NONPOINT SOURCE SUCCESS STORY

Pennsylvania

Aquatic Ecosystem Restoration Efforts Manage Sediment and Improve Ecosystem Services and Functions in the Big Spring Run Watershed

Waterbody Improved

By the late 19th century, reservoirs upstream of tens of thousands of mill dams and other valley grade-control structures had filled with fine sediment eroded from upstream sources. More recently, dam breaching and other valley grade-control changes have led to stream incision, stream bank formation, and bank retreat that generate high sediment yields from the stream channels. In 2006 the Pennsylvania Department of Environmental Protection (PADEP) added Big Spring Run (BSR) to the Clean Water Act (CWA) section 303(d) list of impaired waters because excessive sediment was impairing aquatic life; in 2010 a TMDL was approved. In 2011 accumulated sediment, known as "legacy sediment," was removed from about 7.5 acres of valley bottom to restore natural valley morphology and natural aquatic ecosystems. Recent data have shown that sediment loading from channels in this segment of BSR have declined nearly 100 percent from pre-restoration conditions.

Problem

The rural landscape of Early America was dotted with water powered mills, especially gristmills and sawmills (Figure 1). Throughout the 18th and 19th centuries, landowners dammed streams along valley bottoms to create reservoirs of water that powered these mills. Over time, the reservoirs filled with fine sediment eroded from upstream sources, creating layers of sediment across the valley bottom. These sediments are vulnerable to rapid stream incision and erosion in high water events (Figure 2), made worse as upstream mill dams deteriorate or fail completely, sending slugs of eroded sediment downstream.

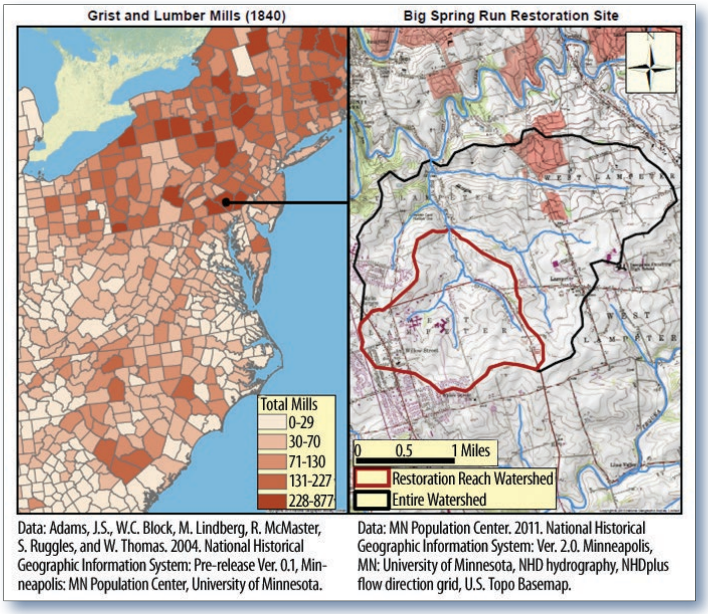

Figure 1. The Big Spring Run watershed is in an area of southeastern Pennsylvania once covered by many millponds (left). A project on Big Spring Run (right) addressed a site where eroding deposits of millpond mud were affecting downstream habitat.

Project Highlights

Research teams studying the BSR site concluded that years of millpond mud accumulation had buried the valley bottom's original aquatic ecosystems and landscapes, leaving only remnants of what used to be a functioning natural aquatic ecosystem. To solve this problem, the research team decided to remove the legacy sediment and restore the natural aquatic ecosystem to a close approximation of its original condition.

Relying on precise surveying controls, project partners removed approximately 22,000 tons of legacy sediment with a low ground pressure dozer, an earth scraper "pan," and track hoes. After removing the sediment, the track hoes were used to excavate a meandering channel system. Partners placed logs and other woody debris in the channels to establish base flow grade controls; woody debris was also

Figure 2. This area of Big Spring Run, directly downstream of the project area, represents the valley bottom conditions before restoration. The creek is cutting down through accumulated millpond mud and sending high levels of sediment downstream.

Figure 3. The project area, after restoration, shows the return of the site to its original valley bottom condition. After excavation, partners seeded the restored area with a specially designed native wetland seed mixture and added woody debris.

added throughout the restored floodplain and wetland complex to increase flow resistance, increase stored carbon and provide habitat niches.

The exposed soils were seeded immediately after excavation with a specially designed native wetland seed mixture developed from on-site paleo-seed analyses and inference of natural plant communities. In spring 2012, additional native wetland seed mixtures were applied to the entire site to ensure development of a well-established natural wetland plant community (Figure 3).

Results

Approximately 3,000 linear feet of stream channels, 4.6 acres of floodplain wetlands, and 3 acres of riparian buffer have been restored at BSR. In addition, substantial load reductions in sediment have been documented and similar outcomes are anticipated for other major nutrients like nitrogen. The total amount of sediment removed was 21,955 tons, with an annual reoccurring estimated reduction of 100 tons. With removal of the legacy sediment the estimated total phosphorus removed is 50,480 pounds, with an additional annual reoccurring estimated reduction of 230 pounds. Recent data have demonstrated that phosphorus loading from the segment is declining.

Partners and Funding

PADEP provided over $1 million in Growing Greener grants and matching funds for project construction and pre- and post-restoration monitoring. U.S. Environmental Protection Agency (EPA) Region 3 provided $200,000 through a Regionally Applied Research Effort agreement with EPA's Office of Research and Development (ORD); in addition, EPA's ORD is providing ongoing monitoring of nutrients and sediments, and EPA Region 3 recently provided the state with a Wetland Program Development Grant of approximately $280,000 for additional long-term monitoring through 2016 and to complement all 5 years of post-restoration monitoring efforts.

Partners and monitoring research collaborators include PADEP, Franklin & Marshall College, U.S. Geological Survey, Chesapeake Bay Commission, Lancaster Farmland Trust, Suburban Lancaster Area Sewer Authority, John Hopkins University, University of California–Berkley, University of Michigan, Elizabethtown College, Pennsylvania State University, Argonne National Laboratory, Millersville University, and Rocky Knoll Farms. Land Studies, Inc., was responsible for the design and also served as the primary contractor for construction oversight.

U.S. Environmental Protection Agency
Office of Water
Washington, DC

EPA 841-F-15-001JJJ
December 2015

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