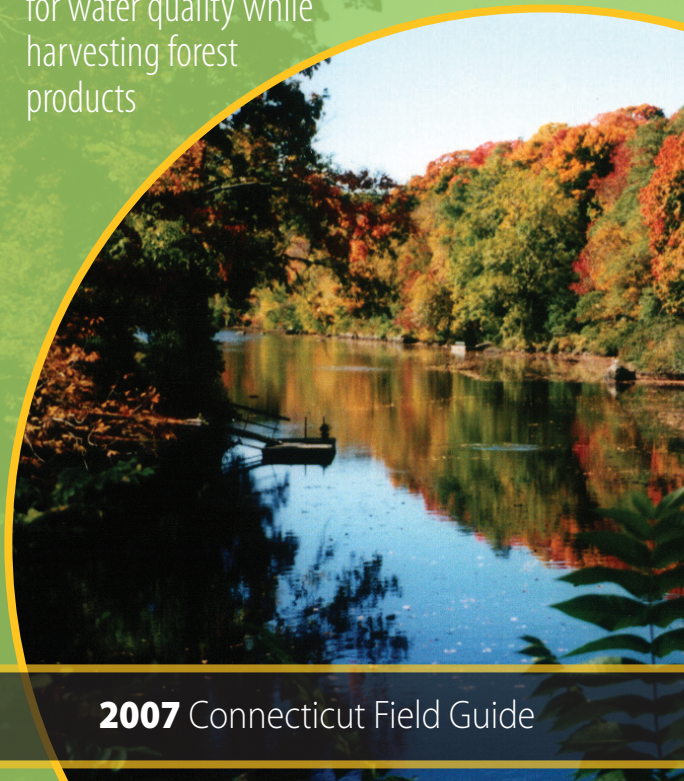
Best Management Practices

for water quality while harvesting forest products



2007 Connecticut Field Guide

This booklet was funded by an Urban Forestry Assistance Grant from The USDA Forest Service, State and Private Forestry.

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Note: Throughout this field guide when key words are first mentioned they appear in bold italics, indicating that they are defined in the Glossary.

Introduction

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Introduction

FORESTS PLAY A VITAL ROLE IN PURIFYING AND MAINTAINING CLEAN WATER TO SUPPORT DIVERSE AQUATIC ECOSYSTEMS AND SATISFY HUMAN DEMANDS. SPECIAL CARE MUST BE TAKEN TO PROTECT THE WETLANDS AND WATER RESOURCES WHEN CONDUCTING TIMBER HARVESTS.

This field guide is intended for certified forest practitioners, private landowners, and municipal officials to use while planning, executing, or monitoring commercial forest practices. The focus of the publication is to promote sound timber harvesting practices in Connecticut woodlands by strengthening planning efforts and fostering better communications between municipal officials, landowners, foresters, and loggers. This guide is a menu of options that allows flexibility for professional discretion and decision-making in the field. It does not present a single prescription that can or should be applied in all cases. The ultimate objective is to have an economically viable timber harvest that protects water quality and site productivity.

The key to success is the proper planning and use of appropriate or "best management practices." Best management practices for water quality, or BMPs as they are often referred to, are minimal standards taken to ensure water quality. In the case of this harvesting guide

they are simple, often low-cost practices and techniques that can be incorporated into timber harvesting practices. The implementation of BMPs can pay big dividends in keeping our water clean, maintaining the productivity of the forest, improving public confidence in forestry and logging professionals, and maintaining public support for sustainable forest management.

The process of felling a tree generally does not cause **erosion**. The potential for, **sedimentation** from harvesting operations originates from erosion to exposed soil on logging roads, skid trails, and landings. The risk of pollution from forest management activities is small compared with most other land uses.

The direct impact of rainfall and subsequent surface runoff causes most of the erosion in logging operations. Surface runoff scours exposed soils and detaches particles, transports sediments, and forms pools in deep ruts and depressions on roads and trails. Erosion and sedimentation may cause a variety of problems including:

- Loss of soil from the forest, reducing productivity.
- Eventual filling of stream channels, resulting in flooding.
- Alteration of habitat for fish and wildlife.
- A traffic hazard, if sediments reach a public road.
- Higher timber harvesting costs.
- Adverse public opinion of timber harvesting.
- Reduction of water quality.

Most erosion associated with forest management activities occurs during and immediately after timber harvesting. The basic principles of erosion control needed to reduce or avoid damage include:

- Disturbing as little land as possible.
- Using erosion control measures to protect disturbed areas.
- Reducing the speed and volume of runoff.
- Diverting runoff away from disturbed areas.
- Conducting conscientious maintenance of erosion controls.
- Assigning someone the direct responsibility of implementing and maintaining erosion control measures.

It is more economical and effective to plan a timber harvest in advance and take preventative measures, than it is to try to fix the problems after they occur. If the suggestions outlined in this field guide are followed, and appropriate practices applied, timber harvesting will have minimal impact on water quality, and will continue to be viewed in a positive manner.

Laws Affecting Forestry Operations

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Laws Affecting Forestry Operations

Regulation of Inland Water Resources

It is important for forest practitioners and agencies that grant permits or make jurisdictional rulings to work closely together so that opportunities to harvest timber at times when ground conditions are most favorable are not lost. Early in the planning process, forest practitioners and landowners must identify which state and local regulations apply, and all permits, jurisdictional rulings or permissions that must be obtained. When forest practitioners and landowners fail to apply for permits or rulings in a timely manner, it may result in the unnecessary delay of the timber harvest. In turn, agencies must act efficiently within the regulatory framework or realize that unnecessary delays might result in the timber harvest occurring when ground conditions are deteriorating.

Activities that occur within a **wetland** or **watercourse** or are in non-wetland and non-watercourses but may impact or affect a wetland or watercourse are called regulated activities and may require a permit. However, in accordance with the Connecticut General Statutes, many but not all forestry activities in wetlands and watercourses are permitted "as of right" and therefore are not regulated activities. As of right activities are described in Section 22a-40 of the Connecticut

General Statutes. Determinations of which activities are as of right may only be made by an Inland Wetland Agency.

When planning a harvest operation, the first step is to contact the local Inland Wetlands Agency for a jurisdictional ruling. Municipal Inland Wetland Agencies are legally entitled to review any non-state agency proposal, including forestry, and to request sufficient information about the operation to determine if it is regulated or qualifies for the as of right agriculture (forestry) exemption.

Certification of Forest Practitioners

The Connecticut Forest Practices Act requires that those who advertise, solicit, contract, or engage in commercial forest practices within Connecticut at any time must be certified by the Department of Environmental Protection (DEP) prior to doing so. A commercial forest practice is any activity undertaken in connection with the **harvest** of timber from a tract of **forest land** in excess of 50 cords, or 25,000 board feet, or 150 tons during any twelve-month period. There are limited exclusions for land clearing. Contact the Division of Forestry, (860) 424-3630, to determine which land clearing practices are exempt from certification.

Planning

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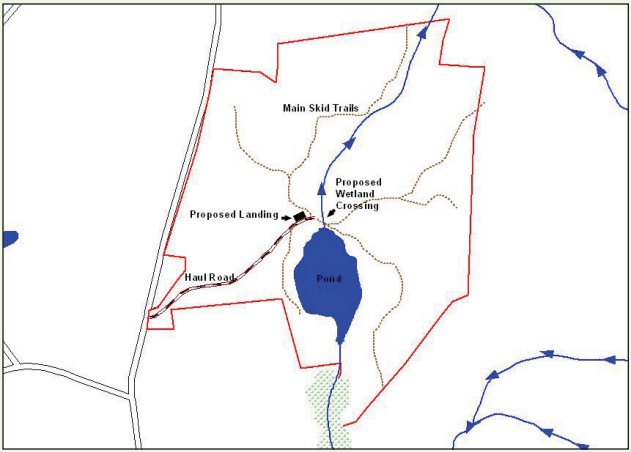
Planning

AN OPERATIONAL PLAN, OR HARVEST PLAN, SHOULD BE PREPARED BEFORE STARTING EACH TIMBER HARVEST. A GOOD PLAN WILL REDUCE SOIL EROSION AND SEDIMENTATION AND INCREASE THE EFFICIENCY OF OPERATIONS AND PROFITABILITY OF THE HARVEST.

Studies have shown that good planning reduces the amount of land used in landings, roads, and trails from 15% or more to 7% or less of the area.



To minimize potential problems, the **operational plan** must consider soils and topography of the area. Planned erosion and sedimentation controls must be both effective and practical. A variety of tools can help in evaluating the site and developing a plan for harvesting activities before entering the site. Useful tools may include: topographic maps, aerial photos, U.S.D.A. soil maps, property maps, tax maps or municipal wetland maps.

Timing can be an important BMP tool. Operating when the ground is dry, frozen, or other wise stable enough to support the equipment being used are excellent ways to reduce or eliminate erosion and sedimentation. When ground conditions are poor it may be necessary for the operator to plan for the use of low impact equipment or consider temporarily suspending the harvest in some or all areas of the property until conditions improve.

Planning

Use the following recommendations when planning timber harvest activities:

- Make a tentative list of site-specific BMPs to be incorporated into any forest management plans, operational plans, and timber harvest sales contracts.

- Review landowner's objectives for the site and any existing forest management or operational plan.
- Walk the property to conduct a site evaluation to verify land features and topography against the maps and to facilitate the possible relocation of timber harvest infrastructure and identify the following:
  - √ Property and stand boundaries.
  - √ Public highways, roads, and utility right of ways.

- √ Existing and planned forest access systems (Roads, trails, and landings).
- √ Equipment maintenance and fueling areas.
- √ Stream crossings.
- √ *Filter strips*– areas next to streams, ponds, lakes, ***vernal pools***, wetlands and other water bodies where activities may need to be modified to protect water quality, fish and other aquatic resources.
- √ Sensitive areas containing endangered and threatened species or trees identified as having special benefits to wildlife.
- √ Poor drainage areas, including springs and seeps.
- √ Areas of special concern for the landowner, such as cultural sites containing stonewalls, historic foundations or walking trails.
- √ Danger areas or hazards such as open wells

- Examine existing roads, trails, and landings to determine if their location and construction is adequate for continued use. Consider whether relocation would provide better long-term routes.

- Mark roads, trails, landings, and stream crossings on the ground and determine specific control devices to be used. Take advantage of natural features that will make construction easier and drainage most effective. Changing the color of flagging used to mark each operational design feature such as landings, roads, and trails helps clarify instructions provided to logging crews .
- Consider weather and ground conditions when scheduling road building and harvesting operations.
- Avoid wet seasons and plan water crossings (including installation of culverts and bridges) for summer months when water is low and fish eggs aren't incubating.
- On wet sites and when working in or around wetlands, time operations to coincide with stable ground conditions or use low impact equipment.

Failure to obtain the proper permits or jurisdictional rulings may result in unnecessary delays. See section on Laws Affecting Forestry Operations.

Landings

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Landings

LANDINGS ARE AREAS WHERE FOREST PRODUCTS ARE COLLECTED FOR PROCESSING, LOADING AND TRANSPORT, AND ARE ONE OF THE MOST VISIBLE AND IMPACTED PARTS OF ANY TIMBER HARVEST. IF LANDINGS ARE NOT PROPERLY LOCATED AND MAINTAINED THE CONCENTRATION OF ACTIVITIES MAY CAUSE COMPACTION, EROSION OR SEDIMENTATION.

Landings

The following recommendations should be considered when planning, locating and constructing landings:

- Use existing landings that meet BMP standards.
- Locate new landings in advance of access road construction.
- Locate landings on firm, well-drained soils with a slight slope, or crown, to promote efficient drainage.
- Locate landings away from natural drainages and divert runoff away from streams.
- Minimize the number and size of landings.
- Locate residue piles such as ***slash***, sawdust or chips away from drainages where runoff may wash residue into streams, lakes or wetlands.

- On skid roads that lead downhill into landings, prevent water from flowing into the landing and pooling by locating drainage structures such as ***water bars*** prior to the landing to divert runoff into a stable area.
- Use tracking pads where trucks enter public roads during or in anticipation of muddy conditions. Tracking pads consist of materials such as stone, wood chips, or tire mats and must be long enough to allow mud to

fall off the tires before the vehicle leaves the site. Periodic maintenance maybe required to keep the tracking pad clean and in working condition.

- On the truck roads, locate drainage structures such as water bars and ***broad based dips*** leading out of the landing to prevent water and sediment from flowing onto public roads.

See the Post Harvest Wrap-Up section for recommendations on stabilizing the landing. For guidelines on general equipment maintenance, and for hazardous materials see the Hazardous Materials section of the manual.

Stream Crossings

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Stream Crossings

HARVESTING ACTIVITIES, EXCEPT FOR THE NECESSARY AND PROPER INSTALLATION OF STREAM CROSSINGS STRUCTURES, MUST BE KEPT OUT OF STREAM CHANNELS. STREAM CROSSINGS ARE ONE OF THE PRIMARY WAYS FOR SEDIMENTS TO ENTER WATERCOURSES.

When properly located, constructed and maintained stream crossing structures can prevent damage to the bed and banks of streams, and control the movement of sediment into the water.

Stream crossings should be designed, constructed, and maintained to safely handle expected vehicle loads. When planning a stream crossing, it is important to consider the stream bottom materials, stream size, storm frequency, flow rates, and intensity of use (i.e., permanent or temporary).

Three common stream crossing structures include: bridges, ***fords*** and culverts. Temporary bridges are recommended for crossing ***perennial streams*** as they cause less modification of the stream and minimize disruption of fish passage. Fords and culverts are generally limited for use in ***intermittent streams*** where fish passage is not a concern. Culvert installation in a perennial stream that supports a fish population requires different instructions than those presented

in this section. For more information on the installation of culverts in perennial streams contact the Department of Environmental Protection Fisheries Division at (860) 424–3474.

Stream Crossing Planning

When planning, locating and constructing stream crossings, the following recommendations should be considered:

- Select a site for stream crossings prior to laying out the road system.
- Keep the number of crossings to a minimum.
- Cross the stream by the most direct route.
- Cross the stream at a 90-degree angle to the direction of stream flow.
- Locate the crossing where the approach has minimal slope.
- The single most effective practices in keeping sediment out of streams is to protect approaches to the crossing with stone, ***corduroy***, slash or other suitable materials.

Whether a bridge, culvert, or ford is planned to cross a stream, town Inland Wetlands Agency must be contacted to determine if the action is permitted as a right or if a permit is required.

- Locate a stream crossing where the stream channel is straight and has a gentle gradient.
- Locate the crossing in a flat area where floodwaters can disperse if the culvert or bridge's capacity is exceeded.
- Never follow streambeds or swales as skid trails.
- Locate road and trail drainages adequate distances from crossing structures to allow sufficient filtering of sediments to prevent them from entering waterways.

Stream Crossing Construction & Maintenance

- In-stream construction activities should be limited to periods of low or normal flow.
- Keep use of equipment in the stream to a minimum.
- Construct a bridge or place fill directly over a culvert higher than the road approach to prevent surface road runoff from draining onto the crossing structure and into the stream.
- Use soil stabilization practices on exposed soil at stream crossings. Apply seed and mulch and install temporary sediment control structures such as hay bales or silt fences immediately following construction to minimize erosion into streams. Maintain these practices until the soil is permanently stabilized.

- Keep culverts and bridges clear and free of debris so that water can pass unimpeded at all times.
- On unmaintained roads, it is recommended to use temporary crossing devices that are easily removed after use.

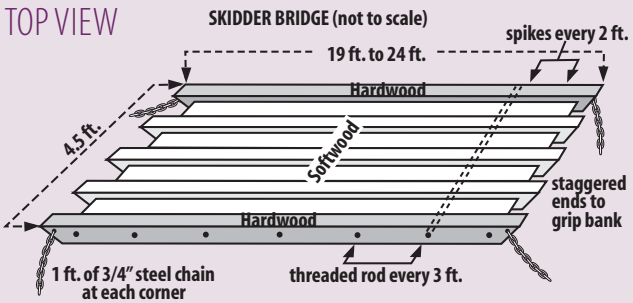
Temporary Portable Bridges

Temporary bridges make excellent stream crossing structures for roads and trails, and are preferred for crossing perennial streams. The installation and use of temporary bridges results in fewer disturbances to the stream channel and results in less soil disturbances than pipe culverts and fords. Effective temporary bridges can be made out of a variety of materials, such as: straight logs chained together or timber stock.

Temporary Portable skidder Bridge Guidelines

- For bridge spans that lay directly on the stream bank, the bridge must overlap the bank adequately to provide enough bearing length to support each side of the bridge.
- Anchor the bridge to ensure it does not move during a period of high water.
- The bridge must sit level side-to-side and end-to-end and provide sufficient clearance for unobstructed stream flow.
- To prevent the logs from sliding off bridges during skidding use large hardwood timbers, poles or cull trees on the outside edges.

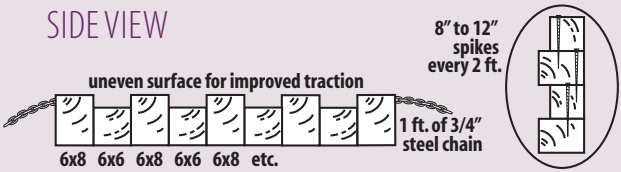
Temporary Portable Bridge Diagram



Assembly:

Predrill and inset 3/4" threaded steel rods every 3' and secure with at least one nut. To increase rigidity, nail individual timbers together every 2' with 8" to 12" barn spikes. This prevents flexing between the threaded rods.

- **Most loggers use a two-piece bridge, dragging both pieces into place with the skidder, or moving them with a forwarder.**
- **Longer is better, as long as it can fit on a log truck.**
- **Many loggers own two bridges, one short [19'] and on long [24'].**
- **Proper installation is very important; a bridge must be level, and provide sufficient clearance for stream flow.**
- **Use larger hardwood timbers on the outside edges for strength, to prevent the hitch from sliding off, and to make it easier for the grapple to grab.**
- **Use softwood timbers on the inside to minimize weight, make drilling easy, and keep the cost down.**



- **Alternate 6x6' and 6x8' softwood timbers on the inside to create an uneven surface for better traction.**
- **Provide for water drainage to prevent rot.**
- **Staggered and beveled ends of the bridge grip the bank and lie flat.**
- **Use 1' of 3/4" chain on the corners to be able to skid the sections from the landing, and hold the two pieces of bridge together.**

- Apply materials such as poles or cull logs perpendicular to the direction of travel on the bridge approaches to reduce the potential for sediment being dropped from the tires onto the bridge deck and washed into the stream.
- Keep the bridge deck free and clear of debris and soil.

Fords

Truck Roads

The use of Fords for truck roads is an acceptable alternative for crossing intermittent streams under the following conditions:

- The streambed has a rocky or coarse gravel bottom, and the approaches are low and stable enough to support traffic.
- The approaches are of nonerodible materials, and should extend 50 feet or more on both sides of the crossing. Stabilizing materials may include crushed rock, riprap, rubber mats or geotextiles.

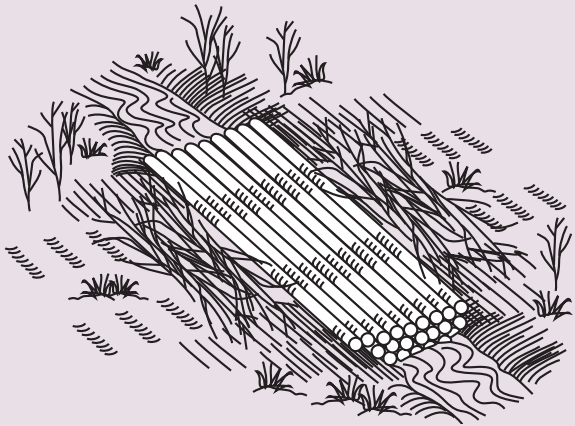
- As an alternative, fords may utilize a temporary corduroy crossing consisting of pole size trees, cull logs, or other materials such as tire mats.

Skid Roads

Poled fords can also be used temporarily for forwarding logs across intermittent streams. To minimize soil disturbance and root mass destruction, a corduroy consisting of pole size, pipe bundles, or cull trees is placed in the streambed perpendicular to the direction of travel. The diameter of the poles must be large enough so that the equipment tires or tracks are kept above the surface of the water and roughly level with the adjoining stream banks. Often, a metal pipe is inserted in place of one pole to provide temporary passage for any water that may build up.

It is critical that measures be taken to protect the approaches and prevent tires or tracks from carrying or dragging soil onto the crossing structure. Extend the corduroy onto the stream banks or line the approaches with slash far enough to permit soil to fall off prior to reaching the crossing structure.

PIPE BUNDLE CROSSING



Culverts

Pipe culverts are an acceptable method for crossing intermittent streams. Installation of a culvert in a perennial stream that supports a fish population requires different construction methods than presented in this manual to ensure that fish passage is not interrupted. For more information on the installation of culverts in perennial streams contact the Department of Environmental Protection Fisheries Division at (860) 424-3474.

Installation of Culverts (For use in intermittent streams only)

- Culvert openings should be large enough to carry all of the runoff that may accumulate above the culvert inlet during severe rain events.

Recommended Culvert Size by Upstream Area

Watershed Area Above Pipe Inlet (Acres)		
Gentle Terrain & Deep Soils	**Steep Slopes, Wetlands or Thin or Hardpan Soils**	**Recommended Pipe Diameter (Inches)**
16	4	15
25	7	18
40	12	21
55	16	21
84	27	30

Source: Hartung, R.E., and Kress, J. m., 1977. Woodlands of the Northeast – Erosion and Sediment Control Guides, U.S.D.A. Natural Resources Conservation Service and Forest Service.

- Position culvert as near as possible to the natural stream channel and no lower than the streambed.
- Install culverts so there is no change in the stream bottom elevation. Culverts should not cause damming or pooling.

- A settling basin should be constructed at the inlet, and may also help at the downstream end of the culvert to trap suspended sediment. Settling basin inlets and outlets should be protected with riprap, be properly maintained and kept clear of any debris that may block water flow.
- The culvert should rest on a smooth, firm surface.
- Culverts should extend beyond the fill bank by at least 1 foot.
- Culverts for stream crossings should be no smaller than 15" in diameter and 18" if there is evidence of a defined stream channel.
- The culvert fill should be compacted at least halfway up the sides of the pipe with clean fill to prevent seepage.
- The top of the culvert should be covered with fill to a depth of at least one foot, or half the culvert's diameter, which ever is greater, to protect the culvert from being crushed by vehicles.
- A headwall of laid stone, concrete, ***riprap,*** or logs should be built if the stream has sufficient force during heavy rain events to cause erosion. The headwall will also prevent the crushing of the inlet pipe.

Road and Trails

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Road and Trails

PROPER CONSTRUCTION OF ROADS IS A VITAL STEP IN PREVENTING EROSION. THE POTENTIAL FOR SOIL LOSS DUE TO WATER EROSION IS GREATEST DURING ACTIVE HARVEST OPERATIONS. CONTINUAL SOIL DISTURBANCE BY HARVESTING EQUIPMENT CREATES A CONDITION WHERE EVEN LIGHT RAIN CAN CAUSE EROSION.

In the course of harvest operations, the operator must deal effectively with both surface water and stream crossings to minimize erosion and sedimentation. Control measures should minimize the amount

of disturbance and related erosion, and prevent detached soil from entering watercourses as sediment. Decisions made during the planning stage will affect road construction costs, maintenance needs, service life and the potential occurrences of erosion and sedimentation.

Note that many of the practices recommended for skid roads and trails are applicable to truck roads, including but not limited to, planning and construction practices.

Truck Roads

Truck roads are used to take logs from a landing to a public road. Whether truck roads are constructed for temporary or permanent access to a parcel of land, the following recommendations should be considered when planning the location of truck roads:

- Locate roads to minimize the amount of cut and fill.
- Provide adequate filter strips by locating roads away from streams, ponds, lakes, vernal pools, and wetlands.
- Locate roads and trails where water may be easily diverted, not in swales or other low points.
- Avoid locating roads on ***slopes*** with unstable soils. Soil Surveys Maps will aid in identifying these soils.

- Avoid planning roads with ***grades*** in excess of 10%. Short sections may approach 20% grade to avoid obstacles.

Surface Water Drainage

Water flowing along or onto the roads should be diverted before it gains sufficient volume or velocity to cause significant erosion. Water accumulation on roads can be minimized by implementing a combination of out-sloped, in-sloped and crowned road cross-sections, as well as water diversion structures within the roadbed itself. The choice of the shape of the road or its cross section depends on drainage needs, soil stability, slope, and expected traffic volume.

Out-sloped roads drain water toward the downhill side of the road. They are for use on moderate slopes for low volume roads with stable soils. Outsloping is not recommended on roads requiring winter hauling or on slopes of 20 percent or more. Insloped roads are for use on steep slopes and areas with fine textured soils. Crowned roads are for use on flat ground where water standing on the surface is a problem and for high volumes roads on steep slopes. In-sloped and Crowned roads require frequent culverts to carry water underneath the road to the downhill side.

Excavation

Recently excavated and exposed soil is a critical factor contributing to the siltation of waters. Recommended methods for placement of excavated materials associated with road construction include the following:

- Place excavated material in a manner that will not impede water flow or potentially increase the sedimentation of wetlands and watercourses.
- Deposit excavated material in stable locations away from filter strips surrounding streams, ponds, lakes and wetlands.

Construction

Proper handling of water drainage during construction will minimize potential impacts on water quality. The key to construction is to anticipate problems and install preventative measures. Take action to mitigate unanticipated drainage problems the same day they are discovered. The following recommendations should be followed to reduce possible impacts:

- Provide adequate drainage for road grades during construction to minimize erosion of unconsolidated materials.

- During construction, provide temporary cross drainage structures such as water bars to drain water off road surfaces.
- Install permanent drainage structures as construction proceeds.
- During construction, install siltation barriers, such as silt fences and hay bales, in sites where wetlands and watercourses are in close proximity and downhill from roads.
- Material used for road fill should be compacted to reduce the infiltration of water, increase load carrying capacity and minimize settling.
- Use Geotextile fabrics and gravel to reinforce road surfaces as necessary.

Skid Roads and Trails

Skid roads are temporary roads designed to move logs from the harvest area to a landing. A skid road may require some preparation, such as clearing or grading. A skid trail is used to bring logs to a skid road or on small harvests directly to a landing, and requires little, if any, preparation. Erosion is less likely to occur on a skid trail than on a skid road, because the roots and organic matter are left intact

and there is less compaction of the soil. The surface of an active skid road or trail is constantly being disturbed and subject to erosion. Skid roads and trails should be closed and permanent BMPs installed as soon as they are no longer needed instead of waiting until the timber harvest is completed.

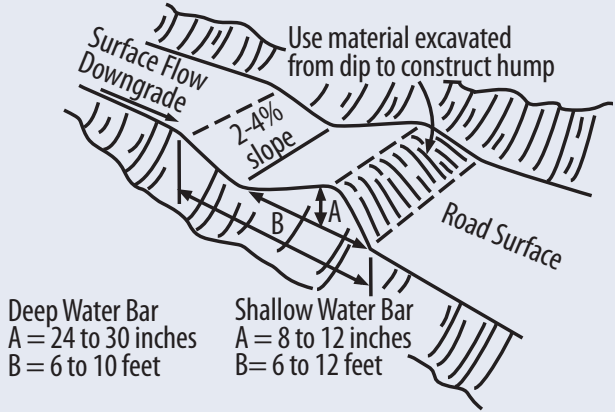
Skid Road and Trail Planning

The following recommendations should be considered when planning the design of the skid roads and trails:

- Consider the topography and soil type in the location of roads and trails. Where possible avoid steep slopes and unstable soils.
- Minimize total road distance and ground disturbance.
- Locate roads and trails where water may easily be diverted, not in streambeds, swales or other low points.
- Minimize the number of water crossings.
- Keep roads and trails uphill from wet or steep areas.
- Identify appropriate stabilization, drainage and erosion control measures.
- Prior to a severe storm, plan to install additional temporary BMPs, since most erosion and sedimentation occurs during and immediately following such events.

- Implement a combination of out-sloping turn-ups, or reverse grades, as well as water diversion structures within the roadbed itself to minimize water accumulation on roads.
- Drain water off of the road and trail surfaces and into undisturbed area at the first opportunity and in the shortest distance possible.

WATER BARS



Recommended Distances Between Water Bars & Turn-ups on Roads and Skid Trails

Road Grade %	Water Bars (Spacing in Feet)	Turn-ups (Spacing in Feet)
1	400	450
2	250	300
5	135	200
10	80	140
15	60	130
20	45	120
25	40	
30	35	
40	30	

Water Bars

A water bar is a ditch and hump or a log lying across a trail or road for the purpose of directing water runoff into vegetation, litter layer, ditch, or dispersion area to reduce water volume and velocity. Deep water bars are usually used on roads that will be closed for extended periods. Water bars may be used temporarily on active operations or permanently in post harvest wrap up.

Turn-Ups

An outsloping turn-up made by slightly changing the direction of a skid trail uphill is an effective way to divert water from the trails surface.

Natural Cross Drains

Natural cross drains may be utilized, but must be kept open to prevent water from pooling.

Vernal Pools

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Vernal Pools

A VERNAL POOL IS A SMALL DEPRESSION THAT CONTAINS WATER FOR APPROXIMATELY TWO MONTHS DURING THE SPRING, LACKS A PERMANENT OUTLET, LACKS FISH, AND USUALLY DRIES OUT BY LATE SUMMER.

Vernal pools provide critical habitat for a number of amphibians and invertebrates, some of which breed only in these unique ecosystems. It is important to walk the property in the beginning of the planning stage to identify vernal pools because they may not be apparent on any wetland maps. Vernal pools may be difficult to identify when

they are dry, but some identifying physical characteristics include: black or gray stained leaf litter from being under water; and trees with water stains on their trunks are a result of the seasonal flooding. Changes to the surrounding vegetation, topography, and the timing and intensity of surface water drainage may destroy the pool or prevent amphibians and invertebrates from effectively re-colonizing an area. To preserve the integrity of the vernal pools the following steps may be taken:

- Prohibit logging equipment from entering vernal pool depressions or operating on the pools perimeter walls at all times of the year.
- Keep tree tops and slash out of the pool depression. If an occasional top does land in the pool depression leave it because removal could cause further disruption.
- Maintain an undisturbed 50 foot vegetated buffer around the vernal pool. If the buffer area must be operated in, schedule operations when the ground is frozen and snow covered to minimize disturbance of leaf litter and mineral soils and maintain a minimum of 50 percent crown cover.

- Locate landings and heavily used skid roads outside the buffer area. Be sure that any water diversion structures associated with skid trails and roads keeps sediment from entering the buffer zone and the vernal pool.
- Smooth out ruts and implement proper BMP practices for road and trail closure.

Erosion Control Tools & Techniques

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Erosion Control Measures

EVEN WITH THE USE OF THE WATER CONTROL MEASURES PREVIOUSLY MENTIONED, THE USE OF ADDITIONAL MEASURES MIGHT BE REQUIRED TO PREVENT TRANSPORTATION OF SEDIMENT OFF SITE.

Filter Strips

Located between watercourses and heavily disturbed areas, such as roads and landings, filter strips work to absorb runoff and reduce overland flow that can carry suspended sediments into water bodies. Timber harvesting is permitted in filter strips, but the operation of logging machinery should be limited to skid trails only. Truck

Recommended Widths of Filter Strips Between Truck Roads and Streams

Land Slope Between Road and Stream (%)	Width of Filter (Feet)
0	25
10	45
20	65
30	85
40	105
50	125
60	145
70	165

and skid roads should not be located in filter strips except where stream crossings are necessary. In order to minimize any increase in streamwater temperature, timber harvesting should not reduce the crown cover below 50 percent

Tracking Mats

Tracking mats can be purchased or made from recycled tires, wooden planks or other suitable material. They can be used in many situations (access roads, skid trails, landings, and ford crossings) to prevent or reduce erosion. Tracking mats protect the underlying root masses and minimize soil disturbance.

Post Harvest Wrap-UP

Best Management Practices
for water quality while harvesting forest products

Post Harvest Wrap-Up

INSTEAD OF WAITING UNTIL THE TIMBER HARVEST IS COMPLETED, INSTALL EROSION CONTROL MEASURES ON ROADS AND TRAILS AS SOON AS THEY ARE NO LONGER NEEDED.

- Smooth ruts on all roads and trails.
- Install water bars where necessary and clean out drainage dips and natural drainage areas (swales). It is better to have more drainage structures than not enough.
- Brush and slash may be placed in skid trails and on slopes to slow water flow and retain sediment.

- Remove culverts, bridges, or other temporary structures placed in watercourses.
- Grade approaches to streams.
- The landing surface should be graded so that the water does not flow onto the access road.
- Seed exposed soil on landings, approaches to stream crossings and steep skid trail sections. Seed mixtures of several species are more likely to protect the soil than a single species.
    - √ Seed mixtures vary with soil and site conditions and intended use. Contact your local extension agent or the Natural Resources Conservation Service (NRCS) for suggestions.
    - √ Seed mixtures should establish quickly, be suited to the soil conditions it is being applied to, develop a solid root mass, and be reasonable in cost.
    - √ A light application of scattered hay over a new seeding on a slope will lessen erosion while the seeds take hold. Excessive hay retards germination and growth.
    - √ Wood chips, sawdust, and hay make excellent cover material for moderate slopes, providing protection from erosion until natural vegetation becomes established.

√ Caution should be taken to avoid using hay contaminated with seed from invasive species.

- Heavily compacted soils may need to be loosened or roughed up prior to seeding. Raking or dragging a tree top will not only serve to rough up the ground but will blend seed into the soil resulting in more vigorous seeding.
- Continued access to skid roads and trails by off road vehicles may destroy the effectiveness of many BMPs. An effective barrier to off road vehicles is a medium-sized tree felled so that the top is in the skid trail and the butt is still partially connected to the stump. The tree cannot be moved without additional cutting and stays alive for a long time. The tops of harvested trees may also be winched into trails, or large barriers of earth and rocks may be placed in trail entrances.
- Inspect erosion control measures periodically and maintain or remove as needed.

Remember: A small amount of extra effort at the end of the timber harvest operation can go a long way in protecting soil and water resources and in maintaining good landowner and public relations.

Forest Harvest Contracts

Best Management Practices
for water quality while harvesting forest products

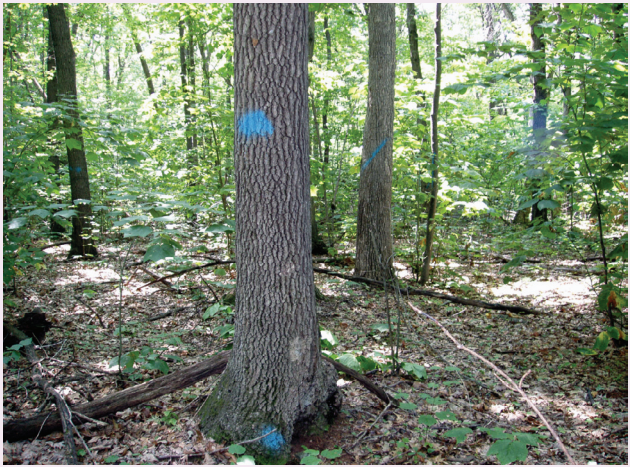
Forest Harvest Contracts

PRIVATE LANDOWNERS SHOULD SELL TIMBER THROUGH A WRITTEN CONTRACT, A LEGALLY BINDING DOCUMENT THAT PROTECTS BOTH THE LANDOWNER AND THE BUYER BY LISTING AND CLARIFYING THE RESPONSIBILITIES OF EACH PARTY.

The contract should be drafted or approved by an attorney representing the landowner who is familiar with timber transactions. At a minimum, a contract should:

- Require the use of BMPs and name the person responsible for their implementation.
- Require that the buyer abide by all local, state, and federal laws and regulations.
- Specify the location of log landings, truck and skid roads
- Describe the timber being sold, its location, and the method of determining which trees will be cut.
- Describe the location of the property and require that the boundaries of the sale be marked.
- Specify the amount of board feet or cords to be harvested and the manner, time, and method of payment.

- Specify the time period covered by the contract.
- Include any special considerations or stipulations that either party may require.
- Consider requiring a performance bond to ensure that BMP's are implemented.



Glossary

Best Management Practices
for water quality while
harvesting forest products

Broad-based Dip: a surface drainage structure specifically designed to divert water from the access road while vehicles maintain normal travel speeds.

Corduroy: logs placed close together perpendicular to the direction of travel to protect the integrity of the underlying soils.

Culvert: buried pipe or structure that allows stream flow or road drainage to pass under a road. Culverts are often round but can be other shapes as well.

Erosion: the detachment and transportation of soil particles.

Fords: stream crossing where vehicles travel directly through the stream.

Forest land: (As defined in the Forest Practices Act) means that portion of a parcel of land which constitutes a total of at least one contiguous acre on which there is no structure, maintained landscape area, access way or other improvement and which is (A) occupied in random distribution by trees having a minimum diameter of three inches as measured from a point on the trunk which is four and one-half feet above the ground such trees comprising at least seven and one-half square feet of basal area and the crowns of such trees occupying no less than fifteen

percent of the total area; or (B) which is planted with at least five hundred trees per acre and is not maintained for Christmas tree or nursery stock production.

Grade: See ***Slope***

Harvest: any activity involving the felling or excavation of a tree, cutting a tree to log length, transporting a tree or log material to landing or public road, or sort or stack forest products at a landing.

Intermittent Stream: a stream, or portion of a stream that does not flow year-round. This definition is not applicable to Inland Wetland Statutes.

Operational Plan: focused plan, which deals strictly with the operational aspects of conducting the harvest of forest products. This plan would address, for example, the design and creation of access roads; felling techniques; erosion and sediment control; and protection of wetland and watercourses.

Perennial Stream: a stream that has running water on a year-round basis under normal climatic conditions. This definition is not applicable to Inland Wetland Statutes.

Riprap: stone placed at the end of a culvert or on a steep slope to reduce erosion.

Sedimentation: the deposition of eroded soil particles.

Slash: any residual woody material left on the site after a harvest operation and usually includes tree stems, branches and foliage.

Slope: same as Grade or Pitch. Slope percentage (%) is determined by dividing the rise in elevation in feet by the distance or run in feet multiplied by 100.

Slope % = rise/run x 100

Vernal Pool: a small depression that contains water for approximately two months during the growing season, that lacks a permanent outlet, lacks fish, and dries out most years usually by late summer.

Water Bars: a ditch and hump across a trail or road for the purpose of carrying water runoff into vegetation, litter layer, ditch, or dispersion area to reduce water volume and velocity.

Watercourses: in accordance with Connecticut General Statutes Section 22a-38(15).

Wetlands: in accordance with Connecticut General Statutes Section 22a-38(16).