



## *Provide a living filter*

Water is one of the most important products your backyard woods produces. Even if a stream doesn't flow through your woods, some of the rain and snow that falls on your land will reach a stream sooner or later. The path water takes through your woods determines how fast it moves, how much of it is available to the trees and other vegetation, and how clean it is when it reaches a stream.

Rain and melting snow can flow over the soil surface or through the soil. Overland flow travels fast and can carry soil with it. Water moving through the soil moves slower and does not transport soil. The structure of the soil determines the path water takes through your woods.

### **Woodland Soils**

The soil beneath your feet is more than a place for the growth of plants and a provider of physical support, moisture, and nutrients. The soil is a dynamic system that serves as home for countless organisms, a disposal area for nature's "wastes," a filter of toxic substances, and a storehouse for nutrients. The soil is a product of its environment, but its quality is a function of trees that grow in it. Woodlands customarily occupy a site for many years,

sending a portion of their roots deep into the subsoil. During this period considerable amounts of organic material are returned to the soil in the form of leaves, branches, and decaying roots. This organic material has a profound influence on the physical, chemical, and biological properties of the soil.

The layer of organic material on the soil surface (litter layer) is incorporated into the top layer of the soil by soil animals, such as worms and millipedes. The mixing of organic material with the soil particles creates structure in the soil. Soil structure is the arrangement of individual soil particles into aggregates or clumps.

The soil clumps increase the size and the amount of spaces in the soil. The soil spaces contain both air and water. The amount of water or air depends on the length of time since the last rain or snow melt. Soil spaces improve water and air movement into and through the soil and increase the amount of water and air the soil can hold. The amount of soil spaces, in most woodland soils, varies from 30 to 65 percent of the soil volume. Soils supporting a variety of tree species have a higher percentage of soil spaces than soils supporting a single tree species.

### **Infiltration**

The movement of water into the soil is called infiltration. When the rainfall intensity exceeds the infiltration capacity, water will run over the soil surface. By virtue of the sponge-like action of the litter layer and the high infiltration rate of the soil below, overland flow is extremely rare in your backyard woods.

The litter layer in your woods is especially important in maintaining rapid infiltration rates. This layer not only absorbs several



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times its own weight of water, but it breaks the impact of raindrops, which would otherwise loosen soil particles and clog soil spaces and reduce infiltration rates.

Woodland soils also have a high percentage of larger channels through which water can move rapidly. Most of these channels develop from decayed roots or from burrows and tunnels made by insects, worms, or other animals.

The presence of stones increases the infiltration rate. The differences in expansion and contraction between stone and the soil result in channels and large spaces. However, stones reduce the water storage capacity of the soil.

If snow covers the soil before prolonged freezing temperatures, it protects the soil from freezing, thus favoring continued infiltration during the spring. But if the soil freezes before snow cover, a snowfall covering the frozen soil will delay thawing in the spring, reduce soil infiltration, and increase overland flow.

### **Producing Quality Water**

Soil particles carried off your property by overland flow and deposited in a channel is the primary pollutant that your woodland can produce. Many woodland activities have the potential to cause soil erosion. Your goal is to keep eroded soil on your land, and not let it reach a road ditch, gully, or stream. Once the water reaches one of these channels, it will eventually be carried to a lake, reservoir, or the ocean where it will be deposited. Along the way it can harm stream fish habitat, fill stream channels, and increase water treatment costs.

Water is a product of your backyard woods and everything you do or do not do in your woods can impact it. Backyard woods management practices, such as protecting your property from wildfire, keeping your woods healthy, attracting wildlife, helping your preferred trees grow, planting trees, harvesting wood and special forest products, building and maintaining roads and trails, providing access to livestock, and doing nothing in your woods are some



No matter how hard it rains, water always enters the soil under trees.

of the practices that can impact water production. Each practice can have either a negative or positive impact on water depending on how it is used or not used. Potential practice impacts on water quality are:

- Wildfires burn the litter layer and can increase erosion.
- A healthy woods produces more leaf litter, which protects the soil from rainfall impact.
- Helping preferred trees grow produces more litter on the ground and reduces fire risk.
- Large numbers of wildlife (deer, as an example) can impact tree growth, which reduces the litter layer.
- Planting trees expands your woods, and more acres of woods produce more clean water.
- Harvesting products may require machinery in your woods that can compact soil and remove litter layer.
- Constructing and maintaining roads and trails remove litter layer and compact the soil.
- Unrestricted livestock access compacts the soil and removes vegetation.
- Doing nothing may increase fire risk and reduce tree health.

Litter layer removal begins the erosion process. As raindrops fall on unprotected soil, soil particles are loosened and fill soil spaces on the surface, reducing infiltration. The water collects on the soil surface and begins flowing over the surface in a sheet. As the rain continues, sheet flow increases and forms tiny channels and these combine to form larger channels. Given enough slope and bare soil, water will reach a road ditch, gully, or a stream.

Soil compaction reduces water infiltration by reducing the number and size of soil spaces. Driving vehicles in your woods compacts the soil. Compaction can occur by driving one pickup truck of firewood over the ground under your trees. As the number of pickup passes increase, over the same area, the compaction becomes severe and can take many years to recover. Wet soils are more susceptible to compaction than dry soils, and clay and loam soils are more susceptible than sandy soils.

Uncontrolled livestock access can cause more serious compaction than periodic vehicle use because it covers a greater portion of your woods and for a longer period of time. Water infiltration rate is lowered in compacted areas and surface runoff will occur. The distance the water trav-



The undisturbed layer of leaves prevents soil erosion.

els overland depends on the extent of the compacted area. If the overland flow reaches an area with no compaction, the water will infiltrate. Soil erosion is scattered across the grazed area, but normally does not leave your land except when livestock trails end at gullies and streams.

Uncontrolled livestock access can cause serious impact to some woods, altering water movement. Compacted soils hinder root growth and reduce tree health. The majority of tree root systems are within 3 feet of the soil surface and most of the fine roots are within 8 inches of the surface. Long-term uncontrolled livestock access damages these roots, killing young trees first, but eventually killing all the trees, converting your woods to an open pasture. Infiltration rates are reduced and overland flow rates increase in the overgrazed pasture.

Roads and trails that cross a stream or even a channel that only contains water periodically are primary entry points for soil into streams. The bare compacted soil in the road, trail, or road ditch is like a channel carrying water and its load of soil into a stream. The solution for this problem is to remove the water from the road or trail before it

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reaches the stream, and turn it into the undisturbed litter layer where it can slow down, spread out, and sink into the ground, depositing its soil onto the litter layer.

Many states have developed practices that will help you control road and trail overland flow, and build a gully or stream crossing. They are called Best Management Practices for Water Quality, and information on how to install them can be found at local Cooperative Extension and Soil and Water Conservation District offices.

Controlled livestock access is the best way to solve compaction and litter layer problems caused by livestock. Methods vary by location and tree type. In some tree types, it is best to eliminate access. In other tree types, trees and grass can be produced on the same area in a managed system. Seek information from your local Cooperative Extension Service and Soil and Water Conservation District office.

### **Riparian Area**

The riparian area is the transition between water and the land at the edge of streams, rivers, lakes, springs, and wetlands. It is the zone of soil and vegetation that feeds the stream energy in the form of leaf litter and dissolved nutrients, and houses soil organisms at densities and diversities nearly 3 times those found in soil farther away from the water. A riparian area dominated by trees is especially important on small streams where intense interaction between land and water ecosystems occurs. These small streams comprise nearly three-quarters of the total stream miles in the United States. Wooded riparian areas are important because they do the following:

- Leaves and other debris fall into streams and provide food for insects, amphibians, crustaceans and small fish, all critical to the stream food chain.
- Wooded riparian areas provide diverse habitats for birds and other wildlife.
- Fallen trees (large woody debris) create pools and shelter for fish and preserve stream habitat.
- Fertilizers and other pollutants in water coming from other land uses (crop fields, lawns, etc.) sink into the soil, where tree roots and bacteria remove them before they reach the stream.
- The leafy canopy provides shade that cools the water enabling it to hold more oxygen, which helps fish and other organisms grow.

- Overland flow from other land uses (crop fields, roads, etc.) slows down, spreads out, and sinks into the ground, depositing the soil it carries on the surface.
- Tree roots stabilize stream banks and reduce bank erosion.
- Riparian areas are travel corridors for wildlife between wooded patches.

The riparian area is an extremely important ecosystem in your backyard woods. Different parts of the riparian area have different functions and require different management practices. Trees next to the water help maintain lower water temperature, provide leaves and debris to the water, and keep banks stable. Trees next to the water are usually not removed. Eventually, these trees will fall into the stream and improve fish habitat.

Trees farther away from the bank provide filtration, deposition, and plant nutrient uptake that removes sediment, nutrients, and toxic substances from water moving through the riparian area soil. Periodic removal of trees is acceptable in this area because it removes nutrients stored in tree stems and branches, and it increases nutrient uptake by younger, more vigorously growing trees.

A third zone to your riparian area may be needed if a crop field, pasture, or similar land use is adjacent to the trees. A grass zone can make the tree zones more efficient by changing channel flow into sheet flow. The high number of grass stems slows down and spreads out overland flow better than the litter layer under the trees. The width of your riparian area will vary by its primary function.

- Wildlife habitat will need a minimum width range between 30 and 300 feet.
- Sediment removal needs a minimum width range between 50 and 150 feet.
- Nutrient removal needs a minimum width range between 35 and 125 feet.
- Water temperature cooling needs a minimum width range between 10 and 60 feet.
- Bank stabilization needs a minimum width range between 10 and 30 feet.

For all purpose use, a minimum width range between 35 and 100 feet is recommended. The wider widths provide the best results. Steep slopes will require wider widths to trap sediment and remove nutrients.



Removing livestock and planting trees can make a dramatic impact on a streamside riparian zone in just 3 years

Riparian areas are vital for water quality, fish, and wildlife. If you are fortunate to have water in your backyard woods, restoring or maintaining riparian areas are critical activities.

#### **Amount of Water**

Trees and other vegetation play a key role in the cycling of water from ocean to land and back to ocean. Rainfall entering the soil fills the soil spaces at the surface. Gravity pulls the water deeper into the soil. Most of the water remains in spaces attached to soil particles and humus. Trees and other vegetation remove most of the stored water, creating space in the soil for more rainfall. The water rises as sap through the trunk and branches to the leaves, where most of the water is transferred to the air. For the Continental United States on average, vegetation (mostly trees) returns about 60 percent of the water entering the soil back to the air. If you add evaporation from leaves and other surfaces, a total of about 70 percent of the precipitation that falls on your backyard woods is returned to the air. Only 30 percent of the rain or snow arrives at a stream.

Removing trees from your woods increases the amount of water in the soil, and the amount of water moving to a stream. Less trees results in less water removed from the soil. More than 50 percent of the trees need to be removed from your woods before an increase can be measured. Tree removals can be caused by fires, storms, insect and disease outbreaks, or tree harvests. Most of the streamflow increase occurs during the growing season when streamflows are normally low. The path water takes through your backyard woods remains the same. Water still enters the soil because the roots and litter layer are still present.

As new trees grow back, your backyard woods gradually returns to its normal water removal rates.

Changing a woodland to a crop field, pasture, residential, or urban use has a different outcome on the amount of water reaching a stream. Changing the use of the land removes the trees, litter layer, compacts the soil, and in some cases covers the soil with surfaces that prevent water from entering it. Water moves over the surface and more water reaches the stream at a faster rate. Greater streamflow throughout the year increases streambank erosion. Streambank erosion reduces fish habitat and decreases water quality. Increased streamflow continues until the land use is changed back to woodland.

#### **Water Management Practices**

A few simple practices can help your backyard woods produce clean water.

- Keep the woods you have and plant more trees in old fields and other open land.
- Plan road and trail locations to reduce the area they cover. Avoid wet soils, and keep them away from streams if possible.
- If you must drive off a road and trail into your woods, do it when the ground is frozen or during dry periods.
- Use stream crossings to eliminate soil movement into the stream or channel.
- Cover roads and trails with woodchips or gravel, especially on steep sections and on approaches to stream crossings to reduce soil movement.







- Be sure that water flowing off roads and trails enters your woods rather than going into a stream or a ditch that flows into a stream.
- Keep livestock out of your woods, confine them to trails and control the surface runoff, or manage the trees and grass as a system that maintains water movement into and through the soil.
- Maintain a minimum 35 to 100-foot wide woody riparian area next to any water on your property.

the principal nonpoint pollutant from forests. Nationwide, only 3 to 9 percent of the total nonpoint pollution comes from forest management practices such as road construction, timber harvesting, planting site preparation, and fire-line clearing. Even though forest land is not a major pollution source, pollution from forest land practices should be controlled because forested areas have high quality water and small changes in this quality can have an impact. Best Management Practices (BMPs) have been developed and adopted by the Forest Service, State forestry agencies, and the forest industry. These BMP's are very similar to the practices recommended for your backyard woods.

## In the Forest

The greatest threat to water quality in the United States is nonpoint source pollution. Nonpoint source pollution includes soil, nutrients, animal waste, pesticides, and other substances from many places over the landscape. Soil is

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