Working Trees for Water Quality

Working Trees: a partner in watershed management.

Agroforestry helps protect water quality while achieving both landowner and community objectives.

Water is a precious national resource. Often, human activities degrade the quality of the water in the streams, lakes, reservoirs, wells, and aquifers on which we depend. Pollutants from agricultural and urban sources have made many of our waters unsuitable for swimming and fishing. Excessive sedimentation, pesticides, and fertilizers are harming fish and other aquatic life. Changes in land use also have had a dramatic effect on floodwater damage and frequency. Both surface and subsurface drinking water supplies are being impaired by human activities.

Water quality is the end result of the individual actions of all the "neighbors" in a watershed. Rural landowners and community residents need to look beyond their own boundaries to improve water quality and coordinate water resource management.

Working Trees can help alleviate water quality and quantity problems. Trees planted along stream banks or along roadsides can slow runoff and trap pollutants in both rural and urban settings. Working Trees means putting the right trees in the right places, and in the correct design, to do specific jobs. Land managers, community planners, and watershed residents can all use Working Trees to make high-quality water a reality.

This brochure illustrates water resource problems and ways that Working Trees and Water Quality are a part of the solution.
Too much runoff

Displacement of permanent vegetation, such as trees, shrubs, and grasses by annual crops or community development increases the amount of runoff into streams and lakes, as well as the speed at which these waters are delivered. This rapidly moving runoff creates flooding and transports high levels of sediments, attached pollutants, and dissolved contaminants into surface waters. Increased runoff also causes the erosion of streambanks, resulting in the degradation of aquatic habitats and the accelerated deposition of sediments into rivers and reservoirs. When rain moves quickly off the land rather than being allowed to soak into the ground, it can recharge soil moisture or maintain groundwater baseflow.

Too many pollutants

Unfortunately, contaminants in many groundwater and surface water sources exceed national health and safety standards. Non-point source pollution, the leading cause of these water quality problems, comes from both rural and urban sources:

- Fertilizers, herbicides, and pesticides from agricultural fields and urban lawns
- Nutrients and bacteria from concentrated livestock operations
- Sediment from crop lands, urban construction sites, and eroding streambanks

Y Oils, antifreeze, and salts from city streets and parking lots

The problems are spilling over into our coastal marine estuary ecosystems. The cumulative effect of a little more runoff from each field or community leads to very large problems, such as the 8,000 square mile hypoxic zone in the Gulf of Mexico that develops each summer. Hypoxic conditions occur when excess nutrients from the Mississippi River Basin enter the Gulf and trigger a biological chain reaction that depletes dissolved oxygen from the water, impairing valuable fisheries.

Fertilizers, pesticides, animal wastes, and soil sediments can enter streams, ponds, and lakes unabated when permanent vegetation is absent from upland and riparian areas.
Restoring Ecological Services

Reducing Flooding and Flood Damage
The leaves and branches of trees intercept rainfall, reducing their erosive energy and allowing the movement of rainwater. Root growth and plant litter improve soil structure and enhance infiltration of rainfall, reducing surface runoff. Stiff stems of trees and shrubs resist and slow out-of-bank stream flow. Plant debris protects exposed soil and roots and soil permeability to resist erosion and stabilize slopes.

Improving Aquatic Habitat
Trees provide shade that reduces water temperature and, more importantly, prevents large and sudden temperature fluctuations. Trees supply debris to streams - large debris creates habitat structure and smaller debris contributes to the aquatic food chain. Woody roots promote stream channel stability and permanence of habitat structure. Improved infiltration of runoff results in contaminant filtering and the gradual release of groundwater into streams, which helps maintain base flow.

Filtering Contaminants
Vegetation and plant debris slow surface runoff, encouraging sediment and sediment-based contaminants to settle before entering surface water. Root growth and plant residue improve soil structure which enhances infiltration of dissolved contaminants. Once in the soil, contaminants can be immobilized, transformed by soil microbes, or taken up by vegetation. Groundwater flowing through the root zone is also filtered by these processes. Additionally, trees can trap wind-blown dust before it enters streams and lakes.

Surface water
Groundwater
Vegetation and plant residue slow runoff, encouraging deposition and infiltration.
Contours and nutrients are processed by plants and microbes.

Water and oxygen are released into the atmosphere.

Shade helps to moderate water temperature.

Roots help to bind soil together.

Stems reduce the energy of flowing water.

Woody debris falls into the stream and provides food and habitat structure.

Nutrients from runoff are stored in woof.
Integrated Watershed Approach

Most watersheds support a mixture of land uses, such as agriculture, forestry, and communities. An integrated watershed approach is an effective way to manage water resource issues. This approach coordinates the planning and activity of all land uses to address ecological, social, and economic concerns throughout the watershed. A linked system of upland and riparian agroforestry plantings, in conjunction with other conservation practices, can restore many ecological functions and reconnect hydrologic processes.

A. Silvopasture
Combined timber/grading systems increase farm s poultry income and minimize water quality problems associated with livestock waste.

B. Windbreaks
Airborne pollutants, including dust and chemicals, are trapped and filtered by windbreaks, preventing deposition into road ditches, streams, and lakes.

C. Alley Cropping
Growing agricultural crops between rows of trees can provide on-farm income from annual and long-term products while reducing soil erosion and improving water quality.

D. Green Infrastructure
Agroforestry technologies can be adapted to help communities use vegetation to restore ecological functions to manage stormwater runoff and address rural/urban interface issues.

E. Wastewater Treatment
Rapidly growing tree species can effectively trap excess nutrients in the runoff from irrigated fields and livestock operations, as well as from municipal and industrial wastewaters.

F. Waterbreaks and
G. Riparian Forest Buffers
Properly designed riparian buffers protect downstream water quality by intercepting and filtering pollutants from agricultural and industrial runoff and stabilizing stream banks. Incorporating perpendicular plantings to serve as waterbreaks can reduce flood damage on adjacent lands.

“Restoration of riparian functions along America’s waterbodies should be a national goal.”
National Academy of Sciences (2002)
Incorporating Working Trees into the landscape at strategic positions in the watershed provides ecological services that protect water resources and meet landowner objectives.
Planning & Design

Landowner Goals

What Functions Should Working Trees Perform?

Upland and riparian tree-based buffers can perform a variety of functions. Buffer design and the choice of plant materials will influence performance. For example, soluble nutrients like nitrogen rely on designs that detain and infiltrate water into the soil, while insoluble nutrients, like phosphorus, are commonly bound to soil particles and can be controlled by the same design elements that control sediments. Once primary functions have been considered, other benefits can often be built into the design.

Where on the Landscape Should Working Trees be Located?

Since it is not practical to install Working Trees in all locations on the landscape, it is desirable to have some process of determining which locations will produce the greatest benefit for water quality. Landscape-scale assessments should be conducted to guide the strategic placement of upland and riparian buffers in water sheds for the purpose of maximizing water protection, while optimizing for other benefits, such as wildlife habitat, carbon sequestration, and economic diversification.

Community Goals

To effectively address water quality issues, rural and urban residents should view themselves as watershed partners whose land use decisions affect one another. When planning Working Trees it is useful to ask several questions:

More information from NAC www.unl.edu/nac

Butterf: A conservation buffer economic decision-making tool.
CanVac: A software tool for illustrating photo-realistic design alternatives.
GIS-based assessments: Determine where buffers can achieve multiple goals.

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