Pennsylvania

Swatara Creek
Section 319
National Monitoring Program Project

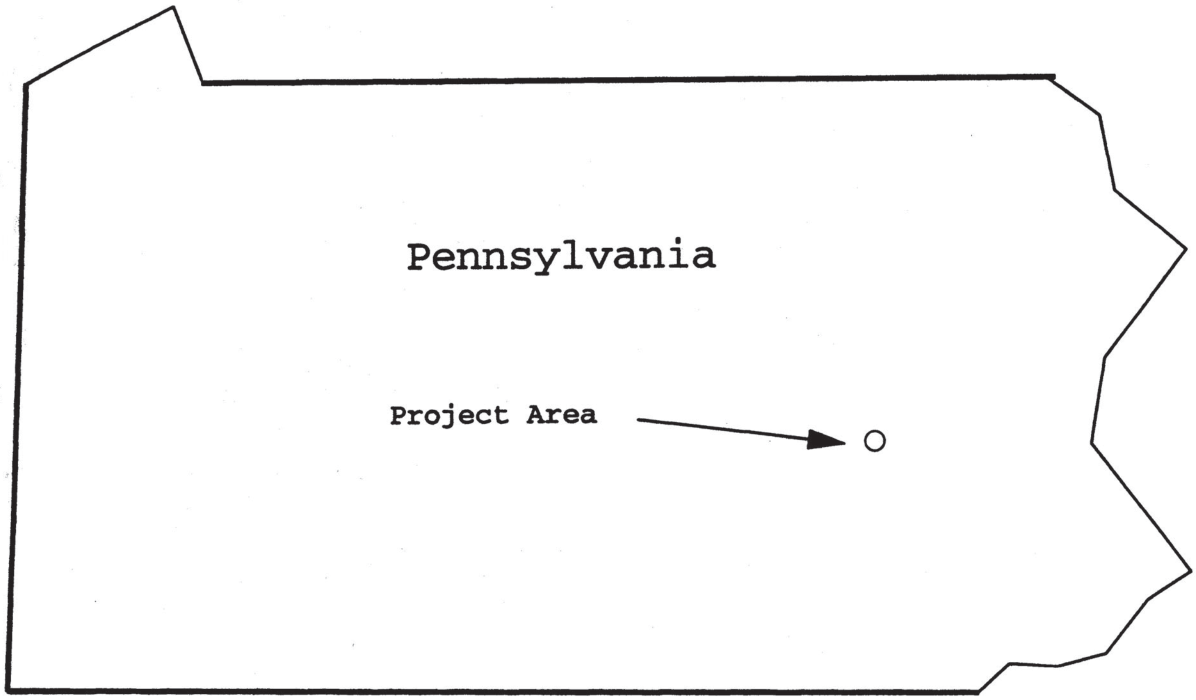

Figure 40: Swatara Creek (Pennsylvania) Watershed Project Location

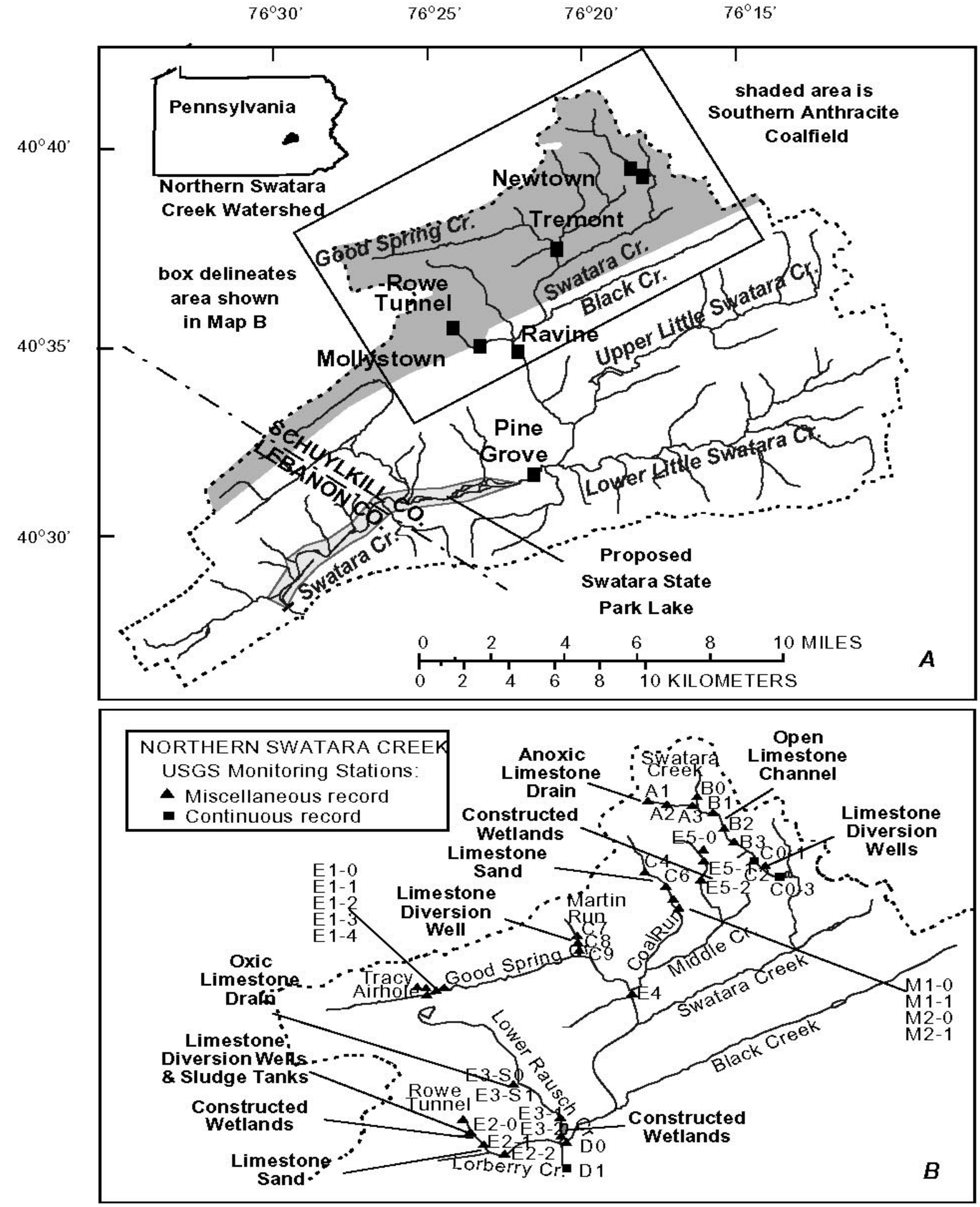

Figure 41. Water-quality and streamflow monitoring sites in the Swatara Creek Basin, Schuylkill County, Pennsylvania: A, continuous monitoring stations on Lorberry and Swatara Creeks; B, CMD treatment systems within the Southern Anthracite Coalfield, above Ravine, and bimonthly monitoring sites in Swatara Creek, Good Spring, Lorberry Creek, and Lower Rausch Creek subbasins.

PROJECT OVERVIEW

Coal mine drainage (CMD) from abandoned mines has affected more than 2,400 miles of streams and associated ground water in Pennsylvania. Approximately half the discharges from bituminous and anthracite coal mines in Pennsylvania are acidic, having pH <5 and acidity > alkalinity. Acidic CMD typically contains elevated concentrations of dissolved sulfate (SO_4^{2-}), dissolved and particulate iron (Fe), and other metals produced by the oxidation of pyrite (FeS_2). Elevated concentrations of sulfate and metals in mine drainage and receiving streams make the water unfit for most uses. Losses of surface water to and CMD from abandoned anthracite mines within the northern 43 mi^2 of the 576-mi^2 Swatara Creek Basin (Fig. 40) degrade the aquatic ecosystem and impair uses of Swatara Creek to its mouth on the Susquehanna River 70 mi downstream from the mined area. Consequently, the Swatara Creek Basin is designated as a “high priority watershed” for reducing nonpoint-source pollution.

To neutralize the acidic CMD and reduce the transport of dissolved metals in the Swatara Creek watershed, innovative passive-treatment systems are being implemented and monitored in the 43 mi^2 northern Swatara Creek Basin. These treatments systems include limestone-sand dosing, open limestone channels, anoxic and oxic limestone drains, limestone diversion wells, and limestone and/or compost-based wetlands. The performance of these new and existing treatment systems is being evaluated using upstream/downstream and before/after monitoring schemes.

The project is currently in the post-BMP monitoring phase. Limestone drains constructed to treat CMD from the Orchard Discharge (1995), Buck Mtn. Discharge (1997), and Hegins Discharge (2000) (fig. 40) and limestone diversion wells constructed on Swatara Creek (1995), Martin Run (1997), and Lorberry Creek (1998) in the Swatara Creek Basin, have had significant effects on the mitigation of acidic baseflow and stormflow and on the restoration of aquatic quality to Swatara Creek. Additionally, recently constructed wetlands in the Lower Rausch Creek (1997) and Lorberry Creek (2002) subbasins in the Swatara Creek watershed (Fig. 40) potentially will reduce the transport of metals to Swatara Creek. However, the long-term performance of these treatment systems and continued recovery of the aquatic ecosystem are uncertain. Data collected to date on treatment system performance have been used to plan modifications of several treatment systems. The project has been extended to 2007.

PROJECT BACKGROUND

Project Area

The 43-mi^2 northern Swatara Creek watershed, upstream from Ravine, Pa., is located in Schuylkill County, Pennsylvania (Fig. 40).

Relevant Hydrologic, Geologic, and Meteorologic Factors

The northern Swatara Creek watershed drains the Southern Anthracite Field in the Ridge and Valley Physiographic Province. The watershed is underlain by siliciclastic bedrock of the Llewellen and Pottsville Groups. The ridges are held up by quartzite sandstone and conglomerate, whereas mostly softer rocks, including shale and siltstone with some interbeds of sandstone and anthracite, underlie the hillslopes and valleys. The mining of coal has had a significant effect on the watershed hydrology, affecting both the flow and quality of surface and ground water.

Average annual rainfall for the watershed area is approximately 44 in/yr, with approximately 33 in/yr of snowfall.

Land Use

Current land use in the 43-mi^2 project area is classified as 86.6 percent forested and 4.9 percent agricultural, with only 6.4 percent classified as barren, mined; however, the land-use classification for this extensively mined area is misleading because underground mines extend beneath much of the surface and “natural” reforestation conceals large tracts of unreclaimed spoil. Agricultural development predominates downstream from the mined area. For example, land use in the 116-mi^2 area of the Swatara Creek Basin upstream from Pine Grove, which is 11 km downstream from Ravine, is classified as 69.7 percent forested, 25.0 percent agricultural, and 2.4 percent barren, mined.

Water Resource Type and Size

The northern Swatara Creek watershed contains approximately 37 miles of streams that will discharge to a proposed water-supply reservoir located in Swatara State Park. The proposed 775-acre reservoir will support recreational activities as well, including boating, fishing, and swimming. The water quality of source streams must be improved for the proposed reservoir to support all its designated uses.

Water Uses and Impairments

The streams of the northern Swatara Creek watershed are classified as cold-water streams. The Pennsylvania Fish and Boat Commission manage some of the streams as put-and-take trout waters. Additionally, the proposed reservoir to be constructed within Swatara State Park will support recreational activities including boating, fishing, and swimming.

CMD is considered to be the leading cause of degraded water quality in the project area. Acidity and high levels of sulfates and metals have created conditions that are toxic to some aquatic organisms. Recent efforts have been undertaken by the Pennsylvania Department of Environmental Protection (PaDEP), Bureau of Mining and Reclamation (BMR) to develop a watershed remediation plan. The goal of this plan is to improve water quality and restore the streams to recreational and fishable waters.

Pollutant Sources

CMD is the primary nonpoint source of pollution in the northern Swatara Creek basin; other sources are negligible. Although several surface and underground anthracite mines presently are active, most mines in the Swatara Creek Basin were abandoned before 1960. Barren, steep banks of spoil and culm and fine coal debris in siltation basins are sources of sediment (suspended solids), sulfate, iron, aluminum, and other metals in water that infiltrates or runs off the surface during storms. The abandoned underground mines have flooded and have collapsed locally causing subsidence. Surface flow is diverted through subsidence pits, fractures, and mine openings to the underground mines where the water becomes contaminated with acidity, sulfate, and metals. In downstream reaches, the contaminated water resurges as CMD contaminating Swatara Creek and its tributaries, while contributing substantially to baseflow.

A substantial proportion of the total streamflow originates as CMD. This source is most important during baseflow conditions. In contrast, during stormflow conditions, as much as 95 percent of the total streamflow for Swatara Creek at Ravine originates as surface runoff. The surface runoff typically has lower pH and lower concentrations of dissolved solids than the baseflow at Ravine.

Plans for pollution control have recently been implemented for one of the largest sources of water, the Rowe Tunnel Discharge, to reduce transport of acidity and loads of iron and aluminum from Rowe Tunnel, averaging 290 and 30 pounds per day, respectively.

Pre-Project Water Quality

Water quality data collected at 49 stations by BMR, Skelly and Loy Engineering Consultants, and the Northern Swatara Creek Watershed Association (NCSWA) volunteers from previous investigations were used to help document stream conditions and identify problem areas prior to installation of passive treatment systems. Data from these previous investigations included analysis of typical CMD; metals, major ions, acidity, and alkalinity.

The data indicated that a substantial proportion of the total streamflow originates as CMD. The investigations also revealed that the majority of the aluminum load to the stream originates from the eastern areas of the watershed upstream from Route 209 near Newtown (sites A, B, and C, Fig. 40) and the majority of the iron load originates from western areas of the watershed, including the Rowe Tunnel and Tracy Airhole which are significant sources of water to Lorberry Creek and Good Spring Creek, respectively.

Water Quality Objectives

The objectives of the project are:

- Design, install, and evaluate the performance of innovative passive-treatment systems for neutralization of CMD and removal of iron from an anthracite mine-tunnel discharge feeding a 4.01 mi^2 subbasin.
- Evaluate the long-term effects on stream water quality from a combination of limestone passive-treatment systems designed to neutralize CMD and remove aluminum in a 2.8 mi^2 subbasin.
- Determine the long-term cumulative effects of a variety of CMD treatments on stream water quality resulting from the remediation of approximately 25 miles (67 percent) of degraded streams in the coalfields of the 43 mi^2 northern Swatara Creek watershed.

Project Time Frame

1998-2001
2002-2007 (extension)

PROJECT DESIGN

Nonpoint Source Control Strategy

Downstream monitoring is critical in evaluating the overall success of watershed-scale implementation of NPS pollution controls within the Swatara Creek watershed. Each passive treatment system has different advantages and disadvantages; however, all suffer from possible complications associated with variability in flow rates, chemistry of the CMD and stream water, and from uncertainties about efficiency and longevity of the treatments. An evaluation of chemical and physical factors affecting reactions within passive treatment systems is needed to resolve uncertainties about the optimum designs and appropriate uses of these systems.

During 1996, BMR and volunteers constructed five limestone based passive-treatment systems with technical assistance from the USGS to begin the cleanup of several major pollution sources in the Swatara Creek headwaters. These treatment systems included limestone sand dosing, open limestone channels, limestone drains, and limestone diversion wells. Limestone sand dosing and open limestone channels are the simplest treatment systems where limestone fragments are added directly to the stream channel semiannually or less frequently. Slow dissolution rates, armoring, burial, and transport of limestone from the channel during high flows are concerns. A limestone drain is another relatively simple treatment method, which involves the burial of limestone in airtight trenches that intercept acidic discharge water. Keeping carbon dioxide within the drain can enhance limestone dissolution and alkalinity production. Furthermore, keeping oxygen out of contact with the discharge water minimizes the potential for oxidation of dissolved iron and the consequent precipitation of solid iron hydroxide [$Fe(OH)_3$], which could armor the limestone and clog the drains. In a limestone diversion well, acidic water is diverted from upstream points and the hydraulic force of the piped flow is deflected upward through limestone fragments inside 4-ft diameter "wells." Hydraulic churning abrades the limestone forming fine particles and preventing the buildup of hydroxide armoring.

Samples will be taken at baseflow and stormflow conditions to determine the effectiveness of the limestone treatment systems. These treatments intend to raise the pH and alkalinity, facilitating the precipitation of dissolved iron, aluminum, and associated metals. Results from the characterization of Lorberry Creek and a dosing field test will be used to design an innovative passive-treatment system to neutralize the CMD and reduce the iron loads. A combination of underground and above ground treatment alternatives will be considered. The combination will include physical, chemical, and biological treatments. Examples of underground treatments that may be considered include fly ash or limestone injection and aeration; while above ground treatments may include diversion wells, settling ponds, wetlands, clarifiers, and biological treatment.

On the basis of the testing described above, an innovative semi-passive treatment system involving limestone diversion wells, a hydraulically powered auger and hopper for caustic chemical delivery, and a 4-cell wetland were designed and installed in 2001-2002 below the Rowe Tunnel on Lorberry Creek. Monitoring and testing of various caustic reagents and delivery rates are ongoing to determine its optimal configuration.

Project Schedule

Management Unit	Pre-BMP Monitoring Dates	BMP Implementation	Post-BMP Monitoring Dates	BMPs
Watershed Area E (Lorberry Creek)	1993-May 1995 1993-Mar. 1999	Feb. 1995-ongoing Mar. 1999-Dec. 2001	Mar. 1996-Mar. 2007 Mar. 2001-Mar. 2007	Limestone sand dosing, Diversion wells, Limestone drains, Wetlands

Water Quality Monitoring

Combinations of upstream-downstream and before-after sampling schemes are being utilized within the northern Swatara Creek watershed. Within stream reaches where passive treatment systems have been established, upstream and downstream monitoring stations have been installed to evaluate the effectiveness of these treatment alternatives. Monitoring stations have also been established on streams within the project area where treatment systems will be implemented in the future. Samples collected from these stations before the implementation of BMPs will be used to assess existing water quality conditions and determine appropriate treatment designs. After treatment systems have been installed, samples will continue to be collected to assess changes in water quality over time due to BMP implementation.

Variables Measured

Biological

Fish surveys
Benthic macroinvertebrates

Chemical and Others

Acidity
Alkalinity
Aluminum
Arsenic
Barium
Cadmium
Calcium
Chloride
Chromium
Cobalt
Copper
Dissolved oxygen (DO)
Iron
Lead
Lithium
Magnesium
Manganese
Nickel
pH
Potassium
Selenium
Silica, as SiO_2
Sodium
Solids, suspended
Specific Conductance
Strontium
Sulfate, as SO_4
Zinc

Covariates

Redox potential
Discharge
Temperature
Streamflow or discharge rate

Sampling Scheme

Three USGS streamflow gages, Swatara Creek at Ravine (D1, Fig. 40), Swatara Creek at Pine Grove (D2, Fig. 40), and Swatara Creek at Newtown (C3, Fig. 40) are used as continuous streamflow and water-quality monitoring stations on the main stem of Swatara Creek. Two additional gages on Lorberry Creek at Mollystown (E2, Fig. 40) and below Rowe Tunnel (E-244, Fig. 40) also are equipped for continuous streamflow and water-quality monitoring. These stations are sampled periodically by the USGS to document and evaluate both the efficiency of a combination of limestone passive-treatment systems, and the long-term water quality changes in the Swatara Creek watershed that result from upstream coal-mine discharges and CMD cleanup.

Within the first year of monitoring on Lorberry Creek (March 1998 - February 1999), water-quality data will be collected monthly. During this same period, fish and benthic macroinvertebrate data will be collected annually upstream (E1, Fig. 40) and downstream (E2, Fig. 40) of surrounding lands that potentially could be utilized for passive treatments. Continuous water-quality monitors also will be installed near E2 (Fig. 40) to correlate water-quality and flow measured at a continuous streamflow record gaging station operated by OSM at the Rowe Tunnel entrance. Once the characterization of Lorberry Creek is complete in March 1999, a treatment system (based upon the acid and iron loads and iron oxidation rate) will be implemented in Lorberry Creek upstream from the junction with Swatara Creek.

Beginning in October 1998, base-flow and high-flow water-quality samples were collected using manual methods at four of the ungaged monitoring stations (A3, B3, C6, and C9, Fig. 40) established during the existing program and quarterly at three new synoptic stations where CMD treatment is expected under other current and proposed 319 projects. The samples will be used to determine system performance under variable flow conditions and to evaluate the long-term treatment effects on water-quality of a combination of limestone passive-treatment systems.

Water quality samples will be collected monthly for base flow, quarterly for stormflow, and annually for biological data at the downstream gages (D1 and C3, Fig. 40) as part of this proposed project. Sampling will determine the long-term cumulative effects from a variety of treatments of CMD discharges from degraded streams in the coalfields of the northern Swatara Creek subbasin. Stormflow samples will be collected using automatic pumping samplers. Annual load and trends in transport of suspended sediments, sulfate, metals, and nutrients will be estimated using a multivariate regression model. Data for continuous water-quality and flow records at stations D1 and C3 (Fig. 40) will be compared with data for synoptic base-flow and high-flow samples to verify that samples represent the range of flow and water-quality conditions. Statistical methods will be used to characterize the flow and water-quality data and to determine intercorrelations among the hydrological and chemical variables.

Concurrent with water-quality sampling, measurements of streamflow, temperature, pH, specific conductance (SC), dissolved oxygen (DO), redox potential (Eh), acidity, and alkalinity will be conducted by USGS. Water-quality samples will be analyzed for major ions and metals in filtered and whole-water fractions by the PaDEP Bureau of Laboratories facility in Harrisburg (1996-2001) and the USDOE Laboratory in Pittsburgh (2001-2007). In addition to the synoptic sampling, flow rates, temperature, pH, and SC, at two stream gages (D1 and C3, Fig. 40) will be monitored continuously by the USGS during the three years after BMP implementation (1998-2000). Statistical correlations will determine if SC and pH can be used as surrogates for laboratory chemical measurements of sulfate, metals, acidity, and alkalinity.

Monitoring Scheme for the Swatara Creek Section 319 National Monitoring Program Project

Design	Sites or Activities	Primary Parameters	Covariates	Frequency of Water Quality Sampling	Frequency of Biological Assessment	Duration
Upstream/ Downstream	E (Lorberry Creek)	SS, Fe, Al, SO_4, fish survey, benthic macroinvertebrates	Discharge Precipitation	Storm sampling, Monthly grab, Continuous temperature, SC, pH	Yearly for benthic macro-invertebrates and fish surveys	2 yrs pre-BMP 1 yr BMP 3 yrs post-BMP

Land Treatment Monitoring

Changes in land-use over the project duration are not expected to be significant.

Sampling Scheme

Changes in land-use over the project will be assessed by considering available aerial photography and digital orthophotoquads in conjunction with information from the PaDEP about completed land-reclamation and coal-mining projects.

Modifications Since Project Start

For 2003-2007, laboratory services will be provided by a commercial laboratory and administered by Schuylkill Conservation District.

Progress to Date

The testing of innovative passive-treatment systems began in March 1996 with assistance from the U.S. Department of Energy (USDOE) and PaDEP. Water-quality and flow data will be collected monthly and biological data annually at stations E1 and E2 (Figure 2) throughout the project to monitor the effectiveness of the treatment system(s) for the removal of dissolved and suspended metals, and rates of removal over variable flows.

Limestone sand, which can dissolve rapidly because of its small size (<1/8 inch), was dumped into Coal Run (14 tons) between stations C4 and C6 (Fig. 40) on September 4, 1996, and into Lorberry Creek (150 tons) below station E2 (Fig. 40) on February 13-14, 1997. An open limestone channel was constructed within a 110-ft long segment of Swatara Creek at station B2 (Fig. 40) on March 21, 1997. A total of 44 tons of sand-size fragments and 70 tons of larger fragments (1-4 inches) were installed as a series of alternating berms extending part way across the 15-ft-wide channel from opposite sides of the stream.

Limestone drains were constructed on March 15, 1995, at station E3 (Fig. 40) to treat a small acidic discharge (10-30 gpm, oxic inflow; 44 tons limestone) along Lower Rausch Creek. On May 21, 1997, limestone drains were constructed at station A1 (Fig. 40) to treat a larger discharge (50-200 gpm, anoxic inflow; 400 tons limestone) at the headwaters of Swatara Creek. On June 10-27, 2000, a large, oxic limestone drain was constructed on Hegins Run at station H1 (Fig. 40) to treat a large, low-pH, high aluminum discharge (100-500 gpm; 900 tons limestone). These larger systems were designed on the basis of results for the smaller system where pH increased from 3.5 to 6.5 through the drain during the < 3-hour residence time.

On November 14, 1995, a pair of diversion wells was installed to treat water diverted from Swatara Creek at station C2 (Fig. 40). On July 13, 1997, a single diversion well was installed to treat water from Martin Run at station C8 (Fig. 40). In December 1998, a pair of diversion wells was installed on Lorberry Creek below Rowe Tunnel. Approximately 1 ton of limestone is consumed weekly by each operating diversion well. Diversion wells can be installed in series to treat large flows, but must be maintained by frequent refilling with fresh limestone. Furthermore, the diversion wells only add alkalinity and increase pH, facilitating the precipitation of dissolved metals; however, they do not remove particulate iron and other metals.

In December 1997, near the mouth of Lower Rausch Creek at station E3 (Fig. 40), a 3-acre compost-limestone based wetland was constructed to remove iron from near-neutral streamflow. In December 2001, near the confluence of Stumps Run and Lorberry Creek at station E2 (fig. 40), a 3-acre wetland was constructed to remove iron from treated water exiting two limestone diversion wells below the Rowe Tunnel discharge. In addition, a large hydraulically powered hopper has been installed to deliver hydrated lime, waste lime, or other alkalinity-producing materials and supplement alkalinity production by diversion wells needed for iron oxidation and particle removal. Ongoing tests conducted since 2002 coupled with monitoring at the wetlands and along Lorberry Creek are being conducted to determine optimal operating conditions for the hopper delivery of reagents, the removal of iron by the wetlands, and the corresponding effects on quality of Lorberry Creek and Swatara Creek.

DATA MANAGEMENT AND ANALYSIS

Data Management and Storage

Data collected for the project will be maintained in the USGS NWIS data base. The water-quality and streamflow data will be published annually in the USGS Water Resources Data Report.

NPSMS Data Summary

Updates to the Nonpoint Source Management System (NPSMS) will be provided annually to the U.S. Environmental Protection Agency and a two or three page annual progress summary will be provided to PaDEP.

Findings to Date

Preliminary results indicate that the constructed treatment systems function well during baseflow conditions. The anoxic limestone drain (A1 in Fig. 40) near the headwaters of Swatara Creek has the greatest benefit, producing significant improvement in pH and alkalinity that are measurable several miles downstream. The diversion wells have greatest potential to treat stormflow, which generally is more acidic than baseflow, however, these systems require maintenance to ensure that they contain sufficient limestone through the duration of a stormflow event and that they do not become clogged with leaves and other debris. At near-neutral pH, the transport of dissolved iron, aluminum, and trace metals including cobalt, copper, lead, and zinc typically is attenuated owing to precipitation and adsorption. Wetlands installed at various locations on tributaries and at CMD sources have demonstrated their effectiveness at reducing metals transport to the main stem of Swatara Creek. Nevertheless, substantial transport of dissolved and suspended metals persists in Swatara Creek because of the long-term accumulation of $Fe(OH)_3$, $Al(OH)_3$, and associated materials within the streambed during baseflow, and the scour and transport of accumulated metal-rich streambed deposits during the rising stage of stormflow events.

At Ravine, immediately downstream of the mined area, annual minimum values of pH have increased from acidic to near-neutral over the study period, and the fish community has rebounded from nonexistent in 1990 to 25 species in 2002. An increased abundance of benthic macroinvertebrate taxa that are intolerant of pollution indicates water quality improved from fair in 1994 to very good in 1999 and 2000.

INFORMATION, EDUCATION AND PUBLICITY

The project will document: 1) the surface-water quality of Swatara Creek and its tributaries within and downstream from the southern anthracite coalfield, 2) aquatic habitat recovery and biological diversity in reaches downstream from treatment, and 3) the operational performance of the treatment systems. Knowledge about factors affecting the performance of passive treatment systems in CMD environments will help in designing cost-effective treatment systems for a variety of situations. The information and technology will be immediately transferable to groups such as the Eastern Coalition for Abandoned Mine Reclamation. This group would benefit from the fact that several treatment scenarios and a wide range of flow-rate and water-quality conditions will be studied at Swatara Creek that are applicable to other watersheds in the anthracite region. Project results also will be applicable to natural and man-made hydrologic systems in which limestone is an important reactant, particularly with respect to neutralization of acidic surface water or ground water.

Documentation of progress is ongoing, and will be distributed to interested groups, local and national. Information of particular interest to local groups includes the methodology used in improving surface-water quality within the watershed (degree of success with treatment systems), remediation of aquatic habitat and biological diversity both within and downstream of the affected area, and the project's extensive degree of flow-rate and water-quality studies. Preliminary results will be presented annually at the National Monitoring Program workshop. Data will be published annually, interpretive reports will be published as journal articles and presented at regional and national meetings, and a final interpretive report will be published in 2007.

TOTAL PROJECT BUDGET

The estimated total cost of the project for 1999-2002 is $670,000 (see previous years NMP Summary Reports for this project for budget details). The estimated total cost of the project for 2003-2007 is $967,340. The USGS and PaDEP will share costs. Laboratory services will be provided by USDOE.

IMPACT OF OTHER FEDERAL AND STATE PROGRAMS

The Schuylkill County Conservation District (SCCD) has been the main coordinator in constructing the abatement measures for the mine drainage pollution, as well as nutrient management and stream-bank stabilization in the farming areas. The SCCD has helped local citizens organize the Northern Swatara Creek Watershed Association (NSCWA) to implement passive-treatment and surface-stabilization projects to clean up the coal-mine pollution in the northern portion of the watershed. The Swatara Creek Watershed Association, a separate organization, has worked hand-in-hand with the Concerned Citizens for Clean Water, and has focused its efforts in the past in Lebanon County and the lower part of the watershed. Other local groups assisting with the project include Schuylkill County, fishing and sportsman's groups, and, in particular, the county's Waste Management Coordinator, who has been instrumental in seeking funding for stream improvement projects.

Local industries have been supportive of the project. Coal companies and limestone quarries have donated supplies and services in the cleanup effort.

PROJECT TASK	FEDERAL FISCAL YEAR					TOTAL
	FY2003	FY2004	FY2005	FY2006	FY2007	
Project Management	$8,088	$5,731	$6,014	$6,311	$6,623	$32,767
Maintenance of Gages	$38,807	$33,774	$34,948	$36,181	$23,238	$166,948
Lorberry Monitoring/Data Mgt.	$43,403	$45,398	$47,492	$49,691	$27,035	$213,019
N.Swatara Monitoring/Data Mgt.	$22,369	$23,447	$24,577	$25,765	$21,289	$117,447
Lorberry Lab Analysis	$22,313	$23,428	$24,600	$25,830	$14,231	$110,402
N.Swatara Lab Analysis	$10,756	$11,294	$11,859	$12,452	$9,764	$56,125
Annual Ecological Surveys	$5,695	$5,972	$6,264	$6,570	$6,892	$31,393
Annual Data Report	$10,391	$10,910	$11,456	$12,028	$12,630	$57,415
Presentations, Interim & Final Report	$19,966	$27,867	$40,367	$30,551	$63,073	$181,824
TOTAL:	$181,788	$187,821	$207,577	$205,379	$184,775	$967,340
Contributions:						
USGS	$55,000	$57,750	$60,638	$63,669	$66,853	$303,910
PaDEP	$104,475	$106,643	$122,339	$115,880	$103,691	$553,028
USDOE	$22,313	$23,428	$24,600	$25,830	$14,231	$110,402

OTHER PERTINENT INFORMATION

None.

PROJECT CONTACTS

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