the proper disposal of hazardous waste.

13.3 Universal Waste Management

The following general guidelines apply to universal wastes:

- Universal wastes must be stored separately in containers with a clear label indicating the type of universal waste (e.g., mercury-containing equipment, pesticides, lamps, or batteries).
- Universal waste should not be stored for longer than one year unless it is being stored for the purpose of accumulating to quantities that are easier to treat or dispose.
- Employees that handle or manage universal waste must be trained on proper handling and emergency procedures. Refer to the Division Hazardous Materials Manager for additional details.
- See RCRA, 40 CFR 273 for additional information.
- For Recycling Services for Fluorescent Lamps, Ballasts and other Mercury Containing Devices, see: http://portal.ncdenr.org/c/document_library/get_file?uuid=f210c8f6-8dd5-4497-8c6a-872aaf15949e&groupId=38322

Additional BMPs are provided for the following universal wastes.

13.3.1 FLUORESCENT BULBS

- Fluorescent bulbs and mercury halide bulbs may contain a sufficient amount of mercury, or other RCRA regulated metals, that would require them to be disposed as universal waste.
- Collect all fluorescent bulbs for recycling. High level and low level mercury bulbs (green ends or green writing) can be collected in the same container.
- Place used fluorescent bulbs in designated storage area, which should be in a secure area out of the way of daily stocking and materials movement and out of the weather, so that the cardboard containers do not become wet.
- Used fluorescent bulbs should not be stored for more than one year.
- Used fluorescent bulbs must be kept in a container, preferably the original box that the lights came in or a storage box supplied by or approved by the Division Hazardous Materials Manager.
- All containers of fluorescent bulbs should be labeled at the start of filling each box with "Universal Waste – Lamps", the date the used fluorescent bulbs were first placed in the container, and the Facility and Building name.
- Provide signage to inform employees that the area contains spent mercury-containing bulbs, as needed.

Universal Waste – used fluorescent bulbs stored in original containers

- If a fluorescent bulb breaks, all broken lights should be cleaned up immediately. Breakage of florescent bulbs could potentially expose employees to mercury. Use a broom and dustpan to gently sweep up the dust and broken glass. Use sticky tape (e.g., duct tape) to small glass fragments and powder. Place cleaned up material into an airtight container (e.g., ziplock bag), seal and label the container and place with the used lamps. DO NOT VACUUM broken bulb debris, as this could disperse mercury throughout the area or into the air.
- Coordinate disposal of used fluorescent bulbs with the Division Hazardous Materials Manager.

13.3.2 Other Light Bulbs

- All broken light bulbs should be cleaned up immediately.
- Coordinate disposal of other light bulbs with the Division Hazardous Materials Manager.
- Refer to USEPA guidance or cleaning up a broken compact fluorescent light (CFL) bulb at http://www.epa.gov/cfl/cflcleaning.htm.

13.3.3 Ballasts

- Ballasts and starters from light fixtures may contain Polychlorinated Biphenyls (PCB)-containing material. The disposal of these materials is regulated. If the ballasts are not plainly marked as "Non-PCB", the material must be treated as PCB-containing (or tested and proven to be non-PCB containing). If PCB-containing materials must be discarded, coordinate with the Division Hazardous Materials Manager for proper disposal.
- Ballasts from fluorescent light fixtures are to be removed and placed in an open-head metal drum with absorbent material that meets DOT specifications. The drums have specific labeling requirements (e.g., drums must be labeled with a hazardous waste label, marked with "This End Up" and "Ballasts containing PCBs", etc.).

13.3.4 Switches

- Thermal switches may contain mercury. Mercury is considered a hazardous waste and must be disposed as such. The Division Hazardous Materials Manager can help determine if the switches should be handled as a RCRA regulated hazardous waste.

13.3.5 Batteries

- Batteries used at NCDOT Facilities should be stored indoors unless they are being used to power equipment or vehicles stored outdoors.
- Batteries stored in stock at NCDOT facilities should be stored with proper secondary containment (e.g., lead acid batteries stored in an acid-resistant containment pan or within an acid storage cabinet).
- Lead acid batteries should be turned in for replacement batteries through local purchase. All batteries which are turned in for recycling should be noted on the receipt for the local purchase or on a hand receipt to the recycler. The number of batteries

Used batteries stored on spill containment pallet inside building should match the number actually delivered. Copies of the receipts for batteries should be kept on-site for recordkeeping purposes. See State recycling contacts at: http://www.doa.nc.gov/ssp/gen-recycontracts.htm.

- Nickel-cadmium, magnesium, and mercury batteries must be managed as universal waste.
- Silver oxide batteries should be included in a precious metals recovery program through the Division Hazardous Materials Manager.
- Lithium batteries should have a determination made as to whether they are reactive (through material safety data sheet (MSDS) review or inquiry to the manufacturer). If reactive, lithium batteries must be managed as Universal Waste.

13.4 Non-Hazardous Solid Waste

If proper procedures for handling and disposing of hazardous wastes are followed, no contact with stormwater should occur. Hazardous waste should be stored under cover and with secondary containment measures in place as described previously.

No such guidelines exist for non-hazardous wastes, however. These wastes vary to such a degree that it is not practical to prescribe one management strategy for all non-hazardous wastes. Wherever possible, stored materials (including waste) should be kept inside or under cover and runoff should be diverted away from the area. Stockpiles of construction & demolition (C&D) waste or land clearing and inert debris (LCID) waste should be removed from the site for recycling or landfilling as soon as practical. Refer to **Outdoor Raw Materials Storage/Stockpiling Chapter, IA-006** of this manual for additional BMPs regarding these wastes. Other chapters with BMP guidance that can be applied to waste handling and disposal include**: Spill Prevention and Cleanup Chapter, IA-001; Good Housekeeping Chapter, IA-002; Stormwater Management Chapter, IA-004; Outdoor Loading and Unloading Chapter, IA-005; Outdoor Container Storage Chapter, IA-007; and Hazardous Materials Management Chapter, IA-012** of this manual.

There are several categories of non-hazardous solid waste, each of which may have unique management requirements.

13.4.1 Garbage/Trash/Refuse

Regarding the management of garbage/trash/refuse, note the following BMPs:

- Garbage/trash/refuse should generally be collected in garbage bags that, when full, are tied off and stored in a solid waste dumpster for pickup by a solid waste contractor.
- Recycling and garbage dumpsters should have working lids that are kept closed to prevent contact with stormwater.

Solid waste dumpsters with closed lids

- Many dumpsters have drain holes that should be plugged to contain leachate within the dumpster.
- Dumpsters should have a label indicating the intended contents, banned substances, and contact information for the solid waste contractor.
- The solid waste contractor is typically responsible for the dumpster. Therefore, if a dumpster is in need of repair, contact the solid waste contractor. Request replacement dumpsters for damaged dumpsters located at the facility.
- Dumpster levels should be monitored so they do not overflow. Contact the solid waste contractor if a larger or additional dumpster is needed, or if more frequent pickup is required.
- It is important to locate dumpsters downstream or away from storm drains as the dumpsters can leak or spills may occur during pickup. Dumpsters should be located in designated areas and on flat or paved surfaces.

13.5 Typical Equipment Shop Wastes

BMPs are provided below for typical wastes generated at NCDOT Equipment Shops to minimize the potential for stormwater pollutants.

13.5.1 USED OIL

Used oil must be managed properly to protect the environment. It can be burned as a fuel, recycled, or discarded. If it is burned (e.g., as a fuel in an appropriate heater) or recycled and not mixed with other materials, it is NOT considered hazardous waste. However, if the used oil is disposed of/discarded then it must be managed like a hazardous waste. [Note: used oil is regulated as a non-hazardous waste in accordance with RCRA, 40 CFR 279]. For additional NCDENR Used Motor Oil Guidance see: http://infohouse.p2ric.org/ref/01/00015.htm.

Regarding the management of used oil, note the following BMPs:

- Used oil and oil-contaminated products are managed by a single contactor, statewide (see http://www.doa.nc.gov/ssp/gen-recycontracts.htm). These items should be stored/discarded in properly labeled containers prior to being picked up by the contractor. The containers should prevent the materials from coming in contact with precipitation. Place used oil into designated, labeled "Used Oil", non-leaking, rust-resistant, containers (e.g., tanks/drums) for accumulation. Used oil containers must be in good condition.

Used oil heater located
in an NCDOT Equipment Shop

- Do not contaminate used oil with small amounts of gasoline, brake cleaner, carburetor cleaner, or other solvents; even small amounts of solvents turn recyclable oil into a hazardous waste.
- Keep storage containers closed when not actively adding or removing material.
- When storing drums keep an aisle space between drums to allow inspection for leaks and damage.
- Provide secondary containment for used oil and any liquid oil-contaminated products. Store used oil in secure areas safely away from workers and the environment.
- Refer to the facility's SPCC Plan and SPPP for additional details on spill prevention and response. Refer to NCDENR Hazardous Waste Compliance Manual for Generators of Hazardous Waste for additional guidance on managing used oil, including information on mixtures of used oil and determining if the oil mixture is actually a hazardous waste.
- Practice safe management of oily wastes. Wear protective equipment such as safety glasses and gloves.
- Locate used oil storage and transfer areas indoors or under cover and away from floor drains, open doorways, storm drains, and watercourses. Double-walled aboveground storage tanks (ASTs) containing used oil can be located outdoors, but should be positioned away from storm drains or ditches. Place spill kit near any outdoor AST containing used oil.

Used oil AST is double-walled

- Require that the oil transfer area be on an impervious surface or that a tarp or drip pan be placed on the ground to catch any spills prior to any oil transfer.
- Minimize the amount of used oil produced. Consider filtering, separating, and reconditioning used oil to prolong its usable life.
- Purchase refined used oil products instead of virgin oil products.
- Recycle or reclaim the free-flowing used oil when changing equipment oil or recovering oil from spills such as hydraulic line leaks.
- Keep containers closed, except when adding or emptying. Use self-closing funnels to add material to waste containers.

- Remove all free-flowing oil to the used oil container. Rags and absorbents, including wash rack filters that are used to wipe up oil from equipment leaks or spills, are not subject to used oil and hazardous waste regulation if there is no visible free-flowing oil or hazardous substances present. Store used rags and absorbents in a container that is properly labeled.
- Other restrictions of used oil disposal/management include:
  - Do not discharge used oil to sewers, drainage ditches, septic tanks, the ground surface, or open water bodies.
  - Do not dispose of used oil in landfills or mix used oil with wastes that will be disposed of in landfills.
  - Do not mix used oil with gasoline or cleaning solvents. The resulting mixture may be a hazardous waste.
  - Do not utilized used oil for road oiling, dust control, weed control, or for similar purposes.

13.5.2 Solvent-Contaminated Rags

Regarding the management of solvent-contaminated rags, note the following BMPs:

- Rags contaminated with solvents will be segregated from other rags. If the spent solvent is a listed hazardous waste, using it on a rag results in the rag becoming a listed hazardous waste. Examples of listed hazardous waste solvents are Methyl Ethyl Ketone (MEK) and 1,1,1-trichloroethane. Chemical mixtures which include these chemicals, such as carburetor cleaner or brake cleaner, should also be treated as hazardous waste when used on rags or absorbent pads.
- Refer to the specific MSDS or contact the Division Hazardous Materials Manager to help determine which solvents are considered as listed hazardous waste.
- Coordinate with your Division Hazardous Materials Manager to determine if any of the solvent-contaminated rags can be sent to a laundry service for cleaning. Rags which can be laundered should be handled according to the operating instructions based on the appropriate contract. Rags which cannot be laundered should be accumulated as hazardous waste at the appropriate labeled accumulation point.
- Additional NCDENR guidance on contaminated wipes/rags is found at: http://portal.ncdenr.org/web/wm/hw/technical/guidance/wipes.

13.5.3 Oil-Contaminated Rags

Regarding the management of oil-contaminated rags, note the following BMPs:

- Rags contaminated with oil and hydraulic fluids should be laundered. If no laundry contract is in place for work rags, those which are soaked in oil or hydraulic fluids should be wrung either mechanically or manually to remove free product (which should be placed in an appropriate used oil container). After free product is removed, the rags may be disposed in a labeled solid waste container.

- Contact the Division Hazardous Materials Manager for additional guidance.

13.5.4 Fuel-Contaminated Rags and Absorbent Pads

Regarding the management of fuel-contaminated rags, note the following BMPs:

- Fuel-contaminated rags and absorbent pads should be accumulated at a satellite accumulation point until they no longer contain free liquid. At this point, in accordance with the State of North Carolina, the materials may be handled as a used oil product. These materials may be disposed in a municipal solid waste (MSW) landfill if the landfill operator grants permission.
- Contact the Division Hazardous Materials Manager for additional guidance.

13.5.5 Antifreeze

Used (diluted) antifreeze (ethylene glycol) is not currently regulated as a hazardous waste. However, because of its potential toxicity to wildlife, it must be handled as follows:

- Used antifreeze may not be drained to the ground or into storm sewers or septic tanks.
- Antifreeze should be collected and placed in approved containers. Reuse of the plastic container in which the antifreeze was shipped is preferred.
- Recycling of antifreeze is mandatory.

13.5.6 Oil Filters

For a facility to properly dispose of used oil filters, the facility needs to drain out the used oil thoroughly first. The oil can then be handled with the rest of the facility's used oil. If correct management procedures are followed, used oil filters should be either recycled or disposed.

Additionally, the State of North Carolina does not consider used oil filters to be a hazardous waste IF the filters are non terne-plated and the used oil is removed from the filter by gravity draining, crushing, disassembly, or air pressure. If one of these methods is performed, the used oil filters can be disposed of as non-hazardous solid waste, subject to local requirements. Used oil filters that are not drained by one of the above methods and/or are terne-plated must be managed as hazardous waste. Terne is an alloy of lead and tin, and the lead in terne plating can make a used oil filter hazardous. Terne-plated filters are used more commonly with heavy-duty vehicles and trucks.

Used oil filter dumpster stored outside an NCDOT Equipment Shop

In summary, the following general BMPs apply to oil filters:

- Oil filters should be crushed, or punctured, and hot-drained for 24 hours.
- Collect oil from filter crushing and manage it the same way as engine waste oil.
- Store drained and crushed filters in a leak-proof container until recycled or disposed.
- Recycle drained or crushed filters with your scrap metals.
- Maintain disposal/recycling receipts for at least three years.
- Free product captured by drained oil filters should be placed in a used oil container at the facility. After draining, the non terne-plated oil filters may be disposed of as solid waste. Terne-plated oil filters should be disposed of as hazardous waste. Oil filters can be recycled if a metal recycling program is in place. Do not throw away any undrained or terne-plated oil filters into solid waste dumpsters or trash containers unless the Division has evaluated the filters first and found them to be non-hazardous. Consult the Division Hazardous Materials Manager for further information on recycling and disposing of oil filters. See Section 13.5.7 below for additional guidance.

13.5.7 USED OIL FILTERS

Regarding the management of used oil filters, note the following BMPs:

- Drain used oil filters of oil before disposing in on-site waste filter container.
- Coordinate disposal of used oil filters with the Division Hazardous Materials Manager.
- Additional NCDENR guidance on management of used oil filters is found at: http://portal.ncdenr.org/web/wm/hw/technical/guidance/wipes.

13.5.8 FUEL FILTERS

Regarding the management of fuel filters, note the following BMPs:

- Fuel filters should be drained in a covered container to capture the free product. After draining, the filters should be dried and crushed. Some filters may be recycled for their metal content. The State of North Carolina allows for a drained, crushed diesel fuel filter to be recycled for its metal content or disposed in a MSW landfill.

Scrap tires stored indoors
at an NCDOT Equipment Shop

13.5.9 Scrap Tires

Regarding the management of scrap tires, note the following BMPs:

- Tires should be re-treaded when possible.
- Tires should be stored in a manner that prevents rainwater from accumulating because water collected in tires is ideal mosquito breeding habitat.
- Store tires in one location at the facility, preferably indoors. If you must store tires outdoors, store them under cover and protected from the weather.
- A maximum of 500 scrap tires may be stored on site at any one time.
- Train employees in emergency response operations in case of a fire involving the scrap tires, paying particular attention to where firefighting runoff water will go.
- Install perimeter runoff controls if the storage area is located near the facility perimeter or adjacent to surface water.
- Scrap tires are banned from North Carolina landfills and each county in North Carolina is required to have at least one scrap tire collection site that accepts scrap tires free of charge.
- For additional guidance, contact the Division Hazardous Materials Manager or refer to NCDENR Scrap Tire Fact Sheet at: http://portal.ncdenr.org/c/document_library/get_file?uuid=2fb36865-d186-44c0-9744-27517d90d05a&groupId=38361.

13.6 Typical Highway Maintenance Wastes

For typical wastes generated by Highway Maintenance activities, BMPs are provided below to minimize the potential for stormwater pollution.

Asphalt release agent drums used to clean equipment [Note: excess cleaning product should be revised or properly disposed]

13.6.1 Asphalt Cleaning Waste

Regarding the management of asphalt cleaning waste, note the following BMPs:

- When cleaning equipment and tools, any excess asphalt release/cleaning agent or agent contaminated with asphalt material should be containerized for reuse.
- Any excess asphalt cleaning product should be used or containerized for evaluation and proper disposal. Proper disposal may include recycling material back into

distributors, mixing with inert material for future road maintenance, mixing with inert materials for landfill disposal (only solids are allowed in landfills and no 55 gallon containers/drums), or disposal through a NCDOT waste disposal contractor.

- Waste material from spray bar cleaning should not be allowed to contact soil and/or water.
- Waste material from spray bar cleaning must be collected in proper container and transferred back to the NCDOT maintenance yard for evaluation and disposal.
- Properly label and store waste containers and contact the Division Hazardous Materials Manager for evaluation and disposal.

13.6.2 CONSTRUCTION AND DEMOLITION WASTE

Regarding the management of construction and demolition waste, note the following BMPs:

- Remove and properly dispose of C&D waste from the facility as soon as practicable.
- C&D waste should be separated into recyclable and non-recyclable materials, and salvageable items should be removed for reuse. Materials that cannot be reused or recycled must be disposed of in a permitted C&D, LCID, or MSW landfill.
- Recyclable materials should be sorted and stored separately for pickup. Prevent paint, soil, garbage, and other non-recyclable materials from mixing with recyclable materials.
- Recyclable C&D materials include, but are not limited to:
  - Concrete/brick/block
  - Corrugated cardboard
  - Carpet and carpet padding
  - Asphalt shingles
  - Ceiling and floor tiles
  - Gypsum/drywall
  - Wood – unpainted and untreated
  - Some plastics
  - Metals

Construction & Demolition waste stockpile located at an NCDOT facility

- The facility or associated construction project's site-specific Stormwater Pollution Prevention Plan may have additional guidance for protecting stormwater from C&D waste located at the facility or project site.

13.6.3 Inert Debris

Regarding the management of inert debris (which includes unpainted concrete, brick, concrete block, uncontaminated soil, untreated and unpainted wood, rock, and gravel), note the following BMPs:

- Inert debris should be separated from other materials and recycled if possible. Recycled inert debris can be used as "clean fill" if the fill activity involves no digging and its purpose is to improve land use potential.
- Inert debris may also be disposed of in a permitted solid waste facility (e.g., LCID or MSW landfill).
- Coordinate with the Division Hazardous Materials Manager to evaluate the potential for recycling inert debris.
- The facility or project-specific SPPP may have additional guidance for protecting stormwater from the inert debris generated at the site.

13.6.4 Land Clearing Waste

Regarding the management of land cleaning waste (which includes stumps, trees, limbs, brush, grass, and other naturally occurring vegetative material generated solely from land clearing activities), note the following BMPs:

- Land clearing waste should be kept free of soil, litter, and other materials.
- Land clearing waste should be taken to a permitted composting, chipping, or mulching facility for recycling. If the material cannot be recycled, it may be disposed of in a permitted LCID or MSW landfill.
- If the land clearing activities are being conducted for a construction project, the facility or project-specific SPPP may have additional guidance for protecting stormwater from the land clearing waste generated at the site.

Land Clearing Waste stockpile located at an NCDOT facility

13.6.5 Animal Carcasses

Regarding the management of animal carcasses, note the following BMPs:

- Animal carcasses collected by NCDOT facility personnel from NCDOT roadways should be promptly disposed using one of the following methods:
    - Composting
    - Burying on NCDOT right-of-way

- Incinerating
- Landfilling

13.6.6 Used Railroad Ties/Creosote Treated Timbers

Regarding the management of used railroad ties/ creosote treated timbers, note the following BMPs:

- NCDOT Bridge Maintenance Yards, Highway Maintenance Yards, and the Rail Division may have used railroad ties or creosote treated timbers from old bridges stored onsite that were acquired from various rail, bridge, or roadway projects. Frequently, NCDOT receives requests for these materials. People often think that railroad crossties or creosote treated timbers can easily be recycled and used for landscaping purposes. Unfortunately, the ties and timbers are coated in creosote, which USEPA has declared a *restricted use pesticide*. While safe for railroad use, they are actually regulated with conditions on their use. In short, NCDOT does not sell or give away used railroad ties or creosote treated timbers.

- The railroad or contractor is responsible for the proper disposal of crossties in North Carolina. Contact the Division Hazardous Materials Manager for additional guidance on proper disposal of used railroad ties or other timbers coated in creosote located at a facility or along NCDOT roadways.

13.6.7 White Goods

White goods consist of refrigerators, ranges, water heaters, freezers, air conditioner units, washing machines, dishwashers, clothes dryers, and other similar domestic and commercial large appliances (typically white in color) that are no longer in use. Regarding the management of white goods, note the following BMPs:

- White goods are typically not accepted by solid waste collectors during weekly trash and recycling pickup and as a result are often abandoned on the side of the road.
- NCDOT has contracted a private company to pick up and haul white goods. Contact the Division Hazardous Materials Manager for additional details including proper disposal of white goods.
- The following information may be useful if the private company is unavailable. A special program has been adopted in the state of North Carolina to encourage proper management of white goods in order to recover scrap metal and refrigerants and other potential stormwater pollutants. White goods can be disposed of in MSW landfills free of charge. Contact the Division Hazardous Materials Manager for assistance.

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13.7 Other NCDOT Wastes

BMPs are provided below for these additional wastes to minimize the potential for stormwater pollution.

13.7.1 Empty Drums

Empty drums stored horizontally on ground
[Note: No cover or signage is provided]

Regarding the management of empty drums, note the following BMPs:

- Remove waste materials from containers to the maximum extent practicable using standard practices (e.g., pouring, pumping, scraping) so that no more than 1 inch of residue remains on the bottom of container or inner liner.
- Empty drums that cannot be reused or are no longer needed should be disposed of properly with assistance from the Division Hazardous Materials Manager.
- Empty drums stored on-site must have all previous markings removed.
- Empty drums stored on-site must be stenciled or labeled with the word “EMPTY” or otherwise unlabeled and stored in a designed and labeled “EMPTY DRUM STORAGE” area.
- Empty drums should be stored horizontally on the ground or on racks. They should also be stored under a covered roof to minimize exposure to precipitation.
- Refer to NCDENR Hazardous Waste Compliance Manual for Generators of Hazardous Waste or RCRA, 40 CFR 261.7 for the specific definition of a RCRA “empty container” and additional requirements for an empty container that previously held hazardous materials or an acutely hazardous waste.

13.7.2 Paint Cans, Paint Brushes, and Paint Related Materials

Regarding the management of paint cans, paint brushes, and paint related materials, note the following BMPs:

- The Division Hazardous Materials Manager should conduct an evaluation of the types of paints used at the facility to determine if associated wastes should be characterized. If the paint contains a high concentration of metals, it is advised that Toxicity Characteristic Leaching Procedure (TCLP) testing be conducted for metals. Representative samples of spent paint brushes, masking paper and tape, dry filters, sand or plastic media from mechanical paint removal operation, and cans that contain more than 3 percent dried paint residue in them should be tested.

13.7.3 Aerosol Cans

Regarding the management of aerosol cans, note the following BMPs:

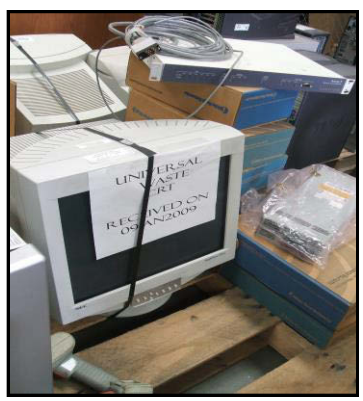
- Empty aerosol cans may be disposed of as non-hazardous waste.
- Any aerosol containers that are partially full, but are not dispensing product, should be managed as hazardous waste.
- Coordinate any puncturing, draining, or disposal of aerosol cans with the Division Hazardous Materials Manager.

13.7.4 Asbestos

Regarding the management of asbestos, note the following BMPs:

- In general, asbestos containing material that has been determined to be in good condition by an experienced licensed professional should be left alone.
- Asbestos fibers, generated from brake lining operations or building maintenance operations, require special handling for disposal. Disposal requirements are specified in 40 CFR Part 61, Subpart M (National Emission Standard for Asbestos).
- All waste asbestos containing material must be placed in two plastic bags, one inside the other. The bags must be securely closed. The outer bag must be labeled appropriately [Refer to 40 CFR, part 61].
- Coordinate with the Division Hazardous Materials Manager regarding the need to prepare appropriate documentation for the turn in of asbestos containing material.
- Removal of asbestos containing materials from buildings must be performed by approved contractors in accordance with 29 CFR 1926.1101.

Asbestos Containing Material placed in plastic bags



Electronic Waste labeled as Univesal Waste

13.7.5 ELECTRONIC WASTE

Discarded electronics are often referred to as e-waste. Regarding the management of electronic waste, note the following BMPs:

- Coordinate with the Division Hazardous Materials Manager regarding reuse or recycling of the raw materials from electronic waste (also known as e-waste), which may include harmful metals, such as lead, cadmium, mercury, or other valuable substances.
- Refer to Section 13.3 (Universal Waste Management) of this chapter for additional guidance.
- Electronic waste should be covered or stored indoors at all times to prevent contact with stormwater.
- See State Recycling contacts at: http://www.doa.state.nc.us/PandC/926a.pdf

13.7.6 SCRAP METALS

Oil and metals that can leach into stormwater runoff from scrap equipment piles are potential sources of pollution if they are exposed to precipitation and stormwater runoff. Regarding the management of scrap metals, note the following BMPs:

- Minimize the quantities of scrap metals, scrap parts, and unused vehicles and equipment stored on-site; utilize salvage/bid process to remove scrap materials from the facility.
- Remove scrap materials promptly.
- Scrap materials must be free of lubricants and loose paint to the extent practical. Salvage vehicle and equipment fuel tanks must be emptied and drained prior to being stored as scrap materials on-site. Scrap or abandoned storage tanks must be properly drained and labeled as empty/scrap.
- Scrap metal dumpsters and bins should be covered with lids or tarps to prevent contact with precipitation.

Scrap metal container covered with tarpaulin

- Scrap metal containers should have a label indicating the intended contents, banned substances, and contact information for recycling contractor as appropriate.

13.8 Unique Wastes Generated by other NCDOT Divisions

NCDOT Rail and Ferry Divisions have unique facilities and operations for which specific waste handling and disposal guidance has been developed. Refer to the future **Ferry Maintenance Waste Handling and Disposal Chapter, FD-008** and **Rail Maintenance Waste Handling and Disposal Chapter, RD-004** of this manual for additional information. Coordinate directly with the appropriate division (e.g., Aviation Division) for specific waste handling and disposal guidance on any other unique wastes generated by those NCDOT divisions.

13.9 Recycling

The International Scan Tour Report (AASHTO/FHWA, 2003) generated a number of recommendations for American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on the Environment and Subcommittee on Materials that are pertinent to recommended practices for state DOTs. These recommendations are described below:

- Include a recycling strategy in the sustainability aspect of strategic plans and long range research priorities.
- Create a framework to consider the use of recycled materials in project planning, alternatives analysis, and mitigation analysis.
- Encourage long term materials supply plans and recycled materials availability plans.
- Develop clear engineering and environmental guidelines at the State and Federal level that are available for suppliers and decision-makers.
- Develop courses on recycling.
- Evaluate contractors with respect to use of recycled materials or environmental protection during contract performance reviews.
- Develop and implement the use of warranty and performance based specifications.

The following BMPs are also recommended to facilitate environmental stewardship in materials management:

- Materials should be used in the most effective way possible.
- Structures should have long lives.
- Materials should be recyclable.
- Consumption of energy in the construction development should be optimized.
- Alternatives for conventional resources should be considered. (See References: Rees and Wackernagel, 1994)

Recycled road construction materials are typically used in such applications as bituminous pavements, concrete pavements, road base, embankments and fills, flowable fills, landscaping, bicycle paths, parking lots, and appurtenances such as signs, fencing, barriers, traffic delineators, etc. Some of the most notable uses of recycled materials in the highway environment in recent years have included recycled asphalt pavement (RAP), reclaimed concrete pavement, coal fly ash, and blast furnace slag. RCRA is a federal regulation that emphasizes waste minimization, reuse and recycling. State and local governments have also passed legislation to promote recycling in road construction. (NCHRP, 2004)

NCDOT policy is to aid in reduction of materials that become a part of our solid waste stream. To that extent NCDOT encourages contractors to initiate, develop, and utilize products and/or construction methods that incorporate the use of recycled or solid waste products in this project. Recycled products or waste materials will be those products or materials which would otherwise become solid waste and are collected, separated, or processed and reused or returned to reuse in the form of raw materials or products that are incorporated into a beneficial reuse on the project. Targeted materials include, but are not limited to, the following: plastic, glass, paper, cardboard, shingles, tires, fly ash, bottom ash, sludge, and C&D debris. (NCDOT, 1996) Additional information on recycling can be found at:
http://www.ncdot.gov/programs/environment/3R/download/FAQRecycling.pdf.

Section 610-3 of NCDOT's Standard Specifications for Roads and Structures provides guidelines for the allowable percentages of RAP and reclaimed asphalt shingle material in any given asphalt mix. NCDOT's Resource Conservation Program under Technical Services also has guidelines that detail how to incorporate recycled products within NCDOT.

13.10 Waste Handling and Disposal Matrix

The following matrix provides general guidance for different types of wastes, the categories under which they typically fall, and BMPs or management strategies for each waste type. Contact the Division Hazardous Materials Manager for more specific guidance and classification of potential waste items.

NCDOT Waste Handling and Disposal Matrix

Waste	Hazardous Waste	Universal Waste	Non-Hazardous Waste	Best Management Practices/ Requirements
Ballasts	X (PCBs)	X		C, SC, ST, L, I, D
Switches	X (MERCURY)	X		C, SC, ST, L, I, D
Fluorescent Bulbs	X (MERCURY)	X		C, SC, ST, L, I, D
Other Light Bulbs		X		C, SC, ST, L, I, D
Batteries		X		C, SC, R, ST, L, I, D
Garbage/Trash/Refuse			X	C, ST, L, I, D
Used Oil			X	C, SC, R, ST, L, I, D
Solvent-Contaminated Rags	X		X	C, ST, L, I, D
Oil-Contaminated Rags			X	C, ST, L, I, D
Fuel-Contaminated Rags/Absorbent Pads	X			C, ST, L, I, D
Antifreeze			X	C, SC, R, ST, L, I, D
Oil Filters			X	C, R, ST, L, I, D
Fuel Filters			X	C, R, ST, L, I, D
Used Oil Filters			X	C, R, ST, L, I, D
Scrap Tires			X	R, ST, D
Asphalt Cleaning Waste	X			C, SC, R, ST, L, I, D
Construction and Demolition Waste			X	ST, R, D (C&D OR MSW)
Inert Debris			X	ST, R, D (C&D OR MSW)
Land Clearing Waste			X	ST, R, D
Animal Carcasses			X	D
Used Railroad Ties/Creosote Treated Timbers	X		X	C, R, ST, I, D
White Goods			X	D (MSW)
Empty Drums			X	C, R, ST, L, I, D
Paint Cans, Brushes, and Related Materials	X (METALS)		X	C, SC, R, ST, L, I, D
Aerosol Cans			X	C, R, ST, L, I, D
Asbestos	X			C, SC, ST, L, D
Electronic Waste	X (METALS)	X		C, R, ST, L
Scrap Metal			X	C, R, ST, L

C = Provide Cover; SC = Provide Secondary Containment; R = Recycle;
Requirements: ST = Storage; L = Labeling; I = Inspect; D= Disposal

13.11 Training

Periodic training should be provided so that NCDOT personnel continue to be mindful of the stormwater pollution prevention BMPs discussed in this chapter. Refer to the Introduction of this manual for further training guidance. Examples of training approaches for this chapter include:

- OSHA 1910.1200 requires Hazard Communication (also known as HazCom) training for employees exposed to hazardous chemicals. USDOT requires Hazardous Material training for employees who ship, load, transport, unload, or package/label these materials.
- Provide RCRA training for NCDOT facility personnel working directly at a hazardous waste accumulation site at least on an annual basis. Training should include the identification, proper storage and management, spill response, and disposal of hazardous waste. RCRA and hazardous waste management training requirements depend on hazardous waste site classifications of each facility.
- Provide awareness training for NCDOT facility personnel who handle or manage universal waste.
- Provide spill prevention and response training on a routine basis and at least annually. Spill prevention and response training should include hazardous substance spills in addition to oil spills. Employee awareness will improve a facility's preventative maintenance and spill prevention and response programs. Spill prevention training should highlight previous spill events, equipment failures, remedies taken, and newly developed prevention measures. Refer to the **Spill Prevention and Response Chapter, IA-001** of this manual for additional details.
- Provide additional hazardous waste management training for shop supervisors or other NCDOT facility personnel that manage large quantities of hazardous waste at NCDOT facilities.

APPENDIX G BMP Selection Tables

BMP Selection Table

BMP	Location	Catchment	Structure	Sed. Ctl. Stone	Surface Area	Volume	Function
T. Rock Sed. Dam A	Swale/large ditch	< 1 ac.	Class I	Yes	$435Q_{10\,(25)}$	3600 ft^3/ac	Remove sand
T. Rock Sed. Dam B	Drainage outlet	< 1 ac.	Class B	Yes	$435Q_{10\,(25)}$	3600 ft^3/ac	Remove sand
Silt Basin B	Drainage outlet/ Adjacent to inlet	< 3 ac.	Earth	No	$435Q_{10\,(25)}$ ($325Q_{10(25)}$ @ inlets)	3600 ft^3/ac (1800 ft^3/ac @ inlets)	Remove sand
Skimmer Basin	Drainage outlet	< 10 ac.	Earth	No	$325Q_{10\,(25)}$	1800 ft^3/ac	Remove sand
Infiltration Basin	Drainage outlet	< 10 ac.	Earth	No	$325Q_{10\,(25)}$	1800 ft^3/ac	Remove sand
Riser Basin(non-perforated riser w/ skimmer)	Drainage outlet	< 100 ac.	Earth	No	$435Q_{10\,(25)}$	1800 ft^3/ac	Remove silt, clay
Stilling Basin/Pumped	Near Borrow Pit/Culvert	N/A	Earth and Stone	No	2:1 L:W ratio	Based on dewatering	Remove silt, clay
Sp. Stilling Basin(Silt Bag)	Near stream	N/A	Geotextile	Yes	N/A	Variable	Remove sand
Rock Pipe Inlet Sed. Trap A	Pipe inlet	< 1 ac.	Class B	Yes	N/A	3600 ft^3/ac	Remove sand
Rock Pipe Inlet Sed. Trap B	Pipe inlet	< 1 ac.	Class A	Yes	N/A	3600 ft^3/ac	Remove sand
Slope Drain w/ Berm	Fill Slopes	< ½ ac.	12-inch pipe	No	N/A	N/A	Carry concentrated runoff
Rock Inlet Sed. Trap A	Stormwater Inlet	< 1 ac.	Class B	Yes	N/A	3600 ft^3/ac	Remove sand
Rock Inlet Sed. Trap B	Stormwater Inlet	< 1 ac.	Class A	Yes	N/A	3600 ft^3/ac	Remove sand
Rock Inlet Sed. Trap C	Stormwater Inlet	< 1 ac.	¼" wire mesh	Yes	N/A	N/A	Remove sand
T. Rock Silt Check A	Drainage outlet	< 1 ac.	Class B	Yes	$435Q_{10\,(25)}$	3600 ft^3/ac	Remove sand
T. Rock Silt Check B	Channel	< ½ ac.	Class B	No	N/A	N/A	Reduce flow velocity
Temporary Earth Berm	Project perimeter	< 5 ac.	Earth	No	N/A	N/A	Divert offsite runoff
Temporary Silt Fence	Bottom of slope	< ¼ acre per 100 feet*	Silt fence	No	N/A	N/A	Create small basin; Remove sand, silt
Special Sediment Control Fence	Bottom of slope	< ½ ac.	¼" wire mesh	Yes	N/A	N/A	Remove sand
Temporary Silt Ditch	Bottom of slope	< 5 ac.	Earth	No	N/A	N/A	Carry sediment/water
Temporary Diversion	Project & Stream perimeter	< 10 ac.	Earth	No	N/A	N/A	Divert turbid water
Earth Berm		< 5 ac.	Earth	No	N/A	N/A	Divert clean or turbid water
Clean Water Diversion	Project perimeter	<5 ac.	Earth/Geotextile	No	N/A	N/A	Divert clean water
Construction Entrance	Exit to road	N/A	Class A	No	N/A	N/A	Clean truck tires
Safety Fence	Permitted Areas	N/A	Orange fence	No	N/A	N/A	Define permitted boundary
Borrow Pit Dewatering Basin	Adjacent to Borrow Pits	N/A	Earth	No	N/A	8.02xQxT	Remove Sand and reduce turbidity
Wattle/Coir Fiber Wattle	Channel	< ½ ac.	Natural Fibers	No	N/A	N/A	Incorporate PAM
Silt Check A with Matting and PAM	Channel	< ½ ac.	Class B	Yes	N/A	N/A	Reduce flow velocity and incorporate PAM

* - Contributing land slope must be <2%

Allowed BMP's for Permitted Areas

BMP	HQW	Trout	Riparian Buffers	303d for Sediment	Wetlands	Endangered Species
T. Rock Sed. Dam A	√	√	√	√	√	√
T. Rock Sed. Dam B	√	√	X*	√	X	√
Silt Basin B	√	√	X*	√	X	√
Skimmer Basin	√	√	X*	√	X	√
Riser Basin	√	√	X*	√	X	√
Stilling Basin/Pumped	√	√	√	√	√	√
Special Stilling Basin (Silt Bag)	√	√	√	√	√	√
Rock Pipe Inlet Sed. Trap A	√	√	√	√	√	√
Rock Pipe Inlet Sed. Trap B	√	√	√	√	√	√
Slope Drain	√	√	√	√	√	√
Rock Inlet Sed. Trap A	√	√	√	√	√	√
Rock Inlet Sed. Trap B	√	√	√	√	√	√
Rock Inlet Sed. Trap C	√	√	√	√	√	√
T. Rock Silt Check A	√	√	√	√	√	√
T. Rock Silt Check B	√	√	√	√	√	√
Temporary Earth Berm	√	√	√	√	√	√
Temporary Silt Fence	√	√	√	√	√	√
Special Sediment Control Fence	√	√	√	√	√	√
Temporary Silt Ditch	√	√	X*	√	X	√
Temporary Diversion	√	√	X*	√	X	√

√ – BMP is allowed in this Permitted Area
X – BMP is not allowed in this Permitted Area
X* – BMP may be allowed in Riparian Buffer if permitted by Environmental Regulatory Agencies

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