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# Best Management Practices for Timber Harvesters

► These best management practices help loggers, foresters, and landowners reduce erosion potential during and after timber harvesting activities. Topics include forest soil erosion and logging impact on water quality.

The Water Quality Act of 1987 (PL-100-1) was enacted by the U.S. Congress to help improve the quality of our nations most valuable natural resource, water. Section 319 of this act deals with non-point source pollution. This pollution category includes forest management activities such as timber harvesting, site preparation, and road construction.

The primary discharges from these activities include soil, petroleum products, and woody debris. Overall, forests are small contributors to the problem of stream sedimentation, but they are a potential supplier of large amounts of clean water.

The responsibility for enforcing the Water Quality Act of 1987 lies with a state-administered program with oversight by the Environmental Protection Agency (EPA). This program is now being developed in Alabama, and standards are being set for appropriate Best Management Practices (BMPs) that are effective in reducing sedimentation from forest lands.

The BMP program is currently voluntary. The Alabama Forestry Commission has been chosen as the lead agency for monitoring silvicultural activities (the development and care of forests), and this includes BMPs. BMP standards will be based on the designated use of streams within each watershed. If a land manager implements an approved BMP, he/she is within the law; if water quality is not maintained or improved, the BMP must be re-evaluated to meet the standard.

The purpose of this publication is to inform loggers, foresters, and landowners about current management practices that are known to reduce erosion potential during and after timber harvesting activities.

## Forest Soil Erosion

Rain falling over the earth follows the pull of gravity as it makes its way to the sea. Along the paths of forests, streams, and rivers, this moving water can erode large amounts of unprotected soil.

In undisturbed areas, a small amount of soil will reach streams during periods of heavy rainfall. In disturbed areas where people have been active, the potential for soil eroding into water sources is much greater. Alabamians must become aware of timber harvesting management practices that will reduce the potential for erosion.

One of the main sources of erosion in the forest is the transportation system. Poorly located and improperly used access roads, skid trails, and log deck areas contribute as much as 80 percent or more to soil erosion from forest operations.

Sediment coming from harvest sites with poorly designed, located, and maintained roads and skid trails can average as much as 1 ton per acre per year over a 30-year rotation and more than 10 tons per acre during the year following road construction. With good planning, construction, and maintenance, the same timber harvest can be made with no significant increase above the natural erosion rate of 0.1 to 0.25 ton per acre per year.

In addition, a good road system saves time when hauling forest products, and it minimizes equipment wear and failure. A good road system is an investment in the accessibility and future use of the forest.

## Logging Impact On Water Quality

Management practices for loggers center primarily on five areas that can significantly affect water quality if poor practices are used. These include roads, log decks, skid trails, stream crossings, and stream-side management zones (SMZ).

Not enough has been done in the past to make people aware of the potential impact of logging practices on water quality. Management practices that will reduce harmful effects on water quality are now more fully realized and are recommended through the application of BMPs.

## Logging Roads

Two of the basic principles of road building are to direct water away from the roadway and to maintam a dry road foundation. Controlling the direction, volume, and rate of flow of water run-off from a road is the key to reducing the sediment carried into neighboring streams and other bodies of water.

Minimizing erosion on forest roads begins with good planning. Plan the road layout well in advance of harvesting. By using a topographic map and aerial photos, you can get a bird's-eye view of the land. You can also locate drainage and minimize road meandering to maintain straight alignment.

After completing your map work, walk the area to be logged and determine the best access route on the ground. When you have located this route, the road locations should be flagged, cleared, and graded as much in advance of logging as possible to allow settling and revegetation of the road bed.

Frequently, old roads can be used when they are properly located. However, these roads are often too close to streams, too badly rutted to establish drainage, or located on steep slopes or weak soils. Locate roads away from perennial and intermittent streams as much as possible.

The road edge should be at least 50 feet or more from any flowing stream. Vegetation in this strip of forest will act as a filter to trap sediment before it reaches the stream.

Although some water will improve road surface compaction and soil strength, the use of forest roads during wet weather is often costly. Such use can damage native soil road surfaces and add sediment to nearby streams.

During unfavorable conditions, restrict traffic on roads which could lead to excessive siltation (obstruction with silt or mud). If travel is required during bad weather, build roads which meet these specific needs.

**Road Grades.** The road grade or rate of slope influences the rate of flow of water run-off. Maintain road grades at a 10-percent slope or less. To minimize cut-and-fill procedures which expose soil, new roads should follow the contour of the terrain while maintaining a road grade of 2 to 8 percent.

Avoid long, continuous grades; they are a potential source of erosion if surface water is not removed. Erosion can be reduced by controlling the volume and velocity of surface water flow. This can be accomplished by changing the grade frequently and by installing water diversion devices such as culverts, turn-outs, broad-based dips, and water bars.

Steeper gradients exceeding 15 percent are acceptable for distances not more than 200 feet, as long as adequate measures are taken to prevent erosion.

**Water Diversion Devices.** Good road design requires that water be removed from the roadway. Road construction must also be environmentally engineered so that run-off water will be diverted into the vegetation, duff, or dispersion area. This reduces the run-off volume and velocity, thereby reducing soil movement and erosion.

Techniques often used to divert water off of or away from the road surface include: 1) turn-out ditches; 2) broad-based dips; 3) culverts; and 4) water bars. Install these diversion devices at adequate distances to remove the water volume away from the road (Table 1).

**Table 1. Suggested Distances Between Culverts, Turn-out Ditches And Broad-Based Dips On Logging Roads**

| Road Grade (Percent) | Distance (Feet) |
|---|---|
| 2 | 300 |
| 4 | 175 |
| 6 | 125 |
| 10 | 80 |
| 20 | 45 |

Source: Simmons, F.C. 1979. Handbook for eastern timber harvesting. USDA Forest Service, Northeastern Area, Broomall, PA.

Diverted water drainage flows should not end at points where they will feed water directly into streams or other surface waters. They should end at least 25 feet from a stream. Surface water should be dispersed onto nearby vegetation. If necessary, build a settling basin between a road and stream to help reduce the amount of sediment being carried to the stream.

Use culverts, both temporary and permanent, to move water under the road surface. Install ditch relief culverts at a 30-degree downgrade angle to the road direction to provide better water inlet conditions on steep grades.

When crossing a natural drainage channel, install the culvert in the channel and on the same grade as the stream. Culverts should generally be installed on a 2- to 4-percent grade to suspend soil particles and prevent clogging caused by sedimentation. Avoid steeper gradients that may lead to scouring at the discharge end of the culvert.

Installing rip-rap or brush near the outlet of culverts or dips will help to absorb and spread discharge waters by reducing the flow rate of runoff. If the road is high enough on the ridge or if there is good vegetative cover, vertical-cut banks of 5 feet or less are permissible with no ditching. This will allow water to flow across the road surface.

Maintain roads during timber harvesting operations to keep drainage systems open. Inspect ditches and culverts and clean them out frequently. Silt-filled drainage structures contribute to roadbed deterioration and more erosion.

Close and protect temporary roads and skid trails by installing water bars at the end of the logging operation. When all harvesting and regeneration activities are complete, reshape the roadbed, open or remove drainage systems, and seed all areas of bare soil for adequate revegetation.

## Log Decks

Log decks are product transfer points that receive a very high volume of traffic. They can be a source of excessive erosion if they are not properly located, constructed, and maintained.

The area of these decks should be no larger than necessary, and they should be located as far away from streams as possible. At a minimum, locate log decks at least 50 feet away from the SMZ.

If there is a small amount of natural vegetation present, use silt fencing, haybale erosion checks, or water diversion to prevent sediment from the log deck from entering nearby streams or other bodies of water.

Preferably, locate these decks on dry sites with good drainage. Avoid low, poorly drained areas. The site chosen should ideally have a slight slope of 2 to 5 percent to allow for drainage, and it should have well-drained soil that will dry quickly.

Provide for adequate drainage on approach roads, trails, and the deck area so that surface water does not contribute to mud holes on the deck.

Log decks are also active places, and they often become eyesores and health hazards due to careless littering. Garbage and trash generated from lunches and machinery parts packaging should be disposed of properly, either hauled away to a trash dumpster or buried.

More dangerous to the aquatic life and wildlife is the careless dumping of waste oil and lubricants. Collect and dispose of these substances in accordance with state-approved waste disposal procedures. Do not allow these wastes to pollute the environment.

At the end of logging operations, log decks should be site-prepared and regenerated or seeded with a grass seed mixture. This will ensure that the log decks are not a continuous source of erosion.

## Skid Trails

Skid trails are necessary for moving timber from the stump to the log deck. But after typical harvesting operations, up to 40 percent of a harvested tract may be covered in skid trails if their location and use have not been properly planned.

Adequately spaced and designated skid trails can reduce the area covered by trails to between 10 and 13 percent. Plan the location of skid trails just as carefully as you would plan the location of haul roads.

Locate major skid trails to minimize damage to the residual stand, reduce erosion, and provide an economical route for skidding. As major skid trails converge, avoid joining several at one point; the disturbed area will continue to expand at the trail intersection. Establish water turn-out ditches on skid trails at the intervals recommended in Table 2.

**Table 2. Recommended Distances Between Water Turn-out Ditches On Skid Trails.**

| Road Grade (Percent) | Spacing (Feet) |
|---|---|
| 2 | 300 |
| 4 | 200 |
| 6 | 167 |
| 10 | 140 |
| 20 | 120 |

Source: Vermont Department of Forests, Irks and Recreation. Water quality on logging jobs in Vermont. Waterbury, VT.

Avoid skidding on steep grades. The gradient of constructed skid trails should not exceed 15 percent. Sections of skid trails may be up to 20-percent grade if the distance does not exceed 300 feet. Take advantage of natural cross-drainage by installing turn-ups.

Turn-ups are built by turning the skid trail uphill for a few feet and then turning downhill again. This grade reversal will cause water to run off the downhill side of the skid trail.

In addition, make sure that skid trails are not built straight up a slope but are laid out along a gradual angle across the slope to reduce the water run-off velocity.

Carefully regulate harvesting in the SMZ. As a general rule, skidders should stay out of the SMZ. Skid trails should not be laid out in these buffer strips along the streams. If crossing an SMZ with a skid trail becomes necessary, install a temporary crossdraining culvert or bridge at the stream crossing.

Include a provision for adequate bankside protection, such as laying corduroy poles along the stream edge. During the dry season, avoid skidding in intermittent stream channels. If crossing an intermittent stream is necessary, always try to cross at right angles to minimize soil disturbance in the stream bed.

Constructed skid trails are usually subject to greater erosion rates than roads, and they should be protected after logging is complete. Establish water bars at the intervals recommended in Table 3. Water bars will remain functional only if there is a small amount of traffic. Therefore, do not install them until the trail is no longer needed.

**Table 3. Recommended Distances Between Water Bars On Skid Trails And Logging Roads After Logging Is Complete.**

| Road Grade (Percent) | Spacing (Feet) |
|---|---|
| 2 | 250 |
| 5 | 135 |
| 10 | 80 |
| 15 | 60 |
| 20 | 45 |
| 25 | 40 |
| 30 | 35 |
| 40 | 30 |

Source: Simmons, F.C. 1979. Handbook for eastern timber harvesting. USDA Forest Service, Northeastern Area, Broomall, PA.

## Stream-side Management Zones

The area adjacent to a stream is generally very fragile and is an essential habitat for wildlife. In addition, the maintenance of an SMZ is a key element in reducing stream sedimentation. The SMZ acts as a natural filter that traps soil particles and potential pollutants before they enter the stream.

The required width of an SMZ depends on the type of groundcover, soil erodibility degree of slope, shape of the stream area, and type of stream. Generally, a minimum SMZ width of 50 feet on each side of the stream is adequate where the stream-side slope is 10 percent or less. For each additional 10 percent of increased slope, add 20 feet of width to the SMZ.

Logging costs normally increase in these areas. Therefore, when logging costs are the main consideration, the SMZ should be no wider than is necessary.

Timber harvesting may be done in the SMZ if it is carefully regulated. Generally, the SMZ may be selectively harvested, removing no more than 50 percent of the crown cover. Leave the forest floor undisturbed as much as possible.

Minimize the use of skidding equipment in these areas with selective tree removal. This can be done with the skidder winch and cable. When you have finished skidding, remove tree tops and limbs from the stream.

Excess organic debris remaining in the stream after the harvest operation will cause an increase in the demand for biochemical oxygen. This reduces the oxygen available for aquatic life.

Tops and limbs also reduce the stream flow by acting as debris dams. These can cause increased flooding and possible stream rerouting during periods of high storm flow.

## Stream Crossings

As that portion of road construction nearest to a body of water, stream crossings can be a major source of sedimentation in streams. Plan roads and skid trails to keep stream crossings to a minimum.

When stream crossings are required, roads and skid trails should cross the stream at a right angle. This produces the shortest and usually the most economical route across a stream and minimizes travel distance over the stream.

The approaches to a crossing should be of maximum practical tangents (straight sections of road), preferably not less than 50 feet of road approach on either side of the stream. At the point selected for the crossing, the stream bed should be straight and should have a well-defined bank to provide a free flow of water at the crossing.

In addition to causing sedimentation problems, stream crossings are expensive. Consider alternate road locations before deciding that a stream crossing is necessary to transport timber out of a specific tract. When a crossing is necessary at a perennial stream, use culverts or bridges.

The required culvert size depends primarily on the area of the drainage, soil type, slope, cover, and soil-moisture capacity. Recommended sizes for corrugated metal culverts are shown in Table 4.

**Table 4. Recommended Diameters For Corrugated Metal Culverts, 15 Feet Long.**

| Drainage Area (Acres) | Terrain (Inches) | | | |
|---|---|---|---|---|
| | Coastal Plain | Piedmont Or Mountains | Flat Woods | Ridge Or Valley |
| 10 | 12 | 12 | 12 | 18 |
| 50 | 18 | 30 | 30 | 36 |
| 100 | 30 | 42 | 48 | 48 |
| 200 | 42 | 54 | 60 | 2(48) |

Source: Golden, MS., C.L. Tuttle, J.S. Kush, and J.M. Bradley, III 1984. Forestry activities and water quality in Alabama: effects, recommended practices, and an erosion classification system. Alabama Agricultural Experiment Station Bulletin 555.

Bridge crossings are preferable to culverts because there is less disturbance of the stream channel. However, bridges are generally more expensive to install and maintain than culverts.

In some situations, it is possible to ford streams where stream beds are stable and approaches are at a low angle. Stable stream beds are generally composed of rock, coarse gravel, or sand.

Loggers should avoid fording streams as much as possible. If a ford is necessary, roadways may be stabilized by applying 4 to 6 additional inches of large gravel or crushed rock.

## Summary

Timber harvesting does not have to be a destruc-tive intrusion by man into the forest ecosystem. Timber harvesting is a necessary process of obtaining products that are beneficial to man. It is also a silvicultural tool used to maintain the health and vigor of the forest.

With proper management, the environmental disturbance that accompanies timber harvesting can be minimized. It is the duty and responsibility of loggers and land managers to ensure that Best Management Practices are employed during all harvesting operations. It is important not only for future generations but also to maintain our current quality of life.

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