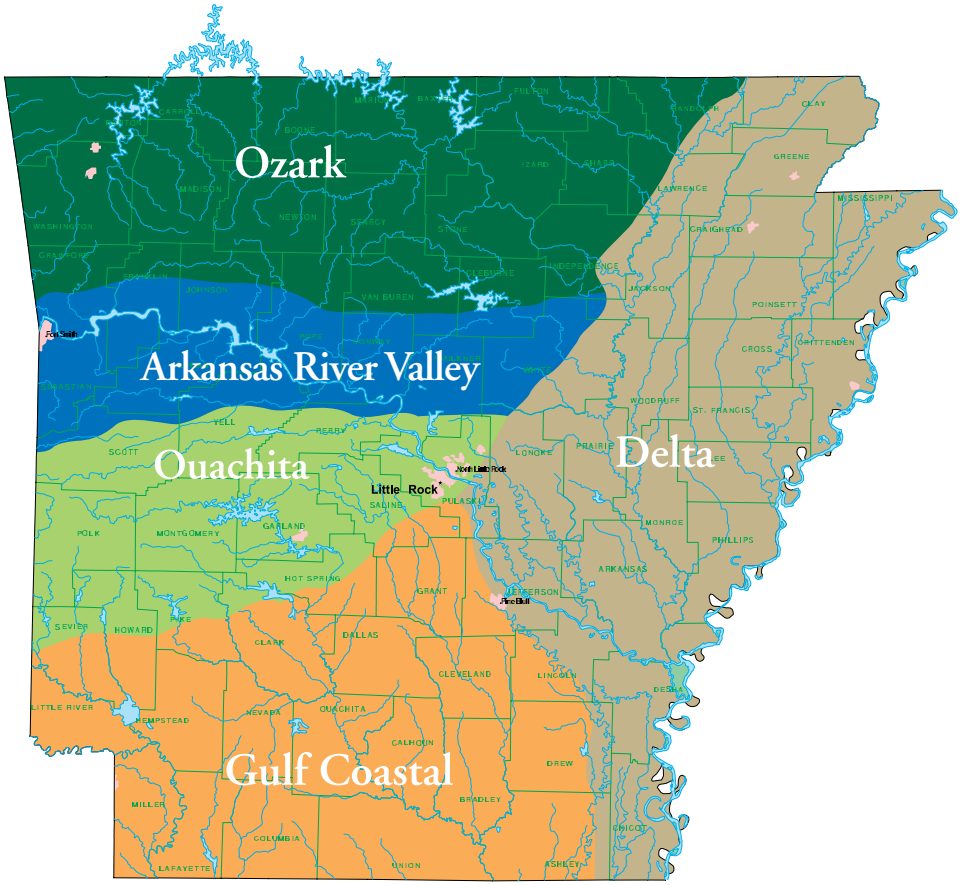
ARKANSAS FORESTRY COMMISSION

BEST MANAGEMENT PRACTICES

FOR

WATER QUALITY PROTECTION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March 16, 2002

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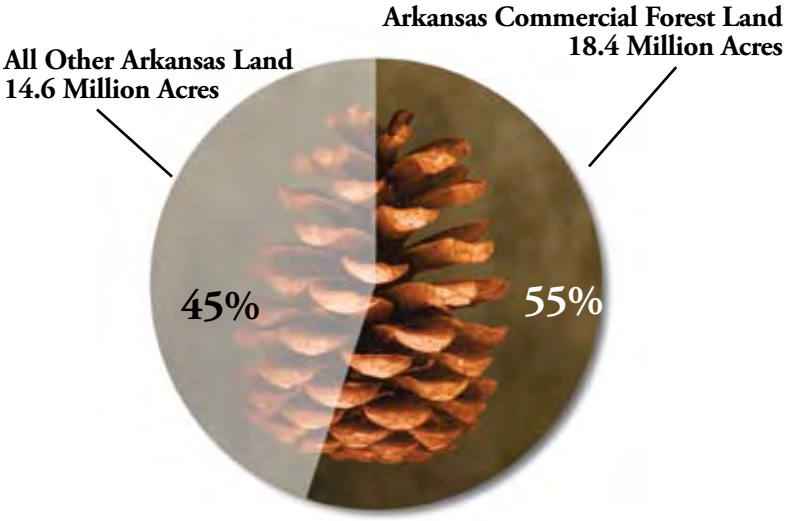
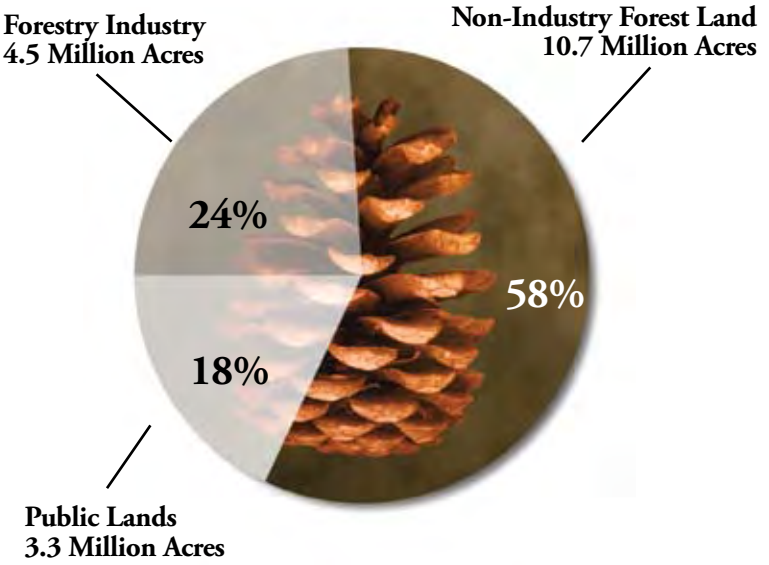
Arkansas Forestry Best Management Practices

Appendix

Status of Arkansas Forests & Lands





INTRODUCTION

Arkansas is fortunate to have vast, healthy, diverse, and productive forests. These forests are a tremendous asset to our environment and economy, providing wood products, recreation, and wildlife habitat. Forests processes maintain clean water. Sound management of forests is compatible with these values.

Silvicultural practices can cause soil to move into streams. Implementing Best Management Practices (BMPs) is an effective way to protect forest water quality. The purpose of this BMP booklet is to help forest landowners and forestry practitioners understand what BMPs are, why BMPs are important, and how to implement BMPs.

Forestry BMPs are important practices, which prevent or reduce the amount of erosion generated by silviculture. BMPs include structural and nonstructural controls, operations, and maintenance procedures that can be applied before, during, and after silvicultural activities.

Implementation of Arkansas' forestry BMPs is voluntary and the Arkansas Forestry Commission (AFC) strongly encourages implementation. The AFC adopted these BMPs in response to the Clean Water Act of 1977 and the Water Quality Act of 1987. The goals of these federal laws are to protect and improve the quality of America's water.

Forest wetlands are environmentally sensitive areas that are protected from nonpoint source pollution by Section 404 of the Clean Water Act Amendments of 1977. Normal forestry activities are exempt from National Pollution Discharge Elimination System (NPDES) permitting requirements within jurisdictional wetlands. Forest managers and landowners should become familiar with requirements that may exist, especially on jurisdictional wetlands. The Natural Resource Conservation Service (NRCS) and the U.S. Army Corps of Engineers can provide additional information. *(See Appendix, Section 15, page 47.)*

A thorough understanding of the BMPs and flexibility in their application are of vital importance in selecting BMPs that offer site-specific control of potential nonpoint source pollution. Those responsible for forest management practices should remain aware of potential problems and be prepared to make changes as they become necessary. With each situation encountered at various sites, there may be more than one correct BMP for reducing or controlling potential nonpoint source pollution. Care must also be taken to select BMPs that are practical and economical while maintaining both water quality and the productivity of forestland.

Use sound technical judgment and common sense when applying these guidelines, because a wide variety of topography, soils, climate, and other factors exists.

The AFC is the lead agency in Arkansas in establishing, interpreting, monitoring, and updating forestry BMPs.

1.0 PLANNING

Careful planning is an essential first step to environmentally sound forest management. Seeking professional assistance during planning can be critical in protecting water quality. The selection of silvicultural operators (loggers, site preparation contractors, foresters, etc.) who have received BMP training can help ensure that BMP plans are prepared and understood before starting silvicultural activities.

The first step in planning is to meet with the landowner and/or forester to determine appropriate BMPs. One of the final critical steps is to ensure the proper and timely implementation of pertinent BMPs.

1.10 General Guidelines

Resources available for planning a silvicultural project include aerial photographs, topographic maps, and soil surveys. These tools help identify sensitive areas including steep slopes and poorly drained or highly erosive soils. These tools can also help in efficient road and skid trail layout. They also assist in the identification of stream types (ephemeral or non-ephemeral), which is important in prescribing the level of protection. *(See Streamside Management Zone, Section 2.0, page 8.)*

Use available topographic maps, aerial photographs, and site visits to locate and plan protection for the following:

- Streams, drainage, and crossings
- Critical areas subject to rutting and/or erosion
- Existing roads and trails
- Proposed haul roads and skid trails
- Log landing locations
- Buffer zones for streams

Other planning considerations may include road and trail specifications, harvesting equipment needed, the best time of year to conduct the activity, timber sale contract requirements, special planning for wet areas, obstructions, and areas to avoid. Planning assistance is available from the

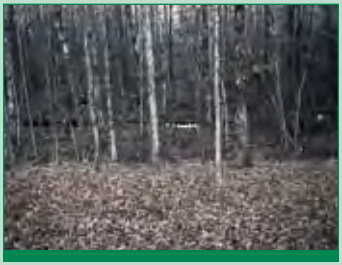
AFC, consulting foresters, and public agencies identified in the *Appendix, Section 15.0, page 47.* Topographic maps can be obtained from the Arkansas Geological Commission. *(See Technical Assistance Providers, Section 15.0, page 47.)* Soil maps can be viewed at county NRCS offices. Aerial photographs may also be available or viewed at NRCS or Farm Service Administration offices.

Effective planning for soil stabilization during all phases of silviculture is important. Planning and preparation result in the effective and timely implementation of BMPs and the protection of water quality. *(See Appendix, Section 11.0, page 39.)*

2.0 STREAMSIDE MANAGEMENT ZONES

Vegetation and soils adjacent to waterbodies are critical for maintaining healthy aquatic systems. Streamside Management Zones (SMZs) are buffer areas, strips of land immediately adjacent to waterbodies where timber management activities are particularly designed to protect water quality.

SMZs are established on both sides of streams.



SMZs:

- Slow and spread water flow
- Serve as a filter, which reduces movement of sediment and nutrients into waterbodies
- Stabilize stream banks
- Minimize logging debris from reaching the waterbody
- Act as a buffer strip separating the waterbody from areas that receive silvicultural chemicals

The SMZ provides water quality protection to adjacent waterbodies by maintaining bank stability and by filtering water moving into the waterbody. Only non-intensive forest management activities should be practiced in the SMZ. SMZ boundaries should be determined before operations begin. Recommended SMZ widths are surface distance not horizontal distance. *(See Appendix, Section 14.0, page 46.)*

For the purpose of establishing SMZ guidelines, the AFC recognizes two types of streams:

- Ephemeral streams have a defined channel but no banks. Water flows only during or immediately after rain. SMZs are not required.
- Non-ephemeral streams (perennial or intermittent) have a defined channel and often have banks. Water flows more than immediately after a rain. SMZs are recommended.

2.10 Non-Ephemeral Streams

.11 For slopes less than 7 percent the minimum SMZ width should be 35 feet on each side.

.12 For slopes 7 percent to 20 percent the minimum SMZ width should be 50 feet on each side.

.13 For slopes greater than 20 percent the minimum SMZ width should be 80 feet on each side.

.14 Select individual trees for harvest. Retain a minimum of 50 square feet of basal area per acre. Leave all trees if less than 50 square feet of basal area per acre exists. Trees should be evenly spaced throughout the SMZ to maintain bank stability and protect water quality.

.15 Fell trees away from the stream except where safety is a concern.

.16 Remove trees in a manner that minimizes disturbance to the forest floor, exposure of mineral soil, or reduction of stream bank stability.

.17 Plant seedlings or direct seed by hand.

.18 Remove significant logging debris dropped into stream channels.

.19 Do not handle or store toxic and hazardous materials such as fuels, lubricants, and solvents in SMZs.

2.20 Ephemeral Streams

.21 The optimal vegetated condition along ephemeral streams is overstory vegetation or trees. If this is not possible, lower lying vegetation and an intact forest floor is desirable.

.22 All harvest systems are allowed.

.23 Mechanical site preparation should not disrupt the ephemeral stream channel.

2.30 Braided Streams

Braided Streams are stream systems with multiple and frequently interconnected channels. Generally these streams have a very low gradient (<0.5 percent channel slope), broad valleys, and well-defined floodplains. Occasionally similar multiple channel streams can be found in higher areas with higher gradients.

.31 Consider the multiple channels as one stream. The SMZ includes all the land between the channels as well as the prescribed SMZ width adjacent to the most exterior channels.

.32 Follow other applicable SMZ guidelines for non-ephemeral streams.

2.40 Lakes and Ponds

SMZs should surround lakes and ponds.

.41 Minimum width of the SMZ should be 35 feet. The SMZ is measured beginning at the break in slope at the top of the shoreline.

.42 Follow SMZ guidelines for non-ephemeral streams. *(See Section 2.10, page 9.)*

2.50 Activities Discouraged in SMZs

.51 Harvesting trees growing directly on the bank or overhanging a water body.

.52 Prescribed fires that burn to mineral soil. Light, cool burns are permitted.

.53 Locating portable sawmills or log decks.

.54 Creating excessive rutting, especially where ruts run perpendicular to a stream.

.55 Leaving logging debris in front of cave entrances and in sinkholes if the effect is to change the natural flow of water.

Permanent Active Road

Temporary Active Road

ROADS

Proper road construction and maintenance protects water quality during and after silvicultural activities. BMP Implementation Surveys conducted by the AFC indicate that practitioners should focus more attention on implementing forest road BMPs.

The AFC distinguishes active roads (permanent or temporary) from inactive roads. BMP recommendations are different for active and inactive roads.

3.0 ACTIVE ROADS

Roads are active if they are subjected to vehicular traffic. Active roads may require implementation of BMPs during construction and maintenance.

3.10 Road Location/Planning

.11 Use soil surveys, topographic maps, aerial photographs, and site visits to plan road locations to protect water quality.

.12 Design roads to avoid or minimize stream crossings.

.13 Cross streams at right angles.

.14 Where topography permits, locate roads along the contour and along the crest of long ridges.

.15 There should be sufficient distance between the SMZ boundary and roadway to allow right-of-way maintenance.

3.20 Road Construction

.21 Use at least the minimum design standard that produces a road sufficient to carry the anticipated traffic load with minimum environmental impact.

.22 Remove timber from rights-of-way and deck it outside SMZs.

.23 Design roads no wider than necessary to accommodate the anticipated use.

.24 Balance cuts and fills to minimize excess excavated material.

.25 Place sidecast or fill material above the ordinary high water mark of any stream except where necessary to stabilize stream crossings.

.26 Plan and conduct work so that water quality is protected during heavy rain. *(See Appendix, Section 11.0, page 39.)*

.27 When needed, use seeding and mulching in a timely manner to reduce erosion. *(See Appendix, Section 11.10, Seed Table 11.1, page 40.)*

.28 Implement appropriate BMPs during road construction.

3.30 Road Drainage

.31 Ensure good road drainage with a combination of properly constructed and spaced wing ditches, broad-based dips, rolling dips, culverts, and bridges. Wing ditches should be constructed so water will be dispersed and not cut channels across the SMZ. At cross drains (culverts or dips) install rip-rap or other devices at the outlets to absorb and spread water. Use brush barriers or check dams along road fill areas or other sensitive areas.

.32 Install ditches, culverts, cross drains, and wing ditches at low points in the road. Use crowning, ditching, culverts, and/or out-sloping to drain roads naturally. Provide cross drainage on temporary roads. Provide out-fall protection if cross drains, relief culverts, and wing ditches discharge onto erodible soils or over erodible fill slopes. Use

diversion or wing ditches wherever possible to carry road drainage water onto the undisturbed forest floor. Use adequate sized culverts to carry the anticipated flow of water. *(See Appendix, Section 12.40, Table 12.4, page 45.)*

.33 A road grade of less than 10 percent is preferred. Changing grade frequently, with rolling or broad-based dips, protects water quality better than using long, straight, continuous grades.

.34 On highly erodible soils, grades should not exceed 8 percent. Grades exceeding 8 percent for 150 feet may be acceptable as long as appropriate BMPs are implemented.

.35 Graveling the road surface can help maintain stability.

.36 Install water turnouts, broad-based dips or rolling dips before a stream crossing to direct road runoff water into undisturbed areas of the SMZ. With the exception of stream crossings, roads should be located outside the SMZ.

.37 Out-slope the entire width of the road where road gradient and soil type permit. Use cross drainage on in-sloped or crowned roads to limit travel distance of runoff water.

.38 Where roads are in-sloped or crowned, and gradients begin to exceed 2 percent for more than 200 feet, broad-based dips or rolling dips should be placed within the first 25 feet of the upgrade.

.39 Road bank cuts normally should not exceed five feet in height, should be sloped, and the soil stabilized to prevent erosion. Cuts may need to be fertilized, limed, seeded, and mulched to establish cover. *(See Appendix, Section 11.10, Table 11.1, page 40.)*

3.40 Road Maintenance

.41 Crown or out-slope the road surface to disperse surface runoff and minimize erosion of the roadbed. Keep wing ditches free of blockages and keep culverts open and clean to allow unrestricted passage of water.

.42 Revegetate or stabilize erodible areas where natural vegetation is not sufficient to stabilize the soil. Minimize traffic on roads during wet conditions. Consider using geomat or rock to reduce road damage.

.43 Periodically inspect roads to see if BMPs remain effective.

.44 Re-establish vegetation as needed.

.45 Minimize traffic following maintenance work on sensitive road sections to allow them to stabilize.

.46 Keep roads free of obstructions to allow free flow of water from the road to the forest floor.

.47 Rework roads if road conditions deteriorate and may harm water quality.

.48 When all forestry activities are completed, reshape the roadbed if needed. Open all drainage systems. Stabilize erosion-prone areas. *(See Appendix, Section 11.0, page 39.)*

3.50 Stream Crossings

Crossing streams can cause water turbidity and can destabilize stream banks.

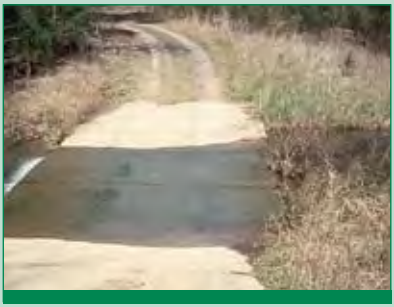
.51 Cross streams only if the harvest site cannot reasonably be accessed otherwise.

.52 Remove temporary crossing structures after use. Stabilize and restore the stream banks. *(See Appendix, Section 11.0, page 39.)*

.53 Permanent stream crossings should use bridges, culverts, shelf-rock fords, geoweb, concrete slabs, or other materials.

.54 Low water fords may be used if excessive turbidity is not created. Stream banks should be stable and stream bottoms should be hard. If not naturally stable, use materials such as geotextiles or temporary bridges. Use planking, geoweb, rock, or other nonerosive material to reduce disturbance to unstable streambeds and streambed approaches.

.55 Except for crossings, equipment should stay out of streambeds.



.56 Design bridges to protect stream-crossing approaches from erosion. The stream bank, stream channel, and adjacent SMZ should have minimum disturbance. Construct stream crossings during periods of dry weather when stream flow is low and the chance of erosion is minimal. Concrete slabs should be excavated so that the surface is level with the stream bottom and at the same slope. Concrete slab approaches should extend beyond the stream channel to prevent scour around the ends of the slab.

.57 Remove from streams excess material and woody debris generated during road construction. Deposit this material above the ordinary high water mark. Stabilize the material. Use head walls, wing walls, rip-rap, or geomat if necessary.

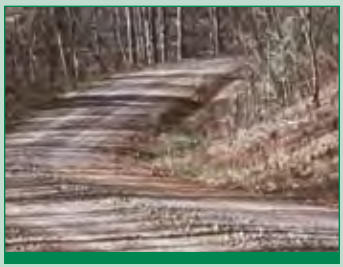
.58 Inspect stream crossings frequently during operations to determine if erosion is being controlled. Stream banks should be stable and soil movement into the stream should be minimal. Correct erosion problems by implementing the BMPs discussed in Section 11.0.

.59 Bridges should not constrict clearly defined stream channels. Bridges should allow bankfull discharge to pass under the bridge unrestricted when bankfull water levels are anticipated.

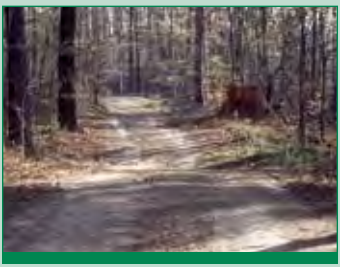
3.60 Broad-Based Dips

.61 Broad-based dips are recommended for roads with less than 10 percent grade.

.62 Installation should take place after basic clearing and grading for roadbed construction. *(See Appendix, Section 12.10, page 43.)*



Broad-Based Dip



Rolling Dip

.63 An energy absorber such as rip-rap and, in some cases, a level area where the water can spread, can be installed at the out-fall of the dip to reduce water velocity.

.64 On some soils the dip and reverse grade section may require bedding with crushed stone to avoid rutting the road surface.

.65 Broad-based dips should be placed across the road in the direction of water flow.

.66 Broad-based dips are not recommended for constantly flowing water.

3.70 Rolling Dips

Rolling dips are a cross between water bars and broad-based dips. Like broad-based dips, they have a reverse grade (except it is shorter) and they tip water off the road. Like water bars, they may also rely on a mound of soil at the downhill side. Rolling dips can be used on haul roads having a slope of 10 percent and greater. *(See Appendix, Section 12.20, page 44.)*

.71 Rolling dips can be used after basic clearing and grading for roadbed construction after logging is completed.

.72 A 10 to 15-foot-long, 3-8 percent reverse grade is constructed into the roadbed by cutting from upgrade to the dip location and then using cut material to build the mound for the reverse grade.

.73 In hills, locate rolling dips to fit the terrain as much as possible. They should be spaced according to the slope of the planned roadbed.

.74 Rolling dips are not suitable for constantly flowing water.

3.80 Wing Ditches

Wing ditches collect and direct road surface runoff from one or both sides of the road away from the roadway and into undisturbed areas. Wing ditches move water from roadside ditches and disperse it onto undisturbed areas adjacent to the road.

.81 The wing ditch should intersect the ditch line at the same depth and have a low-gradient outslope.

.82 On sloping roads, the wing ditch should leave the road ditch line at a 30 to 45 degree angle to the roadbed and be designed to follow the natural contour.

.83 The spacing of wing ditches will be determined by the topography of the area. *(See Appendix, Section 12.30, page 44.)*

.84 Runoff water should be spread, retained, or filtered at the outlet of the wing ditch.

.85 Wing ditches should not feed directly into adjacent drainage, gullies, or channels.

3.90 Pipe Culverts

Road and stream crossing culverts collect and transmit water safely from side ditches, seeps, natural drains, or streams under haul roads and skid trails without eroding the drainage system or road surface. *(See Appendix, Section 12.40, page 45 for culvert size and spacing.)*

.91 The pipe should be long enough so both ends extend at least one foot beyond the side slope of fill material. Culverts should be designed to carry the anticipated flow.

.92 The culvert should be placed with a 1-2 percent downgrade to prevent clogging.

.93 Lay the bottom of the culvert as close as possible to the natural grade of the ground or drain. Firmly seat the culvert and compact earth at least halfway up the side of the pipe.

.94 Cover, equal to a minimum of half the culvert diameter (preferably 1 foot of fill per 1 foot of culvert diameter), should be placed above the culvert.

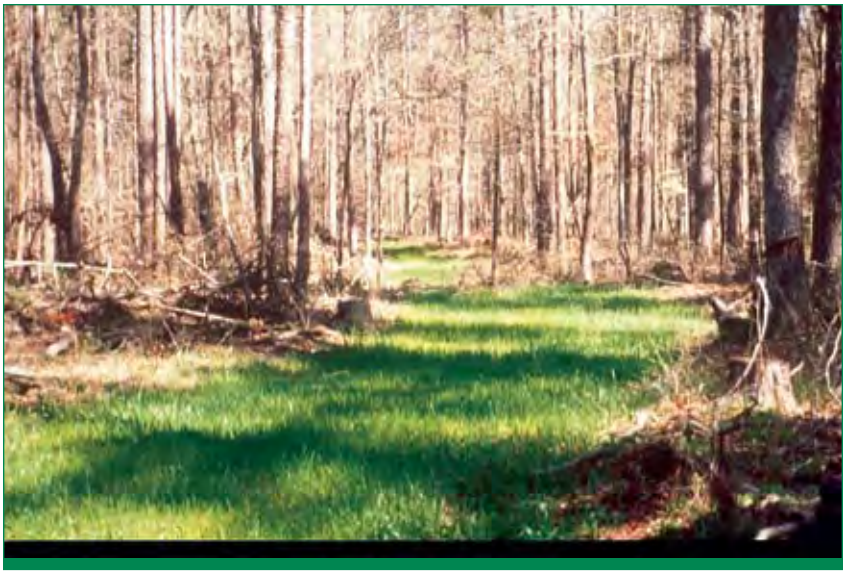
.95 The distance between pipe in a multiple culvert application should be half the pipe diameter.

.96 Provide erosion protection for culverts. This protection can be in the form of headwalls, rip-rap, geotextile filter cloth, large stone, or prefabricated outflow and inflow devices.

.97 Lay aggregate or other suitable material on approaches to fords, bridges, and culvert crossings if needed to ensure a stable roadbed approach and reduce sediment in the stream.

.98 Fill for temporary culverts can be washed rock. Washed rock may remain in the channel when the culvert is removed. Remove culverts, bridges, and fill material other than washed rock from temporary stream crossings upon completion of operations and return the crossing as close as possible to its original condition.

.99 Install erosion protection measures such as rip-rap, geotextile filter cloth, large stone, prefabricated outflow devices, or velocity reducers at the culvert outlet as needed to minimize downstream erosion. Rip-rap or other devices may be necessary on the downstream and upstream edge of fill or roadbed to prevent washout during floods.



4.0 INACTIVE ROADS

Roads are inactive if they will not be subjected to vehicular use. Inactive roads should be closed and BMPs installed.

4.10 Stabilization

Water bars are recommended for stabilizing inactive roads, firelines, and trails. *(See Appendix, Section 13, page 46.)* Logging slash may also be effective. They act to divert side ditch and surface runoff, which minimizes erosion, and provides conditions suitable for revegetation.

.11 Water bars should be placed at an angle to the road, firebreak, or skidtrail. The greater the percent slope, the less angle the water bar should be to the road surface.

.12 To prevent additional erosion, waterbars may be revegetated. *(See Appendix, Table 11.1, page 40.)*

.13 To fully intercept any ditch flows, the uphill end of the water bar should extend beyond the side ditch line of the road and tie into the cut bank blocking the ditch.

.14 Leave sufficient distance between outflow discharge and stream to allow "sediment fallout" before silt laden water reaches the waterbody.

.15 The outflow end of the waterbar should be fully open and extend beyond the edge of the road to disperse runoff water onto the undisturbed forest floor.

.16 Waterbars should be inspected after significant rainstorms. Repair damage or breeches.

.17 Ensure that the outlet is open. Consider the need for energy absorbers (brush or rock) at or below the drain outlet.

4.20 Revegetation

Covering bare soil is the first line of defense in preventing erosion. Revegetation is recommended for bare soil. Recommended seed types, sowing rates, and fertilizers are in *Appendix, Table 11.1, page 40.*

.21 Schedule revegetation when soil and weather conditions promote rapid germination of seeds and development of the plants.

.22 Plant seed to the proper depth, fertilize where needed, and use adequate seeding rates.

.23 Periodically inspect areas of revegetation to ensure successful reestablishment of the intended ground cover.

4.30 Protection

Waterbars are essential to controlling soil erosion due to excessive water volume and velocity of road's runoff. Successful stabilization depends upon water control.

.31 Block vehicular traffic at entrances and exits of retired roads, firebreaks, and trails where vehicular traffic is expected. Use gating, large earthen berms, ditching, fencing, and similar barricades.

Harvesting timber is more than cutting trees. It includes layout and construction of access roads, skid trails for moving logs, and strategic location of landings for transporting products out of the woods.

Timber harvesting activities should be conducted to minimize the effects on soil and water. Special care should be taken on steeper slopes and near bodies of water. If possible, schedule harvests during periods of dry weather to reduce sedimentation.

5.10 Design of Harvest Site

The design of the harvest site can protect water quality.

.11 Plan harvest site, skid trails, and landing locations to reduce the area of ground disturbed.

.12 For areas subject to excessive erosion, plan harvest activities to enable revegetation efforts to occur during times of the year that favor

successful revegetation.

.13 Sites should be inspected frequently during harvesting to identify soil movement into waterbodies.

.14 If erosion is occurring, promptly implement corrective BMPs.

.15 When harvesting is completed, disperse water from landings and skid trails using water bars, logging slash, or vegetative cover. Be prepared to control and limit off-site soil movement. (*See Appendix, Section 11.0, page 39.)*

.16 If revegetation or stabilization is needed, do this work as soon as possible after harvesting is complete. Compacted soils may need to be disked or scarified to improve water infiltration and create a suitable seedbed.

.17 Construct water bars on skid trails and firelines per specifications in *Table 13.1 and Figure 13.1, page 46*, as needed. Pay attention to slope and soil type as it pertains to type of structure and spacing requirements. Where skid trails cross streams install water bars or turnouts to divert all runoff away from stream channel.

.18 Remove temporary fill and stabilize stream banks.

(*See Appendix, Section 11.0, page 39.)*

.19 All areas to be seeded and/or mulched should be stable. Install traffic barriers to prevent off-road vehicle damage to recently stabilized areas.

5.20 Log Landings

Log landings or log decks are areas of concentrated equipment use and traffic. Well-planned and managed log landings will protect water quality. Take precautions to reduce rutting, soil compaction, and/or interference with water flow. For example, if soils are wet, use special techniques such as logging mats and mulch.

.21 Locate landings to avoid or reduce stream crossings.

.22 Locate landings as part of planning the road system.

.23 Minimize the size and number of log landings.

.24 Locate landings away from SMZs on firm, level ground.

.25 Locate landings on dry sites so natural drainage disperses water onto the forest floor but not into a stream.

.26 Restrict fueling and equipment maintenance work to designated

areas of landings. Do not do this work near streams.

5.30 Felling & Bucking

.31 Fell trees away from a stream and keep debris out of the stream whenever possible.

.32 If a tree is felled into a stream, protect the stream banks during tree removal.

.33 Fell trees so the butts face the direction of skid whenever possible.

.34 Promptly remove significant logging debris from streams. Significant debris can alter the flow of the water and scour banks.

5.40 Skidding

Skid trails serve as transport routes for equipment moving trees, logs, or other material from the place of felling to a log landing or deck where they are stored or loaded for transport. Because heavy equipment is usually used in skidding, soil disturbance may occur. Plan skid trail layout to protect water quality.

.41 Follow the contour to the greatest extent possible. Timber should be skidded uphill either to a contour skid trail or more level ground.

.42 On slopes of 20 percent or greater, skid uphill.

.43 Skid trails on slopes should have occasional breaks in grade or logging slash that disperse water.

.44 Where stream crossings are planned, use portable crossing structures, culverts, poles, or natural fords with firm bottoms, stable banks, and gentle slopes. Do not use soil as a temporary fill material when water is in the stream.

.45 If a ford or crossing will cause excessive rutting or turbidity, then bridges, culverts, concrete slabs, or other constructed fords should be used.

.46 Minimize the number of stream crossings. Skid across a stream only at stable locations identified during harvest planning.

.47 Upon completion of skidding, remove all temporary fill material from streambeds. If the banks are crushed or if soil is eroding, stabilize the stream banks.

.48 Do not use stream channels as skid trails.

5.50 Wet Weather Skidding

Avoid logging in excessively wet areas or during excessively wet weather. If skidding in wet weather, take the following precautions to protect water quality.

.51 Stabilize bare areas during any temporary shut-downs in logging operation if needed to protect water quality.

.52 Minimize skid trail construction at grades greater than 30 percent. With grades greater than 30 percent, install frequent rolling dips and follow contours. Stabilize these skid trails.

.53 If off-site soil movement occurs, control it with rolling dips, temporary water bars, and prompt revegetation.

.54 Minimize straight runs of 300 feet or more at grades greater than 20 percent.

5.60 Harvest Site Closeout

To ensure proper implementation of BMPs, a helpful final step is an on-site examination of the harvest area. This procedure is referred to as a "walkout." Review contracts or other documents that set-out BMPs required for the harvest area.

.61 Stabilize roads, skid trails, and log landings by using revegetation techniques if needed.

.62 Clean up spills. Haul litter, such as oil cans, grease containers, crankcase oil filters, old tires, and used fluids to a proper disposal facility.

.63 Remove significant logging debris from streams. Significant debris can alter the flow of the water and scour banks.

.64 Scatter woody debris above the high water mark of stream.

.65 Perform closeout erosion control on erodible areas before equipment is moved off the site.

Mechanical site preparation involves the use of ground contact equipment to manipulate vegetation and soil conditions before reforestation. Methods most commonly used are shearing, raking, subsoiling, disking, chopping, windrow/piling, and bedding. Shearing, raking, windrow/piling, bedding, and disking are high intensity methods of mechanical site preparation that expose a greater percentage of the soil on the treated site. Subsoiling and chopping are lower intensity methods. Erosion potential increases with the higher intensity methods, especially in areas with steep slopes.

6.10 Guidelines

.11 Choose a site preparation method that exposes and disturbs the minimum mineral soil necessary to meet the desired reforestation objective.

.12 The boundaries of all SMZs should be defined before site preparation begins.

.13 Do not conduct mechanical site preparation in SMZs.

.14 Minimize crossing streams. If stream crossings are necessary they should be kept to a minimum, and made at right angles

Mechanical Site Preparation

Ripped on the Contour

to the stream.

.15 Avoid intensive site preparation on soils the NRCS has identified as highly erodible.

.16 Do not damage water control devices (i.e. culverts, wing ditches).

When damage occurs, repair or replace the device promptly.

.17 Avoid heavy equipment operations in wet soil conditions.

.18 Intensive site preparation should follow the contour of the land.

7.0 FOREST CHEMICALS

Pesticides, herbicides, and fertilizers are forest chemicals. The following guidelines for the handling and application of forest chemicals will help prevent their translocation to open water sources.

If any hazardous chemical of reportable quantity is accidentally spilled during normal working hours, notify the Department of Environmental Quality at (501) 682-0744. Outside of normal working hours, notify the Department of Emergency Management at (501) 682-0716. Take immediate measures to contain all chemical spills. Communicate spills to appropriate supervisors, landowners, and authorities.

7.10 Guidelines

.11 Follow label instructions. Do not aerially apply forest chemicals to SMZs unless labeled for open water application or during a forest health emergency (i.e. gypsy moth).

.12 Chemicals should not be allowed to leak from equipment. Do not service equipment near streams or other water sources. Properly dispose of empty containers.

.13 Minimize the use of streams, lakes, ponds, or rivers as water sources. When this water is used to mix chemicals, do not contaminate water source.

.14 Chemicals should not be applied when water contamination is likely to occur from physical spray drift.

.15 Chemicals should not be applied immediately before precipitation, or after a rain if there is still runoff. Consider upcoming storm predictions to time chemical application.

.16 Label containers according to state and federal regulations.

.17 Apply fertilizer at appropriate rates. Seek professional advice on application rates. *(See Appendix, Section 15.0, page 47.)*

Reforestation should be completed as soon as practical after harvesting. Seek professional advice on reforestation options.

8.10 Guidelines

.11 Machine plant along the contour of the land.

.12 Repair and stabilize any damage from machine planting that will

cause erosion.

.13 Machine planting equipment should avoid crossing or turning around in roads, road ditches, and wing ditches.

.14 Use existing access and stream crossing areas when planting. Preserve and replace all BMP harvesting or site preparation installations.

9.10 Guidelines

.11 Arkansas Pollution Control and Ecology Commission has designated certain waterbodies as Extraordinary Resource Waters (PC&E Regulation 2). Take special precautions along these waters. Less intensive silvicultural practices are preferred. The table and map on the following page list currently designated Extraordinary Resource Waters. An up-to-date list of Extraordinary Resource Waters can be viewed at www.adeq.state.ar.us.

9.20 Extraordinary Resource Waters

Lake Ouachita
De Gray Reservoir
Saline River
North Fork Saline River
Alum Fork Saline River
Middle Fork Saline River
South Fork Saline River
Moro Creek
Caddo River
South Fork Caddo River
Cossatot River
Caney Creek
Little Missouri River
Mountain Fork River
Big Fork Creek
Cadron Creek
Mulberry River
Big Creek
Devils Fork Little Red River
Beech Creek
Tomahawk Creek
Turkey Creek
Lick Creek
North Sylamore Creek
Kings River
Bull Shoals Reservoir
Middle Fork Little Red River
Archway Creek
Illinois Bayou
North Fork Illinois Bayou
Middle Fork Illinois Bayou
East Fork Illinois Bayou
Piney Creek
Hurricane Creek
Lee Creek
Salado Creek
Richland Creek
Falling Water Creek
Buffalo River
Current River
Eleven Point River
Strawberry River
Spring River
Field Creek
Cut Creek
Racoon Creek
Myatt Creek
South Fork Spring River
Two Prairie Bayou
Second Creek
Cache River
Arkansas River (Below Dam #2)

.12 Arkansas Pollution Control and Ecology Commission has identified waterbodies impaired by sedimentation. Take special precautions along these waters. Less intensive silvicultural practices are preferred. An up-to-date list of waterbodies can be viewed at www.adeq.state.ar.us.

If a fire becomes "too hot," the entire humus layer can be consumed, exposing the underlying mineral soil to erosion.

AFC BMP Implementation Surveys have found that the erosion potential from sites burned too hot increases as slope increases. Extreme caution should be used when burning on slopes exceeding 20 percent.

10.10 Prescribed Fire

.11 Before ignition, moisture levels within the soil, forest fuels, and the air should be sufficient to prevent major exposure or damage to the

mineral soil, especially on moderate to severely erosive soils.

.12 Install firelines parallel to streams and outside the SMZ. Do not plow firelines through the SMZ. Firelines within the SMZ should be constructed by hand.

.13 On final harvest cuts, when slopes of the site exceed 20 percent, individual fire strips should not exceed 300 feet in width between ignition and burnout.

10.20 Wildfire Suppression and Reclamation

.21 During wildfire emergencies, firefighting activities are not restricted by BMPs. Potential erosion problems should be corrected soon after a wildfire is suppressed.

.22 Actively eroding gullies should be stabilized as part of wildfire reclamation.

.23 Inspect firelines periodically and stabilize as needed to minimize runoff entering streams.

Mulching

Seeding

10.30 Firelines

Control practices can be implemented during fireline construction to prevent erosion. Periodic inspection and proper maintenance can minimize erosion on established firelines.

.31 Use barriers such as roads, rights-of-way, and plowed fields as firelines.

.32 Install firelines on the contour as much as possible.

.33 Use bladed or harrowed firelines instead of plowed firelines whenever possible.

.34 On slopes exceeding 5 percent, and at approaches to streams and roads, install water bars in firelines according to the BMP recommendations for skid trails. *(See Section 5.40, page 27.)*

.35 Use hand tools or back blade firelines away from the edge of gullies, streams, or roads.

10.40 Fireline Maintenance

.41 Mowing or disking, rather than blading, should be used to maintain firelines to reduce exposing mineral soil.

APPENDIX

This section contains additional specifications for BMPs. Practitioners should develop "site-specific" specifications based on BMP implementation, observations, and site-specific experiences.

Table 11.1 Recommended Seeding Rates

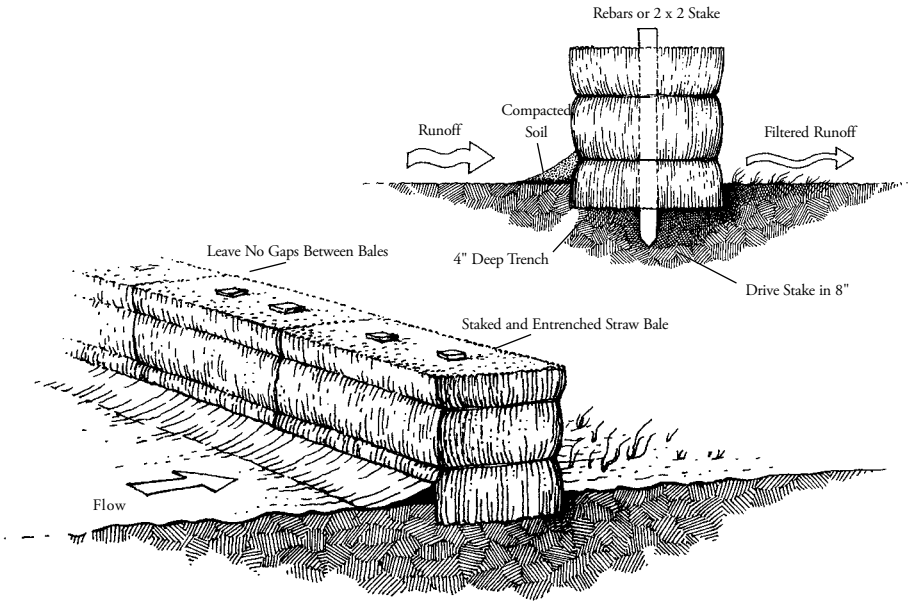
Area	Spring & Early Summer (March - June)		Late Summer, Fall & Early Winter (August - February)	
	Seed Mixture	Rate (lbs/acre)	Seed Mixture	Rate (lbs/acre)
Mountain	Orchard Grass[1]	12	Annual Ryegrass	24
	Browntop Millet	40		
Statewide	Elbon Rye	80[2]	Elbon Rye	80[2]
	Winter Wheat	80[2]	Winter Wheat	80[2]
Gulf Coast or Delta	Bahai	25	Bahai	30
	Browntop Millet	10	Annual Ryegrass	20

[1] Seed in Late Spring [2] Broadcast Application

Soil stabilization practices are used where soil is exposed and natural revegetation is inadequate to prevent excessive soil erosion. This erosion occurs primarily during road and skid trail construction and use. This erosion also occurs from inactive roads and skid trails that aren't properly closed-out.

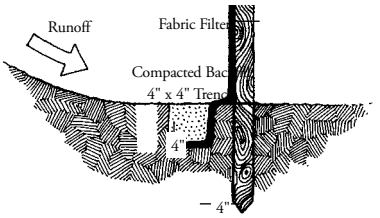
11.10 Mulching & Seeding

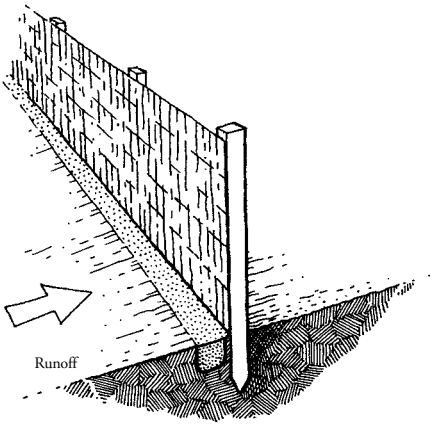
Mulch retains soil moisture, important for seed germination, and protects the soil from erosion. Mulch can be used to: (1) promote natural revegetation, or (2) protect seeds and fertilizers that have been spread over an area. If you broadcast seed and fertilizers, mulching may be needed to prevent washing before germination and rooting. In most situations, seed can be

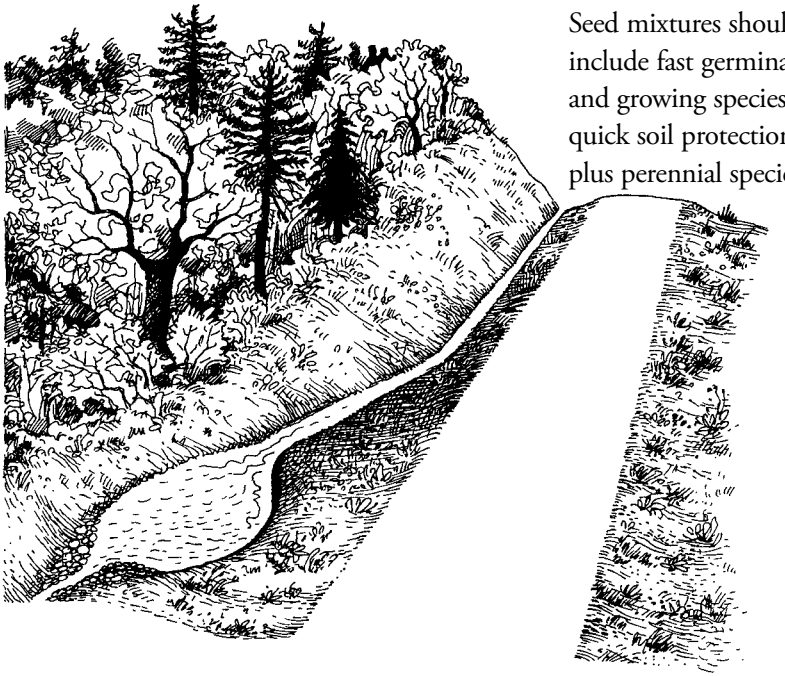


"incorporated" into the soil, an action that enables the seed to remain in place without mulch or netting. Netting may be necessary to hold mulch

in place on extreme steep slopes or on areas where water flow concentrates.

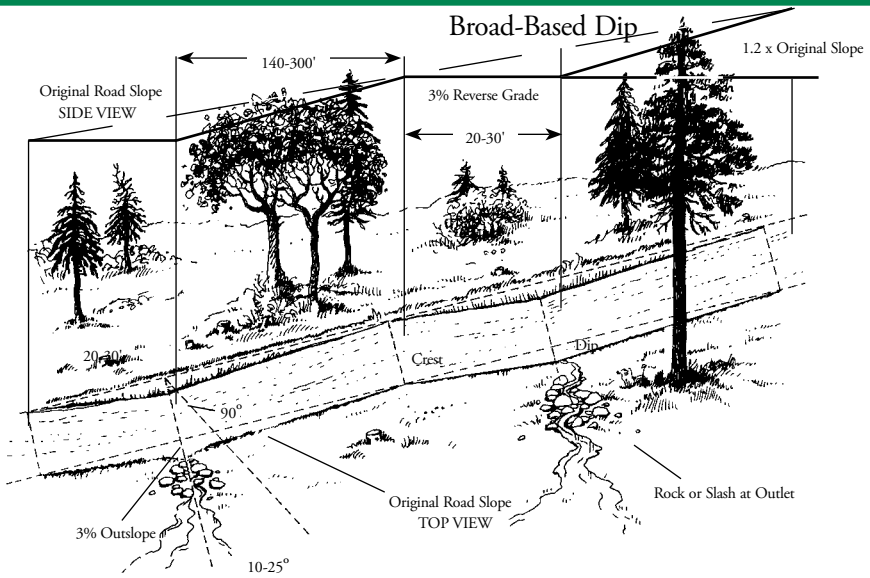






Seed mixtures should include fast germinating and growing species for quick soil protection plus perennial species for

longer soil protection until native vegetation returns to the site.



Timing of seeding is critical in successful revegetation efforts. Professional advice can facilitate successful revegetation.

Information concerning recommended seed mixtures, including prices and availability, can be obtained from the USDA Plant Material Center at Booneville, Arkansas. (*See Appendix, Section 15.0, page 47.)*

Table 12.1 Broad-Based Dips

Road Grade (percent)	Distance Between Dips (spacing in feet)
2	300
4	200
6	165
8	150
10	140

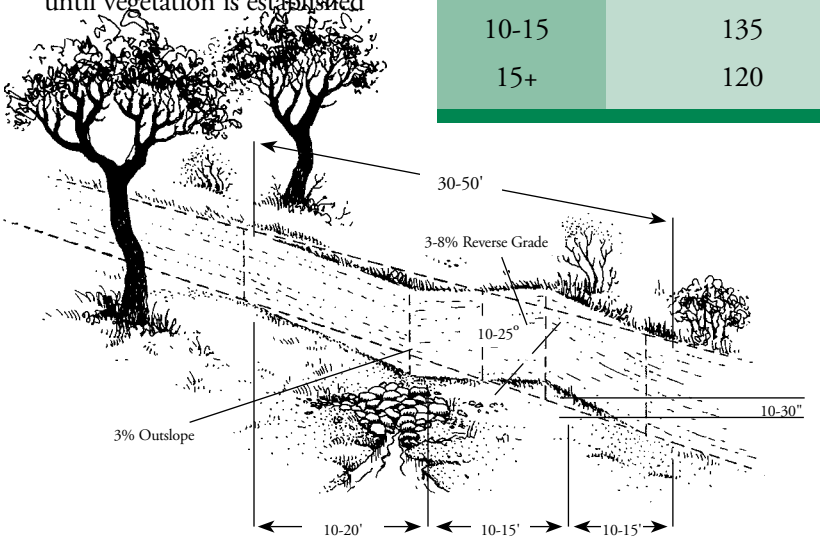
- Broadcast Application; a soil pH of 6.5 to 7.5 is best; 1 ton of limestone equivalent to 1 point soil pH+ (plus); 1 ton sulphur equivalent to 1 point soil pH- (minus).
- Fertilize with 200 pounds per acre of 15-15-15.
- Mulch slopes with 4,000 pounds of straw per acre.

11.20 Sediment Control Structures

Sediment control structures can control off-site movement of excessive soil,

especially during major storm events. Install sediment control structures to slow the flow of runoff and to trap sediment until vegetation is established at the sediment source. Sediment control structures include straw bale fencing, logging slash, silt fencing, and sediment traps. *(See Figures 11.1, 11.2, and 11.3.)*

Table 12.2	Rolling Dips
Road Grade (percent)	Distance Between Dips (spacing in feet)
10-15	135
15+	120



Design & Installation of Turnouts

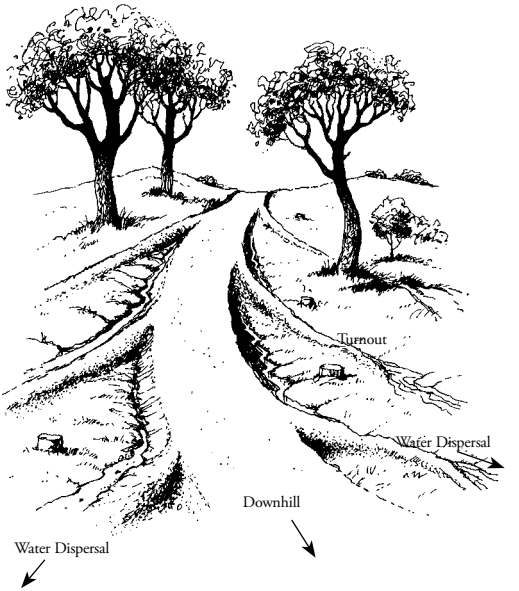


Table 12.3	Wing Ditches
Road Grade (percent)	Distance Between Wing Ditches (spacing in feet)
2-5	200
5-10	100
10+	75

Maintain sediment-control structures until areas of exposed soil are stable.

Figure 11.1 Straw bale fencing to slow runoff and trap sediment for sheet flow or channelized flow.

Figure 11.2 Silt fencing to slow runoff and trap sediment primarily for sheet flow, not channelized flow.

Figure 11.3 A sediment trap to slow runoff and trap sediment for channelized flow.

$$\text{Spacing} = \frac{400'}{\text{Slope \%}} + 100'$$

EXAMPLE: Spacing = $\frac{400'}{}$ + 100' or Spacing = 127'

Table 12.4	Pipe Culverts
Area Above Pipe (acres)	Pipe Diameter (inches)
5	18
10	24
20	27
30	30
40	36
50	36
75	42
100	48
150	54

Typical Upland Cross-Drainage Culvert

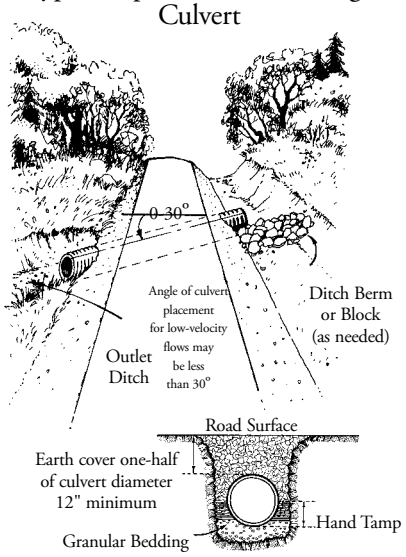


Table 12.5	Culvert Spacing
Grade as %	Spacing in Feet
1	500
2	300
4	200
6	167
8	150
10	140
12	133
14	129
16	125

12.10 Broad-Based Dips

NOTE: An inherent problem in construction of a broad-based dip is recognizing that the roadbed consists of two planes rather than one unbroken plane. One plane is the 15 to 20-foot reverse grade toward the uphill road portion and outlet. Another plane is the grade from the top of a hump or start of a downgrade to the outlet of the dip. Neither the dip nor the hump should have a sharp, angular break, but should be rounded to allow a smooth flow of traffic. Properly constructed

Water Bar Installation

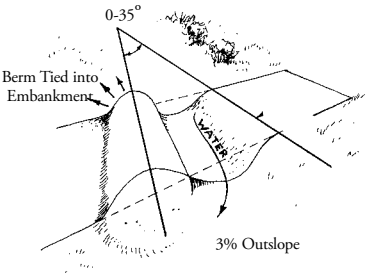
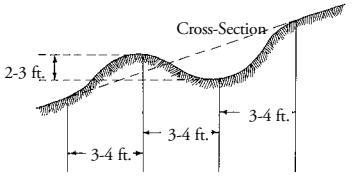
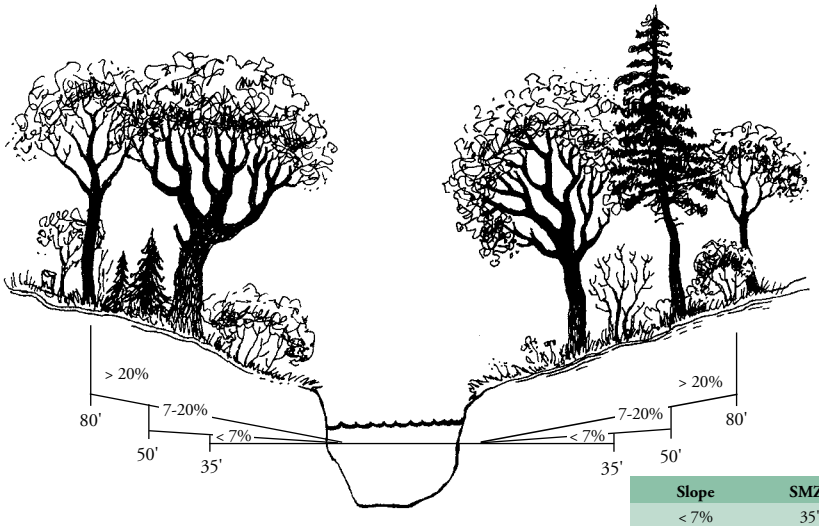


Table 13.1 Water Bar					
Grade of Road (percent)					
2	5	10	15	20	30
Distance Between Water Bars (feet)					
250	135	80	60	45	35





Slope	SMZ
< 7%	35'
7% – 20%	50'
> 20%	80'

broad-based dips do not damage loaded trucks, or slow vehicle speed. Dips require minimal annual maintenance and continue to function years after abandonment. Only the dip should be outsloped to provide sufficient break in grade to turn the water. A 20-foot-long, 3 percent reverse grade is

State Agencies	Federal Agencies	Private Organizations
Arkansas Forestry Commission Best Management Practice Section 3821 W. Roosevelt Little Rock, AR 72204 501/296-1940	U.S. Army Corp. of Engineers Vicksburg District 4155 Clay Street Vicksburg, MS 39183 601/ 631-5052	Arkansas Forestry Association 410 South Cross Street Little Rock, AR 72201 501/ 374-2441
Arkansas Department of Environmental Quality P.O. Box 8913 Little Rock, AR 72219-8913 501/682-0744	U.S. Army Corp. of Engineers Little Rock District 700 West Capitol P.O. Box 876 Little Rock, AR 72203 501/ 324-5551	Arkansas Timber Producers Association 2311 Biscayne Drive Little Rock, AR 72227 501/ 224-2232
Arkansas Game & Fish Commission Two Natural Resources Drive Little Rock, AR 72205 501/223-6300	Natural Resource Conservation Service 700 West Capitol, Room 3416 Little Rock, AR 72201 501/ 301-3100	Local consulting foresters
Arkansas Cooperative Extension Service 2301 South University Avenue Little Rock, AR 72204 501/671-2000	USDA Natural Resource Cons. Serv. Plant Material Center 6883 So. St. Hwy. 23 Booneville, AR 72927 501/ 675-5182	Local forest products companies
Arkansas Natural Heritage Commission 1500 Tower Building, 323 Center Little Rock, AR 72201 501/324-9150	USDA Forest Service Ozark St.-Francis National Forest 605 West Main Russellville, AR 72801 501/ 968-2354	
Arkansas State Plant Board One Natural Resources Drive Little Rock, AR 72205 501/225-1598	USDA Forest Service Ouachita National Forest P.O. Box 1270 Hot Springs, AR 71902 501/ 321-5202	
Arkansas Geological Commission 3815 West Roosevelt Road Little Rock, AR 72204 501/296-1877	Environmental Protection Agency Region 6 Office Fountain Place 1445 Ross Avenue, Suite 1200 Dallas, TX 75202-2733 214/665-6497	
Arkansas Geographic Information Office State Geographic Coordinator Shelby D. Johnson P.O. Box 3155 Little Rock, AR 72203 501/682-**2767**		

constructed into the existing roadbed by cutting from upgrade of the dip location. The cross drain outslope will be 2-3 percent maximum.

12.20 Rolling Dips

Table 12.2 Spacing between rolling dips can be determined from the following table:

12.30 Wing Ditches

Table 12.3 The following table lists the approximate spacing for wing ditches:

12.40 Pipe Culverts

Table 12.4 Recommended diameters of culverts based on drainage area:

Culvert diameter recommendations are based on medium soils. Light sandy soils would require smaller culverts and heavy clay soils would require larger culverts.

Culvert spacing can be determined by the following formula:

Slope in percent expressed as a whole number (i.e. 15% = 15).

Table 12.5 The following table is a guide for spacing between culverts:

13.10 Stabilization

Figure13.1 Water Bar

Water Bar specifications
must be site-specific and suitable
for the soil and slope.

Table 13.1 The following table
is a guide for spacing between water bars:

For additional sources of information and technical assistance on BMPs, Forestry, or Wetlands contact one of the following agencies:

GLOSSARY

Definitions of Forestry BMP Terminology

Active Road – A road that can be either temporary or permanent that allows vehicle movement in and out of forestland.

Bedding – A site preparation method in which special disking equipment is used to concentrate surface soil and forest litter into a ridge, or bed elevated above the normal forest floor on which seedlings are to be planted.

Best Management Practices (BMPs) – A practice, or combination of practices, determined to be an effective, and practical means of controlling

the amount of water pollution generated by nonpoint sources.

Braided Streams – Stream systems with multiple and frequently interconnected channels. Generally these streams have a very low gradient (<0.5 percent channel slope), broad valleys, and well-defined floodplains. Occasionally, similar multiple channel streams can be found in higher areas with higher gradients.

Broad-Based Dip – A forest road surface drainage design for active roadways. Directs rainfall runoff from road surfaces, and at the same time allows normal vehicle movement over roads.

Buck – To saw felled trees into predetermined lengths.

Channel – A well defined, measurable area, either natural or man-made which collects and conveys water.

Chopping – A form of site preparation in which a large, heavy cylindrical drum with cutting blades mounted parallel to its axis is drawn across a site to break up, slash, or crush vegetation prior to (usually) burning and planting.

Contour – An imaginary line along the side of a slope that connects points of the same elevation.

Culvert – A conduit or pipe through which surface water can flow under roads.

Cut – A location on the surface from which earth has been removed by excavation.

Disking – A form of site preparation in which a plow having one or more heavy, round, concave, sharpened, freely rotating steel disks angled to cut and turn a furrow is drawn across a site prior to (usually) planting.

Diversion Ditch – A shallow channel, which had been cut across the top of a slope, or the side of a hill for the purpose of diverting surface runoff.

Ephemeral Stream – Water courses generally with a defined channel, but no banks, that flow only during or immediately after rain.

Erosion – The process by which soil particles are detached, and transported

by water, and gravity to some down-slope, or down-stream deposition point.

Felling – The process of severing trees from the ground and leaving a stump.

Fill Slope – The surface area formed where soil is deposited to build a road or trail.

Fireline – A barrier used to stop or contain a wildfire or control burn. Usually constructed by use of bulldozer by which the fuel is removed down to mineral soil.

Forest Chemicals – Chemical substances or formulations that include fertilizers, herbicides, insecticides, fungicides, repellants, and other pesticides.

Forestland – Land bearing forest growth, or land from which the forest has been removed, and is in any stage of forest growth, or production, or maintains the potential for forest growth.

Forest Road – An access route for vehicles into forestland.

Furrowing – A site preparation method involving plowing a trench in preparation for reforestation.

Geomat – Artificial base structure for stabilization of streambeds and roads in wet areas. Usually installed as a base for geoweb.

Geotextile – A synthetic fabric utilized in soil stabilization and reinforcement of roads and streambeds.

Geoweb – Artificial geotextile structure of modular cells for stabilizing streambeds.

Grade – The slope of a road or trail, expressed as a percent.

Harvesting – The felling, loading, and transportation of forest products.

Herbicide – Any chemical substance or mixture of substances intended to prevent, destroy, repel, or mitigate the growth of any tree, bush, weed, or algae (and other aquatic weeds).

Inactive Road – A road not subject to vehicular use. Former active road.

Landing – A location where logs are skidded to and assembled for temporary storage, loading, and subsequent transportation.

Logging – The felling and transportation of trees from the forest to a delivery location.

Logging Slash – The unused portions of woody material that remain as forest residue after logging.

Mulching – Providing covering for exposed forest soil, using organic residue, such as logging slash, grass, straw, or wood fibers to control erosion and enhance revegetation.

Nonpoint Source Pollution – Pollution which is (1) materials such as chemicals, nutrients, and soil carried into waterbodies by precipitation, seepage, percolation, and runoff; (2) not traceable to any discrete or identifiable point source; and (3) controllable through the implementation of BMPs.

Nutrients – Mineral elements in the forest ecosystem such as nitrogen, phosphorus, or potassium usually in soluble compounds that are present naturally, or may be added to the forest environment as forest chemicals, such as fertilizer.

Ordinary High Water Mark – The mark on the shores of all waters, which will be found by examining the beds, and banks, and ascertaining where the presence, and action of waters are so common, and usual, and so long continued in all ordinary years, as to mark upon the soil a distinct character.

Pesticides – Any herbicide, insecticide, rodenticide, or fungicide including non-toxic repellents or other chemicals.

Raking – Raking is an operation in which debris and vegetation is removed from the site through windrowing or piling. Tooth-type root rakes will be favored over straight and KG blades for raking and piling. Minimize top soil removal and displacement when piling.

Revegetate – To cover bare mineral soil with plant re-growth. In BMP application, this refers to the expeditious establishment of grasses to minimize soil erosion.

Rip-Rap – Aggregate placed on erodible sites to reduce the impact of rain or surface runoff on these areas.

Rolling Dip – A forest road surface drainage design for active roadways. Directs rainfall runoff from road surfaces, and at the same time allows vehicle movement over roads and skid trails. Recommended for grades in excess of 10 percent slope.

Rutting – Depressions made by the tires or tracks of equipment such as skidders, log trucks, pickups, etc., usually under wet conditions.

Scarify – To break up the forest floor and top soil preparatory to natural or direct seeding, or planting of seedlings.

Sediment – Soil particles that have been detached and transported into water during erosion.

Shearing – A site preparation method which involves cutting brush, trees, and other vegetation at the ground line using tractors equipped with angle, or V-shaped cutting blades.

Sheet Flow – Runoff from a rainfall event intense enough to cause direct overland flow prior to entry to a receiving stream.

Sidecast – The material or the act of moving excavated material to the side and depositing such material laterally to the line of movement of the excavating machine.

Silvicultural Activities – All forest management activities, including intermediate cutting, cultural practice, harvest, log transport, and forest road construction.

Site Preparation – Removing unwanted vegetation and other material when necessary and soil preparation carried out before reforestation.

Skid Trail – A route over which logs are moved, usually dragged by a skidder, to a setting (landing) or truck loading zone.

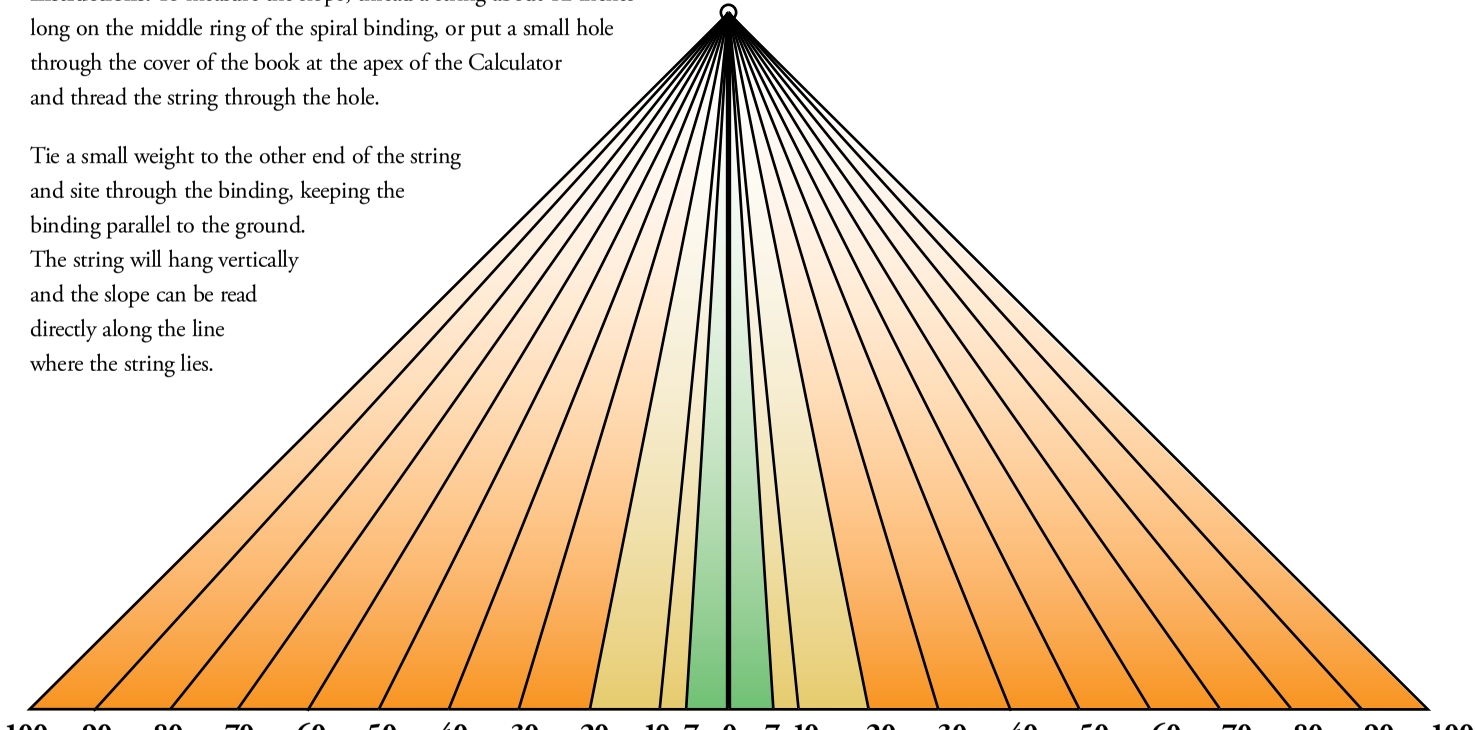
Slope – The steepness of the land expressed as the amount (in percent) of vertical fall per 100 feet of horizontal run. For example, a 3 percent slope means that over a distance of 100 feet, the ground drops 3 feet from the horizontal.

Streamside Management Zone (SMZ) – A strip of land immediately adjacent to waterbodies where timber management activities are particularly designed to protect water quality.

Slope Calculator

Instructions: To measure the slope, thread a string about 12 inches long on the middle ring of the spiral binding, or put a small hole through the cover of the book at the apex of the Calculator and thread the string through the hole.

Tie a small weight to the other end of the string and site through the binding, keeping the binding parallel to the ground. The string will hang vertically and the slope can be read directly along the line where the string lies.



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