

 UI Extension Forestry Information Series

## Forest Water Quality and Sediments

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Water quality issues often bring to mind images of pesticides and dead fish in our streams and rivers. However, the Environmental Protection Agency has noted that sediment, not toxic chemicals or municipal wastes, is our nation's number one water pollutant. Much of the sediment in streams is the result of natural weathering and erosion. This is particularly true in the steep, mountainous terrain characteristic of our forestlands in the Pacific Northwest. Superimposed upon this natural rate, however, is sediment produced by man's cultural activities. Overall, agriculture produces far more erosion than any other activity. But forest operations can also be major contributors to erosion and stream sedimentation, and often seem to take the brunt of criticism from environmental factions.

Sediment is an important factor determining water quality in forest streams because it affects the beneficial uses of water, especially for domestic water supplies, fish, and recreation. The impact of sediment on these uses may be either direct or indirect. For example, public health standards prohibit the distribution of water with high sediment concentrations. Municipalities that use water from forest watersheds (such as Grangeville and Troy, Idaho) without filtration may be directly affected if sediment concentrations suddenly increase. Sediment can affect fish populations in an important, indirect way. For example, sediment concentrations seldom reach levels that are directly lethal to fish, but sediment deposited on the streambed or incorporated into spawning gravel can disrupt the production of insects and other organisms that are basic to the food chain or worse yet, prevent successful hatching of fish.

Water quality standards and regulation invariably include restrictions on the amount of sediment that can

be added to streams from man's activities. Essentially, no increases are permitted, reflecting the public's concern for sediment control.

Sediment reaches forest streams through a complex series of processes, all of which involves water. In a forest ecosystem, water is the principal sediment carrier, even though other forces, such as gravity, may deliver sediment to a stream. Understanding the runoff process for forestlands is important for understanding how sediment reaches forest streams and how this process varies within a watershed and among different watersheds.

In a forested watershed, soil type plays an important role in the relationship between runoff and erosion. The soil infiltration rate and the rate a soil transmits water, along with a soil's inherent resistance to erosion, determine both runoff and erosion rates. Sandy soils permit faster infiltration than clay soils, but dry out quicker, leading to moisture deficit stress. Soils with large amounts of clay tend to swell when wet, which leads to surface sealing and surface runoff. Clay particles, however, may remain suspended in solution for weeks, while coarser particles are deposited in slow moving waters.

Water, wind, and gravity may serve as erosion agents. Soil particles are eroded by three interrelated phenomena: detachment, transport, and deposition. Detachment occurs when a soil particle is dislodged from the soil surface or from the aggregate to which it was attached. The impact of falling raindrops is often sufficient to detach soil particles from the exposed soil surface. Once detached, the bonds that hold soil particles together are no longer effective in keeping

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individual particles in place. At this point, water, wind, or gravity transports them more easily. Available energy and how the energy is dissipated determine the rate and distance that soil particles are transported. When the energy is insufficient to continue soil particle movement, they are deposited. Particles may be deposited within a few millimeters of where they are detached or several kilometers downstream in rivers, impoundments, or estuaries.

The rate at which these processes combine to erode soil particles is highly variable. Soil scientists and geologists often characterize the rate of erosion on undisturbed lands as either “natural” or “geologic”. Erosion on lands disturbed by man’s cultural practices is classified as “accelerated” or “man-caused” erosion. Erosion rates are highly variable in mountainous terrain. Natural erosion rates in unstable or erosive soils can easily be higher than erosion caused by people where soils are stable or cultural practices are not very disruptive.

Suspended sediment is material light enough to be suspended in the streamflow. It is often called “wash load” to indicate that the sediment is washed through the stream and does not settle readily. Sediment carried in suspension may be either organic or inorganic material. Unless specified, both types are included in suspended sediment estimates. Suspended sediment is often reported as the concentration in water using parts per million (ppm) or milligrams per liter (mg/l) interchangeably to express the instantaneous concentration at a given point. Combined with an estimate of discharge to give the number of parts or liters of water, suspended sediment concentration can be converted to instantaneous suspended sediment yield in pounds or grams.

Bed load is sediment too heavy to stay suspended in flowing water. This material rolls or bounces along the stream bottom. The size of particles making up the bed load varies with streamflow, velocity, particle density and shape, and many other factors. The term is an arbitrary one but describes a process of sediment transport significantly different from the transport of fine material. Total sediment yield includes both suspended yield and bed load.

Water turbidity is the degree to which suspended material impedes light penetration. In forest streams with high organic loading, the turbidity may be quite high while the suspended sediment concentration of these very light weight, but darkly colored, platy particles is very low.

Turbidity is a significant quality indicator where water is to be used for direct domestic consumption or in industrial applications where clarity is important. High quality paper products and beverages (especially beer) rely on water with very low turbidity. Turbidity may affect stream biota by reducing photosynthesis of aquatic plants. Such an impact would occur only from sustained high turbidity. Generally, turbidity levels in forest streams are far below levels fatal to fish, and generally, high turbidity is short-lived. Many fish can tolerate short-term high levels of turbidity.

We must limit sediment in water to safeguard the future of our water resources. In response to water quality issues, Idaho has developed a booklet that explains Best Management Practices designed to promote forest activities that will protect and/or enhance water quality. For more information, contact one of the UI Extension Foresters or your local county extension office and ask for the publication *Forestry for Idaho, Best Management Practices (BMP's)*.

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