Mosquito Creek Watershed Restoration Project

The Watershed

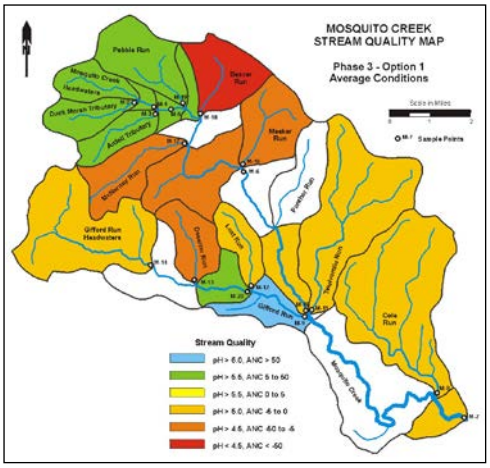
The 90 square mile Mosquito Creek watershed is located in Clearfield and Elk Counties, in north-central Pennsylvania. The watershed is largely undeveloped, forested public lands traversed by forest roads and public hiking trails. The watershed was once regionally famous for its abundance of naturally reproducing wild brook and brown trout. However, since the early 1960's, water quality in the watershed has steadily become more acidic, causing wild brook trout to become scarce and wild brown trout to virtually disappear. Soils in the watershed are naturally poorly buffered, and freestone streams like Mosquito Creek have minimal buffering capacity. Lacking this buffering capacity, the watershed is not able to counter the effects of acidic precipitation. Without intervention, the adverse impacts of acid deposition on water quality are expected to continue indefinitely.

Restoration Goals

Over the last 20 years, the Mosquito Creek Sportsman's Association and others have tried various approaches in their effort to maintain this public fishery. With recent advances in restoration technologies, the Pennsylvania Growing Greener Program has supported renewed efforts of the Association to implement sustainable technologies as part of a progressive restoration plan for the watershed. For the past 3 years, Growing Greener grants have provided the funding to implement a restoration plan using new low maintenance technologies that will neutralize acidity in the streams and soils to improve water quality and restore trout habitat.

Watershed Assessment and Restoration Plan

At the beginning of the project, the Association conducted a study to determine the overall water quality improvement needs of the watershed. In this effort, flow and water quality data were collected on streams throughout the watershed to determine the water quality conditions of Mosquito Creek and its major tributaries under a range of flow conditions. As new acid abatement technologies are implemented, water quality data are being collected and analyzed to determine the rate of alkalinity being generated by each approach. Using this performance data and the alkalinity or Acid Neutralization Capacity (ANC) deficiencies determined for the watershed, future locations for additional treatment systems and applications are being selected to maintain a positive ANC in the watershed under critical flow conditions. Implementation cost and performance data from the different alkalinity addition methods are being used to determine the estimated cost of restoring water quality throughout the watershed. A technical and economic analysis, to be completed in 2005, will provide an assessment of restoration efforts to date and develop long-term plans and funding strategies for future restoration efforts.



Alkalinity Generating Wetland Systems

Three alkalinity-generating wetlands have been constructed along three headwater tributaries to Mosquito Creek. The technology selected for these systems employs limestone dissolution and bacterial sulfate reduction to generate alkalinity without the continual input of materials, labor, or energy. The systems are each one-half acre in size and consist of a limestone aggregate base covered with a layer of spent mushroom compost and shallow surface water. A portion of the flow in the tributaries is diverted to the systems and travels vertically through the spent mushroom compost and limestone aggregate, where chemical and microbial processes produce alkalinity and increase the pH of the water. An underdrain piping system collects the alkalinity-enriched water and discharges it back into the stream, where it mixes with the untreated stream water and increases the ANC and pH of the downstream waters. Together, these systems are intended to improve 6.5 miles of Mosquito Creek to its confluence with Beaver Run.

Whole Watershed Liming Demonstration

As part of the restoration efforts, Penn State University is completing a demonstration project to evaluate the effects of adding lime to the forest soils along Merrill Road and Caledonia Pike. Using a specially modified log skidder with a lime spreader, the liming project will cover approximately 100 acres of riparian areas along the headwaters of Mosquito Creek on State Game Lands 34 and two separate 250-acre tracts on State Forest Lands. Pre-liming studies of the forest ecology and water quality have been conducted, and liming will be completed in the summer of 2004. Two non-limed control watersheds will provide a basis for comparing changes to the watershed that are a result of the liming.

Beaver Run Lake Liming Project

Beaver Run, a tributary to Mosquito Creek, originates in the Quehanna Wild Area and is one of the most acidic streams in the watershed. At the headwaters of Beaver Run is a 25-acre man-made impoundment surrounded by wetlands. The low pH water in the impoundment is unable to support a sustainable fish population other than catfish. To revitalize this lake and make it suitable for other species of fish, the Association, in cooperation with the PADCNR Bureau of Forestry, applied 50 tons of high calcium lime to the lake surface and surrounding wetlands in May 2004. Because the lake is located in the Quehanna Wild Area with limited access, the lime was applied by aerial spreading with a specially equipped plane under a state-approved research project. Pre and post application water quality monitoring will help determine the water quality benefits achieved and how long any lime-induced changes will last. If significant long-term benefits can be documented, the lake will be stocked and placed on an annual liming program to maintain the water quality and fish population.

Gifford Run Seasonal In-stream Liming

To improve and maintain water quality during the trout fishing season, the Association places 22 tons of lime sand (No. 10 aggregate) at each of two locations in Gifford Run prior to spring stocking. The

lime is placed directly in the stream, allowing the stream flow to erode, dissolve, and distribute the sand downstream. The effect is to raise the pH of the downstream water sufficiently to support stocked trout. Although widely practiced as means to counter the low pH caused by acid rain, particularly during spring runoff, it is a relatively uncontrolled method of adding alkalinity to the stream, wholly dependent on rainfall, runoff, and stream flow conditions.

High Flow Buffer Channel – 2006 Construction

As part of the watershed restoration plan, new innovative “High Flow Buffer Channel” designs have been developed to replace the current practice of placing limestone directly in the stream channel. These off-stream bypass channels will add alkalinity to the stream in a more controlled manner by splitting part of the stream flow to a secondary channel when the stream reaches a predetermined flow condition. The first High Flow Buffer Channel will be constructed in the summer of 2006 on Gifford Run at the Lost Run Road Bridge. Using a natural channel design approach, the system will provide buffering capacity during the critical high flow/low pH stream conditions while eliminating some of the negative aspects of stream liming such as the introduction of fines to the stream bed. The design of the channel will promote more effective dissolution of the limestone and the additional capacity will allow greater lime storage for year-round alkalinity addition under controlled conditions. With the ability to capture and recycle un-dissolved limestone within the secondary channel, the design will reduce the amount of limestone required while having buffering capacity in ready reserve when stream flows require acid neutralization.

Limestone Road Surfacing

Field tests of road runoff from limestone-surfaced roads in the watershed show a marked increase in pH compared to runoff from forested areas. The Department of Conservation and Natural Resources, Bureau of Forestry has been using limestone for road surfacing in the watershed for several years in place of native shale. With vehicle travel and spring road grading, the limestone surfacing materials break down and are exposed to rainfall. During dryer periods alkaline dust from vehicle travel adds lime to the soils within the road corridor. Expanding the use of limestone for road surfacing and adding lime sand to road ditches stabilized with limestone rip-rap was completed on a selected road segment in the watershed. As with other alkalinity addition approaches, this application will be monitored specifically for its contribution to water quality improvement to determine the additional benefits that limestone road surfacing can produce. If shown cost effective compared to other systems and applications, such practices may be considered for the many miles of dirt and gravel roads in the watershed.

Watershed and Performance Monitoring

As alkalinity dilutes and dissipates with flow, how far downstream will the excess alkalinity from these efforts buffer the stream, and will these approaches improve the trout population? To help answer these questions, a Penn State research team is comparing water quality and trout biomass before and after implementation of alkalinity addition projects. The team conducts sampling to establish baseline water conditions and electro-fishes to measure the existing fish populations. The monitoring stations are located upstream and downstream of the system or application site, at the mouth of the receiving tributary, and on the main stream downstream of its confluence with the receiving tributary. After the alkaline addition projects are in place, bioassays and sampling will continue on the tributaries to evaluate water quality and fish biomass improvements associated with the alkaline addition. As part of this monitoring program, the Mosquito Creek Sportsman's Association continues to conduct stream monitoring of major tributaries in the watershed to assess the overall water quality benefits of the restoration efforts.

Project Partners

Mosquito Creek Sportsman's Association
PADCNR Bureau of Forestry
PA Game Commission
PA Fish and Boat Commission
PA Dept. of Environmental Protection
Trout Unlimited
Canaan Valley Institute
Clearfield Co. Conservation District
USDA NRCS
PA Dept. of Corrections
Penn State University
Water's Edge Hydrology, Inc.

For Additional Information Contact:

Ron Sartori, President, Mosquito Creek Sportsman's Association
Phone: (814) 263-4831 email: mosquito@pennswood.net
Terry Rightnour, Project Director, Water's Edge Hydrology, Inc.,
Phone: (814) 592-2216, e-mail: trightnour@wehydro.com
Dr. William Sharpe, Professor of Forest Hydrology, Penn State Institutes of the Environment
Phone: (814) 863-8564, e-mail: wes@psu.edu
Gary Byron, Project Advisor, PA Dept. of Environmental Protection
Phone (570) 327-3320, e-mail: gbyron@state.pa.us
Jennifer Means, Project Advisor, PA Dept. of Environmental Protection
Phone (570) 327-3667, e-mail: jenmeans@state.pa.us