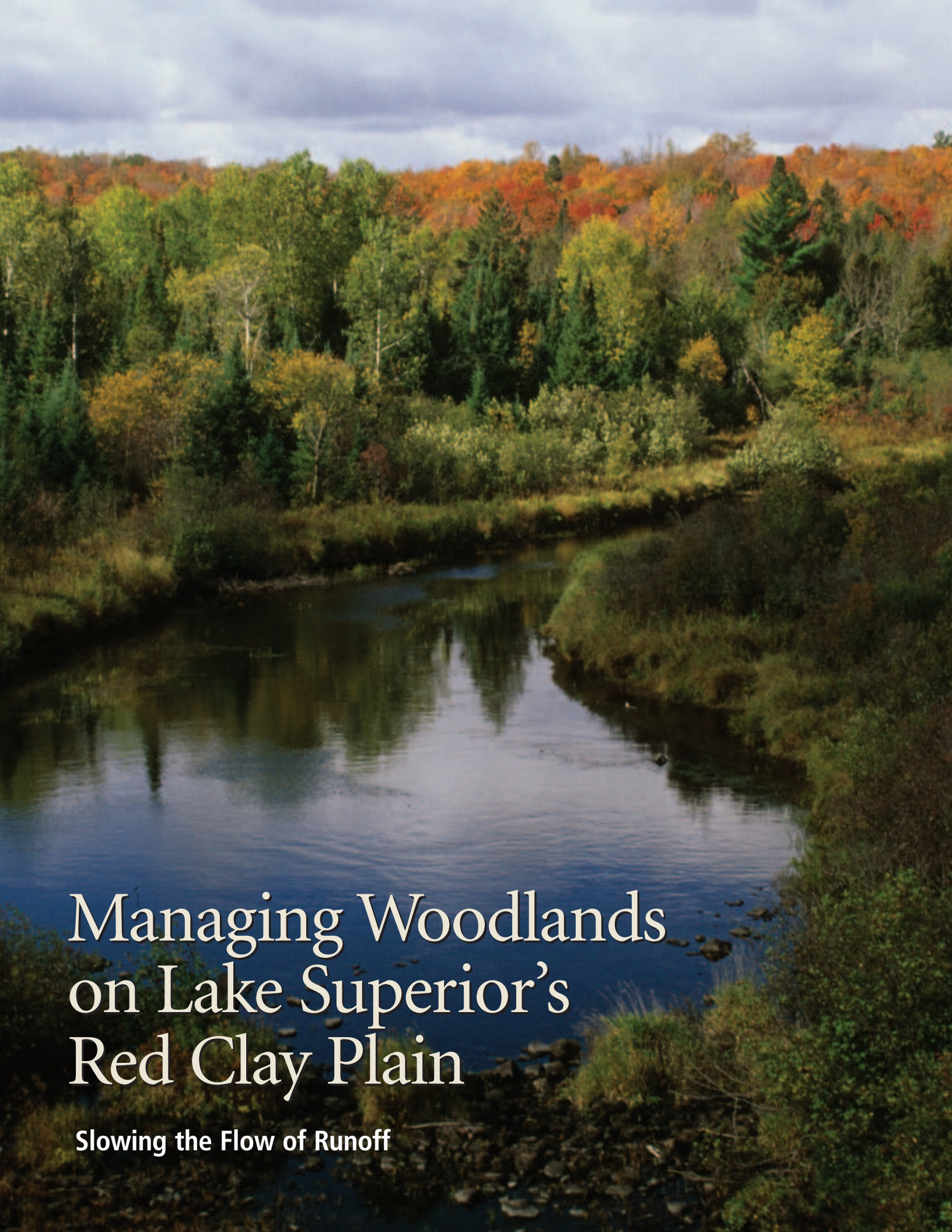
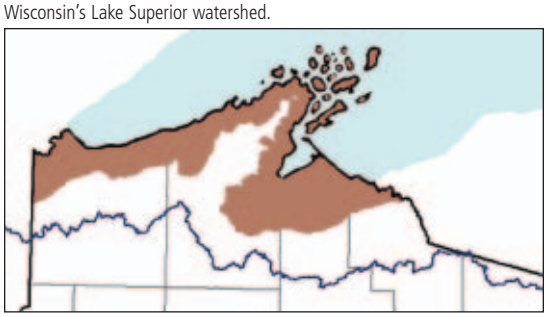


Managing Woodlands on Lake Superior's Red Clay Plain

Slowing the Flow of Runoff

Lake Superior's Red Clay Plain

Wisconsin's Lake Superior watershed.



Lake Superior Basin
Lake Superior's Red Clay Plain

Along Lake Superior's southern shore, you will find the red clay plain in Ashland, Bayfield, Douglas, and Iron counties. The plain has layers of red clay and sand that create many unstable slopes which can easily lead to erosion. This publication describes ways woodland owners can help to slow the flow of runoff and prevent soil erosion while managing their forestland.

The high potential for erosion is an important consideration to guide land management decisions in the red clay plain, including how to sustainably manage forests.

Water runs over clay soils quickly because they are relatively impermeable. Significant amounts of water runoff and the resulting eroding sand and clay can present a number of problems. When the volume and velocity of runoff is more than a stream channel can withstand, its bed and banks can collapse and wash downstream. The sand from the stream's bed and banks then moves slowly downstream and damages habitat by covering gravel spawning beds and filling deep holes used by fish.

As the red clays erode from valley walls, they color streams a bright red, reducing water clarity. The streams carry the clay out into Lake Superior where it can pose problems for cities that use Lake Superior as their source for drinking water.

The high potential for erosion is an important consideration to guide land management decisions in the red clay plain, including how to sustainably manage forests. Forestry Best Management Practices (BMPs) for Water Quality are guidelines designed to protect lakes, rivers, and wetlands from runoff and erosion during forestry activities. These practices have proven to be very successful; however, they do not provide guidance specifically for highly erosive settings, like Lake Superior's red clay plain. This publication provides recommendations on how to minimize erosion in the red clay plain during forestry activities. It is highly recommended that Forestry BMPs are used in addition to the following recommendations.

Albert Dickas, University of Wisconsin–Superior

Sediment plume of red clay in Lake Superior.

Mike Miller, DNR

Sand washing into streams can cover and destroy fish spawning beds.

Historic Impacts to Streams in the Red Clay Plain

Clearing of forestland, including streamside forests, during the late 1800s and early 1900s eliminated many of the benefits that these forests were providing to the streams. The loss of trees and other vegetation caused the amount and speed of water running over the land to increase because there were fewer branches, twigs and leaves to slow the flow of water over the forest floor. As a result, streams had to carry much larger volumes of water traveling at much faster speeds. The excess volume and velocity of water eroded the streambanks. The sediment from those eroding streambanks buried or washed away much of the in-stream habitat for trout and other aquatic organisms. The excess sediment also changed flooding patterns.

The health of streams in the red clay plain has improved since the intensive logging during the late 1800s and early 1900s. Today's landowners have the opportunity to build on those improvements and protect this landscape. Understanding the impacts that past activities had provides insight on how current land management practices might affect streams.

Dennis Pratt, DNR

After poor logging practices, vegetation composition along streams had changed, streambanks had eroded, and streams had much less in-stream habitat due to lack of woody cover.

Managing Forests to Reduce Runoff

Forested areas along streams provide numerous benefits to streams. Forest canopies intercept precipitation, reducing the amount of water reaching the forest floor. When trees shade the ground, snow that has accumulated melts more slowly. The prolonged melting period reduces the peak flows of spring meltwater.

The layer of fallen leaves, branches and other material on the forest floor also help to reduce runoff. Leaves and branches absorb the force of falling raindrops, preventing the soil underneath from moving. This layer of fallen material also increases how far water needs to travel to reach a stream. The extra distance slows down the water, giving it time to soak into the ground, which reduces the amount of water that finally reaches a stream.

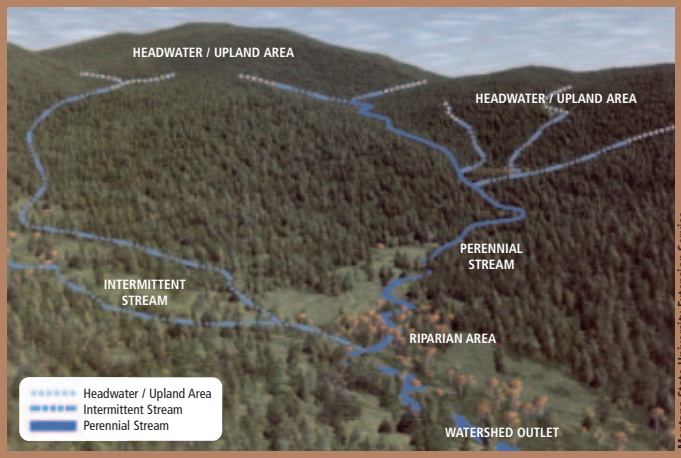
Trees also help to prevent erosion and sedimentation by stabilizing the soil with their extensive root systems. When forests are harvested improperly, the soil is vulnerable to erosion and sedimentation in streams can be greatly increased.

Bob Queen, DNR

Forested areas along streams stabilize the soil and help to reduce the runoff and sediment that may enter a stream.

How You Can Help

You can help prevent runoff and protect water quality even if you do not own land along a stream. How you manage land that eventually drains to a stream can have as much impact on a stream as how the land right next to a stream is managed.



Montana State University Extension Service

A watershed and its parts.

The watershed of a stream includes all the land that drains to that stream. It may include upland areas far from the stream, which are connected to it through a network of drainages or streams that may only have flowing water for a short time during the year (headwater streams). Watersheds can be a few acres in size or hundreds of square miles.

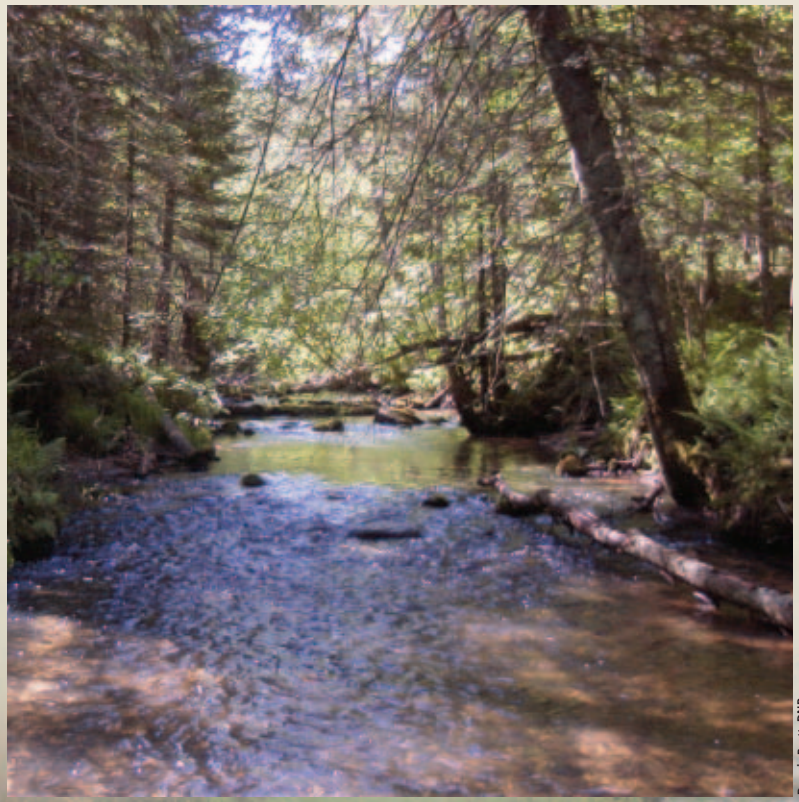
Upland landowners may feel disconnected from a stream farther down in the watershed, but their activities may influence water flows, water quality, and fish habitat much farther down in the watershed. Water quality problems from the uplands can worsen as they move down through the watershed. Sand and clay can erode into a small headwater stream and travel downstream to a perennial stream with one heavy rainstorm or during spring snowmelt. If high volumes of runoff are draining to many small streams throughout the watershed, they will eventually combine to form much faster and stronger flows.

The riparian area, or the land next to a stream, can be thought of as the last line of defense in protecting water quality. A forested riparian area may reduce the amount of runoff and sediment that reaches the stream. The effectiveness of a riparian area at reducing runoff and sedimentation will be partially determined by the management of that riparian area.

Managing Vegetation Composition

The tree species that can successfully grow on a site will depend on site conditions such as soils, topography, and other factors. Managing for long-lived species will help to stabilize the soil, increase the amount of rain and snowmelt that soaks into the ground, and provide a source of woody debris on the forest floor.

- Forest composition that reflects vegetation that existed prior to European settlement is particularly beneficial in riparian areas, headwaters, and steep valley walls. This includes species such as white pine, eastern hemlock, northern white cedar, white spruce, balsam fir, sugar maple, red maple, yellow birch, ironwood, American elm, and ash.
- Consider planting trees in open areas that used to be forested.
- Contact your local forester to discuss which tree species would be most appropriate on your property.



Dennis Pratt, DNR

This photo shows a streamside forest with a healthy mix of forest species.

Harvesting Forest Products

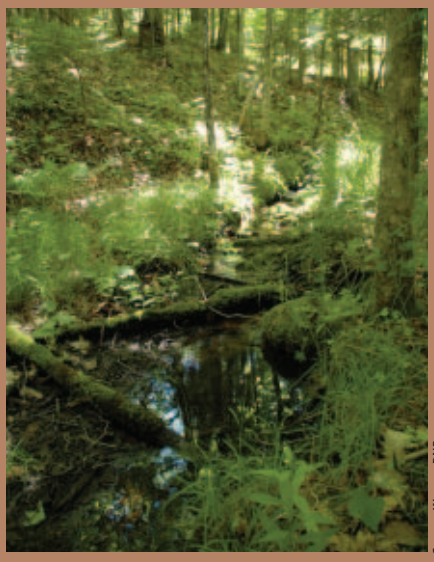
Forest management can be accomplished in the red clay plain, but extra precautions should be taken. Extensive harvesting can have major impacts on streams by increasing the amount and speed of runoff reaching streams. When planning a timber harvest, consider how much timber harvesting is occurring over time and space, both on your individual property and within the watershed.

- Consider the amount of land that is in young forests, such as young aspen stands. Extensive amounts of land in young forests can speed up snowmelt and increase the rate of water runoff.
- Avoid harvesting all of the trees in a stand, because it can increase runoff.
- Plan the layout of a timber sale so that uncut stands will intercept runoff from harvested areas.
- Promote tree species that can be harvested by individual or group selection. These types of harvests should be a minimum of 15-20 years apart.
- Maintain a significant portion of the riparian area in larger, longer-lived tree species.

Jeff Martin

Extensive amounts of land in young forests, like this aspen forest, can speed up snowmelt and increase the amount of runoff.

Protecting Headwaters



Carmen Wagner, DNR

Headwater streams like this one must be protected during timber harvesting. Most of the sediment that enters a stream system is brought from smaller streams to larger streams during rain events.

When harvesting timber near headwater streams and wetlands, take care to protect the integrity of these areas. Most of the sediment that enters a stream system is brought from smaller streams to larger streams during rain events. Also, wetlands act as sponges and hold water in the watershed, keeping it from moving downstream.

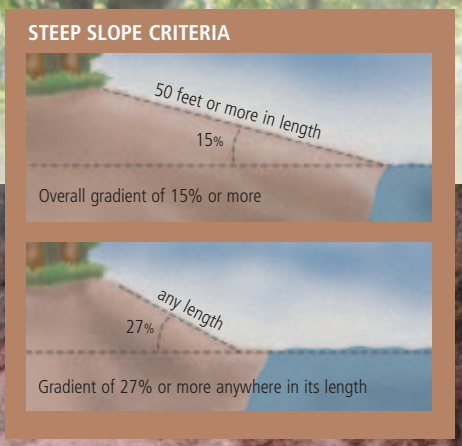
- The best time to identify headwater streams and wetlands is in spring after snowmelt or after heavy rains.
- Black ash, black spruce and other wetland plants may be found in or near these types of water features.
- Mark headwater streams by flagging or painting nearby trees. Be sure that your forester or logger is aware of these areas before any harvesting takes place, so that steps can be taken to protect these resources.
- Promote the growth of native, large, older-aged trees in the riparian area of headwater streams, if appropriate. This will create the opportunity for large woody cover to develop on the forest floor, slowing runoff in the watershed.
- Leave dead and downed trees in the riparian area.

Maintaining Stable Slopes

Steep slopes can be defined as where the slope has an overall gradient of 15% or more and a length of 50 feet or greater, or where the slope has a gradient of 27% or more anywhere in its length. In the clay plain, steep slopes are prone to mass failure, commonly known as "slumping."

- Avoid conducting forest management activities on steep slopes.
- Consider the stability of slopes when using mechanized equipment on or above steep slopes so that erosion can be minimized.
- Avoid activities on land above steep slopes that will cause channelized flow to the slope in order to prevent the formation of rills and gullies that move down the slope.

In the clay plain, steep slopes are prone to mass failure.



Carmen Wagner, DNR

Typical view of an unstable clay slope in the Red Clay Plain.

Managing Aspen and Beaver

Dennis Pratt, DNR

Beaver dams can have a variety of negative impacts on streams, including increased water temperatures, flooding of riparian areas, and blockage of free movement of fish.

When beavers build dams and impound water, water temperatures can rise. Beaver flowages can also destroy critical in-stream habitat features, flood riparian areas killing trees and block the free movement of fish.

- Manage riparian areas for species other than aspen, the preferred food and dam building material for beaver. Native, long-lived conifers or northern hardwoods are preferred.
- Do not perform large aspen clearcuts in riparian areas as this will result in aspen regrowth and local overpopulations of beaver.
- Removal of beavers and their dams may be required to protect cold water trout streams. Consult with a local fish or wildlife biologist if it appears beaver or beaver dam removal will be necessary.

Designing and Installing Forest Road Systems

Roads are the largest source of sediment from forestry-related activities.

- Consider rebuilding and stabilizing old roads as opposed to building new ones.
- Locate landings outside of areas where clay is thin and sand is showing near the surface. These areas are known as "transition areas."
- Surface roads and trails with gravel, especially if being used during non-frozen conditions.
- Remove water from roads and roadsides by installing drainage structures at recommended intervals:

Recommended Maximum Distance Between Rolling Dips or Culvert Cross-Drains	
Road/Trail Grade	**Distance Between Structures**
0–3%	250 feet
4–6%	165 feet
7–9%	130 feet
10–12%	115 feet
12+%	100 feet

Recommended Spacing for Water Bars	
Road/Trail Grade	**Distance Between Structures**
0–6%	130 feet
6–10%	100 feet
11–15%	65 feet
16–20%	50 feet
21–30%	40 feet
30+%	35 feet

USDA Forest Service. Low Volume Roads Engineering: Best Management Practices Field Guide.

- To maintain stability on steep, long road ditches, use geotextiles, rock lining, rock check dams and water diversions. Vegetation alone may not provide enough stability.
- Wait at least two days after heavy rains before using roads and trails to allow soils to drain so that they can again support equipment.
- Follow proper slope modification, seed bed preparation, and seeding mixtures to establish protective and stabilizing vegetation when closing roads.

Dennis Pratt, DNR

Severe erosion problems can occur when forest roads and ditches are not designed and maintained properly.

Kristin Shy, DNR

Cross-drain culverts are one type of drainage structure used on road systems to allow water from roadside ditches to move from one side of the road to the other. To function properly however, they must be maintained and kept clear. This cross-drain culvert is no longer functioning because it is filled with sediment due to improper installation and maintenance.

Kristin Shy, DNR

Wait at least two days after heavy rains before using roads and trails to allow soils to drain so they can again support equipment.

Crossing Streams

Stream crossings, if not properly installed, can prevent fish from moving to different reaches of streams. Stream crossings are also likely areas for erosion and sedimentation to occur.

- Temporary stream crossing structures are recommended if a permanent stream crossing is not needed.
- Bridges may be preferred over culverts.
- Structural plate-arch culverts are the most desirable type of culvert to ensure fish passage and maintain natural stream flow, followed by pipe arch culverts, and the least desirable type of culvert to use is the standard corrugated-round culvert.
- Use one culvert whenever possible. If more than one is needed, use fewer, larger culverts.

DNR

Temporary stream crossings, like these timber mats, can be installed with minimal effects on a stream.

Kristin Shy, DNR

This temporary bridge can support fully loaded logging trucks.

Bobbi Jo Reiser, DNR

Structural plate-arch culverts are set in concrete footings, leaving the natural streambed almost entirely unchanged.

Kristin Shy, DNR

Perched culverts are caused by improper installation and can have a variety of detrimental impacts on streams.

Contact Information

- For questions about vegetation composition and timber harvesting, contact your local forester:
  http://dnr.wi.gov/org/land/forestry/ftax/County.asp
- For questions about stream crossings, contact your local water management specialist:
  http://dnr.wi.gov/org/water/fhp/waterway/watermanagementspecialists.shtml

Additional Sources of Information

Additional information on the topics discussed in this publication is listed below. DNR publications are also available from your local DNR Service Center or by calling (608) 267-7494.

- Wisconsin's Forestry Best Management Practices for Water Quality Field Manual, DNR Publication PUB-FR-093: **http://dnr.wi.gov/org/land/forestry/usesof/bmp/bmpfieldmanual.htm**
- A Landowner's Guide to Building Forest Access Roads, USDA Forest Service Publication #NA-TP-06-98: **http://www.na.fs.fed.us/spfo/pubs/stewardship/accessroads/accessroads.htm**
- Forest Management Practices: Managing Water Series, University of Minnesota Extension Service Publications #1-13: **http://dnr.wi.gov/org/land/forestry/Usesof/bmp/bmpownerguides.htm#3**
- Forest Management Practices: Crossing Options Series, University of Minnesota Extension Service Publications #1-16: **http://dnr.wi.gov/org/land/forestry/Usesof/bmp/bmpownerguides.htm#4**
- Forested Wetlands: Functions, Benefits and the Use of Best Management Practices, USDA Forest Service Publication #NA-PR-01-95: **http://www.na.fs.fed.us/spfo/pubs/n_resource/wetlands/index.htm**

PUB-FR-385 2007

This publication is available from Wisconsin Department of Natural Resources, Division of Forestry, PO Box 7921, Madison, WI, 53707.

For additional information, call (608) 267-7494 or visit our web-site at: www.dnr.wi.gov/org/land/forestry

WISCONSIN DEPT. OF NATURAL RESOURCES

WISCONSIN COASTAL MANAGEMENT PROGRAM

A publication of the Wisconsin Department of Natural Resources.

The Wisconsin Department of Natural Resources acknowledges the Wisconsin Coastal Management Program and the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management under the Coastal Zone Management Act, Grant # NA06NOS4190183, for their involvement in the partial funding of this publication.

GRAPHIC DESIGN: Nan Rudd / RUDD DESIGN

COVER PHOTO: Robert A. Kleppin, The Nature Conservancy

PRINTED ON RECYCLED PAPER