SCHUYLKILL CONSERVATION DISTRICT

1206 AG CENTER DRIVE

POTTSVILLE, PA 17901

MARCH 24, 2008

AUDENREID MINE TUNNEL AMD TREATMENT SYSTEM

FINAL REPORT

DOCUMENT # 4100021568

Table of Contents

1. Project Overview

The Audenreid Mine Tunnel Discharge is located within the Catawissa Creek Watershed approximately 2 miles east of the town of Sheppton in Schuylkill County, Pennsylvania. The Audenreid Mine Tunnel Discharge is the largest abandoned mine drainage (AMD) discharge within the Catawissa Creek Watershed. Monitoring has shown average water quality of the Audenreid discharge to be: pH 4.03, alkalinity 2.31 mg/l, acidity 68.08 mg/l, iron 0.70 mg/l, aluminum 7.93 mg/l, and sulfates 136.25 mg/l, with an average flow of 8,478.40 gpm. The Audenreid Discharge is located in the very headwaters of the Catawissa Creek, and impacts the entire watershed.

On March 1, 2002, the Schuylkill Conservation District received a Pennsylvania Association of Conservation District Technical Assistance Grant to develop a conceptual design, estimate of probable construction costs, and site survey for the Audenreid Treatment System. Also, the CCRA received an additional Technical Assistance Grant from Stream Restoration Inc./Hedin Environmental to provide technical oversight of the conceptual design.

In January 2004, the Schuylkill Conservation District was awarded a Pennsylvania DEP Nonpoint Source Management Program grant to complete both the final engineering and construction portion of the project. Following the awarding of the DEP grant, the access road to the construction site was improved, geotechnical surveying was completed, permits were submitted, final engineering was completed, and the construction contract was competitively bid and awarded. Construction of the treatment system commenced in March 2005 and was completed in December 2005. The System was officially dedicated on June 17th, 2006.

The Audenreid Mine Tunnel Discharge treatment system is responsible for treating the discharge and improving the entire Catawissa Creek watershed. The pollution reductions coincide with recommendations for reduction published in the Catawissa Creek watershed TMDL. The treatment system is restoring 36 miles of the Catawissa Creek. The remediation of the Audenreid Mine Tunnel Discharge will potentially result in the removal of the Catawissa Creek from DEP's 303(d) List of Impaired Waterways.

2. What was the project supposed to accomplish?

The specific goals of the Audenreid project are to:

1. Treat and improve the water quality of the Audenreid Mine Tunnel Discharge.
2. Implementation and evaluation of a passive treatment system to treat the Audenreid Mine Tunnel Discharge, and relate that knowledge to other mine drainage treatment projects.
3. Reduction in the aluminum, iron, and manganese loadings from the Audnereid Mine Tunnel Discharge into the Catawissa Creek.
4. Increase in the pH and alkalinity of the Audenreid Mine Tunnel discharge.
5. Produce water quality improvement to the Catawissa Creek downstream of the Audenreid Mine Tunnel discharge

The primary goal of the project is to restore, to the greatest extent possible, the water quality and quantity of the Catawissa Creek Watershed to natural conditions by designing and installing a passive treatment system. The success of the project is measured by increases in pH and alkalinity, reduction in dissolved aluminum in mainstem Catawissa Creek, and colonization by macro invertebrates.

Long term, the goal of the project is to eventually remove the Catawissa Creek Watershed from the 303(d) List of Impaired Waters. The Audenreid project, which is the top priority in the Catawissa Creek Restoration Plan, will significantly increase the possibility of achieving this goal. Other items that may need to occur before this can fully be accomplished includes the construction of appropriate passive treatment technology systems on other tunnel discharges; restoration of stream channels destroyed by mining activities; and reclamation and restoration of land surfaces impacted by Mining; and the removal of culm banks to reduce sedimentation and erosion and improve water quality and quantity.

3. What you actually did and how it differs from your plan?

The Audenreid Mine Tunnel discharge treatment system was modeled after a similar passive treatment system to one that was used at the Oneida #1 discharge, which had similar water quality conditions. This project involved the construction of a modified limestone drain passive treatment system. The Audenreid Mine Tunnel discharge required innovations to a conventional passive treatment system because of the high-volume discharge and the presence of aluminum. A conventional system would have been cost-prohibitive and area intensive.

System's operation

The innovative passive treatment system utilizes new technologies and design features to treat the high flows of the Audenreid discharge. The water is collected from the discharge through a unique intake system. The water flows out of the mine tunnel into a buried collection system that utilizes stormtech chambers to divert the water into a distribution tank. The intake system allows the water to flow up through a bed of rock to the stormtech chambers, which then directs the water through a 36" pipe into the distribution box. The distribution box then evenly distributes the water into three individual lines to each treatment tank. The specific design of the intake system can be found in the project design documents.

After the water is distributed to the three concrete tanks, the treatment of the water begins. The innovative passive treatment system utilizes new technologies and design features to treat the high flows of the Audenreid discharge. The discharge water is diverted into a series of three, 12' high and 120' wide, circular concrete treatment cells filled with limestone. Once inside these cells, the discharged water reacts with high calcium limestone, which raises the pH of the water and allows the metals to precipitate out of solution. Prior to the placement of limestone, the material was tested by a third party laboratory for purity and results reviewed by the Schuylkill Conservation District to insure that it meets the minimum requirements. Each treatment cell contains about 4,600 ton of limestone and provides about 2 hours of retention time.

Given the likelihood that the accumulation of aluminum hydroxide could plug the treatment system, automatic siphoning systems were installed on each tank. About every 1.5 hours, the treatment tanks are automatically flushed by a series of automatic siphons into a large settling

pond that receives the aluminum precipitate. The water then flows into a second settling pond/wetland to provide final polishing before it is returned to the creek.

Scope of work

Scope of work for this project included detailed surveying and site mapping (both land and geotechnical), final engineering, competitively bidding, access road rehabilitation, system as-built plans, and completion of an operations and maintenance manual.

In order to construct the treatment system, an access road had to be constructed to allow for access into the project site. The construction entrance was competitively bid and constructed in the fall of 2004. The treatment system construction commenced in April, 2005 and was completed in early 2006. Following its completion, extensive system testing took place the system was gradually put online for full operation.

On June, 17th, 2006, the system was formally dedicated and put into full operation.

Project Deliverables

- Site mapping, survey, and evaluation
- Preliminary design alternatives
- Final design, permitting package, and construction bid package
- System as-built plans, operations & maintenance manual
- Completed AMD passive treatment system with water quality monitoring information to effectively evaluate the treatment system and its functionality

The final product of the plan is very much in-line with the original proposal and scope-of-work. Since this project involved final engineering, some project elements of the conceptual design were modified or added, but this was an expected outcome of the project.

Additionally, unique site conditions and severe weather resulted in slight modifications to the original scope-of-work. In Late January 2006, high flows were measured at the Audenreid discharge and some modifications needed to be made to the intake system. Additionally, runoff occurring directly above the discharge posed a threat to the intake system. Additional swales and water diversion items were installed upslope of the intake system to prevent future damage.

4. What were your successes and reasons for your success?

The project has been successfully completed, and resulted in the construction of a treatment system for the largest AMD discharge in the Catawissa Creek Watershed. This treatment system is the largest system in Pennsylvania, and possibly one of the largest ones in the world. Completing this project required innovative thinking that would overcome design challenges posed by both the site characteristics and overall size the discharge.

The limited footprint available for building the system was something that posed a challenge from the start. A conventional limestone drain would have required a much larger footprint due to the high average flow from the discharge. To overcome this obstacle, three concrete tanks were constructed as the limestone cells for the drain. These tanks, 120' wide x 12' high, were never utilized before in an AMD system built in Pennsylvania. The tanks were modeled after concrete manure storage tanks typically utilized in the agriculture industry. This method worked successfully and is currently being replicated in the design of other treatment systems in the Anthracite coal field.

The location of the site, secluded on private land, also posed a design challenge. Since the system requires regular flushing, it was necessary to install an automatic flushing component to the system. 3 sets of 3 individual siphons (9 total) were installed in the system. These siphons flush regularly, every 3-4 hours, and allow for the removal of Al precipitate in the concrete cells. These siphons are innovative as they are much larger than any siphoning system installed on other AMD treatment systems. The siphons continue to undergo tweaking to meet the current flushing needs of the system. It is anticipated that these siphons will greatly reduce the need for manual operations of the treatment system and add to the life and overall effectiveness of the system.

5. Water Quality Improvement Data

The system was disabled in June 2006 due to a flooding event which damaged the treatment system's intake system which impaired the system's ability to function as designed. Data pertaining to treatment system effectiveness is limited since the system operated a short period of time (about 6 months) before the flood damage occurred. Some water quality data was collected while the system was in operation but may not be representative of treatment effectiveness due to the small number of samples collected before the flood damage occurred.

BAMR collected water quality samples from the Cattawissa Creek at the Phinneyville bridge from 1997 through 2001 (Table 1). Cattawissa Creek water samples had an average pH of 4.4 with a pH range of 4.1 to 4.7 from 1997 through 2001 (Table 1). Aluminum (Al) concentration ranged from 2050ug/l to 6780ug/l during the sample period with an average Al concentration of 3655 ug/l. Total acidity in the Cattawissa Creek ranged from 16mg/l to 50mg/l with an average total acidity of 29.4 mg/l while total alkalinity ranged from 0mg/l to 1.6mg/l with an average total alkalinity of 0.2mg/l.

Table 1. Raw water quality parameters on the Cattawissa Creek at Phinneyville bridge which is downstream of the Audenreid Discharge for various dates between 1997 and 2001 with averages for each water quality parameter.

Date	Flow (CFS)	pH	T Alk	SO4	Fe (total)	Fe2	Mn	Al	T Acid
			mg/l	mg/l	ug/l	ug/l	ug/l	ug/l	mg/l
2/13/1997	N/A	4.3	0	47	263	220	909	3530	32
3/13/1997	56.46	4.5	0	43	177	110	712	2480	24
3/27/1997	55.41	4.5	0	32	181	140	702	2620	22
4/7/1997	N/A	4.5	0	28	313	120	563	2050	16.2
4/23/1997	32.50	4.5	0	29	183	140	797	2790	28
5/20/1997	40.39	4.5	0	38	240	170	667	2360	18.6
6/24/1997	24.22	4.3	0	66	222	120	1140	3980	30
7/24/1997	N/A	4.7	1.6	54	482	210	957	2770	24
9/18/1997	15.29	4.4	0	85	92	60	1810	6110	46
10/16/1997	12.63	4.3	0	69	152	130	1630	5650	44
11/13/1997	13.88	4.3	0	70	169	100	1660	5400	38
1/21/1998	67.40	4.5	0	40	202	80	766	2770	22
4/6/1998	56.11	4.5	0	51	243	110	903	3500	28
7/6/1998	13.00	4.4	0	73	286	140	1270	4590	38
10/6/1998	9.48	4.1	0	122	307	220	1940	6700	50
2/2/1999	N/A	4.6	1.2	31	381	270	606	2350	16
4/14/1999	56.50	4.6	0.8	37	286	130	629	2250	18
11/4/1999	42.60	4.3	0	82	274	50	1170	4320	34
2/1/2000	N/A	4.2	0	68	247	150	1100	3880	32
4/13/2000	N/A	4.5	0	37	181	90	618	2240	26
7/13/2000	32.07	4.3	0	51	222	120	1000	3330	28
10/3/2000	13.18	4.1	0	90	307	140	1930	6780	48
1/11/2001	24.87	4.3	0	50	213	130	1010	3150	26
4/24/2001	56.09	4.5	0	46	170	<20	660	2130	16.4
Average	34.6	4.4	0.2	55.8	241.4	137.0	1047.9	3655.4	29.4

BAMR sampled the Audenreid Mine Tunnel several times after the completion of the project in December 2006 (Table 2 & 3). The data for sample dates 03/29/2006 and 06/05/2006 show an improvement in pH, Al, Fe, alkalinity, acidity between the discharge and the outflow of the settling pond (Table 2 &3). A decrease in concentrations of Fe, Al, and Mg was observed in the settling pond outflow compared to Fe, Al, and Mg concentrations in untreated discharge water before treatment (Table 2&3). Increases in pH and alkalinity while a decrease in hot acidity was observed in the samples taken at the discharged compared to the outflow of the settling pond. Although data is lacking after treatment system completion it appears when comparing data at Phinneyville bridge site both before (Table 1) and after (Tables 2&3) treatment system completion that water quality in the Cattawissa Creek improved.

Table 2. Sample parameters for the Audenreid Discharge Treatment System. * samples on 12/19/06 were taken after damage occured to the treatment system in June 2006 due to flooding events.

Date	Location	T. Iron	Alkalinity	T. Manganese	Hot Acidity
		ug/l	mg/l	ug/l	mg/l
3/29/2006	Audenried Disc.	358	1.6	1830	63.8
3/29/2006	Outlet of Settling Pond	<300	8	1470	24.2
3/29/2006	Cattawissa upstream of Audenried	<300	7	111	6.6
6/5/2006	Audenried Disc.	452	2.6	1730	41.6
6/5/2006	Outlet of Settling Pond	182	8.6	1490	11.4
6/5/2006	Cattawissa upstream of Audenried	293	7.2	104	2.6
6/5/2006	Cattawissa @ Phinneyville	140	7.4	597	6.8
6/14/2006	Cattawissa @ Phinneyville	127	0	957	6
12/19/2006*	Cattawissa @ Phinneyville	222	0	829	63

Table 3. Sample parameters for the Audenreid Discharge Treatment System. * samples on 12/19/06 were taken after damage occured to the treatment system in June 2006 due to flooding events.

Date	Location	T. Aluminum	Lab pH	Field pH	T. Sulfate
		ug/l		mg/l	mg/l
3/29/2006	Audenried Disc.	6130	4	n/a	167.1
3/29/2006	Outlet of Settling Pond	3555	5.2	n/a	161.4
3/29/2006	Cattawissa upstream of Audenried	<500	5.4	n/a	<20
6/5/2006	Audenried Disc.	5280	4.1	4.2	99.7
6/5/2006	Outlet of Settling Pond	3100	5	5.2	134.8
6/5/2006	Cattawissa upstream of Audenried	313	5.3	5.5	<20
6/5/2006	Cattawissa @ Phinneyville	1080	5.1	5.4	40.7
6/14/2006	Cattawissa @ Phinneyville	1725	5.1	n/a	76.4
12/19/2006*	Cattawissa @ Phinneyville	2909	4.6	n/a	56.5

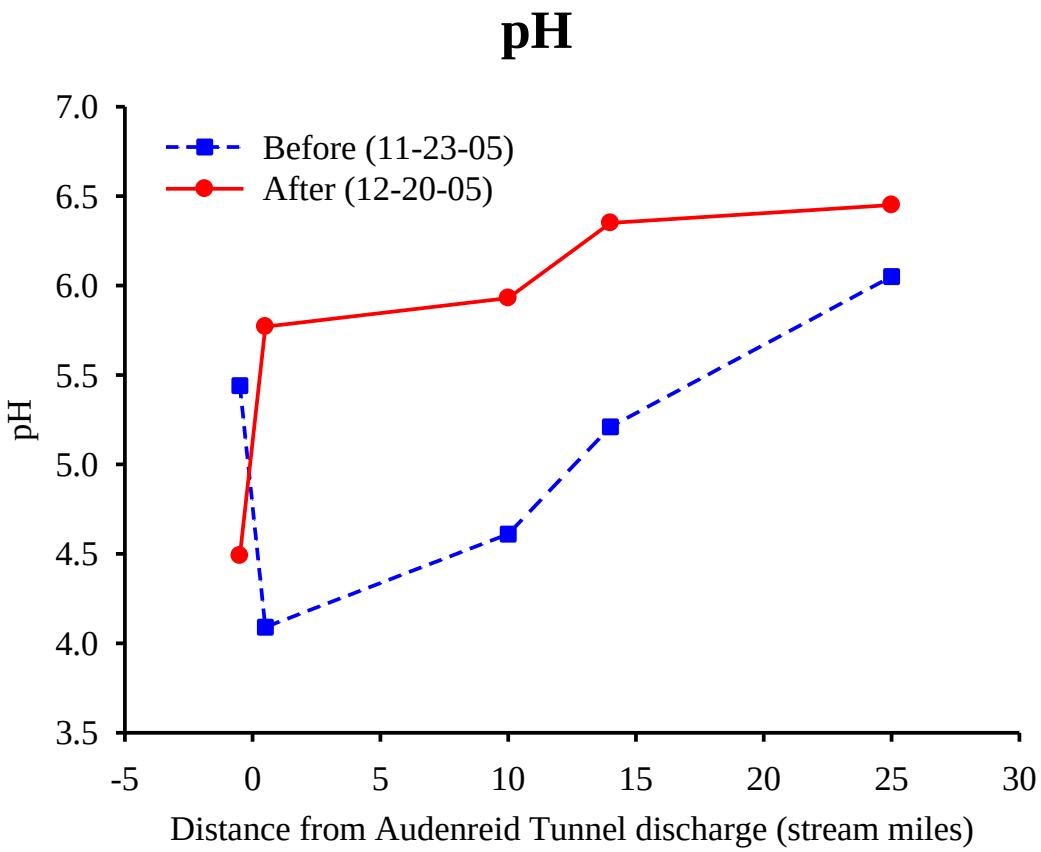

Figure 1. pH at various sampling points (stream miles) along the Cattawissa Creek before and after construction of the Audenreid Treatment System.

Further sampling of the system will be completed once repairs to the system are completed. Funding to repair the damages caused by the June 2006 flooding were acquired through FEMA and all repairs are scheduled to be completed by June 30th, 2008. In-kind sample analysis will be provided by BAMR once the system has been repaired.

6. Project Partners

The Success of the project was largely made possible through the coordinated efforts of project partners. The project was overseen by a group of representatives from local, state, and federal agencies and nonprofit organizations. Individual representation included the U.S. Office of Surface Mining (OSM), Catawissa Creek Restoration Association, Schuylkill Conservation District, Columbia County Conservation District, DEP/Pottsville District Mining Office, DEP/Bureau of Watershed Conservation, DEP/Bureau of Abandoned Mine Reclamation, EPCAMR-Eastern PA Coalition for Abandoned Mine Reclamation, OSM, SRBC- Susquehanna River Basin Commission, PACD- PA Association of Conservation Districts, NRCS- Natural Resources Conservation Service, PFBC- PA Fish & Boat Commission, Hedin Environmental (consultant), and RETTEW (engineering contractor). This group, which served as the technical steering committee, assisted with the review of professional services, design oversight, and construction oversight.

Some of the individual partner actions that led to the project's success include the following. Funding for watershed restoration and environmental education efforts in the Catawissa Creek watershed has been provided by the EPA Environmental Education, Brownfields Initiative, and Section 319 programs; OSM Appalachian Clean Streams Initiative, Summer Internship, and Title IV AML programs; PA DEP Growing Greener Environmental Stewardship/Watershed Protection and Technical Assistance Grant (TAG) Programs; and the EPCAMR Regional Watershed Support Initiative. The U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) provided technical assistance in remediation site review, survey and design and through the Rural Abandoned Mine Land Program. The U.S. Geological Survey provided projection of parameters for design, monitoring, and technical expertise. The PA DEP Bureau of Abandoned Mine Reclamation (BAMR) provided engineering assistance, flow, and water quality data and reclaimed hundreds of acres in the watershed. BAMR is planning to fund construction of additional land and stream channel reclamation activities in the watershed worth approximately $5 million over the next several years. PA DEP Bureau of Dams & Waterways Engineering provided technical assistance on permitting and wetlands identification and delineation. The PA DEP Bureau of Watershed Management assisted in providing EPA Section 319 and other funding for mine drainage abatement projects. PA DEP Bureau of Mining and

Reclamation contributed historical mining data and Scarlift Reports. PA DEP District Mining Operations Pottsville Office coordinated and assisted with data collection, acquiring funding for abatement projects and working with the local community, encouraged re-mining, provided technical assistance and project design. The PA Fish & Boat Commission conducted aquatic surveys and water monitoring. The PA Association of Conservation Districts and Hedin Environmental consultants provided technical assistance for conceptual design and engineering through Growing Greener Technical Assistance Grants. The Schuylkill County District (SCCD) provided technical assistance in project design, coordinating water quality improvement efforts, data collection, and in acquire funding. Columbia and Luzerne County Conservation Districts provided support and publicity. Municipalities and agencies in Schuylkill, Columbia, and Luzerne Counties assisted with identification of landowners, seeking funding for stream improvement projects and in project design. Beaver Township, Ringtown Fire Hall, Brandonville Fire Company, and Catawissa American Legion hosted public meetings. The Susquehanna River Basin Commission and Bloomsburg University assisted with biological studies, monitoring, GIS mapping, and research. The Wildlands Conservancy, North Central PA Conservancy and the Schuylkill County Conservancy provided assistance with landowner consent, acquisition, lease, and easements. Watershed restoration efforts have received strong endorsements from U.S. Congressmen Paul Kanjorski and Tim Holden, Pennsylvania Representatives Dave Argall, Todd Eachus, and John Gordner and Pennsylvania Senators Jim Rhoades and Ed Helfrick. Additional support and assistance were provided by many local groups or businesses including the Catawissa Creek Restoration Association, Schuylkill County Trout Unlimited, Eagle Rock Community Association, Con-Lime and Carmeuse Limestone Quarries, Gezunt Nursery, Blue Knob Sportsmen's Club, and Catawissa Municipal Water Authority. Butler Enterprises and PCA Corporation, landowners, and Paragon Adventure Park, land lessee, have given approval for construction of the treatment system.

7. What problems were encountered and how you dealt with them?

The design, construction, and start-up of the treatment system provided little problems to the overall completion of the project. Both design and construction challenges were expected when completing the project, but all issues that arose, which were minimal, were able to be addressed

by the project's technical steering committee and remediated. The greatest problem encountered occurred in June, 2006, just 2 weeks following the system's dedication.

As a result of the Floods of 2006 the influent collection system was nearly destroyed, and sediment clogged the piping in the system disabling the system. The Floods of 2006 also caused a large portion of the end of the Mine Tunnel to collapse due to the high flow rates and back pressure created by placing large boulders in front of the mine entrance to prevent access into the tunnel.

An approximate graphical representation of the extent of the erosion and collapse of the Mine Tunnel opening was completed along with the calculations of the volume of material lost. The calculations were made by assuming the area lost formed a vertical wall and obtaining the area at every other contour. These numbers were then used to calculate volume by average area resulting in a volume of 7,200 cubic yards. This damage caused large amounts of sediment to be washed downstream and into the influent collection system, influent lines and into the treatment cells disabling the treatment system by clogging it with the sediment. As a result of the erosion the Mine Tunnel opening has moved back into the mountain approximately 70 feet toward a dirt road system and has created a nearly 60 foot unstable vertical wall of soil and very brittle rock.
The influent collection system berm was destroyed by the raging flood waters. The constructed berm was approximately 25 feet wide, had a clay core, and was lined with stone found on-site which was approximately R-6 sized. This berm provided a pool over the collection system to allow sufficient head for the water to penetrate into the influent collection system piping.

The emergency spillway on Settling Pond #2 was also damaged by a combination of high flows within Catawissa Creek and overflows of the treatment system. Additionally, a slight curve exists in the Catawissa Creek where the emergency spillway from Settling Pond #2 enters the creek and was bounded by loose soils on the upstream and downstream sides of the spillway, which added to the erosion problem. Erosion at this location resulted in an approximate two-foot deep x 15-foot long eroded area on the upstream side of the spillway.

The original design high-flow rate of 30,000gpm (43.2 mgd or 80.3 cfs) for the treatment system was extremely under reported. The SCD has found a report that recently became available on-line that analyzed the flow rates from the Audenreid Mine Tunnel. The report titled "Mine Drainage Abatement Measures for the Jeansville Basin" was prepared for the Commonwealth of Pennsylvania Department of Environmental Resources by Gannett Fleming Corddry and Carpenter, Inc. and submitted as final to the Department on November 26, 1974. The report identifies the drainage area of the mine tunnel and calculates mine drainage volumes based on assumptions and measured data collected between November 1969 and September 1970. Three different flow rates were calculated in the report; Design Average 18.4 mgd, Design Wet-Weather 24.5 mgd, and Design Maximum 317 mgd, which are based on a 10-year storm. Given this information the Design Maximum was recalculated for the 100-year storm resulting in a flow of 450 mgd (312,500 gpm or 836 cfs).

Immediately following the damage to the system, The SCD met with represenaties of FEMA to assess federal assistance eligibility for the system. It was deemed that the system was eligible for funding, and assistance was made available to the SCD. Repairs are planned to be completed in the Spring of 2008. Significant design modifications to the existing intake area of the system, and compliance requirements imposed by FEMA, are responsible for the extensive length of time between the flood event and repair start date. The estimated damage to the system is nearly $500,000.

The first step in repairing the system will be to stabilize the slope above the tunnel. This will need to be completed before any other work can start due to the possibility of further collapse of the area and a danger to work being completed on the influent collection system. A drainage channel will also be placed just above the tunnel opening to divert any water falling on the slope above the discharge to an outlet below the reconstructed influent collection berm. A channel similar to this existed prior to the flood damage. The slope will need to be stabilized with erosion control blanket to allow the vegetation to germinate and become established. Once the slope is cut back to a safe slope work can begin on stabilizing the Mine Tunnel Opening.

The Mine Tunnel Opening will be kept open to prevent back pressure within the tunnel from creating additional problems. This will be accomplished by excavating back to stable rock and stabilizing with a concrete structure and shot-creting of any exposed rock outside this structure. A pre-cast structure will need to be anchored into place by a method to be determined to prevent the structure from possibly being pushed out of place by high flow rates. The structure will need to be fitted with a gate to restrict individuals from walking into the tunnel. Additionally, the gate will need to allow high flows to pass with little restriction and allow any large debris such as fallen timbers from within the tunnel to pass through the gate. It is thought that a gate hinged at the top and swinging outward from the tunnel would allow debris to pass by the water pressure behind the gate pushing the gate open to release the debris and closing upon release of the debris. The gate will need to be adequately supported, be heavy enough to prevent a person or persons from lifting the gate and be made of stainless steel to prevent corrosion due to the acidic waters exiting the tunnel.

The influent collection system will be reconstructed as it was originally built, modifications to allow high flows to safely pass through the system will be done to the surface of the influent collection system. The modifications will include placing riprap on top of the influent collection system this will prevent the smaller stone from being washed downstream but still allow the water to pass into the collection system. The PVC inspection ports, approximately 2'-6" in length and six-inch diameter, will be encased with stainless steel sleeves to prevent them from being broken off by high flows. The influent collection system berm width will be increased if feasible due to site constrictions; this will reduce the depth of flow over the berm and reduce the erosive effects. The berm will be constructed to the same cross-section complete with the keyed-in clay core but the riprap lining will be grouted in place to make the entire berm one monolithic structure. The reconstruction on the influent collection system will clean and/or repair items such as the valves, manhole, and influent flow chamber. Additionally any piping or other structures which can be salvaged will be, but it is assumed that all piping upstream of Manhole #1 is destroyed and any piping through the berm was damaged. The valves will be cleaned of any sediment and serviced by a manufacturer's representative if necessary. The manhole and influent flow chamber will be cleaned by hand, vacuum devices, and/or mechanical methods.

The erosion at the Settling Pond #2 emergency spillway will be repaired by adding additional riprap to the damaged area. The riprap will be sized to match that in the emergency spillway. The turbulence caused by the water suspected to be flowing over the spillway coupled with the high water level in the creek and slight bend in the creek path caused this erosion. It is believed placing riprap in the eroded area will be enough protection to prevent future erosion at this location.

It is believed that these repairs and mitigation measures will be able to allow the treatment system to be put back into full operation and will prevent future problems with high flow rates such as those experienced in the Flood of 2006. Currently, the treatment system is operating at about 30% capacity.

8. How your work contributed to solution of original problems?

The water quality of the Audenreid discharge has shown an average of 8,478.40 gpm, a pH of 4.03, alkalinity at 2.31 mg/l, acidity at 68.08 mg/l, iron at 0.70 mg/l, aluminum at 7.93 mg/l, and sulfates at 136.25 mg/l. The treatment system is expected to show reductions that coincide with the recommendations for reduction published in the Catawissa Creek watershed TMDL. Additionally, the Audenreid Mine Tunnel Discharge will hopefully lead to the removal of the Catawissa Creek from DEP's 303(d) List of Impaired Waterways.

The Audenreid treatment system is expected to meet the TMDL for the Catawissa Creek by reducing 21% of the iron, 73% of the manganese, 95% of the aluminum, and 99% of the acidity from the Audenreid Mine Tunnel Discharge. The work completed through this grant has made it possible to begin the process of solving these original problems. Following the FEMA repairs and ongoing water quality data analysis, it will then be possible to determine the extent that the treatment system has led to the remediation of AMD in the Catawissa Creek.

9. What else needs to be done?

Repairs must be made to the treatment system through assistance from FEMA. Additionally, following the repairs, long-term monitoring is necessary to assess the overall effectiveness of the

treatment system. Long term maintenance will eventually be required including replenishment of limestone and dredging of the settling ponds. Future funding will be required to meet these needs.

10. What are your plans for disseminating results of your work?

Knowledge gained from this effort will be distributed through the World Wide Web, PowerPoint presentations, the PA DEP Water Management Nonpoint Source Liaison Work Group, and presentations at the Annual Statewide Conferences on AMD/AMR.

Information about the project will also be available on project partner web sites. These web sites include:

- www.dep.state.pa.us
- www.luzerneconservationdistrict.org
- www.amrclearninghouse.org
- www.srbc.net
- www.columbia.org/ccra
- www.epcamr.org
- audenreid.blogspot.com

EPCAMR, CCRA, PA DEP, and the Conservation Districts will continue to coordinate watershed field tours for public officials, community members, and school students. EPCAMR has a statewide e-mail address book capable of reaching 57 Conservation District Watershed Specialists and nearly one hundred groups, individuals, and watershed associations throughout the region, SRBC will make presentations to community members on the analyses of the water quality collected during the project and will assist volunteers with establishing watershed stream cleanup and monitoring projects. Members of the public, local community organizations and the media were also invited to meetings and press releases for important events such as review of final designs, contract bidding, groundbreaking, and dedication of the completed treatment system.

11. How well did your spending align with your budget request?

The spending of this grant aligned very closely with the projected budget. There was, however a shortfall in funding for limestone at the time that the construction contract was awarded. Escalating energy costs were responsible for increasing the trucking expenses for the limestone. This shortfall was solved through a grant amendment with the PA DEP 319 program and additional funding from outside organizations.

12. Brief Summary

The SCD and project partners completed the construction of the Audenreid Treatment System located in the Catawissa Creek Watershed. The system removes two-thirds of the AMD's aluminum, converts the toxic aluminum in solution to a nontoxic precipitate, and triples the creek's acid-neutralizing capacity. The treatment system significantly improves 36 miles of the Catawissa Creek.

13. Photographs

Additional photographs available on attached CD.

Picture 1. Preconstruction conditions of the Audenreid mine tunnel opening

Picture 2. Preparing the mine opening and surrounding area for intake system with proper E&S controls being utilized.

Picture 3. Above view of the mid-point in construction and site preparation for the audenreid mine tunnel opening and treatment system intake.

Picture 4. View from above the Audenreid mine tunnel opening showing the completed rock filter, rip-rap lined overflow channel and cleared mine opening with water being diverted around the intake system.

Picture 5. Limestone tank and settling pond site preparation through clearing and grubbing .

Picture 6. View of two completed concrete limestone tanks in background while recently poured concrete is "setting up" in tank mould in the foreground.

Picture 7. View perforated pipes on top of non calcareous rock bed for the flushing system piping (large diameter pipes) and water intake piping (small diameter pipe) in the limestone tanks.

Picture 8. Limestone additions to tanks.

Picture 9. View of first settling pond before stabilization and berm construction was completed.

Picture 10. View of second settling pond before bank stabilization.

Picture 11. Aerial view of limestone tanks, and two settling ponds while system was in operation.

Picture 12 View of intake system with tunnel opening in back ground while system was in operation.


Picture 13. Damage to intake system and mine opening during the June 2006 flooding.

14. Financial Report

The project was originally funded for $1,419,910.00 under for the FY 2004 Nonpoint Source Implementation Program. Two amendments requested in 2005; these amendments were approved as Amendment #1 for $356,575.00 and Amendment #2 for $20,320.00. These amendments brought total funding through EPA Section 319 to $1,796,805 with an additional $356,889.00 in matching funds from other sources bring total project cost to $2,153,694.00. See the attached sheet for amendments, transfer of funding, and breakdown of funding for project. Under the original grant document a wetland was to be constructed for an estimated cost of $6,000. Due to time constraints, the proposed wetland was not completed an amount total $6,000 was not requested through the grant by the Conservation District.

Matching Funds

This project has been successful in attracting support for other funding sources, agencies, non-profit organizations, and volunteers. A complete list of matching funds and in-kind contributions is outlined below.

AUDENREID MATCH INFORMATION		
EPA 319 Program	Project Design and Construction	$1,796,805
BAMR	Project Construction	$100,000.00
Catawissa Creek Restoration Association	Project Construction	$20,000.00
OSM	Project Construction	$138,000.00
Western Pennsylvania Watershed Coalition	Additional Limestone	$20,000.00
Schuylkill County Watershed Grant Program	Additional Limestone	$3,000.00
Additional OSM limestone funding	Additional Limestone	$8,500.00
In-Kind Contributions from Project Partners	Project/Construction oversight	$67,389.00
Total Matching Funds		**$356,889.00**

Table 4.

15. Appendix A (Accomplishment Worksheets)

16. Detailed Technical Reports where applicable

Copy of detailed technical report is included in the Operation, Maintenance and Replacement Plan manual.

17. Operation, Maintenance and Replacement Plan

See attached booklet.