North Carolina

Forestry
Best Management Practices
Manual

To Protect
Water Quality

Amended September 2006

North Carolina Forestry Best Management Practices Manual To Protect Water Quality.
Amended September 2006.

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- *Best Management Practices Checklist for Forest Harvest Operations*. Multiple printings. North Carolina Division of Forest Resources publication number WQ0295.
- *Best Management Practices for Forestry in the Wetlands of North Carolina - June 1990*. North Carolina Department of Environment, Health, and Natural Resources.
- *Forestry Best Management Practices Manual - September 1989*. North Carolina Division of Forest Resources, Department of Environment, Health, and Natural Resources.
- *Pocket Guide to the Forest Practices Guidelines Related to Water Quality*. Multiple printings. North Carolina Division of Forest Resources publication number WQ0501.
- *Riparian Forest Buffers.* Multiple printings. North Carolina Division of Forest Resources publication number WQ0198.

This Forestry Best Management Practices Manual was amended as allowed under 15 NCAC 01I .0101(c) with revisions guided under the direction of:

- Technical Advisory Committee for the Forest Practices Guidelines Related to Water Quality as established and defined under N.C. General Statute Ch.113A-52.1(c).
- Director and technical staff of the North Carolina Forest Service.

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As participant-members of the Technical Advisory Committee for the Forest Practices Guidelines Related to Water Quality, as defined within N.C. General Statute 113A-52.1(c), and/or stakeholder participants in the first-ever revision to North Carolina's forestry best management practices, we present the new *North Carolina Forestry Best Management Practices Manual to Protect Water Quality*.

This revised Best Management Practices (BMP) Manual is the result of nearly four years of deliberation, scrutiny and two rounds of technical peer review by professionals from across North Carolina. Agencies that reviewed the document include the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency and the North Carolina Division of Water Quality. The recommendations in this new BMP Manual have been carefully considered for their merits related to the continued protection of water quality during forestry activities.

Built upon the expertise found within the multi-interest stakeholder participants, the recommendations in this new manual embody the concepts of forestry best management practices, as defined in North Carolina Administrative Code 15A NCAC 01I .0102 (4), whereas:

> *"Best Management Practice (BMP) means a practice, or combination of practices, that is determined to be an effective and practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals."*

We are proud to have contributed our time, thought and energy to the development of this comprehensive collection of BMPs that enhances the value of working forests as a viable and sustainable part of North Carolina's landscape for future generations.

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Updates made in the 2015 (fourth) printing

- Changed the NCAC Administrative Code reference citations for the FPGs that changed on April 1, 2014
- Replaced DWQ / Division of Water Quality with DWR / Division of Water Resources in body of text
- Replaced DLR / Division of Land Resources with DEMLR / Division of Energy, Mineral and Land Resources in body of text
- Ch.6: pg 90, 91: Deleted "Classifications and Examples of Forested Wetlands in North Carolina."
- Ch.6: pg 93: Deleted "Generally the term 'waters of the US' includes" paragraph. New text now refers user to the August 2015 federal rule that re-defines "waters of the US" as outlined in Appendix 1.
- Ch.6, pg 95, 96: deleted "Isolated Wetlands" paragraph.
- **APPENDIX 1 IS NOT INCLUDED IN THIS 2015 RE-PRINT**, due to many ongoing review and revisions to state and federal rules at the time of this reprinting. Appendix 1 is available as a separate document from the NCFS website and it will be kept as current as feasible when changes to rules and laws are known. Specific changes in Appendix 1 since the prior printing include:
    - Added a note about current review of NC rules for possible changes or revisions
    - Replaced USACE Regulatory Guidance Letter RGL 87-07 on ditch maintenance with a summary and weblink to download RGL 07-02, which supersedes the earlier Letter
    - Added a new section, 1.17: citation of exemption from temporary driveway permits for forestry operations

How To Use This Manual

Explaining the 'Sidebar Column'

Also Refer To…
-- Other reference materials either in this manual, or elsewhere.

Did You Know?
-- Additional information about the topic in the text.

For Forest Owners:
-- Information that forest owners may find useful.

FPG
-- Reminders that at least one of the FPG rule standards apply to the topic being discussed.

Helpful Hints:
-- Ideas for improvement or options to consider.

Watch Out!
-- Situations or indicators in which you should stop and evaluate your intended course of action.

What the BMP Manual Does

This manual provides practical, effective and economically feasible recommendations aimed at protecting water quality during forestry activities.

What the BMP Manual Doesn't Do

This manual is not intended to be a complete and full description of all possible rules and options for protecting water quality during forestry related activities. Implementation of recommended BMPs for forestry at an intensity greater or less than the guidelines provided in this manual, or using alternative practices, is acceptable if the intent is to achieve the same or better results related to water quality protection.

Though alternative practices are acceptable and encouraged, they should be implemented with caution by an experienced individual. BMP implementation helps, but does not insure, that a site will achieve compliance with the requirements of the North Carolina Forest Practices Guidelines Related to Water Quality, the Clean Water Act, or other applicable regulations.

Forest Practices Guidelines Related to Water Quality (FPGs)

In North Carolina, the performance standards defined by 02 NCAC 60C .0100 -- .0209 *Forest Practices Guidelines Related to Water Quality* must be met if a forestry operation is to remain exempt from submitting an erosion and sedimentation control plan, obtaining permits and meeting other requirements described under the state's Sedimentation Pollution Control Act.

Other Required Practices

The recommendations in this manual are not formal regulatory guidance or legal interpretation from any federal or state regulatory agency.

For your convenience, this manual includes citations of required practices and guidance documents that are known to exist at the time of this manual's printing. This helps assure that forestry activities protect water quality as defined by federal or state laws, rules, or other regulatory guidance documents.

Citations are clearly denoted in the manual using these techniques:

- The cited text is introduced as such
- The text is within "double quotation marks"
- The statement *<start citation>* appears at the beginning of the text
- The statement *<end citation>* appears at the end of the text
- In some cases, the document source of the rule or law is provided.

The Rules Related To…… *Text Box*

At the start of each chapter, this rules box will appear, and a list of rules and/or laws that may apply to your forestry operation is provided.

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Supporting text and references to the specific FPG rule are also included here.

Throughout this manual, you will see this label FPG on the left sidebar column whenever a FPG rule applies to the topic discussed in the text.

Remember: FPGs are the rules. BMPs are the tools you can use to help meet the performance-based FPG standards.

A Note on…… More Text Boxes

Also in this manual, you will find text in a box that further explains a concept or topic being discussed in that chapter. The header for these boxes will state ***A Note on _____{ topic }_____***.

Did You Know?

All state of North Carolina regulatory agencies that have jurisdiction over forestry operations were provided an opportunity to conduct a peer-review of the content and material of this 2006 revision.

Peer Reviewed

Although applicable sections of this manual have been peer-reviewed by technical staff of the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers and applicable North Carolina regulatory agencies, the citations and recommendations provided in this manual must not be considered as the final or most current version or interpretation of any rule, law or other regulatory guidance.

Glossary of Select Terms

Select terms are defined in a glossary located in Appendix 13. Other terms are defined within the various rules citations found in Appendix 1.

The NC-BMP Field Guide

The *North Carolina Forestry BMP Quick-Reference Field Guide* includes numerous illustrations along with user-friendly summaries of some of the BMP recommendations that are provided in this BMP manual.

Chapter 1
Introduction to Best Management Practices and Soil Factors

Chapter 1 Layout:

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For Forest Owners:

Examples of forestry activities that should use BMPs:

- *Chemical application, which includes fertilizer and herbicide*
- *Drainage alterations*
- *Prescribed burning*
- *Road construction and maintenance*
- *Site preparation for forest regeneration*
- *Timber harvesting*
- *Timber stand improvement*
- *Tree planting*
- *Wildfire control*
- *Wildlife habitat improvement*

Part 1 -- Why Best Management Practices?

Properly managed forests are crucial for stabilizing soils, protecting watersheds and producing high quality water. Forestry ('silviculture') activities are noted as one of several contributors of nonpoint source pollution across the landscape.

In 1987, the U.S. Congress amended the Clean Water Act to incorporate nonpoint source pollution prevention. The sections within the Act that relate to nonpoint source pollution require states to develop management measures and guidelines that, when implemented, will reduce the contribution of nonpoint sources during land-disturbing activities, which includes forestry.

These management measures have over the years been widely referred to as 'Best Management Practices,' or BMPs. Forestry BMPs are voluntary in North Carolina and are defined in the North Carolina Forest Practices Guidelines Related to Water Quality, cited at 02 NCAC 60C .0102 (4) as:

<start citation> "A practice or combination of practices, that is determined to be an effective and practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals." *<end citation>*

Water Quality Link

Water quality can be influenced by changes in sediment load, nutrient levels, water temperatures, stream flow, chemicals and dissolved oxygen.

BMPs, or other suitable practices, should be planned ahead of time with careful design and implementation, because:

- Taking this time beforehand will improve the chances of success.
- Maintenance and periodic follow-up are needed to insure the BMPs continue to function.
- Stabilization of the site is considered a BMP itself, and should be planned for accordingly, and not left until the very end.

The overall goal is to protect the biological, chemical and physical integrity of the water.

Part 2 -- The BMP Process

Using BMPs can be thought of as a multi-step process:

1)Planning 2)Implementing 3)Stabilizing 4)Maintaining

Also Refer To…

Chapter 3 outlines what steps to take when planning a forestry operation.

1. Planning

Planning will help you determine a site's conditions. Knowing these conditions and the type of operation you intend to conduct will determine the type and amount of BMPs that you should consider.

Part of planning includes knowing and understanding the rules, laws and other required practices that may apply to your forestry operation. Chapters 2 and 6 explain many of these required practices, while the Appendix includes citation of applicable rules, laws or regulatory guidance documents.

2. Implementing

Correcting implementing BMPs will promote effectiveness and efficiency.

3. Stabilizing

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Stabilizing critical disturbed soil areas is important to assure long-term water quality protection. In many cases, site stabilization can begin even while the operation is still active, by retiring or putting to bed those areas on the job site that no longer have any activity.

4. Maintaining

Maintaining the BMPs once you have put them in place will assure they continue to function.

Part 3 -- The Runoff Process

Did You Know?

It is common for the greatest amount of runoff to take place from just a few major rainstorms.

This means your operations may need to be adjusted or halted if significant precipitation is expected.

Water that falls onto or flows across the ground either soaks in or runs across the surface. This surface flow is called runoff. Runoff can occur when the soil no longer has the ability to absorb water through its surface.

Several factors found naturally in the soil can affect its ability to act like a sponge, and determine how water will either absorb or runoff.

By using BMPs and conducting forestry operations appropriately, you can protect the soil's ability to act like a sponge and allow water to soak in, rather than run-off. This helps prevent erosion and keeps nearby waterbodies protected from nonpoint source pollution.

BMPs provide one or more of the following functions:

- Minimize potential sources of sediment and runoff.
- Confine sediment on site.
- Delay and trap the movement of sediment and/or runoff to allow settling, absorption or evaporation.

As you will see in the next section, BMPs also protect water quality from other potential harmful impacts that may not be directly related to runoff.

Part 4 -- Importance of BMPs

Properly using BMPs can help protect water quality from several potential harmful impacts. This section briefly outlines the major topics that BMPs typically address on forestry operations.

Sediment Control

Watch Out!

In North Carolina, sedimentation is the most frequent water quality concern associated with forestry operations.

BMPs that keep the soil in place and retain the soil's structure can also protect water quality from other potential pollutants.

Sediment is created when runoff and erosion washes soil into a waterbody. While sedimentation is a natural process, too much can cause problems. As a result, a main focus of most BMPs is to control sediment.

The amount of sediment that is produced on a site depends upon the:

- Natural soil erodibility.
- Slope steepness and length.
- Water absorption and storage capacity of the soil.
- Volume and speed of surface water runoff.
- Amount and length of time soil is exposed.
- Degree of blockage for surface water runoff.

With proper planning and implementation, forest management activities can be completed in ways that minimize soil disturbance, slow surface water runoff and maintain the soil's ability to absorb and store water.

Creating or protecting conditions that allow water to soak into the soil minimizes the potential for runoff and erosion.

Table 1-1 below gives a simplified example of the relative costs for implementing, or putting into place, certain BMPs for controlling sediment.

Table 1-1: Relative Comparison of Costs for Forestry BMPs

In many cases the lowest cost BMP to implement can be the most effective in controlling sediment and protecting water quality.

Another way to think about it:
If you don't mess it up, you don't have to fix it!

BMP	Relative Cost
Pre-harvest planning and job site layout. Minimize bare soil. Maintain groundcover.	$
Functioning SMZs and buffers. Bridgemats for stream crossings.	$$
Gravel, waterbars, broad-based dips, sediment traps, silt fences, culverts, straw bales, turnouts.	$$$
Having to stop your work and fix a problem. Returning to a site for stabilization *after-the-fact.*	$$$$$

Importance of BMPs Hydrologic Functions

Forests are among the best land use for protecting hydrology, for not only water *quality*, but also water *quantity*.

Forestry operations should be done in a way that minimizes the negative impact on internal soil-water drainage, water holding capacity, runoff and absorption. Here are three examples where hydrology is especially important:

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1. Stream crossings should be established and used in a way that minimizes impacts to the hydrology of the stream and riparian area.
   Because of the close proximity of disturbance near the water at a stream crossing, these locations have the highest potential for problems.

Also Refer To…

Specific BMPs for wetlands are found in Chapter 6.

2. Conducting forestry operations in forested wetlands.
   Wetlands pose additional challenges since their hydrology often is complex and not easily defined. The BMPs outlined throughout this manual should be evaluated for their applicability in forested wetland sites.

3. Attention should be paid to minimize negative effects on soil structure and infiltration caused by intensive soil disturbance during a forestry operation. Intensive soil disturbance can lead to increased surface runoff and sediment transport on certain sites, both of which may impact water quality.

Did You Know?

Technically speaking, soil can be very difficult to compact.

However, for the purposes of this BMP manual, this term is used to describe the loss of inter-pore spaces between soil particles, which, in turn, influences hydrology and site productivity.

While the soil's chemical or physical structure may not change, the alterations that can occur may increase the risks to water quality.

A Note on Intensive Soil Disturbance

A universal BMP is to minimize the amount of soil disturbance. This is especially true for intensive soil disturbances that are often referred to with terms such as rutting, compacting, souping, mixing and/or churning.

Intensive disturbance to the soil alters the soil's structural properties, reduces air spaces between soil particles, creates underground blockages for water movement, and decreases the soil's ability to absorb precipitation.

When this kind of disturbance occurs, the hydrology of the site may be affected and runoff can increase. That is why it is important to keep this kind of disturbance to a minimum and rehabilitate areas that show signs of excessive disturbance, if doing so will improve hydrology and water quality.

In addition, a well developed, non-eroded forest soil has nearly 85 percent of the fine root system within the top 18 inches. In cases where trees will be left to grow after a partial harvest, it is important to avoid intensive soil disturbance, so the residual trees will still have their fine root systems intact.

Importance of BMPs Sunlight Intensity and Water Temperature

Sunlight is a major factor that controls the water temperature in streams and most small sized or shallow waterbodies.

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Streamside Management Zones and riparian buffers not only are intended to control sediment from entering the water, but also can help control the sunlight intensity and temperature of the water that reaches the stream.

The goal of protecting the biological, chemical, and physical integrity of water includes using BMPs that provide suitable shade so sunlight intensity is not significantly increased along water areas that are shaded prior to forestry operations.

Excessive removal of shade can increase the growth of nuisance plant materials within the water or along the riparian area. Increased light can cause aquatic plants to grow too thick, particularly in nutrient-rich waters. When this vegetation decomposes, the oxygen in the water is used up more than usual, which can harm fish and other aquatic organisms.

For Forest Owners:

Forestry chemicals refers to fertilizer and pesticide.

Importance of BMPs Forestry Chemicals

Chemicals are usually applied on a limited, short-duration basis over the lifetime of a forest area, usually only once every few years or even decades.

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Application of pesticides, which includes herbicides, must be done by a licensed operator in accordance with state and federal rules.

In addition, there are many water-quality BMPs for using forestry chemicals that are actually required, either by state or federal rules. These rules can be found on the product's label and must be followed. Chapter 7 of this manual outlines additional BMPs to consider.

Did You Know?

Some examples of organic matter: Leaves, pine needles, logs, limbs, tree-tops, slabs, chips, bark, roots.

Importance of BMPs Organic Matter and Debris

Contribution of organic matter and debris by natural processes is important for the aquatic health of a waterbody. Organic matter is also a vital component of soil and is needed to maintain good conditions for soil-living organisms and water absorption. The uppermost layer of organic matter atop the soil surface is called duff. This duff layer cushions soil from the impact of falling precipitation.

However, debris can block streamflow and damage the stream channel, which can then lead to accelerated erosion and sedimentation from the streambank.

In addition, if too much organic matter gets into the water, significant amounts of oxygen in the water can be consumed as the material decomposes. This creates poor living conditions for aquatic organisms.

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NOTE: Review the applicable FPG standards and N.C. General Statutes related to this subject. These are described in detail in Chapter 2.

Importance of BMPs Frozen or Surface-Hardened Soil

Soils that are either frozen or otherwise surface-hardened cannot absorb water as well, which leads to increased runoff, erosion and sedimentation potential.

The soil's duff layer acts as a natural blanket, maintaining the natural soil temperature and allowing better water infiltration.

If a site has surface-hardened soil that is not frozen, it may be beneficial to disk, rip, or otherwise till the soil to improve water infiltration and movement.

Importance of BMPs Unique Soil Features in North Carolina

North Carolina has some unique soils that may require additional planning and BMPs for forestry operations:

For Forest Owners:

Many times these organic / muck soils are located in or near wetlands. On these soils, it may be suitable to use the BMPs for forested wetlands in Chapter 6.

Shrink / swell soils exist across an area of the piedmont and foothills of North Carolina known as the Triassic Basin.

Organic and muck soils

These types of soil have large amounts of organic matter, which alters the soil's degree of wetness. As a result, these soils may limit the operability of the site and/or require specialized equipment or techniques to be used so water quality is protected.

Shrink / swell clay soils

Soils with these characteristics can swell-up when they get wet and quickly shrink when dry, forming large cracks and hardened surfaces. These soils are usually more susceptible to intensive soil disturbances, as described earlier in this chapter. Additional measures may be needed to control runoff.

Part 5 -- Landscape and Soil Factors to Consider for BMPs

The type of BMPs to use, and the amount needed on any given site can usually be linked to some key landscape and soil factors, some you have control over, such as slope length, and others that you may not, such as soil texture.

Understanding how these factors relate to each other can help you determine what kind of BMPs to use.

LANDSCAPE Factor Slope Steepness and Length

Did You Know?

Runoff from a steep slope over a short length may have the same long-term effect as a flatter slope that runs for a long distance.

Steeper slopes allow runoff to build up more speed and erosion force. Slope length can also play a role in determining runoff amounts.

In either case, select the right BMP for the site conditions. For example:

- A short, steep slope on a skid trail or fireline may require more waterbars.
- Longer, shallower slopes on an access road may need broad-based dips.

A general guide to follow regarding slope steepness is shown in Table 1-2:

Table 1-2: Effect of Slope on Soil Erosion Potential

Potential For Erosion	Land Slope Percent (%)
Highest	7% or steeper
Medium	2% to 7%
Lowest	0 to 2%

Did You Know?

Generally, sandy and loamy soils absorb water faster than heavier soils like silt or clay.

However, the silt and clay soils typically retain soil moisture for a longer period.

SOIL Factor Texture

Soil texture can influence how much a soil is prone to erosion and how much water infiltrates into the soil.

While you have no control over soil texture, you can recognize the type of soil on the site and adjust the BMPs and operations accordingly. For example:

- A soil with high erosion potential will likely require even more BMPs than usual to control runoff before it picks up speed across the ground surface.
- A soil with lower erosion potential might be adequately stabilized simply with groundcover, since runoff may not be a risk.

Table 1-3: Effect of Soil Texture on Erosion Potential

Potential For Erosion	Soil Texture	Typical Description
Highest	Silt, silt-loam, loam, very fine sandy-loam Sandy-clay-loam, silty-clay-loam, clay-loam	Fine Textured
Medium	Clay, silty-clay, sandy-clay, Fine sandy-loam, sandy-loam	Coarse Textured
Lowest	Loamy-sand, sand	Coarse Textured

SOIL Factor Infiltration Capacity and Water Absorption

These factors deal with how much water can infiltrate and be absorbed into the soil and how well water moves within the soil itself.

Soil will absorb water up to a limit, after which the water runs off the surface. If the soil is altered or excessively disturbed, the water may not move as well.

Some examples of situations that allow good water infiltration, absorption and internal water movement include:

- Maintaining adequate organic matter and groundcover on the soil surface.
- Avoiding intensive soil disturbance.
- Tilling areas of intensive soil disturbance and providing groundcover to increase infiltration and slow runoff.

SOIL Factor Structure

Soil structure defines how individual particles of soil are connected to each other. Some soils have particles that closely bind together, which produces small pores within the soil. Other soils may have a structure that is blocky or bulky, which produces larger pores.

Forestry operations should be done in a way to minimize significant changes to soil structure that may lead to water quality problems. Examples include:

- Operating when soil moisture is dry enough to prevent negative impacts on soil structure and infiltration
- Minimizing intensive soil disturbances, such as rutting or compacting
- Concentrating repeated passes of equipment traffic to primary trails

A Note on Soil Bulk Density:

The total volume of pore space within a soil determines the amount of air and water that soil can hold. Bulk density is used to measure this volume:

- A high bulk density means the soil is denser and has a lower amount of pore space volume.
- A low bulk density means the soil is less dense and has a greater volume of total pore space.

Understanding bulk density and soil structure not only helps determine what kind of runoff control to use, but is important for planning future tree growth.

For Forest Owners:

If pore spaces are decreased, tree seedling roots can have a more difficult time establishing themselves, especially in heavy or droughty soils.

SOIL Factor Moisture Content

Soil moisture content influences how much additional water gets absorbed into the soil at any given time.

When soil moisture is highest, the soil is close to an operational saturation point, and can be very susceptible to negative impacts on soil structure and usually produces greater runoff.

Practices that can address moisture content include:

- Operating when soil moisture is dry enough to prevent negative impacts on soil structure and infiltration.
- Minimizing intensive soil disturbances such as rutting or compacting.
- Using specialized equipment or operational techniques that minimize adverse impacts on soils that have a high moisture content.
- Installing additional BMPs to control runoff that may occur.

Did You Know?

Water infiltration is usually highest in a slightly moist, loose soil.

It can be difficult for water to soak into a soil that is already saturated, or is extremely dry and surface-hardened.

Chapter 1 Summary

Best Management Practices are important tools to protect the biological, physical and chemical characteristics of water quality. In North Carolina, Forestry BMPs should be used to help you meet the performance standards defined by the *North Carolina Forest Practices Guidelines Related to Water Quality*. Compliance with the FPGs will allow a forestry job site to retain the forestry exemption under the state's Sedimentation Pollution Control Act.

Recognizing major landscape and soil factors that influence the choice and use of BMPs can assist you with planning and conducting a forestry operation in a way that protects water quality, wetlands and soil characteristics in an efficient and effective manner.

This manual provides specific Forestry BMPs that:

- ✓ Minimize bare soil area and disturbance.
- ✓ Protect waterbodies.
- ✓ Control surface water runoff.
- ✓ Maintain groundcover.

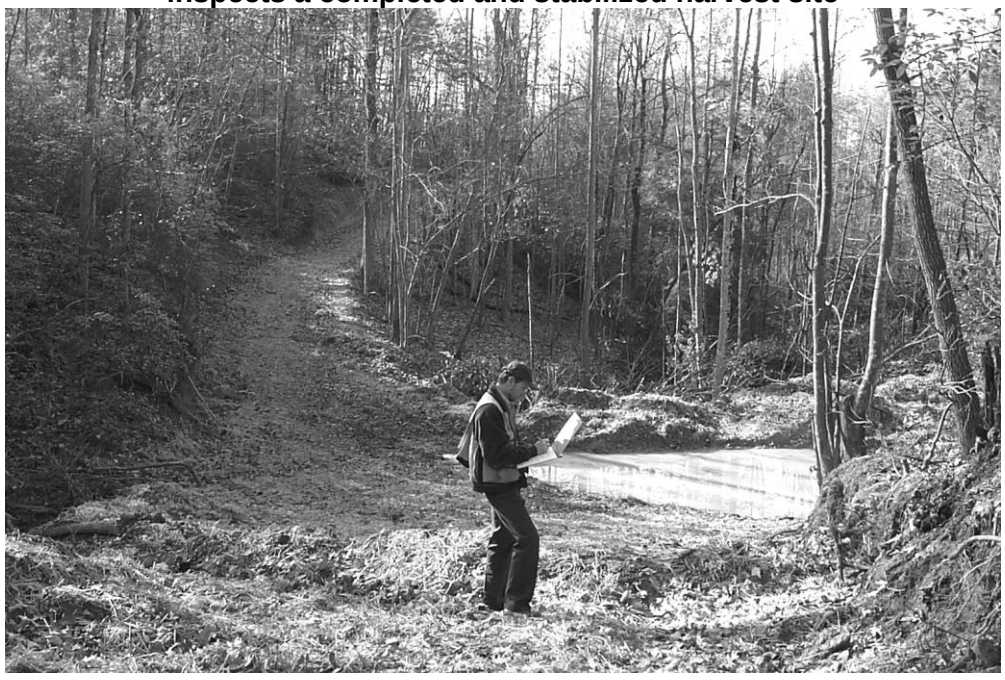
You can obtain technical assistance about soil from local offices of the USDA-Natural Resources Conservation Service or state Soil & Water Conservation District, as well as other natural resources professionals.

Need Help?

Most county NRCS and SWCD offices have soil survey maps containing detailed soils information.

See Appendix 2 for county NRCS and SWCD phone numbers.

Figure 1A: A N.C. Forest Service Water Quality Forester inspects a completed and stabilized harvest site



Caption:

The N.C. Forest Service can inspect your site before, during, and after the forestry operation to assist you with BMPs.

Some BMPs to note in this photo:
- Road grade cut-in along the land contour.

- Seeded and mulched bare soil areas.

- Sediment catchment to trap runoff and allow sediment to settle out.

Chapter 2
Water Quality Regulations Effecting Forestry

Chapter 2 Layout:

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The information and recommendations contained in this chapter are not formal regulatory guidance from any federal or state regulatory agency and do not constitute a legal document.

Helpful Hints:

Representatives of service agencies often can offer technical assistance and recommendations, but may not have authority to make final determinations. That authority is held by the regulatory agency that oversees a specific rule.

NOTE: Regulations concerning activities in forested wetlands are explained in Chapter 6 and are not described here.

Part 1 -- Introduction

Several different types of federal, state, and local government regulatory programs for the protection of soil and water resources affect forest management in North Carolina. This chapter includes discussions about laws, rules, regulations, and guidance documents as well as direct quotes:

- All direct quotes from laws, regulations or guidance documents are cited according to the method described in *How To Use This Manual*.
- Guidance from regulatory agencies provides additional information on specific regulations and how to implement them. Such guidance should be followed unless a regulatory agency representative provides an exemption from that guidance.

Technical Assistance

An important purpose of this chapter is to offer background information and recommendations to assist you in meeting the requirements of federal and state regulatory programs that can effect forestry operations.

Regulatory agencies that are most frequently involved with forestry:

- N.C. Division of Energy, Mineral and Land Resources
- N.C. Division of Water Resources
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency

Service agencies that are often involved with forestry:

- N.C. Forest Service
- USDA-Natural Resources Conservation Service
- N.C. Soil & Water Conservation Districts
- N.C. Cooperative Extension Service

Steps for Knowing the Rules

1. Read the recommendations in this manual. They are written to help you implement effective systems of BMPs and understand the regulations.
2. Discuss applicability of the BMPs for your site-specific situation, as needed, with the appropriate service agency and/or regulatory agency.
3. Check the literature and Web resources for the most recent versions or interpretations of regulations and regulatory guidance.

The rest of this chapter briefly highlights regulations that most frequently come into question on forestry operations in North Carolina. Supporting citations of these regulations are in Appendix 1.

Part 2 -- Nonpoint Source Management Programs

Watch Out!

All North Carolina surface water classifications and water quality standards apply to forestry operations - - Not just the FPG's!

State programs to control nonpoint source pollution are required by the Clean Water Act of 1987 section 319 Nonpoint Source (NPS) Management Program.

The NPS pollution program in North Carolina includes three main elements:
1 - Surface Water Classifications *(see sidebar and following section)*
2 - Surface Water Quality Standards *(see section on next page)*
3 - Regulations: Various rules have been and may be further instituted in an effort to manage NPS pollution so that the water quality standards are met, which maintains the use classification of a targeted waterbody. Specific NPS rules that apply to forestry in North Carolina are explained in Parts 3 and 4 of this chapter.

Surface Water Classifications

Helpful Hints:

Any tributary that is not specifically listed in a stream classification list is classified the same as the stream to which it discharges.

These classifications are designations that define the best uses to be protected within those waters. You may hear these called 'use classifications.'

Effect on Forestry: Streams, waterbodies and wetlands in North Carolina are classified in one of the designations shown in Table 2-1. All land use practices, including forestry, are held to the water quality standards for each classification developed in the NPS pollution program.

Table 2-1: Summary of N.C. Surface Water Use Classifications

Helpful Hints:

Special care should be taken in implementing BMPs in the watersheds of streams with classifications that are most sensitive to sediment inputs.

These include:
HQW, ORW, PNA, SA, Tr, and WS-I through WS-V

B	Primary recreation including swimming on frequent or organized basis
C	Secondary recreation, fishing, aquatic life, and wildlife
FWS	Future Water Supply
HQW	High Quality Waters
NSW	Nutrient Sensitive Waters
ORW	Outstanding Resource Waters
PNA	Primary Nursery Areas
SA	Saltwaters suitable for commercial shellfishing
SB	Saltwaters for primary recreation including swimming on a frequent or organized basis
SC	Saltwaters for secondary recreation, fishing, aquatic life, wildlife
Sw	Swamp waters
SWL	Coastal wetlands
Tr	Trout waters
UWL	Unique wetlands
WL	Waters that meet the state definition of wetlands
WS-I WS-II WS-III WS-IV WS-V	Water supply watershed classifications; WS-I is the most protected with the highest quality water.

Also Refer To…

The classifications and water quality standards are in 15A NCAC 02B .0100 to .0200.

The least stringent and most common of these water quality standards are those for freshwater 'Class C' waters, and are cited in Appendix 1.

Information on all North Carolina surface water classifications is available at: http://portal.ncdenr.org/web/wq/ps/csu/swstandards

The turbidity standard for Class C waters is cited in the Glossary.

North Carolina Surface Water Quality Standards

These standards are:

- Specific criteria for physical, chemical and biological water properties.
- Prescribed limits on the levels of various pollutants.
- Specific to each waterbody's use-classification.
- The goals for managing the water quality of surface waters in the state.

Surface waters that have a progressively higher and better use-classification also have more stringent corresponding water quality standards. Examples include HQW; ORW; Tr; and WS-watersheds (as noted in Table 2-1).

Effect on Forestry: The performance standards in the Forest Practices Guidelines Related to Water Quality come from the water quality standards. For forestry operations, the BMPs in this manual address the principal sources of potential nonpoint source pollution noted in the water quality standards.

A Note on Forestry Compliance Inspections

The N.C. Forest Service (NCFS) handles the vast majority of forestry-related water quality compliance inspections and resolutions. However, the N.C. Division of Water Resources (NCDWR) has the authority to independently evaluate and take action on violations of the North Carolina water quality standards, through the issuance of a Notice of Violation and/or civil penalty.

- The NCDWR may take these actions in parallel, or in conjunction with, NCFS pursuit of FPG compliance on that site.
- The NCDWR may also take action independently and without prior notice, even if the FPG standards are in compliance at that time, but there is still a violation of the state's Surface Water Quality Standards.

Two examples related to forestry activities are noted here as reference:

1 - A forest harvest site has all FPGs in compliance and visible sediment is contained, but high levels of turbidity are created by that forestry operation within the stream or waterbody. In this case, the NCDWR may determine that the surface water quality standards for turbidity are in violation.

2 - NCDWR cites a loss of best use for a stream, due to the accumulation of sediment onto the streambed as a result of a forestry operation. In this case, it is very likely that the FPGs also are not in compliance since visible sediment reached the stream.

Coastal Nonpoint Source Pollution Management Program

Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) established the Coastal Nonpoint Pollution Control Program. The CZARA requires coastal states with approved coastal zone management programs to address nonpoint source pollution that impacts coastal waters.

The North Carolina Coastal Nonpoint Source Program applies within the 20 coastal zone "CAMA" counties described in Table 6-1 in Chapter 6.

Effect on Forestry: The FPGs and the BMPs described in this Manual encompass the forestry management measures described in the 1993 USEPA guidance document for coastal nonpoint source pollution, referenced as: *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. USEPA Publication Number 840-B-92-002. January 1993.*

Part 3 -- Statewide Regulations

Sedimentation Pollution Control Act

Responsible Agency:
-- NCDEMLR
Contact:
-- Land Quality Section
Web site:
http://portal.ncdenr.org/web/lr/erosion
Defining law:
-- NCGS Ch113A, Art4, par. 50-52, Sedimentation Pollution Control Act of 1973

The purpose of the North Carolina Sedimentation Pollution Control Act of 1973 (SPCA) is to control the sedimentation pollution of surface waters of the state. The regulatory program specified by the SPCA is called the North Carolina Erosion and Sediment Control Program. The SPCA requires that an erosion and sediment control plan be approved by the State for qualifying land-disturbing activities.

Effect on Forestry: The provisions of the SPCA may be required on a forestry site if the activity is deemed to be in non-compliance with the FPGs upon a referral by NCFS to NCDEMLR (discussed below).

Forest Practices Guidelines Related to Water Quality

FPG

Responsible Agency:
-- NCFS (delegated)
Contact:
-- Water Quality & Wetlands Staff Forester
Web site:
www.ncforestservice.gov
Defining Rule:
-- 02 NCAC 60C .0101 through .0209

The FPGs became effective Jan. 1, 1990.

The Forest Practices Guidelines Related to Water Quality (FPGs) are performance standards for forestry operations that, if followed, provide for exemption of those operations from the permitting requirements of the SPCA. This manual provides recommendations of BMPs that may be used to help forestry operations remain in compliance with the FPG performance standards.

Effect on Forestry: As long as the FPG performance standards are met, the operation remains exempt from the requirements of the SPCA that relate to land-disturbing activities.

The N.C. Forest Service (NCFS) is delegated the authority to monitor compliance of the FPGs on forestry operations and assist you to remain in compliance by providing technical service assistance and site inspections. However, if enforcement action is needed, NCFS staff must make a referral to the appropriate state regulatory agency.

The topics covered by the FPGs are listed below. The full rule citation is in Appendix 1: *(The administrative code is 02 NCAC 60C .0100 to .0209)*

FPG

For example, in this manual "FPG .0201" refers to that portion of the administrative code.

.0201 Streamside Management Zone
.0202 Prohibition of Debris Entering Streams and Waterbodies
.0203 Access Road And Skid Trail Stream Crossings
.0204 Access Road Entrances
.0205 Prohibition of Waste Entering Streams, Waterbodies and Groundwater
.0206 Pesticide Application
.0207 Fertilizer Application
.0208 Stream Temperature
.0209 Rehabilitation of Project Site

History of FPGs

Prior to a 1989 amendment to the SPCA, land disturbing forestry activities were exempt from the permitting requirements of the SPCA that apply to land development and construction activities. The amendment:

1. Provided for the development and implementation of the FPGs.
2. Specified that land disturbing forestry activities not conducted in accordance with the FPGs would be subject to the provisions of the SPCA.

Current FPG Rules

Implemented on January 1, 1990, the FPGs are administrative rules that provide performance criteria for the protection of water quality during land-disturbing activities related to the production, harvesting and utilization of forest resources in North Carolina.

FPGs are regulations defined under N.C. Administrative Code, but the BMP methods of complying with them are voluntary.

Did You Know?

The NCFS conducts flight missions on a routine basis.

These flights help to:
- Support wildfire location and suppression.
- Identify potential water quality problems.
- Locate harvest sites.
- Assess forest insect & health conditions.

Such flights increase field work efficiency, allowing field staff to locate forestry sites while they are still ongoing. Flights also provide assurances that NCFS is inspecting some of those forestry sites that may otherwise be difficult to find.

Flights increase our confidence that the pool of inspected sites is an accurate sample of the number and types of forestry operations across the state.

NCFS attempts to conduct flights for water quality purposes on a monthly basis or as fire control, budget, aircraft or other constraints allow.

Monitoring Compliance of the FPGs

N.C. Forest Service personnel routinely inspect timber harvesting, site preparation and other forest management activities on sites across the state for compliance with the nine performance standards of the FPGs. Sites selected for compliance inspections are identified in several different ways, including:

- Ongoing or recently completed forestry activities noted by NCFS staff.
- Aerial location using NCFS aircraft *(see sidebar).*
- As they coincide with the development of forest management plans.
- Technical evaluation for approval of state or federal cost-share assistance.
- As a result of citizen complaints.
- At the request of foresters, timber buyers, loggers or landowners.

For any forest management project for which the landowner applies for state or federal cost share assistance, the NCFS is required to verify that the forestry practices are carried out in an environmentally sound manner.

FPG Inspection and Follow-Up Process

A typical inspection of a logging operation or other site disturbing activity is conducted in the presence of the identified responsible party (forester, contractor, logger, foreman, timber buyer, etc.) when possible.

NCFS personnel will attempt to conduct FPG exams while the operator is actively working the site.

Such face-to-face meetings on active sites usually lead to better communication, faster turnaround on bringing tracts back into FPG compliance, and the benefit of identifying and avoiding potential problems before they occur.

Following examination of the active job, an NCFS representative also attempts to follow up with a closeout FPG exam after the operation has ended.

In addition to the rest of the FPGs, a heavy emphasis during this final exam focuses on whether disturbed areas on the site that might affect water quality have been permanently stabilized.

Response to FPG Violations

When FPG violations are noted during inspections, the responsible parties are encouraged to implement appropriate onsite corrective measures using BMPs or other effective means. Typically, there is some degree of education and/or technical advice provided by the agency or person performing the inspection.

Specific violations are documented and shared with the responsible parties as needed (logger, timber buyer, consultant, landowners, etc.) so corrective actions can be made. Original documents are sent to that responsible party who was deemed to be in 'operational control' at the time of the violation. Usually there is a determined period of time provided for the site to be brought into compliance with the FPGs.

Helpful Hints:

You should closely monitor your site if it is in temporary compliance, to make sure it doesn't fall back into a non-compliance condition.

If compliance with the FPGs is proving difficult to attain due to bonafide reasons, it is critical that you communicate your situation to the NCFS representative who is overseeing the FPG case.

Such communication is vital so that all parties are working together towards a resolution that benefits water quality in a timely and reasonable manner.

FPG Compliance Re-Inspections

Upon a re-inspection after the initial period of time has elapsed, there are usually one of three courses of action taken by the NCFS:

1 - Temporary Compliance: A tract may be determined to be in 'Temporary FPG Compliance' if the necessary rehabilitation work has been done, but the site still needs additional time for soil to stabilize and/or groundcover to become established.

In such cases, a new follow-up date is established. Ideally the follow-up visit(s) will confirm that the site has stabilized and there are no water quality problems. Once this is confirmed, the site can be put into 'Permanent FPG Compliance.'

2 - Permanent Compliance: A tract may be determined as in 'Permanent FPG Compliance' during the initial follow-up inspection if there are no areas of the tract that require additional time for adequate stabilization to occur. Generally, once the site is determined to be in 'Permanent FPG Compliance' within the prescribed timeframe, no further action is taken.

NOTE: Once a site is in 'Permanent Compliance' future water quality problems usually become the landowner's responsibility to correct.

3 - Additional Follow-Up: More time may be provided to make corrective actions if, upon the first follow-up visit, it is deemed that extenuating circumstances led to the lack of compliance. In these cases, the responsible parties must show that they made a good faith effort on their first attempt at corrective actions. In this case, a new compliance deadline is established.

Referrals for Enforcement

If FPG compliance fails to occur on the tract within the established timeframe, then the violation will be referred to the appropriate state agency for potential enforcement action. The four most common examples of referrals are:

1 - Tracts that have uncorrected sedimentation violations.

- These are referred to the N.C. Div. of Energy, Mineral and Land Resources (NCDEMLR) for assessment and potential enforcement.
- At this point, that forestry site loses its exemption from the full requirements of the Sedimentation Pollution Control Act (SPCA).
- To achieve compliance with SPCA requirements, the responsible parties will be required to submit a sediment and erosion control plan, have it approved by NCDEMLR, and implement the approved plan.

Did You Know?

NCDEMLR staff may issue a "Notice of Violation" (NOV) for sedimentation problems.

Daily civil penalties may be levied until the tract is brought into compliance with the SPCA.

NCDWR staff may levy daily civil penalties until corrective action is satisfactorily completed on water-quality related violations.

2 - Tracts that have uncorrected water quality violations other than sedimentation.

- This may include petroleum spills or stream temperature violations.
- These situations are referred to the N.C. Division of Water Resources (NCDWR) for further assessment and potential regulatory action.
- The forestry operation does not lose its SPCA exemption for these types of referrals. However, actions must be taken to correct the violations and assure that the water quality resources are protected.

3 - Tracts that have stream or ditch obstruction violations.

- If not corrected within the established deadline, these sites are referred to the NCFS Law Enforcement Unit. The law enforcement personnel will take the necessary actions to bring the responsible party into compliance.
- If compliance is still not achieved, the law enforcement personnel will begin the necessary deliberations with the county district attorney for prosecution as a crime, according to N.C. General Statutes.

4 - Observed potential water quality violations not related to FPGs.

- There are situations when a NCFS representative may observe what is perceived to be a potential violation of a state or federal water quality rule or law that is not covered by FPGs or state laws.
- The NCFS is required to document and communicate these observations according to protocols described by the agency's policy.
- The two most common examples of such situations include NCDWR riverbasin and watershed 'Riparian Buffer Rules' and U.S. Army Corps of Engineers' areas of jurisdiction within wetlands.

Stream and Ditch Obstructions

There are two North Carolina General Statutes that relate to obstructions in streams and/or ditches, and each applies to forestry sites:

North Carolina G.S. §77-13 Obstructing streams a misdemeanor
North Carolina G.S. §77-14 Obstructions in streams and drainage ditches

Responsible Agency:
-- NCFS
Contact:
-- Water Quality & Wetlands Staff Forester
-- Chief Investigator, Law Enforcement
Web site:
www.ncforestservice.gov
Defining Rule:
NC General Statutes (GS) §77-13 and §77-14

Effect on Forestry: Each state law specifies the conditions under which the law applies, and what penalties may be levied if no corrective action is taken. It is important to recognize that these two General Statutes are different from the performance standard defined under FPG .0202 *Prohibition of Debris Entering Streams and Waterbodies*. However, NCFS field staff may cite a violation of either a FPG or appropriate statute law that best applies to your site conditions, depending upon the circumstances.

A Note on Streams and Ditches in North Carolina

Historical land-use activities in North Carolina have resulted in formerly natural looking streams now appearing with characteristics that are more similar to a ditch than a stream.

However, just because a stream looks like a ditch or canal, it still requires the same level of protection as a natural looking stream.

If you have doubts about the condition and status of a stream or ditch on your forestry site, you can seek assistance from the NCFS or other qualified natural resources professionals.

General Development Buffer Rule

Responsible Agency:
-- NCDEMLR (EMC)
Contact:
-- Land Quality Section

Web site:
http://portal.ncdenr.org/web/lr/erosion

Defining Rule:
Part of the SPCA, NC GS 113A-57(1)

The SPCA defines rules for erosion and sediment control during land disturbing activities related to land development and construction. Contained in these rules is a requirement for maintaining a buffer along the margins of lakes and natural watercourses during land clearing and grading for development. A portion of the rule is cited from the SPCA, as reference: *<start citation>* "No land-disturbing activity during periods of construction or improvement to land shall be permitted in proximity to a lake or natural watercourse unless a buffer zone is provided along the margin of the watercourse of sufficient width to confine visible siltation within the twenty-five percent (25%) of the buffer zone nearest the land-disturbing activity." *<end citation>*

Effect on Forestry: As long as the forestry activities are in compliance with the FPGs, the general development buffer rules do not apply to forestry operations. However, if a site is designated as noncompliance with the FPGs, then it may be subject to this buffer rule.

Pesticide Use and Handling

Responsible Agency:
-- NC Department of Agriculture & Consumer Services (NC-DACS)
Contact:
-- Pesticide Section, Food and Drug Prot.Div.
Web site:
www.ncagr.gov/SPCAP/pesticides/index.htm
Defining Rule:
NC GS §143-434 through §143-470.1

There are several state laws and rules dealing with pesticide use, handling, licensing and application.

Effect on Forestry: Consult with a licensed pesticide applicator if you have questions about how to work with, or what requirements are needed, for pesticide use on forestry sites. The extensive rules are beyond the scope of this manual for discussion. Two of the more notable portions of these laws and rules that deal with forestry are noted here:

Pesticide applicator licensing: (NC G.S. §143-452(a)) *<start citation>*
"No person shall engage in the business of pesticide applicator within this State at any time unless he is licensed annually as a pesticide applicator by the North Carolina Pesticide Board." *<end citation>*

Aerial application of pesticides: (02 NCAC 09L .1001 - .1009)
These extensive Rules include sections on general recommendations, drift control, restricted areas and notification requirements, among other items.

Spills of Pesticides, Petroleum and Other Hazardous Substances

Responsible Agency:
-- NCDENR-DWR
Contact:
-- Surface Water Protection Section
Web site:
http://portal.ncdenr.org/web/wq/swp
Defining Rule:
NC G.S. Art.21A §143-215.75 to 215.85A

North Carolina law requires that discharges of pesticides, petroleum products or other hazardous substances to any stream or waterbody or land surface in close proximity to a stream or waterbody in the state be removed or otherwise appropriately treated and that such spills be reported to the appropriate state agency.

Effect on Forestry: There are specific rules on when you must notify the state of a fluid spill. These rules are explained, in detail, on the first page of *Chapter 8 - Equipment Fluids and Solid Waste* in this manual.

Definitions and designation of hazardous substances and quantities of hazardous substances that are deemed harmful to the environment follow the guidelines established by the U.S. Environmental Protection Agency *(see N.C. G.S. 21A, 143-215.77A.)* Applicable sections of the statute are included in Appendix 1.

Part 4 -- Regional and Local Rules

Riverbasin and Watershed 'Riparian Buffer Rules'

Responsible Agency:
-- NCDWR (EMC)
Contact:
-- DWR Nonpoint Source Planning Unit
Web site:
http://portal.ncdenr.org/web/wq/swp/ws/401/rianarianbuffers/rules

Defining Rules:
-- Portions of 15A NCAC 02B .0200-series

In certain river basins and watersheds of North Carolina, there are specific rules that overlay the already-mandated requirements of the FPGs.

These 'riparian buffer rules', as they are referred to in this manual, are established by the N.C. Environmental Management Commission and are administered through the N.C. Division of Water Resources (NCDWR). In some cases, you may hear these rules called the 'DWR buffer rules.'

Effect on Forestry: The requirements of these rules are more specific than those of the FPGs, and in those watersheds/basins where the rules apply, they must be followed in addition to the FPGs. Generally, these riparian buffer rules establish stricter limits on what kind of forestry operations can occur within the designated buffer zone(s).

A Note on Stream Identification, Definition and Determination

The stream identification process and definitions used in the 'riparian buffer rules' are different from how streams are defined under the FPGs. Be aware of this difference and consult the rules citations or a professional who is familiar with these rules for help if needed.

Stream *Identification* for 'riparian buffer rules'

Each riparian buffer rule describes the types of streams and waterbodies to which the rule applies, as well as how each is identified. Identification methods may include consulting topographic maps and soil surveys. Any person can follow the descriptions to assess if the rule applies to the site.

Stream *Determination* for 'riparian buffer rules'

If there is a question as to whether or not a rule applies to a specific stream or waterbody, only those individuals certified by the NCDWQ can provide the stream determination for these purposes (often known as 'stream calls.')

- Stream determinations may include the origin, location, and type of stream or waterbody, and requires an extensive on-site inspection.
- While certain staff of NCFS and individual N.C. Registered Foresters may be certified to make these 'stream calls', the NCDWR reserves the authority to make the final determination on any site in the state.

Watch Out!

There may be future buffer rules which could impact forestry operations within certain river basins or watersheds. Stay informed on new rules in your operating area.

At the time of this manual's 2015 fourth printing, there are 'riparian buffer rules' in six North Carolina river basins or watersheds, and each of these rules was under review for possible changes. Refer to the actual rule code and the NCFS *Forestry Leaflet* for each respective rule to determine if the rule applies to your site and what conditions must be met in order to comply with the rule.

Remember: The stream definitions in these rules are different from the ones used in the FPGs. Consult the specific rules citation in Appendix 1.

Catawba River and Mainstem Lakes: Rule Code 15A NCAC 02B .0243.
Forestry Leaflet #WQ-10

Goose Creek Watershed: Rule Code 15A NCAC 02B .0600 to .0609.
Forestry Leaflet #WQ-13

Jordan Lake Watershed: Rule Code 15A NCAC 02B .0267.
Forestry Leaflet #WQ-14

Neuse River basin: Rule Code 15A NCAC 02B .0233.
Forestry Leaflet #WQ-11

Randleman Lake Watershed: Rule Code 15A NCAC 02B .0250
Forestry Leaflet #WQ12

Tar-Pamlico River basin: Rule Code 15A NCAC 02B .0259.
Forestry Leaflet #WQ-11

Water Supply Watershed Rules

In those watersheds classified as 'water supply', local governments are required to develop ordinances to protect the water quality of the watershed.

Effect on Forestry: These rules do not apply to forestry operations in North Carolina. As a reference, excerpts from the governing General Statutes and Administrative Code that provide this exemption are cited below. It is unclear as to whether these rules would apply retroactively if your forestry site was deemed in noncompliance with the FPGs.

Helpful Hints:

In this citation, the term 'Commission' refers to the N.C. Environmental Management Commission.

G.S. §143-214.5 (d1). Water supply watershed protection *<start citation>*
"A local ordinance adopted to implement the minimum statewide water supply watershed management requirements applicable to agriculture and silviculture activities shall be no more restrictive than those adopted by the Commission. In adopting minimum statewide water supply watershed management requirements applicable to agriculture activities, the Commission shall consider the policy regarding agricultural nonpoint source discharges set out in subsection (a) of this section. The Commission may by rule designate another State agency to administer the minimum statewide water supply watershed management requirements applicable to agriculture and silviculture activities. If the Commission designates another State agency to administer the minimum statewide water supply watershed management requirements applicable to agriculture and silviculture activities, management requirements adopted by local governments shall not apply to such activities." *<end citation>*

<start citation>
15A NCAC 02B .0104 (v) CONSIDERATIONS / ASSIGNING / IMPLEMENTING WATER SUPPLY CLASSIFICATIONS
"Silviculture activities are subject to the provisions of the Forest Practices Guidelines Related to Water Quality (15A NCAC 1I .0101 - .0209). The Division of Forest Resources is the designated management agency responsible for implementing the provisions of the rules in 15A NCAC 2B .0200 pertaining to silviculture activities." *<end citation>*

Trout Waters Buffer Rules

Responsible Agency:
-- NCDEMLR
Contact:
-- Land Quality Section
Web site:
http://portal.ncdenr.org/web/lr/land-quality
Defining Rule:
Part of the SPCA, NC GS 113A-57(1)

This rule applies to development activities adjacent to streams and waterbodies and restricts timber harvesting that is related to development. This so-called 'trout buffer rule' is a requirement contained in the SPCA of 1973 and mandates a minimum 25 foot undisturbed vegetative zone along waterbodies classified as Trout Waters (Tr) by the EMC.

Effect on Forestry: As long as the forestry activities are in compliance with the FPGs, these 'Trout Waters Buffer Rules' do not apply to forestry operations. However, if a site is designated as noncompliance with the FPGs, then it may be subject to these special buffer rules.

A Note on Different "Trout Waters" Designations

The Environmental Management Commission / Division of Water Resources Trout Waters (Tr) classification is not the same as the N.C. Wildlife Resources Commission (NCWRC) trout waters designation.

Trout Waters classified by the EMC / DWR are mountain streams that are cool, 'High Quality Waters' that are capable of supporting trout populations and are protected with the 'Tr' classification to protect that habitat.

The NCWRC Designated Public Mountain Trout Waters are streams with fishable trout populations, are managed or protected to maintain a fishable trout population and to which NCWRC trout fishing regulations apply.

Helpful Hints:

The NCWRC trout waters are denoted by on-site signs and are generally a subset of the 'Tr' classifications.

NCWRC regulations are found at www.ncwildlife.org

Local Government Ordinances

In recent years, there has been an increasing interest from local governments to enact ordinances, or zoning laws, that impose additional limits on forestry operations.

Did You Know?

SB681 is commonly referred to as the 'Right to Practice Forestry' bill.

Refer to "Woodland Owner Note No.41 - Practicing Forestry Under Local Regulations": www.ces.ncsu.edu/forestry/pdf/WON/won41.pdf

Effect on Forestry: With the 2005 enactment of North Carolina Session Law 2005-447 Senate Bill SB681 *An Act To Clarify The Role Of Counties And Cities In Regulating Certain Forestry Activities*, forestry activities should generally remain exempt from local ordinances. The Session Law bill is cited in Appendix 1, and describes when forestry activities are exempt.

Local governments retain their ability to exercise planning and zoning authority, and there may be cases where local zoning laws could affect forestry. This zoning authority typically extends beyond the city's actual city limits into its extra-territorial jurisdiction, or ETJ. In some cases, a town or city ETJ can extend well past the built-up areas, and out into rural, undeveloped areas.

Temporary Driveway Access Permit Exemption

Effective with Session Law 2013-265:

Forestry operations and silviculture operations, including the harvesting of timber, and other related management activities that require temporary access from a property to a State road shall be exempt from the temporary driveway permit process of the NCDOT for State-maintained roads, except for controlled access highways, if the operator of the temporary driveway has attended an educational course on timbering access and obtained a safety certification. Driveway access points covered by this section shall be temporary and shall be removed upon the earlier of six months or the end of forestry or silviculture operations on the property.

Chapter 3
Planning Forestry Operations and BMPs

Chapter 3 Layout:

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For Forest Owners:

A forest management plan commonly includes information about:

- *Property area (map).*
- *Tree size, age, type and quality.*
- *Soil conditions.*
- *Proximity to streams.*
- *Forest health, such as insects or disease.*
- *Overall forest growth and vigor.*
- *Options for forest regeneration.*

Forest management plans are most commonly available from:

- *Private consulting foresters.*
- *N.C. Forest Service.*
- *Forest industry programs.*
- *Other natural resources agencies or professionals.*

Water Quality Link

There are two beneficial reasons for planning before starting your operation:
1. Understanding how to protect water quality on the job site.
2. Recognizing site-specific conditions that can determine what BMPs are needed in order to protect water quality.

Loggers, landowners, timber buyers, foresters and anyone else who has a financial stake in the forestry operation, should take an interest in making sure BMPs are properly implemented, maintained, and functioning. Planning affords you time to know where special attention may be needed on a site, and is a cornerstone of sustainable forestry stewardship.

Part 1 -- Forest Management Plans

The most important goal of a forest management plan is to make prescriptions or offer options on how the forested area should be managed in order to achieve the landowner's objectives.

Forest management plans should include a description of how water quality will be protected when management activities are undertaken, and plans should denote areas on the property that may require special attention.

Examples of special areas include locations of streams or ditches, stream or ditch crossings, springheads or wetlands. A plan usually includes a brief summary of environmental rules that may apply on the property.

Specific recommendations for BMPs may be more appropriate for the preharvest plan, or other operational plan, once a more detailed site examination is conducted.

When Forest Management Plans Are Required

DWR riverbasin and watershed 'Riparian Buffer Rules'

- The buffer rules for specific riverbasins or watersheds require a forest management plan to be in place before any timber harvesting can occur within the defined buffer area.
- Refer to each applicable buffer rule in Appendix 1 for more information.

Forestry Present-Use Tax Valuation of Property

- For a landowner to receive a forestry-use valuation on his or her property, a forest management plan must be in place. Each county tax assessor's office has different interpretations. Refer to your local tax office.

Part 2 -- Preharvest Planning

For Forest Owners:

Similar operational plans can be done for other forestry activities besides harvesting.

A few examples include:
- Site preparation
- Pesticide / Fertilizer Use
- Prescribed Burning
- Road Construction
- Drainage Maintenance

Whenever forestry activities are done on your property, it is highly recommended that you use a written contract that includes an operational plan.

A preharvest plan provides greater detail than a forest management plan and should include descriptions of BMPs or other measures that will be implemented to protect water quality.

An 11-step preharvest planning list is outlined below for your reference. This list is only generic and should be modified to fit your specific needs.

Step 1 - Rules that apply for water quality (and/or other rules)

- N.C. Forest Practices Guidelines Related to Water Quality
- NCDWR riverbasin and watershed 'Riparian Buffer Rules'
- Wetland rules and requirements (state and federal)
- Local zoning requirements
- Endangered species considerations
- Other forestry-related rules: waste disposal, burning, fluid spills

Step 2 - Layout and access

- Examine the site to see the 'lay of the land'; study maps or photos.
- Determine access to the property by rights-of-way or easements and establish access onto public roads.
- Make sure the boundaries of the harvest and/or ownership area are well marked and visible.
- Begin marking important features on the tract map and taking notes.

Also Refer To…

Chapter 5 for roads, skid trails, decks;

Chapter 1 to learn about soil factors;

Appendix 8 for logging system descriptions;

Step 3 - Site and timber conditions

- Topography and terrain of the land can determine the placement of roads, skid trails, firelines and decks.
- Slope is a factor that influences the amount and speed of runoff that will need to be controlled and/or captured.
- Soil conditions can influence where roads and decks are placed, as well as the operating window of time suitable for heavy equipment.
- The volume and spacing of timber to be harvested will determine the location of roads, skid trails and decks. These factors also play a role in selecting what type of logging system to use.

Chapter 4 for SMZs and riparian buffers;

Chapter 6 for wetlands and hydrology information

Step 4 - Streams, waterbodies and hydrology

- Locate streams and waterbodies that will need protection.
- Establish appropriate Streamside Management Zone (SMZ) and/or riparian buffer, as needed. See Step 5 below.
- Recognize the hydrology of the site, because this can influence how a harvest is conducted and be an indicator of possible wetland areas.
- Determine if stream crossings are needed. See Step 6 below.

Step 5 - SMZs and riparian buffers

- Establish any needed SMZs according to **FPG .0201**. You are encouraged to visibly mark the SMZ so everyone on the job site knows its location, especially the heavy equipment operators.

- Establish any needed 'riparian buffers' that are specific to certain river basins and watersheds of North Carolina. You should mark these riparian buffers so everyone on the job site knows their location.
- Refer to Chapter 4 of this Manual for explanations of what riparian buffer rules may apply to your location and for SMZ width suggestions.

Step 6 - Locate stream crossings and determine the best method

FPG

- Avoid stream crossings if possible. Know the rules related to crossings.
- Refer to Part 5 of Chapter 5 for details on choosing a good stream crossing location and method.
- Determine if a crossing will be temporary or permanent. This decision can influence the type of crossing that is used.
- Invest in appropriate BMP tools to control runoff and capture sediment.

Step 7 - Access roads and entrances

FPG

- Know the rules related to access road placement and construction.
- The type and amount of roads needed are determined by many factors, including safety needs, size of area, timber conditions, soil conditions, slope, landowner's objectives, and the type of logging system or harvest.
- Establish access from the site onto public roads. This may require obtaining N.C. Department of Transportation driveway permits.
- Prepare to use measures that minimize mud and debris from being dragged onto public roads.
- Provide a suitable sight-distance at the public road entrance point. Warning signs should be considered along public roads to warn oncoming traffic.
- If a new road must be built, establish the control points and road right-of-way through the tract to lay out the road before construction occurs.
- Refer to Part 3 of Chapter 5 for BMPs related to forest roads.
- Refer to Chapter 6 for required practices for roads in forested wetlands.

For Forest Owners:

A helpful resource for mountain roads is the Layman's Guide to Private Access Road Construction in the Southern Appalachian Mountains. *Contact your nearest NCFS District Office or USDA-NRCS office for a free copy.*

Step 8 - Skid trails and decks

- Plan to minimize the number and size of skid trails and decks.
- Take note of any critical locations on the skid trail and deck locations that may need additional precautions and/or BMPs to protect water quality.
- Locate the skid trails and decks as far from waterbodies as practical given the site layout and conditions.
- Different types of logging systems may require different types and/or sizes of skid trails and decks. Recognize this need and plan accordingly.
- Refer to Part 6 of Chapter 5 for BMPs for skid trails and decks.

Step 9 - Site map and harvest scheduling

For Forest Owners:

Some timber harvest contracts may need allowances for time extensions due to wet site conditions. This allows a logger to perform the work in a way that best protects water quality.

- Create a site map that includes expected BMPs and notes important features, such as those already mentioned in Steps 1 through 8. Refer to the following Figure 3A for an example of a hand-drawn preharvest map.
- Make sure workers on the job site understand what the site looks like, and what to expect when it comes to BMPs, rules and water quality protection. This is especially valuable for heavy equipment operators.
- Determine which portion of a site will be harvested first and have a contingency, or backup, plan if site or soil conditions deteriorate.

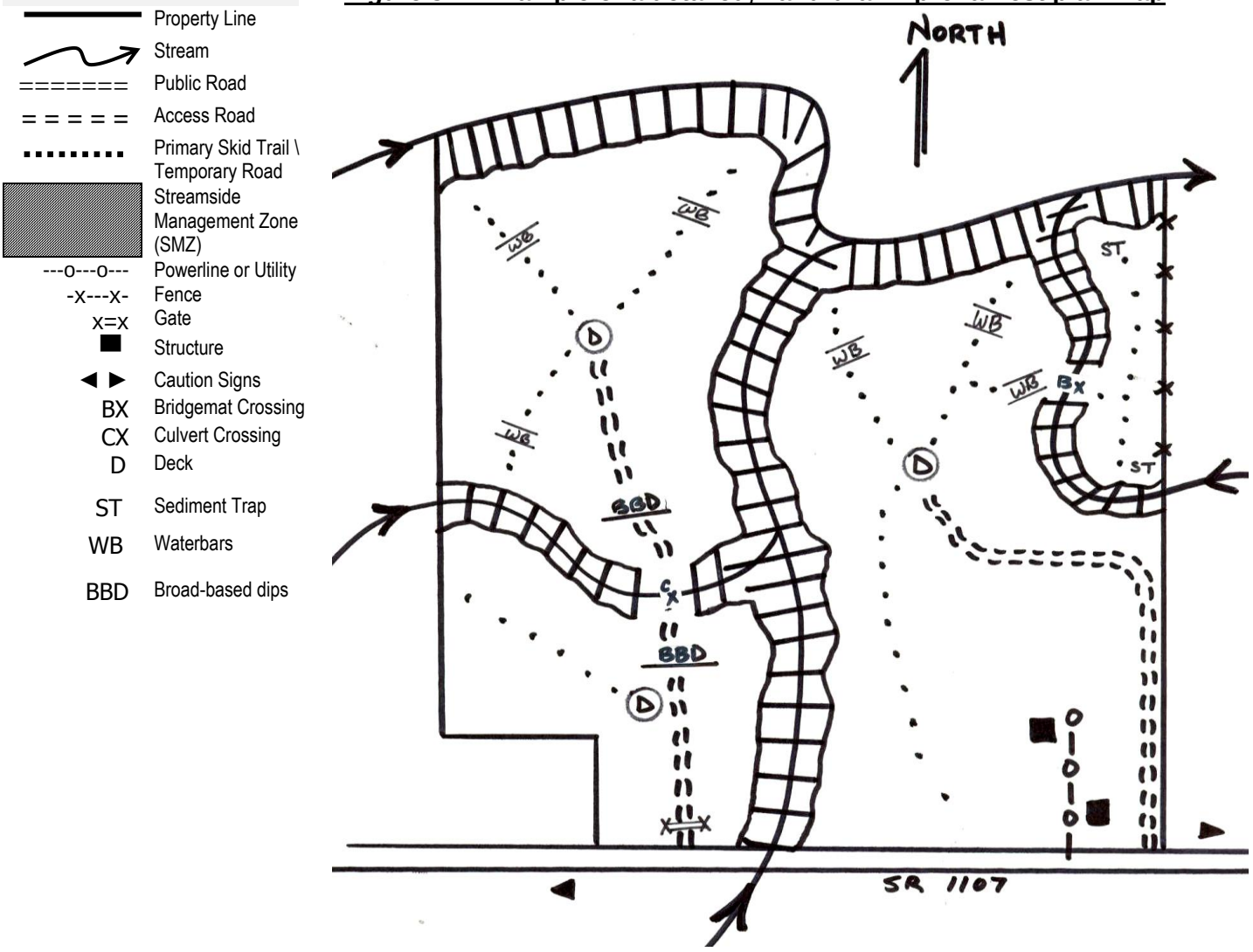
Step 10 - Site stabilization and tract close-out

- Know the rules related to site stabilization.
- Specify who is responsible for stabilizing the different areas of the site.
- Understand how roads, skid trails, stream crossings and decks will be stabilized or closed-out. This may involve mulching, culvert removals, re-grading of roads and installation of fences or gates.

Step 11 - Monitor and Maintain BMPs

- Specify how BMPs will be monitored and maintained so they continue to function effectively.
- Evaluate BMPs and site conditions after heavy precipitation to determine if water quality is still protected and that BMPs are not failing. Make necessary corrections as soon as possible.

Figure 3A: Example of a detailed, hand-drawn preharvest plan map



Part 3 -- Logging Systems

For Forest Owners:

A brief explanation of the most common logging systems found in the southeastern U.S. is provided in Appendix 8.

Knowing this information allows you to recognize what BMPs may be appropriate for the site, given the type of equipment that is used.

The logging system and type of harvest can affect the design and layout of access roads, skid trails and decks. Roads and skid trails used during logging are the most common source for sediment in nonpoint source pollution contributed by forestry activities.

As a result, it is worthwhile to consider the relationship between the type of logging system that is used and implementation of appropriate forestry BMPs, so water quality is protected. Two example situations:

1. Long tractor-trailers may require wider access roads and larger turning areas than straight-body trucks. Likewise, chipping operations usually require wider, flatter roads so the high-dimension chip trailers remain stable during transport. These wider road surface areas will need additional BMP attention to insure erosion and sedimentation is minimized.

2. A harvest with many different log products can require larger deck areas for the sorting and handling of multiple log stacks. As with the roads, these larger exposed soil decks may require additional attention for BMPs.

BMPs for Logging Systems

In Other Words…

Use the correct equipment, and use the equipment correctly!

- Planning should be done to find out what kind of site conditions exist. These conditions and the type of operation you intend to conduct will determine the type and amount of BMPs that should be used.

- Understand the limitations of the equipment and how it can be best operated to protect water quality during harvesting.

- If a single pass with the equipment produces a significant rut, evaluate your options for working on the site. Choose an alternative that will protect water quality.

For Forest Owners:

A backup plan may be as simple as moving off site or stopping operations while waiting for conditions to improve.

- Harvest timber in a manner to minimize significant changes to soil structure or organic matter, both of which contribute to changes in surface runoff that may negatively impact water quality.

- Have a backup plan when inclement weather and/or wet site conditions do not allow operations to continue on a specific site.

Part 4 -- Planning Resource Aids

Helpful Hints:

You may find it helpful to talk with neighbors, hunters, or other local individuals when examining the tract.

Many resources are available to aid in the planning process. Appendix 7 provides a list of sources where some of these aids may be available for review or purchase. In some cases, you may be able to look over or obtain photocopies of these resources at local NCFS county ranger offices.

Did You Know?

The topo maps referred to here are those prepared by the U.S. Geological Survey (USGS).

Topo maps at 1:24000 scale are also called the '7.5 Minute Series', and usually provide the best resolution of detail for field use, when compared to 1:100000 scale maps.

On Site Examination

The best resource for planning is an on-the-ground examination of the site. This allows you a chance to see first-hand what the site is like and where water quality or BMP issues need to be addressed.

Topographic Maps ('topo' maps)

These are detailed maps that indicate slope, land contours and estimated stream features. While topo maps provide good planning information, they are not always sufficiently accurate for forestry purposes, especially related to stream location and identification.

Commercially available topo map atlas books are excellent references, but often do not have the fine level of detail you may need. You should make an on-site examination to verify the features shown on the map.

Figure 3B: Excerpt from the USGS 'Rougemont' 7.5-minute quad topo map

Caption:

As contour lines get closer together, this indicates steeper slopes (circled).

- - -

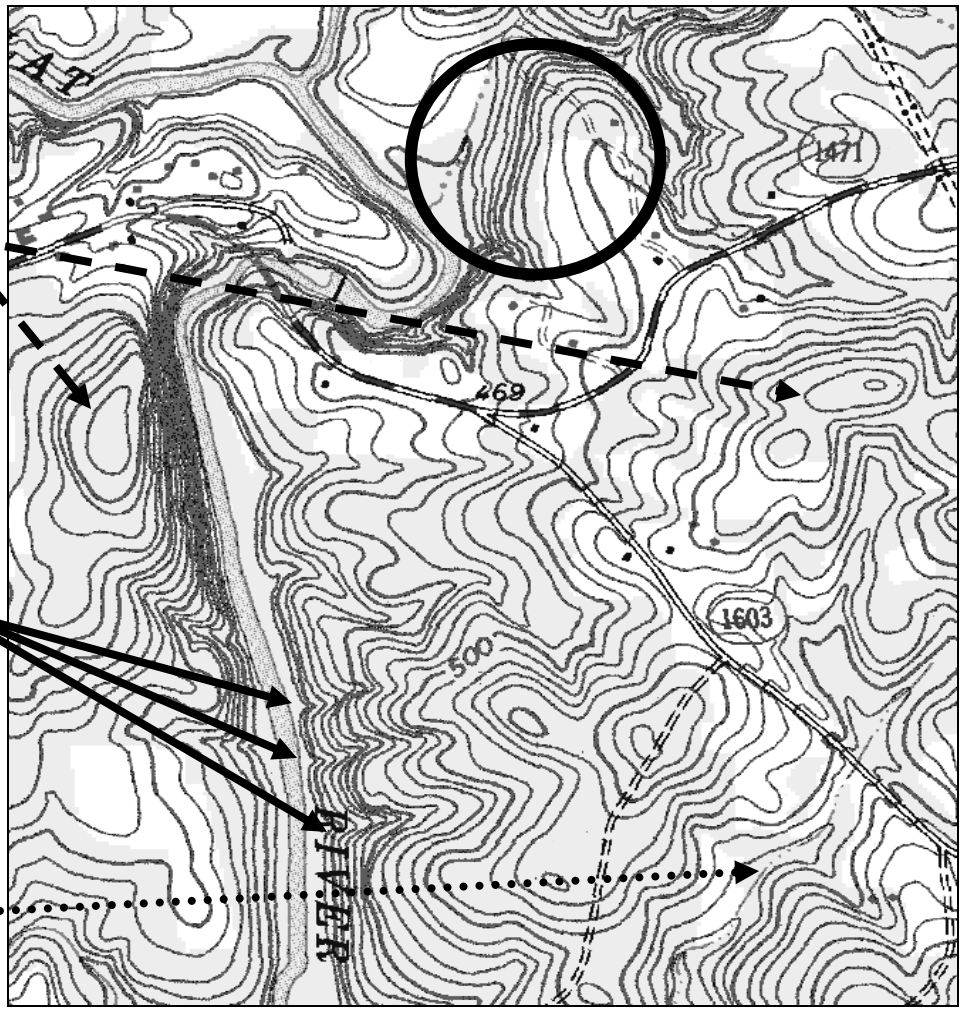
Complete circles of contour lines indicate the peaks of hilltops (dashed arrows)

- - -

Where contour lines are shaped like a V, this indicates gullies, or some form of water drainage on the land. Note that no streams are indicated in the three V-notched locations shown by solid arrows. Compare this topo map with the soil survey map on the next page.

- - -

Streams are indicated by either a dashed / dotted line or a solid line. On color topo maps, these lines appear in blue color, which is why they are often called 'blueline' streams (shown here by dotted arrow).



Did You Know?

Soil surveys are produced by the USDA-Natural Resources Conservation Service (NRCS).

This agency used to be known as the SCS or 'Soil Conservation Service'

Soil surveys may also be available from county Soil & Water Conservation District (SWCD) offices.

Soil Surveys ('soil maps')

Soil survey maps are usually black and white, and provide details on the expected soil conditions of the site, along with estimated stream features.

Many of these surveys also provide generic recommendations on the operability of a soil type for heavy equipment use and forest growth.

While soil maps provide good planning information, they are not always sufficiently accurate for forestry purposes, especially related to stream location and identification. You should make an on-site examination to verify the features shown on the survey map.

Soil survey maps are a good way to determine whether any unique soil conditions exist on your site. Examples include organic, muck soils or shrink/swell clay soils, both of which are explained in Part 4 of Chapter 1.

Figure 3C: Excerpt from NRCS soil survey map of the same location as shown in Figure 3B

Caption:

Soil maps show public roads, and some woods- or field-roads.

\- - -

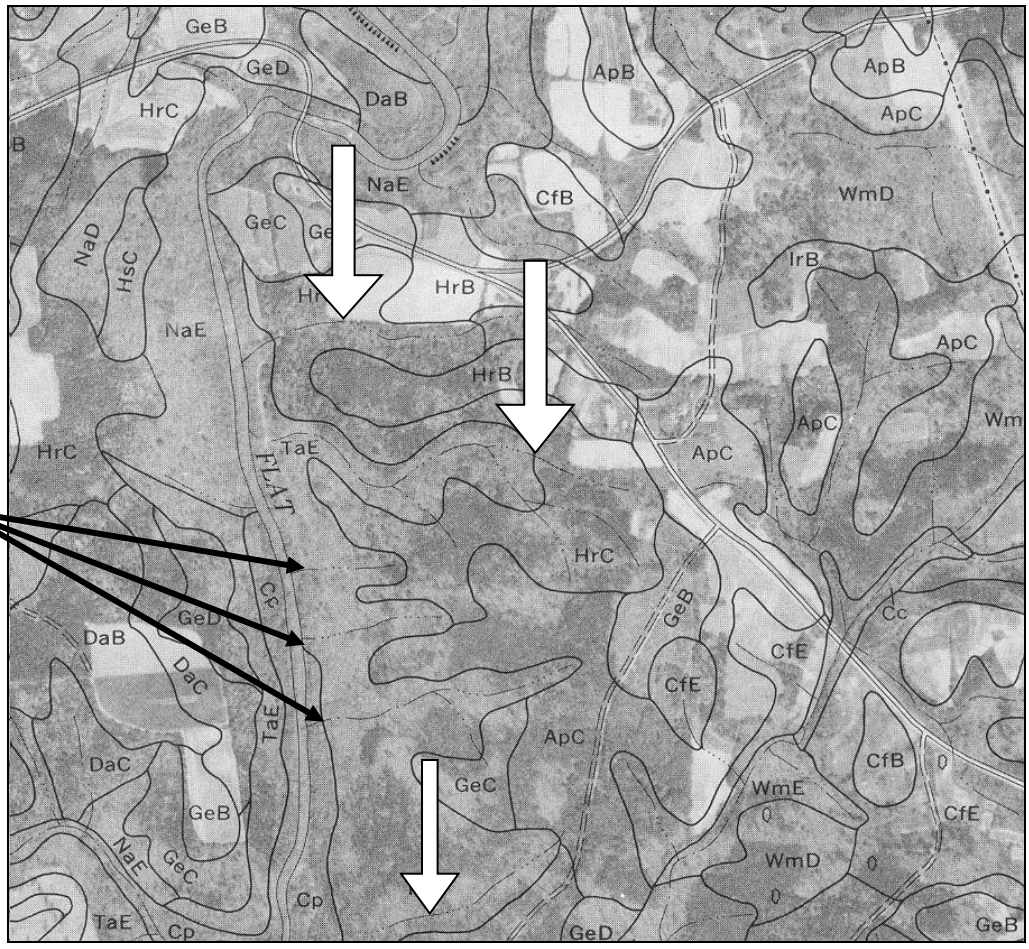
The alphabetic codes refer to the different soil types estimated for that location. Each code is explained in the soil survey book.

\- - -

Streams are indicated with dashed/dotted lines.

On the topo map, the three V-notch areas along the Flat River did not indicate any streams. However, on the soil map, each V-notch is estimated to have a stream.

Also note the other streams estimated on the soil map, that are not indicated on the topo map (shown by white arrows).



Did You Know?

Photos may come in black & white, true color, or color-infrared (CIR).

Aerial photos are a good way to verify the features shown on a topo map or soil survey map.

Aerial Photographs / Satellite Images

Aerial photographs and satellite images provide a scaled, overhead view of the ground surface. Overlapping photos with stereographic coverage can be used to measure slope and land contours, which will help in laying out roads.

Subtle differences in timber type, coloration of the ground surface, and changes in stream channels can help give you an idea of places on the job site that may need extra precautions to protect water resources.

Figure 3D: Aerial photo of same Durham County location as shown in Figures 3B and 3C

Caption:

This aerial photo shows the same location as the above two maps.

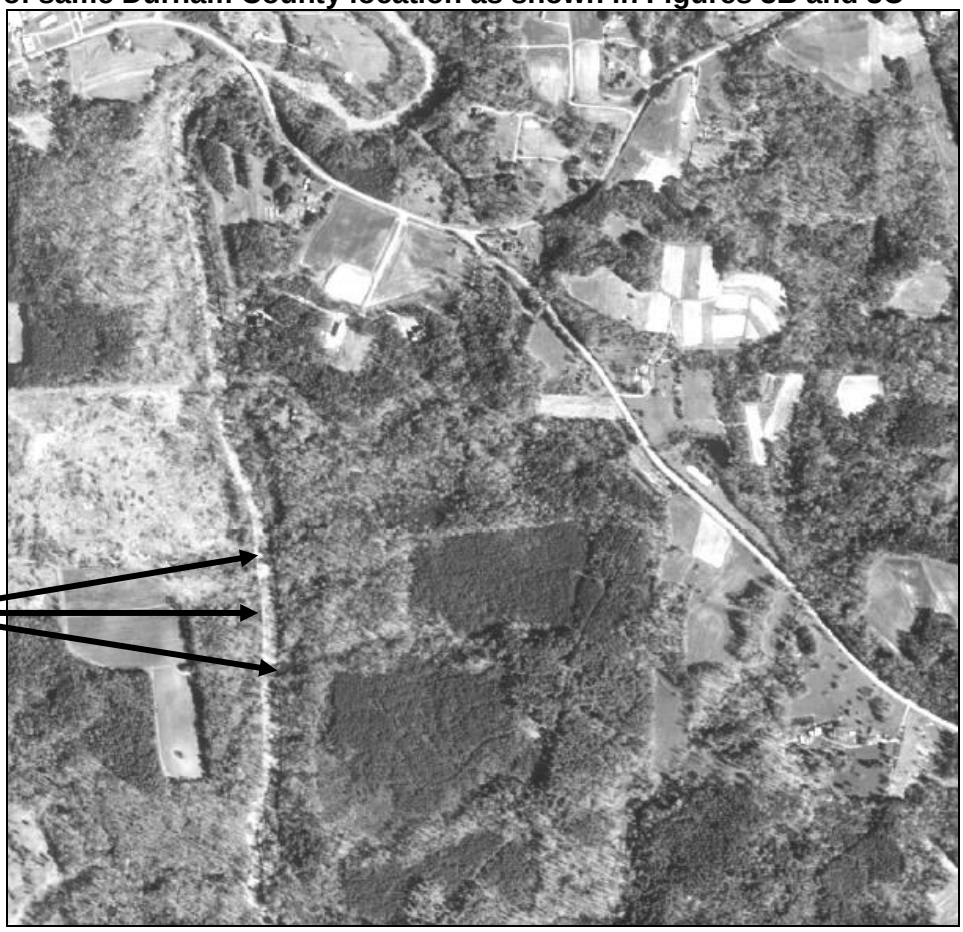
- - -

Roads, rivers, forest edges, and major corridors are easy to see on a photo, but small individual streams are not.

- - -

Looking carefully, you may notice differences of shadowing in the area of the three V-notches along the Flat River. Shadowing like this may be your only clue on a photo that a stream or gully exists.

A 'ground-truth' on-site examination will help verify exactly what stream and ground conditions exist.



For Forest Owners:

*It is **your** responsibility to verify and locate your property lines!*
Don't rely on the logger, forester, or timber buyer to do it for you.

*Only a Registered Land Surveyor can **establish** property lines*

Tax Parcel Information (tax maps)

County tax offices may have tax parcel information that can help identify the general vicinity of a site's property boundary lines.

NOTE: It is important to remember that tax maps are only a general approximation and do not provide the same high level of detail or accuracy as a surveyor's property line survey drawing.

>>> Remember the 6P's of Planning <<<

[1]***Proper*** [2] ***Prior*** [3]***Planning*** [4]***Prevents*** [5]***Poor*** [6]***Performance!***

Chapter 4
Streamside Management Zones and Riparian Buffers

Chapter 4 Layout

-- -- -- --

For Forest Owners:

In most cases SMZs and riparian buffers need not be treated as 'no-cut' preserve areas. Forest harvesting can be used to regenerate trees in the SMZ or buffer. This fresh tree growth in turn helps protect water quality and maintain the biological and financial viability of working forests.

Part 1 -- Function of SMZs and Riparian Buffers

A streamside management zone (SMZ) or riparian buffer can help achieve multiple water quality goals, many of which are discussed in detail under Chapter 1, Part 4 -- Importance of BMPs. These goals usually focus on:

-- Slowing and filtering runoff.
-- Capturing sediment.
-- Providing shade from sunlight intensity.
-- Maintaining streambank stability.
-- Ameliorating impacts from biological pollution agents such as nutrient input or fecal coliform, both of which can result from other land use practices.

Water Quality Link

Establishing a zone or buffer of reduced or minimal disturbance alongside the edges of a stream or waterbody has proven to be one of the most effective and least expensive methods to implement for protecting water quality.

In this manual, BMPs are recommended that protect water quality and conserve soil resources based upon site-specific factors that determine the degree of protection needed for a stream or other waterbody. The site factors that most often influence SMZ and riparian buffer use are noted below:

Slope

Steeper slopes may require wider buffers and/or additional measures to slow down and capture fast-moving runoff.

Soils

Some soils are more likely to erode than others. In these cases a wider buffer or other measures are needed to prevent erosion. A NRCS soil survey or local assistance can help you determine the erosion potential of a soil.

Waterbody Use

There may be cases where a waterbody of special designation should have extra precautions taken to insure water quality is protected (see sidebar).

Vegetation and Groundcover

Vegetation and groundcover are the main reason that SMZs and riparian buffers work. Recognizing the amount and distribution of vegetation or groundcover can influence the extent of activities within the SMZ or buffer.

Other Purposes

Even though water quality is the focus of this manual, SMZs and riparian buffers can help you achieve many different goals at the same time. To achieve these goals, an SMZ or buffer may need different treatment or size layout than what would normally be expected for protecting water quality.

Part 2 -- Rules Related to SMZs and Riparian Buffers

North Carolina has several different requirements on the need, location, size and amount of activity for SMZs and riparian buffers:

FPG

In North Carolina, the term "streamside management zone" is a defined item within the FPGs.

- **Forest Practices Guidelines Related to Water Quality (FPGs)**
  Streamside Management Zones (SMZs) are defined in FPG .0201. There may be other sections within the FPGs that also apply to SMZs. In Parts 3, 4 and 5 of this chapter, there are BMPs related to SMZs that you might find useful in meeting the FPG standards.

Watch Out!

If a forestry operation is deemed in non-compliance with the FPGs or DWQ 'buffer rules', the operation may also be subject to other state or local rules.

- **DWR riverbasin and watershed 'Riparian Buffer Rules'**
  These rules are enforced by the N.C. Division of Water Resources (DWR) and limit certain forestry operations within the required buffer area.

- **North Carolina General Statute 77-13**
  Obstructing streams a misdemeanor

- **North Carolina General Statute 77-14**
  Obstructions in streams and drainage ditches

A Note on Beaver Ponds:

Streamside Management Zones (SMZs) as defined and required under FPG .0201 are <u>not required</u> around beaver ponds:

- However, it is still required that you comply with all of the FPGs as well as the applicable N.C. General Statutes related to stream/ditch obstructions.
- The installation and use of SMZs is most often an economical and effective preventative measure in these situations.

Take note that the DWQ river basin and watershed 'Riparian Buffer Rules' <u>are required</u> alongside the margins of beaver ponds:

- Seek professional technical assistance, if needed, to assess the options you may have in these circumstances on a site-by-site basis.

This page briefly highlights state-implemented requirements for SMZs and riparian buffers for forestry operations in North Carolina at the time of this manual's 2012 re-printing.

The types of streams and waterbodies noted here are defined in the FPGs. Even though a stream has been modified, it is still a stream and requires attention to see if or how FPGs and other rules apply to it.	**Name:**	Streamside Management Zone (SMZ)
	Location:	Entire state on any forestry-related, site-disturbing activity
	Applicability:	Required as defined in FPG .0201
	Size Width:	Shall be of sufficient width to confine within the SMZ any visible sediment resulting from accelerated erosion.
	Where to Use:	Establish along the margins of Intermittent streams, Perennial streams, and Perennial waterbodies as defined in the FPGs.

These rules became effective August 1, 2004.	**Name:**	Catawba 'Riparian Buffer Rule'
	Location:	Portions of the Catawba River and mainstem lakes
	Applicability:	Required as defined in 15A NCAC 2B .0243
	Size Width:	50 feet on each side of waterbody
	Where to Use:	• Mainstem of the Catawba River below Lake James. • Shorelines of mainstem Lakes from (and including) Lake James, south to the NC/SC border.

These rules became effective February 1, 2009. ***NOTE: THIS BUFFER RULE IS TOTALLY DIFFERENT FROM THE OTHERS. BE AWARE OF THESE DIFFERFENCES.***	**Name:**	Goose Creek Watershed 'Riparian Buffer Rule'
	Location:	Portions of Mecklenburg and Union counties
	Applicability:	Required as defined in 15A NCAC 2B .0600 through .0609
	Size Width:	**100 or 200 feet**, depending upon location within the floodplain
	Where to Use:	Intermittent streams, Perennial streams, lakes, ponds, and estuaries as defined in the rule.

These rules became effective July 1, 2008.	**Name:**	Jordan Lake Watershed 'Riparian Buffer Rule'
	Location:	In the watershed of Jordan Lake.
	Applicability:	Required as defined in 15A NCAC 2B .0267
	Size Width:	50 feet on each side of waterbody
	Where to Use:	Intermittent streams, Perennial streams, lakes, ponds, and estuaries as defined in the rule.

These rules became effective August 1, 2000. The type of streams where this rule applies are defined differently than how the FPGs define streams. ***Be aware of this difference!***	**Name:**	Neuse River Basin 'Riparian Buffer Rule'
	Location:	Neuse riverbasin / watershed only
	Applicability:	Required as defined in 15A NCAC 2B .0233
	Size Width:	50 feet on each side of waterbody as measured horizontally
	Where to Use:	Intermittent streams, Perennial streams, and Modified natural streams as defined in the rule; and perennial lakes, ponds and estuaries.

These rules became effective June 1, 2010. *The type of streams where this rule applies are defined differently than how the FPGs define streams.* ***Be aware of this difference!***	**Name:**	Randleman Lake Watershed 'Riparian Buffer Rule'
	Location:	The watershed of Randleman Lake: This includes portions of Forsyth, Guilford, and Randolph counties
	Applicability:	Required as defined in 15A NCAC 2B .0250
	Size Width:	50 feet on each side of waterbody
	Where to Use:	Intermittent streams, Perennial streams and Perennial lakes and ponds as defined in the rule.

These rules became effective August 1, 2000. The type of streams where this rule applies are defined differently than how the FPGs define streams. ***Be aware of this difference!***	**Name:**	Tar-Pamlico River Basin 'Riparian Buffer Rule'
	Location:	Tar-Pamlico riverbasin / watershed only
	Applicability:	Required as defined in 15A NCAC 2B .0259
	Size Width:	50 feet on each side of waterbody as measured horizontally
	Where to Use:	Intermittent streams, Perennial streams, and Modified natural streams as defined in the rule; and Perennial lakes, ponds and estuaries.

Part 3 -- Recommended SMZ Widths

Helpful Hints:

It is recognized that SMZ widths vary according to the purpose for the SMZ and the site's conditions.

Professional judgment is needed to determine the right SMZ width that matches the site-specific conditions while meeting water quality (or other) goals.

The general BMP recommendation for SMZ width is 50 feet along each side of intermittent streams, perennial streams, and perennial waterbodies.

The SMZ width should continue and wrap around the head of the stream, where the ephemeral(s) transitions into the stream channel:

- Refer to Figure 4A on the following page for illustration of this concept.
- The waterbodies noted above follow the definitions described in the FPGs.
- Each of the DWQ Riparian Buffer Rules also has a required buffer width. Refer to the rule specific for your job site, if a 'buffer rule' applies.

SMZs wider than 50 feet may be needed on sites that exhibit one or more of these conditions:

- Steep slopes adjacent to the stream.
- Long, continuous slope lengths leading toward a stream.
- Highly erodible soils.
- Soil areas with little or minimal groundcover near the waterbody.
- Areas of intensive soil disturbance nearby the SMZ.
- Special waters (ex: trout, water supply, nutrient sensitive, shellfish, etc.)

Watch Out!

If SMZs less than 50 feet are used, you may need to use more BMPs or take additional action to protect water quality.

SMZs narrower than 50 feet may be suitable on sites that exhibit one or more of these conditions:

- Flat terrain within or adjacent to the stream.
- Short slope lengths that lead toward the stream.
- Stable or undisturbed soils.
- Soils with sufficient groundcover or vegetation to allow sheetflow and/or adequate water infiltration
- Stable streambank.

Table 4-1 below provides a range of options for SMZ widths that may be suitable for your site and operation.

Table 4-1: Range of Options for SMZ Widths on Forestry Operations in North Carolina

The range of options for SMZ widths is adapted and summarized from various publications and/or reports that are cited in Appendix 12.

Objective of SMZ	Range of Suggested Widths (feet)	Factors to Consider in Selecting SMZ Width
Sediment Control	30 to 150	Slope, Soils, Groundcover, Sediment Load, Waterbody Use
Nutrient Management	15 to 200	Hydrology, Vegetation, Soils, Nutrient Load
Streambank Stabilization	25 to 55	Vegetation, Soils, Streamflow
Wildlife and Aquatic Organisms	25 to 300	Specific to each Species

Figure 4A: Diagram showing SMZ continuing and wrapping around the head of a stream channel.

Caption:

The SMZ should wrap around the beginning of the stream channel, for the same general width as the SMZ used along the edge(s) of the stream.

Diagram Legend:

SMZ width

Ephemeral

Intermittent Stream

Perennial Stream

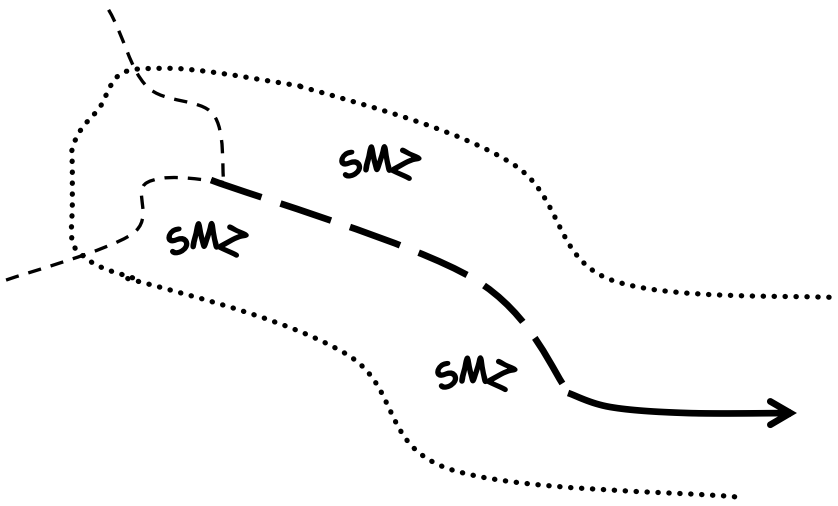


Figure 4B: SMZ corridors on a timber harvest in Burke County, N.C.

Caption:

SMZs are well maintained on this harvest operation.

The residual trees and vegetation within the SMZ should provide adequate shade and overall water quality protection.

Note the extent of skid trails on this harvest. Extensive erosion control work and/or stabilization will be needed to assure sedimentation is minimized from these skid trails.

Part 4 -- BMPs for Forest Operations in SMZs

Watch Out!

Take note that each* 'Riparian Buffer Rule' *has different, specific requirements and limits on timber harvesting.

Timber Harvest

- Recognize waterbodies that are on the site before you start harvesting:
  -- Pre-harvest planning can help you identify where SMZs are needed.
  -- You may find it useful to mark the SMZ for easy identification and share this information with the heavy equipment operators.

FPG

- In those limited situations in which access roads, skid trails, decks, or portable mill sites must absolutely be placed within the SMZ:
  -- Adhere to the requirements as specified under **FPG .0201**
  -- Keep these features at least 10 feet away from the stream or waterbody
  -- Limit heavy equipment usage within 10 feet of the edges of streams and waterbodies to protect bank stability and maintain the function of the riparian buffer.

- Maintain approximately half of the pre-harvest vegetative canopy cover within the SMZ in order to provide adequate shade:
  -- If significant removal of overstory canopy trees occurs within the SMZ, minimize disturbance to the mid-level and understory vegetation in order to maintain shade-producing canopy cover.

- Allow no more than 20 percent evenly distributed bare soil surface within the SMZ.

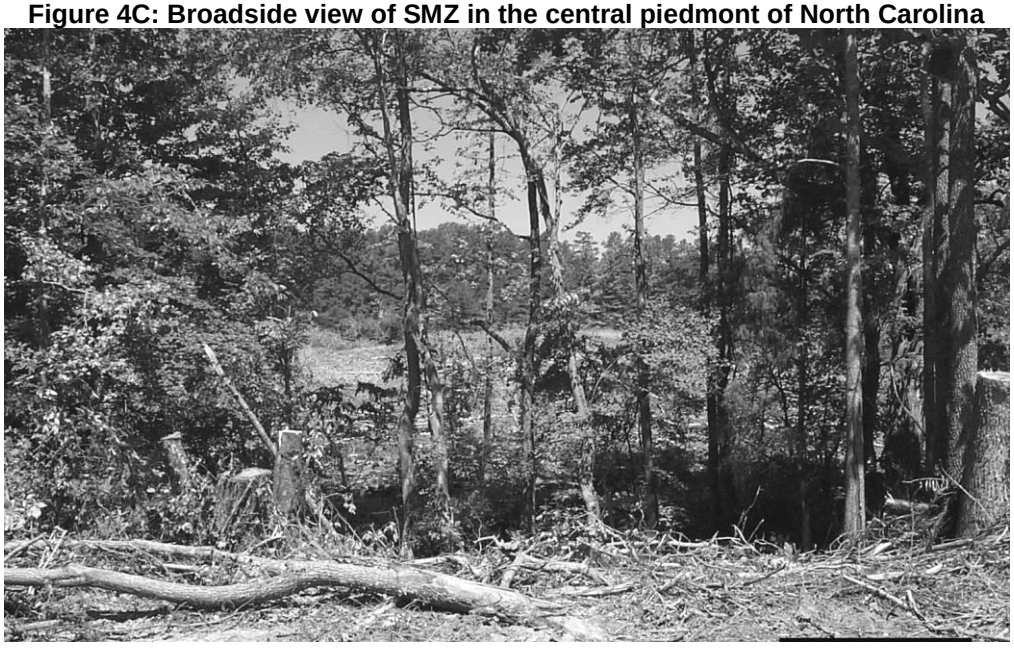
- Fell and remove trees away from the stream or waterbody:
  -- Do not use the SMZ as a 'de-limbing gate' for felled trees.

- When removing trees from the SMZ, avoid gouging the soil in a manner that could funnel runoff and transport sediment to the waterbody:
  -- Promptly take action where needed to stabilize these disturbed spots and reduce the chance of accelerated erosion.

FPG

- Service and refuel equipment outside of the SMZ. If mechanical failure requires repair work, be sure to control any fluids and prevent them from entering the surface water or groundwater, as required in **FPG .0205**.

Figure 4C: Broadside view of SMZ in the central piedmont of North Carolina



Caption:
Take note of these BMPs:

-- Shade is maintained in the SMZ, even with trees harvested.
-- Soil disturbance is minimized
-- Trees were not felled or de-limbed into the SMZ
-- Streambank stability is maintained

Although this SMZ appears to be less than 50 feet due to the site's conditions, the careful attention to maintaining the SMZ should help protect water quality.

Figure 4D: SMZ on a timber harvest in Orange County, N.C.

Caption:
This SMZ is approximately 50-feet wide along each side of the stream.

The trees and vegetation left intact should provide adequate shade upon leaf-out in the spring.

It appears that heavy equipment usage was minimized within the SMZ, which reduces soil disturbance.

Forest Roads

FPG

- Keep roads out of the SMZ, as required in **FPG .0201**, unless barriers prevent them from being established outside of the SMZ.

- If roads must be placed within the SMZ:
  -- Keep roads at least 10 feet away from the waterbody.
  -- Establish only as wide of a road as needed to meet your safety and operation needs.
  -- Minimize the amount of bare soil exposed.
  -- Use suitable BMP tools to control runoff and capture sediment (see Chapter 5) or take other effective action to protect water quality.

Figure 4E: A forest road constructed through a SMZ

Caption:
Note the many BMPs:
- Gentle sloping road grade and crowned surface

- Minimize road width through the SMZ

- Broad-based dip, with a sediment pit (center/left in photo)

- Seed and mulch applied on bare soil areas

- Silt fence along the stream channel (right photo edge)

FPG

Site Prep and Silviculture

- Store forest chemicals such as pesticides or fertilizers outside of the SMZ.
- Conduct servicing, filling and fueling activities outside of the SMZ and as far from the stream or waterbody as practical. Refer to Chapter 8 for BMPs on fluids and Chapter 7 for BMPs on forest chemicals.
- Avoid high intensity prescribed burns within the SMZ that removes significant amounts of groundcover and/or organic matter. Chapter 9 has additional BMPs for fire management
- Minimize heavy equipment operation within the SMZ:
  -- This will protect streambank stability and maintain SMZ function.
- Forest regeneration and timber stand improvement practices generally are acceptable in the SMZ, however:
  -- Low-impact methods should be used to minimize use of heavy equipment and disturbance to soil and groundcover.
  -- Additional BMPs or other suitable actions should be taken to protect water quality if significant removal of vegetation in the SMZ is needed for the regeneration of shade-intolerant tree species.

Also Refer To…

Chapter 10 has additional BMPs for specific site-prep practices.

Part 5 -- BMPs for Special Cases

Braided Streams

Braided streams have multiple, interconnected channels with very flat slope gradients, resembling the strands of a braid. Braided stream systems generally have broad valleys with well-defined floodplains. Such characteristics create unique conditions for timber harvesting and other forestry activities.

Watch Out!

These areas can present extremely challenging conditions for timber harvesting, and the risk/reward for conducting these activities should be seriously evaluated.

Braided stream areas often are also wetlands, and may require additional precautions.

BMPs for Braided Streams

- Locate and identify braided streams before starting operations. It is usually best to locate the channels during normal flow, because:
  -- During dry times the braided channels may not appear to be significant enough to be considered as a stream
  -- During flooded times, the entire floodplain may be underwater, and the individual braided channels will be hidden from view.
- Conduct operations during dry soil conditions whenever possible, and limit heavy equipment usage.
- Use matting systems for skid trails and/or road access, including the use of bridgemats for temporary channel crossings.
- Try to avoid heavy equipment usage when braided channels are close together, since access between each channel is extremely difficult to accomplish while still protecting water quality conditions.

For Forest Owners:

Timber harvests in braided areas may take longer to complete, since site conditions may only allow a short time period for activities to take place.

- When braided channels are wide apart, establish the appropriate SMZ and/or riparian buffer along the outermost channel limits and minimize soil disturbance between the channels.

Hydrologically-Connected Ditches

NOTE: In this manual, a hydrologically-connected ditch refers to those ditches that have an immediate or eventual outlet to a stream.

While this Manual does not specifically recommend SMZs or buffers along ditches, action should be taken to prevent sediment and other nonpoint source pollution that may be produced by forestry operations from being transported by these features into streams or waterbodies.

BMPs for Hydrologically-Connected Ditches

Helpful Hints:

Portable bridgemats or well-constructed pole crossings are usually appropriate for temporary ditch crossings, as well as culverts.

- Limit heavy equipment usage along the ditch edge to the extent that the structural integrity of the ditch bank is protected and sediment transport within the ditch is prevented.

- Establish temporary ditch crossings in a way that protects water quality from accelerated erosion or sedimentation while still allowing adequate water flow in the ditch.

Figure 4F: Stabilized roadside ditch crossing in Bertie County, N.C.

Caption:

This roadside ditch crossing uses steel bridgemats and wooden road pallets to effectively cross the ditch, while protecting the ditchbank integrity.

Extra logs are positioned to carry the overhang from the log trailer's wheels.

Did You Know?

On average, 80 to 85 percent of the land surface drains to the smallest of stream drainage ways within any given watershed. Ephemeral streams often are the first main drainageway that collects and funnels surface runoff from precipitation.

Ephemeral Streams

NOTE: In this Manual, an ephemeral stream refers to those as defined under the North Carolina FPGs, as cited in the glossary and Appendix 1.

While this manual does not specifically recommend SMZs or buffers along ephemeral drainages, action should be taken to prevent sediment and other nonpoint source pollution that may be produced by forestry operations from being transported by these features into streams or waterbodies.

BMPs for Ephemeral Streams

- During forestry operations minimize disturbance to the soil and groundcover within the ephemeral stream area.
- When conducting site preparation, maintain surface groundcover and woody debris accumulations, if material already exists in place.
- If equipment must be operated in the ephemeral stream area, minimize the number, area and use of skid trails as well as access roads and decks.
- When establishing a SMZ on intermittent or perennial streams, the SMZ width should continue and wrap around the head of the stream, where the ephemeral(s) transitions into the stream channel.

Figure 4G: Ephemeral area protected during logging

Caption:

Note how the SMZ on this site was wrapped around the main channel where the ephemeral transitions into the stream.

Soil disturbance was minimized on the site, and within the SMZ.

It appears that no primary skid trails or decks were located within this ephemeral area, which is another BMP to consider.

Chapter 5
Runoff Control and Forestland Access

Chapter 5 Layout:

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Take note of how this chapter is organized:

Part 1 describes methods to control runoff, while Part 2 includes practices to capture sediment. These two topics are explained first because implementing these types of 'BMP tools' are essential for properly built stream crossings, roads, skid trails and decks.

Also note in this Chapter (and throughout this manual), that the term 'runoff' refers to surface runoff that flows atop the ground surface. This term should not be confused with below-surface or groundwater flow.

Water Quality Link

The BMPs in this chapter can help you plan, put into place, and maintain good access in a way that should protect water quality:

- Roads, skid trails, stream crossings and decks are widely considered the most likely source of potential erosion and nonpoint source pollution on a forestry operation.
- Having BMPs correctly implemented can add value to the forestland for its owner and to those who benefit from the land or its resources.
- Not having these features done the right way may lead to prolonged and substantial erosion and water quality problems that will likely cost much more to repair than it would have taken to prevent them in the first place.

Helpful Hints:

Remember the four key elements for controlling runoff:
1 - Prevent It
2 - Slow it down
3 - Spread it out
4 - Capture it

'Getting the Job Done …'

Your ultimate goal is to protect water quality when working with roads, skid trails, stream crossings, or decks. Preventing runoff, controlling runoff and/or capturing sediment can go a long way towards accomplishing this goal.

Whether it is accomplished by using the BMPs in this manual, or by some other methods, the result must be the same: protecting the water.

FPG
Refer to the FPGs in the Appendix

Text Box for Rules References

Under each part of this chapter, a text box similar to this one contains references to those rules that may apply to that topic.

- **There are several state and/or federal rules that apply to the features discussed in this chapter, including most of the North Carolina FPGs.**

- **Specific requirements about forest roads in wetlands are briefly discussed in this chapter. Refer to Chapter 6 for detailed information.**

Part 1 -- BMP Tools to Control Runoff

Did You Know?

The type of BMP tools in Parts 1 and 2 have many common names:

- *Water control structures*
- *Erosion control structures*
- *Water diversions*
- *Runoff diversions*
- *Drainage structures*
- *Drainage diversions*

No matter what you call them, they serve the same purpose of controlling runoff and capturing sediment.

Controlling runoff reduces its speed and volume before it can get out of hand, thereby reducing the likelihood of accelerated erosion.

The BMP tools covered in Part 1 are:

- Broad-based dip
- Turnouts
- Cross-drains
- Waterbars
- Inside ditchlines
- Insloping, outsloping and crowning

These different methods of controlling runoff can be used for nearly any suitable forestry application. These may include permanent or temporary roads, skid trails, stream crossings, firelines, access trails and log decks.

Installing these BMP tools usually is best during initial construction. However, they can be successfully retrofitted with proper equipment and techniques.

Locations where these BMP tools are especially useful include:

- Steep slopes or slopes with soil of high erosion and runoff risk.
- Top of slopes or grades to control runoff before it can pick up speed.
- Approaches to stream crossings.

Some Benefits of Controlling Runoff

- Protection of water quality from pollution potential by reducing erosion risk and allowing better water absorption.
- Improved access on your forestland.
- Protection of your financial investment in sustaining forestland access.

Helpful Hints:

Table 5-1 is arranged to focus first on the steeper grades, then recognize their correspondingly shorter spacing ranges, as the slope grade increases.

The layout of this table emphasizes the point that steeper slopes often require more BMPs to control runoff.

Distance Spacing for Runoff Control BMPs

Table 5-1 below provides a range of suggested spacings for installing the different BMP tools used for controlling runoff. *See 'Helpful Hints' to left.*

The spacing ranges are only general guidelines and should be adjusted according to your specific site, soil, groundcover, equipment or other conditions.

Table 5-1: Suggested Spacing Ranges for BMP Tools to Control Runoff

Slope Grade (*percent*)	**Broad-based dips, Turnouts, Cross-drains** (*feet*)	**Waterbars** (*feet*)
20 +	60 to 40	40 to 30
16 to 20	100 to 60	60 to 40
11 to 15	140 to 100	80 to 60
6 to 10	180 to 140	100 to 80
0 to 5	250+ to 180	120+ to 100

Broad-Based Dip

Helpful Hints:

Broad-based dips are not suitable *to provide drainage for Inside Ditchlines or groundwater seeps. Cross-drains should be used instead.*

A broad-based dip is a combination of a shallow depression (dip) excavated into the road surface with a slight hump at a reversed grade, formed immediately on the downhill edge of this dip. An outlet area is provided for the runoff to leave the road surface.

The dip works by diverting runoff away from the roadbed and through the outlet. The hump acts as a barrier to continued runoff flow downhill along the road surface.

BMPs for Broad-Based Dip

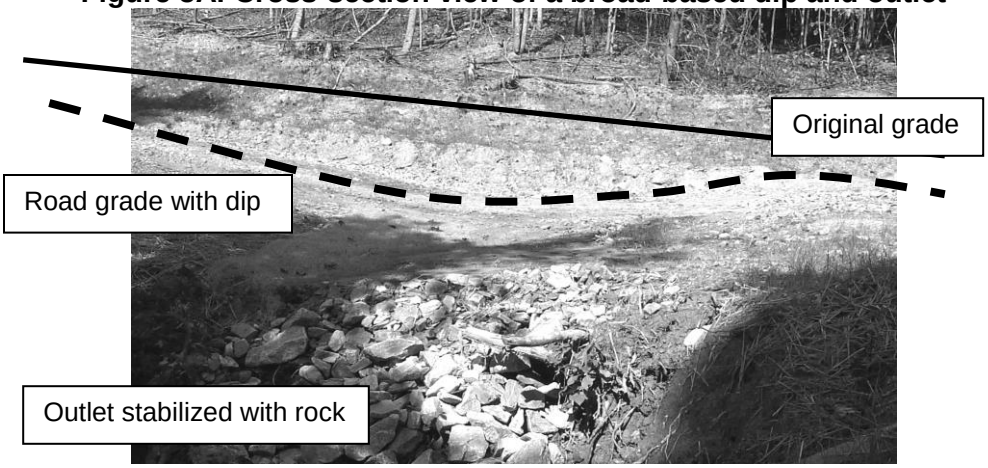
- Lay out and construct the broad-based dip at right angle to the travel surface and across the full width of the road.
- Excavate a shallow dip approximately 15 to 20 feet long into the uphill travel surface.

Helpful Hints:

Try to use the native soil from the site, and compact it when forming the reverse-grade hump.

- Construct and compact a slight hump across the downhill edge of the dip. The reverse grade of the hump should not exceed 2 to 3 percent slope down toward the base of the dip.
- Outslope the bottom of the dip at enough of an angle to turn away water and runoff, but generally no more than a 2 to 3 percent outslope angle.
- On slopes greater than 8 percent, or when needed, hardening the travel surface of the broad-based dip with stone or other materials can prevent erosion and improve vehicle traction.
- Situate the broad-based dip outlet in a manner that prevents runoff from flowing directly into streams or waterbodies. Take measures to capture the sediment from the outlet as needed.
- Avoid siting the outlet onto soft soil or fill material, unless measures are implemented to prevent accelerated erosion from the outlet.

Figure 5A: Cross-section view of a broad-based dip and outlet



Caption:

In this photo, you can see the dip in the road, and the outlet created for carrying runoff.

It is recommended to only create enough outslope angle within the dip to turn the runoff without creating a hazardous driving condition for vehicles.

Waterbars

Helpful Hints:

Waterbars are usually used when closing off, or 'retiring' skid trails and roads.

It is not recommended to drive over waterbars, since this will wear down the hump and alter the drainage function of the trench.

A waterbar can be thought of as an angled 'speed bump' with a shallow trench along the uphill edge that diverts runoff. There are two key points to remember for functional waterbars:

1. **A waterbar must be constructed to extend completely across the trail or road surface to be fully functional:**
   -- Doing so reduces the likelihood of runoff finding its way around the ends of the waterbar and flowing past it.
   -- This may require 'tying-in' the waterbar with adjacent side / cut slopes.
   -- This may require extending the waterbar well beyond the width of the road or trail travel surface.

Watch Out!

Remember: Waterbars are excavated and constructed.

Simply piling soil on the trail or road surface IS NOT the same as installing a waterbar.

2. **The waterbar is not intended as a trap to block or pool runoff. It should be angled and have a suitable outlet for diverting runoff into an area where sediment will settle and/or filter out:**
   -- Proper angling is needed to allow the runoff to drain and not backup.
   -- Excavation of a shallow trench along the uphill edge of the waterbar hump is helps collect and drain off the diverted water.

BMPs for Waterbars

- Waterbars should be excavated and constructed using equipment and/or techniques that assure proper angles and a firm waterbar hump.

Also Refer To…

Table 5-1 provides spacing ranges for waterbars.

- When building waterbars next to a side / cut slope, tie the uphill end of the waterbar into the side / cut slope, and angle the waterbar downhill towards the outfall edge of the road or skid trail.

- Use an angle ranging from 15 to 30 degrees (downslope) for the waterbar to properly drain while preventing pooling of runoff behind it.

- Excavate the trench with enough gradient to allow adequate flow of water runoff, but generally not to exceed 2 to 3 percent.

Helpful Hints:

Don't set the waterbar backwards, which diverts water into the side / cut slope, unless there is an Inside Ditchline to collect the runoff.

- Situate the waterbar outlet in a manner that prevents runoff from flowing directly into streams or waterbodies. Take measures to capture the sediment from the outlet as needed.

- Avoid siting the outlet onto soft soil or fill material, unless measures are implemented to prevent accelerated erosion from the outlet.

- Establish groundcover or harden the waterbar with stone or other material, if needed to maintain long-term function.

Figure 5B: Waterbar constructed across a skid trail in Wilkes Co., N.C.

Caption:
The waterbar shown here is properly angled diagonally across the skid trail, to allow runoff to flow off the surface.

A shallow trench can carry the runoff.

The waterbar and trench extends past the edge of the skid trail to prevent passage of runoff around the waterbar mound.

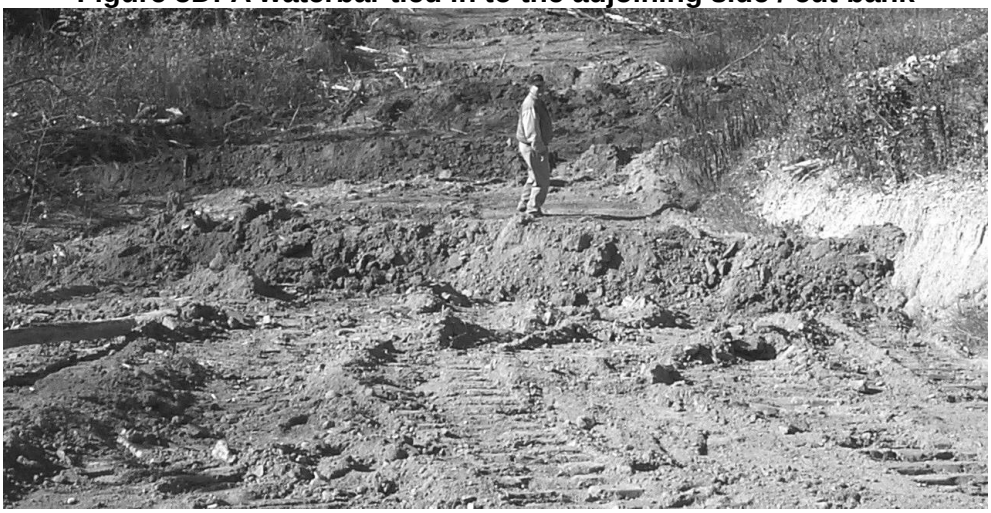
Figure 5C: View of the trench along the uphill face of the waterbar

Caption:
The trench that is excavated along the uphill face of the waterbar allows water to flow off the trail surface and through the outlet.

This outlet extends into a well-vegetated area that provides good infiltration and sediment capturing effectiveness.

NOTE -- Be sure to minimize any curvature of the waterbar across the road or trail. The waterbar shown here would be best if it were a little less curved, but it appears that it should function satisfactorily.

Figure 5D: A waterbar tied in to the adjoining side / cut bank



Caption:
The waterbar in this photo demonstrates some good BMPs to remember:
-- Angled across the path
-- Mounded soil waterbar
-- Tied into side / cut bank (right side of photo)
-- Outlet onto stable soil

NOTE -- A trench should be excavated along the uphill base of the waterbar, to carry runoff and keep the soil mound from getting 'blown out.'

Turnouts

Did You Know?

The word **turnout** *can also be used to describe a wide section of forest road that allows vehicles to pass each other.*

A turnout is a type of shallow trench or pathway that diverts runoff from the surface of a road, skid trail or fireline.

A wing-ditch or lead-off ditch is a specific type of turnout used for controlling runoff within roadside ditches.

In both cases, the turnout should be constructed as a continous offshoot of the road, skid trail, fireline or roadside ditch. This helps maintain an uninterrupted connection for runoff to flow.

BMPs for Turnouts

Also Refer To…

Table 5-1 provides spacing ranges for turnouts.

- Begin the inflow of the turnout at the same grade level as the road, skid trail, fireline or ditch so runoff can flow easily without being interrupted.
- Excavate the turnout with enough outlet gradient angle so runoff can drain in a controlled manner, generally from 1 to 3 percent is adequate.
- Construct using a turnout angle between 15 to 30 degrees downslope.
- Situate the end of the turnout outlet in a manner that prevents runoff from flowing directly into streams or waterbodies. Take measures to capture the sediment from the outlet as needed.
- Avoid siting the outlet onto soft soil or fill material, unless measures are implemented to prevent accelerated erosion from the outlet.
- For use in roadside ditches, take action to minimize erosion within that ditch so the inflow of the turnout does not create a gully.

Helpful Hints:

Remember, there are two angles on a turnout:
- *The outlet gradient angle is the slope needed to drain runoff from the road surface.*
- *The turnout angle describes how wide apart the turnout veers away from the roadside or trail.*

Figure 5E: A turnout used together with a waterbar on a skid trail

Caption:
This turnout was pushed out into a vegetated area so water can soak into the ground and sediment will settle out.

Note the use of additional waterbars further down the skid trail.

Figure 5F: A turnout, used as a wing ditch alongside a forest access road in Henderson County, N.C.

Caption:
The turnout in this photo is used as a wing ditch, which carries surface runoff from the roadside inside ditchline (see next section for explanation).

The wing ditch or turnout outlets to a well-vegetated area.

Also note the slight hump in the road surface, which helps divert runoff into the wing ditch or turnout.

Inside Ditchlines

Did You Know?

Other names for this:
- *Inside ditch*
- *Grader ditch*
- *Shoulder ditch*

An inside ditchline provides a place to collect runoff that comes off the surface of an insloped or crowned road. The ditchline carries this runoff for a short distance until a cross-drainage technique is used to move the runoff from the inside edge of the road to the outside edge of the road, where the runoff drains.

Inside ditchlines can be difficult to correctly construct and maintain. While BMPs are provided below, you are encouraged to consider the alternative of installing an outsloped road surface, which does not need inside ditchlines.

BMPs for Inside Ditchlines

Helpful Hints:

Ditchlines are most often needed in sloping terrain where roads have a side / cut slope.

Additional BMP tools are often needed so the ditchlines don't become deep gullies or constant sources of potential erosion or pollution.

Ditchlines can be useful, though, when managing groundwater seeps along side / cut banks.

- Excavate the ditchline to the minimum depth and width needed to carry the expected runoff from the road surface drainage area:
  -- The cross-sectional area within the ditchline should be matched to the cross-sectional area of the pipe to be used for cross-drainage.
  -- A conservative rule of thumb is to approximately match the ditchline cross sectional area to the same cross sectional area as a 15-inch diameter pipe (1.25 square feet).

- Control runoff speed and volume to reduce the likelihood of creating a high-risk and long-term erosion hazard.

- Avoid allowing the ditchline to down-cut or become an erosion gully. Where appropriate, install geotextiles, matting, stone or other suitable material to reduce the potential for accelerated erosion.

Watch Out!

The further apart you set turnouts or cross-drains, the more volume and speed you will have to handle within each section of ditchline.

- Install turnouts or cross-drains at intervals adequate to carry the expected runoff from each uphill section of ditchline and/or road surface.

- Situate the ditchline outlet or cross-drainage outlet in a manner that prevents runoff from flowing directly into streams or waterbodies. Take measures to capture the sediment from the outlet as needed.

- Avoid siting the outlet on soft soil or fill material, unless measures are taken to prevent accelerated erosion from the outlet.

Figure 5G: A forest road with an inside ditchline in Ashe County, N.C.

Caption:

In this photo, the inside ditchline is located at the base of the hill slope, at the left edge of the roadbed.

The inside ditchline appears to be stabilized, with no accelerated erosion or down-cutting within the ditchline.

Helpful Hints:

Cross-drains should use culvert pipes. The pipe must be large enough to carry the runoff, but small enough to fit within the roadbed.

Open-top drains or trenches are not suitable for forestry applications.

Also Refer To…

Table 5-1 provides spacing ranges for cross-drains.

Watch Out!

Smaller pipe sizes can easily get clogged with debris and/or sediment.

If smaller pipes must be used, perform more frequent regular inspection and maintenance to remove blockages.

If plastic culverts are used you may need more substantial fill material atop the pipe to provide vehicle support.

Cross-Drains

Cross-drains move water and runoff from one side of a road or trail to the other, usually under or through the roadbed.

Cross-drains can be used to:

- Carry runoff out of an inside ditchline.
- Drain water and runoff along grades.
- Provide drainage for groundwater seeps or springs.
- Direct runoff away from log decks.

BMPs for Cross-Drains

- Set cross-drains on a 2 to 4 percent downslope angle to provide good drainage and help prevent debris from clogging the drain.

- Install cross-drains at an approach angle suitable to allow free flow of runoff into and through the cross-drain.

- Match the base level of the cross-drain inflow to the base elevation of the ditchline so runoff can flow into and through the cross-drain uninterrupted.
  -- A drop-inlet can improve inflow at places where the elevation of the cross-drain inlet is lower than the ditchline.

- If culvert pipe is used, cover the pipe with at least one foot of fill and harden the crossing location as needed to protect the pipe from traffic:
  -- Use at least a 15-inch diameter pipe on heavy flow areas.
  -- Use at least a 12-inch diameter pipe if only needed for groundwater seeps or for locations where minimal runoff volume and/or debris is expected.
  -- The cross-sectional area of the pipe should be matched to the cross-sectional area of the ditchline being drained.

- Minimize erosion on both ends of the cross-drain so the ditchline does not down-cut and create a gully or produce accelerated erosion.

- Where needed, harden the inflow headwall of the cross-drain with stone, sandbags, geotextiles, vegetation, drop-inlet, or other suitable materials to avoid headcutting or accelerated erosion.

- Situate the cross-drain outlet in a manner that prevents runoff from flowing directly into streams or waterbodies. Take action to capture the sediment below the outlet as needed.

- Avoid siting the outlet onto soft soil or fill material, unless measures are implemented to prevent accelerated erosion from the outlet.

Figure 5H: View of the outlet end of a cross-drain installed underneath a permanent forest road in Wilkes County, N.C.

Caption:
This cross-drain provides drainage of runoff that flows within the inside ditchline (which is located at the base of the slope in background, alongside road edge).

Note that the cross-drain is installed diagonally through the roadbed, to provide improved flow of the water.

Also note that the culvert pipe extends well past the travel surface of the road, to protect it from being damaged by vehicles.

Insloping, Outsloping and Crowning

The degree to which a road surface is tilted or angled can determine a lot about runoff flow. By insloping, outsloping or crowning a road surface, you are creating a tilt or angle that naturally moves water and runoff from the surface.

Insloping allows runoff to drain into an inside ditchline. Because the ditchline is between the uphill side / cut bank and the roadbed, the ditchline must be drained with a turnout or cross-drain.

Outsloping allows runoff to drain from the road surface towards the outside (downslope) edge of the road, where the runoff can be controlled or allowed to absorb into the ground. This method generally requires less maintenance than insloped roads because there are no, or very few, ditchlines or cross-drains.

Crowning creates a slight hump across the road's cross section, by having the centerline of the road higher than both roadside edges. If a road is to be crowned, other BMPs tools to collect and/or capture runoff may be needed. Crowning is usually used on wider, permanent access roads or in flat lands with a ditch on at least one side to collect runoff.

For Forest Owners:
Insloped roads may be suitable on steep grades with slick soils and/or sharp curves, but require the excavation and maintenance of an inside ditchline, with cross-drains.

Outsloped roads, with appropriate water control measures, are the preferred road design in steep terrain. This design eliminates the need for an inside ditchline and allows for better control of runoff.

Watch Out!
Use whatever surface drainage method is best to meet your safety needs for slick soils, steep grades, sharp curves, vehicle type(s) and traffic frequency.

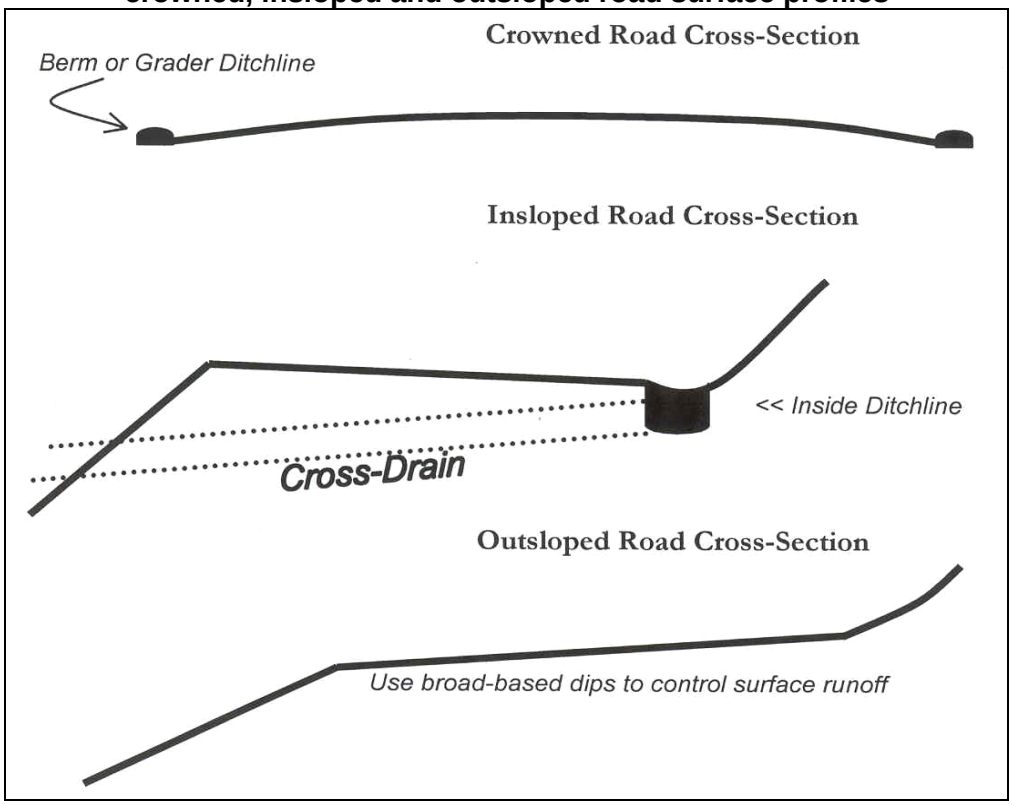
BMPs for Insloping, Outsloping and Crowning

- On insloped roads, excavate and maintain inside ditchlines and cross-drains in order to carry runoff. Refer to the BMPs for inside ditchlines.

- For freshly graded outsloped or crowned roads, a temporary low berm along the outside (downslope side) edge of the road may prevent washing away of the soft soil and fill material:
  -- If a temporary berm is installed, provide outlets or gaps so runoff can move away from the road surface in a controlled manner.

- Maintain the road surface as needed to minimize or repair ruts, holes, or depressions that hold water, which can weaken the roadbed or create concentrated runoff with sediment transport.

Figure 5I: Schematic cross-sectional sketch of crowned, insloped and outsloped road surface profiles



Caption:
A crowned road may need slight berms and/or grader ditchlines alongside either edge to control runoff.

An insloped road needs appropriate inside ditchlines to collect runoff. A cross-drain (dotted line) is also needed to drain the inside ditchline.

An outsloped road can effectively use broad-based dips to manage surface water runoff.

Part 2 -- BMP Tools to Capture Sediment

Capturing or containing sediment is the second part of using BMPs related to roads, skid trails, stream crossings and decks.

Your first goal should be to prevent or halt accelerated erosion once you have controlled the runoff. When those efforts are not adequate, capturing the sediment before it reaches a stream is the last option you have:

-- Stop or prevent sediment transport at its source.
-- If that doesn't work, keep the sediment on site.
-- Above all else, keep the sediment out of the streams and waterbodies.

The BMP tools discussed in Part 2 are:

- Filter Areas
- Silt Fences
- Brush Barriers
- Sediment Traps / Pits
- Straw Bales
- Check Dams

Consider the long-term potential for effectiveness and maintenance when deciding which BMP tools to use when capturing sediment.

Locations where these BMP tools are especially useful include:
-- Disturbed soil areas near streams or other waterbodies.
-- Approaches to stream crossings.
-- Steep slopes or slopes with soil of high erosion and runoff risk.
-- Along slopes or grades to periodically capture sediment in runoff.
-- As a catchment for collected or diverted surface runoff.

Some Benefits of Capturing Sediment

- Protection of water quality from pollution potential by containing sediment in runoff before flow picks up speed and volume or enters a waterbody.
- Improved access on your forestland.
- Added value of your financial investment in sustaining forestland access.

Figure 5J: Temporary sediment capture alongside a forest road

Caption:
This temporary holding area, reinforced with stone, is successfully capturing runoff and sediment.

The stone provides good support and backing.

Filter Areas

Filter areas are usually a long-term, low-cost option to capture, slow, and contain runoff so sediment and other potential pollution can settle out before reaching a waterbody.

Filter areas can be differently shaped or sized, depending upon the application and needs of the soil and site.

FPG

Refer to FPG .0201 as it relates to SMZs, which are a type of required filter area.

The DWQ riparian buffer rules are also a type of <u>mandatory</u> filter area that must be applied in certain parts of North Carolina.

BMPs for Filter Areas

- Permanent groundcover should be retained or established that allows runoff to slow down and soak into the soil:
  -- Natural, relatively undisturbed groundcover and/or vegetation is usually the best choice for a filter area.
  -- Established groundcover can also be effective, but may require additional BMPs and/or maintenance.

- Intensive soil disturbance should be minimized.

- Use stable, well-drained soils for filter areas when available.
  -- If unstable soils must be used for a filter area, install treatments such as erosion matting or other methods to stabilize the soil.

Did You Know?

Other names for these include:
- *Sediment basins*
- *Settling pit*
- *Silt trap or silt pit*
- *Tank traps*

Sediment Traps or Pits

Sediment traps are excavated holes that trap and store runoff, and are usually installed where runoff is concentrated nearby streams and other waterbodies.

Traps or pits can be used for either temporary runoff control, or long-term installation. Permanent use of traps / pits will require more substantial construction and periodic maintenance.

Helpful Hints:

Traps or pits are effective to collect runoff that is diverted by a broad-based dip, waterbar, cross-drain, turnout or ditchline.

BMPs for Sediment Traps or Pits

- Excavate the pit with a suitable opening and depth to capture the expected sediment runoff while minimizing soil disturbance to the adjacent area. Refer to Appendix 14 for suggested sediment pit sizing dimensions.

- Locate the pit within stable, well-drained soils when available.
  -- If the pit must be situated within unstable soils, install additional measures to provide soil stabilization around the pit.

- Dispose or stabilize the excavated spoil material to keep it from washing away. Avoid using the spoil to build up the sides of the pit, since this loose spoil material can easily wash away or fall back into the pit.

- For sediment pit installations intended to be permanently functional:
  -- Create a reinforced outlet for overflow capacity that will reduce the likelihood of the pit walls being washed away or 'blown out'.
  -- Harden the walls of the pit to minimize the risk of structural failure.
  -- Revegetate exposed soil around the perimeter of the pit.
  -- Periodically clean out accumulated sediment. A useful rule is whenever the pit is half full, remove and stabilize the accumulated sediment.

Caption:
This sediment pit is located in a good position to capture sediment that flows off of this graveled, outsloped forest road.

The pit is positioned well away from the stream (in background).

NOTE -- The headwall on this pit may need reinforcement, or have to be sloped back, to keep soil from falling into the pit after being saturated from precipitation.

Figure 5K: A functioning sediment pit excavated alongside a forest road

Silt Fence

Silt fence is a geotextile or fabric that is supported with stakes, with the bottom partially buried into the ground and is for temporarily capturing runoff.

Helpful Hints:

Silt fences are usually man-made materials.

Think of a silt fence as similar to a coffee filter - - the idea is to capture the sediment in the runoff, while allowing the water to still trickle through.

A silt fence is most effective for temporarily capturing sediment and delaying runoff that occurs across the ground surface, before reaching a channel or forming gullies and erosion trenches in the land.

Silt fence cannot effectively capture mass movement of sediment or capture runoff for an extended period of time.

Silt fencing may be useful to capture sediment in areas of exposed bare soil until vegetation can be established. Due to the natural roughness and uneven terrain on forestry job sites, a silt fence can be very difficult to correctly install and still remain effective.

BMPs for Silt Fence

- Additional measures upslope and downslope of the silt fence may be required to slow, control and capture sediment.
  -- If there is considerable sediment build-up along the silt fence, determine the sediment source and adjust or add BMPs accordingly.

- The suggested drainage area limit is 100 feet of fence for every one-quarter acre of land. Refer to Table 5-2 below for further reference.

- Set fencing along the land contours and extend the fencing far beyond the expected pathway(s) of runoff flow. The ends of the fencing should be gently turned like a sideways 'J', with the hook facing uphill.

Watch Out!

Silt fence should never be used as the only BMP tool on the job site.

Additional BMPs are needed to control runoff and capture sediment.

You should expect silt fencing to fail during heavy precipitation - - plan accordingly.

If you observe a heavy sediment accumulation, look up-slope and re-evaluate your BMPs.

- Bury the bottom 4 to 6 inches of silt fence securely into the ground to keep runoff from flowing underneath:
  -- Install the fence so that the buried portion is along the upslope face of the fence, to prevent the fence from getting washed over by sediment.

- Adequately reinforce the silt fencing from being knocked over or blown out. Wire fencing backer or additional staking can be used.

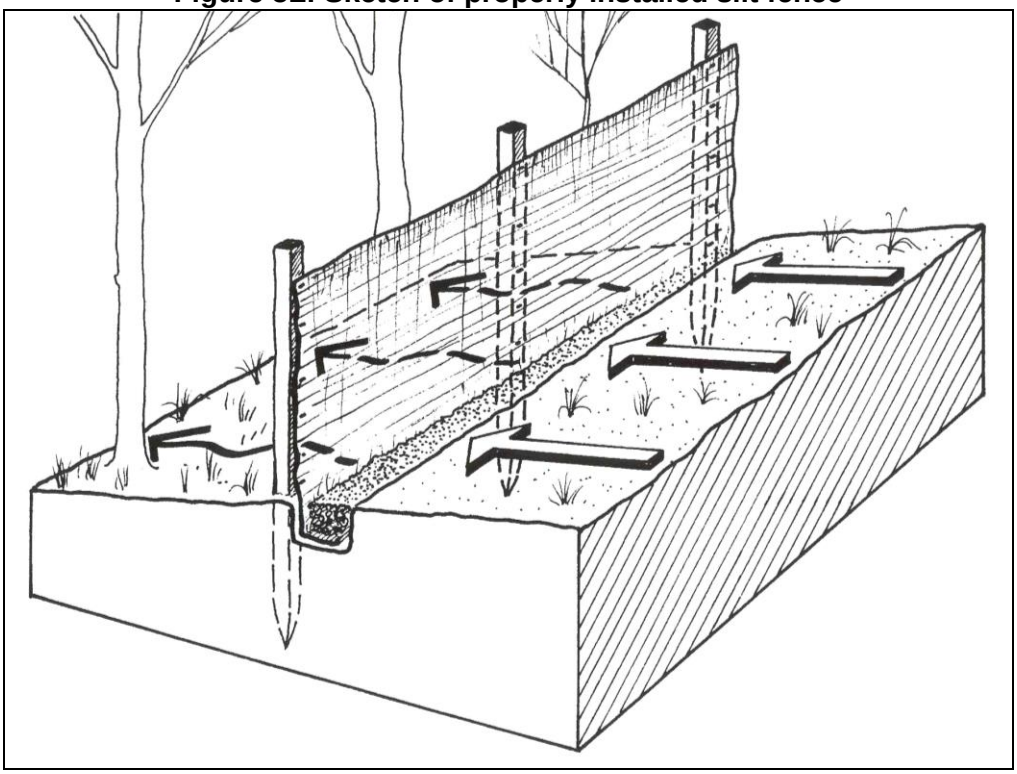
- Frequently monitor the silt fence after installation. Promptly take action to maintain or improve the filtering effectiveness.

Table 5-2: Recommended Applications for Every 100 Feet of Silt Fence

Slope	Maximum Slope Length Between Fence-rows (feet)	Maximum Drainage Area (acres)
0 to 2%	100	0.23
2% to 5%	75	0.17
5% to 10%	50	0.11
10% to 20%	25	0.06
20% +	15	0.03

Table 5-2 was adapted from N.C. Division of Land Resources' Erosion and Sediment Control Handbook "Practice Standards and Specifications."

Figure 5L: Sketch of properly installed silt fence



Caption:
This sketch depicts the proper installation of silt fence.

Note the bottom of the silt fence along the upslope side is buried into the soil, and the fence is securely staked.

Consider setting multiple rows of fencing to provide additional protection.

Avoid using silt fence to divert water - - it should be used only as a temporary sediment filter.

(Illustration provided with permission and courtesy of Maine Forest Service).

Helpful Hints:

Places where bales may be helpful:

- *Outlets of water diversion tools described in Part 1*
- *Stream crossing approachways*
- *Alongside freshly graded outsloped roads*
- *Around edges of log decks*
- *Supporting or supplementing silt fence installations*

Straw Bales

Straw bales, or a bale of other natural fibers, can be a low-cost and effective tool to slow runoff and capture sediment. Bales often are better than silt fence or brush barriers since they can conform better to the ground surface.

Bales can be placed around the perimeter of an area with exposed soil, or across the pathway of runoff flow. The bales will help control the runoff, and act as a sediment filter.

However, since they are natural fibers, the bales will eventually decompose and breakdown. As a result, they should be used for temporary runoff capture and control.

BMPs for Straw Bales

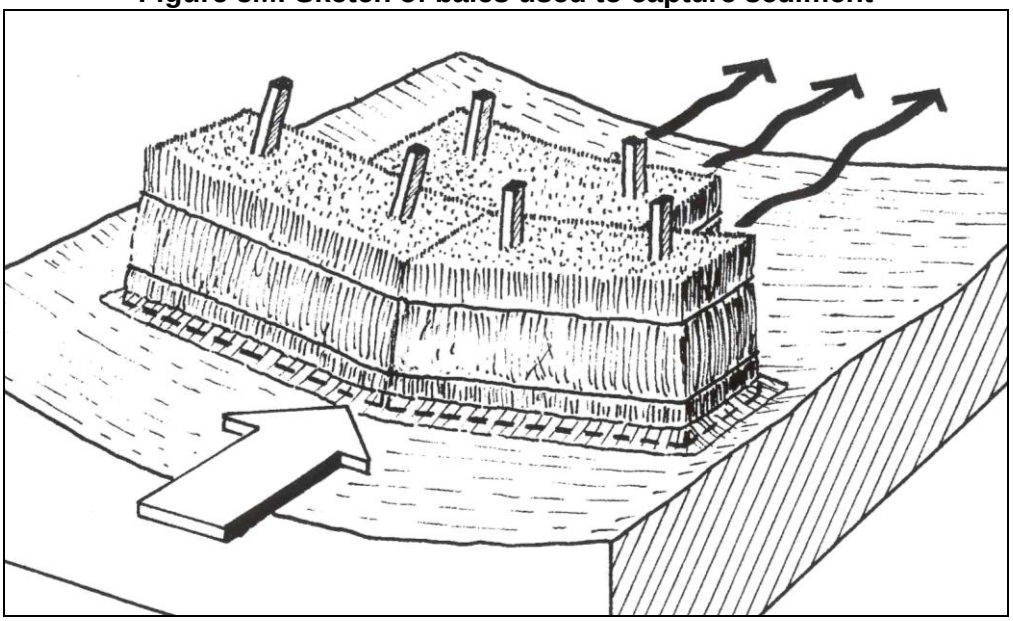
- Additional measures upslope and downslope of the bales may be needed to slow, control and/or capture sediment.
  -- If there is considerable sediment build-up along the bales, determine the sediment source and adjust your BMPs accordingly.

- Set bales tightly against the ground surface and anchor the bales firmly into the soil if the bales are likely to wash away.

- If square bales must be stacked, stagger the joints between bales so they do not line up over the joints in the previous layer, similar to brick laying.

- Frequently monitor bales after installation. Promptly take action to maintain or improve effectiveness.

Figure 5M: Sketch of bales used to capture sediment



Caption:

When bales are used to capture sediment, you should make sure that:
-- Bottom of the bales conforms to the ground surface to prevent leakage.

-- Bales are secured if needed to prevent them from being washed away.

-- Joints between successive bales are staggered like bricks.

(Illustration provided with permission and courtesy of Maine Forest Service)

Helpful Hints:

Places where brush barriers may be helpful:

- *Alongside newly constructed or graded roads*
- *Alongside and on top of skid trails*
- *Around edges of log decks*
- *Stream crossing approachways*

Brush Barriers

Brush barriers are piles of leftover, unusable tree and vegetation debris that is carefully piled and packed down to act as a temporary filter barrier to slow runoff and capture sediment.

Creating brush barriers is a productive use and disposal for debris that is generated by road or skid trail construction and can be a low-cost method of temporary sediment capture.

BMPs for Brush Barriers

- Pile and pack down brush to achieve close contact with the ground surface.
  -- This may require breaking or cutting large pieces of material into smaller chunks that more easily conform to the surface of the ground.

- Use additional BMP tools such as silt fences, bales, filter areas or other methods to improve trapping effectiveness where brush barriers fail to capture enough sediment because of their loose configuration.

- Avoid removing the brush barrier once it is established.

Figure 5N: A brush barrier alongside a closed road in Caldwell Co., N.C.

Caption:
The brush barrier installed along the right edge of this stabilized forest road will help capture sediment before it can move downslope.

Figure 5O: A brush barrier at the base of an active road

Caption:
Brush has been laid down at the base of the roadbed, in the center of the photo. Also note the well-vegetated roadbed and side / cut bank.

(Photo figure 5O provided courtesy of Coweeta Hydrologic Laboratory, Southern Research Station, USDA-Forest Service.)

Helpful Hints:

While usually constructed of stone rip-rap, check dams can also be built from sandbags, sacks of concrete, logs or other suitable hardened materials.

Check Dams

Check dams are short, hardened barriers established within inside ditchlines to slow the speed of runoff and capture sediment. Check dams can also be useful to control the runoff that comes from the outlets of water diversions (such as those described in Part 1 of this chapter.)

BMPs for Check Dams

- Consider laying down geotextile fabric before placing the check dam's construction material. This keeps material from sinking into the ground.
- Provide ample support at the base of the check dam in order to hold back and contain the sediment.

Watch Out!

Check dams are not appropriate for installation within streams.

- Tie-in the base of the check dams with the soil to keep runoff from seeping under or 'blowing out' around sides of the the dam location.
- The center of the check dam should be lower than each outer edge to provide overflow capacity of water during heavy flows.
- The total height of the check dam should not exceed 3 feet. Taller structures are more prone to failure.
- Space the check dams within the channel so the top of each downslope check dam matches the same elevation as the base of the next higher dam.
- If check dam effectiveness is compromised by sediment buildup, periodically remove built-up sediment from behind the dams. Dispose of or stabilize this material to keep it from washing into waterbodies.

Figure 5P: Check dams installed within a turnout from a forest road

Caption:

These small check dams provide sediment capture within a turnout that drains a graveled forest road.

Note the sediment accumulation captured by the front two check dams.

The rear two check dams appear to not have any sediment accumulation yet, but provide good reinforcements.

The area is well vegetated and stabilized.

Part 3 -- Stream Crossings

Helpful Hints:

BMPs for the four most common types of stream crossings are provided:
- *Bridgemats*
- *Culverts*
- *Fords*
- *Pole Crossings*

Stream crossings are often necessary for roads, skid trails and firelines to gain access to forestland for management. Permanent crossings usually are for roads, or in some cases, firebreaks. Temporary crossings are most common for timber harvesting or other short-duration forestry operations, such as site prep, tree planting, fertilization or herbicide application.

Because of the obvious potential for water quality impacts at stream crossings, there are several rules that require practices be used or actions taken. Since the North Carolina FPGs were enacted in 1990, stream crossings have been the most frequent location on a job site where sediment may get into the water.

Rules Related to Stream Crossings

FPG

Forest Practices Guidelines Related to Water Quality (FPGs)

North Carolina General Statute 77-13 and General Statute 77-14

DWR riverbasin and watershed 'Riparian Buffer Rules'
These 'buffer rules' for specific river basins and watersheds set limitations on stream crossings within the 50-foot buffer zone

North Carolina Dredge and Fill Law
This state law requires that permits be secured for discharges of dredged or fill material in certain locations within the 20 Coastal Area Management Act (CAMA) counties. Refer to Chapter 6 for more information on this law.

Planning Stream Crossings

Stream crossings should be carefully planned in advance of their need to determine how water quality can be best protected. This section provides suggested BMPs when planning crossings.

BMPs for Planning Stream Crossings

FPG

- Avoid having stream crossings if possible. Take note of the FPGs.

- Use maps, photos and/or on the ground examinations to determine the minimum number of crossings needed to efficiently access the property while protecting water quality.

Helpful Hints:

Recommendations on stream crossings are available from:
- *Consulting Foresters*
- *N.C. Forest Service*
- *Soil & Water Conservation Districts*
- *USDA-Natural Resources Conservation Service (NRCS)*

- Designate the location of the proposed stream crossing on the ground to avoid confusion about where to construct the crossing.

- When conditions allow, give preference to locations for crossings where:
  -- The stream is relatively straight so crossing distance is minimized.
  -- Approaches to the stream are relatively flat to better control runoff.
  -- The crossing can be installed at a right-angle (90°) to the stream channel so crossing distance is minimized.

- Select the type of stream crossing(s) based on site characteristics and the ability to best protect water quality while providing safe, efficient access.
- Maintain as close to normal (pre-construction) streamflow by maintaining depth, width, gradient and capacity of the stream channel at the crossing.
- Perform construction, installation, and removal work during low-water flow if circumstances allow.
- Stabilize the approachways and/or stream crossing locations so sediment is not transported into the stream as prescribed in the FPGs.

FPG

Caption:
The BMPs noted here:
- Properly sized culvert.

- Culvert installed to handle low flow stream conditions.

- Sloped road fill, reinforced with a side support log/timber.

- Ample fill material over the culvert.

- Headwall reinforced with large rock.

Figure 5Q: A permanent stream crossing on a forest road

A Note on Permanent Bridges:

Permanent bridges require professional engineering expertise. Specifications are beyond the scope of this Manual. Some generic BMPs to consider:

- *Use bridges on deep, wide streams with heavy streamflows.*
- *Minimize soil disturbance during construction.*
- *Avoid placing a bridge in the curve of a stream or road.*

Bridgemats

Bridgemats are heavy wood or steel panels placed over a stream or ditch channel, usually for temporary crossing. Other names include dragline mats, skidder bridges or pontoons. When bridgemats are carefully installed, used, and removed, they typically do a very good job of protecting water quality.

BMPs for Bridgemats

- When site conditions allow, select a stream crossing location that has these characteristics:
  -- Narrow channel width.
  -- Firm, stable streambanks.
  -- Solid footing on either side to support bridgemats and equipment.
  -- High, level ground on each side.
- Create a solid-surface crossing that provides a barrier over the channel to minimize debris, soil, and other materials from falling into the water.
- Keep equipment out of the channel during installation and removal of the crossing unless doing so is necessary for handling the bridgemats.

A Note on Log Bridges:

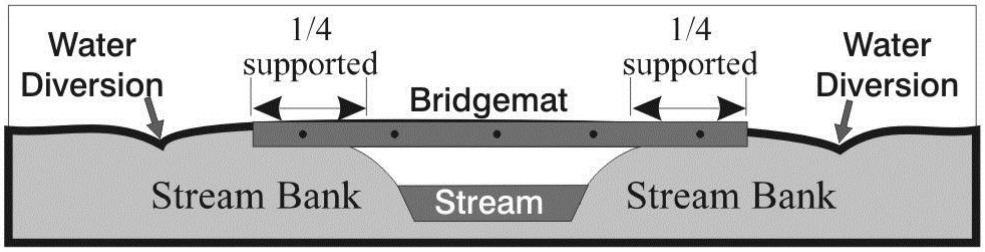
Temporary crossings constructed of de-limbed logs may be suitable in certain cases.

A log bridge is not the same as a 'pole crossing', which is explained later in this Chapter. A log bridge should completely span the watercourse:

- *Avoid gouging or damaging stream channel with the logs as they are installed and removed.*
- *Keep logs butted tight to each other to minimize debris and soil from falling between.*
- *Keep equipment out of the stream when placing and removing logs.*

- Minimize the amount of over-hang from logs, trees, or trucks/trailers that may disturb the channel or approachways.
- Control runoff and/or capture sediment on the approachways. See Part 1 and Part 2 of this Chapter for possible options.
- As needed, periodically inspect the crossing and take action to provide for safety while protecting water quality from runoff, debris, soil, or other potential pollution factors.
- Stabilize the approachways and crossing location in accordance with **FPG .0203** and **.0209**.

Figure 5R: Schematic drawing of proper bridgemat installation



Bridgemat for Stream Crossing

Caption:
BMPs noted here include:

- Good support on each end of the bridgemat.

- Adequate clearance between the stream flow and bridgemat.

- Three panels are used to create full-width crossing, with no gaps.

Figure 5S: Side view of a wooden bridgemat skid trail crossing

Figure 5T: Steel bridgemat installed for a skid trail stream crossing

Caption:
BMPs noted here include:

- A full-width panel crossing is used, with no center gap that could allow debris to fall into the stream.

- A straight section of stream is used for the crossing location.

- The bridgemat ends are well supported to prevent damaging the stream banks.

Culverts

Culverts are typically used for forest road stream crossings but can also be used for skid trail crossings. While culverts are readily available and can be a relatively inexpensive method, a major disadvantage of culverts is that they require disturbance in the stream channel. That includes placing fill material in close proximity to the water.

For Forest Owners

Smaller diameter culverts (less than 15 inches) can get clogged or blocked too frequently and create potential water quality problems.

A single larger diameter culvert is usually better than multiple, smaller diameter culverts since the smaller culverts may be more prone to blockages.

The cross-sectional area of a culvert opening cannot simply be added together to determine multiple culvert needs. Two 24 inch diameter pipes DO NOT provide the same volume as one 48 inch diameter pipe.

BMPs for Culverts

- Use a culvert sized to meet your needs that can carry the expected amount of runoff and streamflow from the upstream watershed:
  -- Take into account the volume of heavy runoff that can result from precipitation and storms.

- Use a culvert long enough to extend at least 12 inches beyond the edge of the fill material:
  -- If a shorter culvert is required, then protection should be added to the inlet and outlet headwalls. Examples include rip-rap, stone, sandbags, drop-inlets, or other erosion-preventing material.

- For forestry stream crossings, it is recommended to use culverts that are at least 15 inches in diameter.

- For temporary culvert installation, refer to Table 5-3 as a quick-reference table of suggested culvert diameters.

- For permanent culvert installation, refer to Table 5-4 for recommendations of culvert diameters.

- If multiple culverts are used, provide adequate cross-sectional opening area of the culverts to handle the expected streamflow. Refer to Table 5-4 for suggested diameters of multiple culverts.

- Install the culvert crossing during low-flow periods in the stream, if possible.

- Place culvert approximately in the center of the existing or expected water flow within the channel.

Helpful Hints:

If a culvert is partially imbedded into the streambed, a larger diameter pipe may be needed to make up for this loss of open area within the pipe itself.

-- -- --

Avoid backfill with debris or large rocks that could create air pockets within the backfill or damage the culvert.

Moist mineral soil usually works best.

- Set the culvert(s) with a downslope grade so streamflow is not impeded and to prevent debris from clogging the pipe.

- Minimize the height that water drops from the outlet of the culvert:
  -- For temporary installation, placing the culvert immediately upon the stream bottom is usually suitable.
  -- For permanent installation, it may be appropriate to place the culvert partially imbedded into the stream bottom to allow better passage of fish and other water-living organisms.

- Backfill over the culvert with at least 12 inches of suitable material. Culverts larger than 30 inches diameter should have backfill thickness equal to at least one-third of the culvert's diameter.

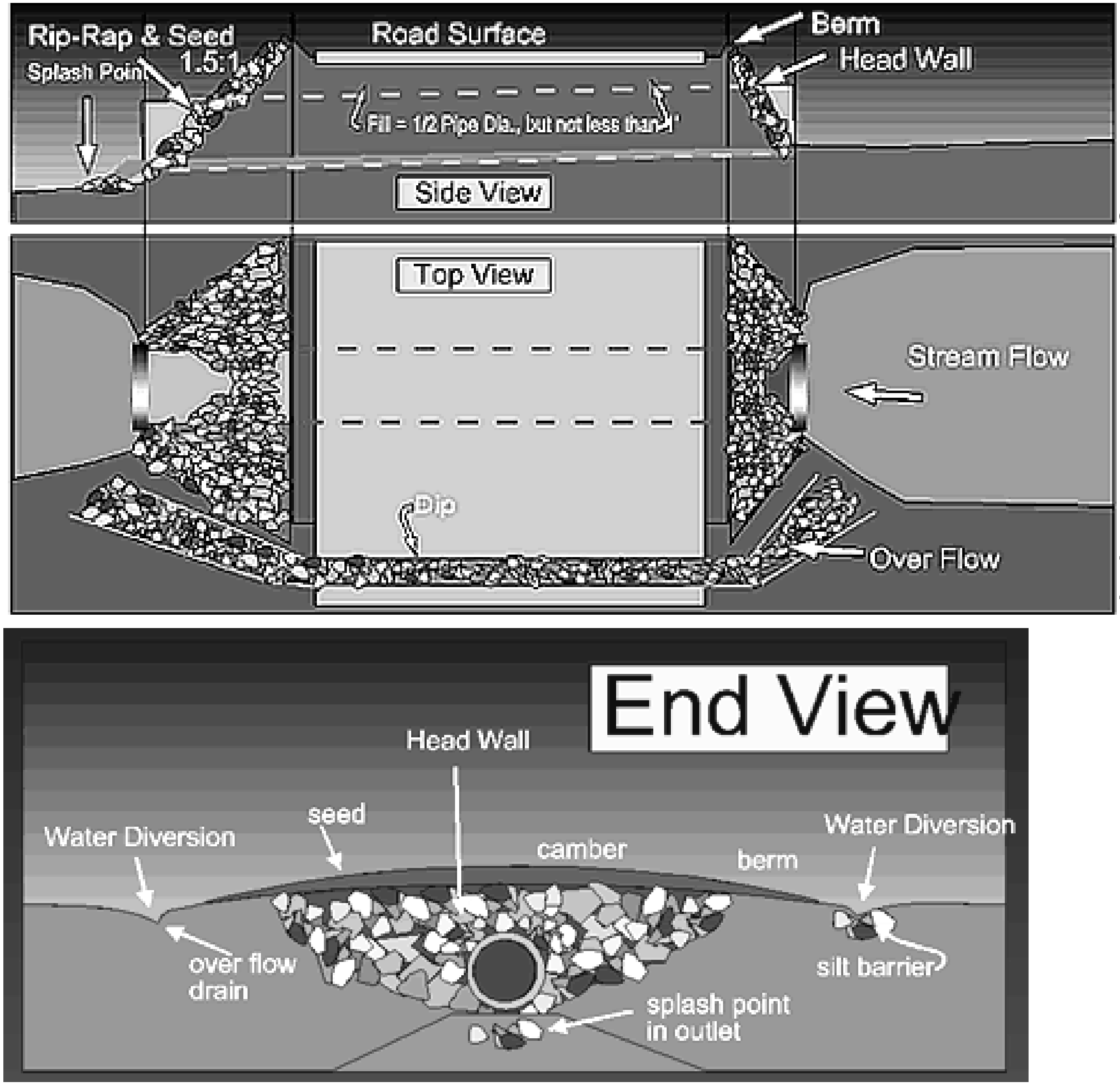
- Use backfill material that will pack down tightly. Secure the culvert in place and provide adequate support for vehicle traffic:
  -- Tamp down the backfill along the length of the culvert to block seepage that may flow around the culvert and wash it out.

- Protect the inlet and outlet of the culvert and the fill material to minimize erosion from the streamflow and runoff.

- Construct the crossing so it allows floodwaters to flow around the crossing location to minimize water backups and the potential of the culvert from being washed away (commonly called 'blowing out'):
  -- Elevating the backfill over the culvert and creating a very slight crown can help divert floodwaters around the crossing location.
  -- Creating a low depression area within the approachways can provide a flow-way for floodwaters to bypass around the crossing.

- Use surface hardening materials on the culvert crossing and approachways as needed to provide vehicle support and minimize erosion potential.

Figure 5U: Schematic views of proper culvert installation



Caption: The top illustration (side view) shows proper culvert layout along the contour, with a slight downslope gradient to promote good streamflow and minimize back-ups or blockages.	
The middle illustration (top view) shows the overflow dip that should be installed to allow floodwaters to flow around the culvert location and reduce the likelihood of the culvert blowing-out.	
The bottom illustration (end view) shows how the road should be crowned over the culvert, with rock used to stabilize the inlet and outlets. Also note the water diversions on each approachway.	

Culvert Sizing Diameters for Temporary Installation

The information on this page can be used for temporary installations of round culvert. Table 5-3 is based upon streamflow that could normally be expected from a '1 to 3 year' interval storm-flow event.

You should consider the recommendations found in Table 5-3 for sizing culverts:

- **When needed for temporary access.**
- **During dry periods.**
- **On sites with low soil moisture.**
- **No precipitation has occurred or is forecast to occur while the crossing is needed.**

Table 5-3: Suggested Diameter Sizes of Round Culverts for Temporary Installations

Average Channel Width (inches)	***Average Channel Depth (inches)***						
	6	***12***	***18***	***24***	***30***	***36***	***42***
12	15	18	18	24	24	30	36
18	15	18	24	24	30	30	36
24	15	24	30	30	36	36	48
30	18	24	30	30	36	48	48
36	18	24	30	36	48	48	48
48	24	30	36	48	48	48	60

FIGURE 5V: Sketch of a stream channel cross-section for determining temporary culvert size

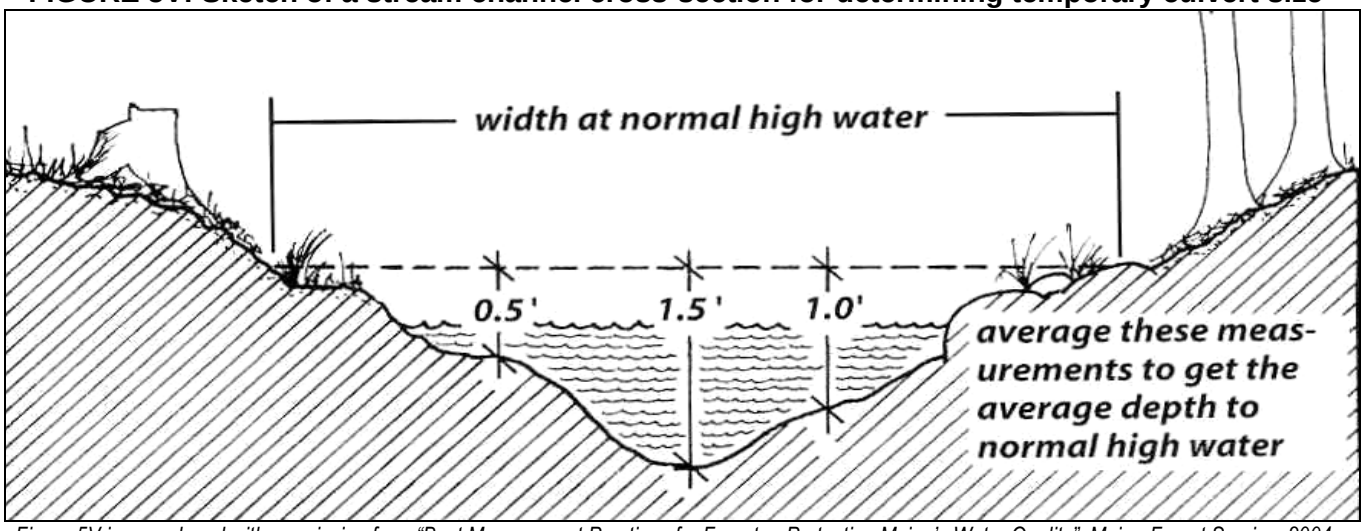


Figure 5V is reproduced with permission from "Best Management Practices for Forestry: Protecting Maine's Water Quality". Maine Forest Service, 2004.

Determining Average Channel Width for Table 5-3:

Measure how wide the channel is at the point of normal high water mark. Take several measurements and average them together to get the Average Channel Width for Table 5-3.

Determining Average Channel Depth for Table 5-3:

Measure how deep the channel is from the point of normal high water mark. Take several measurements and average them together to get the Average Channel Depth for Table 5-3.

NOTE: ***In each case, do not simply measure how deep the water is. Instead, you need to measure the average stream channel dimensions at the point of normal high water mark.***

Table 5-4: Suggested Diameter Sizes of Round Culverts for Permanent Installations

The recommended culvert sizes on Table 5-4 should be considered for crossings that are expected to be in place for more than one year. Table 5-4 is adapted from Talbot's formula for a 2.5-inches-per-hour rainfall. The complete Talbot's formula table is in Appendix 9 for further reference.

	Impervious 100% runoff	Steep slopes, heavy soils, moderate cover		Moderate slopes, heavy to light soils, dense cover		Gentle slopes, agricultural-type soils and cover		Flatland pervious soils
	The letter 'C ' indicates the amount of runoff to expect. High value C means more runoff and heavier streamflow volume Low value C means less runoff and lighter streamflow volume							
Acres	*C = 1.00 Bare soil*	*C = .80 Higher Runoff*	*C = .70 Lower Runoff*	*C = .60 Higher Runoff*	*C = .50 Lower Runoff*	*C = .40 Higher Runoff*	*C = .30 Lower Runoff*	*C = .20 Normal runoff*
2	15	15	15	15	15	15	15	15
4	18	18	15	15	15	15	15	15
6	24	18	18	18	15	15	15	15
8	24	24	18	18	18	15	15	15
10	30	24	24	24	18	18	15	15
20	36	30	30	30	24	18	18	18
30	42	36	36	30	30	24	18	18
40	48	42	36	36	30	30	24	24
50	48	42	42	36	36	30	24	24
60	36+36	48	42	42	36	36	30	24
70	30+30+30	48	48	42	42	36	30	24
80	36+36+24	30+30+30	48	48	42	36	30	30
90	48+48	36+36	48	48	42	42	36	30
100	48+48	36+36+24	30+30+30	48	48	42	36	30
150		48+48	36+36+36	36+36+24	30+30+30	48	42	36
200			48+48	36+36+36	36+36+36	30+30+30	48	36
250	**A Note About Multiple Culverts:**					36+36+36	48	42
300	It is recommended that if a crossing requires an opening					36+36+36	30+30+24	42
350	greater than 48 inches, that you use bridging, arch-culverts or multiple						30+30+30	48
400	round culverts. Some options for multiple culverts are offered in this table.						36+36+24	48
450	• There may be other combinations that can work.						36+36+30	48
500	• Consult with someone who has experience if you are unsure.						36+36+36	30+30+30

Caption:
This culvert installation exhibits these BMPs:
- Properly sized to accommodate stormflow.
- Situated at, or just below grade to allow low-flow conditions.
- Headwall stabilized with rock.
- Vegetation established on bare soil near the water's edge.

Figure 5W: Culvert installed on a forest road in Montgomery Co., N.C.

Fords

For Forest Owners:

When properly built and maintained, fords can provide efficient and inexpensive road access.

Fords are hardened-surface, low water crossings in which a vehicle drives directly through and across the stream channel. Places where a ford crossing may be appropriate include:

- A stream that has an existing rocky bottom surface.
- Streams that are too wide for bridgemats or multiple culverts.
- Areas prone to beaver activity that could dam-up a culvert crossing.

BMPs for Fords

Watch Out!

Because a vehicle drives directly in the water, fords are usually the least preferred method of crossing for protecting water quality.

- Minimize the grade slope of the approachways into the ford crossing. Control runoff and capture sediment along and/or from the approachways.

- When site conditions permit, give preference to crossing at a:
  -- Low streambank.
  -- Solid and level bottom.
  -- Straight section of stream channel.

FORDS ARE NOT RECOMMENDED for use on skid trail crossings.

- If the stream bottom is soft and unstable, consider laying down geotextiles as underlayment for the added rock or hardening material.

- Use clean hardening materials to create a firm vehicle traffic surface. Avoid using asphalt-based materials.

DO NOT BLOCK the natural flow of water in the stream channel.

- Spread the material as even as possible across the channel to avoid dips or humps that could alter the streamflow:
  -- Leave a low trough within the centerline of the channel so streamflow can continue during low-flow or dry periods.

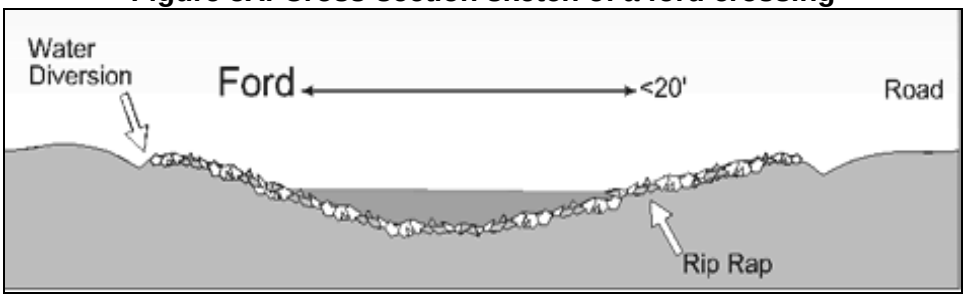
- Within the first 50 feet of the ford crossing, establish permanent groundcover covering at least 80 percent of the approachway area, or spread stone (or other suitable materials) atop each approachway.

Safety 1st - - -
Never drive through a ford during high water or rapid currents.

- When driving through the ford, you may need to:
  -- Maintain a slow speed to avoid damaging the crossing location.
  -- Stagger the tire-tracks through the ford to minimize creation of tire ruts.

- Inspect the crossing to insure safe usage, proper water flow, and water quality protection. Take action as needed to protect water quality.

Figure 5X: Cross-section sketch of a ford crossing



Caption:
This sketch drawing of a ford includes:
- Water diversions.

- Short fording distance.

- Hardened stream bottom.

Figure 5Y: A ford crossing in Henderson County, N.C.

Caption:
Note the BMPs on this ford crossing:

- Gentle grade on the approachways so runoff can be controlled.

- Substantial stone is used to stabilize the road approachway and provide a firm base.

- A shallow trough is left within the centerline of the stream channel to allow continued stream flow during low-flow periods.

Pole Crossings

Pole crossing is the name used to describe a temporary channel crossing that is made by stacking logs that are free of limbs and soil within the channel high enough so equipment can travel across.

Pole crossings are usually appropriate for temporary access across ditches or ephemeral drainages.

Pole crossings are not suitable for either an intermittent stream that has water, or for any perennial stream.

FPG

Read and understand the requirements of FPG .0202, FPG .0203, N.C. GS 77-13 and N.C. GS 77-14.

Helpful Hints:

To provide water flow, one possible option is to place one or more culverts on the base of the channel so water can still flow through.

BMPs for Pole Crossings

- Establish the pole crossing in a way that:
  -- Allows water to flow through the crossing location.
  -- Does not contribute to accelerated erosion, runoff or sediment transport.
  -- Protects the integrity of the channel's structure.
- Use only topped and de-limbed logs that are free of soil and excess debris.
- Use logs of a large enough diameter so they do not pack too tightly together. Logs of 'pulpwood' size or larger usually work best.
- Do not place soil within or on top of the pole crossing.
- Build up the pole crossing to an elevation higher than the adjacent channel or bank. That way, when the logs settle, the channel is still protected.
- Pack down limbs, tops, slash, or other woody material atop the approachways to the pole crossing to protect the channel structure.

- Immediately remove the pole material after the crossing is no longer needed, or when precipitation is forecast for the watershed area.

- Stabilize the crossing location to prevent accelerated erosion or sediment transport.

Figure 5Z: A pole crossing installed within a dry ditch for temporary log road access in northeastern North Carolina

Caption:
This pole crossing uses adequately sized logs to provide support and are free of soil, limbs, or excessive debris.

Instead of placing soil atop the pole crossing, wooden road pallet/mats are used here to provide a running surface for the log trucks.

Part 4 -- Forest Roads

Roads are necessary for the sustainability of working forests in North Carolina. The ability to utilize renewable forest resources, enjoy the visual beauty of the forest, and provide efficient and effective property access are among the most common needs for forest roads.

However, roads that are poorly planned, constructed or not well maintained are among the most common origins of sediment within nonpoint source pollution from forestry activities.

Because of the high potential for sediment problems from forest roads, there are several state and federal rules or laws requiring that certain practices be implemented, or actions be taken, to protect water quality.

NOTE: A summary and further explanation of the rules or laws are provided in Chapter 2 and Appendix 1. Forest roads in wetlands are discussed in Chapter 6.

Rules Related to Forest Roads

Forest Practices Guidelines Related to Water Quality (FPGs)

North Carolina General Statute 77-13 and General Statute 77-14

DWR riverbasin and watershed 'Riparian Buffer Rules'
These buffer rules for specific river basins and watersheds set forest road limitations within the mandatory buffer zone.

U.S. Army Corps of Engineers 15 mandatory best management practices for forest roads in wetlands as cited within 33 CFR Part 323
Construction of access roads in jurisdictional wetlands for the production of forest products does not require a Corps' permit if these 15 best management practices outlined by the Corps of Engineers are implemented.

U.S. Army Corps of Engineers Information Regarding Compliance with the Federal Clean Water Act Section 404(f)(1) Provisions for the Construction of Forest Roads within Wetlands, in North Carolina
This information should be used when planning for and constructing new forest roads and maintaining existing roads within waters of the U.S. including streams and wetlands subject to regulation under the Clean Water Act.

North Carolina Dredge and Fill Law
This state law requires that permits be secured for discharges of dredged or fill material in certain locations within the 20 Coastal Area Management Act (CAMA) counties. Refer to Chapter 6 for more information on this law.

FPG

The FPGs are detailed in Chapter 2 and the Appendix

Also Refer To:

The Forestry Leaflets and rules citations for DWR buffer rules are in the Appendix 3.

Both U.S. Army Corps of Engineers' documents are in Appendix 1 and further discussed in Chapter 6.

For Forest Owners:

Good forest roads provide many benefits, including:

- *Adding economic value to your property.*
- *Making property access more efficient, with no unnecessary roads.*
- *Reducing or eliminating the number of stream crossings.*
- *Minimizing or preventing potential long-term and significant erosion risks.*
- *Providing wildlife corridors and firebreaks.*

Forest Road BMPs

The following three sections within this Part 3 provide BMPs for planning roads, constructing roads, and maintaining roads.

- **Planning:** This allows you to establish a road that is best suited for the site conditions and intended usage while minimizing impacts to the forest landscape and water quality.
- **Constructing:** Roads should include BMP tools that are outlined in Part 1 and Part 2 of this chapter, or other suitable methods, so water quality is protected and erosion is controlled.
- **Maintaining:** Roads should be maintained to assure that the variety of BMP tools you use are still functioning, water quality is protected, and your investment in the road retains its value.

BMPs for Planning Roads

- Consider using maps, aerial photos, and your own on-the-ground site examination to help determine where roads should be placed.
- When feasible, plan to construct roads at least one year before usage to allow the roadbed to stabilize and settle prior to use.

- Minimize the number of stream crossings. Avoid crossings when possible.

- Minimize soil disturbance and road placement within ephemeral drainages:
  -- If roads are needed within an ephemeral drainage, you should consider using BMPs to control runoff and capture sediment.

- Establish roads along the land contours when conditions allow:
  -- In steep terrain, try to establish roads along gentle hill slopes, just below the ridgeline. This allows better runoff control and keeps the road from downcutting into the ridgeline, which creates an erosion channel.

- Try to keep the road atop firm and well-drained soils. Avoid wet-natured soils, loose soils, or highly erodible soils if possible.

- Plan the road to minimize the amount of cut and/or fill needed.

- Look for opportunities to naturally drain runoff from the road, but never directly into streams or other waterbodies. Avoid placing outlets within ephemerals where possible.
  -- Often the best solution in steep terrain is to construct an outsloped road with broad-based dips or other suitable BMP tools to control runoff.

Did You Know?

*Providing sunlight to a road or trail surface is known as '**daylighting**.'*

- Plan adequate right-of-way widths to provide ample sunlight for drying the road surface.

BMPs for Constructing Roads

- Construct roads at the minimal width that meets your safety and traffic needs while protecting water quality and allowing adequate runoff control:
  -- Travel surfaces of 10 to 14 feet, with intervals of wider road for passing, are usually suitable for light-duty roads.
  -- Travel surfaces from 14 to 20 feet, or slightly more, may be needed for frequently used roads.

- Keep grade slopes to 10 percent or less when conditions allow:
  -- For steeper grade slopes, limit road-segment lengths to 200 feet or less when possible. This allows improved runoff control and capture.

- Limit height of side / cut banks to 5 feet or less if possible:
  -- For loose soils, the side / cut bank should be sloped at a ratio no steeper than 2:1 where site conditions allow.
  -- For tight soils, a steeper side / cut bank may be acceptable, but generally should be no steeper than a ratio of ½:1.
  -- Roads with side / cut banks steeper than 1:1 or more than 5 feet tall should only be constructed when no other practical alternative exists.

Helpful Hints:

To learn how to measure slope ratio, and how it differs from percent (%) slope, refer to Appendix 6.

FPG

- Minimize soil disturbance and the amount of road at any stream crossings in accordance with **FPG .0201** and **FPG .0203**. Also see Part 5 of this Chapter for BMPs on stream crossings.

FPG

FPG

- Establish access entrances to public roads in accordance with **FPG .0204**.
  -- Use rock, stone, wooden mats, or other suitable materials for a distance of at least 50 feet from the public road, if soil conditions require.

- Stabilize bare soil areas in accordance with **FPG .0209**. Also see Chapter 11 for suggestions on establishing groundcover.

- In low-lying areas, especially areas prone to flooding, keep the roadbed as close to the original ground level as possible, to minimize potential blockage of natural overland surface water flow:
  -- When fill material is needed, provide adequate cross drainage.

- Use insloping, outsloping and/or crowning techniques as appropriate to provide drainage from the road surface and control runoff:
  -- This may require the excavation of an inside ditchline to carry runoff.

- Control and capture runoff.

Also Refer To…

Recommendations on using geotextiles and gravel are in Appendix 4 and 5.

- Stabilize and/or harden the road surface as needed to provide runoff control and vehicle access. Consider using geotextile fabric as underlayment.

Watch Out!

Full bench construction may require side / cut banks steeper than 2:1.

- Consider using full-bench construction in sloping terrain where soil is loose and prone to sliding or accelerated erosion:
  -- A full bench road is cut entirely into the side / cut bank, with all excavated spoil material hauled away. No spoil is side-cast over the downslope edge, therefore the roadbed sits entirely upon a solid, undisturbed soilbank.

Figure 5AA: A forest road with broad-based dip

Caption:
This forest road has many BMPs, including:

- Outsloped road with broad-based dip (under the rear wheels of the vehicle).

- Well vegetated road shoulders and graveled road surface.

- Silt fence and roadside berm to capture sediment.

Figure 5BB: A forest road and stream crossing

Caption:
Note the BMPs used on this road:
- Gentle sloping grades.

- Turnout (on right) to divert runoff upslope of the stream.

- Solid-surface panel crossing of bridgemats at the stream crossing.

- Graveled road surface.

- Open daylight corridor for rapid surface drying.

NOTE -- Shallow ruts are beginning to appear in the road surface; these may require attention if runoff begins to concentrate and flow within them.

Figure 5CC: A permanent forest access road in Montgomery Co., N.C.

Caption:
While flat terrain roads may seem simple to construct and manage, take note of the BMPs found on this road:

- Open daylight corridor for rapid surface drying.

- Road width only as wide as needed for vehicles.

- Well-vegetated road shoulders that can capture sediment.

- Slightly crowned road surface to promote controlled drainage.

- Stone surfacing on the road to allow better drainage and trafficability.

Figure 5DD: A public road entrance from a forest road

Caption:
This entrance onto a public roadway from a forest road is well stabilized.

It appears that the graveled surface of the forest road is adequately stabilizing the road, and providing a rough surface that 'kicks off' dirt and mud from truck tires, before entering the public road.

NOTE -- Some type of runoff control may be needed near the curve in the forest road, to control runoff before it flows toward the public road.

BMPs for Maintaining Roads

FPG

- Rehabilitate and stabilize the road and side / cut banks according to the standards of **FPG .0209.**
- Monitor the condition of the road and its BMPs to see if runoff is being controlled and captured as intended. Take prompt action to protect water quality if BMPs are not properly functioning.
- Clean out built-up silt and sediment as needed from sediment traps, silt fences, bales, check dams, brush barriers or other places where sediment poses a risk to water quality.
- Maintain an open daylight corridor that provides suitable drying for the road surface.
- Maintain a road surface that provides good runoff control, water quality protection, and vehicle access.
- Close access to roads when suitable to minimize unnecessary use.
- If practical, perform road and ditch maintenance during times when heavy precipitation is not expected, so freshly tilled soil is less likely to be exposed to runoff flows.

For Forest Owners:

Limiting access protects the road and its BMPs from damage, and protects your investment.

Consider reconstructing, relocating, or 'retiring' a road section that proves difficult to maintain, or shows signs of repeated heavy erosion.

Part 5 -- Skid Trails

Skid trails are pathways used to transport trees, logs, and other forest products from the woods to a deck, landing or roadside. Skid trails are usually for temporary use. However, if they are not constructed or used correctly, skid trails can have long-lasting impacts on water quality and site conditions.

Rules Related to Skid Trails

Forest Practices Guidelines Related to Water Quality (FPGs)

FPG

North Carolina General Statute 77-13 and General Statute 77-14

DWR riverbasin and watershed 'Riparian Buffer Rules'
These 'buffer rules' for specific river basins and watersheds set limitations on skid trails within the mandatory buffer zone.

North Carolina Dredge and Fill Law
This state law requires that permits be secured for discharges of dredged or fill material in certain locations within the 20 Coastal Area Management Act (CAMA) counties. Refer to Chapter 6 for more information on this law.

Figure 5EE: A skid trail and stream crossing in Durham County, N.C.

Caption:
Note the BMPs on this skid trail and stream crossing:
- Good use of leftover logging debris to mat the skid trail surface.

- Full-width, solid-surface panel stream crossing using bridgemats.

- Skid trail width is kept to a minimum.

- Skid trail curves (background) as it approaches the stream crossing from upslope, creating a 'break in the grade' before the stream.

Figure 5FF: A curving skid trail in western North Carolina

Caption:
Note these BMPs -- Skidding is going uphill, which allows for better control of runoff.

The skid trail curves along the slope contour, rather than simply straight up/down.

Skid trail width is kept to a minimum, despite the long timber turning radius.

NOTE -- While the trail appears to be soft, there are no intensive ruts, gouges or trenches that might funnel runoff.

BMPs for Skid Trails

- Minimize disturbance to the soil such that surface runoff does not result in sediment transport into waterbodies. Where conditions warrant:
  -- Concentrate skidding on as few skid trails as needed.
  -- Limit primary skid trails to 10 percent of the total working area.
  -- Avoid widespread or random skidding patterns with repeated passes.
  -- Minimize placement and use of skid trails in ephemeral drainages. If skid trails must be within or cross an ephemeral drainage, additional BMPs are needed to protect water quality.
  -- Create skid trails only as wide as necessary to safely operate your equipment and conduct the forestry operation. Avoid creating two-lane skid trails, which disturb more soil area.
  -- Minimize the extent of gouges or trenches upon the ground surface that are created by the skidding of trees or logs.

- On sloping terrain, skid trails should follow along the land contours and should be kept to 25 percent grade or less when practical:
  -- If trails must be located on steeper slopes, more BMPs than usual are needed to control and capture runoff to protect water quality.

- Install waterbars, brush barriers, turnouts or use other methods as needed to control and capture runoff.

- When forest management goals and site conditions warrant, frequently pack down leftover logging debris atop primary skid trails to minimize further disturbance to exposed soils:

Helpful Hints:

The BMPs offered in this Part 4 may also be suitable for temporary roads that are needed for forestry use. If a road is likely to become permanent, then it is suggested you use the BMPs provided in Part 3 of this Chapter.

Minimizing the width of skid trails is especially important on thinnings and other partial harvests.

A switchback, or zig-zag pattern, may be useful when laying out skid trails in steep terrain.

Did You Know?

This debris is commonly called 'slash' or 'laps.'

-- To be most effective, this should be done as the skidding is taking place, not simply after the job is completed. As the equipment operates on the debris, it helps break down the debris with each pass.

-- Packing down logging debris is often an effective and affordable BMP to install at the approaches to stream crossings.

Part 6 -- Decks and Landings

Did You Know?

Other names for decks include: landings, ramps, setouts and docks.

Log decks are locations where trees, logs or other forest products are removed from the forest and temporarily placed so they can be loaded onto trucks and transported from the job site. Because of the disturbance to exposed soil and repeated equipment traffic in a concentrated area, decks have the potential to produce significant runoff and erosion. As a result, there are rules that determine certain actions and practices that must be undertaken to protect water quality. These rules are noted below:

Rules Related to Decks and Landings

Forest Practices Guidelines Related to Water Quality (FPGs)

FPG

North Carolina General Statute 77-13 and General Statute 77-14

DWR riverbasin and watershed 'Riparian Buffer Rules'
These 'buffer rules' set limitations on the location of decks and landings.

North Carolina Dredge and Fill Law
This state law requires that permits be secured for discharges of dredged or fill material in certain locations within the 20 Coastal Area Management Act (CAMA) counties. Refer to Chapter 6 for more information on this law.

BMPs for Decks & Landings

- Minimize the number and size of decks.

- Establish decks at locations where soil disturbance is minimized.

- Site your deck with these factors in mind, as conditions allow:
  -- Outside of the SMZ. If a deck must be sited within the SMZ, read and understand the requirements outlined within **FPG .0201**.
  -- Outside of ephemeral drainages.
  -- On flat terrain or gentle slopes.
  -- Upon stable soils.

FPG

- Control runoff and/or capture sediment that flows off of the deck site.

- During use of the deck, maintain groundcover materials on exposed bare soil areas that may pose a risk to accelerated erosion.

For Forest Owners:

Deck locations should provide the most efficient access for the site, to minimize the number that are needed.

Consider using the BMPs in this Part 6 for portable in-woods sawmills, wood chippers, and debris processors.

- If decks must be placed in steep terrain:
  -- Select side-ridge locations as high on the slope as practical, to provide as much room as possible for controlling runoff and/or capturing sediment before it reaches a waterbody at the bottom of the slope.
  -- Use more BMPs than usual to control runoff and capture sediment.

Figure 5GG: Active logging deck

Caption:
This active logging deck has some BMPs worth noting:

- Flat terrain so runoff is easier to control.

- Open sunny area to promote drying of the soil after precipitation.

- Wooden road pallets / mats promote soil stabilization.

- Crushed gravel minimizes soil disturbance and provides good traction for log trucks.

Chapter 6
Silvicultural Activities in Forested Wetlands

Chapter 6 Layout:

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NOTE: You are encouraged to read all parts of this chapter if you are interested in wetland topics. There is information in the earlier parts that help to explain the information provided in later parts.

This chapter includes discussions about laws, rules, regulations, and guidance documents as well as direct quotes:

- All direct quotes from laws, regulations, or guidance documents are cited according to the method described in *How To Use This Manual*.
- Guidance from regulatory agencies provides additional information on specific regulations and how to implement them. Such guidance should be followed unless a regulatory agency representative provides an exemption from that guidance.

Technical Assistance

An important purpose of this chapter is to offer background information and recommendations to assist you in meeting the requirements of federal and state regulatory programs that can affect forestry operations. Representatives of service agencies often can offer technical assistance and recommendations, but may not have authority to make final determinations. That authority is held by the regulatory agency that oversees a specific rule.

The information and recommendations contained in this chapter <u>are not</u> formal regulatory guidance from any federal or state regulatory agency and do not constitute a legal document.

Regulatory agencies that are most frequently involved with forestry:

- N.C. Division of Energy, Mineral and Land Resources
- N.C. Division of Water Resources
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency

Service agencies that are often involved with forestry:

- N.C. Forest Service
- USDA Natural Resources Conservation Service
- N.C. Soil & Water Conservation Districts
- N.C. Cooperative Extension Service

Did You Know?

The BMPs for forested wetlands in this manual are designed to meet the general requirements of the Clean Water Act (CWA) Section 404, (discussed later) and the specific requirements of the silviculture exemption to CWA Section 404.

Steps for Knowing the Rules

1. Read the recommendations in this manual. They are written to help you implement effective systems of BMPs and understand the regulations.
2. Discuss applicability of the BMPs for your site-specific situation, as needed, with the appropriate service agency and/or regulatory agency.
3. Check the literature and Web resources for the most recent versions or interpretations of regulations and regulatory guidance.

The rest of this Chapter briefly highlights regulations, guidance documents, requirements (‘mandatory BMPs’) and voluntary BMPs related to forestry operations in wetlands of North Carolina. Supporting citations of these regulations are in Appendix 1.

For Forest Owners:

Forested wetlands include complex soil and hydrologic conditions that often require additional attention when planning and conducting forestry operations.

Foresters usually consider soil drainage class, rather than wetland conditions, in developing forest management plans.

Silvicultural prescriptions often are based first on soil conditions that influence production of the desired forest resources and site operability, after which consideration is made on of whether the site may be subject to the federal or state wetland regulations.

Knowing the soils and hydrology of your site can help you address:
- Harvest scheduling
- Equipment types
- Flooding potential
- Reforestation options

Part 1 -- Introduction to Forested Wetlands

Forested wetlands provide important water quality and ecological functions. Because of the value of these functions, several federal and state regulations have been implemented over the years to make sure land-use practices in wetlands are done in a way to minimize degradation of the wetland.

Agencies that Regulate Wetlands

Wetlands are regulated at both the federal and state level. The U.S. Environmental Protection Agency and U.S. Army Corps of Engineers (USACE or Corps) are the two lead agencies regarding most wetland regulations. The Corps is delegated the authority by the U.S. EPA to administer the wetland regulations that most commonly effect forestry.

In North Carolina, the Division of Water Quality and Division of Coastal Management also have authority to regulate wetlands that do not necessarily fall under the authority of the federal agencies.

Primary Federal Agency:	U.S. Army Corps of Engineers
Contact:	Wilmington District, Regulatory Division
Web site:	http://www.saw.usace.army.mil/Wetlands/
Primary State Agency:	N.C. Division of Water Resources
Contact:	Wetlands and Stormwater Branch
Web site:	http://portal.ncdenr.org/web/wq/ws

BMP Objectives

The objectives of the BMPs recommended in this chapter include:

- Addressing the provisions of the U.S. EPA and Corps regulations related to the Clean Water Act-Section 404 and policy guidance from the Corps' Wilmington District Regulatory Division.
- Addressing provisions of state of North Carolina wetland rules that affect forestry operations.
- Minimizing adverse impacts on water quality, both onsite and offsite.
- Protecting hydrologic functions of forested wetlands that are being managed for timber or other forest resources.
- Protecting soil physical properties that could impact hydrologic functions.
- Complement the BMPs described in other chapters of this manual.

Assessing Your Site for Wetlands

When planning a forestry activity, you should assess your site to see if the regulations and BMPs associated with forested wetlands apply to your operation(s).

To be considered a 'jurisdictional' wetland, a site must exhibit positive evidence of wetland hydrology, hydric soils and hydrophytic vegetation. Consider using the following steps when assessing your site:

1. Review the most recent county soil survey map

Review the area and the soils mapped on your site to determine the possible extent of hydric soils. A soil-mapping unit named as a hydric soil series is likely to be a predominantly hydric soil, and therefore may be a wetland.

When a determination of a jurisdictional wetland is performed, if it is needed, there must be an on-site field investigation as part of the process. The investigator cannot rely solely upon maps, soil surveys or photos. If a final determination is needed, only the U.S. Army Corps of Engineers has the authority to conduct and make that determination.

2. Examine the hydrology and vegetation on the site

Wetland hydrology occurs when there is a water table or soil saturation at or near the surface at a frequency sufficient to have an overriding influence on the vegetation and soils due to anaerobic and reducing conditions (typically at least 5 percent of the growing season at least one out of every two years, on average). Consider asking these questions:

- Does the site have frequent, long duration periods of flooding or soil saturation at the surface?
- Does the water table on the site commonly decline well below the surface in late summer or early fall, and, as a result, provide a window of good soil conditions for forestry operations?

Examining the site for the presence of hydrophytic vegetation will also assist you in making an assessment. Hydrophytic vegetation includes woody and herbaceous plants that are adapted to living in soils that are saturated for extended periods in the rooting zone.

3. Obtain technical assistance

If you think there is a need to have a determination of wetlands on your site, seek technical assistance to conduct an assessment. Qualified personnel from agencies such as the NCFS, NCDCM, or USDA-NRCS personnel can make an initial assessment and determine whether a U.S. Army Corps of Engineers' representative should be contacted to make a wetland determination.

When a jurisdictional wetland determination is performed, it should be done by an experienced or trained wetland delineator in accordance with procedures of the U.S. Army Corps of Engineers' Wetlands Delineation Manual of 1987.

Also Refer To…

The Corps' Wetlands Delineation Manual (USACE 1987) outlines methods for identifying and delineating wetlands subject to Section 404 regulation. A jurisdictional determination of a wetland's presence is often abbreviated as a 'JD'.

For Forest Owners:

The Seven Common Types of Forested Wetlands are described in Appendix 11. They are:

- *Depressional Wetlands.*
- *Lacustrine Fringe Wetlands.*
- *Mineral Flat Wetlands.*
- *Organic Flat Wetlands.*
- *Riverine Wetlands.*
- *Slope Wetlands.*
- *Tidal Fringe Wetlands.*

However, past hydrologic alterations that altered flooding regimes may have caused wetland areas to become wetter or drier. Examples include large reservoirs in river bottomlands, stream channelization that limited flooding on small streams, and land drainage that altered water table regimes.

In such situations, the soil condition may be different than described in the county soil survey.

Onsite assessment of wetland condition should consider the effects of historical hydrologic alterations.

Did You Know?

Small wetlands, particularly isolated depressions that serve as breeding habitat for amphibians, have high ecological value in addition to the hydrologic and water quality functions addressed by federal and state regulations.

A Note on Wetland Size and Status

It is important to understand that the provisions of CWA Section 404 apply to all jurisdictional wetlands regardless of size.

FPG The North Carolina water quality standards and the FPGs apply equally to all wetlands, regardless of size or status.

Small areas of wetland that do not appear as hydric soil mapping units on soil survey maps are often present in forest stands in which the predominant condition is non-wetland.

In such cases, silvicultural plans should take note of these small wetlands and specify appropriate BMPs for activities that could impact these wetland areas.

Part 2 -- Regulations, Terms and Concepts

Did You Know?

Activities that result in the degradation of waters of the U.S. are subject to regulation under the Clean Water Act (CWA).

Clean Water Act

The Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (CWA) establishes federal authority for regulating activities effecting the chemical, physical and biological integrity of the nation's waters. The CWA has several sections with each explaining certain aspects of the regulation. The three sections most commonly of interest to the forestry community are noted below:

Section 301 of the CWA specifies that discharges of pollutants (including sand, rock and other fill materials) into the nation's waters is unlawful except if it is in compliance with the provisions of the Clean Water Act.

Section 401 of the CWA requires that any applicant for a permit to discharge into waters of the U.S. under the provisions of the CWA must receive certification from the state in which the discharge will occur. The N.C. Division of Water Resources administers the provisions of Section 401.

Section 404 of the CWA outlines the procedures for permitting discharges of dredged or fill material into waters of the U.S. and provides information on those activities for which no permit is required.

Effect on Forestry: Forestry or 'silvicultural' activities are exempted from having to secure permits for discharging dredged or fill material, as cited within Section 404. However, there are several requirements that forestry activities must comply with in order to maintain this exemption.

Section 404 responsibilities have been delegated to the U.S. Army Corps of Engineers. In North Carolina, the Wilmington District of the Corps administers the provisions of Section 404.

CWA Section 404 Historical Impact & Phase - In Dates:

On July 25, 1975, the Corps published regulations identifying a phase-in schedule to implement the permit requirements of S.404

Effective on that date, a S.404 permit was required for discharges of dredged or fill material into navigable waters of the U.S. and wetlands adjacent to these waters.

Effective September 1, 1976, permit requirements were expanded to include discharges into primary tributaries of navigable waters of the U.S. and adjacent wetlands, as well as natural lakes greater than five acres in surface area.

Effective July 1, 1977, permit requirements were expanded to include all waters of the U.S.

On July 19, 1977, the Corps issued Nationwide Permits authorizing all activities occurring prior to these phase-in dates. Silvicultural activities occurring in wetlands prior to these phase-in dates were thus permitted and, unless the activities are modified, require no further permitting.

Such areas that were sufficiently drained to convert a wetland to a non-wetland, and which remain in that drained condition, are not now jurisdictional wetlands and are not subject to Section 404.

The specific phase-in dates are described in 33 CFR 330 Nationwide Permits - Section 330.3 Activities Occurring Before Specific Dates.

Definition of Waters and Wetlands

The Section 404 regulations apply to 'waters of the United States' as defined in the current U.S. Army Corps of Engineers regulations *Title 33 Code of Federal Regulations Part 328 (33 CFR Part 328)*, provided in Appendix 1.

NOTE: On June 29, 2015 the USEPA and USACE published a new rule that re-defines "waters of the US". This new rule is effective August 28, 2015. Refer to Appendix 1.13.1, or the USEPA website for the new rule: http://www2.epa.gov/cleanwaterrule/documents-related-clean-water-rule.

A Note on Federal and State 'Waters'

For regulatory purposes, the federal government and the states have established definitions of 'waters of the U.S.' and 'waters of the state' respectively. In both cases, 'waters' also includes most 'wetlands' and streams.

The federal definitions stem from the Clean Water Act and related regulations. North Carolina's definitions are found in N.C.G.S. Ch.143 Sec.212(6) and 15A NCAC 02B .0202 (71) and 15A NCAC 02H .0506 (c)(2).

'Waters of the U.S.' and 'waters of the state' may not be synonymous in certain situations, so site specific questions should be directed to the appropriate agency.

Federal Wetland Definition

For the purposes of the Corps' regulatory program, 'wetlands' are defined in 33 CFR 328.3(c)(4) and this definition is cited below for your reference: *<start citation>*

> "The term wetland means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." *<end citation>*

North Carolina Wetland Definition

The N.C. Environmental Management Commission adopted the U.S. EPA / Corps' definition of wetlands (with a slight revision in wording), as cited below from [15A NCAC 2B .0202 (64)]. *<start citation>*

> "Wetlands are 'waters' as defined by G.S. 143-212(6) and are areas that are inundated or saturated by an accumulation of surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances, do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands classified as 'waters of the state' are restricted to 'waters of the United States' as defined by 33 CFR 328 and 40 CFR 230." *<end citation>*

Federal Clean Water Act Silviculture Exemption (Section 404)

Typically, normal and ongoing farming, ranching, and silviculture activities are exempt from the permit requirements of Section 404 of the CWA.

Section 404 of the CWA describes the permitting process and lists activities under Section 404(f) that are exempt from permit requirements.

Section 404(f)(1) lists activities which are exempt from CWA permit requirements. This list includes two activity types commonly practiced in forest management, which are commonly referred to as the 'silviculture exemption':

- Normal farming, silviculture, and ranching activities.
- Construction or maintenance of farm roads or forest roads.

FPG Silvicultural activities that may be conducted in jurisdictional wetlands in accordance with the silviculture exemption must also be conducted in accordance with the FPGs.

To retain the silviculture exemption of Section 404, the Corps regulations require that forestry operators:

1. Must not convert an area of the waters of the US into a use to which it was not previously subject.
2. Must conduct all forestry operations in a manner that:
   -- Does not result in the immediate or gradual conversion of a jurisdictional wetland to a non-wetland and that;
   -- Does not impair the flow or circulation or reduce the reach of waters of the U.S.
3. Conduct site preparation activities for establishment of pine plantations in accordance with specific BMPs that limit soil disturbance and hydrologic alterations.
4. Must comply with all BMPs required by regulation for the specific activity.

Also Refer To…

The site prep BMPs mentioned here are explained in Part 5 of this Chapter.

Minor drainage

Also Refer To…

Minor drainage is explained in more detail in part 6 of this chapter.

Minor drainage allowed under the Section 404 silviculture exemption must be conducted in a manner that does not result in:

- The immediate or gradual conversion of a wetland to a non-wetland, or
- The conversion from one wetland use to another, or
- Draining or significantly modifying an area of waters of the U.S.

State of North Carolina Wetland Regulations

Water Quality Standards

The state regulations for wetlands outline a series of wetland uses and water quality standards designed to assure the maintenance or enhancement of the existing uses of wetlands.

Effect on Forestry: State rules specify certain soil disturbing activities related to normal silviculture that are deemed to be in compliance with the North Carolina Wetland Standards. The state rule essentially repeats the main elements of the federal silviculture exemption of Section 404 with some additional references to state rules.

Two compliance criteria are provided in the rule (15A NCAC 02B .0231):

1. The silvicultural activities must comply with the most current versions of the U.S. EPA and Corps regulations to implement Section 404(f);
2. The silvicultural activities must be conducted in accordance with the North Carolina FPGs.

The North Carolina 'Dredge and Fill Law'

North Carolina G.S. 113-229 is commonly referred to as the North Carolina dredge and fill law, and requires permits to dredge or fill in or about estuarine waters or state-owned lakes. The N.C. Division of Coastal Management issues these permits and administers this law.

Effect on Forestry: Forestry related activities (such as road construction, minor drainage, or other activities) that create discharges of dredged or fill material in estuarine waters, tidelands, marshlands, or state-owned lakes **will require a permit** from the N.C. Division of Coastal Management.

As cited within N.C. General Statute 113-229(n): *<start citation>*
"(1) State-owned lakes include man-made as well as natural lakes.

(2) 'Estuarine waters' means all the waters of the Atlantic Ocean within the boundary of North Carolina and all the waters of the bays, sounds, rivers, and tributaries thereto seaward of the dividing line between coastal fishing waters and inland fishing waters agreed upon by the Department and the Wildlife Resources Commission, within the meaning of G.S. 113-129.

(3) 'Marshland' means any salt marsh or other marsh subject to regular or occasional flooding by tides, including wind tides (whether or not the tidewaters reach the marshland areas through natural or artificial watercourses), provided this shall not include hurricane or tropical storm tides. Salt marshland or other marsh shall be those areas upon which grow some, but not necessarily all, of the following salt marsh and marsh plant species:

Smooth or salt water Cordgrass (*Spartina alterniflora*), Black Needlerush (*Juncus roemerianus*), Glasswort (*Salicornia* spp.), Salt Grass (*Distichlis spicata*), Sea Lavender (*Limonium* spp.), Bulrush (*Scirpus* spp.), Saw Grass (*Cladium jamaicense*), Cattail (*Typha* spp.), Salt-Meadow Grass (*Spartina patens*), and Salt Reed-Grass (*Spartina cynosuroides*)." *<end citation>*

North Carolina Coastal Area Management Act (CAMA) and Areas of Environmental Concern (AEC)

Also Refer To…

CAMA regulations are cited in N.C. General Statute 113A-103(5)b.4

The North Carolina CAMA sets regulations related to development activities within 20 coastal counties of the state, as noted in Table 6-1 (next page).

Also Refer To…

The summary of CAMA rules on this page is excerpted and adapted from the N.C. Division of Coastal Management Web site: http://dcm2.enr.state.nc.us/

The CAMA requires permits for development in Areas of Environmental Concern (AEC). An AEC is an area of natural importance: It may be easily destroyed by erosion or flooding or it may have environmental, social, economic or aesthetic values that make it valuable to North Carolina.

You must obtain a CAMA permit for your project if it meets all of the following conditions: *(see 'Also Refer To…')*

- It is in one of the 20 counties covered by CAMA;
- It is considered 'development' under CAMA; *(see 'Helpful Hints')*
- It is in, or it affects, an Area of Environmental Concern established by the N.C. Coastal Resources Commission;
- It doesn't qualify for an exemption. *(see 'Permit Exemptions' below)*

Helpful Hints:

As noted on the NC-DCM Web site:

"Development" includes activities such as dredging or filling coastal wetlands or waters, and construction of marinas, piers, docks, bulkheads, oceanfront structures and roads.

You are probably in an AEC if your project is:

-- In or on navigable waters within the 20 CAMA counties.
-- On a marsh or wetland.
-- Within 75 feet of the mean high water line along an estuarine shoreline.
-- Near the ocean beach.
-- Near an inlet.
-- Within 30 feet of the normal high water level of areas designated as inland fishing waters by the N.C. Marine Fisheries Commission.
-- Near a public water supply.

For Forest Owners:

In addition, CAMA allows the Coastal Resources Commission to exempt some types of minor maintenance and improvements.

These types of projects are those with successful track records in protecting the resources around them.

For assistance in determining whether or not your project qualifies for an exemption, you can contact the NC-DCM.

North Carolina CAMA Permit Exemptions

Section 103(5)(b) of the CAMA exempts the following activities from permitting requirements:

- Road maintenance within a public right-of-way.
- Utility maintenance on projects that already have CAMA permits.
- Energy facilities covered by other laws or N.C. Utilities Commission rules.
- Agricultural or forestry production that does not involve the excavation or filling of estuarine or navigable waters or coastal marshland *(**Note:** The activities noted in this bullet are not exempt from permitting requirements under the N.C. Dredge and Fill Law).*
- Agricultural or forestry ditches less than 6 feet wide and 4 feet deep.
- Emergency maintenance and repairs when life and property are in danger.
- The construction of an accessory building usually found with an existing structure, if no filling of estuarine or navigable waters or coastal marshland is involved.

Table 6-1: The 20 coastal zone CAMA counties in North Carolina

Beaufort	Carteret	Dare	New Hanover	Pender
Bertie	Chowan	Gates	Onslow	Perquimans
Brunswick	Craven	Hertford	Pamlico	Tyrrell
Camden	Currituck	Hyde	Pasquotank	Washington

Did You Know?

A key concept of 'normal silviculture' is the use of effective practices that minimize adverse impacts on soil and water resources.

Normal Silviculture and Forestry Operations on Wetlands

Normal silviculture is considered to be the collection of silvicultural practices commonly used for forest management on jurisdictional wetlands for the purpose of producing timber and other resources of the forest.

The U.S. EPA and Corps regulations and guidance for implementation of Section 404 address five elements of normal silviculture on forested wetlands:

1 - Forest Product Harvesting [as cited from 33 CFR 323.4(a)(1)(iii)(B)]

<start citation> "Harvesting means physical measures employed directly upon farm, forest, or ranch crops within established agricultural and silvicultural lands to bring about their removal from farm, forest, or ranch land, but does not include the construction of farm, forest, or ranch roads." *<end citation>*

2 - Site Preparation [as cited from 33 CFR 323.4(a)(1)(iii)(D)]

Components of the site preparation system that involve soil disturbance are included in the definitions of plowing: *<start citation>*
"Plowing means all forms of primary tillage, including moldboard, chisel, or wide-blade plowing, discing, harrowing, and similar physical means utilized on farm, forest, or ranch land for the breaking up, cutting, turning over, or stirring of soil to prepare it for the planting of crops. The term does not include the redistribution of soil, rock, sand, or other surficial materials in a manner which changes any area of the waters of the United States to dry land." *<end citation>*

3 - Bedding and Planting of Seedlings [as cited from 33 CFR 323.4 (a)(1)(iii)(E)]

<start citation> "Seeding means the sowing of seed and placement of seedlings to produce farm, ranch, or forest crops and includes the placement of soil beds for seeds or seedlings on established farm and forest lands." *<end citation>*

4 - Construction and Maintenance of Forest Roads [33 CFR 323.4(a)(6)]

Fifteen (15) mandatory BMPs are described in the regulations. In addition, the Corps prepared specific information regarding compliance with Section 404 for the construction of forest roads within wetlands in North Carolina in 2004. This information document is in the Appendix. Forest roads are further discussed in Part 4 of this chapter.

5 - Minor Drainage [as cited in 33 CFR 323.4(a)(1)(iii)(C)(1)(ii)]

<start citation> "Minor drainage means the discharge of dredged or fill material for the purpose of installing ditching or other such water control facilities incidental to planting, cultivating, protecting, or harvesting of rice, cranberries, or other wetland crop species, where these activities and the discharge occur in waters of the United States which are in established use for such agricultural and silvicultural wetland crop production." *<end citation>.* Minor drainage is explained in Part 6 of this chapter.

Helpful Hints:

As an example, raking and piling woody debris into windrows or large piles when accompanied by significant movement of surface soil into the windrows or piles, or significant blockage of surface flows, may not be considered an exempt silvicultural activity.

***Remember*:**

Silvicultural activities in all wetlands, regardless of size, should be conducted in a manner that minimizes adverse impacts on the unique hydrologic and ecological functions of those ecosystems.

Forestry operations in wetlands:

- Must limit both water quality degradation and hydrologic alterations in accordance with Section 404 of the Clean Water Act as specifically described by the Corps; *and*
- Must limit water quality degradation in accordance with the state water quality standards and the FPGs; *and*
- Follow the provisions of the state wetlands standards.

A Note on Corps Interpretation of Normal Silviculture

Historical interpretations from the Corps on one aspect of normal silviculture are noted in a Regulatory Guidance Letter *RGL 96-02. Subject: Applicability of Exemptions under Section 404(f) to 'Deep Ripping' Activities in Wetlands*, which is included in the Appendix. Two key points are made in RGL 96-02:

1. Normal silvicultural activities subject to the exemption are limited to those named in Section 404(f)(1)(A) and the Corps' regulation and other activities of essentially the same character as those named.

2. Deep ripping (interpreted as greater than 16 inches deep) is not an exempt activity if it is required to establish silviculture for the first time or if it breaks-up a restrictive soil layer resulting in significant drainage that immediately or gradually converts a wetland to a non-wetland.

Watch Out!

Mechanized land clearing for purposes other than production of forest products is not considered a 'normal' part of a silvicultural operation and would therefore not be exempt from S.404 regulation.

For Forest Owners:

Normal silviculture on a managed forest involves long periods of relative inactivity on specific stands. Continuous forest management refers to the forest as a whole.

Remember - - - - -
Normal silviculture activities must not immediately or gradually convert a wetland to a non-wetland.

Any forestry activity resulting in the conversion of a wetland to a non-wetland would not be considered exempt from Section 404 permit requirements.

Established and Ongoing Silviculture

The requirement of an established and ongoing silvicultural operation is generally considered to be met when:

- There is a forest management plan for the forest property, *and*
- There is documented and on-site evidence that the land has been managed continuously for silvicultural purposes, *and*
- The landowner intends to continue forest management.

Note: Under [33CFR323.4(a)(ii)] an operation ceases to be 'established' when the area on which it was conducted has been converted to another use or has lain idle so long that modifications to the hydrological regime are necessary to resume operations.

Therefore, a forest site on which an existing drainage system has not been maintained for a long time such that the drainage system no longer provides effective drainage may no longer be considered 'ongoing.'

Part 3 -- BMPs for Timber Harvesting

Harvesting of timber is considered a normal silvicultural activity, as noted earlier from [33CFR323.4(a)(1)(iii)(B)]. The bulleted items in this part 3 are general BMPs to consider when harvesting timber within forested wetlands.

- Recognize the soil and hydrology conditions on the site. Plan your harvest to minimize activity in sensitive areas that could be wetter than normal, or in areas near waterbodies:
  -- Consider sharing this information with the heavy equipment operators so they understand what areas are sensitive and may need to be protected.
  -- Consider marking these areas for high visibility and awareness.

- Operate equipment during periods of relatively dry surface soils if possible. Minimize activity on saturated soils and near waterbodies.

- Use appropriate harvesting equipment, methods and/or techniques that minimize significant alterations to the soil structure:
  -- Consider constructing a shovel-mat trail of logging debris for primary skid trails and pathways. This debris will help keep equipment off of the soil surface. If a shovel-mat trail is used, remove this debris as soon as possible once you are finished using the trail.

- Concentrate heavy equipment use to the primary skid trails and decks. Avoid randomly dispersed equipment traffic on the site:
  -- Consider ceasing operations or choosing a better harvest method if a single pass of equipment produces ruts deeper than six inches across a significant area of the site beyond the primary skid trails and decks.

- Limit heavy equipment use along the edge of ditches to the extent that the structural integrity of the ditchbank is protected and sediment transport within the ditch is prevented.

- Avoid crossing streams when possible. Portable bridgemats are a preferred method for crossing streams and ditches. Pole crossings may be suitable in certain cases. Refer to chapter 5, part 5 for BMPs on stream and ditch crossings.

- On areas that show signs of significant or intensive soil disturbance that may adversely affect the site hydrology or water quality, it is recommended to rehabilitate the soil structure by ripping or tilling:
  -- Tillage must not convert a wetland to a non-wetland.
  -- Soil tillage should be done when the soil is relatively dry.
  -- Till or rip the soil through the bottoms of ruts, as long as doing so does not convert the wetland to a non-wetland.

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For Forest Owners:

Prior to undertaking any deep ripping in jurisdictional wetlands, you should refer to the Corps' Regulatory Guidance Letter RGL 96-02, in Appendix 1.

For Forest Owners:

In the section of the regulations related to roads or skid trails for logging in wetlands, the phrases 'forestry activities' or 'forestry purposes' are interpreted by USEPA and the Corps to mean operations and activities necessary for production of forest products.

While a road can be used for multiple purposes, its primary use must be for forestry activities, and the road dimensions and extent should be limited to that necessary for the forest activity.

***Therefore, roads constructed primarily for hunting or recreational access would require a permit**.*

Refer to the November 2004 Corps information document about forest roads in wetlands of N.C., provided in Appendix 1.

If you plan to conduct forest operations, including roadwork, in jurisdictional wetlands which may exceed the recommendations provided in this 2004 information paper, you should be prepared to justify the need for the additional road construction and are encouraged to contact appropriate natural resources agency staff prior to starting work to ensure the intended discharge is not prohibited by, or otherwise subject to, regulation under CWA Section 404.

Part 4 -- Requirements and BMPs for Forest Roads

Temporary and permanent roads constructed for forestry purposes in wetlands are exempt from CWA Section 404 permitting requirements as long as they are constructed in accordance with the mandatory 15 best management practices prescribed in the Corps' regulations:

-- These 15 mandatory BMPs are described later in part 4.

FPG **-- Roadwork must also remain in compliance with the North Carolina FPGs and other applicable state regulations.**

-- You are encouraged to read and understand the information prepared by the Corps in 2004 regarding road construction.

Regulatory Statement

The regulation pertaining to forest roads in wetlands is cited from 33 CFR 323.4(a)(6)(i) and requires that: *<start citation>*
"Permanent roads (for farming or forestry activities), temporary access roads (for mining, forestry, or farm purposes) and skid trails (for logging) in waters of the U.S. shall be held to the minimum feasible number, width, and total length consistent with the purpose of specific farming, silvicultural or mining operations, and local topographic and climatic conditions." *<end citation>*

U.S. Army Corps of Engineers Forest Road Information

In November 2004, the Corps' Wilmington District prepared an information paper on road system planning and design that provides general specifications for road lengths, widths, spacing and height of fill above the ground surface.

This road information document is in the Appendix, and is entitled *Information Regarding Compliance with the Federal Clean Water Act Section 404(f)(1) Provisions for the Construction of Forest Roads Within Wetlands, in North Carolina*. (See sidebar)

Also, the Corps' Wilmington District currently maintains that, to be considered exempt from Section 404 permit requirements, borrow ditches dug to obtain fill for forest road construction must not be connected to an outlet. The District holds that such connection would adversely affect flows and circulation patterns within the wetland and would result in the conversion of land adjacent to the borrow ditch to a non-wetland.

Road Crossings of 'Waters of U.S.'

Note that the regulatory guidelines of 33 CFR 324.4(a)(6) apply to the waters of the U.S., not just wetlands. Therefore:

Forest road crossings of tributaries of Waters of the US are subject to the Corps' 15 mandatory BMPs.

Corps' 15 Mandatory BMPs for Forest Roads in Wetlands

For an access road to be exempt from federal permitting requirements, any forest road constructed within or across waters of the U.S. must be necessitated by timber production activities and may be constructed only to the minimum standards necessary for the forestry activity.

NOTE: Construction of forest roads in jurisdictional wetlands for production of forest products does not require a permit as long as these 15 [(i) through (xv)] BMPs are followed.

The portion of the regulation that deals with forest roads is cited for reference:
<start citation>
"(a) General.
Except as specified in paragraphs (b) and (c) of this section, any discharge of dredged or fill material that may result from any of the following activities is not prohibited by or otherwise subject to regulation under section 404:

(6) Construction or maintenance of farm roads, forest roads, or temporary roads for moving mining equipment, where such roads are constructed and maintained in accordance with best management practices (BMPs) to assure that flow and circulation patterns and chemical and biological characteristics of waters of the United States are not impaired, that the reach of the waters of the United States is not reduced, and that any adverse effect on the aquatic environment will be otherwise minimized. These BMPs which must be applied to satisfy this provision shall include those detailed BMPs described in the state's approved program description pursuant to the requirements of 40 CFR Part 233.22(i), and shall also include the following baseline provisions:

(i) Permanent roads (for farming or forestry activities), temporary access roads (for mining, forestry, or farm purposes) and skid trails (for logging) in waters of the U.S. shall be held to the minimum feasible number, width, and total length consistent with the purpose of specific farming, silvicultural or mining operations, and local topographic and climatic conditions;

(ii) All roads, temporary or permanent, shall be located sufficiently far from streams or other water bodies (except for portions of such roads which must cross water bodies) to minimize discharges of dredged or fill material into waters of the U.S.;

(iii) The road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows;

(iv) The fill shall be properly stabilized and maintained during and following construction to prevent erosion;

(v) Discharges of dredged or fill material into waters of the United States to construct a road fill shall be made in a manner that minimizes the encroachment of trucks, tractors, bulldozers, or other heavy equipment within waters of the United States (including adjacent wetlands) that lie outside the lateral boundaries of the fill itself;

(vi) In designing, constructing, and maintaining roads, vegetative disturbance in the waters of the U.S. shall be kept to a minimum;

(vii) The design, construction and maintenance of the road crossing shall not disrupt the migration or other movement of those species of aquatic life inhabiting the water body;

(viii) Borrow material shall be taken from upland sources whenever feasible;

Helpful Hints, for (x):

Impacts to wetlands should be avoided if practical alternatives exist, as cited in 33 CFR 323.4(a)(6)(x).

You should not only consider whether the impacts to wetlands could be avoided by locating roads in upland areas, but also whether the need for road construction could be avoided by conducting the forest operation during drier periods.

(ix) The discharge shall not take, or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species;

(x) Discharges into breeding and nesting areas for migratory waterfowl, spawning areas, and wetlands shall be avoided if practical alternatives exist;

(xi) The discharge shall not be located in the proximity of a public water supply intake;

(xii) The discharge shall not occur in areas of concentrated shellfish production;

Helpful Hints, for (xiii):

National Wild and Scenic River Systems: *As of March 2012, there are segments of five designated National Wild and Scenic River Systems in N.C.:*

- *Chattooga River*
- *Horsepasture River*
- *New River*
- *Lumber River*
- *Wilson Creek*

Specific river sections and location information is available on the Web site www.rivers.gov

(xiii) The discharge shall not occur in a component of the National Wild and Scenic River System;

(xiv) The discharge of material shall consist of suitable material free from toxic pollutants in toxic amounts; and

(xv) All temporary fills shall be removed in their entirety and the area restored to its original elevation." *<end citation>*

Types of Forest Roads Commonly used in Wetlands

The descriptions provided below may also apply to non-wetland areas. The section that follows provides specific BMPs for forest roads in wetlands.

Permanent roads

Roads that provide year-round, all-weather access for silvicultural operations and fire protection. Such roads are maintained on a regular basis and become a permanent part of the forested landscape.

Temporary roads

Roads that provide access into a specific area for a specific operation. Once that operation is complete, temporary roads are closed, structures are removed, the road is restored to original grade and, if necessary, the disturbed soils are stabilized to prevent accelerated erosion.

Flat roads

Roads that are graded atop the ground surface, sometimes with a small, shallow grader ditch on one or both sides. No fill material is added which might build the road elevation above the adjacent land surface.

Such roads minimize adverse impacts on wetlands and are often used:

-- As permanent access where all-weather use is not necessary and the road can be temporarily closed when inundated or the soils are very wet.

-- For temporary access when constructed and used during periods of relatively dry soils.

-- For crossing nonwetland areas as part of a larger road system that traverses both wetland and non-wetland forest areas.

Fill roads

Roads that are most usually permanent and where year-round, all-weather use is required. The road is built upon fill material situated above the adjacent land surface to provide for drainage of the roadbed and road surface sufficient to maintain a stable and usable road.

Recommended BMPs for Forest Roads in Wetlands

- Plan and implement road designs, locations, alignments and water management devices as needed to minimize hydrologic alterations.
- Construct roads during periods of relatively dry soils when possible.
- Minimize the lateral extent of wetland disturbance during construction
- Maintain a daylight corridor to allow more rapid drying of the road if doing so provides better control of surface runoff.

Helpful Hints:

If fill material must be placed next to the road, use small piles adjacent to the road that are separated by openings so surface water flow is not blocked by the piles.

- If fill material is generated by the road construction process, place suitable mineral soil fill on the road surface or remove it from the wetland to a non-wetland area, if feasible.

- After construction is completed, stabilize disturbed areas of the roadbed with vegetation if accelerated erosion and transport of sediment to a receiving stream is likely.

- Establish and maintain groundcover vegetation along road shoulders to capture sediment that may come from the road surface.

- On frequently used roads that are regularly graded, apply gravel or other suitable stabilizing material on areas where erosion and sedimentation may occur.

- On lightly used roads, establish and maintain vegetative groundcover or other suitable stabilizing materials upon the road surface.

- If culverts are needed for stream crossings or for cross-drainage:
  -- Install culverts of adequate number and/or capacity to handle floodwaters. The spacing between culverts is site-specific.
  -- Construct the crossing in a way that prevents floodwaters from flowing over the road at the culvert. Build up the road elevation atop the culvert and create a gradual hump over the culvert.
  -- Create shallow depressions in the road on each approach to the culvert. These depressions should act as a floodway for heavy water flow to go around the pipe, and reduce the risk of the culvert blowing out.

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Helpful Hints:

Think of each 'floodway' as a dry ford crossing where water can run during heavy flows.

- As needed, apply stabilizing materials atop the culvert crossing, on each culvert headwall, and within each crossing approach floodway.

Additional BMPs for Flat Roads

- Keep the grade of the road as close to the normal land surface grade as practical, to minimize the chances of blocking surface water flow.

- Install water turnouts, sediment pits, or other suitable water control structures within the roadside grader ditch to prevent sediment runoff into streams or other waterbodies.

- On places where surface water flows are expected to cross the road, stabilize and/or harden the road surface with suitable materials. This is especially important in riverine wetlands.

- Establish and maintain a grader ditch if needed to control runoff.

Additional BMPs for Fill Roads

- When possible, conduct construction work in dry periods and in advance of when you need to use the road. This allows the road to settle and not contribute excessive amounts of sedimentation that can result during wet conditions.

- Use appropriate fill material from nearby or adjacent non-wetland areas where practical:
  -- Minimize the amount of excavation and disturbance in the wetland.
  -- Minimize the amount of organic matter within the fill, since this will retain moisture and not allow the road to rapidly drain or dry out.

Watch Out!

Even the best laid-out and constructed fill roads can act as an unintentional barrier to surface (or near-surface) water flow.

This is why it's important to allow ample cross - drainage, and minimize the use and extent of fill roads in wetlands.

- Provide ample cross-drainage within the road structure for surface water flow. This includes culverts, bridges, fords or some combination of each. Refer to the BMPs noted above related to culvert installations and the creation of floodways for heavy water flows.

- Build up a slight, stabilized berm along each roadside edge that can collect surface runoff and help capture sediment. Create stabilized gaps in the berm periodically for runoff to drain from the road surface.

- If borrow ditches are used to obtain fill material:
  -- Only excavate as much material as needed to construct the road. Minimize the depth, width and length of the borrow ditch.
  -- Do not connect the borrow ditch to an outlet.
  -- Place unsuitable fill material in small piles adjacent to the borrow ditch and provide openings for surface water flow.

Additional BMPs for Maintaining Fill Roads that are Adjacent to Existing Roadside Collector Ditches

For Forest Owners:

Most of the drainage systems for silviculture that were constructed in the 1960's and 1970's use the roadside ditch as a collector and transport ditch as part of the overall drainage system.

This arrangement may allow the transport of sediment from the roadside collector ditch to a drainage outlet, unless measures are put in place to restrict sediment transport.

- Where feasible, maintain a grader ditch, roadside berm and/or vegetative groundcover alongside the road edges to control and capture the runoff before it flows into the roadside collector ditch.

- Maintain a crowned road surface or use other appropriate BMPs to control runoff and allow adequate drying of the road surface.

- For roadside ditches that are connected to an outlet, protect or maintain groundcover at least 4 to 5 feet wide adjacent to the ditch (on the side opposite the road) during soil disturbing silviculture operations.

- Where ditch erosion or sediment transport are occurring, install flow control devices within the roadside collector ditch to manage the water flow speed and volume (see sidebar 'Did You Know?').

Did You Know?

One common example of a flow control device is a flashboard riser.

Flow control devices may also help:
-- Sediment to settle out in the ditch water before it reaches the outlet.
-- Manage nutrient or bacteria contributions from natural runoff.
-- Temporarily store water in the ditch for wildfire control.

For Forest Owners:

It is important to recognize that intensive management for pines, and the associated site prep work often needed, (including bedding) is only appropriate on certain wetland sites.

Not all wetland areas are suitable for mechanical site prep and/or pine management.

Consult a forestry and/or natural resources professional that can help you determine the correct species for your site, and decide the best methods for managing those species in a productive and low-impact manner.

While it is not the intention of this manual to advocate the use of site prep for pine management in wetlands, there are BMPs provided in this chapter for those situations where these activities are undertaken.

Also see chapter 10.

Part 5 -- Requirements and BMPs for Site Prep

Site Preparation (site prep) is the term used to describe activities undertaken to prepare a site's conditions for forest tree regeneration that may occur either by manual methods or natural processes.

While site prep is generally considered a normal silviculture activity in jurisdictional wetlands, there are requirements defined by the U.S. EPA and Corps for mechanical site prep work in wetlands when that work is done for the regeneration of pine species in the wetlands.

These six requirements are outlined in a *Memorandum to the Field* dated November 28, 1995, that was issued jointly by the U.S. EPA and Corps. This memorandum is provided in Appendix 1 for reference.

When a Permit is Required

The guidance in that memorandum specifies that a Section 404 permit is required to conduct mechanical site preparation for the establishment of pine plantations on nine types of forested jurisdictional wetlands in the Southeast. These nine wetland types that require a permit are:

1. Permanently flooded, intermittently exposed, and semi-permanently flooded wetlands.
2. Riverine Bottomland Hardwood wetlands.
3. White Cedar Swamps.
4. Carolina Bay wetlands.
5. Non-riverine Forest wetlands.
6. Low Pocosin wetlands.
7. Wet Marl Forests.
8. Tidal Freshwater Marshes.
9. Maritime Grasslands, Shrub Swamps, and Swamp Forests.

A Note on Stump Removal

As the regulations are written, the removal of underground vegetation, including stumps, may not be an exempt activity under Section 404.

Minimizing the amount of debris that is pushed during site prep will help reduce the likelihood of removing stumps, which could then require a permit from the U.S. Army Corps of Engineers.

USEPA/Corps' 6 Mandatory BMPs for Site Prep

In addition, the above noted U.S. EPA / Corps memorandum prescribes six mandatory best management practices for all mechanical site preparation activities undertaken for pine plantation establishment on jurisdictional wetlands.

It is implied that these six mandatory practices must be implemented in order to retain the silviculture (Section 404) exemption for that activity.
These six mandatory BMP requirements are cited below for reference:

<start citation> ".....The following forested wetlands BMPs are designed to minimize the impacts associated with mechanical silvicultural site preparation activities in circumstances where these activities do not require a permit (authorization from the Corps is necessary for discharges associated with silvicultural site preparation in wetlands described above as requiring a permit.) The BMPs include, at a minimum, the following:

1) position shear blades or rakes at or near the soil surface and windrow, pile, and otherwise move logs and logging debris by methods that minimize dragging or pushing through the soil to minimize soil disturbance associated with shearing, raking, and moving trees, stumps, brush, and other unwanted vegetation;
2) conduct activities in such a manner as to avoid excessive soil compaction and maintain soil tilth;
3) arrange windrows in such a manner as to limit erosion, overland flow, and runoff;
4) prevent disposal or storage of logs or logging debris in streamside management zones -- defined areas adjacent to streams, lakes, and other waterbodies -- to protect water quality;
5) maintain the natural contour of the site and ensure that activities do not immediately or gradually convert the wetland to a non-wetland; and
6) conduct activities with appropriate water management mechanisms to minimize off-site water quality impacts." *<end citation>*

Additional BMPs for Site Prep

- Recognize the soil and hydrology conditions on the site. Plan your work to minimize activity in sensitive areas that could be wetter than normal, or in areas nearb waterbodies.

- Operate equipment during periods of relatively dry surface soils where possible. Minimize activity on saturated soils and near waterbodies.

- Minimize soil movement when shearing, piling, bedding, or conducting other soil tillage operations.

- Use appropriate equipment, methods and/or techniques that avoid movement of soil or debris into wet, depressional areas.

- Limit heavy equipment use along the edge of ditches to the extent that the structural integrity of the ditchbank is protected and sediment transport within the ditch is prevented.

FPG

- Avoid crossing streams when possible:
  -- Portable bridgemats are a preferred method for crossing streams and ditches. Pole crossings may be suitable in certain cases. Refer to Chapter 5, Part 5 for more BMPs on stream and ditch crossings.

Watch Out!

Prior to undertaking any deep ripping in jurisdictional wetlands, you should refer to the Corps' Regulatory Guidance Letter RGL 96-02, in the Appendix

- On areas that show signs of significant or intensive soil disturbance that may adversely affect the site hydrology or water quality, it is recommended to rehabilitate the soil structure by ripping or tilling:
  -- Tillage must not convert a wetland to a non-wetland.
  -- Soil tillage should be done when the soil is relatively dry.
  -- Till or rip the soil through the bottoms of ruts, as long as doing so does not convert the wetland to a non-wetland.

- Implement additional BMPs that are appropriate for your site:
  -- Suggested options are provided in Chapter 10 of this manual, including recommendations for bedding activities.

Part 6 -- Requirements and BMPs for Water Management

For Forest Owners:

Water management practices include minor drainage, flow control devices, and certain silvicultural practices.

Such practices are commonly utilized in low relief Mineral Flat wetlands, large Carolina Bays, and Organic Flat wetlands.

*Minor drainage **should not be installed** in Riverine Wetlands (floodplain) because the ditch systems may alter the reach and flow of floodwaters.*

Water management provides temporary surface storage during and after large rainfall events. This is accomplished by means of minor drainage.

If the requirements as prescribed within the silviculture exemption in Section 404 are met on a forestry operation, then a formal jurisdictional determination is not necessary. If questions arise as to whether or not the Section 404 exemption applies to a specific site or activity, then a jurisdictional determination can help determine exactly where wetland regulations apply.

Effect on Forestry: It is recommended to follow the Section 404 requirements whenever conducting forestry operations upon poorly drained or very poorly drained soils as a conservative approach to meeting the specifications under the silviculture exemption in Section 404.

Objectives of Water Management

Water management, as it applies to forestry, is the implementation of normal silvicultural practices that may control water infiltration, absorption, transport and/or surface-water storage on the site. Water management on forested wetland areas can influence water cycling between the vegetation and soil, water infiltration, water storage and movement of water. Common objectives of water management are noted below.

Did You Know?

Other wetland-adapted tree species, such as cypress and Atlantic White Cedar, have shown to respond well in their seedling stage to the same intensive silviculture practices used for pine growth.

Improve the survival of seedlings

Trees regenerated on wetland areas require at least some aerated soil to ensure survival of seedlings after germination. Newly established seedlings cannot survive long periods of inundation or soil saturation at the surface.

Improve the growth of young trees

Water management improves the early growth rates of planted pine trees and shortens the length of time to a commercial harvest.

Improve soil trafficability and minimize soil disturbance

Water management can lengthen the 'operating window' of the time during which heavy equipment used for timber harvesting or site prep can be used without causing intensive soil disturbance. By providing a longer period of drier soils, the equipment is less likely to operate in saturated or near-saturated soil conditions.

Limit the degree of drainage

Successfully managing the site's water resources can be valuable to assure an adequate supply of water. Having too much drainage capacity can be detrimental to optimizing tree growth because plant-available soil moisture is typically limiting in many wetland soils during the summer and fall.

Maintain wetland hydrology and hydrologic functions

Silvicultural practices that assist in maintaining or enhancing soil water storage and surface retention storage, and limiting rates of drainage outflow all contribute to maintenance of wetland hydrology.

Other objectives of water management:

Minimize adverse impacts on water quality, both onsite and offsite.
Establish a supply of water within the ditch for use in wildfire suppression.

Minor Drainage

Minor drainage, when used for silviculture, is usually seen on very poorly drained soils and some poorly drained soils, most of which are hydric types, and many of which are jurisdictional wetlands.

Watch Out!

Do not rely upon past activities in wetlands as an indicator of today's appropriate practices.

You are encouraged to be familiar with current U.S. EPA and Corps interpretations if conducting minor drainage activities.

The drainage of water should occur by subsurface flow into the ditch. The objective often is to lower the average water table level in the soil between successive ditches during periods of the year when a high water table is normally expected, usually the late winter and early spring.

In practice, minor drainage means the minimal and temporary drainage needed to harvest and successfully regenerate a forest tree stand.

Therefore, to continue the Section 404 silviculture exemption on an intensively managed forest stand that has minor drainage (on a site that was jurisdictional wetland prior to installation of the minor drainage), that site must continue to meet the vegetation, hydric soils, and hydrology criteria for a jurisdictional wetland.

Helpful Hints:

The key to having minor drainage fall within the Section 404 exemption is whether the drainage system has the potential to significantly alter the hydrology of the site.

Effect on Forestry: To be considered exempt from Section 404 permit requirements, minor drainage systems installed within jurisdictional wetlands after 1977:

- Must not result in the immediate or gradual conversion of the wetland to a non-wetland; *and*
- Should not include the construction of any canal, ditch, dike or other waterway or structure which drains or otherwise significantly modifies a wetland or any other water of the U.S.

Establishment of minor drainage is a normal silvicultural activity on forested wetlands and is exempt from Section 404 permitting if:

- It is part of an established and ongoing silvicultural operation; *and*
- It does not drain (convert from wetland to non-wetland) or significantly modify a stream, lake, swamp, bog or any other wetland or any other water of the U.S.

Recapture Provision

Of importance related to minor drainage are the recapture provisions defined at 33 CFR 323.4 (b) and (c). Recapture means that the Section 404 silviculture exemption is lost and the site becomes subject to all the permitting requirements of federal rule 33 CFR Part 323.

According to these provisions, 'recapture' can be implemented:

- If a discharge of dredged or fill material occurring in the course of normal agriculture or silviculture activities contains a toxic pollutant, *or*
- If the purpose of such discharge is to convert an area of the waters of the U.S. into a use to which it was not previously subject, *or*
- Where the flow or circulation of waters of the US may be impaired or the reach of such waters reduced.

Ditch Definitions

Different types of generic ditch terms are commonly used in the course of normal silviculture on forested wetlands in North Carolina. For the purposes of this manual, the following definitions are used.

Borrow Ditch

A borrow ditch retains water that either seeps in from groundwater sources, and/or runs off from the surface as a nonpoint source. Borrow ditches are usually excavated with a backhoe or similar equipment and often are located alongside roadways, so that the spoil material from the borrow ditch can be used to construct or maintain a road. A borrow ditch does not have an outlet to a natural waterway.

The Corps' Wilmington District currently holds that to be considered exempt from Section 404 permit requirements, borrow ditches dug to obtain fill for forest road construction must not be connected to an outlet due to the potential for wetland drainage.

Grader Ditch (or grader ditchline)

Grader ditch is the name given to a shallow, angled trench that is excavated into the roadway surface along the roadside edge, usually no more than 3 to 6 inches deep, and most often created by using the end of the blade on a motor grader, bulldozer or similar blade. The purpose of the grader ditch is to control surface runoff from a roadway.

Hydrologically-Connected Ditch

A hydrologically-connected ditch has an outlet to a stream network, within which sediment and other nonpoint source pollution may enter that stream network unless appropriate BMPs or other measures are implemented to prevent this action from occurring.

Did You Know?

Other names often used for a minor drainage ditch may include:
-- lateral ditch.
-- field ditch.
-- silvicultural ditch.

Minor Drainage Ditch

A minor drainage ditch is one constructed to provide minor drainage for normal silviculture and is connected to an outlet.

Such ditches should be constructed at the maximum spacing and minimum depth that will achieve the minor drainage objective. These ditches also should have flow control devices at appropriate locations in the ditch network.

The Corps considers discharges of fill material associated with construction of minor drainage ditches within jurisdictional wetlands exempt from Section 404 permit requirements provided:

- The activity is incidental to planting, cultivating, protecting or harvesting of a wetland crop species, *and*
- The activity occurs in an area which is in established use for silvicultural production, *and*
- The activity does not result in the immediate or gradual conversion of a wetland to a non-wetland, *and*

- The activity does not drain or otherwise significantly modify a stream, lake, swamp, bog or any other wetland or aquatic area constituting waters of the U.S.

Helpful Hints:

The historical note is only offered here as a historical reference so that you can be aware of what you may encounter on a job site.

The installation of these types of ditches and drainage systems most likely do not meet the current U.S. EPA and Corps interpretations of exempted drainage.

However, maintenance of these types of historical ditches and systems installed prior to July 19, 1977 would be considered exempt, because their construction was not at that time a violation of the CWA.

A Historical Note on Past Drainage Practices

A number of ditch systems in a large portion of the drained forest stands under management today in North Carolina were constructed in the 1960's and 1970's prior to those sites coming under CWA/Corps jurisdiction.

Standard practice at that time was to use roadside borrow ditches as multifunction channels. Historically, roadside ditches adjacent to permanent roads were often called collector ditches and served multiple functions:
- Provided a hydraulic gradient from the lateral ditches to promote drainage.
- Transported drainage discharge to an outlet.
- Provided fill for building up the base of the road above the ground surface.
- Drained the roadbed to facilitate all weather use.

In addition, there were two common designs of drainage systems:
1) Prescription drainage systems: These systems had no standard pattern of ditch arrangement or spacing and usually can be found on sites with a mix of hydric and non-hydric soil units.
2) Pattern drainage systems: These systems included regularly spaced parallel ditches and are commonly found on large, low-relief sites dominated by hydric soils where drainage is needed throughout the site.

BMPs for Water Management

For Forest Owners:

Given your management objectives, consider whether or not minor drainage is practical or necessary on your site for conducting silvicultural work.

Where practical, use a silvicultural plan that does not require the need for minor drainage.

If minor drainage is necessary, you are encouraged to document the jurisdictional status of the wetland area, and seek technical assistance for planning these activities.

- Water management activities, including minor drainage, must not convert a wetland to a non-wetland, in order to maintain normal silviculture status under the Section 404 exemption clause.

- Limit the depth, width and length of new minor drainage ditches to only that which is needed to provide effective minor drainage for silvicultural activities on the given soil type of the site. Plan the system with the maximum effective distance between lateral ditches. *Refer to Figure 6A on the next page for a design example*.

- A drainage system should be designed, constructed, and maintained in a way to minimize surface runoff from entering into the ditch(es).

- Conduct excavation and other operations during periods of relatively dry soils, if conditions allow.

- Start excavation near the discharge end while leaving a plug of soil in place to serve as a temporary dam within the newly excavated ditch. This soil plug allows settling out of suspended sediments before connecting the new ditch with an existing drainage.

Technical assistance is available from public and private forestry or natural resources professionals.

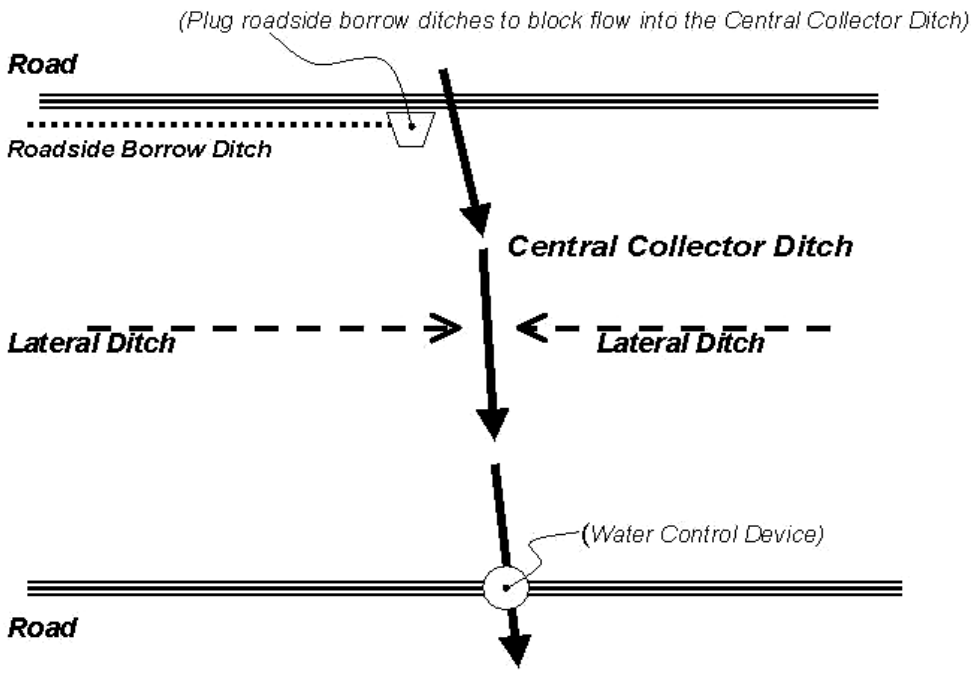
- For initial construction or maintenance, deposit excavated material (spoil) atop existing roads or on top of old spoil locations, if possible. Removal of the spoil from the site is also an option:
  -- If piling is necessary, use small piles with frequent gaps between them to minimize blockage of surface water flow during flood events.

  -- Stabilize the spoil material as needed to minimize sedimentation into nearby waterbodies.

- Install and maintain flow control devices as needed to manage water velocity and volume. These devices can help you to meet your water management objectives, as described earlier in this Part 6.

- Once flow control devices are no longer needed and your forestry objectives can still be met, consider re-filling or plugging the minor drainage ditch(es).

Figure 6A: Example diagram of block layout for ditches



Caption:
A generic layout design is provided here, as an example.

Position the lateral ditches in blocks parallel to roads, and discharge them into a central collector ditch perpendicular to the road.

By doing this, one water/flow control device at the outlet end of the collector ditch can control drainage outflow from that block without interfering with flow in the next collector ditch where discharge capacity may be needed for temporary minor drainage in another part of the forest.

Chapter 7
Forest Management Chemicals

For Forest Owners:

Chemicals used in forestry generally fall into two categories: Fertilizers and Pesticides.
Pesticides include:
- Herbicides (plants)
- Insecticides (insects)
- Rodenticides (rodents)
- Fungicides (fungus, mold)

The careful prescription and application of select chemicals can enhance forest growth in a number of ways. These chemicals, which include fertilizer and pesticide, are useful for:

- Controlling undesirable or invasive/exotic vegetation.
- Reducing wildfire risks.
- Improving soil nutrition.

In most cases, there are federal and/or state rules that describe what actions must be done to use the chemical properly. This information should be available on the product's label and/or Safety Data Sheets (SDS).

Helpful Hints:

Valuable information is provided on the product container labels, including recommended drift control additives, surfactants and other enhancing adjuvant.

Labels also alert you to protective equipment needs, mixing instructions, wind speed, temperature limitations, and first aid procedures.

Water Quality Link

When applying these chemicals it is necessary to take precautions so water quality is protected. For many chemicals used in forestry, it is illegal to apply them to water, or allow them to be washed into waterbodies. Only those chemicals labeled for aquatic use may be applied over or into waterbodies.

Rules Related to Using Forestry Chemicals in North Carolina

FPG

FPG .0206 and FPG .0207 explain what standards must met when using pesticides and fertilizers.

Forest Practices Guidelines Related to Water Quality (FPGs)

DWR riverbasin and watershed 'Riparian Buffer Rules'
Restricts the use of pesticides and fertilizers within the buffer.
Consult each rule for your specific riverbasin or watershed.

Pesticide Applicator Licensing Requirement
02 NCAC 09L .0503 through .0519 defines who is allowed to apply pesticides and what procedures they must follow to be licensed.

Aerial Application of Pesticides
02 NCAC 09L .1001 through .1005 defines rules related to aerial application of pesticides, including restricted areas.

N.C. Pesticide General Permit #NCG560000 under the NPDES
This permit may be required when aerially applying pesticides.

Site and Chemical Factors to Consider

Also Refer To…

Part 5 of Chapter 1 to learn about soil factors.

Protecting water quality must be considered when using forestry chemicals. When planning their use, it is important to learn the characteristics of the chemicals to be used. It is necessary to take into account site factors such as topography, soil conditions, drainage and other factors to adequately protect water quality. Two important chemical characteristics are explained below.

1. Mobility: The ability of the chemical to move through the soil and environment. A chemical that has high mobility may easily move off-site.

2. Persistence: The length of time a chemical remains active after application. A chemical with long duration persistence may have long-lasting effects once it is applied.

Caption:
Herbicides, other pesticides, and fertilizer may be applied with ground-based equipment or helicopters.

The weather conditions during and immediately following application can determine how water quality may be affected by the chemical's usage.

Figure 7A: Applying herbicides with tractor-mounted equipment in eastern North Carolina

BMPs for Handling, Mixing and Storing Forestry Chemicals

- Refer to the product's label(s) and/or SDS for specific recommendations.
- Properly store, mix, and load chemicals away from SMZs or in a location where spills or leaks will not enter the water.
- Properly dispose of chemical containers according to product label recommendations and applicable laws.
- Park equipment used for application equipment outside of the SMZ or away from water.
- Plan for the containment and cleanup of spills or leaks by having suitable tools or materials available.

Also Refer To…
Chapter 8 to review the BMPs for Fluid Management for their potential application as it relates to equipment and fluids.

BMPs for Applying Forestry Chemicals

- Refer to the product's label(s) and/or SDS for specific requirements.
- Maintain accurate and calibrated application equipment so the correct amount of chemical is applied.

Helpful Hints:

Consider getting a soil or foliage analysis to determine the amount of fertilizer needed.

Did You Know?

For many forestry-labeled pesticides, helicopters are required that have specific nozzle pressures and configurations.

Refer to the label for specific requirements.

Most herbicide labels require aerial spraying to cease when:

- *Wind speed exceeds 6 MPH, or*
- *Air temperatures reach 90°(F), or*
- *In advance of unstable weather.*

For Forest Owners:

When contracting for chemical application:

-- Obtain and talk with references of other customers.

-- Be certain the applicator is licensed (if applying pesticide).

-- Ask for proof of liability insurance and Worker's Compensation insurance.

-- Require a written contract that specifies the details of BMPs, the chemical treatment, and a clause that the applicator is responsible for adherence to all state and federal laws.

- Use the minimal amount of suitable chemical(s) needed to accomplish the desired result(s).

- Avoid broadcast-style of application within or over SMZs and water, unless the chemical to be applied is labeled for aquatic use.

- Apply at least 50 feet away from an intermittent or perennial stream or perennial waterbody, unless the targeted area falls within this distance range. Take precautions to protect water quality if applied closer than this.

- Apply in a controlled manner and only to those areas that need it:

Pesticide :

-- Refer to the rules that apply regarding FPGs, buffers and restricted areas.
-- Use aerial and ground application methods designed to assure optimum control of the spray path that produces minimal drift.
-- Low-pressure and large droplet nozzle equipment should be used.

Fertilizer :

-- Refer to the rules that apply regarding FPGs and buffers.
-- Apply sparingly within ephemeral areas. Avoid applying if forecast precipitation could wash the fertilizer into an intermittent or perennial stream or waterbody.

Emergency, Toxic Exposure and Spill Contacts

Personal Health & Safety - - *Call 911 for immediate life-saving help*
Carolinas Poison Center
1-800-222-1222 (www.ncpoisoncenter.org)

Spill Control and Notification NCDENR Regional Offices

Asheville	(828) 296-4500	Washington	(252) 946-6481
Fayetteville	(910) 433-3300	Wilmington	(910) 796-7215
Mooresville	(704) 663-1699	Winston-Salem	(336) 771-5000
Raleigh	(919) 791-4200		

N.C. Division of Emergency Management 24-hour HotLine
1-800-858-0368

National Response Center
1-800-424-8802 (www.nrc.uscg.mil/nrchp.html)

Pesticide Rules -- N.C. Department of Agriculture and Consumer Services (NCDACS) Pesticide Section:
(919) 733-3556 (www.ncagr.gov/SPCAP/pesticides/Authorit.htm)

Pesticide Information, National Pesticides Information Center
1-800-858-7378 (http://npic.orst.edu/)

Chapter 8
Equipment Fluids and Solid Waste

Helpful Hints:

For more information, refer to the product's Safety Data Sheets, or SDS.

Contact the NCDENR / DWR Regional Office for spill reporting rules information.

NCDENR / DWR Regional Offices:
Asheville
828-296-4500

Fayetteville
910-433-3300

Mooresville
704-663-1699

Raleigh
919-791-4200

Washington
252-946-6481

Wilmington
910-796-7215

Winston-Salem
336-771-5000

N.C. Division of Emergency Management:
24-hour HotLine to report environmental emergencies
1-800-858-0368

National Response Center
1-800-424-8802

Careful management of fluids and solid waste during forestry operations can protect water quality. Some ways to achieve water quality protection include:

- Maintain equipment to prevent or control fluid leaks.
- Store fluids in a way that contains any leakage or spill.
- Collect used fluid and waste to dispose of them properly according to applicable rules or laws.

Water Quality Link

Solid waste, oils, and other fluids can be potential pollution risks to water quality if not managed and controlled. This includes surface water and groundwater. The main points to remember are:

1. Control fluids to prevent them from entering the ground and water.
This includes maintaining equipment, preparing for spills, and properly disposing used materials

2. Collect and dispose of trash and other wastes.
This keeps waste from being washed into the water if left on the job site

A Note on Oils, Fuels, and Fluids:

This chapter focuses on BMPs and those rules only related to water quality. There are other rules about oils, fuels and fluids that you should be aware of. Those rules address product labeling, storage capacity and safe handling.

Rules for Notification of a Petroleum Spill*

Regardless of the amount of a spill, take immediate action to control and contain the spilled fluid.

Notify NCDENR / DWR within 24 hours of discharge or spill if:

- Amount is 25 gallons or more, *or*
- Spill causes a sheen on nearby surface water, *or*
- Spill occurs within 100 feet of any surface water.

No notification is needed, but cleanup must still occur if:

- Amount is less than 25 gallons, *and*
- No sheen is produced on nearby surface water, *and*
- The spill is located more than 100 feet from surface water.

Notify NCDENR / DWR immediately if:

- Amount is less than 25 gallons, *and*
- You cannot effectively clean it up within 24-hours of spill, *or*
- Spill causes a sheen on surface water.

**Petroleum spill notification rules are taken from N.C.G.S. Ch.143-215.85(b)*

Watch Out!

Keep the fluid from flowing into lakes, streams, or other waterbodies.

BMPs for a Fluid Spill

Protect yourself and others.

- Wear protective clothing and equipment.
- Avoid contact with any vapors or fumes.

Control the spill - - stop the leak.

- Keep fluid from spreading.

Contain the fluid.

- Create a temporary berm or dike around the spill.
- Use material such as bark, chips, sawdust, soil, limbs, or logs to soak up and/or contain the fluid.

Contact the nearest N.C. Department of Environment and Natural Resources' Regional Office for guidance on clean up and disposal per state regulations, or if you have doubt about how to handle the spill.

Quick action to contain the spill, stop its source, clean up the site, and report the incident will help to keep a spill from becoming a larger problem.

Managing Fluids

Helpful Hints:

To avoid the potential for large spills or leaks, only bring as much fuel, oil, and other fluids that you need for that day's work onto the job site.

Working over a tarp on the ground while servicing equipment may help keep fluid from soaking into the soil.

Prevention of a spill or leak by maintenance is typically less expensive than cleaning up a spill and site mitigation.

Ignoring a leak, spill or accepting fluid loss as a normal occurrence is not an acceptable practice. Be prepared for accidents and spills!

BMPs for Managing Fluids

- Frequently inspect equipment for leaks and repair them promptly or otherwise prevent the fluid from entering the ground and water.
  -- This is especially important on sites in which the groundwater level is close to the ground surface, such as in swampy locations.

- If equipment is washed while inspecting for leaks, only use plain water. Do not use degreasers or detergents.

- Designate specific areas for equipment maintenance and fueling. Level ground away from waterbodies provides the best location to avoid spills.

- Park and service equipment at least 100 feet from all streams, wetlands, ditches, and ephemeral streams if site conditions allow.

- Service equipment in a manner that minimizes the risk of fluids from entering nearby waterbodies or the groundwater.

FPG

Refer to FPG .0205

Helpful Hints:

A selection of locking pliers may also be handy to have for closing off broken hoses.

- Maintain tools and materials to contain and clean up spills and leaks. At a minimum, it is suggested to have on-hand and available:
  -- A variety of plugs and clamps to control a hose leak.
  -- Containers to catch and contain leaking fluid.
  -- Shovels and absorbent material or pads (booms) to stop fluid, soak it up and keep it from running across the ground.
  -- Plastic sheeting or tarp to create a barrier on top of the soil.

Consider using biodegradable lubricants.

- Keep used oil and other fluids in separate, labeled containers to prevent mishandling and allow for easier fluid disposal or recycling.

- Use suitable containers to store oils, fuels and other fluids that control or minimize leakage and spillage. Keep this material away from streams and waterbodies.

Figure 8A: A trailer used for holding fluid containers on a logging job

Caption:
An equipment trailer can be used to securely store fluid containers out of the way from vehicle movement where they may get crushed and leak fluids.

Even if a trailer is not used, you should keep fluid containers in a central and secure location away from streams.

Solid Waste Management

Manage waste products to keep them from getting out of control. Dispose of the waste properly.

Did You Know?

Most North Carolina towns and counties have waste & recycle drop-off stations, usually called Convenience Centers.

Waste includes containers, equipment parts, hoses, tires, batteries, trash, and other leftover man-made debris. Leftover waste or debris can pose a risk to water quality if left uncontrolled. In addition, a cleaned-up job site provides a much more favorable visual impression.

BMPs for Solid Waste Management

- Keep garbage in a container to collect all trash for proper disposal. If left uncontrolled, garbage and waste may pose a risk to water quality.

Helpful Hints:

In particular, remove and properly dispose all containers and parts that may have fluid on them.

- Empty waste containers once they get full.
  -- Doing this will keep waste in check and help prevent leakage, which protects water quality from pollution.

Also Refer To…

Recycling Vendors:
www.p2pays.org
N.C. Division of Pollution Prevention and Environmental Assistance 1-877-623-6748.

See Appendix 10 for an example.

- Secure the waste bin after work hours to prevent accidentally tipping it over or vandalism.

- Do not bury or burn the waste and trash on the job site. The remnants may wash into nearby waterbodies and create pollution problems.

Chapter 8 Summary

Proper handling of fluids and wastes will protect water quality.

Remember the five C's related to fluid and waste management:
Check equipment and the job site frequently for fluids and waste.
Contain any stored fluid and waste on-site with suitable containers.
Control leaks and waste material before it gets out of hand.
Clean-up and dispose of spills and waste promptly.
Contact the appropriate state agency for petroleum spills when required.

Chapter 9
Fire Management

Did You Know?

Fire is a natural part of North Carolina's forests.

Fire management includes both prescribed burning and wildfire suppression.

This chapter contains BMPs that can be used to protect water quality when using fire for forest management. There are BMPs for planning burns, using firelines, and controlling wildfire.

Water Quality Link

Using fire as a forest management tool may reduce soil disturbance that might otherwise happen from using heavy equipment to accomplish the same task.

However, if a fire burns too hot, (as happens on some wildfires) the upper layer of organic matter can be completely burned off, which exposes bare soil.

Helpful Hints:

Organic matter in the top layer of the soil's ground surface acts as a cushion to allow rainwater to soak into the soil below.

This top layer of organic matter is known as duff.

There are two main goals when protecting water quality related to fire usage:

1. **Retain a duff layer on the soil to allow precipitation to absorb into the ground, while still meeting the goals of the prescribed burn.**
   When water soaks into the ground, there is less chance that it will run-off and cause erosion into a waterbody.

2. **Minimize the risk of erosion into a waterbody from firelines.**
   Proper layout, construction, and stabilization will help control runoff.

For Forest Owners:

A prescribed burn uses fire to achieve forest management goals:
- Silviculture
- Reforestation
- Reducing wildfire hazard
- Wildlife enhancement
- Ecological restoration

Additional factors play a role in determining the erosion risk from using prescribed burns:

- **Groundcover**: Duff layer provides improved water infiltration.
- **Slope**: Steeper sites need more protection from runoff.
- **Firelines**: Minimize the area of bare soil and control runoff.
- **Rainfall**: Hard rains after a fire can easily wash away soil.
- **Intensity**: Intense fires may burn off duff or damage the soil.
- **Soil**: Some soils are more likely to erode than others.
- **Revegetation**: Promptly revegetate critical areas.

Rules Related to Forest Management Burning in North Carolina

FPG

Forest Practices Guidelines Related to Water Quality (FPGs)
Requires you to take action to prevent accelerated erosion.

DWR riverbasin and watershed 'Riparian Buffer Rules'
Restricts the use of prescribed burns within the buffer.
Consult each rule for your specific riverbasin or watershed.

Helpful Hints:

Contact your local office of the N.C. Forest Service if more information is needed on any of these rules.

Regulation of Open Fires [Cited in N.C.G.S. Ch113, 60.21 - 60.31]
Sets criteria for when and where burning permits are required.

North Carolina Prescribed Burning Act [Cited in N.C.G.S. Ch113, 60.40 - 60.45]
If you choose to follow the guidance defined by this Act, you must obtain a burn plan that is prepared by a certified burner, file it with the N.C. Forest Service, and burn according to the parameters in the plan.

For Forest Owners:

Variable burn conditions may include:
- Slope / terrain
- Fuel types / loads
- Weather
- Soil Conditions
- Forest health

Planning a Prescribed Burn

As part of a burn plan, it is suggested to include a description of where and what BMPs may be needed on the tract.

These BMP descriptions should also account for the variable conditions that may affect the fire behavior on your tract. *(see sidebar For Forest Owners)*

BMPs for Planning and Burning

- Burn according to site and weather conditions to achieve the desired results while protecting water quality.

Watch Out!

Retaining duff is especially important on areas with high erosion hazard or highly erodible soils.

- Retain a duff layer on the soil to allow water to absorb into the ground, while still meeting the goals of the prescribed burn.

- Keep high intensity burns out of the SMZ unless suitable measures are used to insure protection of water quality.

- When conditions allow, use natural or in-place barriers such as roads, canals, utility rights-of-way, streams, lakes, or wetlands to minimize the need for fireline construction.

- The type, width and location of firebreaks or firelines should be noted on the burn plan and/or map.

Firelines for Prescribed Burning

Firelines or firebreaks are needed to contain a prescribed burn. In many cases it is necessary to turn over several inches of earth with disks or plows to expose bare mineral soil for the fireline.

On sites where bare soil must be exposed to create an effective and safe fireline, you should pay attention to the potential erosion risk of exposed soil.

A Note on Firelines for Wildfire Control:

Firelines are also necessary to safely and efficiently control wildfires:

- The BMPs below are for firelines that are intended for a prescribed burn.

- While some of these recommendations may also apply to a wildfire situation, there are specific BMPs for wildfires later in this chapter.

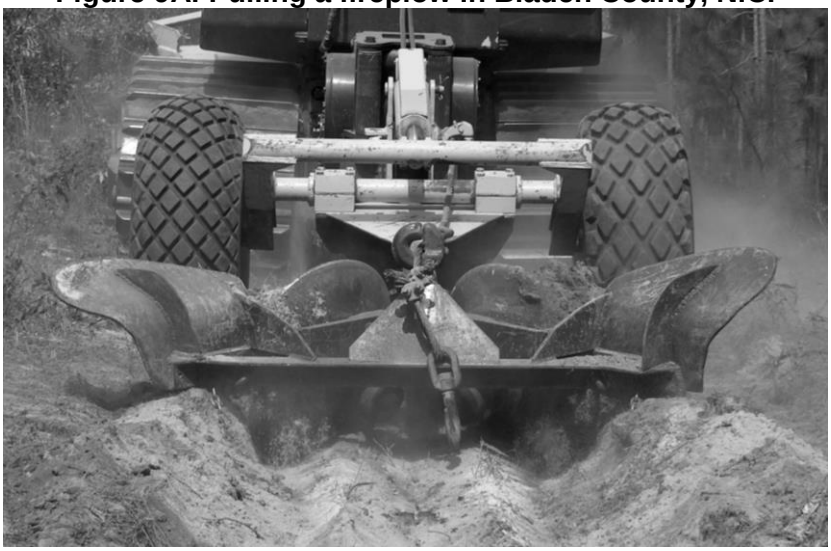
Also Refer To:

Chapter 5 for BMPs suggested for roads and skid trails that may also be useful for firelines.

While firelines are usually for temporary use, they should be planned and constructed with the same care and attention paid to water quality protection as with temporary roads and skid trails.

Firelines should be rehabilitated, retired, or otherwise stabilized in areas that pose a risk to water quality.

Figure 9A: Pulling a fireplow in Bladen County, N.C.



Caption:
Minimize soil disturbance when installing fireplow-lines, especially when located near streams or along slopes.

This fireplow-line is exposing an adequate amount of mineral soil to starve the fire but is not overly deep or wide.

BMPs for Fireline Construction

- Construct firelines only as deep and/or wide as necessary to contain the prescribed fire.
- Minimize using soil disturbing tractor-plow firelines if conditions allow.
- Construct firelines in a way that minimizes erosion and prevents runoff from directly entering waterbodies by installing and maintaining water bars, sediment traps, turnouts, or using other appropriate methods.
- When site conditions or burning techniques are suitable, construct firelines along the contour and avoid straight uphill/downhill placement.
- Fireline slope should be kept to 25 percent or less if possible.
- Try to keep constructed firelines out of SMZs, marshes or other environmentally sensitive areas. If a constructed fireline is needed in these areas, avoid using heavy equipment.

Helpful Hints:

Possible alternatives to constructed firelines include hand-cleared lines, natural firebreaks, or wet-lines.

Wet-lines are strips of land that are kept saturated with water during the fire.

Did You Know?

Slope percent is measured by vertical rise divided by horizontal run.

A 25 percent slope has 25 feet of height rise for every 100 feet of distance run.

BMPs for Fireline Maintenance

- Maintain erosion control structures to control runoff on firelines. Provide adequate cross-drainage where needed to avoid damming surface runoff.
- Minimize accelerated erosion into waterbodies and stabilize those areas that pose a risk to water quality.
- Clear streams and ditches of debris that was pushed in by fire equipment.
- Revegetate and/or stabilize firelines that pose a risk of accelerated erosion to waterbodies.

Also Refer To…

Chapter 11 for detailed BMPs on revegetation.

Wildfire Control

Did You Know?

The main objective of wildfire control is to protect life, property, and natural resources, in that order.

During a wildfire, firefighters work aggressively to contain, control and extinguish the fire.

Site rehabilitation and stabilization after a wildfire includes BMPs, but is usually the last step taken.

In most cases, these BMPs are not implemented until after a fire is both contained and controlled, and it is safe to operate in the burn area.

BMPs for Wildfire Control

Also Refer To…

Other previously noted fire management BMPs should be considered for their potential application when working a wildfire.

- Expose no more ground surface than is necessary to control the fire.
- Protect surface waters such as streams, rivers and other waterbodies from polluted runoff.
- Minimize soil disturbance along streambanks and within SMZs or riparian buffers. Avoid crossing streams with heavy equipment unless necessary.

Did You Know?

BMPs for wildfire suppression are usually implemented after-the-fact and depend upon the severity of the fire and the type of suppression techniques used to control the wildfire.

- Keep fire-retardant chemicals out of SMZs, riparian buffers or waterbodies as conditions allow.
- Clean and maintain firefighting equipment away from SMZs, riparian buffers or waterbodies.
- If water retention areas are constructed, they should be returned to their pre-existing hydrology as close as possible after they are no longer needed.

Helpful Hints:

Firefighter training can address the importance of protecting water quality with BMPs and doing site rehabilitation afterwards.

- Stabilize and/or retire firelines and access trails or roads that were created to control the wildfire. Consider installing suitable water (runoff) diversions, as described in Chapter 5.
- Establish groundcover, re-vegetate or stabilize areas that are a high risk of accelerated erosion.

Chapter 10
Site Preparation and Reforestation

For Forest Owners:

1) Successful site prep can improve the financial advantages of forest management by shortening the period of time to a partial and final harvest.

2) Sites that are very cleanly harvested may not require much site prep. This should be a goal during a timber harvest.

3) Intensive site prep may not be needed if converting former cropland or pasture to forest, unless weeds or grasses need to be controlled. This usually can be done with herbicides.

4) Seek consultation from a registered forester or other natural resources professional when evaluating your site prep needs.

5) Obtain a detailed plan and map outlining what site prep treatments will be done, including BMPs and a timeline.

The Reason for Site Preparation

Trees vary in their requirements for sunlight and soil exposure to successfully regenerate. This includes the majority of North Carolina's commercially valuable trees, as well as many that are valued for wildlife, recreation and visual beauty. Site preparation (referred to as "site prep") accomplishes one or more of the following objectives:

- Creates soil conditions for successful natural regeneration or tree planting.
- Promotes tree seedling survival by reducing plant competition for nutrients, water and sunlight.
- Improves soil moisture conditions.
- Makes tree planting easier by reducing or eliminating unusable debris.
- Enhances food and habitat conditions for certain wildlife species.
- Reduces wildfire hazards and improves access for firefighting.

Water Quality Link

There are numerous methods to prepare a site for tree regeneration. In many cases, site prep requires the use of heavy equipment and some degree of soil disturbance. Common themes for site prep to protect water quality include:

- Select the method(s) that accomplish your goals while minimizing negative impacts to the soil, organic matter, and hydrology.
- Operate heavy equipment when soil conditions are favorable for water quality protection and soil conservation.
- Only expose the minimum amount of bare soil as needed, especially on areas with high potential for erosion or near waterbodies.
- The site prep operation should not significantly reduce the infiltration capacity of the soil.
- Adjust site prep methods according to topography, soils, and water features Do not assume the same treatment will work across the entire site.

Rules Related to Site Prep for Forest Management

FPG

Forest Practices Guidelines Related to Water Quality (FPGs)

North Carolina General Statute 77-13 and General Statute 77-14

DWR riverbasin and watershed 'Riparian Buffer Rules'
These rules restrict certain site prep activities within the buffer zones.

Also Refer To…

Chapter 6 explains in more detail the Dredge and Fill Law and Corps/U.S.EPA Memorandum to Field

North Carolina Dredge and Fill Law
This state law requires that permits be secured for discharges of dredged or fill material in certain locations within the 20 CAMA counties.

U.S. Army Corps of Engineers / U.S. EPA Memorandum to the Field Related to the Silviculture Exemption (Mechanical Site Prep BMPs for Pine Plantations on Wetlands of the Southeast)

For Forest Owners:

Successful site prep should include planning.

A site prep or 'regen' (regeneration) plan should take into account:

- *Site, soil, and soil moisture conditions.*
- *Inventory of competing vegetation.*
- *Use of methods that minimizes soil disturbance and protects water quality while meeting the forest owner's goals.*
- *SMZs, buffers and BMPs.*
- *Consideration of using non-mechanical methods in areas prone to accelerated erosion or intensive soil disturbance.*
- *Required use of correctly maintained and operated equipment.*

Site Prep Methods and BMPs

The following site prep methods are commonly used for forest management in North Carolina, either by themselves or together with other methods.

The specific site prep prescription should be unique to the forest owner's objectives and the current condition of the site to be reforested.

Prescribed Fire

Prescribed fire improves access for tree planting and can create a suitable soil seedbed for natural seeding. Fire can also control competing vegetation.

Burning is cost-effective, but must be done by trained individuals due to obvious hazards involved with the use of fire. A burning plan likely will be needed as part of the regeneration plan if fire is used.

Refer to Chapter 9, *Fire Management* for BMPs on prescribed fire.

Shearing, Raking or Piling

These methods include the use of heavy equipment, such as bulldozers to knock down and pile unusable trees or leftover debris.

Extreme care by a skilled operator, using proper equipment, is required to insure water quality is protected from potential increased erosion and runoff and to prevent soil from being intensively disturbed.

A key point to remember is to minimize the amount of bare soil that is exposed, especially in areas prone to accelerated erosion or near waterbodies.

BMPs for Shearing, Raking or Piling

- Minimize the amount of soil that is disturbed by the equipment blade / rake and avoid uprooting leftover trees and stumps, thereby reducing the likelihood of loose soil eroding and being deposited into waterbodies.
- Prevent the movement of significant amounts of soil into debris piles, because this loose soil can easily erode and wash into nearby waterbodies:
- When conditions and goals warrant, minimize the removal of surface organic matter. However, in certain cases, heavy organic surface root-mats may need to be displaced to create suitable growing conditions for tree seedlings.
- Maintain existing debris and groundcover within ephemeral drains or dry gullies to provide filtering of runoff.
- Keep equipment out of the SMZ or riparian buffers.

Helpful Hints:

A toothed-rake may be more suitable for piling than an enclosed blade, since soil can escape between the rake's tines.

FPG

Refer to FPG .0202, N.C. G.S. 77-13 and N.C. G.S. 77-14

Helpful Hints:

Leaving gaps within a windrow also provides better access for wildlife and for wildfire control.

- For windrow placement:
  -- Set windrows along the land's topographic contour when suitable.
  -- When leaving openings within the windrow, stagger the openings from one windrow to the next. Doing so will filter the runoff and reduce the chances of concentrating or funneling the surface runoff.
  -- Avoid gouging the soil surface in a manner that could funnel runoff and transport sediment into nearby waterbodies.
  -- Frequently inspect the job site and stop work or change methods if intensive soil disturbance occurs, or water quality protection cannot be achieved at that time.

For Forest Owners:

Chopping is most effective on small diameter material and brushy vegetation. The intent is to chop the debris and vegetation, not the soil underneath!

Chopping during summer is usually preferred because:
- Soils are usually drier.
- It reduces the density of sprouts from undesirable vegetation.
- Leftover debris dries out better, allowing for a more effective prescribed burn.

Drum Chopping

A rolling drum chopper is used to sever, chop and/or compact vegetation, brush and small debris. If left standing, this residual vegetation and debris will shade out and inhibit growth of the newly regenerated trees.

The size, weight, and use of the chopper should be adjusted so vegetation is chopped and not pushed over.

BMPs for Drum Chopping

- Minimize the uprooting of leftover trees and stumps, which reduces the likelihood of loose soil eroding and being deposited into waterbodies.
- Appropriate equipment and usage should minimize intensive soil disturbance and reduce the risk of erosion and sediment transport.
- Avoid creating large contiguous areas of exposed, bare soil.
- Minimize the potential of concentrating surface runoff.
- Keep the number of passes made with the chopper and equipment to a minimum.
- Consider testing the chopper on a small area first, to see if it will meet water quality and site prep goals.

For Forest Owners:

Bedding is considered an acceptable forestry ('silvicultural') practice, including work in forested wetlands. However, in wetland situations, bedding must be done in a manner that does not convert a wetland to a non-wetland.

{continued}

Bedding

Bedding is the mounding of soil into strips or narrow rows ('beds'), usually done to improve spot-drainage and soil conditions in the rooting zone of planted seedlings. Bedding might also be done to incorporate needed nutrients.

BMPs for Bedding

- Conduct bedding work when the soil moisture is appropriate to avoid negative impacts to soil structure and infiltration.
- Keep the number of passes made with the bedding equipment to a minimum, according to site prep goals.

Bedding is usually only one part of a more comprehensive site prep prescription.

This Manual does not suggest that using bedding methods for site prep is, in itself, a BMP.

BMPs are provided here for situations where bedding is performed.

- When conditions allow, align beds along the land contours, and not up or down the slope. Minimize the potential of creating surface runoff.
- Retain undisturbed groundcover between beds.
- Stop beds at the outer edge of the SMZ or riparian buffer.
- Keep beds from connecting into a stream or water drainage system. Do not tie beds into ditches that outlet directly to intermittent or perennial streams.
- When leaving gap openings within the bed row, stagger the openings from one bed row to the next. Doing so will reduce the chances of concentrating or funneling the surface runoff, while preventing blockage of surface flow.
  -- Staggered openings are recommended on wetland sites, or on sites with frequent surface water sheetflow or heavy surface runoff.
- Consider pulling a test bed across a small area first to see if it will meet water quality and site prep goals.

Figure 10A: Ground-level view of a freshly pulled bed in eastern N.C.

Caption:
On this site, a single pass with a 'Savannah'-type bedding plow created beds (left) suitable for planting.

Un-bedded strips of soil (right) were left in between the bed rows.

The bedding was performed when soil moisture conditions were appropriate and not too wet.

Did You Know?

Tillage can be accomplished by one of several different methods:
-- Disking
-- Furrowing
-- Scalping
-- V-blading

Tillage

Tillage is a term used to describe the loosening of soil. Tillage in forestry applications often is used to create suitable root zone conditions for new plant growth, reduce unwanted vegetation, or incorporate soil amendments. Tillage can also improve water infiltration and soil structure conditions on areas of intensive soil disturbance (such as compaction, rutting, churning, etc.)

For Forest Owners:

For old fields or pastures, tillage may be all that is needed to prepare a site.

These old fields typically have a thick root mat of old grasses and a compacted layer of subsoil known as a 'hardpan' that must be tilled so tree roots can grow.

Ideally, soil should be moist when tilling, not too wet or too dry.

BMPs for Tillage

- Conduct tillage activities when soil moisture is appropriate to avoid negative impacts to soil structure and infiltration.
- When conditions allow, till along the land contours, and not up or down the slope. Minimize the potential of creating surface runoff.
- Retain undisturbed vegetation and groundcover between tillage strips to provide filtering of runoff across the ground surface.
- Stop tillage work at the outer edge of the SMZ or riparian buffer. Tillage should not funnel runoff into streams or other water drainage systems.
- Minimize tillage work within ephemeral drainages. Where possible, maintain existing debris and groundcover within ephemeral drains or dry gullies to provide filtering of runoff.
- Keep the number of repeated passes of the tillage equipment to a minimum, according to site prep goals.
- Consider pulling a test strip across a small area first to see if the tillage method you select will meet water quality and site prep goals.

Helpful Hints:

Lopping can be cost-effective on sites that have large, scattered trees as the only material needed to remove for tree regeneration.

Lopping

Lopping is the use of hand tools and/or chainsaws to fell, cut up and otherwise reduce leftover tree stems and debris. Lopping is a good choice on sites with soil that is susceptible to erosion or intensive soil disturbance because heavy equipment is not used and soil disturbance is minimized.

FPG

Refer to FPG .0202, FPG .0208, N.C. G.S. 77-13 and N.C. G.S. 77-14

BMPs for Lopping

- Lopping is a preferred method of vegetation management and site prep within the SMZ or riparian buffer.
- Retain sufficient shade within the SMZ as appropriate for site prep goals.
- Keep felled or lopped vegetation out of streams and waterbodies.

Herbicides

Watch Out!

Herbicides must be applied according the product label's requirements.

There are several herbicides that are suitable as a site prep method for forestry. Soil disturbance is usually minimized when using herbicides alone. However, herbicides often are only one part of a more comprehensive regeneration plan.

Herbicides can be applied in a variety of methods, including:

- Air application using a helicopter.
- Ground application using tractors or bulldozers.
- Directly injecting into stems or stumps ('hack & squirt method').
- Basal spraying ('thin line method').

BMPs for Herbicides in Site Prep

- Refer and implement the BMPs for forest chemicals as recommended in Chapter 7.

- If tractors are used to apply the herbicide, operate the equipment when site conditions are appropriate to avoid negative impacts to soil structure, infiltration or runoff.

- Keep the number of passes made with the tractor and equipment to a minimum.

For Forest Owners:

Planting work done with the assistance of a tractor is called machine planting.

This method is usually used on flat or rolling terrain that is relatively free of debris.

Tree Planting

Forest tree seedlings are either planted by hand or with the assistance of a tractor-mounted planting mechanism.

Generally speaking, hand planting does not create conditions that may be a water quality concern, but you may want to review the BMPs listed below to see if any apply to your job site.

Machine planting requires tractors to operate on the site. When heavy equipment works on a site, you should consider appropriate BMPs that will protect water quality as a result of equipment activity.

Watch Out!

Safety 1st - - - Evaluate the chances of the tractor and equipment rolling over when working on steep slopes.

BMPs for Tree Planting

- Conduct machine planting when the site conditions are appropriate to avoid intensive soil disturbance or accelerated runoff.

- Keep the number of passes made with the tractor to a minimum.

- Operate equipment along the contours if possible to avoid channeling surface runoff within the trench or slit created by the tree-planting machine.

- Properly dispose of all seedling bags, boxes and culled seedlings. Do not place them in or near streams or other waterbodies.

- Refer to Chapter 8 for BMPs on equipment fluids and solid waste.

Chapter 11
Site Rehabilitation and Stabilization

Chapter 11 Layout:

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Site rehabilitation (site rehab) includes those actions needed when closing out a job site, or portion of that job site, to promote the continued protection of water quality from accelerated runoff after the forestry operation is concluded.

Stabilization is only one part of overall site rehab, and usually refers to the application of groundcover, such as erosion matting and/or vegetation seeding.

Water Quality Link

Effective site rehab and stabilization will improve water absorption into the soil and help capture sediment, both of which minimize runoff. By reducing runoff, you protect water quality from potential pollution sources.

Allowing a site to naturally heal over usually is not enough on critical areas that may be prone to accelerated erosion, or on sites near waterbodies. That is why site rehab is needed, and required, by the FPGs.

FPG

FPG .0203 and .0209 are the two primary rules in the FPGs that deal with stabilization and/or rehabilitation.

Rules Related to Site Rehabilitation and Stabilization

Forest Practices Guidelines Related to Water Quality (FPGs)

North Carolina General Statute 77-13 and General Statute 77-14

DWR riverbasin and watershed 'Riparian Buffer Rules'
These describe situations within the buffer zone that require stabilization and/or site rehabilitation. Refer to the specific rules for your site.

Part 1 -- Planning Site Rehab

For Forest Owners:

Your long-term goals can influence the rehab and stabilization work done on your property. Examples of questions to think about include:

- *Are roads permanent or temporary?*
- *Are stream crossings needed after the job is complete?*
- *Is there a problem with trespassing?*
- *Do you want to attract wildlife to your land?*

Runoff after precipitation may wash sediment and other pollutants to nearby waterbodies at any time during a forestry operation. Because of this, it is important to consider site rehab and stabilization before, during and after forestry activities.

- For example, if a portion of a harvest site is completed and no other activities will be conducted on that portion, site rehab can be accomplished right away, instead of waiting until the end of the harvest job.

The most common places on a job site that need rehab work include roads, skid trails, decks, firelines and stream crossings. However, there may be other places on your job site that need rehab.

Helpful Hints:

Selecting an appropriate plant / seed to use is important to avoid the introduction of a nuisance plant that could inhibit the growth of native vegetation. Examples of pest plants include:

- *Japanese wisteria and honeysuckle*
- *Japanese stilt-grass ('microstigium')*
- *Sericea Lespedeza*
- *Some fescue and rye grasses*

BMPs for Planning Site Rehab

- Consider actions that may be necessary to stabilize and rehabilitate the site during and following the forestry operation. Implement these actions as soon as needed. Preharvest planning can help you with this. More information on planning is in Chapter 3.

- Understand the soil conditions so you will know which type of vegetation is appropriate, and how much (if any) soil additive will be needed:
  -- Consider having a soil test or foliar test done. Other sources of soils information include soil surveys, local knowledge or resource professionals with the USDA-NRCS, state Soil & Water Conservation District, or Cooperative Extension Service, among others.

- Evaluate which vegetation or plant seed will be appropriate for the job site. Knowing the landowner's objectives for the site may help you with this, but is not required in all cases.

Part 2 -- Controlling Runoff and Capturing Sediment

Part of site rehab includes installing BMP tools that control runoff and/or capture sediment.

BMPs to Control Runoff and Capture Sediment

Also Refer To…

Parts 1 and 2 of Chapter 5 to learn about these BMP tools.

- Use appropriate methods to control and/or capture runoff or sediment from entering into a waterbody. As a reminder, this may include:
  -- Broad-based dips, waterbars, turnouts, inside ditchlines, cross-drains, filter areas, sediment traps or pits, silt fences, hay bales, brush barriers, check dams or insloping, outsloping and crowning of roads.

- Consider placing logging debris such as slash, laps or limbs on critical bare soil areas as the forestry operation is ongoing. This material can help control runoff during and after the job:
  -- With each pass of the equipment, the logging debris is packed onto the soil surface, creating a mat of debris that intercepts precipitation and protects the soil surface from intensive soil disturbance by repeated equipment traffic.

Also Refer To…

Chapter 8 for additional BMPs on waste management.

- Remove waste and trash from the job site:
  -- Leftover materials can become a water quality pollution risk if they remain on site and are then washed into waterbodies by runoff.
  -- Do not bury or burn leftover waste on the site. Remove the waste products for appropriate disposal or recycling.

Caption:
This skid trail has debris packed down atop its running surface.

This debris acts like a cushion and protects the soil, while also filtering runoff.

If you use this method of stabilization, you need to pack down debris from the very beginning, rather than waiting until the end of the job to lay down the debris.

Figure 11A: Skid trail with logging debris packed down on the trail

Part 3 -- Rehab for Stream Crossings

Stream crossings should receive special attention during site rehab. This is due to the potential for direct flow of nonpoint source pollution from the job site into the water at the stream crossing.

FPG

BMPs for Stream Crossing Rehab

- Remove debris from the stream channel to avoid violations of the nine FPG standards as well as the N.C. General Statutes §77-13 and §77-14.

- Remove the stream crossing itself, if appropriate for the landowner's goals:
  -- This should include all fill material used for culvert installations.
  -- If all material cannot be removed, take action to insure this loose material does not enter the stream.

- Re-contour the streambank edges and approachways if needed to resemble their natural condition before disturbance:
  -- Minimize the potential for runoff to flow into the stream at the crossing.
  -- Reshaping may also promote successful groundcover establishment and/or growth.

- Use appropriate BMP tools to divert, control and/or capture runoff or sediment from entering the stream along the approachways to the crossing.

Caption:
This stream crossing is shown before rehab (above) and after (below).

Note the BMP/rehab work that was done:

- Logging debris removed from stream channel.

- Soil ruts eliminated at the crossing location.

- Streambanks and approachways seeded and mulched with fresh 'green up' of grasses.

- Additional brush barrier material piled near the crossing, on the opposite side of the stream.

Before removing and rehabilitating a stream crossing, be sure all of your work is completed on the 'other side' of the stream, because you do not want to cross back over once it is stabilized!

Figure 11B: A stream crossing that needs rehabilitation work

Figure 11C: Same stream crossing after rehab work is completed

Part 4 -- Controlling Access

Controlling access to forest roads, firelines, and skid trails results in more effective site stabilization which leads to clean water, improved property control, attractive aesthetics and enhanced wildlife habitat.

Part of access control includes monitoring and maintaining the site after the activity is complete. Monitoring the site will let you know if your BMP and rehab work has been altered or is no longer functioning the way it should.

For Forest Owners:

Prohibiting vehicles, ATVs, livestock, or intensive use of recently stabilized areas is important to promote the establishment of groundcover that can protect water quality for the long-term.

Don't forget to check at any unauthorized entry points such as utility and railroad corridors or along public road fronts.

BMPs for Controlling Access

- If a road or trail will no longer be needed, consider placing gates, fences or other barriers to keep out unnecessary traffic until the site stabilizes.
  -- Monitor the site or work with individuals in the area to monitor and inform you of unexpected activity on the site.

- Periodically monitor the BMP work and other potentially critical areas on the job site to see if erosion is being controlled as intended. Promptly make improvements or use corrective measures, as needed.
  -- Monitoring is especially helpful soon after heavy precipitation.

- In some cases, water diversion structures can be used as a deterrent to trespassing along a road or trail. Examples include waterbars, hay bales, brush piles, sediment traps or silt fences.

Part 5 -- Stabilization

FPG

FPG .0203 and .0209 are the two primary rules in the FPGs that deal with stabilization and/or rehabilitation.

Stabilization is the most vital part of closing out a job site. Successful stabilization often requires the application of some form of groundcover that will help:

- Soften the impact of raindrops and their erosion energy.
- Reduce the amount and speed of water runoff.
- Re-vegetate exposed critical soil areas that pose a risk to water quality.
- Add organic matter to the soil, which improves water infiltration.

Achieving successful stabilization usually involves some combination of:

- Preparing the soil, which could include adding fertilizer and/or lime.
- Seeding of vegetation.
- Establishing groundcover or mulch.

Helpful Hints:

Lime is strongly encouraged for most of North Carolina's soils, which are naturally too acidic for a quick 'green-up' of ground vegetation.

Factors to consider when selecting grass or vegetation seed type include:
- Season, weather.
- Soil type.
- Soil acidity (pH).
- Landowner objectives.
- Soil moisture.
- Plant characteristics.
- Cost.

BMPs for Preparing the Soil

- Where needed to promote vegetation establishment, limit disking or tilling to those areas that exhibit surface hardening, intensive soil disturbance or may be prone to accelerated runoff that can flow into a stream or waterbody:
  -- Doing so will allow better water absorption and reduce runoff.
  -- Disking also provides a better rooting zone for the vegetation roots.

- If soil additives such as fertilizer, lime, or organic matter are needed, adding them at the time of disking or tilling will incorporate them into the subsurface soil.
  -- This will improve the chances that the additives will not be wasted or wash away from the soil surface.

BMPs for Seeding of Vegetation

- Use seed or mixtures adapted for the site and soil conditions:
  -- Refer to the suggested seeding options provided in Table 11-1.
  -- Avoid the use of plants that historically have shown to become pests in a forest environment. These plants typically have little or no ecological value and in some cases can hinder long-term forest management.

- Spread seed evenly across the selected area during a time when adequate soil moisture and site conditions allow successful germination and growth:
  -- If conditions do not allow, use temporary measures, such as mulch until seed and/or vegetation can successfully establish on the site.

BMPs for Mulch or Groundcover

Helpful Hints:

Consider using straw for mulch instead of hay, since it is easier to apply and less likely to have noxious weed seeds.

- Apply mulch cover over seeded areas if needed to help seed germination, plant survival and to protect the seed from being washed away:
  -- Spread the mulch to cover approximately 50 to 75 percent of the seeded area or as needed according to the site conditions.
  -- Spread the mulch at a rate of about 100 pounds per 1,000 square feet

- Wood bark or wood chip mulch can sometimes also be used, either by itself as temporary groundcover, or as mulch overtop seeded areas:
  -- If used for temporary groundcover, spread the material several inches thick completely across the surface. Netting may be needed to secure the material in place.
  -- If used over a seeded area, cover approximately 50 to 75 percent of the seeded area or as needed according to the site conditions. Spread the material at a rate of about 250 pounds per 1,000 square feet.

Did You Know?

Other names for ECM:
- Coir mat
- Jute mat
- Excelsior mat
- Erosion blanket

- Erosion control matting, or ECM, may be a useful tool for permanent stabilization:
  -- Follow the seller's or manufacturer's instructions for installing.
  -- ECM can be very effective to stabilize side/cut banks and slopes.

Figure 11D: Erosion control mat installed for groundcover

Caption:
This erosion control mat is installed within a turnout outlet.

The mat allows rainfall to soak into the soil, and provides a seedbed for vegetation to permanently establish.

Helpful Hints:

More information is available from (alphabetically):

- *Consulting or Registered Foresters.*
- *Forest industry cooperative programs.*
- *N.C. Cooperative Extension Service.*
- *N.C. Forest Service.*
- *N.C. Wildlife Resources Commission.*
- *N.C. Soil & Water Conservation District.*
- *USDA-NRCS.*

Table 11-1 describes seeding options that can provide stabilization for the purposes of water quality protection on forestry sites. These seeding options have been field-tested and were selected because they are:

- Relatively low-cost.
- Readily available at many farm or garden supply centers.
- Easy to apply and handle.
- Visually pleasing.
- Adaptable to a wide range of soil conditions.
- Multi-functional and effective for stabilization while still allowing native plants and grasses to naturally revegetate in subsequent growing seasons.

Creeping Red Fescue is a critical component in these mixes. This grass is fairly tolerant of deer browse and provides non-invasive perennial grass cover, even on sites with active browse. Grains such as oats, wheat or rye provide quick green-up cover for site stabilization.

Table 11-1: Seeding Options for North Carolina Forestry Operations

Generic soil additive amounts for all seasons:	**Spring Application Mix**	
Fertilizer: *400 pounds per acre with 10-10-10.*	Creeping Red Fescue	20 pounds / acre
	Red Clover	10 pounds / acre
Lime: *2,000 pounds per acre with ground 'agricultural' lime.*	Oats	1 to 2 bags / acre
	Summer Application for Temporary Cover	
Conversions: *Pounds (#) of fertilizer that provide 1.0# of nitrogen per 1,000 sq.ft.:* *20# of 5-5-5.* *20# of 5-10-5.* *20# of 5-10-10.* *10# of 10-10-10.* *12.5# of 8-8-8.* *6.25# of 16-0-0.*	German Foxtail or Browntop Millet	25 pounds / acre
	Early Fall Application Mix	
	Creeping Red Fescue	20 pounds / acre
	Red Clover	10 pounds / acre
	Wheat	1 to 2 bags / acre
	Late Fall Application Mix	
	Creeping Red Fescue	20 pounds / acre
	Annual Ryegrass	10 pounds / acre
	Rye	1 to 2 bags / acre
	Winter Application for Temporary Cover	
	Annual Ryegrass	20 pounds / acre

Grain Application Notes:

- Grains are often sold by weight in pounds, or by volume in bushels:
  -- Wheat may be sold in 50-pound bags, or 1-bushel bags that weigh about 60 pounds.
  -- Rye is usually sold in 1-bushel bags that contain about 55 pounds.
  -- 'Certified' seed oats are sold in 2-bushel bags that contain about 65 pounds.
  -- Whole feed oats are sold in 50-pound bags. Feed oats are lower cost than certified seed oats, and can be used with the **Spring Application Mix**.
  -- Oats are not as cold-tolerant as wheat and rye, and they may die in the winter at high elevations if used in the **Fall Application Mix.**
  -- If the grain in the suggested application mix in Table 11-1 is not available, another should be substituted.
- For seeding with grains, a single bag (between 50 to 60 pounds) should be adequate for most sites. However, if slope or soil conditions warrant, increase the amount of grains to two bags (between 100 to 120 pounds).

North Carolina Forestry BMP Manual Appendix 1: (updated 2015)
Citation of Laws, Regulations, and other Requirements

.Pages 138 through 232 are not included in this Manual.
You can download Appendix 1 from the NCFS website, http://ncforestservice.gov

This is an updated version of Appendix 1 created for the 2015 re-printing of the N.C. Forestry BMP Manual. Certain rules that were cited in previous editions of the BMP Manual are not included, while new rules that were enacted since the original printing are included in this updated Appendix 1.

NOTE: AT THE TIME OF THIS 2015 REPRINTING, MANY STATE RULES WERE BEING REVIEWED FOR POSSIBLE CHANGES. PLEASE REFER TO THE RULES ON THE NC OAH WEBSITE FOR THAT RULE'S STATUS IF IN QUESTION: http://www.ncoah.com/rules/

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