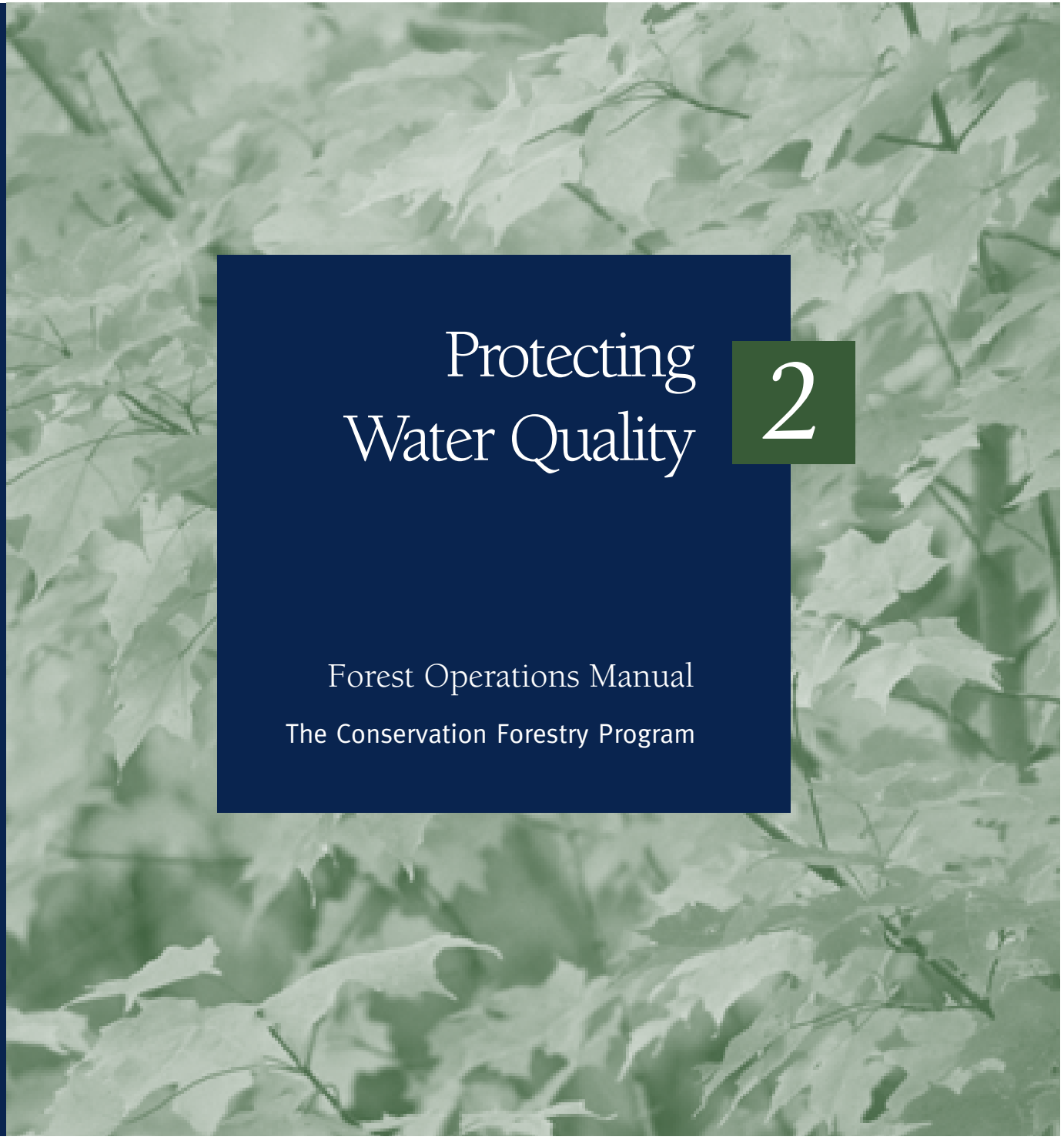


Protecting Water Quality

2

Forest Operations Manual

The Conservation Forestry Program

Protecting Water Quality

CHAPTER 2

2.1 The Nature Conservancy Philosophy

Protecting water quality is the primary conservation concern of the Conservation Forestry program. Humans, of course, enjoy clean water for drinking, cooking, bathing, and playing. We often take steps to treat impure water to meet our needs, but we aren't the only ones dependent on water quality. Mussels, fish, salamanders, mayflies, and a variety of other species all require clean water to survive.

Many of these animals, including many different species of mussels and fish, are endangered, threatened, or otherwise of concern in southwestern Virginia. These species depend on landowners and resource managers to provide clean, clear water.

By taking all the steps necessary to ensure quality water from the forestlands in southwest Virginia, we can support a broad array of plant and animal life. Riparian area management that promotes good water quality can also enhance timber production, help reduce the severity of floods, prevent bank erosion, recharge groundwater, filter pollutants and sediment from runoff and shallow groundwater, and even create important wildlife travel corridors. In many ways, protecting our water is at the heart of protecting the ecosystem.

PROTECTING our water is at the heart of protecting the ecosystem.

2.2 Key Strategies

To PROTECT and IMPROVE WATER QUALITY on all managed lands, Nature Conservancy staff will:

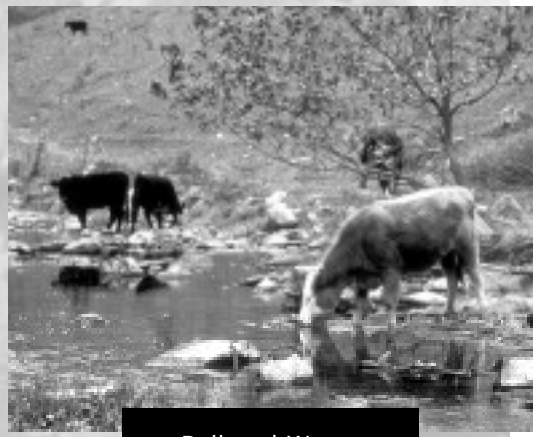
- Abide by all provisions of the Virginia Silvicultural Water Quality Law
- Designate Riparian (Streamside) Management Zones (SMZs) along the shores of all lakes, ponds, rivers, streams, and wetlands that meet or exceed the guidelines in the Virginia Department of Forestry Best Management Practices (BMPs) and adaptively change these based on the results of monitoring programs
- Implement a "no-harvest" policy in all SMZs
- Prevent erosion during all timber harvest operations through properly planning the harvest, laying out and building roads, monitoring logging activity, and closing out the harvest site
- Properly design unavoidable stream crossings to prevent any adverse impact to both water quality and in-stream organisms, using temporary bridges whenever possible
- Store all hazardous materials being used during forest management activities away from any and all water courses
- Closely monitor all logging operations to prevent or immediately clean up signs of pollution (leaking fuel, oil, hydraulic fluid, and other hazardous material)
- Reclaim disturbed or damaged soil areas by replanting with native plants and trees to prevent future erosion
- Working with partners using the best science available, monitor the water quality on selected enrolled tracts to ensure that water quality standards are met

Among other provisions, the **Water Quality Law** allows state foresters to advise, fine, or shut down any land or timber owner conducting or allowing ***any silvicultural activity leading to sediment deposition*** For the complete act, visit the DOF web site at www.dof.state.va.us.

2.3 Principles of Water Quality

Quality Water

Supports Valuable Ecological and Economic Use



Polluted Water

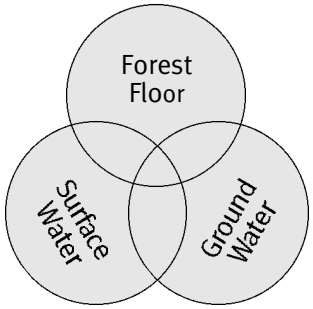
Can No Longer Meet Intended Use

Quality water, by definition, is water that has the physical, chemical, and biological properties necessary for its intended use – animal habitat, recreation, drinking, irrigation, and so on. Polluted water, in contrast, is water that can no longer meet its intended use, typically because of contamination from human activity.

The WATER CYCLE in Ridge and Valley Province

The ability of both surface water (rivers, streams, ponds) and groundwater (water collected under the earth's surface in aquifers, or geologic formations where water accumulates) to fulfill its uses depends heavily on what happens to the earth above and around it; *water quality is closely related to soil quality*

To adequately protect the water resource, forest managers and landowners need to understand the interactions between surface water, groundwater, and the forest floor.



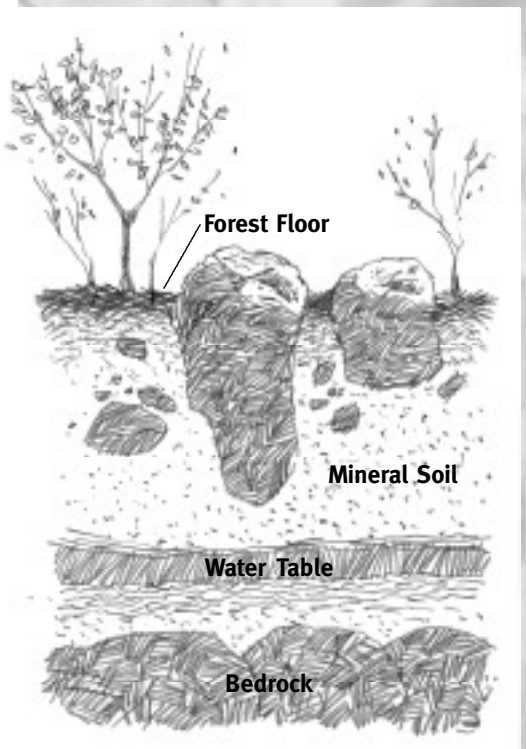
These interactions vary to some degree with geologic conditions. A region with similar geologic structure and climate that has a characteristic set of landforms is called a physiographic province. The Virginia Appalachians are primarily in the **Ridge and Valley** physiographic province (a small portion of the Clinch operating area is also found in the Cumberland Plateau), where about 50% of the surface water flow comes from groundwater. Rain, snow, and other forms of precipitation enter the soil and overlying rock materials, then filter down to fill up aquifers, which in turn replenish springs and streams. The valleys typically have limestone and dolomite under the surface, which form very productive aquifers, whereas the sandstone and shale underlying the ridge make much poorer storage areas that often yield only enough water for rural and domestic supplies.

The forest floor plays a crucial role in the water cycle because it absorbs the impact of raindrops and delivers water to the mineral layer of soil. This is particularly true when the water table is near the surface. The soil in turn acts as a kind of purifier as it filters the water down to the aquifers. Importantly, because the leaves, vegetation, debris, and other components of the forest floor can capture and hold water, short bursts of rain can infiltrate the lower layers of soil gradually, rather than running off. Even shallow forest floors, such as those covered with pine needles, can hold enough water to take care of all but the heaviest rains.

Within the Ridge and Valley area, though, certain topographical formations allow water to bypass this holding and filtration system and increase the risks of contamination. As water erodes the limestone bedrock, it forms karst topography, where fractures, cracks, and solution channels form in the limestone, and sinkholes, sinking streams, and large springs appear on the surface.

Karst landscapes play a crucial role in water quality. In these areas, the surface water can lead directly to the aquifer through a fault or sinkhole, so water from above can enter the aquifer without the benefits of purification through the soil layers. For example, if a sinkhole or fault diverts a stream underground and links it to the aquifer, any contaminant in the stream can quickly and directly enter the groundwater. This process puts entire underground water basins at risk from a single contamination point because pollutants can enter easily and move rapidly through the underground channels.

When dealing with karst topography forest managers must be particularly careful to prevent sedimentation, erosion, and other forms of water contamination.



PROTECTING WATER QUALITY demands a cooperative effort from everyone involved in land use and management. If not handled properly, these activities and conditions can adversely affect water turbidity, chemistry, and temperature.

WATER QUALITY AND FOREST MANAGEMENT

Obviously, any activity that disturbs the forest floor–including timber harvests–can lower water quality; although the forest recovers relatively easily on its own and the effects of disturbances are temporary in most cases. Problems, if they occur, result not from removing trees, but rather from improperly managing the related activities, including:

- Constructing and using roads and log landings, especially *near stream crossings*
- Felling, skidding, and loading timber
- Operating in or *near aquatic ecosystems*
- Applying fertilizers and pesticides
- Preparing the site for replanting

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Turbidity

Turbidity of water is the degree to which light penetration is impeded by suspended material, or sediment. Sedimentation, both organic and inorganic, is the greatest single source of poor water quality, causing both physical and biochemical degradation. Fine soil sediments harm aquatic habitats by blanketing spawning grounds, smothering fish eggs, suffocating aquatic insects, burying oxygen-producing plants, and clogging the gills of fish. Muddy water blocks sunlight, reducing photosynthesis of aquatic plants, reducing oxygen production and making it more difficult for fish to see and capture prey. Soil sediments can also pave stream bottoms, filling in pools and riffles and thus reducing fish habitat. The scope of the potential damage to both aquatic and human habitats makes it critical for forest managers to prevent erosion and sedimentation on forested land by carefully managing timber harvests and helping eroded areas recover.

Chemistry

A number of contaminants can change the chemical makeup of surface and groundwater, which in turn adversely affects all aquatic life that depends on a certain water environment. On managed timberland, mineral soil and organic matter from erosion and runoff represent the major problems, though leaks and spills of petroleum products from logging equipment and vehicles can also contribute. Timber harvests can also increase the rate at which the forest floor releases nutrients into water sources, increasing nutrient concentrations in streams and other surface water temporarily. Nitrogen, in particular, tends to increase noticeably in streams immediately after a timber harvest. Even without harvests, pesticides, fertilizers, and fire retardant chemicals can be major sources of pollution on forestlands.

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Temperature

Thermal pollution represents another major danger to water quality on managed timberland because water temperature plays a key role in aquatic life. Water temperature helps determine how much oxygen is available for aquatic organisms, as well as their rate of metabolic activity. At the most basic level, all aquatic animals have an optimum temperature range; above or below that range, the animals experience physiological stress and, at temperature extremes, die. Temperature affects the types of species present; the timing of fish spawning, and migration; animal growth and development rates; concentrations of dissolved gases; and decay rates, all of which are crucial to a healthy, balanced ecosystem.

To help preserve that balance, trees and other vegetation along stream channels serve as important temperature regulators by protecting the water from the sun's direct rays and maintaining water temperatures within appropriate ranges. Cutting these trees and clearing the vegetation exposes the water and increases the stream temperature, which in turn disrupts aquatic life cycles.

As noted earlier, all of these factors represent potential dangers. By developing Streamside Management Zones, carefully monitoring all harvest activity, restoring damaged areas, and working closely with landowners, The Nature Conservancy can protect, and even improve, water quality and enhance the overall habitat on managed lands.

2.4 Related Management Practices

Applying the strategies listed in Section 2.2 and adequately protecting water quality involves a broad range of practices, including:

- Developing a management plan that takes water resources into account (*see Chapter 7*)
- Road layout and construction (*see Chapter 9*)