

Dam Removal

as an Ecosystem Restoration Tool

Kate Ebel

Wildlands Conservancy, a nonprofit land trust in eastern Pennsylvania, has been tackling environmental issues since its creation in 1973. For the past 45 years, Wildlands Conservancy has been working to restore degraded stream and wildlife habitat, protect valuable land from development, create trail connections for recreation, educate and engage local communities in environmental issues, and improve water quality. A staff of 23 dedicated full-time professionals work to achieve Wildlands' mission to "Protect and restore critical natural areas and waterways, and educate the community to create a legacy of a healthy, sustainable environment for future generations." Wildlands envisions a Lehigh Valley and Lehigh River watershed that contain expansive natural areas, connected green spaces, healthy waterways, and an enlightened community where people embrace conservation and sustainability.

Wildlands Conservancy works primarily in the Lehigh Valley and Lehigh River watershed, a 1,345 square mile drainage area that eventually flows into the Delaware River. In this area, Wildlands owns and maintains nine nature preserves that have permanently protected more than 2,600 acres of dense forestland, glacial wetlands, coldwater streams and native meadows. The Conservancy also does extensive conservation work with other property owners, connecting green spaces through trails and greenways, permanently protecting large areas of wildlife habitat, restoring degraded stream and floodplain habitats, and reestablishing rare habitats like grasslands and meadows. This work includes removing obsolete dams that are degrading watershed streams; Wildlands has been at the forefront of this emerging stream

restoration initiative. There are thousands of dams in Pennsylvania, including eight on the main stem of the Lehigh River and at least one on each of its major tributaries (Figure 1). Many of these structures that no longer serve a purpose are degrading the stream ecosystems, and need to be removed.

The Problem with Dams

Dams convert lotic (moving water) environments into lentic (standing water) ones. Impairments to water quality, including high temperatures, low dissolved oxygen levels, and an accumulation of silt and sediment, characterize the lentic environment within a dam's impoundment. Native coldwater fish species have evolved in lotic environments, and are typically unable to survive in the impounded water behind dams. The stagnant water disorients them while excess sediment and particles can damage their gills and blanket the stream substrates they rely on for spawning. Dams also prevent the free transfer of nutrients and sediment, creating nutrient- and sediment-laden areas upstream and sediment-starved areas downstream.

In addition to ecological concerns, dams pose a major threat to public safety. These structures cause streambank erosion and instability, create a downstream boil which poses a drowning risk, and often have jagged metal or concrete edges. Many are located in public spaces, and signage must be installed to warn people of the dangers associated with recreation in the vicinity.

Wildlands Conservancy worked with Moravian College for a number of years to study the effects of dams on instream macroinvertebrate communities. At the sampled sites, the results of an Index of Biological Integrity, which is

used to determine the health of aquatic communities based on the number of pollution-tolerant and -intolerant species, consistently ranged from fair to poor. Aquatic worms, midges, black fly larvae, and other pollution-tolerant species were common at the sites. Additionally, many of the species are more typically associated with slow-moving water or even pond ecosystems. Dams radically alter the local ecosystem, creating stream sections that are uninhabitable for desirable native species.

The Benefits of Removing Dams

The removal of obsolete, deteriorating dams has the power to transform a local stream ecosystem. It converts an often-forgotten section of stream that is degraded from decades of impoundment into a healthy, thriving stream system. Removing dams allows the ecosystem to recover, restoring free-flowing conditions and the natural stream structure, clearing out accumulated sediment, and connecting stream systems to allow for diverse recreational opportunities. The stream once again becomes wild and free, as if the dam had never been there in the first place.

The ecological and community benefits of dam removal are numerous and lasting. It uncovers buried gravel and cobble that provide structural and spawning habitat for macroinvertebrates and fish. Water quality improves as dissolved oxygen levels rise and temperatures fall. These benefits to the ecology of the stream lead to benefits for local communities as well. The improvements to water quality and habitat increase fishing opportunities for anglers. Removal decreases flooding; dams keep the stream channel at maximum capacity, which causes excess water from storm

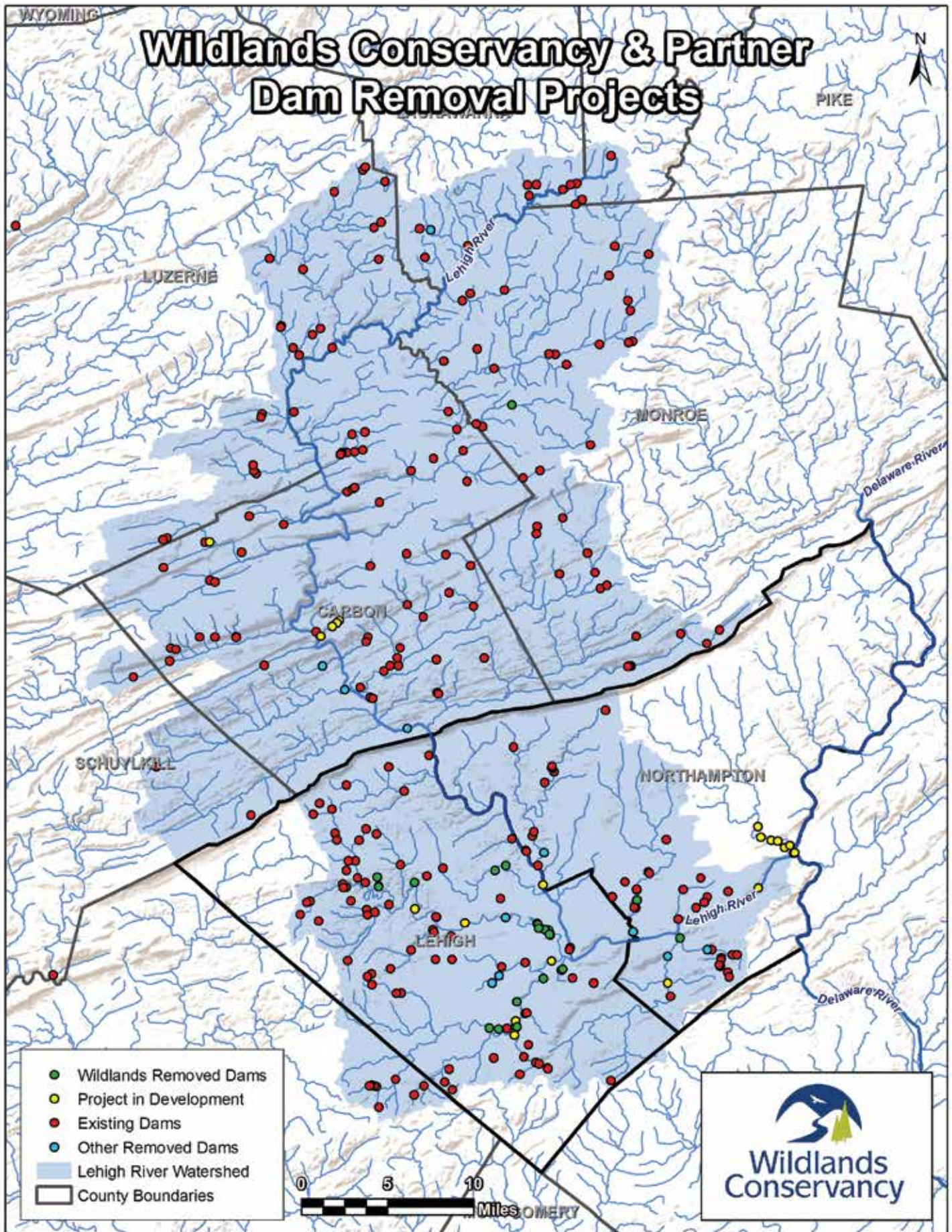


Figure 1. Watershed map showing Wildlands Conservancy (and partners) dam removals in Pennsylvania.

events to be diverted around the structure. Restoration of free-flowing conditions opens up waterways for canoeing and kayaking. The removal of dams from waterways eliminates a significant public safety hazard, as explained by the Pennsylvania Fish and Boat Commission, "Of all the things you may encounter on a river or stream, the low-head dam is one of the most dangerous. In fact, if an engineer designed an efficient, unattended, self-operated drowning machine, it would be hard to come up with anything more effective than a low-head dam."

The stream ecosystem begins to come back to life as soon as a dam is removed. Almost immediately, the unnaturally high water level in the former impoundment begins to drop and riffles that have long been buried reappear. From this point, it will take many more months for the stream to form and settle into a narrower, deeper and cooler channel. The diversity of native aquatic life returns once a normal flow regime and habitat structure has been restored. Soon enough, a wild, free-flowing stream sits in place of the previously stagnant, sediment-choked impoundment and deteriorating concrete structure.

A dam removal project typically provides the opportunity for a holistic approach to restoring a stream. Several stream and floodplain restoration strategies may be combined to improve wildlife and stream habitat. Once the dam is removed, the streambanks are stabilized and regraded if needed, which allows for improvements to the surrounding habitat. Dams create an area of disturbance that often degrades the nearby riparian zone, but removal of the structure and stabilization of the streambanks allows for riparian buffer restoration. A healthy, intact riparian buffer will further stabilize the streambanks, shade the stream, and provide cover and nutrients for aquatic and terrestrial species. This holistic approach provides an opportunity to engage the public in the project through streambank planting events.

The Dam Removal Process

Wildlands Conservancy has worked with many partners to remove 20 dams in the Lehigh River watershed. Each project requires extensive planning and comes with its own unique challenges

and benefits. It can be a long process to get from project inception to the actual removal. The first step is to obtain landowner permission, followed by creation and submission of project designs to the relevant permitting agencies such as the Department of Environmental Protection, the local conservation district, the Fish and Boat Commission, and the Army Corps of Engineers. Meanwhile, there are several grant programs from state and federal agencies, private foundations, and counties that provide potential project funds. Both the permitting and funding cycles take about a year. With funding and permits acquired, a contractor must be secured to remove the dam. The entire process tends to take two to three years all told. The costs to complete this process depend on the size and complexity of the project. Completing the designs, permitting, and construction may range from \$15,000 for a smaller project to hundreds of thousands of dollars for a larger project.

Many challenges may arise during this process, often in the earlier project planning stages. It can be difficult to approach a landowner to start the conversation about dam removal. Several attempts at outreach and education may be needed to develop a project. Sometimes surrounding infrastructure complicates the project designs if it is in close proximity to a dam. The designer may have to take into account things like nearby bridges or utility lines. It can be difficult to obtain enough funding to complete a project, and often a series of small funds from different sources gets strung together to complete the removal on a tight budget. However, by far the most challenging aspect of dam removal is public opposition.

When public opposition to a dam removal does arise, it can become an impediment to the success of that project. Dam removal is supported by an endless list of environmental organizations, but there are also some vocal critics. These critics often value the aesthetics of the dam, believe these structures prevent flooding, believe they improve fishing opportunities by confining stocked fish, value the history of the structure, or have an image of the dam from before years of deterioration and channel degradation. Wildlands Conservancy is no stranger to public opposition, having faced it on

numerous projects. It has occasionally been the reason a removal did not move forward as municipalities faced pressure from vocal opposition. However, momentum for dam removal, as well as the list of partners, is growing. The best way to combat public opposition is through community education and outreach to showcase local successes and the benefits to the stream.

Coordination with various state agencies is necessary to obtain authorization under Chapter 105 of the Pennsylvania Code for a dam removal project. This includes attaining clearances from agencies such as the Pennsylvania Historical and Museum Commission and the Pennsylvania Natural Diversity Index, sending notification letters to the relevant municipalities and planning commission, and obtaining a Drawdown Permit from the Pennsylvania Fish and Boat Commission. These are sent to the Pennsylvania Department of Environmental Protection along with maps and design drawings, an Erosion and Sediment Control Plan, and permitting forms. Specific restrictions and requirements for construction are listed in the permit authorization when it is granted. For example, no instream work can be conducted between October 1st and December 31st in streams supporting naturally reproducing trout in order to protect the wild population.

The construction phase of a dam removal project is the fruition of years of planning and preparation. After careful planning, a dam is often removed in a matter of days or weeks. To remove the structure from the stream, Wildlands Conservancy works with a contractor who has the experience and equipment needed to break up and remove the concrete and rebar. The contractor will make an initial breach in the center of the dam and let the water level slowly adjust, rather than unleashing the impounded water all at once. Once the water level is drawn down sufficiently, the remainder of the dam can be removed and the streambanks stabilized. While the typical dam consists of concrete or stone and rebar, there are occasionally some unexpected components; an entire 12-inch auger bit was imbedded as fill in one of Wildlands' dam removal projects on Coplay Creek. Wildlands conducts oversight through the removal process to ensure the

designs, permit requirements, and erosion and sediment controls are correctly implemented.

Notable Projects in the Lehigh River Watershed

A great local example of overcoming adversity and completing a successful dam removal project is Atlas Dam on Hokendauqua Creek, a tributary to the Lehigh River. This structure was over 600 feet long and ranged from 8 to 15 feet high, impounding Hokendauqua Creek for more than 4,000 feet. Most of this impoundment had filled up with sediment and stagnant water. The Hokendauqua Chapter of Trout Unlimited obtained permission from the landowner and began the process of planning for the dam removal. However, what was supposed to be a two-year process got stretched out closer to ten. Trout Unlimited, and later the Martins-Jacoby Watershed Association, faced numerous obstacles including outspoken public opposition, unexpected costs, and hurdles in permitting. After years of perseverance, the dam was successfully removed in 2014 and replaced with a free-flowing stream and stabilized, planted streambanks.

Wildlands Conservancy's first dam removal, on Little Lehigh Creek which is a tributary to the Lehigh River, was one of the early dam removal projects in Pennsylvania. This dam was located at Wildlands' Pool Wildlife Sanctuary, the base of operations for the organization. Since that first project, Wildlands began building partnerships with local watershed organizations to work with other landowners on dam removals. The Conservancy assessed the existing dams in the watershed, identified the highest priority dam removal projects, and began working through the list to restore streams in the watershed. This led to a large-scale restoration project on the Little Lehigh and Jordan Creeks, in which six dams were removed in summer of 2013, restoring fish passage to more than 15 miles of stream habitat. In 2017, Wildlands circled back around to practice what they preach by removing a dam on Tunkhannock Creek on the Conservancy-owned Maple Tract Preserve.

Much of Wildlands' focus has been on removing dams on public land. The Conservancy has partnered

with numerous municipalities and state agencies, such as the Pennsylvania Game Commission and the Pennsylvania Fish and Boat Commission, to remove dams in public parks and on state land. A strong partnership with permitting agencies has made the dam removal process in Pennsylvania efficient and cost-effective, allowing for many successful projects. These partnerships have helped leverage resources to remove dams on public open space. Removing dams on public lands facilitates outreach by giving communities the opportunity to enjoy the benefits of safe park conditions, successful fish passage, and healthy streams. Wildlands removed a dam on Coplay Creek in 2015, which facilitated an ongoing opportunity for public outreach. The dam, located along a local rail trail, was causing flooding and erosion on the trail, and degrading instream habitat. After the removal, Wildlands held a public event to educate local citizens about the project and plant a native riparian buffer along the newly restored stream. Interpretive signage now sits at the project site to continue educating trail users about streamside best management practices.

Looking Ahead

Wildlands Conservancy is a growing organization with an ever-expanding presence in the Lehigh River watershed and surrounding areas. The main strategic goals for the Conservancy are to continue protecting, restoring and enhancing regional waterways, increase our educational programming, continue connecting people to nature, expand our nature preserves, and increase public awareness of our organization. This means the organization will continue building partnerships to restore streams, protect high quality land, educate local communities, build trails to connect public spaces, and restore wildlife habitat.

Wildlands Conservancy will continue focusing on removing obsolete dams to restore the health of watershed streams and their inhabitants. There are seven dam removal projects slated to take place in the next three years, with an additional nine targeted for project development. A notable upcoming project has Wildlands partnering with state and federal agencies, municipalities, private landowners, local watershed organizations, and a local college to remove four dams on Bushkill Creek. This project will restore fish passage and habitat along a significant section of this High Quality – Coldwater Fishery. A local trail makes this area publicly accessible, so the project will also increase public safety and recreational opportunities for local communities. This and other future projects will allow Wildlands to continue leading dam removal efforts to restore stream ecosystems in the Lehigh River watershed.

References

Pierce, Daryl. 2011. American shad passage through the Easton and Chain fishways, Lehigh River. *Pennsylvania Fish & Boat Commission Biologist Report*: 3.

Kate Ebel is the senior environmental scientist at Wildlands Conservancy where she works on such projects as large-scale stream and floodplain restoration, dam removal, riparian buffer restoration, invasive species management, and naturalization of open space. She has been working for the last four years to build partnerships and restore stream health throughout the Lehigh River watershed and surrounding areas. 🌱



Next Issue – Summer 2018 National LAke Assessment Data

At the NALMS Symposium in Colorado in 2017, several sessions were offered to showcase work that was done using data derived from the National Lake Assessment (NLA). Many of the talks that were given at that symposium will be highlighted in the summer issue of *LakeLine*, though additional articles related to utilization of NLA data are welcome.