



# NONPOINT SOURCE SUCCESS STORY

## Pennsylvania

### Reclaiming Abandoned Mine Lands Reduces Impact of Acid Mine Drainage in the Bennett Branch Basin

#### Waterbodies Improved

Acid mine drainage (AMD) degraded water quality in Pennsylvania's Bennett Branch Sinnemahoning Creek. As a result, Pennsylvania added the stream to its 1996 Clean Water Act (CWA) section 303(d) list of impaired waters for high metal concentrations. To address the AMD problem, significant partnerships were developed with the mining industry to accomplish mine reclamation and to use recoverable coal and waste coal resources. Water quality in Bennett Branch has dramatically improved after restoration, with decreased metal concentrations and increased alkalinity.

#### Problem

Bennett Branch Sinnemahoning Creek (Bennett Branch) is a 38-mile-long wild and scenic river in Clearfield, Elk and Cameron counties in north-central Pennsylvania (Figure 1). Bennett Branch flows into the Susquehanna River, which empties into the Chesapeake Bay. Restoring Bennett Branch is a priority because the watershed contains much of the state's growing elk population and also has enormous potential for growth in tourism and other outdoor recreation.

Coal mining in the area began in the late 1800s. Extensive underground mining was underway by the early 1900s; surface and strip mining began in the 1940s. Both continue to a limited extent today. Many established mines were eventually abandoned and left unclaimed. Drainage from these abandoned mine lands contribute dissolved metals to Bennett Branch.

The Pennsylvania Department of Environmental Protection (PADEP) first designated Bennett Branch as impaired for metals in 1996, and placed much of the stream on the CWA section 303(d) list of impaired waters. PADEP conducted additional sampling in the early 2000s. At present, 19 segments of Bennett Branch are on the impaired waters list.

In July 2004, PADEP and the Bennett Branch Watershed Association completed a "Watershed Snapshot" study to identify critical areas of AMD pollution. The study identified three distinct watershed drainage areas in need of AMD treatment—Hollywood, Dents Run and Caledonia. The Hollywood Area tributaries collectively contributed 41 percent of the acid load to Bennett

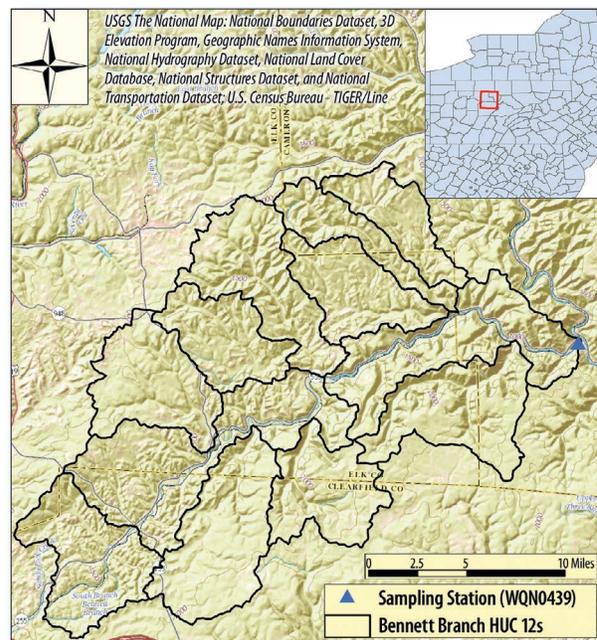


Figure 1. Bennett Branch flows through coal mining lands in north-central Pennsylvania.

Branch, while Dents Run and Caledonia Run contributed 27 and 24 percent, respectively.

Total maximum daily loads (TMDLs) were approved for Bennett Branch in 2009 and consisted of load allocations for iron, manganese, aluminum and acidity to seven sampling sites on Bennett Branch (BBSC6, DENT 1.0, BBSC5, BBSC4, BBSC3, BBSC2 and BBSC1). The TMDLs require aluminum and iron concentrations to be below 0.75 and 1.5 milligrams per liter (mg/L) respectively, and for pH values to be between 6 and 9.

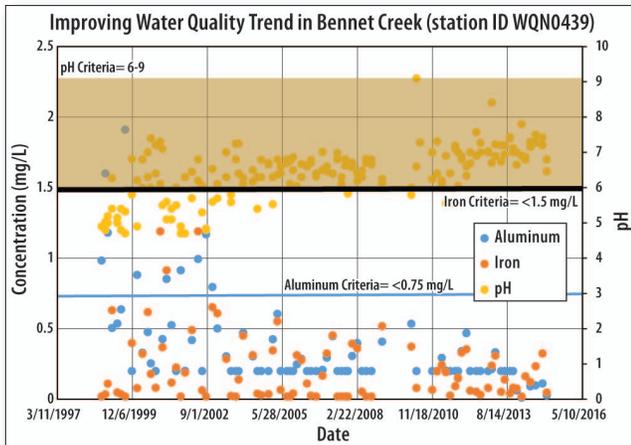


Figure 2. Bennett Branch water quality data.

## Project Highlights

In 1998 the Bennett Branch Watershed Association formed to begin the restoration work needed on Bennett Branch to restore it to its pre-mining condition. In each of the three distinct areas with severe AMD damage, the partners implemented projects that focused on reclaiming abandoned mine lands.

In 2007 construction began on the Hollywood Treatment Facility, which has been operational since July 1, 2012. The facility dramatically improves water quality by treating an average of 2.7 million gallons per day of mine drainage from 21 separate discharges originating in four different underground mine complexes (Table 1).

**Table 1. Average pump station intake water quality compared to treatment plant effluent**

Sampling Location	Water Quality Averages		
	pH	Total Iron (mg/L)	Aluminum (mg/L)
At intake	3.27	47.7	17.75
In effluent	7.54	0.98	0.44

In addition, a re-mining operation was conducted at Mills Run, a tributary to Bennett Branch. In the Caledonia Area, PADEP completed projects that reclaimed more than 100 acres of abandoned surface mining areas. At Dents Run, a partnership was formed with the active mining industry. This partnership provided a low-cost source of alkaline material for alkaline addition and passive treatment.



Figure 3. Dents Run (2009), after treatment of AMD seeps in the watershed (see inset photo).

## Results

As of March 2009, water quality in Bennett Branch had dramatically improved. Water samples collected after 2012 in Bennett Branch below the Hollywood treatment plant show pH levels in the range of 6.9 to 7.3, iron levels between 0.5 and 1.3 mg/L, and aluminum levels between less than 0.5 and 0.7 mg/L (Figure 2). Dents Run became net alkaline for the first time in over a century, eliminating 27 percent of the acid load to Bennett Branch (Figures 2 and 3). Monitoring data show water quality improvement in five Bennett Branch segments: PA2800 (4.9 miles), PA7999 (23.1 Miles), PA8000 (8.6 miles), PA9804 (8.9 miles), and PA3687 (3.0 miles).

Over 800 acres of new rangeland have been created for Pennsylvania's growing elk population through reclamation and re-mining efforts within the watershed. The projects completed to date have reclaimed or treated 390 acres of abandoned mine lands through alkaline addition, which significantly reduced AMD within the watershed. Construction of the Hollywood treatment plant eliminated approximately 40 percent of the acid load to Bennett Branch.

## Partners and Funding

The restoration of Bennett Branch was supported by private, state and federal investments. Overall, more than two dozen projects have been completed, for a total cost of approximately \$44 million in Bennett Branch. Of this funding, the private sector contributed approximately \$6.1 million, the PADEP Bureau of Abandoned Mine Reclamation contributed \$34 million, and the Army Corps of Engineers contributed \$4.1 million.



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