GUIDE TO FORESTRY

Best Management Practices in Tennessee

TN Department of Agriculture | Forestry

This document is a publication of the Tennessee Department of Agriculture Division of Forestry. It fulfills a portion of the state's commitment under its Nonpoint Source Program and replaces the 2010 edition of "Guide to Forestry Best Management Practices in Tennessee".

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INTRODUCTION

An abundant supply of clean water has long been one of the main benefits derived from Tennessee's forested watersheds. Protecting water quality and preventing soil erosion during forestry operations is an important responsibility for forest managers, forest landowners, and loggers.

To meet the objectives of the Federal Clean Water Act, which states "to restore and maintain the chemical, physical and biological integrity of the Nation's waters," Tennessee has adopted Best Management Practices (BMPs) for forestry operations. These guidelines are to be used during the construction of roads, log landings, and skid trails to minimize the environmental impact of forest management activities. BMPs offer a flexible, preventative, and non-regulatory approach to protecting water quality and are designed to be low-cost, practical, and easily applicable to all forestry operations.

This BMP handbook is a reference guide for those who own forestland and/or work in the forest. Topics covered include forest road design, construction, and maintenance; stream crossings; special considerations for Streamside Management Zones (SMZs); timber harvesting and site preparation; wetlands and sensitive areas.

For help with BMP training, technical guidance, or the master logger program, contact the Tennessee Department of Agriculture (TDA), Division of Forestry (TDF) listed in the section on State resources.

FORESTRY BEST MANAGEMENT PRACTICES

As reported in the Tennessee Department of Environment and Conservation (TDEC), 2008 305(b) Report, The Status of Water Quality in Tennessee (305(b)), forest harvesting operations were a source of only 52 miles of pollutants in assessed rivers compared to 4,608 miles impaired by grazing of livestock in Streamside Management Zones (SMZs). Pollution from silvicultural activities is a small source of non-point source (NPS) pollution. However, poor road location, construction and logging practices can result in unnecessary environmental problems. Where roads, skid trails, log landings, and stream crossings expose soil, the possibility exists for the transport of sediment into streams.

NPS pollution can result from runoff associated with land management activities. This runoff can carry natural and manmade pollutants into waterways, wetlands, and ground water. NPS pollution can result from agriculture, forestry, mining, construction, and urban runoff. TDA maintains a non-regulatory NPS program to address agriculture and forestry water quality issues. Regulatory programs address NPS pollution resulting from mining, construction, and urban sources.

Pollutants from Forestry Activities Include:

- **Inorganic material** (soil) is the material suspended in water resulting from erosion. Soil from runoff causes cloudy water. These conditions inhibit the ability of aquatic organisms to breathe, feed, and reproduce.

- **Organic matter** is debris from living organisms. Examples of organic matter include leaves, twigs, limbs, treetops, and other plant material. Organic matter in waterways can impede navigation, restrict water flow, reduce oxygen, and change watercolor.

- **Sediment** is the matter (soil, inorganic material, or other solids) that settles to the bottom of a stream; material deposited by water, wind, or glaciers and covers the bottom of streams and lakes. Suspended sediments inhibit the ability of aquatic organisms to breathe, feed, and reproduce.

- **Pesticides** are chemicals used to control undesirable insects, disease, vegetation, animals, or other life forms. If used incorrectly, pesticides can be toxic to aquatic plants and animals.

- **Nutrients** are chemical elements required by plants/animals to live and grow. Fertilizer is an example of a nutrient that could be used in forestry operations. If used incorrectly, fertilizer can be toxic to aquatic life, cause undesirable aquatic plant growth, and change watercolor.

- **Elevated Water Temperature** caused by vegetation removal adjacent to waterways results in direct sunlight warming the stream. Warm water holds less dissolved oxygen than cool water and may not contain enough dissolved oxygen for survival of native species of aquatic life.

The 2020 Tennessee Forest Action Plan prioritizes protecting forests and soil to mitigate the impacts of a changing climate which are expected to manifest as prolonged, intense rain events followed by severe drying periods. With these anticipated extreme conditions, the soil column is at risk from desiccation and degradation thereby jeopardizing its ability to absorb and filter surface runoff. Forest managers, forest landowners and loggers can help to protect these resources by using the Best Management Practices described in this manual. Additional consideration may be taken to further mitigate against these impacts by installing larger culverts then prescribed, increasing the width of Streamside Management Zones, or increasing the number of sediment control structures.

Best Management Practices are forest management practices developed as practical and effective means to minimize or prevent pollution (NPS and point source) to waters of the state, and to prevent deterioration of the land and forest resources. This manual is a practical guide explaining how BMPs are best implemented.

In addition to above climate change mitigation strategies, forest industry and forest workers can help mitigate against increasing harmful greenhouse gas emissions. Some strategies may include: optimizing harvesting equipment, turning off equipment when not in use, plan and build roads to minimize disturbance, reduce skidding trips and utilizing wood waste.

LOCATING AND CONSTRUCTING LOG LANDINGS

Log landings are areas used to collect and process logs for transport to a mill. Due to concentrated traffic and heavy equipment, log landings experience a high degree of soil disturbance, soil compaction, and rutting. Storm water runoff and surface erosion may increase on these exposed areas and, depending on their locations, could influence water quality.

Figure 1. Revegetated log landing

BMP Guidelines for Log Landings

- Use existing landings from previous timber harvests, when possible.
- Locate landings outside of SMZs and sensitive areas.
- Slope landings 2-5% to allow for drainage.
- Maintain equipment to prevent leaking of fuels and lubricants.
- Install dikes and or berms to prevent runoff of sawdust, chips, fuels, and lubricants from entering streams.
- Revegetate landings to prevent undue soil erosion (Figure 1).
- Install drainage and sediment control structures to divert runoff.
- Examples of sediment control structures are silt fencing, hay bales, compost sock, etc.

LOCATING AND CONSTRUCTING FOREST ROADS

Figure 2. Permanent seasonal forest road

Forest roads are a necessary part of forest management activities. Construction of roads allow transporting timber products to market, providing access for fire protection and making the forest available for recreation and other uses. Forest roads, if not properly planned and constructed, are one of the single greatest sources of pollution. Forest roads should be designed, constructed, and retired in a way that prevents pollution from entering waterways.

There are three types of forest roads:

- **Temporary roads** are the most common type of forest road and are designed for short-term use during a specific project such as timber harvesting. When harvesting is completed, temporary roads are usually closed, and stream crossing structures are removed.
- **Permanent all-season roads** may have gravel surfaces and are designed for year-round use.
- **Permanent seasonal roads** are generally narrower than permanent all-season roads, built to lower design standards and have minimal surface gravel. Use of permanent seasonal roads may be restricted when conditions are excessively wet or during periods of freezing and thawing (Figure 2).

BMP Guidelines for Road Location

- Use soil surveys, aerial photo/imagery, topographic maps, field surveys, and site-specific knowledge to develop a road plan prior to road construction.
- Minimize the length of road to be constructed by using existing roads where practical and if properly located.
- Locate roads as far from water bodies as possible and practical. Avoid locating roads at the confluence of streams.
- Avoid building roads in SMZs and sensitive areas.
- Avoid or minimize stream crossings. If crossings are unavoidable, roads should cross streams at right angles . If possible, access the trees on the opposite side of the stream through another approach.
- Locate roads on upper slopes near the crest of ridges to promote drainage; locating roads on ridgetops is acceptable when proper drainage is taken into consideration.
- Fit the road to the topography by following natural features and contours.

BMP Guidelines for Road Construction

- Construct new roads several weeks or longer in advance of logging or other activity to allow the roadbed time to settle before carrying heavy traffic.
- Avoid road construction during periods of wet weather.
- Construct roads on grades of 2 to 12 percent, where possible. Steeper grades are acceptable for short distances only if adequate water control/drainage structures are provided.
- Minimize runoff into streams at crossings by using drainage and erosion control structures before approaches to the stream crossing.
- If constructing roads in SMZs, use gravel to reduce the risk of sediment getting into water sources.
- Runoff from roads should not directly discharge into a stream channel.
- Control runoff from roads using such techniques as varying the slope of the road, crowning, outsloping, insloping with ditches, water turnouts, sediment control structures, broad-based dips, rolling dips, water bars, and/or cross-drain culverts.
- Push trees and brush cleared for road corridors to the downhill side of the road to assist in trapping soil.
- Construct roads to increase sunlight hitting the surface to promote drying of the road.
- Minimize soil disturbance during road construction by keeping road width, right-of-way, and stream crossings to a minimum.
- Revegetate exposed soils in potential problem areas that could generate sediment. Examples of areas potentially needing revegetation include culvert inlets, ditch lines, stream crossings, cut and fill areas, and road surfaces (Figure 3).
- Gravel a minimum of 100 ft at entrances to public roads to remove mud from truck tires and reduce sediment transfer to the roadway.

DRAINAGE FROM ROAD SURFACES

Figure 3. Main log road with turn out.

Providing for adequate water drainage is a critical element of road construction and design. Properly drained roads produce less erosion, are easier to maintain, can be used for longer periods and allow more timely resumption of logging activities. Methods and structures for providing effective road drainage include varying the grade of the road, crowning, insloping and outsloping, water turnouts, broad-based dips, water bars and cross drain culverts. Water diversion and filter devices should be used to retire temporary roads, skid trails and roads that are not going to be used for long periods.

Table 1. Recommended Intervals for Changing Grade and Broad-Based Dips*

Road Gradient (%)	Approximate Distance Needed Between Grade Change or Broad-Based Dip (ft.)
2	300
3	233
4	200
5	180
6	167
7	157
8	150
9	144
10	140
11	136
12	133

*Computed from the formula: Spacing in feet = 400/slope % + 100 feet

BMP Guidelines for Road Drainage

- Vary road grade to reduce concentrated flow in road drainage ditches, culverts and on fill slopes and road surfaces (Table 1).
- Crown roads when located on flat or gently sloping terrain and when crossing a ridge.
- Outslope roads 2 to 4 percent when road gradient slope is less than 10 percent.
- Inslope roads 2 to 4 percent on extremely steep slopes and sharp turns as a safety measure. Insloped roads require drainage ditches, broad-based dips, rolling dips and/or culverts to carry water to downhill sides of road.
- Install water turnouts (wing ditches) to move water quickly away from roads. Water turnouts should route water into undisturbed areas allowing filtration before entering water bodies.
- Build broad-based dips during road construction at the recommended intervals (Table 1).
- Some highly erodible soils may justify armoring broad-based dips with large, crushed rock, gravel or other suitable material and installing riprap or other suitable material at the outlet of the dip to slow and absorb runoff to prevent water pollution and maintain road integrity (Figure 4).

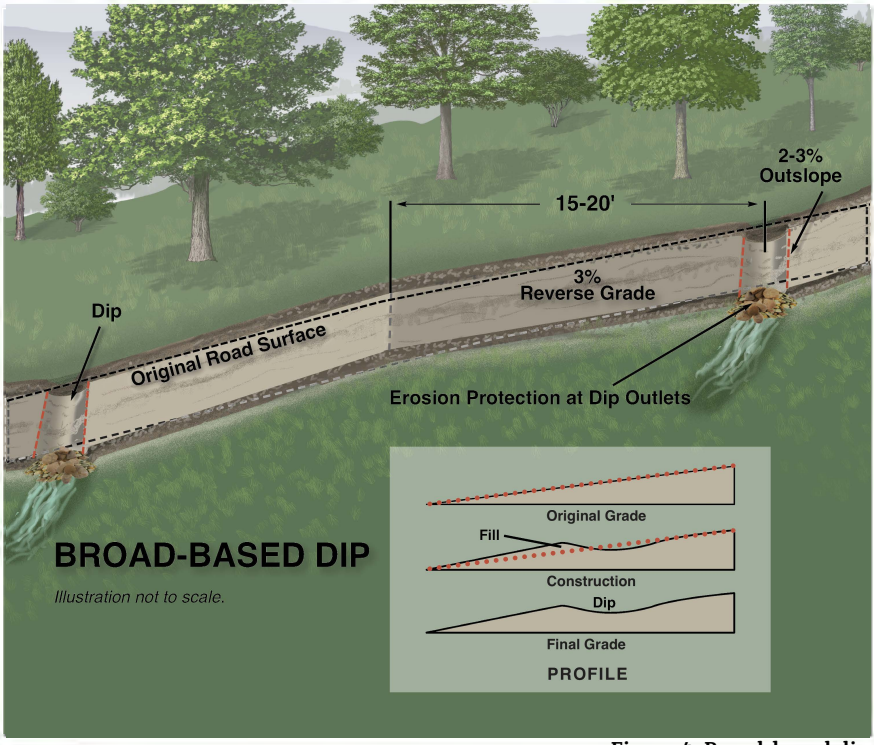

Figure 4. Broad-based dip

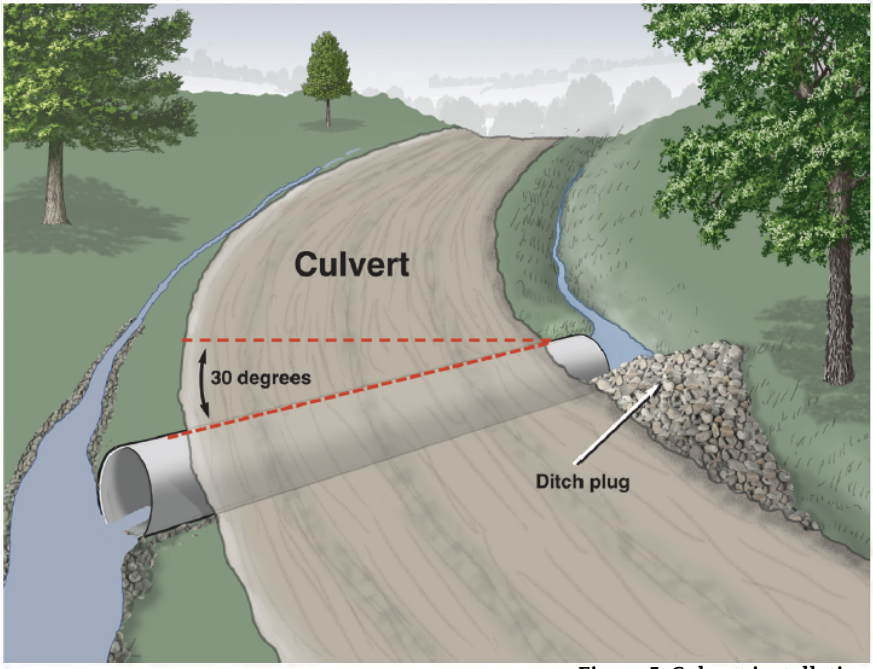

Figure 5. Culvert installation

Table 2. Recommended Spacing of Pipe or Cross-Drain Culverts	
Road Gradient (%)	Spacing (ft)
2 - 5	300 - 500
6 - 10	200 - 300
11 - 15	100 - 200
16 - 20	100

- Install cross-drain culverts at recommended intervals to carry water in drains, small streams, and side ditches across roads (Table 2).
- Install cross-drain culverts on a grade at least 2 percent more than the grade of the ditch it drains.
- Install cross-drain culvert on an approximately 30-degree angle down slope (Figure 5).
- Raise cross-drain culvert above ground level on the inlet end to allow sediment to settle. The inlet ditch should be plugged just beyond the culvert inlet to direct the water flow into the culvert. Provide a short fall at the outlet end and armor with rock just below the outlet so water will move away from the culvert.
- Keep cross-drain culvert inlets and outlets clear.
- Revegetate disturbed areas around cross-drain culverts soon after installation. Use cross-drain culverts adequately sized to handle drainage area above culvert location (Table 3).
- Compact soil on both sides of the culvert. Fill over the top should be at least half the diameter of the culvert with a minimum of one foot (Figure 6).

Table 3. Recommended Diameters of Culverts Based on Drainage Area

CULVERT SIZE	AREA DRAINED - ACRES		
Diam. in inches	Mountain Country	Rolling Country	Level Country
15	1	6	11
18	2	9	18
21	3	14	28
24	5	20	39
30	8	36	71
36	14	59	115
42	20	89	175
48	29	125	250
54	40	175	345
60	55	230	455
66	70	295	585
72	85	375	735

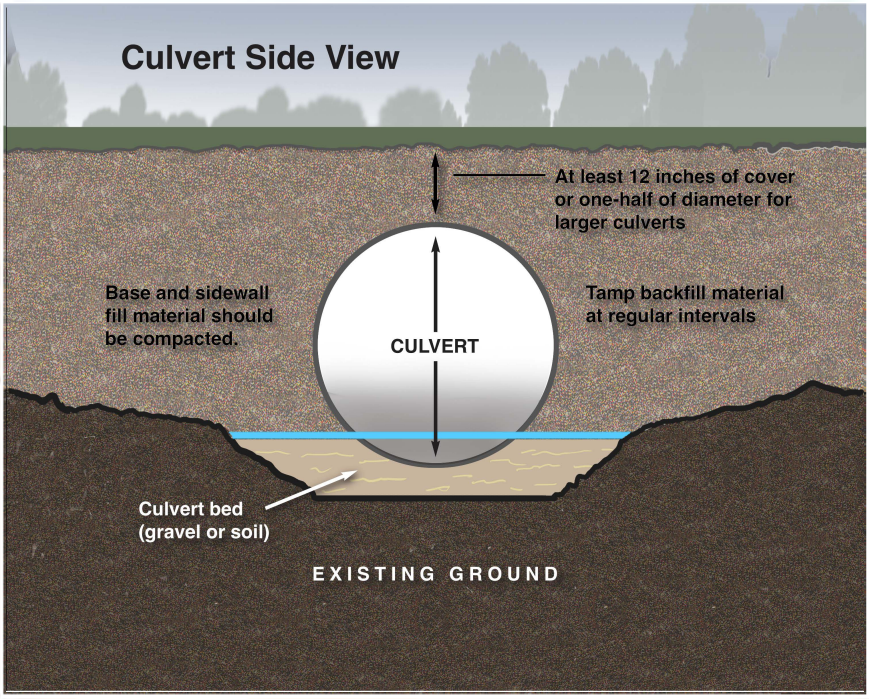

Figure 6. Culvert side

RETIREMENT OF ROADS AND SKID TRAILS

On temporary haul roads and skid trails, install water control structures immediately after finishing logging activities. Install structures such as water bars, brush dams, or lopping and scattering slash individually. If site is a high traffic area for 4x4 vehicles, consider installing gates or rock barriers to block off road from future unauthorized use.

BMP Guidelines for Water Control Structures

Construct water bars or other water control structures immediately after active logging has ceased. Logging delayed for substantial time requires the construction of temporary water and erosion control structures. Construct water bars/brush dams at the recommended intervals on temporary roads or skid trails once forestry operations are complete (Table 4, Figure 7). Typically place water bars at intervals of 6-10' change in road elevation and angled at 30 to 45 degrees with unobstructed turnouts. Construct brush dams so that water contacts the dams to slow velocity of the water and allows water to infiltrate into soil. Check turnouts and water bars following storm events to ensure they continue to function properly.

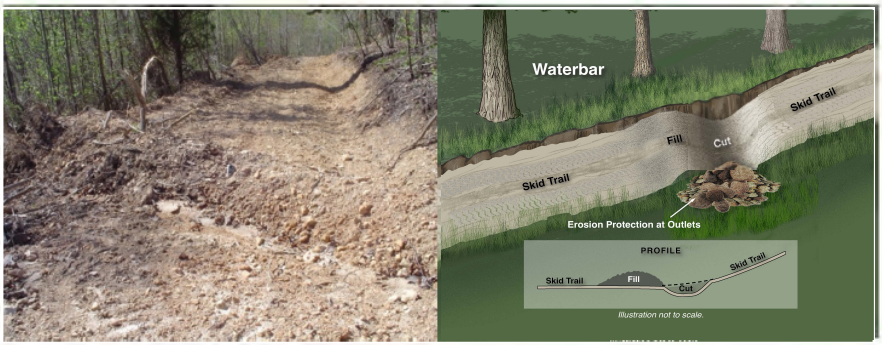

Figure 7a. Water bar construction

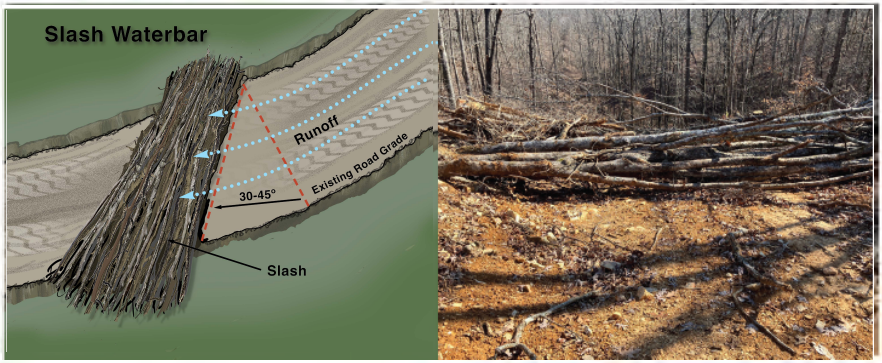

Figure 7b. Water bar construction

Table 4. Recommended Water Bar Spacing	
Road Gradient (%)	Spacing (ft)
2	250
5	135
10	80
15	60
20	45
25	40
30	35
40	30

- Water bars should have an outlet to carry water off roads or skid trails.
- Install water bars with a 20 to 45-degree angle.
- Revegetate water bars if they pose a potential water quality problem.

BMP Guidelines for Removing Temporary Structures
Upon completion of logging, remove temporary bridges, culverts, and pole crossings; remove soil deposits and debris from dips, ditches, and culverts; and revegetate/ stabilize problem areas.

BMP Guidelines for Revegetation
Use mulch and/or seed with lime and fertilizer when needed to prevent soil erosion. Recommendations concerning lime and fertilizer are available from University of Tennessee Agricultural Extension Service county offices.

Some plant types can stabilize disturbed sites quickly but do not offer good value for wild life and are not native species. It is best to discuss long term management goals with the landowner prior to harvest as well as who will be responsible for cost of the seed. Refer to Table 6 Seeding Recommendation on page 22 for details.

LOCATING AND CONSTRUCTING SKID TRAILS

Skid trails are paths established to transport logs or trees from the stump to a landing or log deck. Skid trails are for temporary use during the timber harvest. Improperly designed, located, and constructed skid trails can produce large amounts of sediment. Water pollution can occur if sediment from skid trails enters water bodies.

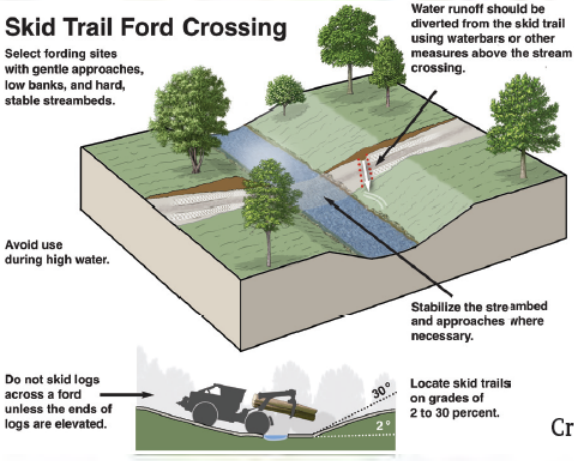

Figure 8a. Typical Ford Crossing Details

BMP Guidelines for Building Skid Trails:

- Minimize the number of skid trails
- Use existing trails, if properly located
- Locate skid trails on grades of 2 to 30 percent. Steeper grades are acceptable for short distances only if using adequate water control/drainage structures.
- Construct skid trails so that runoff does not discharge into a stream.
- Control runoff from skid trails using techniques such as:
  - varying trail grade,
  - installing water bars,
  - creating water turnouts, and
  - utilizing sediment control structures (i.e., brush/woody material).
- Prevent runoff associated with stream crossings
  - Avoid skidding across streams, wetlands, drains, and other wet and sensitive areas; do not use fords to skid across streams
  - Skid away from streams and drains to avoid channeling runoff
  - Use temporary crossing structures where necessary
- Do not operate equipment in streams.
- Skid following the contour or use a “zigzag” pathway
- Avoid channeling of water by not creating ruts and/or skidding directly up or down hill.
- Upon completion of logging:
  - remove temporary bridges and culverts
  - remove sediment and debris from ditches and culverts
  - revegetate potential problem areas
- Use mulch and/or seed to prevent soil from entering the stream. Recommendations concerning lime and fertilizer are available from University of Tennessee Agricultural Extension Service county offices when needed.

STREAM CROSSINGS

Stream crossings are often necessary for access to forestlands. Crossing a stream or wet weather conveyance improperly can result in erosion and introduction of sediment into a stream. BMPs for stream crossings also apply to ephemeral streams and wet weather conveyances. Contact your local Area Forester office about complicated stream crossing planning assistance or the TDF Water Quality Forester for questions regarding compliance with BMPs.

BMP Guidelines for Stream Crossings

- Avoid or minimize stream crossings. If crossings are unavoidable, roads should cross streams at right angles where stream banks are low and should be used for hauling, not skidding.
- Locate crossings on the straightest section of streams to minimize disruption of normal stream flow.
- Avoid locating crossings at the confluence of streams.
- Design crossings to minimize disruption of movement of aquatic life.
- Approaches to stream crossings should rise away from streams to minimize erosion during high water and be graveled when necessary to prevent soil from entering the stream.
- Install broad-based dips and water turnouts to turn water off roads before entering the stream.
- Water turnouts should be installed on the forest road approximately 25ft (dependent on topography) from each side of the stream crossing to help disperse water & sediment before it can reach the stream crossing

Fords

- Use fords for haul roads, NOT for skid trails.
- Locate fords where stream banks are low.
- Fords should have a solid bottom.
- Where necessary, establish a smooth hard surface by using clean (not crushed) gravel to establish a low water crossing. Material should not significantly impede stream flow or release significant amounts of fine material into the stream.
- Use rock to armor entrance/exit to stream crossing (Figure 8b).
- Do not use or relocate rock already in the stream channel.

Figure 8b. Correctly Constructed Ford

Figure 9. Riprap to stabilize outlet

Culverts

- Size culverts to accommodate the area to be drained (Table 3, page 9).
- Install culverts in a manner that minimizes disturbance of stream channels and banks. Stabilize fill material with riprap and/or vegetation to prevent soil movement (Figure 9).
- Inspect culverts periodically to ensure that they remain free of debris and other blockages.
- Install culvert outlets on grade with the bottom of the stream channel to allow free movement of fish and aquatic life.

Figure 10. (left) Portable steel bridge suitable for hauling. (right) Temporary pole bridge suitable for skidding and hauling. Temporary bridge structures should be removed after use.

Bridges

- Locate bridges across narrow points of the stream on firm soils.
- Protect banks when constructing and removing temporary bridges.
- Do not cover bridges with soil.
- Skid trails can utilize temporary bridges or other crossing structures, but need to be designed to prevent equipment, logs, and sediment from entering stream channels, and structures removed after use (Figure 10).

ESTABLISHING SMZs

Streamside Management Zones (SMZs), also referred to as Riparian Management Zones (RMZs) are designated areas consisting of the stream and adjacent area of varying width (dependent on slope) where management practices that might affect water quality are modified (Figure 11). SMZs filter sediment and nutrients from overland runoff, allow water to soak into the ground, protect stream banks and lakeshores, provide shade for streams, and improve the aesthetics of forestry operations. In addition, SMZs function primarily for water quality protection and provide food, habitat, and movement corridors for both aquatic and terrestrial communities.

Figure 11. Streamside management zones

PERENNIAL AND INTERMITTENT STREAMS
Protect perennial or intermittent streams with an SMZ. This buffer provides protection to the stream even if water does not flow in the channel year-round. The following types of streams should have an SMZ:

Perennial Streams
- Contains surface water and flows most of the year
- Well-defined stream channel
- Aquatic plants and animal life present

Intermittent Streams
- Flows during wet seasons of the year, but not entire year
- Well-defined stream channel
- Aquatic insects and animal life present, but sometimes difficult to assess during dry periods
- Exhibits signs of water velocity enough to move soil material, litter, and fine debris

BMP Guidelines for Perennial and Intermittent Streams
- Plan SMZs before beginning the timber harvest.
- The width of an SMZ should be a minimum of 25 feet from the disturbed area to the stream bank for zero percent slope and 20 additional feet for each additional 10 percent of slope (Table 5). This applies to both sides of the stream (total minimum width of 50 feet).

Table 5. Streamside Management Zone Width Guidelines	
Slope Next to Stream (%)	Recommended SMZ Width (ft)
0	25
10	45
20	65
30	85
40	105
50	125
60	145

- Do not remove any trees within the SMZ if such removal would result in soil potentially getting into streams. If trees are harvested within the SMZ, maintain 50 percent of the overstory canopy within the SMZ.
- Do not use stream channels as roadways for any type of equipment or vehicles.
- Avoid operating harvesting equipment or vehicles within the streamside management zone. Cable and winch timber harvested within SMZs. Clearly mark SMZ boundaries prior to harvest.
- Immediately remove tops, branches, limbs, etc. from stream channel if inadvertently put there during harvest operations

Ephemeral Streams

- Flow in a diffuse manner during and for short periods following precipitation
- May not have a well-defined stream channel; commonly referred to as drains, draws, dry washes or wet weather conveyances
- Aquatic plant and animal life are not present, but care should be taken to ensure that sediment is not transported from the ephemeral stream into waterbodies downstream
- Leaf, twig and other forest litter is typically present or sporadically displaced

The establishment of an SMZ is not necessary for ephemeral streams. However, sediment deposited into these features could be transported into other waterbodies. Operators should modify and limit sediment producing activities near such features. Rutting in ephemeral areas that hold moisture for long periods after precipitation can alter how water is drained and should be avoided if possible. Consult with landowner or land manager if unsure.

BMP Guidelines for Ephemeral Streams

- Avoid skidding across streams, except at properly constructed crossings.
- Avoid locating roads in streams, except where necessary for crossings.
- Runoff should not be directed into ephemeral streams and drainages.
- Minimize soil exposure and compaction to protect ground vegetation.

SENSITIVE AREAS

Sensitive areas are site-specific natural or topographic features of consequence to an aquatic resource including, but not limited to, fragile soils, wetlands, sinkholes, seeps, springs and heads of springs, landslides, old gully systems, karst areas, and known locations of officially listed threatened or endangered species. Additional information on cultural and historic resources can be obtained from TDEC Division of Archaeology. Additional information on listed threatened and endangered species is available from the TFA, TDEC, and NatureServe online resources (https://www.tnforestry.com/species). Avoid activity that disturbs or disrupts such areas and promotes potential water pollution. Activity is not necessarily excluded from these areas; however, caution and judgment must be used when these areas are encountered.

BMP Guidelines for Sensitive Areas

- Avoid skidding within sensitive areas.
- Avoid locating roads within sensitive areas.
- Runoff should not be directed into sensitive areas.
- Minimize soil exposure and compaction to protect ground vegetation.

Karst, Caves and Sinkholes

Karst is a landscape descriptor for areas of soluble bedrock (e.g., limestone) which are characterized by underground drainage systems that are often directly connected to surface water via recharge points such as sinkholes, caves, sinking streams and base level springs. Fluviokarsts are also abundant in TN with those systems having water transition from surface water to groundwater back to surface water again. Therefore, the purpose of karst system BMPs is to minimize point and nonpoint sources of pollution from impacting both groundwater and surface water.

Soil Disturbance Activities, Trash, and Dirt

- Do not put trash or dirt in sinkholes, cave entrances, or sinking streams.
- Minimize soil disturbing activities (roads, decks, skid trails) in areas that drain into sinkholes, caves, or sinking streams.

Soil, Logging Debris, Fluids, and/or Other Waste Materials

- Do not push soil, logging debris, and/or other waste materials into sinkholes, caves, or sinking streams.
- Do not drain fluids from equipment onto the ground. They should be collected in a container, transported off site, and recycled or disposed of properly.

Sinkhole Buffer Zones

- Leave a minimum 25-foot buffer of undisturbed ground from the edge of all sinkhole areas.
- Divert runoff from haul/access roads, skid trails, and log landings so it does not drain directly into sinkholes, sinking streams, or caves. If runoff from these areas does enter a sinkhole, a Underground Injection Control (UIC) permit authorization may be required (see Modified Sinkholes in Appendix A). Contact Tennessee Department of Environment and Conservation, Division of Water Resources at 615-532-9224 to inquire about authorization requirements.
- Leave a buffer zone between any disturbed area and the open swallet of a sinkhole or cave entrance. Buffer zones should be 25 feet for areas of 5 percent slope, and an additional 10 feet in width should be added to this zone for each 5 percent increase in slope. Management techniques include buffer zones around sinkhole and cave entrances to provide food sources for cave life, regulate thermal variations, and prevent sedimentation.

Modified Sinkholes
Any sinkhole that has been modified to receive additional storm water runoff can be classified as a Class V Underground Injection Control (UIC) Well, which must be authorized by TDEC, Division of Water Resource's Underground Injection Control Program.

Cave Streams and Other Underground Surface Waters
Tennessee statutes and regulations have defined and protect surface water and groundwater as waters of the State. Classifications and criteria for waters of the State are provided in Rule Chapter 0400-40-03, General Water Quality Criteria.

Karst Groundwater Basin Protection
Wellhead Protection Areas are established for public water supplies that use karst springs or groundwater as their water source.

WETLANDS

Wetlands are a valuable component of Tennessee's forest resource base, providing benefits and functions including:
- Filtering silt and other pollutants, recharging groundwater supplies, lessening the potential for erosion and reducing downstream flooding during periods of heavy rainfall.
- Producing valuable timber.
- Providing high quality fisheries and wildlife habitat; and furnishing outdoor recreation opportunities.

Potential Impacts of Forestry Operations in Wetlands
Water movement in and out of the area maintains a wetland's unique characteristics. Forestry operations can potentially interrupt the natural movement of water in wetlands. Fill materials, logging debris, and soil rutting can impede natural drainage. This impediment can alter plant and animal species composition in wetlands. Other potential impacts of forestry operations in wetlands include accelerated soil erosion and soil compaction.

BMP Guidelines for Wetlands - Forest Roads
- Minimize the number of permanent and temporary access roads consistent with the purpose of the silvicultural operation.
- Roads should not impede natural flow in or drain wetlands.
- Locate all roads above and away from streams and wetlands to minimize discharges of dredged or fill material into streams or wetlands, when possible.
- Design the road fill with bridges, culverts, or other drainage structures to prevent the restriction of expected flood flows.
- Stabilize and maintain the fill during and following road construction to prevent erosion.
- Design road stream crossings not to disrupt the movement of aquatic life.
- Take fill material from upland sources whenever feasible.
- Remove all temporary fills in their entirety and restore the area to its original elevation.

- Provide for revegetation of roads following operations.
- Wetlands are unique areas and professional advice for BMP installation is recommended
- Establish riparian management zones (RMZ) around wetlands
- When there are streams located inside wetlands, follow SMZ guidelines.

BMP Guidelines for Wetlands - Timber Harvesting

- Plan logging during dry weather. Suspend harvesting operations when woods are flooded and during wet weather to reduce erosion, rutting and soil compaction.
- Locate log decks on elevated areas away from streams and as far as practical from SMZs and WMZs. Keep log landings small and few.
- Minimize site disturbance and soil compaction by using low ground pressure equipment and concentrate skidding on a few primary trails.
- Use wood mats when necessary to redistribute equipment and load weight (lbs per square inch) over a larger surface area.
- Avoid use of skidders in SMZs and RMZs; never skid logs through streams or sloughs.
- Revegetate log landings, skid trails and other disturbed areas if they pose a potential water quality problem.
- Do no leave excessive woody debris in wetlands.
- Avoid creating deep ruts; if created, restore, or fill deep ruts with natural materials after logging to prevent permanently altering wetland hydrology.

DEBRIS AND HAZARDOUS MATERIALS IN STREAMS AND LAKES

Figure 12. Avoid leaving logging debris in streams

Trees and associated slash can block the flow of waters in streams, cause channel erosion, and introduce excessive organic matter into streams (Figure 12). If not removed, logging debris has the potential to cause extensive flooding and alter stream channels. Improper equipment servicing can introduce hazardous or toxic materials to the harvest site. Plan when servicing harvesting equipment to ensure fluids and other materials do not spill and are disposed of properly.

BMP Guidelines for Limiting Logging Debris in Streams and Lakes:

- Do not fell trees in or across streams. Remove trees accidentally felled in or across streams in a manner that prevents channel and stream bank disturbance.
- Do not pile slash close to waterways. Pull slash far enough away from waterways to prevent it from washing into waterways during high water.
- Do not drag trees and tops through a stream channel.
- Do not remove stumps and roots from stream banks.

BMP Guidelines for Servicing and Maintaining of Logging Equipment:

- Prevent oil and fuel spills. If a spill occurs, clean up all spilled materials and contaminated soil and dispose of both properly. Information on proper spill containment and clean-up is available from a TDEC Environmental Assistance Center (EAC). Contact EAC by dialing 1-888-891-8332 to determine which field office to call. After 4:30 pm and on weekends contact the Tennessee Emergency Management Agency (TEMA) at 1-800-262-3300.
- Improper waste disposal may be a criminal offense. Tennessee Code Annotated 39-14-408 addresses "vandalism," (including polluting another person's real property). Tennessee Code Annotated 39-14-105 defines "grading of theft" (gradations of penalties based on value of theft or damage).

SITE PREPARATION AND TREE PLANTING

Use site preparation to control competing vegetation associated with forest stand regeneration. Many site preparation techniques expose soil and can cause soil erosion. The site preparation technique used depends on soils, slope, condition of the site, natural vegetation, tree species and cost.

There are three site preparation techniques:

- **Mechanical** site preparation controls undesirable vegetation using equipment and/or mechanical implements. Mechanical site preparation methods can create significant areas of disturbed and exposed soil. Such methods are more appropriate on level to gentle slopes.
- **Herbicide** site preparation controls undesirable vegetation. Herbicide site preparation is preferred in many situations since it does not disturb the soil.
- Use **prescribed fire** alone or in conjunction with mechanical or chemical site preparation. A properly conducted prescribed burn consumes a portion of the litter layer and only slightly increases erosion potential. Very hot fires that expose significant area of mineral soil on steep slopes may significantly increase erosion potential.

BMP Guidelines for Site Preparation:

- Choose a site preparation method that will expose and disturb as little bare soil as possible.
- Favor chemical methods over mechanical methods on steep slopes and highly erodible soils.
- Establish RMZs around waterways to minimize the possibility of sediment or chemicals entering waterways during site preparation activities.

Mechanical Site Preparation

- Carry out all mechanical site preparation operations and mechanical tree planting along contours.
- Avoid operating mechanical site preparation and tree planting equipment on slopes greater than 30 percent; hand plant on slopes over 30 percent.

Chemical Site Preparation:

- Follow all local, state, and federal regulations and label requirements in the application of chemicals and fertilizer.
- Never apply pesticides directly to water, except when registered for application over water.
- Establish RMZs between waterways and treatment areas to avoid airborne drift.
- Avoid the use of chemicals in or near sensitive areas.
- Consider weather conditions (such as temperature, wind speed and precipitation) and equipment capabilities to avoid herbicide drift.
- Calibrate spray equipment to apply chemicals uniformly and in correct quantities.
- Prevent chemical leaks from equipment. Check all equipment for leaking hoses, connections, and nozzles.
- Mix and load chemicals outside of RMZs and sensitive areas.
- Rinse spray equipment and discharge rinse water only in areas that are part of the application site. Never rinse tanks or sprayers in or near streams or wetlands.
- Dispose of chemical containers according to label instructions.

Prescribed Fire:

- Construct firelines on the contour in advance of prescribed burning.
- Avoid building firelines near sensitive areas such as streams and wetlands.
- Plow or blade firelines only as deep and wide as necessary to control the spread of the prescribed fire and to minimize soil disturbance.
- Construct water bars and water turnouts at recommended intervals on firelines to turn water into adjacent undisturbed areas (Table 4).

FERTILIZATION

Chemical fertilization is a valuable silvicultural practice that enhances tree survival and growth. The primary nutrients applied are nitrogen and phosphorus. Plan any fertilization to prevent direct applications and runoff into waterways. When conducted properly, fertilization poses little threat to water quality.

BMP Guidelines for Fertilization

- Determine appropriate amounts and types of fertilizer needed before application.
- Consider weather conditions (such as temperature, wind speed and precipitation) and equipment capabilities to avoid fertilizer drift into RMZs and/or waterways.
- Conduct all on-site fertilizer handling, such as mixing and loading, away from streams, ponds, wells, roadside ditches, and sensitive areas.
- Clean up and/or contain all fertilizer spills immediately.
- Dispose of fertilizer containers and/or excess fertilizer according to local, state, and federal regulations and label requirements.

STABILIZATION AND REVEGETATION OF DISTURBED AREAS

The purpose of revegetating disturbed areas is to reduce soil erosion. In combination with water control structures such as water bars, turnouts and broad-based dips, revegetation can help to limit soil loss and reduce nonpoint source pollution. Natural seeding from adjacent vegetation will colonize most exposed soil on disturbed areas in the long run, but areas with high erosion potential need to be regenerated quickly by seeding to reduce soil movement in the short term.

Proper Seeding Mix

- The objective is to stabilize the soil surface quickly. Different situations and planting dates require different seed mixes. Usually, an initial seed mix is applied that germinates quickly. Another mix of seed may be applied later to maintain longer lasting cover and to reduce erosion.
- Winter cover annual grasses, clovers, and native perennial species are recommended in replacement of other non-native species where possible to meet stabilization goals. While the species' grow less quickly, they may be appropriate in instances where other ecosystem factors such as native biodiversity are a concern.
- Table 6 outlines a few of the recommended seed mixtures, pure seed seeding rates (accounting for seed purity and germination percentage) and seeding dates.

Millet or buckwheat are recommended as more wildlife friendly alternatives to Kentucky 31 fescue on gentle slopes. If you have a shady area, consider using a creeping red fescue mix (option 3b). The vegetation in option 2c needs sunny conditions and will not thrive in deep shade. These grasses usually take longer to establish and need more care than mixes with millet, buckwheat, or fescue.

Even though fescue is not wildlife friendly, it is recommended on steeper slopes because of its ease of establishment with minimal site preparation and its hardiness during droughts. Fescue is one of the better grasses for controlling erosion on logging sites with exposed slopes.

Table 6. Seeding Recommendations

	Lbs/Ac	Seeding Dates
1. Temporary Quick Germinating Seeding		
a. Winter wheat, Spring oats or Cereal rye (annuals)	100-150	Aug 15-Oct 15 Feb 15-Mar 15 (oats only)
b. Browntop, Proso or Foxtail millet (annuals)	35	Apr 15-June 15
Longer Term Seeding		
c. Red or White Clovers (biennial and perennial)	8	Aug 15-Oct 15 or Feb 15-May 1
d. Switch grass, Big bluestem, or Indian grass with red clover added (perennials)	1-3 4	April 15-June 1
e. Tall Fescue (perennial)	15-20	Aug 15-Oct 1 or Feb 15-May 1
2. Permanent Mixtures on Slopes		
a. Tall Fescue and Birdsfoot trefoil (perennials)	15-20 10	Aug 15-Oct 1 or Feb 15-May 1
b. Creeping red fescue and White clover (shady perennials)	20 2	Aug 15-Oct 15 or Feb 15-May 1
c. Switch grass (perennial) and Partridge pea (annual)	8 5	Apr 15-June 1
3. Seeding Mixtures for Wet or Poorly-Drained Areas		
a. Red **and** Alsike clovers (biennial & perennial) **and** Birdsfoot trefoil (perennial)	6 each 6	Feb 15 – May 1 or Aug 15 – Oct 15
b. Switch grass **and** Alsike clover or Birdsfoot trefoil	8 6	April 15 – June 1 or Aug 15 – Oct 15
4. Seeding Mixtures with Native Species		
a. Switch grass and Indian grass **and** Big bluestem and Little bluestem (perennials) Partridge pea (annual)	2 each 1.5 each 5	April 15 – June 1

References:

Clatterbuck, W.K.; Coakley, C. 2023. Minimizing Erosion on Harvest Sites By Revegetating Logging Roads, Skid Trails and Landings. University of Tennessee Extension Publication PB1916. Knoxville. (https://extension.tennessee.edu/publications/Documents/PB1916.pdf).

Harper, C.A. 2019. Landowners' guide to wildlife food plots. University of Tennessee Extension Publication PB1874. Knoxville. (https://extension.tennessee.edu/publications/Documents/PB1874.pdf).

Some landowners prefer using native grass species on their property. These grasses need a relatively good seedbed, require special care in seeding, have a narrow range of planting dates and take a year or more to establish. Generally, native grasses are used on log landings that are relatively flat, cultivated and in full sun. These mixtures will not thrive in shady areas. Native warm-season grasses are not a substitute for wildlife food plots. The grass provides nesting and escape cover only, with little wildlife nutritive value. These native seeds are sometimes hard to find and more expensive than other options. Additional information on native warm-season grasses and other wildlife habitat considerations is available from Tennessee Wildlife Resources Agency (TWRA) offices.

Preparing the Site for Seeding

Complete all site work following the logging operation such as removing berms, installing water control structures and grading for proper drainage before seeding. The seedbed should be prepared, especially when exposed soils are hard and dry. Simple measures that can be used are back-dragging dozer or skidder blades, or using a farm tractor with a disk, harrow, or rake. Good seedbed preparation will increase revegetation success and save money from repeated attempts to establish cover. Fertilization and liming are often effective in promoting growth on disturbed sites.

Seeding roads, skid trails and log landings reduce erosion and water pollution. Although the protection of water quality is the primary purpose of BMPs, landowner surveys indicate more satisfaction with the logging job when more attention is given to revegetating roads and landings. The “green” appearance of these areas shows that special care to control erosion is taken to ensure that the logging job is left in a desirable condition.

On areas where seeding is done to prevent sediment from entering streams, the sown areas should be mulched with hay or wheat straw to provide seed protection during the establishment period.

SEDIMENT CONTROL STRUCTURES

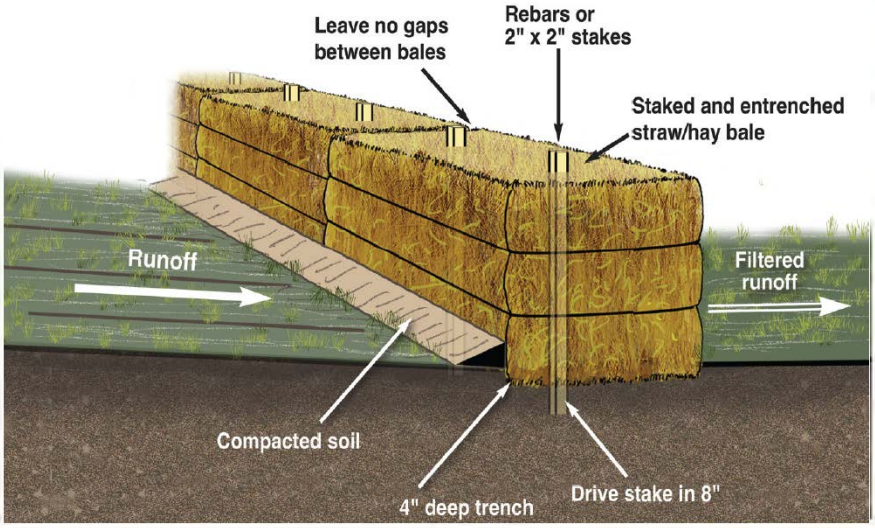

Figure 13. Use of straw/hay bales or a wattle for sediment control

Sediment control structures are natural materials, terrain features or manmade structures that trap and hold sediment and are generally located adjacent to water sources. New sediment control products and techniques are continually being developed with some proving to be practical and effective trapping and holding sediment. These structures can include straw/hay bale fencing, silt fencing, brush barriers and wattles (Figure 13). Sediment control structures slow the flow of runoff and trap sediment until vegetation is established on the sediment source. Barriers can also be used to keep sediment out of sensitive areas. Place sediment control structures as a linear filter fence along the lower margin of an area of disturbed soil, such as a road, skid trail or log landing. Position the material to prevent water from running under it. Monitor, maintain, clean, or replace sediment control structures to stabilize areas of exposed soil. Do not install Sediment control structures in stream channels.

FEDERAL WATER QUALITY LEGISLATION AFFECTING FORESTRY ACTIVITIES IN TENNESSEE

Federal Water Pollution Control Act
The passage of the 1972 Federal Water Pollution Control Act, now commonly referred to as the Clean Water Act (CWA), first linked water quality and forestry activities in Sections 319 and 404 of the act. Section 319 required states to establish non-point source pollution programs. Section 404 deals with dredge and fill activities occurring in streams and wetlands.

How Section 319 Affects Forestry
Amendments to the CWA specified that states could adopt either regulatory or non-regulatory programs for reducing water pollution discharges resulting from non-point source pollution. Non-regulatory programs, adopted by most states including Tennessee, are based on non-regulatory compliance with state water quality objectives. These programs often depend on educational and technical assistance for loggers (i.e., Master Logger program) and forest landowners that are enhanced by cost sharing or tax incentives. Regulatory programs impose mandatory restrictions on forest management practices and penalties for non-compliance. These programs tend to rely on inspections of forest management activities while the activities are in progress, as well as follow-up inspections to confirm compliance.

How 404 Affects Forestry Activities
Section 404 of the CWA requires that a permit be obtained from the Corps of Engineers before a discharge of dredged or fill materials can be made into streams and/or wetlands in Tennessee.

Although forestry activities that discharge these materials into wetlands are regulated, those activities are exempt if they meet the following conditions:

1. The activity's purpose is not to convert a wetland into upland where the flow or circulation of public waters may be impaired, or the reach of the waters reduced.
2. The disturbance is a part of an established or ongoing silvicultural, farming, or ranching operation and not a new use to which the wetland was not previously subject.
3. The logging or management activity uses normal silvicultural, farming, or ranching activities, which are in compliance with state and federal BMPs.
4. The area has not lain idle for so long that hydrological modifications will be necessary to resume operations.
5. The disturbance does not introduce any toxic pollutants listed under Section 307 of the CWA.

A forestry activity or operation will require a 404 permit from the Corps of Engineers when:

1. The activity results in the immediate or gradual conversion of a wetland to upland because of altering the flow and circulation or reducing the nation's waters.
2. The activity results in a change from the historical use of a wetland into a different use where the flow or circulation of waters is impaired, or the reach of the waters is reduced. Such a change does not meet the established ongoing requirement and causes the activity or operation to lose its exemption. An example would be an area where tree planting has been the established use and the landowner wishes to convert the site for use as pasture, green tree reservoir, agriculture, real estate, or aquaculture. In such cases, the landowner must first obtain a 404 permit before proceeding with the change.

3. The area has lain idle for so long that hydrologic modifications are necessary to resume operations.

Section 404 specifies that to obtain the silvicultural exemption, forest roads and skid trails must be constructed and maintained in accordance with the following baseline BMPs to retain Section 404 permit exemption status for the road operation.

1. Permanent roads, temporary access roads and skid trails in waters of the U.S. shall be held to the minimum feasible number, width, and total length consistent with the purpose of specific silvicultural operations and topographic and climactic conditions.
2. 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.
3. The road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows.
4. The fill shall be properly stabilized and maintained during and following construction to prevent erosion.
5. Discharges of dredged and fill material into waters of the U.S. 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 U.S. (including adjacent wetlands) that lie outside the lateral boundaries of the fill itself.
6. In designing, constructing, and maintaining roads, vegetative disturbance in the waters of the U.S. shall be kept to a minimum.
7. 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.
8. Borrow material shall be taken from upland sources whenever feasible.
9. 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.
10. Discharges into breeding and nesting areas for migratory waterfowl, spawning areas and wetlands shall be avoided if practical alternatives exist.
11. The discharge shall not be in the proximity of a public water supply lake.
12. The discharge shall not occur in areas of concentrated shellfish protection.
13. The discharge shall not occur in a component of the National Wild and Scenic River System.
14. The discharge of material shall consist of suitable material free from toxic pollutants in toxic amounts.
15. All temporary fills shall be removed, and the area restored to its original elevation.

STATE WATER QUALITY LEGISLATION AFFECTING FORESTRY ACTIVITIES IN TENNESSEE

Tennessee Water Quality Control Act
The Tennessee Water Quality Control Act (TWQCA) prohibits any person from causing a condition of pollution in state waters or altering the physical, chemical, radiological, biological, or bacteriological properties of state waters without the authority of a permit. A logging operation may be subject to the terms of this law. The TWQCA regulates forestry operations that create a point source discharge and any logging operation that causes pollution to any water source. These logging practices must comply with all aspects of the law, including obtaining any necessary permit(s). Typically, any forestry operation that implements the BMPs described in this manual will not likely create a point source discharge and therefore, will be exempt from the Act. However, silvicultural activities are still susceptible to creating point source discharges.

The following are some examples of logging practices that can create a point source discharge:

- Improperly constructed or placed stream crossings,
- Logging debris (treetops/limbs) in streams or wetlands,
- The discharge or spill of petroleum products, herbicides, or other chemicals into waters,
- Loose dirt, soil and sediment from haul roads or landings that enter waters,
- Improperly constructed skid trails, haul roads or landings,
- Altering a stream channel or wetland and
- Operating heavy equipment in a stream channel or wetland.

The Tennessee Department of Environment and Conservation, Division of Water Resources (TDEC-DWR), is the state agency responsible for "the abatement of existing ground and surface water pollution, the reclamation of polluted waters and the prevention of future pollution of waters in the state." The TDEC-DWR has been empowered "to exercise general supervision and control over the quality of all state waters, to administer and enforce all laws relating to pollution of such waters and to administer and enforce all laws consistent with the purposes of Tennessee's Water Quality Control Act (TCA 69-3-101)."

In 1995, TDEC and the TDA entered into a memorandum of agreement for the purposes of "establishing a cooperative, comprehensive and efficient program of effective water quality protection associated with silvicultural and agricultural production activities". The "cooperative and complementary expertise, resources, and authorities of TDA and TDEC are necessary to implement a successful water pollution protection program as may apply to these activities". TDA's primary role and function is to provide technical and financial assistance services associated with the design, installation, and maintenance of BMPs and the determination of the effectiveness of BMPs. TDEC-DWR's role is the administration and enforcement of Tennessee's Water Quality Control Act.

How TWQCA Affects Forestry Activities

- The TWQCA exempts agriculture and silviculture (forestry) activities from general permitting requirements "unless there is a point source discharge from a discernible, confined, and discrete water conveyance (TCA 69-3-120g)." Landowners are exempt from obtaining a permit for forestry activities on forest management operations.
- If the forest operation requires a federal §404 Permit, a state permit must also be obtained. The §404 Permit may be Certified by the State of Tennessee (which is called a §401 Certification). In this case, the §404 Permit is also the state permit. If the State of Tennessee does not certify the §404 Permit, an Individual Permit must be obtained from the TDEC-DWR. Additional information on permitting is available from a TDEC Environmental Field Offices.
- Activities that involve working in a stream such as stream bank disturbance and alteration, gravel removal or bank stabilization and installation of permanent stream crossing structures require an Aquatic Resource Alteration Permit (ARAP) from the TDEC-DWR.
- Stream, wetlands, and other aquatic habitat disturbances that result from forestry activities may be subject to a notice of violation, which requires operators to cease improper activities and/or unnecessary site disturbances. TDEC may impose fines for refusal to comply with notices of violation.

Master Logger

- According to Tenn. Code Ann. 69-3-138:
  - (a) (1) Whenever a person contracts in writing with a master logger to conduct any type of timber harvesting on the person's property, the master logger shall assume sole liability for compliance with this chapter for a period of one (1) year after the timber harvest is completed; provided, that the master logger gives written certification to the person that the master logger has designed a plan of best management practices (BMPs) to ensure compliance with all applicable water pollution control laws and that the master logger will install, maintain and adhere to established BMPs to ensure erosion and sediment controls to protect waters of the state in all harvesting activities on the property.
  - (2) The master logger shall not be responsible for the negligent or intentional acts of the landowner or any third party when such actions are the cause of a water quality violation. Actions and appeals resulting from a violation issued by the department shall be heard by the board of water quality, oil and gas established in § 69-3-104, in accordance with the procedures established by the board and in accordance with the Uniform Administrative Procedures Act, compiled in title 4, chapter 5.
  - (2) The master logger shall not be responsible for the negligent or intentional acts of the landowner or any third party when such actions are the cause of a water quality violation. Actions and appeals resulting from a violation issued by the department shall be heard by the board, in accordance with the procedures established by the board and in accordance with the Uniform Administrative Procedures Act, compiled in title 4, chapter 5.
- (b) As used in this section, "master logger" means a person who is identified by the Tennessee Division of Forestry as having completed all requirements of the Tennessee master logger program or a master logger program of substantially equal rigor provided in another state, including, but not limited to, maintaining all current continuing education requirements.

Silvicultural Activity Stop Work Order

The TWQCA was amended in 2000 giving the Commissioner of TDEC authority to issue a stop work order associated with silvicultural activities. Before a stop work order is issued, the operator will be given an opportunity to come into compliance, except when the Commissioner of TDEC deems otherwise necessary to address an immediate water pollution issue.

The following three conditions must exist before a stop work order can be issued:

1. An operator has failed or refused to use forestry best management practices (BMPs),
2. A point source discharge has been created because of failure or refusal to use BMPs, and
3. Waters of the State have been polluted because of silvicultural activities.

A stop work order will remain in effect until compliance is achieved.

The operator must notify TDEC and TDA of any new timber harvesting operations for a period of two years after the issuance of a stop work order or notice of violation.

GLOSSARY

Best management practice (BMP) - a practice or combination of practices which has been determined to be the most effective and practical means of preventing or reducing water pollution to a level compatible with water quality goals.

Broad-based dip - a surface drainage diversion built into the bed of a haul road. Broad-based dips are specifically designed to intercept and divert surface water flow out of a dirt road while allowing vehicles to maintain normal haul speeds.

Channel - a natural or manmade course that conveys water.

Contour - an imaginary line on the surface of the earth connecting points of equal elevation or a line drawn on a map connecting points of equal elevation.

Cover - any substance or material, such as grass, leaves, logging debris, or rock which overlies mineral soil and prevents raindrop erosion.

Culvert - a conduit through which surface water can flow under roads.

Crowning - road building technique slightly elevating the center of a road to allow water to drain into side ditches.

Ephemeral stream - commonly referred to as drains, draws, dry washes or wet weather conveyances that typically have no well-defined channel and flow in a diffuse manner only during and for short periods following precipitation. Leaf, twig, and other forest litter is typically present or sporadically displaced in the ephemeral area. Aquatic plants and animal life are not present in these areas.

Erodibility - the relative tendency of soil to erode based on physical structure and other characteristics.

Erosion - the process by which soil particles are detached and transported by water and gravity to some downslope or downstream deposition point.

Erosion rate - a measure of soil movement usually expressed as tons per acre per year.

Exceptional Tennessee Waters - are surface waters designated by the Division as having the characteristics set forth at Tennessee Rules, Chapter 0400-40-03-.06(4). Characteristics include waters within parks or refuges; scenic rivers; waters with threatened or endangered species; waters that provide specialized recreational opportunities; waters within areas designated as lands unsuitable for mining; waters with naturally reproducing trout; waters with exceptional biological diversity and other waters with outstanding ecological or recreational value.

Fill slope - the surface area formed where soil is deposited to build a road or trail.

Gully erosion - erosion process whereby water accumulates in narrow channels and over short periods of time soil is eroded away to substantial depths (one foot or more).

Harvesting - cutting and removal of timber products from forested lands which usually includes felling and bucking trees, skidding bucked and tree length logs, and loading logs at landings.

Herbicide - a substance used to prevent, control, or kill vines, bushes, trees, or other vegetation.

Hydrology - the science dealing with water on the surface of the land, in the soil, and in the atmosphere.

Infiltration - the process by which water enters and percolates through the forest floor and mineral soil.

Insecticide - a substance used to prevent, control, or kill insects.

Intermittent stream - a watercourse that flows in a well-defined channel during wet seasons of the year, but not the entire year. They exhibit signs of water velocity sufficient to move soil material, litter and fine debris. Aquatic plants and animal life are usually present, but sometimes are difficult to assess during dry periods.

Litter - organic matter such as leaves, branches, and other dead plant material which overlies mineral soil in forested areas.

Log deck/landing - an area, usually less than an acre in size, to which logs are skidded to an on-site mill or bunched for loading onto trucks for transport out of the woods.

Mulch - a layer of plant residue or other materials covering the land surface which conserves moisture, holds soil in place, minimizes temperature fluctuations, and aids in establishing plant cover. Examples include hay, straw, bark, wood fibers.

Non-point source pollution - pollution of water which is: carried or conveyed by natural processes including precipitation, seepage, percolation, and runoff; not traceable to a distinct or identifiable source; and better controlled through the application of good management practices.

Non-regulatory - a water quality management program under which forestry practices and use of BMP are not enforced by laws and regulations but which are expected to be adopted by land managers and forest operators.

Outfall protection - a riprap or aggregate placed at the outlet of a culvert or water control device to protect that area from erosion due to the force or velocity of water from the outlet.

Outsloping - an effective means of rapidly draining forest roads surfaces by tilting the road surface toward the downhill side at the rate of 1/4 inch per foot of road width or 2 to 3 percent.

Overland flow - waterflow across the ground surface caused by inability to infiltrate the soil.

Percolation - movement of water through the soil profile by gravity flow.

Perennial stream - a watercourse with surface water that flows in a well-defined channel throughout most of the year under normal climactic conditions. Some may dry up during drought periods. Aquatic plants and animal life are normally present and easily found.

Permeability - that quality of the soil which transmits infiltrated water deeper into the profile. Permeability decreases with depth of the mineral soil.

Pesticide - any substance used to prevent damage by, control, or kill animal or plant pests. Examples include insecticides, fungicides, herbicides, and rodenticides.

Point source pollution - pollution of water which is traceable to a distinct or identifiable source such as effluent draining from a pipe into a lake or stream.

Prescribed burning - deliberate use of fire as a tool to reduce hazardous fuel, prepare sites for planting, improve wildlife habitat, control vegetation and disease, or achieve other silvicultural objectives.

Regulatory program - a water quality management program under which laws and regulations are imposed by enforceable regulation of forestry activities and use of best management practices.

Rill erosion - surface erosion in which numerous small channels only several inches deep are formed.

Riparian area - that portion of the land along streams and wetlands where water has a major and direct influence on the land and its vegetation, and the land and vegetation have a direct and major influence on water. (See also riparian management zone)

Riparian Management Zone (RMZ) - a designated area that consists of the stream or wetland itself and an adjacent area of varying width (dependent on slope) where management practices that might affect water quality, fish, or other aquatic resources are modified. RMZs areas of closely managed activity, not areas of exclusion.

Riprap - aggregate placed on erodible sites to reduce the impact of rain or surface runoff.

Road cut - a portion of land surface or area from which soil has been removed or will be removed by excavation; the depth below original ground surface to an excavated surface.

Road segment - an indefinite length of road such as that portion of road between sequential control points.

Scarify - to loosen or cultivate the forest floor and topsoil to create conditions suitable for germination of seed.

Sediment - the matter (soil, inorganic material, or other solids) that settles to the bottom of a stream; material deposited by water, wind, or glaciers and covers the bottom of streams and lakes.

Sedimentation - deposition or settling of soil particles from suspension in water.

Sensitive area - site-specific natural or topographic features of consequence to an aquatic resource including but not limited to fragile soils, wetlands, sink holes, seeps, springs and head of springs, landslides, old gully systems and known locations of officially listed threatened or endangered species.

Sheet erosion - removal of a uniform layer of soil from the soil surface by overland (surface) flow.

Silvicultural activity - any practice or activity related to regenerating, growing, or harvesting trees for production of forest products and related benefits.

Site preparation - modification of a site for tree planting by controlling undesirable vegetation and/or cultivating the soil. Site preparation may be carried out by either chemical and/or mechanical methods.

Skid trail - an ungraded path in the woods along which wheeled or tracked vehicles or animals drag logs to log decks for processing or loading.

Slash – tops, limbs, and branches from harvested trees

Streamflow scour - erosion of stream channels and banks caused by the flow of running water.

Streamside Management Zone (SMZ) - consisting of the stream and adjacent area of varying width (minimum 25' dependent on slope) where management practices might affect water quality; also referred to as a Riparian Management Zones (RMZ)

Transpiration - loss of water into the air from leaves and other aerial plant parts by evaporation.

Truck road - an access road usually constructed for removal of timber from the woods to public road by truck.

Water bar - a structure constructed into a skid trail for achieving effective drainage, especially on temporary roads and trails.

Waters of the state - any and all water, public or private, on or beneath the surface of the ground, which are contained within, flow through, or border upon Tennessee or any portion thereof except, those bodies of water confined to and retained within the limits of private property in single ownership which do not combine or effect a junction with natural surface or underground waters.

Watershed - a drainage basin; an area of land from which a stream or other body of water gets its water supply; an area bounded on all sides by water parting and draining into a watercourse or other body of water. A watershed may be as small as the area that feeds water into a farm pond or as large as the Mississippi River Basin.

Wetlands - areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wetland Management Zone (WMZ) - consisting of the wetland and adjacent area of varying width (minimum 25' dependent on slope) where management practices might affect water quality; also referred to as a Riparian Management Zones (RMZ)

Wet weather conveyance - man-made or natural watercourses, including natural watercourses that have been modified by channelization, that meet the following:

a) The conveyance carries flow only in direct response to precipitation runoff in its immediate locality.
b) The conveyance's channels are always above the ground water table.
c) The flow carried by the conveyance is not suitable for drinking water supplies.
d) Hydrological and biological analyses indicate that, due to naturally occurring ephemeral or low flow under normal weather conditions, there is not enough water to support fish or multiple populations of obligate lotic aquatic organisms whose life cycle includes an aquatic phase of at least two months. (Tennessee Rules, Chapter 0400-40-3-.04(3)).

Wing ditch - a water turnout or diversion ditch constructed to move and disperse water away from a road and side ditches into adjacent undisturbed areas so that the volume and velocity of water is reduced on the road surface.

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